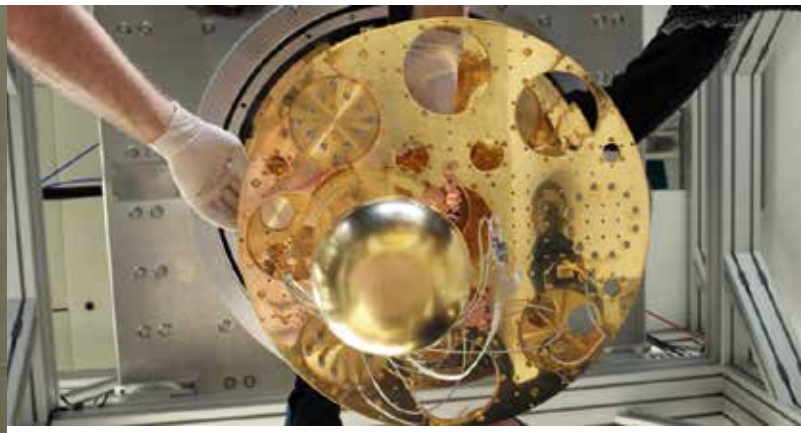
swiss physical society

Nr. 52
Juli 2017

SPG MITTEILUNGEN
COMMUNICATIONS DE LA SSP



Left: The Plaque at the new EPS Historic site "Bastions" (p. 32). Top: Cryogenic refrigerator at IBM Research - Zurich used for quantum experiments (p. 38) (Credit: IBM Research - Zurich)

Swiss Technology to drive the new ESA Mars mission 2020 (p. 36) (Animation: ESA).

The SESAME facility has been inaugurated in Jordan (p. 43)

Joint Annual Meeting of the
Swiss Physical Society
Austrian Physical Society

in cooperation with

CHIPP and Swiss Society for Astrophysics and Astronomy

21 - 25 August 2017, CERN and CICG, Genève

General Information: p. 12, Preliminary program: p.16

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Schweizerische Akademie der Technischen Wissenschaften
Académie suisse des sciences techniques
Accademia svizzera delle scienze tecniche
Swiss Academy of Engineering Sciences

Editorial

Challenges and opportunities of the 21st century: science, education and workforce

Maurice Campagna, President, Swiss Academies of Arts and Sciences, Bern

Migration, primarily from the Mediterranean region, jobs security, lack of work force, the cost of medical care, mobility and the supply of sustainable energy – compatible with the *global* climate change and with *local* air pollution goals - characterize our times and will keep us busy in the forthcoming years. The integration of the Global Sustainable Goals SDG into the 6 platforms of the Swiss Academies of Sciences for a prioritized Swiss national strategy is other big challenge.

Table 1: the Strategic Subjects of the Swiss Academies of Science a+ for the period 2017-2020 and beyond.

The media, in their struggle for survival today battle over attention and not just for market share, "Experts" sprout like mushrooms, blending into the quarrel among lobby groups, contributing to social confusion.
Large institutions like the EU (European Union), the IPCC (Intergovernmental Panel for Climate Change) or even e.g. the EPA (Environmental Protection Agency), in failing to address the root of their structural problem, are actively eroding their credibility.

As a consequence, free minds in science and engineering are not so free anymore today, having to witness the political closure of many of their mental playgrounds.

"Massification" of low quality science and the dramatic expansion of "scientific" copy-paste news require a critical voice from those with a strong rigorous scientific/technical background to rescue "open science", "data science", "open source" from becoming mere entertainment.

We are witnessing an increase of the speed and of the undisputable global role of the scientific and technical progress. Despite the validity of the old principle "think global, act local", we urgently need to adapt our understanding of what "culture" actually means.

Indeed science and technology are slowly emerging as a framework behind a noble, moral organism fighting for a true democratic global culture free of ideologies, corruption and inequalities.

As a physicist, let me recount some anecdotes and a few subjects that at first will sound familiar to physicists, but will be non-negligible to all of us in the next decades.

The driving force of curiosity, from the Alps to Tsinghua University, China

The Swiss are proud of their country, of their environment including their mountains, a "piece of nature's paradise". Additionally, most people know that the Gotthard region not only hosts of the longest railway tunnel of the world, 57 km directly connecting Europe's North and South, but also provides a unique reservoir of a large variety of minerals, of which quartz crystals, iron roses or magnetite are the most popular. (s. Fig. 1a, 1b, 1c and 1d).

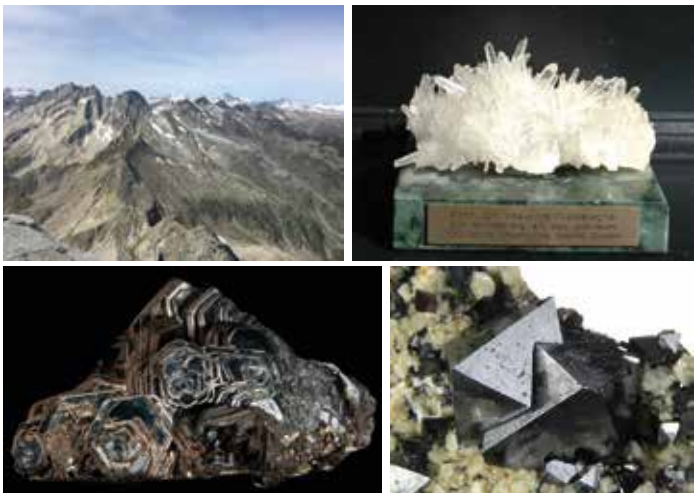


Fig 1: a) The Gotthard region; b) SiO_2, Quartz crystals; c) Fe_2O_3, hematite - iron roses; d) Fe_3O_4, Magnetite

As a native of the region, I was used to go searching for valuable minerals as a young man in the Sixties. While using a compass in the fog, as a child I was told that life on Earth exists as a consequence of God's gift, the earth magnetic field. I thereby was both intrigued and fascinated by geomagnetism, looking for iron roses (Fe_2O_3) and - with the help of a horseshoe magnet - for magnetite Fe_3O_4, even in truly challenging weather conditions.
A side remark: while giving lectures at Tsinghua University in China in the Nineties, I was presented with a copy of a spoon

Fig. 2: Chinese emperor's spoon made of magnetite

(a compass) used in the period 480-221 BC by the emperor, made of natural magnetite. The aim of this nice gesture was to recall me that the compass made of magnetite was used by the Chinese for navigation and other purposes already in such ancient times (Fig. 2).

Photoemission of spin polarized electrons

My basic curiosity provided the motivation to understand the origin of magnetism in Fe, Co and Ni, rare earth metals and their compounds. This took me to the historic site of the Physics Laboratory of ETHZ (Fig. 3) for the PhD.
At this site, a new spectroscopic technique was invented: photoemission of spin polarized electrons [1, 2].

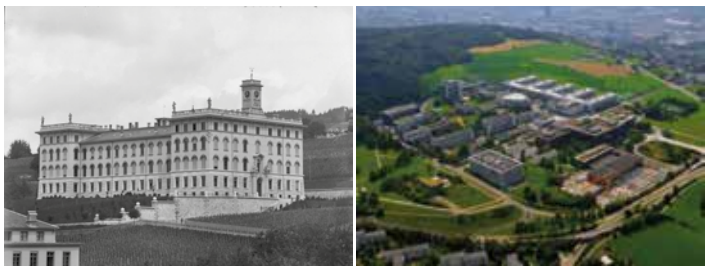


Fig. 3: The former Physics building of ETHZ at the Gloriastrasse 35 (left) and the new location at the site ETHZ Hönggerberg (right)

The surprising early results on 3d-metals demonstrated experimentally the limitations of the famous Stoner Wohlfarth band theory of magnetism and – during discussions at the Cavendish Lab in Cambridge with Phil Anderson - new ideas were born on the role of many-body interactions in the spectroscopy of correlated metals [3].
My original passion for magnetism continued to affect my scientific career.
From Bell Labs I brought the idea to study magnetism and phase transitions at surfaces and in ultra-thin films to the Institute for Solid State Physics (Institut für Festköperforschung IFF) of the Research Center in Jülich in 1978. The method uses the new technique developed for III-V compounds developed at Bells by Al Cho and Federico Capasso, molecular beam epitaxy. In Jülich, with my colleague Werner Zinn in 1982 we engaged Peter Grünberg as a researcher joining us from Toronto. Peter used transport and magneto-optical methods for his dedicated research on thin films for 25 y. His success in discovering “giant magnetic moments” is documented by the Nobel Prize for Physics 2007.
The Nobel Prize for Physics 2016 to Haldane, Kosterlitz and Thouless for their theoretical work on topological phase transitions is currently motivating additional experimental investigations to confirm their predictions. Magnetism and superconductivity are just examples of rather conventional – almost historical – fields of research which provide an endless source of novelty, both in term of new instrumentation and new ideas.

Universality and phase transitions in complex systems

Even old-fashioned concepts like the one of *magnetic domains* acquire, in the light of continuing experimental and theoretical advances, a completely new flavor. The concept was put forward 1907 in the old Physics building in Zürich by Pierre Weiss, a French physicist and engineer, cofounder of the Swiss Physical Society. Interestingly, 110 years later excellent experiments both at the Solid State Physics laboratory of ETHZ and in Solid State Physics Institute, Research Center Jülich (DE) confirm the dramatic advances in the microscopic understanding of magnetism [4, 5].
The most remarkable scientific value of these specific field of research areas, however, resides in the fact that, dealing with phase transitions, they have become examples of a more fundamental concept: *the cooperative behavior of complex systems.*

Cooperative phenomena: toward the understanding of collective behavior in biology, economics and society.

The areas of data science, economics, quantitative biology and social behavior all profit now from the progress in the apparently old-fashioned fields such as phase transitions, which had developed exclusively within physics, with important contributions from mathematical sciences. The *Ising model of magnetism*, for instance, has become the tool of choice for the understanding of the evolution of interacting systems, found in seemingly unrelated fields ranging from biology over economics to social sciences. These methods are being currently used by quite different players, from the World Bank to the Chinese governmental think-tank Development Research Center (DRC) of the State Council, aiming at providing predictions on the industrial competitiveness of a country. The value of these models studying cooperative behavior, simulating interactions with large size computers, is one that ultimately will help making life sciences and social sciences to become more rigorous and less descriptive disciplines [6].

Large facilities and the finding of our ultimate origin.

The technological impact of apparently esoteric, though fascinating, subjects such as gravitational waves, black holes, dark energy and matter and the entire research of astro-particle physics, regularly is matter of debates. The aim: Further investigating the origin and fate of our universe and, ultimately, ourselves. A true cultural aim, with no economic motivation whatsoever.
Large facilities operate at the forefront of human endeavor, they drive technological development deeply into uncharted terrain. Their role relies on extremely advanced and unique instruments. Like in energy, e.g. fusion, or space research, these instruments exceed the capabilities of single national laboratories or even of a single nation. They require a multinational approach, with fruitful political impact and minimal bureaucracy. Their time scale is a generational one, reaching 30 to 50 years ahead of the present (s. CERN). The supporting experience of national institutes, such as the Swiss Plasma Center of EPFL or the Paul Scherrer Institute PSI, is valuable for the training of young students. They help introducing them to hands on, trans-disciplinary and multicultural teamwork at an early stage.

Novel materials, quantum and neuromorphic computing, intelligent power electronics

Fabrication of artificial materials using III-V and II-VI compounds, often referred as metamaterials, have and will continue to have an enormous economic relevance for modern integrated electronics and photonics. Unexpected applications in environmental research are already becoming pos-

sible, see e.g. the use of quantum cascade lasers. Surprising new optical devices like flat lenses have been produced using nano-design (2016 Balzan Prize to Federico Capasso, [7]). Novel devices will undoubtedly to find unconventional applications, e.g. in medical diagnostics. Other promising area are nano-fabrication and 3d-printing for polymer- filters capable of selection at a molecular level, bound to improve early detection of cancer in the blood significantly [8].
The decreased use of fossil fuels (de-carbonization) in all industrial processes and the forecasted increased use of electricity, especially in the area of *electrical mobility in mega-cities* will generate a strong need for sensors and intelligent power electronics, not only in decentralized electrical grids. The funding must be based on an approach integrating the value chain with environmental costs, like already practiced in, e.g. in Singapore. Totally new, robot assisted, automated production processes with high-quality control in developed countries must replace the concept of exploiting cheap labor forces in emerging countries so as to cut production costs to remain competitive. Switzerland already in the 90.ies of the last century was showing how possible this was, see Swatch industries. Emerging countries like China or India, simply by their large number of "hungry" scientists and engineers with their entrepreneurial approach will soon lead the way and help speeding innovation, regardless from the western world. They are already doing so in the use of nuclear energy for peaceful uses, in order to mitigate CO_2 emissions and particulate air pollution from the use of fossil fuels.

Thanks to extensive experimental work by Alain Aspect [9], the scientific community has become aware that concepts like Bell's inequality relating the classical to the quantum world (e.g. quantum entanglement) have practical relevance for information processing and communication. Radically new computer architectures and algorithms, based on quantum computing and/or neuromorphic computing, with incredible speeds at very low energy use are within reach [10]. Soon these tools will outmatch human brain capabilities. Novel computation technologies/algorithms will allow to extend our understanding how the brain works, leading to a revision of our current views even on cognitive human behavior [11].

Education, learning and apprenticeship in the 21st century

Despite the current nationalistic tendencies and manipulation of entire populations, the noble role of science and technology in education and as a base for the cultural/social progress has been accepted by almost all nations.

Programs for strengthening Mathematics, Informatics/Computer Sciences, Natural Sciences and Technology (MINT) at early school levels and for making apprenticeship more attractive with respect to classical academic curricula have been launched. In Switzerland, the second round of a 4 years MINT program, 2017-2020, has been approved by the parliament with a budget of several Mio CHF. A third round will be prepared with the help of the academies for the period 2020/2024. While paying attention to reforms of teaching curricula, we should not forget the eminent role of motivated, innovative teachers. Curiosity for natural phenomena, interest for "hard" sciences and practical work in the early years of life can be nurtured by discussions with gifted teachers. This is why teachers and parents need support in answering to the question: what should we teach to our children in revolutionary times?

I suggest since long time *three priorities*, to be adapted according to the level of children/ students and geographical location. For Switzerland:

1. Reading and writing in the mother language, a second national language and English
2. Strengthening the role of MINT curricula, within an experimental and historical approach
3. Integrating history, geography, economics and social sciences

This can be achieved while promoting/strengthening respect towards:
- ethic and civic values
- a "learn to learn", "think and work in team", "life-long learning" approach
- apprenticeship as a true alternative to the purely academic path and trying to limit the subconscious influence, the conditioning of media and consumer goods industry upon our children and families.

References

[1] M. Campagna, D. T. Pierce, F. Meier, K. Sattler and H. C.Siegmann, Advances in Electronics and Electron Physics, **41**,113,1976 ed. L. Marton, Academic Press.
[2] M. Campagna, Z. Phys. **B 60**, 441, 1985
[3] P. W. Anderson, Phil Mag. **24**, 203, 1971
[4] N. Saratz, D. A. Zanin, U. Ramsperger, S. Cannas, D. Pescia, and A. Vindigni, Nature Communications, **7**, 13611 (2016)
[5] S. Eich et al. Science Advances 3, n.3, e1602094, March 2017 and Ref. cited therein
[6] *www.lucianopietronero.it*, Nature editorial on Economic Complexitiy: *http://www.nature.com/news/physicists-make-weather-forecasts-for-economies-1*, V. Amati, A. Lomi, A. Mira submitted to Social Network Modelling, 2017
[7] *www.balzan.org* – prizewinners 2016, F. Capasso
[8] P. Patterlini – Bréchot, "Tuer le cancer", ed. Stock, 2017
[9] *www.balzan.org* – prize winners 2013, A. Aspect
[10] A. Curioni, in "Silicon valley meets Switzerland", Lugano 31.03.2017
[11] M. Campagna, Swiss Neurology 2017, ed. C. Bassetti

Following the years of research at the Bell Laboratories NJ/USA, **Maurice Campagna** - a physicist - was managing Director in the Research Center of Jülich/ DE, Professor for Physics at the University of Cologne and at the Swiss Federal Institute of Technology Zürich, ETHZ. Thereafter he joined the global ABB Group to direct Corporate Research and later ABB - Alstom in Brussel and Paris as a Chief Technology Officer. He is a fellow of the American Physical Society, of the Swiss Academy of Technical Science and member of Economiesuisse, commission for education, research and innovation. From January 1st 2016 Maurice Campagna is the President of the Swiss Academies of Arts and Sciences.

Gemeinsame Jahrestagung in Genf, 21. - 25. August 2017
Réunion annuelle commune à Genève, 21 - 25 août 2017

Vorwort

Die diesjährige gemeinsame Jahrestagung von SPG und ÖPG, mit Beteiligung von CHIPP, NCCR MARVEL und SGAA, findet in Genf statt, und zwar am CERN, das gleichzeitig auch Gastgeber der Tagung ist, und am CICG.

Neben der bewährten Mischung aus Plenarvorträgen, Fachsitzungen und Händlerausstellung stehen auch zwei öffentlichee Vorträge, sowohl für Tagungsteilnehmer als auch das allgemeine Publikum, auf dem Programm. Ein Vortrag wird am CERN gehalten, der andere am CICG.
Zusätzlich können sich die Teilnehmer für verschiedene Besichtigungen am CERN anmelden (Teilnehmerzahl beschränkt).

Im Folgenden finden Sie die wichtigsten Tagungsinformationen sowie eine vorläufige Programmübersicht. Das definitive Programm wird in Kürze auf der SPG-Webseite verfügbar sein. In diesem Sinne hoffen wir auf eine rege Beteiligung an der diesjährigen Tagung und freuen uns auf Ihren Besuch.

Avant-propos

La réunion annuelle conjointe de la SSP et de l'ÖPG, avec cette année la participation de CHIPP, NCCR MARVEL et de la SSAA, aura lieu à Genève, à savoir au CERN, qui est en même temps l'hôte de la conférence, et au CICG.

En plus de la combinaison de conférences plénières, sessions techniques et de la participation d'exposants, nous aurons au programme deux conférences publiques, destinée aussi bien aux participants à la conférence que pour le grand public. L'une de ces conférences aura lieu au CERN, l'autre au CICG.
En plus, les participants peuvent s'inscrire pour diverses visites au CERN (nombre de places limitées).

Vous trouverez les principales informations sur la conférence ainsi qu'un aperçu du programme préliminaire ci-dessous. Le programme définitif sera disponible prochainement sur le site de la SSP. Nous nous réjouissons de votre visite et espérons avoir une participation soutenue à la conférence avec le programme stimulant de cette année.

Generalversammlung 2017 - Assemblée générale 2017

Dienstag 22. August 2017, 15:15h - Mardi 22 août 2017, 15:15h
CERN, Main Auditorium 500-1-001

	Traktanden	Ordre du jour
1.	Protokoll der Generalversammlung vom 23. August 2016	Procès-verbal de l'assemblée générale du 23 août 2016
2.	Kurzer Bericht des Präsidenten	Bref rapport du président
3.	Projekte	Projets
4.	Rechnung 2016, Revisorenbericht	Bilan 2016, rapport des vérificateurs des comptes
5.	Wahlen	Elections
6.	Diverses	Divers

Preisverleihungen - Cérémonies de remise des prix

SPG Preise, ÖPG Preise, CHIPP Preis und Charpak-Ritz Preis
Prix de la SSP, ÖPG, CHIPP et prix Charpak-Ritz

Dienstag 22. August 2017, 17:45h
Mardi 22 août 2017, 17:45h
CERN, Main Auditorium 500-1-001

Preise für die besten Poster
Prix pour les meilleurs posters

Freitag 25. August 2017, 10:20h
Vendredi 25 août 2017, 10:20h
CICG, Raum 2 - Salle 2

A note from the President

It is my pleasure to give you some highlights from the activities of our Society during the last period between our 2016 and 2017 General Assemblies.

In 2016, the Swiss Physical Society was once more very active in organizing and in participating in a variety of projects and events with the aim to intensify the relations between universities, research centres and industry, and to promote networking with young students and teachers throughout Switzerland. Examples of such events, briefly summarised in the following, are the Annual Meeting of our society, a Young Physicists Forum (YPF) workshop in Lausanne, a scientific participation in the Commission Romande de Physique (CRP) teacher course and the Dautreppe seminar of SFP meant mainly for PhD and students and post-docs.

Another issue, to which the Society puts particular emphasis, is the communication with its members, partners and the Swiss physics community at large, by means of publishing its bulletin, our flagship "*SPG Mitteilungen, Communications de la SSP*" as well as disseminating information via its Web portal, which is under revision. Of particular importance is the electronic publication of our Newsletter, which will allow us to strengthen the link between the Board and each and everyone of the Society Member as well as other persons who could be interested by our activities. I would like to highlight here the work of the Board, which led to this achievement.

The Annual Meeting of the Swiss Physical Society was organised in Lugano at the *Università della Svizzera Italiana* (USI). The meeting was supported in part by the USI, which the SPS would like to acknowledge here. In total, there were about 300 participants with about 220 contributions. It was a long time that we did not hold our Annual Meeting in Ticino, and I believe that both USI and our participants enjoyed the meeting. At this occasion, we had the pleasure to distinguish last year a new Honorary Member in the person of Piero Martinoli, who was, at the time of the conference, President of the USI.

The commitment of the Society with respect to the young generation is shown through our support to the Young Physicists Forum YPF, our involvement with teachers and our support to Swiss Physic Olympiad, SwissPhO. Note that one Swiss student won a Bronze Medal at the International Physics Olympiad and three others a "Honourable Mention". The event was organized in Switzerland. Our Society is also sponsoring a common event with the German colleagues, the "Physik im Advent".

Swiss Physics was honoured by EPS first through the selection of two sites as EPS Historic Sites. The fist one is the building "*Bastions*" of the University of Geneva (see p. 32 for a detailed article). The inauguration of the plaque commemorating this event was performed on 29 March 2017 in the presence of the President of the EPS. Two members of the family of Prof. Stueckelberg, adding a touching note to the event. The second EPS Historical site awarded is the one of IBM. The unveiling of the plaque for the IBM Rüschlikon site will be performed on the 26 September 2017.

Alongside with the usual SPS Awards, the winner of the *Charpak-Ritz Prize* was nominated by the SPS Prize Committee, based on the three names proposed by the *Société Française de Physique* (SFP). The winner, Prof. Carlo Sirtori, will give a talk at our Geneva meeting. The SPS is preparing the proposals for the 2018 *Charpak-Ritz Prize*, for selection by the SFP in the fall of 2017.

At the last General Assembly, Hans Peter Beck was elected as Vice President of our Society. According to our usual way of proceeding, I shall propose to the General Assembly to elect him as President for the next two years term. I would like to thank all of you, in particular the members of the Board, for your support and trust during my tenure. As a last word, I would like to mention that I firmly believe that, in Switzerland, our Industry and Economy, as in any developed and industrial country, can only progress if both fundamental and applied physics research is vigorously supported: We should not forget the logical chain: scientific discovery and understanding- invention- innovation, and not only retain the buzz word "Innovation". As much as I shall be able, I shall continue to defend this idea whenever and wherever I could.

Good luck to the Swiss Physical Society and to each and every one of you!

Minh Quang Tran, SPS President

Protokoll der Generalversammlung vom 23. August 2016 in Lugano
Protocole de l'assemblée générale du 23 août 2016 à Lugano

Agenda

1. Minutes of the General Assembly held in Vienna on 2 September 2015
2. Report of the President
3. Projects 2016 -2017
4. 2015 Finances and Auditors Report
5. Modifications of the By-Laws
6. Clarifications for the rules of the SPS Prizes
7. Elections
8. New Honorary Member
9. Miscellaneous

The President opens the meeting at 14:30. The assembly counts 71 persons.

1. Minutes of the General Assembly held in Vienna on 2 September 2015

The protocol of the last General Assembly, published in the *SPG Mitteilungen* Nr. 49 on p. 7 is unanimously approved.

2. Report of the President

The President welcomes all the new members. As a small request, as there has been in the last year a slight decrease in the number of members, the president asks the audience to promote the SPS among their colleagues.
A brief report can be found in the last *SPG Mitteilungen* (Nr. 49) on the activities of last year like the project on "Physics and Society" or the project on "Physics input" to increase our country's competitivity (in collaboration with SATW).
A new prize for advanced physicists has been created in collaboration with the *French Physical Society*: The **Charpak-Ritz Prize**.
The Geneva-Bastion Building has been selected as EPS Historical site. The inauguration of the "plaque" will be done during the first months of 2017.
At the 2016 International Physics Olympiads, Markus Köhler from Balgach (SG) has won a Bronze Medal and 4 other members of the Swiss team have won "Honourable Mention".
The website of our society is being renewed with new features and new layout and a first "Newsletter" will soon be sent.
M. Q. Tran has been elected as member of the Executive Committee of the European Physical Society.

3. Projects 2016 - 2017

Completion of the project "Modernizing the Communication".
Completion of the projects "Physics and Society" and the joint project work with SATW.
Advanced career physicists: The first **Charpak-Ritz Prize**, in collaboration with the French Physics Society, will be awarded at the 2017 annual meeting (the prize will be given in alternation to a Swiss and a French nominee).
The next annual meeting, joint with our colleagues from Austria, will be held in Geneva (CERN and CICG) in the week from 21 to 25 August 2017.

4. 2015 Finances and Auditors Report

The 2015 Financial Report is presented by the treasurer, Dr. Pascal Ruffieux, on pages 8 and 9 of the *SPG Mitteilungen* Nr. 49. Prof. Dr. Ph. Aebi and Dr. P. Gröning, the revisers of this report, have approved the numbers and their statement can be found on page 9.
A benefit of 4'486.35 Swiss Francs is accounted for. The treasurer clarifies that the benefits or losses depend mostly on the success of the annual meetings but some reserves have been achieved allowing to target new projects like the improvement of the communications.
The Financial Report is approved unanimously by the General Assembly.

5. Modifications of the By-Laws

In order to share the power of signature between the President and the Vice-President, it is proposed to change the right of signature from "President + Secretary or Treasurer" to "President or Vice-President + Secretary or Treasurer" (see *SPG Mitteilungen* Nr. 49, p. 10).
Further modification: Members of VSMP (SSPMP) can now also become members of SPS at a reduced price.
These changes are approved unanimously by the General Assembly.

6. Clarifications for the rules of the SPS prizes

SPS prizes are given to young physicists. The committee proposes to define the term "young" by "physicists at the early phase of their career" (not necessarily right after their PhD). The criteria of scientific achievement should not be defined by the criteria of the publication policy as not everybody publishes in reviews. The criteria of "exceptional performance or achievement" of the candidate is now applied.

7. Elections

The new committee members are elected unanimously by the General Assembly:
- Condensed Matter: Prof. Laura Heyderman (ETHZ and PSI) and Prof. Patrycja Paruch (Univ. Geneva)
- Education and Promotion of Physics: Dr. Céline Lichtensteiger (Univ. Geneva)

New functions:
- Vice-President: Dr. Hans-Peter Beck
- TASK: Dr. Andreas Schopper (in agreement with CHIPP)

Special replacement: Dr. Antoine Pochelon (Secretary) and Prof. Jan Lacki (History of Physics) have reached the maximum of their term. As the Board could not find replacements for them, it asks the GA for an exception and to re-conduct these persons for 2 more years (one term).
After a short discussion about the difficulties in finding suitable replacements, this exceptional prolongation has been accepted by a vote (49 for, 6 abstentions, 0 against).
The president thanks Christian Rüegg (Condensed Matter and Prize Committee) for his contribution to the SPS.

8. New Honorary Members

The committee has received this year two proposals for new Honorary Members: Prof. Piero Martinoli and Prof. Norbert Straumann.

Laudatio for Prof. Martinoli: "*for his contribution to solid state matter physics especially the fundamental experiments in two-dimensional superconducting systems and for his constant service to higher education and research in Switzerland.*"

Laudatio for Prof. Straumann: "*in recognition of his extraordinary research and notably for his landmark results in General Relativity, as well as for the standards in teaching he set throughout Theoretical Physics.*"

The GA approves these 2 nominations.

9. Miscellaneous

Happy Birthday to our "SPG Mitteilungen" which will celebrate its 50th issue! Many thanks to Bernhard Braunecker and to all contributors for their high quality scientific articles.

The President closes the meeting at 15:25.

Protocol: Edith Grüther

Statistik - Statistique

Neue Mitglieder 2016 - Nouveaux membres en 2016

Amato Alex, Bacani Mirko, Baumann Veronika, Bernard Carlo, Bonnin Anne, Bourqui Michel, Brunetti Maura, Calic Ivan, Cococcioni Matteo, Del Burgo Riccardo, Dimitrov Anton, Fanciulli Mauro, Fayet Pierre, Fehr Armin, Gerber Simon, Gerlach Benedikt, Goulette Marc, Herb Konstantin, Jacquier Murièle, Jolivet Renaud, Kahle Leonid, Khoo Teng Jian, Krieger Jonas, Kruchkov Alex, Lichtensteiger Céline, Margiani Gabriel, Marrazzo Antimo, Martinoli Piero, Mazzone Daniel, Mendil Johannes, Molina Campoverde Ariana, Moraes de Almeida James, Muff Stefan, Náfrádi Bálint, Najafian Kaveh, Neil Iain A., Paruch Patrycja, Pásztor Árpád, Piegsa Florian, Plumb Nicholas, Prandini Gianluca, Ramires Neves de Oliveira Aline, Ritjoho Narongrit, Salman Zaher, Schildknecht Dominik, Schilling Christian, Scholtes Theo, Schwarz Silvan, Sigrist Karl, Sohier Thibault, Staudacher Fritz, Terrier Christophe, Tóth Sándor, Waser Stephan, Wehinger Björn, Wetter Selina, Yoo Jaiyul

Ehrenmitglieder - Membres d'honneur

Prof. Hans Beck (2010)
Dr. J. Georg Bednorz (2011)
Prof. Jean-Pierre Blaser (1990)
Prof. Jean-Pierre Borel (2001)
Prof. Jean-Pierre Eckmann (2011)
Prof. Charles P. Enz (2005)
Prof. Hans Frauenfelder (2001)
Prof. Jürg Fröhlich (2011)
Prof. Hermann Grunder (2001)
Dr. Martin Huber (2011)
Prof. Piero Martinoli (2016)
Prof. Verena Meyer (2001)
Prof. K. Alex Müller (1991)
Prof. Hans Rudolf Ott (2005)
Prof. T. Maurice Rice (2010)
Prof. Louis Schlapbach (2010)
Prof. Herwig Schopper (2015)
Prof. Norbert Straumann (2016)

Assoziierte Mitglieder - Membres associés

A) Firmen

B) Universitäten, Institute

- Albert-Einstein-Center for Fundamental Physics, Universität Bern, 3012 Bern
- CERN, 1211 Genève 23
- Swiss Plasma Center (SPC), EPFL, 1015 Lausanne
- Département de Physique, Université de Fribourg, 1700 Fribourg
- Departement Physik, Universität Basel, 4056 Basel
- Departement Physik, ETH Zürich, 8093 Zürich
- EMPA, 8600 Dübendorf
- Lab. de Physique des Hautes Energies (LPHE), EPFL, 1015 Lausanne
- Paul Scherrer Institut, 5332 Villigen PSI
- Physik-Institut, Universität Zürich, 8057 Zürich
- Section de Physique, Université de Genève, 1211 Genève 4
- Section de Physique, EPFL, 1015 Lausanne

C) Studentenfachvereine

- AEP - Association des Etudiant(e)s en Physique, Université de Genève, 1211 Genève 4
- Fachschaft Physik und Astronomie, Universität Bern, 3012 Bern
- Fachschaft Physique, Université de Fribourg, 1700 Fribourg
- Fachverein Physik der Universität Zürich (FPU), 8057 Zürich
- Fachgruppe Physik Universität Basel, 4056 Basel
- Les Irrotationnels, EPFL, 1015 Lausanne
- Verein der Mathematik- und Physikstudierenden an der ETH Zürich (VMP), 8092 Zürich

Verteilung der Mitgliedskategorien - Répartition des catégories de membres (31.12.2016)

Ordentliche Mitglieder	666
Doktoranden	55
Studenten	39
Doppelmitglieder DPG, ÖPG, APS oder VSMP	160
Doppelmitglieder PGZ	64
Mitglieder auf Lebenszeit	123
Assoziierte Mitglieder	20
Bibliotheksmitglieder	2
Ehrenmitglieder	18
Beitragsfreie (Korrespondenz)	6
Total	**1153**

Jahresrechnung 2016 - Bilan annuel 2016

Bilanz per 31.12.2016

	Aktiven	Passiven
Umlaufsvermögen		
Postscheckkonto	84381,32	
Bank - UBS 230-627945.M1U	28649,94	
Debitoren - Mitglieder	1753,00	
Debitoren - SCNAT/SATW u.a.m.	39826,63	
Transitorische Aktiven	1377,70	
Anlagevermögen		
Beteiligung EP Letters	15840,00	
Mobilien	1,00	
Fremdkapital		
Mobiliar		1,00
Mitglieder Lebenszeit		64488,25
Transitorische Passiven		13390,97
Eigenkapital		
Vefügbares Vermögen		99195,84
Total Aktiven/Passiven	**171829,59**	**177076,06**
Verlust	**5246,47**	
Summe	**177076,06**	**177076,06**

Verfügbares Vermögen per 31.12.16 nach Verlustzuweisung: 93949,37

Erfolgsrechnung per 31.12.2016

	Aufwand		Ertrag
Gesellschaftsaufwand		**Ertrag**	
EPS - Membership	12650,12	Mitgliederbeiträge	97289,55
SCNAT - Membership	7966,00	Inserate/Flyerbeilagen SPG Mitteilungen	5270,00
SATW-Mitgliederbeitrag	1750,00	Aussteller	4852,66
		Zinsertrag	1,15
SCNAT Verpflichtungskredite		Ertrag aus EP Letters Beteiligung	3052,81
SPG-Jahrestagung	32520,94		
Schweizer Physik Olympiade	4000,00	**SCNAT Verpflichtungskredite**	
SPG Young Physicist's Forum	5432,10	SPG-Jahrestagung (SCNAT)	15000,00
Lehrerfortbildungsevent 2014 ff	208,15	Schweizer Physik Olympiade	4000,00
International Physics Tournament	1118,48	SPG Young Physicist's Forum	4000,00
SPG Bulletin/Tagungsband (SCNAT)	5364,50	Lehrerfortbildungsevent 2014 ff	5000,00
SCNAT Periodika (SPG-Mitteilungen, Druckkosten)	24474,14	International Physics Tournament	3000,00
SCNAT Swiss Young Phys. Tournament	5500,00	SPG Bulletin/Tagungsband (SCNAT)	5000,00
		Periodika (SPG-Mitteilungen, Druckkosten) (SCNAT)	5000,00
Betriebsaufwand		Internationale Zusammenarbeit (SCNAT)	2000,00
Löhne	16151,84	SCNAT Swiss Young Phys. Tournament	6000,00
Sozialleistungen, berufl. Vorsorge, Versicherung	3173,42		
Porti/Telefonspesen/WWW- und PC-Spesen	880,10		
Versand (Porti Massensendungen)	5322,85		
Unkosten	4189,62		
Büromaterial	3839,55		
Bankspesen	218,10		
Debitorenverluste Mitglieder	2610,00		
Debitorenverlust SCNAT/SATW u.a.m.	9173,37		
Sekretariatsaufwand extern	18169,36		
Total Aufwand/Ertrag	**164712,64**		**159466,17**
Verlust			**5246,47**
Summe	**164712,64**		**164712,64**

swiss physical society

Revisorenbericht zur Jahresrechnung 2016

Die Jahresrechnung 2016 der SPG wurde von den unterzeichneten Revisoren geprüft und mit den Belegen in Übereinstimmung befunden.
Die Revisoren empfehlen der Generalversammlung der SPG, die Jahresrechnung zu genehmigen und den Kassier mit bestem Dank für die gute Rechnungsführung zu entlasten.

Die Revisoren der SPG:

Prof. Dr. Philipp Aebi

Dr. Pierangelo Gröning

Basel, 21. April 2017

SPG Buchhaltung, Departement Physik, Klingelbergstrasse 82, CH-4056 Basel
Email : sps@unibas.ch

Allgemeine Tagungsinformationen - Informations générales sur la réunion

Konferenzwebseite und Anmeldung

Alle Teilnehmeranmeldungen werden über die Konferenzwebseite vorgenommen.

www.sps.ch

Anmeldeschluß: 1. August 2017

Site web de la conférence et inscription

L'inscription des participants se fait sur le site web de la conférence.

www.sps.ch

Délai d'inscription: 1er août 2017

Tagungsorte

21. - 22.08.: CERN, 1211 Genève 23
23. - 25.08: CICG (Centre International de Conférences Genève), 17 Rue de Varembé, 1211 Genève

Lieux de la conférence

21 - 22.8: CERN, 1211 Genève 23
23 - 25.8: CICG (Centre International de Conférences Genève), 17 Rue de Varembé, 1211 Genève

Tagungssekretariat

CERN: Das Tagungssekretariat befindet sich in der Halle vor dem Hauptauditorium.
Öffnungszeiten:

Mo 21.08.	14:00 - 17:00
Di 22.08	08:00 - 17:00

CICG: Das Tagungssekretariat befindet sich in der Halle beim Haupteingang.
Öffnungszeiten:

Mi - Do 23.08 - 24.08.	08:00 - 18:00
Fr 25.08.	08:00 - 11:00

Secrétariat de la conférence

CERN: Le secrétariat de la réunion se trouve dans le hall situé devant l'Auditoire principal.
Heures d'ouverture:

Lundi 21.8	14:00 - 17:00
Mardi 22.8	08:00 - 17:00

CICG: Le secrétariat de la réunion se trouve dans le hall situé prés de l'entrée principale.
Heures d'ouverture :

Mercredi - Jeudi 23.8 - 24.8	08:00 - 18:00
Vendredi 25.8	08:00 - 11:00

Alle Tagungsteilnehmer melden sich bitte vor dem Besuch der ersten Veranstaltung beim Sekretariat an, wo sie ein Namensschild und allfällige weitere Unterlagen erhalten sowie die Tagungsgebühr bezahlen.
Wichtig: Ohne Namensschild ist kein Zutritt zu einer Veranstaltung möglich.

Wir empfehlen Ihnen, wenn möglich den Montag Nachmittag für die Anmeldung zu nutzen. So können Sie am Dienstag direkt ohne Wartezeiten die Vorträge besuchen.

Hörsäle

In allen Hörsälen stehen Beamer und Hellraumprojektoren zur Verfügung. Bitte bringen Sie Ihre eigenen Mobilrechner und evtl. Adapter und USB Stick/CD mit.

Postersession

Die Postersession findet am Mittwoch während der Mittagspause sowie am Donnerstag Abend in der Halle statt. Bitte bringen Sie Befestigungsmaterial (Reissnägel, Klebestreifen) selbst mit. Die Posterwände sind entsprechend diesem Programm numeriert, sodaß jeder Teilnehmer "seine" Wand leicht finden sollte. Alle Poster sollen an allen beiden Tagen ausgestellt bleiben.
Maximale Postergröße: A0 Hochformat.

Zahlung

Wir bitten Sie, die Tagungsgebühren im Voraus zu bezahlen. Sie verkürzen damit die Wartezeiten am Tagungssekretariat, erleichtern uns die Arbeit und sparen darüber hinaus noch Geld !
Die Angaben zur Zahlung werden während der Anmeldung direkt auf der Webseite angezeigt.

Am Tagungssekretariat kann nur bar bezahlt werden (in CHF). Kreditkarten können vor Ort leider nicht akzeptiert werden.

ACHTUNG: Tagungsgebühren können nicht zurückerstattet werden.

Tous les participants doivent se présenter en premier lieu au secrétariat de la conférence afin de recevoir leur badge et les divers documents ainsi que pour le paiement des frais d'inscription.
Attention: Sans badge, l'accès aux sessions de la manifestation sera refusé.

Nous vous recommandons dans le mesure du possible de vous inscrire déjà le lundi après-midi afin d'éviter des temps d'attente inutiles mardi matin.

Auditoires

Les auditoires disposent tous d'un projecteur multimédia (beamer) et d'un projecteur pour transparents. Veuillez apporter votre ordinateur portable ainsi que d'éventuels accessoires tels que clé USB ou CD.

Séance posters

Les posters seront présentés dans le hall pendant la pause de midi de mercredi et le jeudi soir. Veuillez amener vous-même le matériel nécessaire pour fixer les posters (punaises, ruban adhésif). Les panneaux de posters seront numérotés suivant le numéro de l'abstract indiqué dans le programme. Tous les posters doivent rester installés pendant les deux jours.
Dimension maximale: A0, format portrait.

Paiement

Nous vous prions de régler à l'avance vos frais d'inscription. De cette manière vous évitez des files d'attente et facilitez notre travail. De plus, vous réalisez des économies !
Les informations pour le paiement sont indiquées directement sur la page web lors de l'enregistrement.

Les paiements lors de la conférence ne pourront être effectués qu'en espèces (CHF). Les cartes de crédit ne pourront malheureusement pas être acceptées sur place.

ATTENTION: Les frais d'inscription ne sont pas remboursables.

Preise gültig bei Zahlung bis 1. August - Prix valable pour des paiements avant le 1er août	
Kategorie - Catégorie	**CHF**
Mitglieder von SPG, ÖPG, CHIPP, SGAA, ÖGAA - Membres de la SSP, ÖPG, CHIPP, SSAA, ÖGAA	140.-
Doktoranden, die in einer der obigen Gesellschaften Mitglied sind - Doctorants membres d'une des sociétés mentionnées ci-dessus	100.-
Nicht-Mitglieder - Non-membres	180.-
Doktoranden, die NICHT Mitglied sind - Doctorants qui ne sont PAS membres	140.-
Studenten VOR Master/Diplom Abschluß - Etudiants AVANT le degré master/diplôme	80.-
Plenarsprecher, Eingeladene Sprecher, Preisträger - Conférenciers pléniers et invités, lauréats	0.-
Spezialangebot für "Noch nicht Mitglieder" (s.u.) - Offre spéciale pour "Pas-encore-membres" (voir ci-dessous)	190.-
Konferenz Abendessen - Dîner de la conférence	70.-
Zuschlag für Zahlungen nach dem 1. August sowie Barzahler an der Tagung - Supplément pour paiements effectués après le 1er août et pour paiements en espèces à la conférence	**20.-**

Kaffeepausen, Mittagessen

CERN: Kaffeepause und Wilkommensapéro finden in der Nähe des Hörsaals statt (Details folgen später). Diese Leistungen sind in der Konferenzgebühr enthalten.
Zum Mittagessen stehen die Restaurants auf dem CERN-Gelände zur Verfügung.

CICG: Kaffeepausen, Apéro und Lunchbuffet (Mittwoch) finden in der Halle bei der Händlerausstellung statt. Diese Leistungen sind in der Konferenzgebühr enthalten.
Für das Mittagessen am Donnerstag kann das Restaurant im 1. Stock des CICG oder umliegende Restaurants genutzt werden.

Konferenz-Abendessen

Das Abendessen findet am Mittwoch im "Restaurant du Parc des Bastions" im Anschluß an die Parallelsessions statt. Der Preis beträgt CHF 70.- pro Person (beinhaltet Menü und Getränke). Die Anzahl der Plätze ist limitiert, bitte registrieren Sie sich unbedingt im Voraus, damit wir disponieren können. Eine Anmeldung vor Ort ist nicht möglich !
Hinweis: Der Transfer findet individuell mit dem öffentlichen Verkehr statt. Hotelgäste erhalten beim Einchecken die " Geneva Transport Card", welche zur Gratis-Benützung von Tram und Bus während Ihres Aufenthalts berechtigt (*http://www.tpg.ch/geneva-transport-card*).

Spezialangebot für "Noch-Nicht" SPG-Mitglieder

Planen Sie, an unserer Tagung teilzunehmen sowie Mitglied der SPG zu werden ? Sie können nun beides zum äusserst günstigen Preis von nur CHF 190.- (CHF 210.- nach dem 1. August). Dieser Betrag deckt die Konferenzgebühr sowie die Mitgliedschaft für 2017. Verpassen Sie dieses Angebot nicht ! Wählen Sie einfach bei der Online Registrierung die Kategorie "Special Offer", laden Sie das Anmeldeformular (*http://www.sps.ch/fileadmin/doc/Formulare/anmeldeformular_d-f-e.pdf*) für neue Mitglieder herunter, drucken es aus und schicken oder faxen es ausgefüllt an das SPG-Sekretariat.

(Dieses Angebot gilt nicht für Studenten oder Doktoranden. Diese profitieren sowieso von der Gratis-Mitgliedschaft im ersten Mitgliedsjahr, und zahlen nur die in der Tabelle angegebene Konferenzgebühr.)

Anreise und Unterkunft

Alle Informationen zur Anreise finden Sie auf den Webseiten von CERN (*http://home.cern/directions*) und CICG (*http://www.cicg.ch/en/access-map/*).

Hinweis: Für den Zutritt zum CERN ist ein Besucherpass erforderlich. Registrierte Tagungsteilnehmer können den Pass im Empfangsgebäude 33 (direkt bei der Tramhaltestelle) abholen und sich anschließend zum Tagungssekretariat begeben.

Für die Tagungsteilnehmer ist ein Kontingent an Hotelzimmern zu speziellen Konditionen vorreserviert. Details finden Sie auf *www.sps.ch*.

Pauses café, repas de midi

CERN: Pause café et apéro de bienvenue se dérouleront proche de l'auditoire (plus de détails prochainement). Ces prestations sont inclues dans les frais d'inscription.
Les restaurants au campus du CERN sont disponibles pour les repas de midi.

CICG: Pauses café, apéro et le buffet de midi (mercredi) se dérouleront dans le hall près des exposants. Ces prestations sont inclues dans les frais d'inscription.
Pour le repas de jeudi midi le restaurant au 1er étage du CICG ainsi que ceux situés aux alentours pourront être utilisés.

Dîner de la conférence

Le dîner se tiendra le mardi soir dans le "Restaurant du Parc des Bastions", après les séances orales. Le prix est de CHF 70.- par personne (repas et boissons inclus). Le nombre des places étant limitée, veuillez s.v.p. absolument vous enregistrer à l'avance pour des raisons d'organisation. Il n'est plus possible de s'inscrire sur place !
Note: Le transfert se passe individuellement avec les transports publics. En s'inscrivant à l'hôtel, les voyageurs reçoivent le « Geneva Transport Card » autorisant l'usage gratuit des trams et bus pendant leur séjour (*http://www.tpg.ch/geneva-transport-card*)

Offre spéciale pour les non-membres de la SSP

Voulez-vous participer à la conférence et devenir en même temps membre de la SSP ? Profitez de notre offre avantageuse ! Pour la somme de CHF 190.- (CHF 210.- après le 1er août) nous vous offrons l'inscription ainsi que la cotisation de membre de la SSP jusqu'à fin 2017. Ne ratez pas cette occasion! Cochez simplement la case « Special Offer » lors de votre inscription en ligne, téléchargez le formulaire d'admission à la SSP de *http://www.sps.ch/fileadmin/doc/Formulare/anmeldeformular_d-f-e.pdf* , imprimez-le, et renvoyez-le dûment rempli par courrier ou par fax au secrétariat de la SSP.

(Cette offre ne s'applique pas aux étudiants et aux doctorants. Ceux-ci profitent en effet d'une affiliation gratuite à la SSP pendant la première année et ne paient que les frais d'inscription indiqués dans le tableau ci-dessus.)

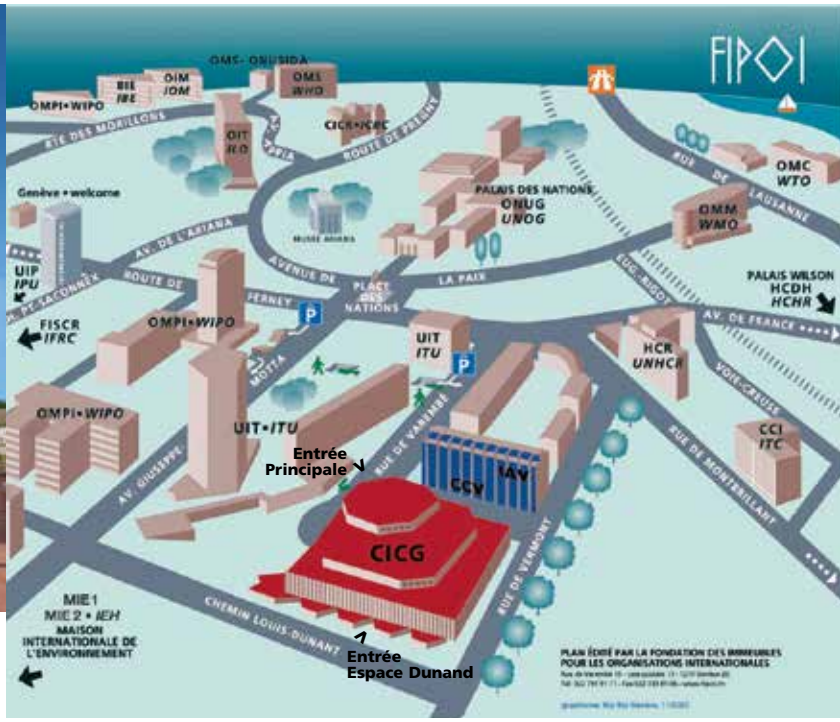
Arrivée et hébergement

Toutes les informations se trouvent sur la site web du CERN (*http://home.cern/directions*) et du CICG (*http://www.cicg.ch/en/access-map/*).

Note: Pour entrer au CERN vous avez besoin d'un badge de visiteurs. Les participants inscrits à la conférence peuvent obtenir ce badge au bâtiment de réception 33 (à coté de l'arrêt du tram) et se rendre ensuite au secrétariat de la réunion.

Un contingent de chambres d'hôtel a été pré-réservé a des conditions spéciales pour les participants à la conférence. Les détails se trouvent sur *www.sps.ch*.

CICG (Centre International de Conférences Genève)



Aussteller - Exposants

Dyneos AG, CH-8307 Effretikon
www.dyneos.ch

EPL-IOP, UK-Bristol
www.iop.org

GMP SA, CH-1020 Renens
www.gmp.ch

Hamamatsu Photonics, CH-4500 Solothurn
www.hamamatsu.ch

Handelsvertretung Technische Produkte für Forschung und Industrie, DE-44623 Herne
www.vacgen.com

Hiden Analytical Ltd., UK-Warrington, WA5 7UN
www.hidenanalytical.com

NanoScan AG, CH-8600 Dübendorf
www.nanoscan.ch

PINK GmbH Vakuumtechnik, DE-97877 Wertheim
www.pink-vak.de

Springer Verlag GmbH & Co. KG, DE-69121 Heidelberg
www.springer.com

TOPTICA Photonics AG, DE-82166 Gräfelfing
www.toptica.com

VAKOM Vakuum Komponenten und Messtechnik GmbH, DE-07751 Großlöbichau
www.vakom.com

World Scientific Publishing Co Pte Ltd., DE-80333 München
www.worldscientific.com

X-Tronix AG, CH-1027 Lonay & CAEN Electronic Instrumentation
www.xtronix.ch

Zurich Instruments, CH-8005 Zürich
www.zhinst.com

Vorläufige Programmübersicht - Résumé préliminaire du programme

Das vollständige Programm wird allen Teilnehmern am Tagungssekretariat abgegeben sowie auf der Konferenz- und der SPG-Webseite publiziert.

Hinweise:

- Je Beitrag wird nur der präsentierende Autor aufgeführt.
- Die Postersitzung ist am Mittwoch von 12:30 - 14:00 (mit Lunch Buffet) sowie am Donnerstag von 18:30 - 20:00 (mit Apéro).
- (p) = Plenarsprecher, (i) = eingeladener Sprecher

Le programme final complet sera distribué aux participants au stand du secrétariat de la conférence et sera publié sur le site de la conférence et de la SSP.

Indication:

- seul le nom de l'auteur présentant la contribution a été indiqué.
- la session poster a lieu le mercredi de 12.30 à 14.00 (avec buffet de midi) ainsi que le jeudi de 18:30 à 20:00 (avec apéro).
- (p) = orateur de la session plénière, (i) = orateur invité

Plenary Session

Tuesday, 22.08.2017, CERN: Main Auditorium (500-1-001)

Time	ID	
10:30		**Official Conference Opening** *Chair: Minh Quang Tran, EPFL* ***Welcome of the SPS and ÖPG Presidents and the CERN Director General***
10:45	1	**General introduction of CERN, its mission and future projects** *Martin Steinacher (i)*
11:15	2	**Title not yet known** *NN (i)*
		Plenary Session I *Chair: Eberhard Widmann, SMI Wien*
11:45	3	**The Experimental Physics Program of CERN** *Manfred Krammer (p)*
		Chair: Andreas Schopper, CERN
12:30	4	**Accelerators: multifaceted instruments for science and industry** *Leonid Rivkin (p)*
13:15		***Lunch***
		Chair: Antoine Pochelon
14:30	5	**Gravitational waves: a new window to explore the Universe** *Philippe Jetzer (p)*
15:15		***General Assemblies of SPS and ÖPG ****
16:30		***Coffee Break***
		Chair: Georges Meynet, Uni Genève
17:00	6	**The CHEOPS mission: Goals and challenges** *Willy Benz (p)*
17:45		***Award Ceremony***
19:00		***Welcome Apéro***
		Evening Lecture *Chair: Hans Peter Beck, Uni Bern*
20:00	7	**A Higgs-Eye View of the Cosmos** *Matthew Philip McCullough (p)*
21:15		***END***

* Room for the ÖPG General Assembly: Council Chamber (503-1-001)

Wednesday, 23.08.2017, CICG: Room 2

Time	ID	
		Plenary Session II *Chair: Philipp Treutlein, Uni Basel*
09:00	8	**Quantum photonics with solid-state emitters** *Richard Warburton (p)*
		Chair: Rainer Leitgeb, Med. Uni Wien
09:40	9	**Biophotonic micromanipulation of cells – empowering biomedicine by the force of light** *Cornelia Denz (p)*
10:20		***Coffee Break***
		Chair: Bernhard Braunecker
10:50	10	**Technology dependance of reflective optical systems for EUV and astronomical applications** *Iain A. Neil (p)*
		Chair: Alain Fontaine, Société Française de Physique (SFP)
11:30	11	**Light-matter interaction at the nanoscale** *Carlo Sirtori (i)*
		Chair: Reinhold Koch, JKU Linz
12:00	12	**The angulon quasiparticle: novel approach to angular momentum in quantum many-particle systems** *Mikhail Lemeshko (i)*
12:30		***Postersession with Lunchbuffet***
14:00		***Topical Sessions***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 2

Time	ID	
		Plenary Session III *Chair: Martin Sterrer, Uni Graz*
09:00	13	**Liquid Phase Epitaxy of Molecular Frameworks on Solid Substrates: A New Class of Designer Solids?** *Christof Wöll (p)*
		Chair: Alberta Bonanni, JKU Linz
09:40	14	**Molecular spintronics: towards the active control of nano-scale hybrid units** *Mirko Cinchetti (p)*
10:20		***Coffee Break***
10:45		***Topical Sessions***
13:00		***Lunch***
14:00		***Topical Sessions***
18:30		***Postersession (continued) with Apéro***
		Public Lecture *Chair: Minh Quang Tran, EPFL*
20:00	15	**De la place de la science dans la société **** *Thierry Courvoisier (p)*
21:15		***END***

** This talk will be given in French.

Friday, 25.08.2017, CICG: Room 2

Time	ID	Plenary Session IV *Chair: Eberhard Widmann, SMI Wien*
09:00	16	**Spectroscopy of trapped antihydrogen atoms** *Claudio Lenz Cesar (p)*
		Chair: NN
09:40	17	**Trapped-ion interfaces for quantum networks** *Tracy Northup (p)*
10:20		***Poster Award Session***
10:40		***Coffee Break***
11:15		***Topical Sessions***
14:15		***END OF CONFERENCE***

Physics in Startups

Wednesday, 23.08.2017, CICG: Room 6

Time	ID	Physics in Startups *Chair: Thomas Brunschwiler & Patrick Ruch, IBM Rüschlikon*
15:00	51	**Start-Up Ecosystem Switzerland** *Raphael Nerz (i)*
15:10	52	**Bringing a frequency-comb spectrometer to market – account of a journey** *Markus Geiser (i)*
15:30	53	**Ultrafast femto laser turns creativity into smart monolithic micro-systems** *Andrea Lovera (i)*
15:50	54	**Crystalline Mirror Solutions: spinning off high-performance laser optics from fundamental quantum research** *Markus Aspelmeyer (i)*
16:10	55	**From Bits to Atoms: Fablabs as a useful bridge from physical inspired ideas to real products** *Christian Teissl (i)*
16:30		***Coffee Break***
17:00	56	**DECTRIS - 10 years counting what matters** *David Murer (i)*
17:20	57	**Urban growth and Energy challenge** *Asef Azam (i)*
17:40	58	**Wind Energy with Tethered Drones** *Rolf Luchsinger (i)*
18:00	59	**Bringing back the Investigative Approach in Science Education** *Philipp Wissgott (i)*
18:20	60	**Start-Up Challenges and Experiences (*Panel Discussion*)** *Raphael Nerz (Moderation)*
18:40		***END***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

History of Physics

Friday, 25.08.2017, CICG: Room 6

Time	ID	History of Physics *Chair: Jan Lacki, Uni Genève*
11:15	71	**The disappearance of spacetime in quantum theories of gravity** *Christian Wuthrich (i)*
11:45	72	**The 1955 Bern Conference on General Relativity and Gravitation: an Institutional Innovation** *Jean-Philippe Martinez*
12:15	73	**Stefan Meyer and the age of the sun** *Johann Marton*
12:45	74	**Karl Przibram – from the good old time to modern solid state physics** *Franz Sachslehner*
13:15	75	**The Diffusion Hygrometer: A late invention of H. Greinacher** *Jean-François Loude*
13:45	76	**Scientific contacts between universities and high schools in 19th-century Northern Italy: the *Liceo Maffei-University of Padua* case.** *Fanny Marcon*
14:15		***END***

Astronomy and Astrophysics

This session has been organised by the SSAA.

Friday, 25.08.2017, CICG: Room 14

Time	ID	Astronomy and Astrophysics *Chair: Georges Meynet, Uni Genève*
11:15	91	**Open questions in the formation of binary stellar systems containing black holes.** *Tassos Fragos (i)*
11:45	92	**The spin of the second-born Black hole in coalescing double BH binaries** *Ying Qin*
12:00	93	**Fermi acceleration under control: η Carinae** *Roland Walter (i)*
12:30	94	**The Evolution of Supermassive Population III Stars** *Lionel Haemmerlé*
12:45	95	**Observation of Exoplanetary Atmospheres with High-Resolution Transmission Spectroscopy** *Aurélien Wyttenbach (i)*
13:15	96	**Quantifying degradation of a cavity detector in a total solar irradiance instrument on a FengYun3 satellite** *Huiduan Li*
13:30	97	**Modelling the thermal system of an electrical substitution radiometer for measurement of total solar irradiance on a near-Earth orbit satellite** *Hongrui Wang*
13:45		***END***

KOND

Wednesday, 23.08.2017, CICG: Room 4

Time	ID	KOND I: Award Session *Chair: Laura Heyderman, PSI & ETHZ*
14:00	101	**Quantum dots as sources of entangled photons** *Tobias J. Huber (i)*
14:30	102	**Dynamic mesoscopic conductors: single electron sources, full counting statistics and thermal machines** *Patrick Hofer (i)*
15:00	103	**Reading and writing single atom magnets** *Fabian D. Natterer (i)*
15:30	104	**Nanofabricated model systems combined with single particle spectro-microscopy to visualize catalysis** *Waiz Karim (i)*
16:00	105	**The early Universe in a multiferroic** *Sinéad M. Griffin (i)*
16:30		***Coffee Break***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 4

Time	ID	KOND II: $TiSe_2$ and Miscellanea *Chair: NN*
10:45	111	**Topological quantum states visualized by ARPES: from topological Kondo insulator to Weyl semimetal** *Nan Xu (i)*
11:15	112	**A local real-space view of the periodic lattice distortion in 1T -$TiSe_2$** *Baptiste Hildebrand*
11:30	113	**Evolution of the CDW in Sulfur substituted 1T-$TiSe_2$: A combined ARPES and STM/STS study** *Marie-Laure Mottas*
11:45	114	**Strong inter-valley carrier scattering in high-temperature phase of 1T-$TiSe_2$ disclosed by optical spectroscopy** *Kristijan Velebit*
12:00	115	**The role of many particle interactions in the integer quantum Hall effect regime** *Josef Oswald*
12:15	116	**Spectroscopic perspective on the interplay between electronic and magnetic properties of doped topological insulators** *Jonas A. Krieger*
12:30	117	**Exchange Bias Like Effect In Co:ZnO** *Martin Buchner*
12:45	118	**All-electron benchmark results with nonlocal van der Waals functionals** *Fabien Tran*
13:00		***Lunch***
		KOND III: Magnetism *Chair: Patrycja Paruch, Uni Genève*
14:00	121	**Learning phase transitions by confusion** *Evert van Nieuwenburg (i)*
14:30	122	**Nature of $Ba_3MIr_2O_9$ (M=Sc,Y,In) ground state probed by μSR** *Jean-Christophe Orain*
14:45	123	**Defects in spin chains** *Gediminas Simutis*
15:00	124	**Extending Haldane's conjecture to SU(3) spin chain systems** *Miklos Lajko*
15:15	125	**Role of the antisymmetric exchange in quantum spin liquids** *Péter Szirmai*
15:30	126	**Quantum spin liquid ground states in rare-earth pyrochlore hafnates** *Romain Sibille*
15:45	127	**Correlated decay of the triplet excitations in the frustrated quantum magnet $SrCu_2(BO_3)_2$** *Diane Lançon*
16:00		***Coffee Break***
18:30		***Postersession and Apéro***
20:00		***Public Lecture***

Friday, 25.08.2017, CICG: Room 4

Time	ID	KOND IV: NESY (X-rays & Neutrons) *Chair: NN*
11:15	131	**SLS-2: upgrade of the Swiss Light Source** *Andreas Streun*
11:30	132	**Beam-Induced Dynamics in Oxide Glasses** *Christoph Tietz*
11:45	133	**Atomic diffusion in alkali oxide glasses** *Katharina Holzweber*
12:00	134	**Electrode swelling during ion electrosorption in carbon based supercapacitors** *Christian Koczwara*
12:15	135	**Speeding up transient absorption measurements by two orders of magnitude** *Bernhard Lang*
12:30	136	**Investigation of complex photonic structures in the extreme ultraviolet** *Ronald Meisels*
12:45	137	**Full Elasticity Tensor from Thermal Diffuse Scattering** *Björn Wehinger*
13:00	138	**Direct Path State Characterization in Neutron Interferometry** *Stephan Sponar*
13:15		***END***

ID	KOND Poster
141	**Atomic scale X-Ray Photon Correlation Spectroscopy** *Michael Legenstein*
142	**Diluted spin-dimer system $Ba_{3-x}Sr_xCr_2O_8$: single crystal growth and study of the magnetic properties** *Alsu Gazizulina*
143	**Structural, electronic and magnetic properties of $Cr_xCd_{1-x}O$ alloys** *Malika Labidi*
144	**Computational study of Y NMR shielding in intermetallic Yttrium compounds** *Leila Kalantari*
145	**First-principles study of the electronic energy bands and state density of Rock-salt $Zn_{1-x}Sr_xO$ ternary alloys** *Salima Labidi*
146	**Probing the change of Coulomb energy through a superconducting phase transition** *Michaël K. Tran*
147	**Using physics in linguistic research: Language diffusion in Austria and Hungary** *Katharina Prochazka*

148	**Two-dimensional Raman Correlation and THz-Raman Spectroscopic Investigation of the Brill Transition in Nylon 6,6** *Maurizio Musso*
149	**InCIMa: Smart Characterization of Smart Materials** *Maurizio Musso*
150	**Characterization of Tannin-Furanic Foams by UV Raman and Infrared Spectroscopy and by X-ray Computed Microtomography** *Maurizio Musso*
151	**Raman spectroscopic characterization of PLA 3D printing filaments** *Maurizio Musso*

Surfaces, Interfaces and Thin Films

Thursday, 24.08.2017, CICG: Room 4

Time	ID	Surfaces, Interfaces and Thin Films *Chair: NN*
16:30	171	**Charge transfer and charge trapping at the interfaces between 2D materials and molecular semiconductors** *Aleksandar Matković (i)*
17:00	172	**Electronic structure and solid-state optical properties of indigo from time-dependent optimally tuned range-separated hybrid functional theory** *Bernd Kollmann*
17:15	173	**Growth of perfluoro-pentacene on Ag(110) studied with PEEM and DRS** *Andrea Navarro-Quezada*
17:30	174	**Co-Pyrphyrin on Cu_2O(111) and TiO_2(110): Properties and Stability under Near Operando Conditions** *Michael Hotz*
17:45	175	**The (O12) surfaces of hematite and their interactions with water – a DFT study** *Magdalena Bichler*
18:00	176	**Surface single-molecule dynamics controlled by entropy at low temperatures** *Jeffrey C. Gehrig*
18:15	177	**Origin of the Enantioselective Adsorption of prochiral molecules on PdGa(111) surfaces** *Carlo Antonio Pignedoli*
18:30		***END; Postersession and Apéro***
20:00		***Public Lecture***

ID	Surfaces, Interfaces and Thin Films Poster
181	**Investigation of SERS Substrates Fabricated via Injection Molding and Surface-Mediated Nanoparticle Formation** *Maurizio Musso*
182	**Growth of polar molecules on ultrathin hexagonal boron nitride** *Christian Teichert*
183	**DFT Study of Water Adsorption on Ca-Doped (001)-MgO Surfaces** *Thomas Ruh*
184	**In-situ observation of electron beam induced nanocrystallization of an ultra thin tungsten foil** *Stefan Noisternig*
185	**The influence of correlation effects on the dilute, two-dimensional electron liquid** *Dominik Kreil*

Applied Physics & Earth, Atmosphere and Environmental Physics (combined session) Plasma Physics

Thursday, 24.08.2017, CICG: Room 6

Time	ID	Combined Session *Chair: Stéphane Goyette, Uni Genève*
10:45	201	**Kerr lens mode-locked femtosecond thin-disk lasers: towards powerful sub-50 fs oscillators** *Norbert Modsching*
11:00	202	**Mid-infrared Quantum Cascade Lasers for spectroscopic applications** *Borislav Hinkov*
11:15	203	**COSAMI - A Compact Storage Ring for Actinic Mask Inspection** *Terence Garvey*
11:30	204	**Size selection of helium nanodroplets for tailoring synthesis of nanostructures** *Monisha Rastogi*
11:45	205	**Nanoindentation in ZrO_2 ceramics – pitfalls and consequences** *Katharina Werbach*
12:00	206	**Advantages and challenges of SC magnets in gantries** *Alexander Gerbershagen*
12:15	207	**Experimental and numerical methods for the fluid dynamic and acoustic characterization of heat exchanger icing** *Christoph Reichl*
12:30	208	**Positioning Systems Based on Geomagnetic Distortions in Indoors Environments** *Patrick Fodor*
12:45	209	**Towards the nesting of a glacier mass balance algorithm in a regional climate model** *Marjorie Perroud*
13:00		***Lunch***
		Plasma Physics *Chair: Stephan Brunner, EPFL*
14:00	211	**Divertor detachment in alternative magnetic geometries in the TCV fusion experiment** *Christian Theiler*
14:30	212	**Design of a fast-moving Langmuir probe array to probe the TCV edge plasma** *Hugo De Oliveira*
14:45	213	**Enhanced plasma shape and vertical stability control in TCV** *Federico Pesamosca*
15:00	214	**Characterization of Jacobian Free Newton Krylov algorithm to solve the free boundary equilibrium problem** *Francesco Carpanese*
15:15	215	**The RAID experiment for the investigation of negative ion physics for fusion application** *Riccardo Agnello*
15:30	216	**Experimental validation of numerical plasma simulations for niobium coating by DC-magnetron and bias diode sputtering** *Thibaut Richard*
15:45	217	**Indirect Measurement of the Self-Modulation Instability in the AWAKE experiment at CERN** *Marlene Turner*
16:00		***END; Coffee Break***
18:30		***Postersession and Apéro***
20:00		***Public Lecture***

ID	Applied Physics & Earth, Atmosphere and Environmental Physics & Plasma Physics Poster
221	**Photodissociation Cross Section of Cesium Iodide Clusters** *Emanuel Oswald*
222	**IR spectroscopy and reactivity studies of hydrated $CO_2^{\cdot-}$** *Andreas Herburger*
223	**Stable Carbon Dioxide Anion Radical in Salt Clusters** *Nina K. Bersenkowitsch*
224	**Reactivity of $M(CO_2)(H_2O)_n^+$; M=Co,Mg** *Erik Barwa*
225	**Evaluation of ethyl tert-butyl ether biodegradation in a contaminated aquifer by compound-specific isotope analysis and in situ microcosms** *Norbert Nägele*
226	**Laser Lightning Rod** *Thomas Produit*
227	**Modelling of Radiative Heat Transfer for Plasma Arc Simulations** *Frank Kassubek*
228	**Plasma fuelling in tokamaks** *Andre Coroado*
229	**Studying the effect of non-adiabatic passing electron dynamics on turbulent transport in magnetic fusion plasmas** *Ajay Chandrarajan Jayalekshmi*

Theoretical Physics

Wednesday, 23.08.2017, CICG: Room 3

Time	ID	Theoretical Physics I *Chair: NN*
14:00	251	**Non-uniqueness for the Navier–Stokes initial value problem** *Julien Guillod (i)*
14:30	252	**Universal upper bounds on the Bose-Einstein condensate** *Christian Schilling*
14:45	253	**Renormalization group approach to time-periodic driven-dissipative bosons** *Steven Mathey*
15:00	254	**Physical Relevance of Generalized Pauli constraints** *Felix Tennie*
15:15	255	**Exploring non-local observables in shock wave collisions** *Philipp Stanzer*
15:30	256	**Swift state-of-the-art calculations of the 2D Electron Liquid** *Clemens Staudinger*
15:45	257	**Entanglement of Gaussian Fermionic States** *Katharina Schwaiger*
16:00	258	**Bulk-Edge Duality and Complete Localization for Chiral Chains** *Jakob Shapiro*
16:15	259	**Reconstructing quantum states from single-party information** *Carlos L. Benavides-Riveros*
16:30		***Coffee Break***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 6

Time	ID	Theoretical Physics II *Chair: NN*
16:30	261	**Symmetry and Topology of Unconventional Superconductors** *Manfred Sigrist (i)*
17:00	262	**SLOCC hierarchy for generic states in 2 x m x n level systems** *Martin Hebenstreit*
17:15	263	**Understanding hybrid strong/weak thermalisation of the QGP** *Alexander Soloviev*
17:30	264	**Simplified models of heavy Higgs bosons decaying to supersymmetric particles** *Lukas Lechner*
17:45	265	**Measurement of entanglement dynamics in the many-body localized phase: A random matrix approach** *Andreas Elben*
18:00	266	**Flexible resources for Quantum Metrology** *Davide Orsucci*
18:15	267	**Confidentiality of the hashing protocol and applications to the quantum repeater** *Alexander Pirker*
18:30		***END; Postersession and Apéro***
20:00		***Public Lecture***

Nuclear, Particle and Astrophysics (TASK)

This session has been organised in conjunction with **CHIPP**.

Monday, 21.08.2017, CERN: Main Auditorium (500-1-001)

Time	ID	CHIPP Plenary Meeting (Non Scientific Topics) *Chair: Tatsuya Nakada, CERN*
16:30	31	**Welcome, news from Board and EB** *Tatsuya Nakada*
16:50	32	**TBA** *NN*
17:00	33	**TBA** *NN*
17:10	34	**TBA** *NN*
17:20	35	**TBA** *NN*
17:30	36	**TBA** *NN*
17:40	37	**TBA** *NN*
17:50	38	**TBA** *NN*
18:00		***END***

Wednesday, 23.08.2017, CICG: Room 2

Time	ID	TASK I: Opening Session *Chair: Tatsuya Nakada, CERN*
14:00	301	**CHIPP Award Winner** *NN (i)*

14:25	302	**Effective mass signatures in multiphoton pair production** *Christian Kohlfürst (i)*
14:50	303	**Status of the International Future Circular Collider Study** *Michael Benedikt*
15:10	304	**AWAKE, the Proton Driven Plasma Wakefield Acceleration Experiment at CERN** *Edda Gschwendtner*
15:30	305	**Physics at the HL-LHC** *Günther Dissertori*
15:50	306	**CTA experiment** *Ueli Straumann*
16:10	307	**Precision Experiments with cold and ultracold Neutrons** *Hartmut Abele*
16:30		***Coffee Break***
		TASK II: Standard Model I *Chair: Günther Dissertori, ETH Zürich*
17:00	311	**ITk performance and pixel detector layout at the High-Luminosity LHC** *Noemi Calace*
17:15	312	**DL1: A new Deep Neural Network-based higher level tagger for ATLAS Flavour Tagging** *Marie Lanfermann*
17:30	313	**Identification of Hadronically-Decaying W Bosons and Top Quarks Using Machine Learning in ATLAS at $\sqrt{s}$ = 13 TeV** *Ece Akilli*
17:45	314	**Combination of Higgs differential observables and limits on Higgs couplings at CMS** *Thomas Klijnsma*
18:00	315	**Semileptonic decays at LHCb** *Brice Emile Maurin*
18:15	316	**CP violation in b-baryons at LHCb** *Rafael Silva Coutinho*
18:30	317	**Flavour tagging in *pp* collisions at LHCb** *Vincenzo Battista*
18:45	318	**Measurement of the CP violation parameter A_γ in $D^0 \rightarrow h^+h^-$ decays at LHCb** *Pietro Marino*
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Wednesday, 23.08.2017, CICG: Room 3

Time	ID	
		TASK III: Detectors I *Chair: Roland Horisberger, PSI Villigen*
17:00	321	**Modeling of the detector response in $H \rightarrow \gamma\gamma$ differential cross section measurements at CMS** *Janik Walter Andrejkovic*
17:15	322	**Improving sensitivity to jetty physics by using tracks: ATLAS evolution from the LHC to the HL-LHC** *Teng Jian Khoo*
17:30	323	**Improving jet substructure performance in ATLAS** *Sofia Adorni Braccesi Chiassi*
17:45	324	**Beam Tests of HV-CMOS Pixel Sensors for the ATLAS HL-LHC Tracker Upgrade** *Thomas Weston*
18:00	325	**Track-based pileup subtraction for jet and MET triggering at the HL-LHC ATLAS upgrade** *Marco Valente*
18:15	326	**Data analysis at Level-1 Trigger level: Migrating complex selection algorithms from offline analysis and High-Level trigger to the trigger electronics** *Manfred Jeitler*
18:30	327	**Barrel time-of-flight detector for the PANDA experiment at FAIR** *Nicolaus Kratochwil*
18:45	328	**Beam-gas vertex detector for beam profile measurement at the LHC** *Plamen Hristov Hopchev*
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 2

Time	ID	
		TASK IV: Machine & Accelerators *Chair: Lenny Rivkin, PSI Villigen & EPFL*
10:45	331	**FCC(-hh) detector design studies** *Julia Hrdinka*
11:00	332	**Designing a 100 TeV Future Circular Hadron Collider: beam-beam studies.** *Javier Barranco Garcia*
11:15	333	**PSI High-Field Magnet Design for the FCC Design Study** *Bernhard Auchmann*
11:30	334	**Electron cloud effects in hadron colliders** *Lotta Mether*
11:45	335	**High efficiency cyclotron trap assisted positron moderator** *Lars Gerchow*
12:00	336	**Non-linear dynamics diffusive mechanisms and impact on accelerators.** *Tatiana Pieloni*
12:15	337	**A cold neutron beam facility for particle physics at the ESS** *Gertrud Konrad*
12:30	338	**muCool: Development of a novel high-brightness low-energy muon beamline** *Ivana Belosevic*
12:45	339	**Investigating the solid deuterium in the PSI UCN source moderator** *Nicolas Hild*
13:00		***Lunch***
		TASK V: Research & Development I *Chair: Olivier Schneider, EPFL*
14:00	341	**Radiation damage in the LHCb silicon tracker** *Elena Graverini*
14:15	342	**Development of a new class of scintillating plastic fibres** *Lukas Gruber*
14:30	343	**Characterisation of multi-channels Silicon Photomultipliers** *Maria Elena Stramaglia*
14:45	344	**Production and Quality Assurance of Scintillating Fiber Detectors for the LHCb Upgrade** *Vladimir Macko*
15:00	345	**Performance of Multiplexed XY Resistive Micromegas detectors in a high intensity test beam** *Dipanwita Banerjee*
15:15	346	**Test beam characterization results with CCPDv4 capacitively coupled to FEI4** *Francesco Armando Di Bello*
15:30	347	**TCT studies of irradiated HV-CMOS sensors** *Claudia Merlassino*

15:45	348	**HV-CMOS MAPS tests for the ATLAS ITk LH-LHC upgrade** *Mateus Vicente Barreto Pinto*
16:00		***Coffee Break***
Time	**ID**	**TASK VI: Detectors II** *Chair: Michael Doser, CERN*
16:30	351	**Current status of the ASACUSA Hbar HFS experiment** *Volkhard Maeckel*
16:45	352	**A Detector for Measuring the Ground State Hyperfine Splitting of Antihydrogen** *Bernadette Kolbinger*
17:00	353	**In-Orbit Performance and First Results of POLAR: A dedicated Gamma-Ray Burst Polarimeter** *Tancredi Bernasconi*
17:15	354	**Background free search for neutrinoless double beta decay with the GERDA experiment** *Roman Hiller*
17:30	355	**The Mu3e Fiber Detector** *Antoaneta Damyanova*
17:45	356	**Single Photon Extraction for Atmospheric Cherenkov Gamma-Ray Telescopes with Silicon Sensors allows for Novel and Promising Particle Shower Representation** *Sebastian Achim Müller*
18:00	357	**The 1S-2S Spectroscopy of Positronium** *Gunther Wichmann*
18:15	358	**PERC Status Report** *Xiangzun Wang*
18:30		***Postersession (continued) with Apéro***
20:00		***Public Lecture***

Thursday, 24.08.2017, CICG: Room 3

Time	**ID**	**TASK VII: Standard Model II** *Chair: Eberhard Widmann, SMI Wien*
14:00	361	**Holographic QCD predictions for glueball decay patterns** *Anton Rebhan*
14:15	362	**$\Lambda_c \rightarrow \Sigma \pi \pi$ decays at Belle** *Manfred Berger*
14:30	363	**Fully differential NLO predictions for rare and radiative lepton decays** *Yannick Ulrich*
14:45	364	**Coherent double and triple neutral Pion Photoproduction off Deuterons** *Michael Sven Günther*
15:00	365	**Measurement of Mixed-Charge Double Pion Photoproduction off the Deuteron with the A2 Experiment** *Sebastian Lutterer*
15:15	366	**Cosmic-ray muon radiography for Alpine glaciers** *Ryuichi Nishiyama*
15:30	367	**NLO QCD corrections to Higgs boson pair production via gluon fusion** *Seraina Glaus*
15:45	368	**Measurement of low-mass dielectrons in p-Pb collisions from LHC Run 2** *Aaron Capon*
16:00		***Coffee Break***
		TASK VIII: Neutrino & Astroparticles *Chair: Michele Weber, Uni Bern*
16:30	371	**Neutrino cross sections and oscillation physics** *Callum Wilkinson*
17:00	372	**Neutrino cross section measurements at the T2K experiment** *Roman Berner*
17:15	373	**Extraterrestrial Neutrino Searches with IceCube** *Stephanie Bron*
17:30	374	**Dark matter search with the XENON1T experiment** *Shingo Kazama*
17:45	375	**Search for axion dark matter with ultracold neutrons** *Michal Rawlik*
18:00	376	**First Gamma-ray observations with DAMPE** *Maria Fernanda Munoz Salinas*
18:15	377	**The ArDM Experiment** *Wei Mu*
18:30		***Postersession (continued) with Apéro***
20:00		***Public Lecture***

Friday, 25.08.2017, CICG: Room 2

Time	**ID**	**TASK IX: Research & Development II** *Chair: Hartmut Abele, Atominstitut Wien*
11:15	381	**High purity 100 GeV electron identification with synchrotron radiation** *Emilio Depero*
11:30	382	**Xurich II: A Dual-phase TPC for Scintillation and Ionization Yield Measurements in Liquid Xenon** *Alex Kish*
11:45	383	**Calibrations of the XENON1T dark matter detector** *Chiara Capelli*
12:00	384	**Studies of a magnesium fluoride (MgF_2) photomultiplier tube for neutrinoless double beta decay experiments** *Chloe Ransom*
12:15	385	**SST-1M camera prototype commissioning for the Cherenkov Telescope Array** *Theodore Ekoume & Cyril Alispach*
12:30	386	**A Thin Time-of-flight PET scanner based on fast monolitic silicon pixel detectors** *Yves Bandi*
12:45	387	**Status Update of NoMoS** *Daniel Moser*
13:00	388	**SHiP: a new facility with a dedicated detector to search for new long-lived neutral particles** *Iaroslava Bezshyiko*
13:15	389	**A novel Transient-Current-Technique based on 2-Photon Absorption in Diamond** *Christian Dorfer*
13:30	390	**The Bern Cyclotron proton irradiation facility** *Armin Fehr*
13:45	391	**FACT - More than five Years of Reliable Operation with SiPMs in an IACT Camera** *Dominik Neise*
14:00		***END***

Friday, 25.08.2017, CICG: Room 3

Time	**ID**	**TASK X: Beyond the Standard Model** *Chair: Tobias Golling, Uni Genève*
11:15	401	**New Physics in the Flavour Sector** *Andreas Crivellin*
11:30	402	**Tests of lepton universality in semileptonic beauty quark decays** *Patrick Haworth Owen*

11:45	403	**Test of lepton flavour universality at LHCb** *Federica Lionetto*
12:00	404	**Charmless hadronic B decays at LHCb: results and prospects** *Sebastiana Giani*
12:15	405	**A sensitivity study for the measurement of the photon polarization in $B^+ \to K^+ \pi \pi^+ \gamma$ decays at LHCb** *Violaine Bellee*
12:30	406	**Search for strongly and electroweakly produced SUSY in final states with opposite sign dileptons** *Leonora Vesterbacka*
12:45	407	**Search for direct top squark pair production in final states with two leptons in $\sqrt{s}$ = 13 TeV *pp* collisions with the ATLAS detector** *Marco Rimoldi*
13:00	408	**Search for supersymmetry in the fully hadronic final state with the CMS detector** *Myriam Schönenberger*
13:15	409	**Heavy Neutral Lepton search in ATLAS LHC's run 2** *Arnaud Dubreuil*
13:30	410	**Search for a single produced vector-like quark B decaying to a b quark and a Higgs boson in a full hadronic final state using boosted topologies** *Giorgia Rauco*
13:45		***END***

ID	TASK Poster
431	**eTCT studies and Thermal Characterisaions towards the ITK Phase II Upgrade** *Abhishek Sharma*
432	**Lloyd's Mirror with Very-Cold Neutrons** *Hanno Marius Filter*
433	**Snapshots of a Quantum Bouncing Ball realized with the qBounce gravity spectrometer** *Martin Thalhammer*
434	**Measurement of the Proton Asymmetry in Neutron Beta Decay** *Michael Klopf*
435	**Study of Central Exclusive Production with ALICE** *Deniz Mostarac*
436	**A CsI detector system at low temperatures for an antimatter gravity measurement** *Sebastian Kalista*
437	**Offline Track Reconstruction for the Future Circular Collider** *Emmerich Kneringer*
438	**A Study of Annual Modulation of the Rate of Beta Decays** *Adam Brown*
439	**Electron identification with deep neural networks in the DAMPE experiment** *David Francois Droz*
440	**Production and quality assurance of scintillating fibre mats for the LHCb tracker upgrade** *Guillaume Max Pietrzyk*
441	**Muonium formation in superfluid helium** *Narongrit Ritjoho*
442	**PSI nEDM Systematic: Leakage Currents** *Prajwal Mohanmurthy*
443	**Machine Learning in the Analysis of Low-mass Dielectrons in ALICE** *Sebastian Lehner*
444	**Machine Learning for the ALICE Upgrade: Performance Enhancement of Dilepton Analyses** *Sebastian Templ*
445	**The Mu3e Fiber Detector Readout** *Simon Corrodi*
446	**Measuring the Carbon Flux in Primary Cosmic Rays with the Alpha Magnetic Spectrometer** *Yao Chen*
447	**Measurement of beta-beating due to strong head-on beam-beam interaction** *Patrik Goncalves Jorge*
448	**Estimation of neutrino oscillation parameters in the T2K experiment** *Leila Haegel*
449	**Performance Evaluation of Novel Silicon Photomultipliers and their Application in Xenon-based Dark Matter TPCs** *Julien Wulf*
450	**SST-1M project for the Cherenkov Telescope Array, a high energy gamma-ray telescope** *Theodore Ekoume & Cyril Alispach*
451	**Transient Current Technique measurements of a HV-CMOS demonstrator chip** *Ettore Zaffaroni*
452	**Landau damping and coherent stability in colliders** *Claudia Tambasco*
453	**A compact scitillating fibre detector addon for ASACUSAs hodoscope** *Markus Fleck*
454	**The SHiP Timing Detector with SiPM Readout** *Christopher Betancourt*
455	**Point source studies in IceCube** *Tessa Lauren Carver*

Atomic Physics and Quantum Optics

Thursday, 24.08.2016, CICG: Room 5

Time	ID	I: Quantum optics and quantum information *Chair: NN*
10:45	501	**Temporal control of polarization entanglement in semiconductor waveguides** *Alexander Schlager*
11:00	502	**On the inequivalence of the CH and CHSH inequalities due to finite statistics** *Marc Olivier Renou*
11:15	503	**Simple atomic quantum memory suitable for semiconductor quantum dot single photons** *Gianni Buser*
11:30	504	**Experimental certification of millions of genuinely entangled atoms in a solid** *Florian Fröwis*
11:45	505	**Robust quantum state transfer in photonic networks** *Pierre-Olivier Guimond*
12:00	506	**Universal systematic polarization-dependent errors at the wavelength-scale for position measurements in super-resolution microscopy** *Stefan Walser*
12:15	507	**Memory network dynamics in projective simulation model** *Alexey A. Melnikov*
12:30		***Lunch***
		II: Matter waves and cavity QED *Chair: NN*
14:00	511	**A free space selforderd atom-photon crystal** *Helmut Ritsch*
14:30	512	**Disorder-Driven Density and Spin Self-Ordering of a Spinor Bose-Einstein Condensate in a Cavity** *Farokh Mivehvar*

14:45	513	**Subradiance via entanglement in atoms with several independent decay channels** *Laurin Ostermann*
15:00	514	**Quantum-Interference assisted Metrology with Vitamins in the Gas Phase** *Lukas Mairhofer*
15:15	515	**Optimal preparation of vibrational state superpositions in a 1D Bose-Einstein condensate** *Mira Maiwöger*
15:30	516	**The Symplectic Fermi Liquid and its realization in cold atomic systems** *Aline Ramires*
15:45		
16:00		***Coffee Break***
18:30		***Postersession (continued) with Apéro***
20:00		***Public Lecture***

Friday, 25.08.2017, CICG: Room 5

Time	ID	III: Atomic precision spectroscopy *Chair: NN*
11:15	521	**Laser-pumped high performance vapor-cell atomic clocks** *Gaetano Mileti*
11:45	522	**PHySES - Measurement of the Positronium Hyperfine Structure in the first Excited State** *Michael Heiss*
12:00	523	**Laser cooled anions as a sympathetic coolant** *Julian Valentin Fesel*
12:15	524	**Superconductor Shielding of Pb and Nb tubes for momentum sensitive measurements of neutral Antimatter** *Alexander Hinterberger*
12:30	525	**Search for a violation of the Pauli Exclusion Principle with electrons in an underground laboratory** *Andreas Pichler*
12:45		***END***

ID	Atomic Physics and Quantum Optics Poster
531	**Wave propagation in an exponential index profile: Exact solution and application to pump-probe spectroscopy** *Arno Schneider*
532	**Multi-Path Waveguide Interferometer with Individually Shuttered Paths** *Sebastian Gstir*
533	**Towards non-destructive, real-time transport measurements of interacting Fermi Gas** *Barbara Cilenti*
534	**Superstatistical energy distributions of an ion interacting with a neutral buffer gas** *Ian Rouse*
535	**Electron Interactions with Doped Neon Clusters** *Rebecca Meißner*
536	**Laser Cooling of Molecular Anions for Sympathetic Cooling of Antiprotons** *Christian Zimmer*

Correlated-Electron Physics in Transition-Metal Oxides

This session has been organised by the NCCR MARVEL.

Wednesday, 23.08.2017, CICG: Room 13

Time	ID	Correlated-Electron Physics in Transition-Metal Oxides I *Chair: Marisa Medarde, PSI Villigen*
14:00	601	**Resonant elastic x-ray scattering of oxide multilayers** *Eva Benckiser (i)*
14:30	602	**Breathing mode distortion and magnetic order in rare-earth nickelates $RNiO_3$** *Alexander Hampel*
14:45	603	**Distortion mode analysis of the lattice anomalies across the metal-to-insulator transition in $PrNiO_3$** *Dariusz Jakub Gawryluk*
15:00	604	**New magnetic phase in the nickelate perovskite $TlNiO_3$** *Lukas Korosec*
15:15	605	**Interplay between the structural and metal-insulator transition in rare-earth nickelates** *Oleg Peil (i)*
15:45	606	**Optical probe of correlations in rare-earth nickelates films** *Jérémie Teyssier*
16:00	607	**Electronic structure of buried $LaNiO_3$ layers in (111)-oriented $LaNiO_3$/$LaMnO_3$ superlattices probed by soft x-ray ARPES** *Flavio Bruno*
16:15		
16:30		***Coffee Break***
		Correlated-Electron Physics in Transition-Metal Oxides II *Chair: Claude Ederer, ETH Zürich*
17:00	611	**Ultrafast demagnetization dynamics in $TbMnO_3$** *Elsa Abreu*
17:15	612	**Strain effects on the magnetic properties of orthorhombic rare-earth manganites** *Natalya Fedorova*
17:30	613	**Oxygen-vacancy engineering in strained multiferroic $SrMnO_3$ thin films** *Laura Maurel*
17:45	614	**Magnetic spiral order and multiferroism through impurity-induced frustration** *Markus Müller*
18:00	615	**Effect of epitaxial strain on the spin and spin-orbital excitations of Sr_2IrO_4 observed by Resonant Inelastic X-ray Scattering (RIXS)** *Eugenio Paris*
18:15	616	**Investigation of Metal-Insulator transition in $NaOsO_3$ using Resonant X-Ray Diffraction** *Namrata Gurung*
18:30		
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 13

Time	ID	Correlated-Electron Physics in Transition-Metal Oxides III *Chair: NN*
10:45	621	**A Different Route to Unconventional Superconductivity: New Spectroscopy on Bismuth Oxides** *Nicholas Plumb (i)*

11:15	622	**Identifying detrimental effects for multiband superconductivity – Application to Sr_2RuO_4** *Aline Ramires*
11:30	623	**Hallmarks of Hund's coupling in the Mott insulator Ca_2RuO_4** *Denys Sutter*
11:45	624	**Electronic Phase Separation and Dramatic Inverse Band Renormalization in the Mixed-Valence Cuprate $LiCu_2O_2$** *Gianmarco Gatti*
12:00	625	**Hubbard interactions from density-functional perturbation theory** *Iurii Timrov*
12:15		***END; Lunch***
18:30		***Postersession and Apéro***
20:00		***Public Lecture***

ID	Correlated-Electron Physics in Transition-Metal Oxides Poster
631	**Charge localization and energetics of Li-ion batteries cathodes from extended Hubbard-corrected functionals** *Matteo Cococcioni*
632	**Optical evidence for bad-metal behavior in the doped Mott-insulator Sr_2IrO_4** *Nimrod Bachar*
633	**Orbital characters of the band structure in a high-temperature cuprate superconductor** *Kevin Hauser*
634	**Doping evolution of the multi-band Mott insulator Ca_2RuO_4** *Sara Ricco*
635	**Metal-insulator transition in $CaVO_3$ thin films from DFT+DMFT** *Sophie Beck*
636	**Tuning magnetic spirals beyond room temperature with chemical disorder** *Mickael Morin*
637	**Decisive electronic interactions in iron-based superconductors as seen by ARPES** *Daniil Evtushinsky*
638	**Isotope effect in superconducting n-doped $SrTiO_3$** *Adrien Stucky*
639	**Higgs and Goldstone dynamics in h-$RMnO_3$** *Adrien Stucky*
640	**Evidence of electron-phonon interaction in single crystal of (Ru^{3+}/Ru^{4+}) mixed-valence $Na_{2.7}Ru_4O_9$ and $NaRu_2O_4$** *Arvind Yogi*

Emergent Phenomena in novel low-dimensional materials

This session has been organised by the NCCR MARVEL.

Thursday, 24.08.2017, CICG: Room 13

Time	ID	Emergent Phenomena in novel low-dimensional materials I *Chair: Marco Gibertini, EPFL*
14:00	651	**Gate Induced Superconductivity in Transition Metal Dichalcogenides** *Alberto Morpurgo (i)*
14:30	652	**Thickness dependence of the charge density wave order parameter in thin exfoliated 1T-VSe_2** *Árpád Pásztor*
14:45	653	**Spin-orbit interactions in graphene induced by transition metal dichalcogenides substrates** *Zhe Wang*
15:00	654	**Electrons Leave the Flatland** *Edoardo Martino*
15:15	655	**Exploring point defects in the 1T' and 2H phases of single-layer MoS_2** *Michele Pizzochero*
15:30	656	**High-throughput search for topological insulators in two-dimensional materials** *Antimo Marrazzo*
15:45	657	**Lattice instabilities in metallic Transition Metal Dichalcogenides** *Diego Pasquier*
16:00		***Coffee Break***
		Emergent Phenomena in novel low-dimensional materials II *Chair: Oleg Yazyev, EPFL*
16:30	661	**Topological electronic phases in graphene nanoribbons** *Roman Fasel (i)*
17:00	662	**Predicting fundamental gaps of physisorbed one-dimensional acenes** *Jan Wilhelm*
17:15	663	**On-surface synthesis of novel open-shell graphene nanostructures** *Shantanu Mishra*
17:30	664	**Structure and diffusion mapping of manganese atomic chains on Si(001)** *Renan Villarreal*
17:45	665	**Orbital character of the mobile and localized electron states at the LAO/STO interface** *Alla Chikina*
18:00	666	**Subband structure and electron-phonon coupling in the two-dimensional electron gas at the $SrTiO_3$ (001) surface** *Siobhan McKeown Walker*
18:15		***END***
18:30		***Postersession and Apéro***
20:00		***Public Lecture***

Scientific Opportunities with SwissFEL

Wednesday, 23.08.2017, CICG: Room 14

Time	ID	Scientific Opportunities with SwissFEL I *Chair: NN*
14:00	701	**SwissFEL: The New Femto Second X-ray Laser Source at PSI** *Luc Patthey (i)*
14:30	702	**Using X-ray Techniques to Investigate Ultrafast Chemical Dynamics** *Chris Milne (i)*
15:00	703	**New opportunities for molecular physics using high-harmonic and FEL light sources** *Hans-Jakob Wörner (i)*
15:30	704	**Serial femtosecond crystallography of two-dimensional proteincrystals on solid supports: state of the art and perspectives** *Cecilia Casadei*
15:45	705	**Spectrometers for Photon Diagnostics at SwissFEL** *Jens Rehanek*
16:00	706	**Design of the interaction chamber for ACHIP at PSI** *Eugenio Ferrari*

16:15	707	**Superconducting Undulators for Porthos** *Marco Calvi*
16:30		***Coffee Break***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 14

Time	ID	Scientific Opportunities with SwissFEL II *Chair: NN*
14:30	711	**Athos: The Soft X-ray Line of SwissFEL** *Marco Calvi (i)*
15:00	712	**Femtosecond x-ray techniques: a window towards material control** *Steven Johnson (i)*
15:30	713	**Time and spin resolved photoemission: A new look at ultrafast magnetism** *Yves Marc Acremann (i)*
16:00		***Coffee Break***
16:30	714	**Nonlinear electron-phonon coupling in doped manganites** *Vincent Esposito*
16:45	715	**Investigating ultrafast magnetization dynamics with circularly polarized soft x-ray FEL radiation** *Christian Stamm*
17:00	716	**Observing a phonon-driven structural phase transition in $Sn_2P_2Se_6$** *Martin Kubli*
17:15	717	**Replicating the short-time recovery of a charge density wave state after photoexcitation** *Martin Josef Neugebauer*
17:30	718	**Optically induced transient enhancement of a structural order parameter monitored via a FEL** *Michael Porer*
17:45		***END***
18:30		***Postersession and Apéro***
20:00		***Public Lecture***

Magnetism and Spintronics at the Nanoscale

Wednesday, 23.08.2017, CICG: Room 4

Time	ID	I: Nanomagnetism *Chair: Naëmi Leo, PSI Villigen*
17:00	801	**Spintronics with topologically charged structures – vortex sensors for speed wheel sensors to the potential of skyrmion storage** *Dieter Suess (i)*
17:30	802	**Achiral tilted domain walls in perpendicularly magnetized nanowires** *Benedikt Boehm*
17:45	803	**Nanoscale magnetic ratchets based on shape anisotropy** *Jizhai Cui*
18:00	804	**The triangular-lattice, Ising antiferromagnet with dipolar interactions: tuning a classical spin liquid** *Andrew Smerald*
18:15	805	**Angular Dependent Magnetization Dynamics of Quasicrystalline Nanomagnet Lattices** *Vinayak S. Bhat*
18:30	806	**Direct investigation of microstructure and magnetism of individual cobalt nanoparticles** *Tatiana M. Savchenko*
18:45	807	**Antiferromagnetic order probed in individual goethite nanoparticles** *David M. Bracher*
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Friday, 23.08.2017, CICG: Room 13

Time	ID	II: Dynamics and Magnetoelectric Effects *Chair: Susmita Saha, PSI Villigen*
11:15	811	**Using quantitative Magnetic Force Microscopy to assess average and local values of Dzyaloshinskii-Moriya interaction** *Hans J. Hug (i)*
11:45	812	**Creating Skyrmions with Electric Fields: Experiment and Theory** *Alex Kruchkov*
12:00	813	**Probe magnetism in an ultrafast transmission electron microscope: skyrmion creation by optical pulses in FeGe** *Gabriele Berruto*
12:15	814	**Time- and spatially-resolved magnetization dynamics driven by spin-orbit torques** *Manuel Baumgartner*
12:30	815	**Magnetoelectric coupling between ultrathin Fe films and Pb $(Mg_{1/3}Nb_{2/3})O_3]_{(1-x)}$-$[PbTiO_3]_x$, x = 0.32 (001) (PMN-PT)** *Cinthia Piamonteze*
12:45	816	**Electric field control of magnetism through field effects in perpendicularly magnetized multilayers** *Jaianth Vijayakumar*
13:00	817	**Tuning Ferromagnetism at Room Temperature by Visible Light** *Bálint Náfrádi*
13:15	818	**Spin Hall effect measured by magneto-optical Kerr microscopy** *Christian Stamm*
13:30	819	**Time-resolved X-ray detected ferromagnetic resonance with spatial resolution using scanning X-ray microscopy** *Taddäus Schaffers*
13:45		***END***

ID	Magnetism and Spintronics Poster
831	**Radio-frequency scanning tunneling microscopy on molecular and atomic resonators** *Stefan Müllegger*
832	**Superlattice of single atom magnets** *Stefano Rusponi*
833	**Additive Manufacturing of Polymer Bonded Rare-Earth Magnets for a Predefined External Field** *Christian Huber*
834	**Anomaly in electric transport behavior across Verwey transition in spintronic Fe_3O_4 oxide thin films** *Murtaza Bohra*
835	**Magnetic properties and morphology of cobalt-cobalt oxide core-shell structured nanoparticles** *Jaianth Vijayakumar*
836	**Magneto-optical detection of the spin Hall effect in Pt and W thin films** *Christoph Murer*
837	**Spin wave scattering by a magnetic defect in a magnonic crystal detected by Brillouin light scattering microscopy** *Korbinian Baumgaertl*

838	**Broadband spin-wave spectroscopy performed on single crystals of the insulating chiral magnet Cu_2OSeO_3** *Ping Che*
839	**Spin transport properties of ferromagnetic nanotubes** *Maria Carmen Giordano*
840	**Spin wave excitations in ferromagnetic antidot lattices with penrose tilings** *Sho Watanabe*
841	**Skyrmion Confinement in Magnonic Antidot Lattices** *Susmita Saha*
842	**Photoemission Electron Microscopy Studies of Dynamics in Dipolar-Coupled Arrays of Nanomagnets** *Hanu Arava*
843	**Controlled aggregation of magnetic nanocrystals in Fe-doped GaN** *Andrea Navarro-Quezada*
844	**Magneto-mechanical metamaterial** *Paolo Testa*
845	**Monte Carlo Renormalization Group study of dipolar coupled XY spins** *Dominik Schildknecht*
846	**Magnetic correlations in artificial 2D XY spin systems** *Naëmi Leo*

Biophysics and Medical Physics

Wednesday, 23.08.2017, CICG: Room 5

Time	ID	Biophysics and Medical Physics I *Chair: Giovanni Dietler, EPFL*
14:00	901	**Using physics to interpret co-evolutionary data for proteins: protein structure and protein-protein interaction reconstruction** *Paolo De Los Rios (i)*
14:30	902	**Architecture of Allosteric Materials** *Matthieu Wyart (i)*
15:00	903	**The tortoise and the hare: Bacteria and mitochondria division dynamics revealed by time-lapse super-resolution microscopy** *Suliana Manley (i)*
15:30	904	**Multi-channel optical coherence tomography in ophthalmology** *Andreas Wartak*
15:45	905	**Point spread function engineering for image scanning microscopy** *Franziska Strasser*
16:00	906	**Lensless endoscopy using a fiber bundle and holographic imaging approach** *Lara Marie Wurster*
16:15	907	**Multi-color operation of tunable diffractive lenses** *Martin Bawart*
16:30		***Coffee Break***

Time	ID	Biophysics and Medical Physics II *Chair: NN*
17:00	911	**Transcriptional bursting and promoter cycles in mammalian cells** *Felix Naef (i)*
17:30	912	**Buckling of visco-elastic sheets in endocytosis and development** *Aurélien Roux (i)*
18:00	913	**The physics of locust swarms** *Katja Ried*
18:15	914	**Combined function superconducting magnets for light and compact proton therapy gantries** *Ciro Calzolaio*
18:30	915	**True tapping mode Scanning Near-Field Optical Microscopy with bent glass fiber-made probes** *Anton Smirnov*
18:45	916	**The SAFIR project: a fast 7T-MR compatible PET insert for real-time dynamic studies** *Jisoo Kim*
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

ID	Biophysics and Medical Physics Poster
921	**Cell poration of fixed and live cells by phase shaped femtosecond pulses** *Gabriel Campargue*
922	**Development of Fast Timing Silicon Pixel Sensors for Positron Emission Tomography** *Daiki Hayakawa*
923	**From ligand-receptor interactions to antimicrobial drug development: application of a biosensor based on surface waves** *Ekaterina Rostova*
924	**Analysis of degraded energy spectra, and its importance for proton therapy facilities** *Valeria Rizzoglio*
925	**Studies on time dependent activity distributions for the SAFIR project** *Avraam Chatzimichailidis*
926	**Spontaneous deswelling of pNIPAM microgels at high concentrations** *Urs Gasser*

Progress in Physics (59)

Investigating oxide heterostructures: Towards new materials with tailored electronic properties

Céline Lichtensteiger, DQMP – University of Geneva

In this short paper, we review some of the efforts carried out in Geneva in the group of Prof. Jean-Marc Triscone on the realization and studies of oxide films and heterostructures. This research area is rapidly progressing on a worldwide scale with strong activities in Switzerland – for instance at ETH, EPFL, the Universities of Fribourg and Zürich and at PSI. It is not the goal here to give a comprehensive view of the efforts pursued in Switzerland or throughout the world, but rather to spark the reader's interest in this fascinating field of research.

Oxide materials

Oxides belong to a large family of chemical compounds sharing the common feature of having at least one oxygen atom. They can have different structures, from simple individual molecules to more complex polymeric and crystalline structures (bixbyite, corundum, fluorite, garnet, perovskite, pyrochlore, scheelite, spinel, wolframite, wurtzite, zircon and many others). We will focus here on perovskites.

One of the fascinations for oxide materials is that they display a wide range of electronic properties providing a plethora of possible functionalities that can be useful for applications. Ferroelectricity, high-temperature superconductivity, multiferroicity, piezoelectricity, thermoelectricity are exciting properties that can be used in many areas, including spintronics, transparent electronics, and photonics or energy harvesting, to name but a few. Oxide materials already display a broad spectrum of properties in bulk. Once in the nanoscale form and combined with other materials, further new intriguing phenomena appear. Devices incorporating oxides are already widely found in our standard electronic equipment.

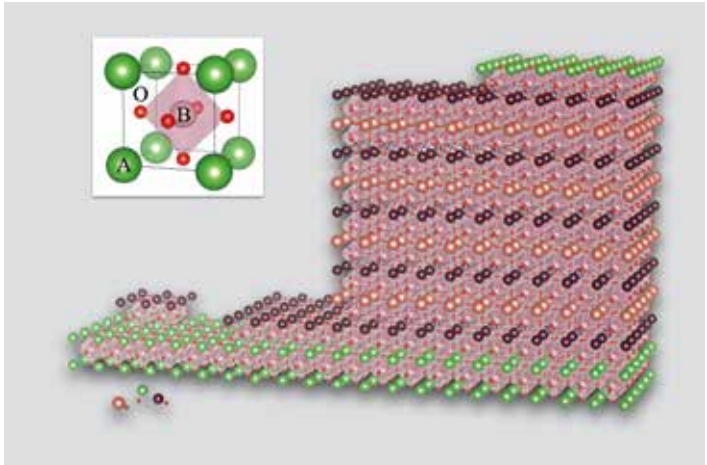


Figure 1. Schematic representation [1] of a heterostructure combining different perovskite materials with a perfect crystallographic alignment, a precision attained today with different growth techniques. The inset shows the simple perovskite structure ABO_3, with the B-cation at the center, surrounded by an oxygen-octahedron, and with the A-cation at the corners of the unit-cell.

1 Drawn using VESTA [K. Momma and F. Izumi, J. Appl. Crystallogr., 44, 1272-1276 (2011).]

Among oxide materials, perovskites (see inset of Figure 1), with their simple ABO_3 formula, are a unique class of compounds due to their simple crystal structure and to their flexibility: changing the A and B cations modifies the properties of the system without substantially changing the crystal structure. This allows such perovskites to be combined in perfect epitaxial heterostructures, as schematically represented in Figure 1 – just like children building with Lego® blocks – creating new functional materials with tailored electronic properties. The properties of such heterostructures can be further tuned by modulating strain, doping, stoichiometry or oxygen octahedral rotations.

Nowadays, these exciting materials are in the spotlight of many theoretical and experimental research groups worldwide. With the recent advances in deposition techniques, artificial materials can be produced with atomic-scale control

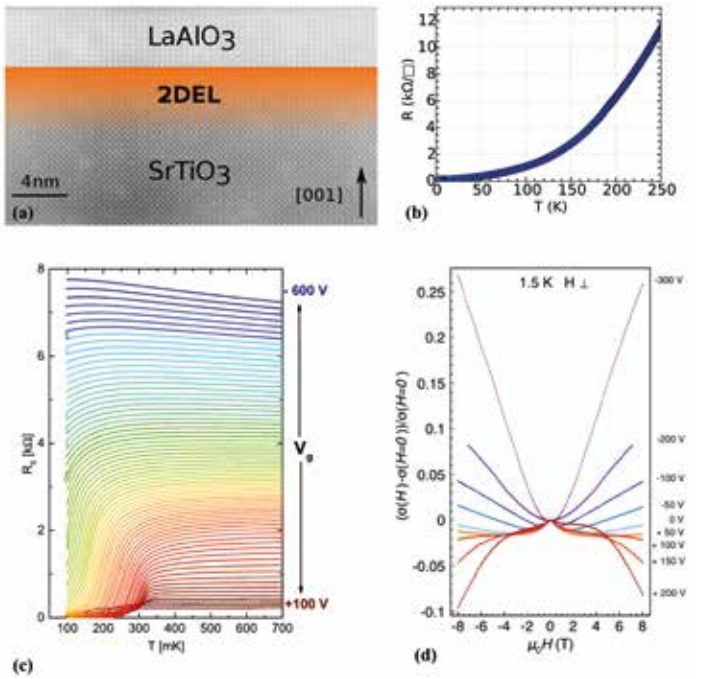


Figure 2. In this figure are summarized the main properties of the electron system confined at the interface between $LaAlO_3$ and $SrTiO_3$. (a) TEM image of the heterostructure, with the region where the electrons are confined highlighted in orange. (b) Sheet resistance of a standard interface as a function of temperature. (c) Sheet resistance between 100 and 700 mK for different gate voltages: by moving from a positive to a negative gate voltage, the system evolves from a superconducting to an insulating state [S. Gariglio, M. Gabay and J.-M. Triscone, APL Materials 4, 060701 (2016)]. (d) Effect of the gating on the magnetoresistance of the 2DEL at 1.5 K. A transition from a weak-localization to a weak-antilocalization regime is observed as a function of doping [A. D. Caviglia et al., Phys. Rev. Lett. 104, 126803 (2010)].

- as demonstrated with the transmission electron microscopy (TEM) image shown in Figure 2 (a) - using various epitaxial growth techniques, such as molecular beam epitaxy, pulsed laser deposition and sputtering. Here we focus on heterostructures based on perovskite materials grown and investigated in Geneva: $LaAlO_3/SrTiO_3$ interfaces and vanadates grown by pulsed laser deposition, and ferroelectrics and nickelates grown by sputtering.

Conducting oxide interfaces

At the frontier between two complex oxide materials, new physics can emerge. A remarkable example is the interface between the two insulating oxides $LaAlO_3$ and $SrTiO_3$ (Figure 2). Between these two good insulators, a two-dimensional electron liquid (2DEL) forms when a thin layer of $LaAlO_3$ is epitaxially grown on a $SrTiO_3$ substrate. The metallic conduction at the interface between these two excellent band insulators was discovered by Ohtomo and Hwang [A. Ohtomo and H. Y. Hwang, Nature 427, 423 (2004)] and triggered intensive research activities around the globe. In collaboration with the group of Prof. Mannhart (MPI Stuttgart), it was found in Geneva, in 2007, that this interface is not only conducting but also superconducting [N. Reyren *et al.*, Science 317, 1196 (2007)]. Among its spectacular electronic properties, the 2DEL displays a large Rashba type spin-orbit coupling. The superconducting T_c and the spin-orbit coupling strength can be tuned by an electric field in a unique way allowing, for instance, superconductivity to be switched on and off [A. D. Caviglia *et al.*, Nature 456, 624 (2008)]. High magnetic field studies of high mobility samples reveal complex Shubnikov-de Haas quantum oscillations of the resistance.

Currently, the superconducting state is attracting considerable interest with open questions on the pairing mechanism itself, the possible role of spin-orbit coupling and its impact on the symmetry of the superconducting order parameter.

Related publications can be found directly on our website at: *http://dqmp.unige.ch/triscone/research.php?topic=conductingoxides*

Nanoscale ferroelectrics

Perovskites also display exciting properties while remaining entirely insulating. Here we very briefly discuss some of the properties of ferroelectric films and structures.

Ferroelectrics are insulating materials characterized by a spontaneous polarization that can be reversed by the application of an electric field (Figure 3 (a,b)). Regions of different polarization orientations are called domains. These domains and their domain walls – the boundaries between different domains – deeply affect the sample properties. Domain walls by themselves are also the focus of current intensive research, boosted by the discovery of their room temperature electrical conductivity in $BiFeO_3$ [J. Seidel *et al.*, Nat. Mater. 8, 229 (2009)], making them interesting for nanoscale applications.

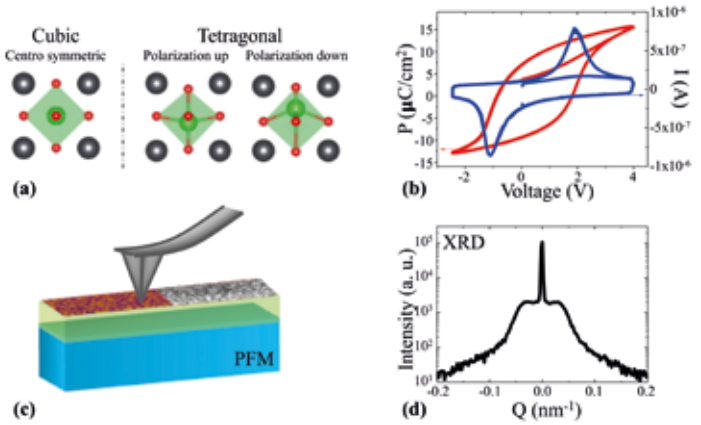


Figure 3. Ferroelectrics are insulating materials characterized by a spontaneous polarization that can be reversed by the application of an electric field. (a) In the perovskite structure, the polarization is related to a displacement of the O-octahedron and the B-cation with respect to the A-atom cage. (b) The application of a voltage results in the well-known P-V loop (in red), obtained by measuring the switching current (in blue). Domains of opposite polarizations can be observed by PFM (c) or XRD (d), but can be observed simultaneously using both techniques only in very specific cases, as discussed in the text (here: PST thin film with x = 0.8 and thickness = 42 nm).

In ferroelectric ultrathin films, the properties are to a large degree affected by the electrical boundary conditions [C. Lichtensteiger *et al.*, Ch. 12 in Oxide Ultrathin Films, Science and Technology, Wiley (2011)]. In collaboration with the group of Prof. Paruch (University of Geneva), we found that the polarization orientation, stability and domain formation in $PbTiO_3$ ultrathin epitaxial films can be controlled by choosing the correct electrodes and by tuning their effectiveness via the insertion of spacer layers of varying thicknesses [C. Lichtensteiger *et al.*, NanoLetters 14, 42025 (2014), C. Lichtensteiger *et al*, New Journal of Physics 18 043030 (2016)].

By combining $PbTiO_3$ and $SrTiO_3$, we revealed an interesting type of ferroelectricity for very short wavelength superlattices (i.e. with a few unit cells of $PbTiO_3$ and $SrTiO_3$). With theoretical support of Prof. Ghosez and his group (University of Liège), it has been shown that this phenomenon is linked to a very particular coupling of different structural instabilities at the interface between the two materials [M. Dawber *et al.*, Phys. Rev. Lett. 95, 177601 (2005), E. Bousquet *et al.*, Nature 452, 732 (2008)]. This new behavior leads to unusual properties including a very high, temperature-independent dielectric constant, which may be of interest for applications. The coupling of instabilities is one of the paths that is explored today to develop new multiferroic materials – materials that are both ferroelectric and ferromagnetic.

In another series of superlattices composed of $PbTiO_3$ and $SrTiO_3$ layers, 180° ferroelectric domains were observed using X-Ray Diffraction (XRD) [P. Zubko *et al.*, Phys. Rev. Lett. 104, 187601 (2010); P. Zubko *et al.*, NanoLetters 12, 2846 (2012)]. But the small domain size made it challenging to image them by piezo-force microscopy (PFM): it is only within a narrow range of domain sizes that both techniques can be suitable. By incorporating $PbTiO_3$ and $SrTiO_3$ into a solid solution of chemical formula $Pb_xSr_{1-x}TiO_3$ (PST) in thin film form, we found a regime in which the 180° domains had the ideal size allowing their investigation both with x-ray diffrac-

tion (XRD) and PFM to be performed, as shown in Figure 3 (c,d) [S. Fernandez-Pena *et al.*, APL Materials 4, 086105 (2016)]. These PST samples allowed us also to shed light on the effect of domain walls on the sample properties. A clear increase in the dielectric susceptibility for samples with larger domain wall concentrations was observed, which may prove important for possible future applications involving high domain wall density ferroelectric thin films.

Related publications can be found directly on our website at: *http://dqmp.unige.ch/triscone/research.php?topic=nanoscaleferroelectrics*

Nickelates

The rare earth nickelates are another fascinating family of oxides with formula $RNiO_3$, R = rare earth. These materials have attracted interest in the oxide community for many years because of their sharp metal to insulator transition (MIT). Indeed, as the temperature is decreased, $RNiO_3$ materials display a bandwidth-controlled MIT and a unique ground state, characterized by a breathing distortion of the NiO_6 units and an uncommon antiferromagnetic order (Figure 4 (a)).

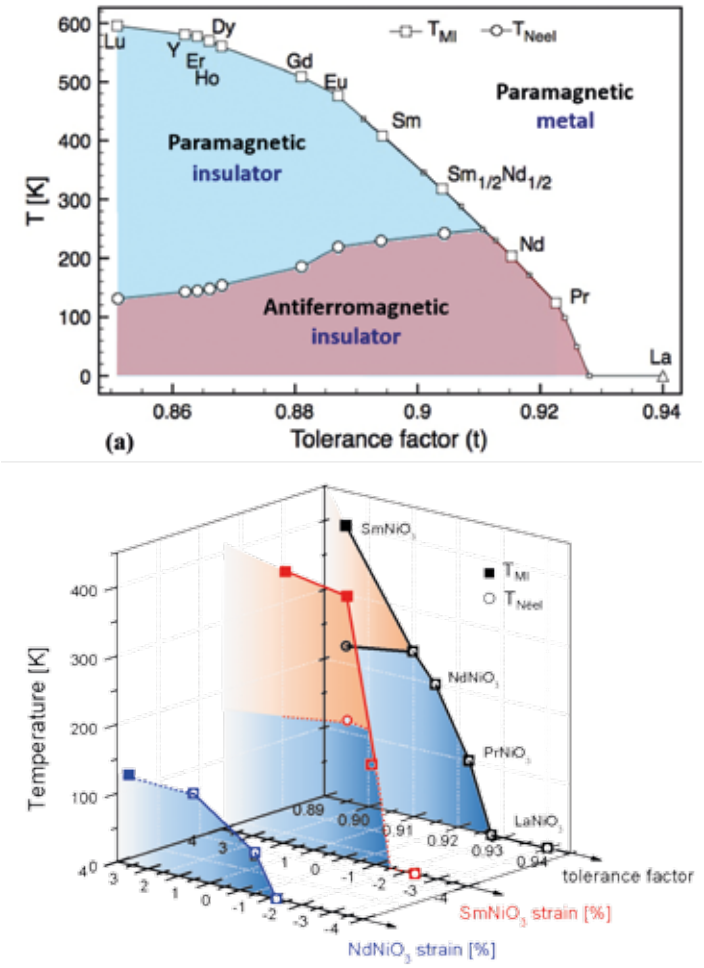


Figure 4. (a) Phase diagram of the nickelate family showing the different MIT and Néel transition temperatures for different rare earth ions. (b) Studying $NdNiO_3$ and $SmNiO_3$ thin films grown on different substrates, we were able to demonstrate that epitaxial strain is as efficient as steric effects to control the MIT and Néel transition temperatures in nickelates

Due to the lack of reasonably sized single crystals, high quality thin films are a unique playground for the study of the nickelates. In Geneva, high quality nickelate thin films and superlattices are grown by radio frequency off-axis magnetron sputtering.

In the past years, we achieved control of the MIT and magnetic properties of $SmNiO_3$ and $NdNiO_3$ through a variety of approaches, using strain, confinement, light excitation, electric field effect or heterostructuring (Figure 4(b)) [see for instance R. Scherwitzl *et al.*, Advanced Materials 22, 5517 (2010), S. Catalano *et al.*, APL Materials 2, 116110 (2014).] Currently, we are studying the role of the growth direction and substrate symmetry on the $NdNiO_3$ properties, focusing on the special clamping conditions provided by $(111)_{pc}$ oriented interfaces [S. Catalano *et al.*, APL Materials 3, 062506 (2015)].

$LaNiO_3$ is the only nickelate that has no MIT and remains paramagnetic at all temperatures in bulk. However, we showed that a transition to an insulating state occurs in $LaNiO_3$ thin films as its thickness is reduced to few unit cells. [R. Scherwitzl *et al.*, Appl. Phys. Lett. 95, 222114 (2009); Phys. Rev. Lett. 106, 246403 (2011)]. Interestingly, for films of 6-11 u.c. thick there is an enhancement of conductivity resulting from the existence of three local structures within the thin films, as revealed by TEM analysis and density functional theory calculations [J. Fowlie *et al.*, Adv. Mater. 29, 1605197 (2017)]. Antiferromagnetism is also stabilized in the ultrathin insulating $LaNiO_3$ layers when grown along the [111]-direction in $LaNiO_3$/$LaMnO_3$ superlattices [M. Gibert *et al.*, Nat. Mater. 11, 195 (2012); Nat. Commun. 7, 11227 (2016)].

Related publications can be found directly on our website at: *http://dqmp.unige.ch/triscone/research.php?topic=nickelates*

Vanadate superlattices

Finally, let us mention the vanadates AVO_3, a family of compounds that are metallic or insulating depending on the valence of the A-cation chosen. For example, $SrVO_3$ is a d^1 correlated metal (Sr is 2^+), while $LaVO_3$ is a d^2 Mott insulator (La is 3^+), both of which are being studied in this group.

In $SrVO_3$, studies of electronic transport versus strain and thickness are pursued.

For heterostructures of 3^+ insulating vanadates, ab-initio calculations predict a novel improper ferroelectric ground state coupled to a magnetic structure that should be generated in well-defined superlattices. This effect, linked to an interaction between rotational and anti-polar instabilities, could lead to the observation of a new class of multiferroic compounds with large magnetoelectric coupling.

Related publications can be found directly on our website at: *http://dqmp.unige.ch/triscone/research.php?topic=vanadates*

Frontiers in Quantum Materials Control

Last but not least, October 2013 marked the start of the ERC Synergy Grant research project "Frontiers in Quantum Materials' Control" (Q-MAC).

This project is a collaboration between the groups of Andrea Cavalleri (Max Planck Institute in Hamburg), Dieter Jaksch (University of Oxford), Antoine Georges (École Polytechnique near Paris/University of Geneva) and this group.

The project combines sophisticated ab-initio approaches, advanced oxide growth techniques allowing artificial materials to be grown layer-by-layer, and state of the art ultrafast laser experiments to explore different ideas to design new superconductors and to tune or improve the properties of superconducting materials on short lengthscales.

As examples, we are investigating methods to both induce and stabilize superconductivity by modifying the atomic structure of a system in particular ways through shining highly controlled laser light on the sample.

More information can be found at:
http://dqmp.unige.ch/triscone/research.php?topic=q-mac

Conclusion

Oxides are very promising compounds to design new materials with tailored electronic properties. They display exciting behavior on their own, and when combined in heterostructures their physics is even richer. The very new and exciting field of "interface engineering" brings the scientists to the frontier between fundamental science and possible novel applications. The few examples described in this short article, together with recent developments worldwide, suggest that novel electronic properties can be found at oxide interfaces. In addition to the desire to understand the intriguing fundamental physics of these systems, the technological potential is large and is a strong motivation for further research that will undoubtedly continue to be actively pursued in the next years with many opportunities for young researchers. The possibilities offered by combining two or more oxide materials seem endless – the main limitation currently being our imagination!

Acknowledgements

The author would like to thank everyone in the group, and especially Margherita Boselli, Sara Catalano, Stéphanie Fernandez, Elias Ferreiro, Jennifer Fowlie, Stefano Gariglio, Marta Gibert, Hugo Meley and Jean-Marc Triscone for their valuable contribution in the preparation of this article and for their nice illustrations.

Collaborations

A few collaborations were cited directly in the text. Below is a more complete list of the present on-going collaborations throughout Switzerland and worldwide.

In Switzerland: Felix Baumberger, Antoine Georges (also from Collège de France/Ecole Polytechnique), Thierry Giamarchi, Alberto Morpurgo, Patrycja Paruch, Christoph Renner and Dirk van der Marel from the University of Geneva; Cinthia Piamonteze, Thorsten Schmitt, and Phil Willmott from the Paul Scherrer Institut; Philipp Aebi and Christian Bernhard from the University of Fribourg; Hans-Josef Hug from EMPA; Ulrich Aschauer from the University of Bern.
In France: Marc Gabay and Odile Stéphan from the University Paris Sud; Michel Viret from Iramis-Saclay; Nicolas Jaouen from SOLEIL.
In Italy: Marco Saluzzo and Daniela Stornaiuolo from the Universita degli Studi di Napoli Federico II; Daniele Marré from the University of Genoa.
In Belgium: Philippe Ghosez from the University of Liège.
In Luxembourg: Jorge Iniguez and Jens Kreisel from the Luxembourg Institute of Science and Technology.
In Germany: Andrea Cavalleri from the Max Planck Institute in Hamburg; Jochen Mannhart and Bernhard Keimer from MPI Stuttgart.
In the Netherlands: Andrea Caviglia from the Delft University of Technology.
In the UK: Dieter Jaksch at the University of Oxford; Pavlo Zubko from the University College London.
In Australia: Nagarajan Valanoor from the University of New South Wales.
In Canada: George Sawatzky from the University of British Columbia.

Reviews

The interested reader might find more information on oxide heterostructures and interfaces in the following reviews:

M. Lorenz et al., The 2016 Oxide Electronic Materials and Oxide Interfaces Roadmap, *J. Phys. D: Appl. Phys.* **49**, 433001 (2016)

J. Mannhart, and D. G. Schlom, Oxide Interfaces – An Opportunity for Electronics, *Science* **327**, 1607 (2010)

P. Zubko, S. Gariglio, M. Gabay, P. Ghosez, and J.-M. Triscone, Interface Physics in Complex Oxide Heterostructures, *Annu. Rev. Condens. Matter Phys.* **2**, 141 (2011)

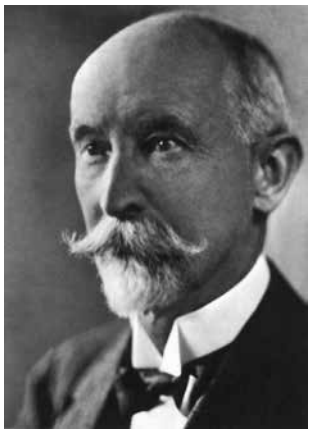
H. Y. Hwang, Y. Iwasa, M. Kawasaki, B. Keimer, N. Nagaosa, and Y. Tokura, Emergent Phenomena at Oxide Interfaces, *Nature Materials* **11**, 103 (2012)

History of Physics (18)

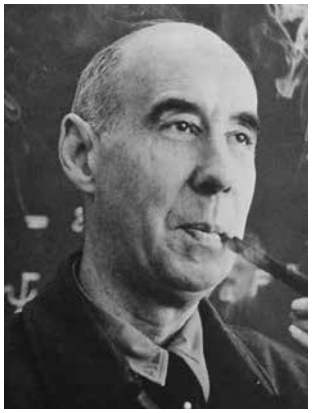
An EPS Historic Sites Award celebrating two Genevan physicists

Jan Lacki, Uni Genève

"*The EPS Historic Sites Award commemorates places in Europe important for the development and the history of physics*" [1]. This initiative is a genuine success: until today (May 2017) 33 places have been distinguished and so many commemorative plaques affixed. On March 29, 2017, the *Bastions* building of the Geneva University hosted the unveiling of its Historic Sites plate celebrating the activity of two distinguished Genevan professors, Ch.-E. Guye and E. C. G. Stueckelberg. The ceremony was a success: University officials, SPS and EPS boards members, together with some noteworthy guests (most of them Stueckelberg's former students, collaborators or just admirers), happily enjoyed the speeches and admired the plate. Before I describe the respective achievements of the two Genevan scholars and how they shaped local physics, let me briefly comment on the *Bastions* building itself. Indeed, it is intimately related to the history of the Geneva University and, since its erection till the middle of 20th century, of Geneva physics. From present-day perspective this latter fact may come as a surprise, as the *Bastions* building is today known for hosting mostly the activities of the Humanities and hence is definitely not charged with scientific connotations. But the investigations which made Genevan academic physics enter resolutely in the era of relativity and quantum revolutions all happened in the *Bastions* premises.



Charles-Eugene Guye



E. C. G. Stueckelberg

To start with, let us recall that the University of Geneva, in the form we know today, is a rather late creation. Its origin is Calvin's Academy founded in 1559 by the protestant leader as an institution aiming at educating future city's elite, predicators, lawyers and civil officers. The introduction of science teaching came much later and went stabilized only during the 18th century. In spite of some efforts, throughout its history, to expand its scope, one had to wait until 1872 and a substantial revision of Geneva's higher education system to see it finally granted a full university status [2]. For centuries, Calvin Academy did not have at its disposal any own premises and one had to wait until the 1870's to see inaugurated the very first (and for some time almost unique) building specifically dedicated to academic activities. What is called today the *Bastions* building, together with its adjacent wings, was initiated in 1868 in the perspective of the transformation of the Academy into a University, and was achieved four years later. It was aimed at hosting most of the academic activities, and in particular physics. To the central building were added two wings, one dedicated to host the scientific and naturalistic collections of the City, to constitute what was to be called the *Musée académique*, and the other designed to host the Library. The physics collections, the *Cabinet de Physique* as it was then called (mostly the collections of scientific instruments donated to or acquired by the academic authorities), were instead moved to the basement of the central building. Its first floor hosted the physics laboratories. These premises proved soon too exiguous and when chemistry moved out, in 1880, for a building of its own, the laboratory of experimental physics took possession of the vacant space in the basement.

How was Genevan physics at the time? As much physics was done outside than inside the university. The end of the 19th century witnesses indeed the very last decades when front-rank research is, in substantial proportion, still done outside the academic institutions. Let me remind that our contemporary characterization of universities as institutions which take care of front-rank research and simultaneously dispense most up-to-date education is the outcome of a transition which took place over decades of the 19th century. Until then, universities were not really promoters and/or places of genuine scientific progress. The later was achieved elsewhere and owed substantially to the activities of individuals who were acting on an independent basis and/or were supported to various extents by scientific societies (such as the *Royal Society* in London, the Paris *Academie des Sciences*, or the *Königlich-Preussische Akademie der Wissenschaften* in Berlin, to name a few best known). These societies remained for long the main promoters of research. Universities, on the other hand, until roughly the mid 19th century, were rather dedicated to teaching and even then, they were usually not dispensing the most up to date knowledge. When university professors were involved in research, they were doing it mostly because of personal interests, rather than as a regular part of their academic duties. In the last decades of 19th century, the case of Geneva is more or less illustrative. In 1848, Elie-François Wartmann obtained the chair of experimental physics after Auguste de la Rive, a specialist of electricity, resigned his position for political reasons. Wartmann took care of physics teaching until 1886 and investigated optical phenomena, vision physiology and electricity. Then father Louis Soret (1827-1890) and son Charles Soret (1854-1904) took over. Louis, from 1866 on, was in charge of a complementary teaching in physics before he was promoted full professor in medical physics in 1876. He was interested in various physical topics, none

1 Quote from the EPS Historic Sites Award web page, http://www.eps.org/?page=distinction_sites as of June 1st, 2017.

2 For details, as well as for other historical facts concerning Genevan physics, its sites and its actors, see J. Lacki, The Physical Tourist. Geneva: From the Science of the Enlightenment to CERN, *Physics in Perspective*, vol. 9 (2007), p. 231.

of them really innovative. His son Charles, lecturer at the department of crystallography and mineralogy in 1879, then full professor in 1881, is better remembered for his investigations of thermodiffusion (the so-called *Soret effect*, with a law named after him). An interesting and symptomatic case is Raoul Pictet (1846 - 1929), well known for his research in low temperature physics and in particular for his liquefaction of Oxygen (1877, obtained independently by the French Cailletet). It is only after this achievement that Raoul Pictet was proposed a chair in "industrial physics" (1878) created especially for him. Unfortunately, he did not hesitate, following an entrepreneurial disagreement over the commercial use of his discovery, to resign and to leave Geneva without any negative impact on his research, fully independent of his academic position. Equally, maybe even more innovative, and closer to fundamental issues was the activity of Lucien de la Rive, the son of Auguste. Soon after Hertz discovery of electromagnetic waves, Lucien de la Rive, assisted by his friend Edouard Sarasin, produced and observed the latter in the facilities of the Genevan Société pour la construction des instruments de physique, known later as *Societé des instruments de physique* (SIP) [3]. De la Rive's and Sarasin's experiments, which occasionally refined and completed Hertz's own, extended over the period 1889 - 1893 [4]. Later on, Lucien published studies in gravitation, electron theory, Maxwell equations and relativity of which he was an early promoter in spite of his already considerable age. He did it without any genuine academic support: in spite of his front rank scientific activity, Lucien was never appointed by Geneva university. The latter, however, eventually granted him a doctorate *honoris causa* in 1909, the same year it honored the young Albert Einstein.

The mention of Einstein's links with Geneva University brings me now to Charles-Eugène Guye (1866 - 1942). Using this brief survey of Genevan physics at the turn of the century as background, I intend to show that Guye can be considered as the man who brought a systematic tradition of front rank research to Geneva University. He made the Physics Institute the center of ambitious experimental and, to a lesser extent, theoretical investigations and, from this point of view, he is the genuine founder of Genevan modern academic physics. Now, I already had the opportunity to tell the story of Charles - Eugène Guye's famous relativity experiments in the *SPG Mitteilungen* some years ago [5], so let me just remind the essential facts. Guye obtained his Ph. D. in Geneva under the guidance of Charles Soret with a study of the refraction properties of quartz. He moved then to Zürich where he started his academic career, ending up as lecturer at the Federal Institute of Technology. He specialized in various problems related to electrical technology, studying in particular problems of electric line transmission.

When the University of Geneva called his former pupil to the chair of experimental physics, he was not its first choice. After the resignation of Charles Soret in 1900, the vacant chair needed a successor and after laborious discussions with the renowned Pierre Curie from Paris, the latter agreed to come to Geneva, where he was offered very advantageous conditions. However, at the very last moment, Curie changed his mind, for reasons which remain today still unclear [6], causing much disappointment and even some resentment.

Be it as it may, the choice of Guye proved a clever one. Aside from studies on magnetic hysteresis, electrical arcs, internal friction of matter and gas discharges at high pressure, Guye moved resolutely into the frontier domain of electrodynamics, specifically into the field of research related then to the revolutionary hypothesis of an electromagnetic foundation of physics. Between 1907 and 1915, Guye performed, with the help of his students, a series of experiments aimed at studying the effects of variation of mass with velocity. The experiments were located in the *Bastions* building (probably in the basement). Guye's motivation was to compare two rival theories, that of Max Abraham, and the one of Lorentz and Einstein. Taking part in an ongoing controversy over the pioneering experiments of Walter Kaufmann who concluded to the validity of Abraham's theory of the rigid electron, Guye vindicated in the most precise way the relativistic theory of Lorentz and Einstein. Thanks to this success, Guye achieved a considerable fame, sitting in numerous commissions and committees [7]. Before relativity theory became widely accepted and Einstein its undisputed hero, Guye was among its foremost promoters. Indeed, Guye early recognized Einstein's merits. In 1909, when the University celebrated its 350th anniversary, and the City the fourth centennial of Calvin's birth, he managed to nominate Einstein among the numerous scientists who were to be honored as special doctors *honoris causa* of the celebration.

During Guye's times, the faculty of sciences kept growing. The teaching of physics gained a new chair of mathematical physics in 1930 which was offered to Guye's protégé, Arthur Schidlof (1877 - 1934). The latter is remembered for his early atomic model before Bohr's 1913 breakthrough [8], but it is his successor, E. C. G. Stueckelberg von Breidenbach (1905 - 1984) who definitely initiated a tradition of most advanced theoretical physics in Geneva. He was initially appointed temporarily to take over Schidlof's courses left orphan following the latter's untimely death (1934) but just a year later he was promoted full professor. His office which saw much of his best science was in the *Bastions* building until Geneva physics moved eventually to a dedicated building two decades later [9].

Definitely one of the most illustrious Swiss physicists of the 20th century, on par with the best minds of his time, Stueck-

3 Founded in 1862, the SIP became in the following decades a world-renowned constructor of scientific instrumentation, measuring devices and also various machines (in particular its famous "machine à pointer").

4 It is an interesting story for its own sake; for the details see the captivating account by D. Pestre and M. Atten, *Heinrich Hertz. L'Administration de la prevue*, PUF, 2002.

5 *SPG Mitteilungen* Nr. 25, pp. 14-17.

6 As it appears, Pierre Curie did not receive a really convincing counter-offer from Paris; rather, it could be that the cosmopolitism of Paris with respect to a more provincial Geneva had a part in his brisk change of mind. Some biographers point to the determinant role of Pierre's wife, Marie Curie (see Françoise Giroud's biographic study of Marie Curie, *Une femme honorable*, Fayard, 1981, pp. 127 - 128).

7 Today, people remember Guye probably best from the famous picture of the participants to the fifth Solvay congress in 1927. Guye served on the scientific committee of the Solvay Institute three times in a row, from 1927 to 1933, but this is the only time he appeared on the commemorative photography, see my paper on Guye in the *SPG Mitteilungen*, Nr. 25, pp. 14 - 17.

8 See my article on Schidlof in the *SPG Mitteilungen*, Nr. 34, pp. 48 - 51.

9 In 1953, the physics laboratories moved from the old building of the *Bastions* into a new dedicated edifice.

elberg was an eccentric character. Beset by an recurrent mental disorder, he managed nevertheless to achieve in the 1930's - 1950's some most important discoveries in the pioneering field of theoretical high-energy physics, among other in his study of relativistic quantum field theory (covariant perturbation theory), of unitary theories of interactions (the mesic theory of strong interactions, the Stueckelberg's B-field), and of the causal S-matrix theory (the causal propagator and the renormalization group). In 1949, during an episode of his illness, he unexpectedly resigned from his position and it took a decade before he was restored to his professorial status [10].

In his paper published in the *SPG Mitteilungen* [11], Gerard Wanders covered Stueckelberg's initial steps in science, so I pass directly to discussing some of his most remarkable scientific achievements. During the years (1927 - 1932) that he spent in Princeton after obtaining his Ph.D. in Basel, Stueckelberg was mainly busy with molecular physics. He considered problems of molecular collisions, of interpretation of continuum emission and absorption spectra and of calculations of the energy levels of molecules. His work, together with Winans, on the continuous discharge spectrum of the hydrogen molecule, and then with Morse on the ionized Hydrogen molecule were genuine achievements but it is his contribution to the theory of collisions that best characterizes Stueckelberg's creativity in this period. Indeed, in his study of the inelastic atomic collisions, Stueckelberg introduced a formalism still commonly used and known today as the Landau-Zener-Stueckelberg (LZS) theory. It is fundamental in collision situations where there are non-adiabatic state changes associated to the existence of an "avoided crossing" at the level of the potential energy curves [12]. While Lev Landau and Clarence Zener gave first versions of the LZS mechanisms at the turn of 1931, Stueckelberg provided, almost a year later, a much more sophisticated analysis [13].

Just before he was appointed in Geneva, and while still privatdozent at Zürich University (1933), Stueckelberg turned to a new field of interest, quantum electrodynamics and more broadly the theory of elementary particles, at the time a most prominent and rapidly developing topic. It did not take him long to make a remarkable contribution. One of the problems at the time was the lack of a formalism that would enable to do relativistic quantum calculations in an explicitly covariant way. Indeed, in the conventional scheme for time-dependent perturbation theory, because of the distinguished role played by time, the perturbative terms contain denominators involving differences in energy, and so *explicit* covariance is lost. In his approach, Stueckelberg obtained the perturbative corrections, in Pauli's words: "by eliminating time and space [variables] completely from the theory and examining directly the coefficients of the *four*-dimensional Fourier expansion of the wave function" [14] (the method is also characterized by a smart use of complex contour integration). This was, in 1934, the first fully and manifestly covariant perturbative formalism in quantum electrodynamics [15] and it could be used to investigate as well other interactions. Stueckelberg used it successfully over the next years to study Compton scattering, Bremsstrahlung, and most importantly, creation and annihilation of particle-antiparticle pairs [16]. It should be noted that in 1941, Stueckelberg studied the problem of pair creation and annihilation in three papers where he stated the revolutionary interpretation of positrons as electrons travelling back in time. Much later (1949) Feynman came up with the same idea (apparently suggested to him by Wheeler); after initially mentioning Stueckelberg's prior work, Feynman gave up doing so later. This certainly contributed to the fact that Stueckelberg's pioneering works on (classical and) quantum electrodynamics remained rather unknown to the later generations [17].

Stueckelberg could also apply his perturbation theory to the study of beta-decay and of nuclear forces, two research fields which, in the years 1930 - 1935, witnessed an impressive progress. The postulation of the neutrino by Pauli (1930) and the discovery of the neutron by Chadwick (1932) opened new avenues for solving old problems (violation of energy conservation in beta-decay, the structure of the nucleus) and suggested the first unified models of electromagnetic, weak and nuclear processes. Inspired by Fermi's theory of beta decay, by its application to nuclear interactions viewed as an exchange of electron-neutrino pairs between nucleons, and by de Broglie's idea of a photon as a compound particle made of two neutrinos, Stueckelberg proposed in 1936 an ambitious theory of all interactions based exclusively on spinor fields. Because of some fatal problems, he modified his first attempt introducing, in 1937, instead of spinor current couplings, a (non-spinor) field-mediated coupling. The latter, in the case of nuclear forces, involved a charged scalar field that Stueckelberg readily identified with the "heavy electron" found in cosmic rays a year earlier. Doing so, Stueckelberg hit independently on an idea that the Japanese Yukawa had already proposed in 1934 to explain nuclear force as an exchange of a new particle, roughly 200 times heavier than the electron, the meson. Hence, one can consider Yukawa and Stueckelberg as independent proponents of a meson theory of nuclear forces [18]. Yukawa's clear priority and his analysis closer than Stueckelberg's to concrete phenomenology may explain why Stueckelberg is usually not considered as a co-discoverer. As is well known, the new cosmic rays particle turned

10 For an account of this troubled decade, see my article entitled "1946-1960: Une période difficile pour la physique genevoise", in *SPG Mitteilungen*, Nr. 43, pp. 50 - 54, also Nr. 44, pp. 44 - 48.

11 *SPG Mitteilungen* Nr. 32, p. 20, see also chapter 1 in *E.C.G. Stueckelberg; an unconventional figure of twentieth century physics*, J. Lacki, H. Ruegg and G. Wanders (eds), Birkhäuser, 2009 (further quoted as LRW).

12 For details, see my article on Stueckelberg and molecular physics in LRW , chapter 3, p. 13 - 23.

13 See also the interesting historical study of the non-adiabatic transitions by Nikitin and Di Giacomo, "The Majorana formula and the Landau-Zener-Stueckelberg treatment of the avoided crossing problem", Physics *Uspekhi,* vol. 48 (2005) p. 515 - 517.

14 Quoted from a letter to Heisenberg dated 5 February 1937.

15 See my contribution in LRW, chapter 4, p. 25 - 51 and references therein.

16 Ibid, see also Olivier Darrigol's analysis in chapter 5 of LRW, p. 54 - 72.

17 See the final analysis in Lacki, Ruegg and Telegdi, The road to Stueckelberg's covariant perturbation theory as illustrated by successive treatments of Compton scattering, *Studies in History and Philosophy of Modern Physics*, vol. 30 (1999), pp. 457 - 518, also the contribution of Ruegg and Ruiz-Altaba in LRW, chapter 6, pp. 73 - 87.

18 For details, see Olivier Darrigol's contribution to LRW, op. cit.

not to be a meson but instead a muon. Nevertheless, Yukawa obtained in 1949 the Nobel prize for his theory of meson-exchange forces. Because of the reasons above, any talk of Stueckelberg missing the Nobel prize [19] is idle, but this episode clearly illustrates that he was on par with the best.

Stueckelberg's originality and priority is instead undisputable in his work on S-matrix theory. Taking up in 1944 Heisenberg's original idea of an S-matrix (1943), Stueckelberg produced many papers alone or with students until the final version of his formalism in 1950. The theory was meant to present an alternative to the theory of interacting quantized fields which was then plagued with difficulties, most notably divergences no one knew how to get rid of. Heisenberg proposed the S-matrix approach as a theory based on general physical principles and a formalism directly based on transition probabilities in collisions as these are the only observables in (scattering) experiments [20]. The perturbative versions of this program were finally obtained in the 50's. Stueckelberg, who caught on quickly on Heisenberg's proposal, worked out his own original approach where he early recognized the key idea that causality is crucial to the construction of the S-matrix: the features of the space-time evolution in collision processes must be taken into account so that relying only on observable quantities is not sufficient. He also anticipated again some important aspects of Feynman's well-known formalism (1949) for quantum electrodynamics, most notably the causal propagator [21] which was a logical follow-up of the idea of positrons being electrons moving back in time, obtained as we saw in 1941, before the emergence of S-matrix program.

The S-matrix approach had, in Stueckelberg's and students' hands, an unexpected but very important spin-off. As it turns out, the perturbative terms of the S-matrix are not exempt of divergences (contrary to Heisenberg's hopes) but Stueckelberg and Rivier were able to eliminate the latter (1949). This was however at the price of introducing arbitrary quantities appearing because of the necessity to give mathematical meaning to notoriously singular products of propagators such as typically the square of the causal propagator. After the proper handling of the square (mathematically the square of a distribution, hence not uniquely defined), it turns out that it is defined only up to an additive term proportional to a delta function, with the proportionality constant an arbitrary real coefficient. This arbitrariness transpires up to the pertubative terms of the S-matrix. Stueckelberg, with Green, and then with Petermann were eventually able to show that the elimination of the divergences was possible (reviving thus Heisenberg's expectations), at the price of the perturbative terms being defined up to finite linear combinations of delta-functions and their derivatives. Stueckelberg and Petermann, using normalization prescriptions, were in turn able to fix the constants. These prescriptions are not unique, but the final result should not depend on their choice. Studying the dependence of the constants on the prescriptions, Stueckelberg and Petermann eventually hit on the renormalization group which is today widely applied in many fields much beyond the original context of its discovery [22].

This already impressive list of achievements of Stueckelberg does not stop here. Because of lack of space, I shall not comment on the very clever mechanism that Stueckelberg imagined to circumvent the difficult problem of the quantization of massive vector fields: the introduction of an auxiliary scalar field, the so-called B-field, enables to obtain a massive gauge field while preserving gauge invariance [23]. I shall also not comment on Stueckelberg's interest in (relativistic) thermodynamics that kept him busy in the final years of his activity [24].

Let's reach a conclusion. Looking back at the span of years from Guye's appointment to Stueckelberg's odd resignation, one can grasp how much Geneva physics owes to both men whose activity amply justifies the EPS Historic Sites Award. As much a brilliant experimentalist as an able science manager, Guye firmly anchored Genevan physics in modernity, making of the Physics Institute the prime place for physical research. His successor, the experimentalist Jean Weigle could lean on this tradition to push it further and open new fields, most notably by initiating Genevan biophysics. On the other hand, Stueckelberg and his theoretical activity firmly legitimated and established a tradition of advanced theoretical physics (he did the same in Lausanne). It is true, Genevan physics met a difficult decade after Weigle's leave for the USA (1948) and Stueckelberg's resignation in 1949 [25]. But when the theoretician Josef Maria Jauch (1914 - 1974) was finally appointed in 1958 as Stueckelberg's successor and became effectively the boss of all of Geneva's physics, he revived a lost momentum and pushed things further [26]. As much as Stueckelberg was not really interested in administration and science management, Jauch did excel in these matters while simultaneously keeping a very high standard of research [27]. Until recently, much of Geneva physics and its organization still reflected the touch Jauch gave it from the 60's on. So, one can say that the plaque inaugurated last March in Geneva not only honors outstanding scientific achievements which had an impact at international level. From a more local perspective, it pays a tribute to the founders of Genevan 20th century physics.

19 This is often to be found in the folklore surrounding Stueckelberg's science.

20 Heisenberg's S-matrix philosophy was thus again based on the methodological requirement to stick only to observable quantities, already erected as guiding principle in Heisenberg's formulation of matrix mechanics, see for instance Max Jammer's *The conceptual development of quantum mechanics*, 1966.

21 It is used in an unpublished manuscript from 1947 and is explicitly mentioned in 1948 in a *Letter to Physical Review*, details, see Gerard Wanders contribution to LRW, chapter 7, pp. 88 - 91.

22 Ibid, pp. 93 - 99.

23 For an extensive discussion, see H. Ruegg and M. Ruiz-Altaba, The Stueckelberg Field, *Int. J. Mod. Phys A*, vol. 19 (2004), pp. 3265 - 3347, also chapter 6 of LRW, *op. cit.*

24 See the account of Werner Israel in chapter 8 of LRW, pp. 101 - 113.

25 See my account in the SPG Mitteilungen, Nr. 43, pp. 50 - 54, also Nr. 44, pp. 44 - 48.

26 The prestige of Stueckelberg's chair might have played a role in Jauch's acceptance to leave his position in Iowa but the then newly founded CERN must have been an even more powerful source of attraction.

27 He is best remembered as making Geneva a famous place for studies in the foundations of quantum theory.

Physicists in Industry (4)

Motors, Mars and Mobility

Our interview partner is the physicist Dr. Ulrich Claessen, who is head of R&D at ***maxon motor ag*** in Sachseln, in the Swiss Canton of Obwalden. In the preface, he writes:

Machines and motion are fundamental elements of technology. For many years, electrical drive technology was found mainly in the fields of factory automation and railway vehicle traction. Over the past few decades, it has become commonplace in all areas of society. Today, the term small drives (drives with less than 1 kW power) stands for a global billion-dollar market.
The ongoing trend towards miniaturization has also changed electrical drive technology. New magnetic materials and high-quality mechanical designs have greatly improved the power density, efficiency and service life of small precision drives. For battery-operated devices, the high efficiency (80 - 90%) of small motors is a decisive advantage.

Q: Mobility is one of the main societal focal points in the coming years, not only in public transport and industrial sectors, but also in private life. This means that drive units of all types, sizes and power ratings are needed. How can and will *maxon motor* participate in this?

The core competence of *maxon motor* is the development of customer-specific drive solutions. Each drive problem first has to be thoroughly understood. Here it always helps to have a good comprehension of physics. The various components, i.e. motor, gearhead, feedback sensor and controller, have to be optimally configured to provide the needed motion (load chart, operating point, losses, ambient conditions).

Q: How will mobility develop in the coming decades?

Today four directions of impetus are responsible for the strong growth in the market for precision drive technology: Smart & connected machines, Medical devices and medical robotics, Electromobility and automotive, Industrial automation and Industry 4.0.

- **Smart & connected machines and robots**
  Humanoid robots require precision drives with very high power density and resilience if they are to match the abilities of the human body (upright gait, moving the arms and hands, grasping with fingers, moving the legs, etc.). Paired with sensors and artificial intelligence, robots will in future become workers and helpers in our day-to-day lives.

- **Medical devices and medical robotics**
  Controlled administration of medication (e.g. insulin) directly into the human body is a field of innovation in medical technology (drug pumps, patch pumps, needle-free injection, implantable pumps). Cardiac pumps support the activity of the heart in patients with an insufficiency, or replace the heart completely (artificial heart).
  A growing number of surgery robots are performing high-precision minimally invasive surgery under the watchful eyes of a surgeon. Another current topic is intelligent walking aids, such as motor-driven prostheses and exoskeletons.

- **Electromobility and automotive**
  In conventional vehicles with a combustion engine, the electric motors of today already control a range of convenience functions (seats, mirrors, lane departure warning) and auxiliary operations (pumps, injection procedures, etc.). With the rise of electromobility, electrical power traction has become a part of our vehicles. Another focus is battery technologies.

- **Industrial automation and Industry 4.0**
  Manufacturing processes are being networked with sensors, actuators and bus systems (Internet of Things and Industry 4.0). As a result, the demand for decentralized drive technology is increasing.

maxon motor is the worldwide leading provider of precision drives and systems, with manufacturing facilities in Switzerland, Germany, Hungary and South Korea. The company has 2400 employees and a turnover of 400 Million Swiss Francs (2015). At the headquarters in Sachseln, in the Swiss Canton of Obwalden, approx. 1200 employees develop and manufacture customized and high-quality drive solutions. The areas of application range from medical technology to industrial automation, from test and measurement technology to communication solutions and safety engineering, as well as applications for the automotive industry and the aerospace industry.

Even today, maxon makes half of its revenue from drives for medical technology. It is expected that the field of robot technology - an area that used to be the domain of university research - will show strong growth.

Q: Where are technical advances needed and how can Switzerland contribute?

Technological advances are constantly being achieved in the power density and in the precision of mechanical execution. Even in applications that use customary brush motors with graphite brushes as a conventional slide contact, not all phenomena are fully understood. However, today the focus is no longer on the individual components, but instead on the complete drive with integrated controller.

What is Switzerland's contribution?

“Switzerland is the Silicon Valley of robotics,” says ETH Professor Roland Siegwart. Switzerland is strong in the fields

of smart & connected machines, robotics and medical robotics, microrobotics, motion control, autonomous motion, drones and unmanned air vehicles.
The long tradition of the Swiss clock industry has also given Switzerland a head start in precision mechanical engineering and precision manufacturing methods.
In magnetic materials, progress currently tends to be continuous, but increased remanence is always an advantage, as this means the motor gets stronger (an adequately high coercive field strength is also important, to ensure that the motor is not demagnetized during operation). Today China dominates the development and production of rare earth magnets.
The development of sensors for rotor position detection is based on magnetic or optical principles. It is important to have sensors with robust mechanical and electrical designs that are not sensitive to interference and offer a good signal quality.
Today, Asia is the main location in the business for low-cost drive technology. The manufacturing costs in Switzerland are too high for this market segment. But if we succeed in lowering the direct costs of the drives, by means of new materials and new manufacturing methods, it will be an important step towards improving the competitiveness of Switzerland.

Q: With the motors for the Mars rover, *maxon motor* has drawn attention from all over the world. How important are such challenges that go to the limits of what is technically possible?

For more than 20 years, *maxon* has faced the challenges involved in producing drives for use in outer space. The drives are "off the shelf," but need to be reconfigured for the ambient conditions in space (low temperatures down to minus 120 °C, large temperature fluctuations, operation under vacuum conditions or CO_2 atmosphere, high stress caused by impact, vibration and acceleration). The joining methods (welding, adhesive bonding, soldering) have to be validated in test series. Each manufacturing step has to be controlled and verified. Future Mars missions by ESA (Exo Mars) and the Jet Propulsion Lab (Mars 2020) are already in planning, and once again *maxon motor* will be on board.

Q: Our readers are physicists. What recommendations do you have for physics graduates?

In the field of drive technology, physicists compete with ETH engineers and graduates of universities of applied sciences, who have more practical experience in a company, and usually more experience in mechanical engineering and manufacturing methods. The recurring topic is costs and how to reduce them.
For physicists who plan a career in the industry, I recommend starting with internships in the industry as early as possible and developing an interest in applied research. The reknown physicist Rudolf Peierls once said: "If you want to work in a technical field, you really have to be interested in it."
For physicists, I see advantages in their fundamental comprehension of electrical and mechanical phenomena. Heinz Maier-Leibnitz, famed university professor of the Technical University Munich, always emphasized: "Once you understand something well, it can become the starting point for something new."
A challenging topic, even for physicists, is the configuration and simulation of motors and magnet circuits. Finite element analysis for simulation of the electromagnetic and mechanical forces that take effect has become very important. Prediction of vibration characteristics and noise generation is an important topic.
Today, physics graduates have the option of working in a start-up company first. Here they can gain valuable experience at a young age, without being ground by the mills of the larger companies' personnel recruitment processes.

Q: What are the limits of mobility? Last year's Nobel Prize in chemistry was awarded for nano-mobility. In fact, EMPA (Swiss Federal Laboratories for Materials Science and Technology) was involved in this (see *SPG Mitteilungen* Nr. 51, page 18). Will there be a molecular motor by *maxon motor* one day?

Molecular machines that work in cells and organisms as nature's robots are a fascinating field of study.
Today, the smallest motor by *maxon* still has a diameter of 4 mm. For smaller dimensions, there are other actuator principles (MEMS, piezo) that have advantages for micromotion. *maxon motor* is mainly active where a market is forming. Completely new technologies that are still in the basic research stage are best developed to a first level of maturity in a start-up. If this development is successful, these companies then become candidates for a takeover, if the company owners want this.

Ulrich Claessen (born 1956 in Bremerhaven/Germany) studied Physics in Tübingen and Munich. In Munich he worked with Frederick Koch (Semiconductor Subband Physics) and Hans Jörg Mang (Nuclear Models). PhD Thesis in 1986 from Munich Technical University. Executive MBA from St. Gallen University in 1998.
From 1987 to 1990 he worked at Siemens Research Labs Munich on transistor modelling for CMOS Analogue Integrated Circuits.
In 1991 Ulrich Claessen went to Switzerland to work for ABB Transportation Systems. At ABB he was responsible for Vehicle Control Engineering.
In 2000 he started to work for CSEM (Centre Suisse d'Electronique et de Microtechnique) und built up a Research Center for Microrobotics in Alpnach/Obwalden. The center won the 2007 Swiss Innovation Award for developing a Microfactory. In 2007 Ulrich Claessen was employed by *maxon motor ag* in Sachseln/Obwalden and became Research & Development Director.

Field trip of the SPS Board to IBM Rüschlikon

Antoine Pochelon, Patrick Ruch

Making the Society stronger and better responding to the various challenges arising is a reason to periodically take some distance to the day-to-day business, dedicating some time for introspection. This allows focusing on the mission and mechanisms of the SPS as well as the function of the executive board.

Aerial view of the campus of IBM Research - Zurich
(Images: Courtesy IBM Research - Zurich).

This is why the board convened for a two-day meeting on 4-5 May 2017, which was hosted by IBM's research laboratory in Rüschlikon, near Zürich (www.zurich.ibm.com). Best known for the Nobel prizes in physics awarded to Gerd Binnig and Heinrich Rohrer (scanning tunneling microscopy, 1986) and Alex Müller and Georg Bednorz (high-temperature superconductivity, 1987), the lab continues its mission of pursuing cutting-edge research for tomorrow's information technology and cultivating close relationships with academic and industrial partners.

Rolf Allenspach with the spin-polarized scanning electron microscope (spin-SEM) in one of the noise-free labs.

Staying at IBM Rüschlikon included the opportunity to hear about selected research at the Science and Technology Department in a presentation by Rolf Allenspach, manager of the "Physics of Nanoscale Systems" group at IBM Research – Zurich, Rüschlikon.

The research activities of the Science and Technology department (www.zurich.ibm.com/st) today notably include technologies for quantum computing, neuromorphic devices and systems, technologies for Internet of Things (IoT), materials and device integration and packaging, nanoscale and molecular manipulation, microfluidics for precision diagnostics … a diverse portfolio where fundamental research clearly neighbours industrial innovation.

The board could also visit the Quantum computing lab. Technological progress goes hand in hand with continuous advances in computing power. However, current progress in downscaling transistors reaches physical limits when approaching atomic dimensions, and heat dissipation becomes a severe issue when increasing transistor densities. Above all, certain complex physical problems such as computing energy spectra, correlations or time dynamics in molecular and condensed matter systems are beyond the reach of classical computers. Thus Stefan Filipp tells us that "The goal is to build a quantum computing and simulation platform based on superconducting qubits to explore and potentially overcome the limits of classical computation. In our laboratory, we explore quantum computing and simulation schemes based on analogue and hybrid analogue-digital schemes that will have practical implications before universal quantum computing platforms become reality."

Stefan Filipp inspecting components of the cryogenic refrigerator used for quantum experiments.

Indeed, there is no clear-cut boundary between fundamental research and the development of new ideas and applications ready for market. The SPS board members from various fields and domains in academia, education, and industry could fully profit from the inspiring visit to the labs and infrastructures installed and maintained by IBM in the calm and green neighbourhood area of Rüschlikon.

Physics and Society

Some Ethical Questions in Particle Physics

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1. Introduction

Nowadays we are witnesses of increasing distrust of governments and political system in society. Some groups question democracy itself. To make things worse, it appears that science is not an exception and a growing number of people look upon it either with suspicion or find it less and less relevant for their lives. As a result, many fill the empty space with cheap substitutes and fall prey to conspiracy theories, superstition and dubious alternative healing methods, to name just a few.
When looking for reasons within science domain, we find that there is an objective barrier between complex language and methods used by modern science on the one side and the public on the other side which requires more and more effort to get through. For us scientists it can be a grueling task among all our research obligations. Nevertheless, the questions, suspicion, doubts and fears we face are understandable and it is our duty to address them in an honest way. In fact, communicating our results to the public and sharing the beauty of our discoveries with the young generation should be considered an intrinsic part of research work within the scientific community. In this contribution we will describe how particle physicists deal with some of these ethical issues.

2. Demystifying the Universe

Particle physics probes the basic building blocks of matter and their interactions, which determine the structure and properties of the extreme diversity of matter in the universe. It aims at explaining what holds the world together in its most fundamental constituents.
Modern physics relies on an elegant «Standard Model of particle physics», a quantum field theory based on three symmetries and a symmetry breaking. This theory describes and explains magnificently all experimental results obtained so far. With the discovery of the Higgs particle in 2012 at the Large Hadron Collider at CERN, the last missing piece of the Standard Model has been experimentally confirmed. Experiments at CERN and at other international laboratories now continue to test the validity and limits of the Standard Model in ever widening scope. However, for a comprehensive understanding of the laws of nature a theory beyond the Standard Model is needed, which should include gravity and explain the presence of dark matter and dark energy in the universe.
The quest for deeper and deeper understanding is therefore pushed in all thinkable and affordable manners at laboratories and universities worldwide. With the scale, complexity and costs of modern experiments ever increasing, physicists have learned that only when concentrating in international, large-scale collaborations, involving thousands of physicists from hundreds of institutions, from many tens of countries and all continents worldwide, ground-breaking advancements can be achieved. Examples are the above-mentioned discovery of the Higgs boson at CERN by the A Toroidal LHC ApparatuS (ATLAS) and Compact Myon Solenoid Spectrometer (CMS) Collaborations in 2012 [1 and 2], the detection of gravitational waves by the Laser Interferometer Gravitational-Wave Observatory (LIGO) Collaboration in the US [3], the detection of the highest energies of cosmic ray particles by the Icecube Collaboration at the South pole in 2015 [4], the new upper limits on Darkmatter candidates by the Large Underground Xenon experiment (LUX) Collaboration in 2016 [5], to name just a few.
As a reaction to such fundamental large-scale experiments, which often make head-lines in the public press, questions arise on the usefulness of fundamental research, whether money should better be spent otherwise, e.g. to cure world hunger, or to invest in cancer research instead. Often fears and potential dangers from such experiments are expressed along-side such critics. Applications based on new knowledge gained from fundamental research may not only be used for the better of mankind, but can indeed be life threatening, which, as often is argued, should be reason enough for not pursuing fundamental research any more. Further, some people may question whether mankind should even address scientifically a deeper understanding of the Universe, its coming to existence, evolution and possible fate.
Only when addressing openly these questions, emphasizing the relevance of fundamental research, its benefits to society and mankind worldwide, by leading an open dialogue, such perceived fears can be recognized as irrational or at least be lingered. Furthermore, the costs can be explained, put in relation with other state expenses, and be recognized as dwindling when compared with medical, educational, or infrastructure costs, and be understood as well placed investments for a flourishing future.

On the costs of Big Science projects:
It is true that e.g. building the Large Hadron Collider at CERN and the associated experiments, ALICE, ATLAS, CMS, and LHCb, meant an investment in the order of 10 billion Euros. A cost factor that at first sight seems extremely high, when not be put in relation. The overall project of the LHC has a life-span of the order of four decades, from the initial ideas, the research and development phase on how to build the accelerator and the experiments, their construction and commissioning, it already took two decades [6]. Adding the data-taking, the detector and machine upgrades, and the data analysis time scales to this, which takes another two decades, explains the long time span of such projects,

during which generations of young people get trained and are working at the forefront of knowledge in a demanding truly international environment. Further, the overall funding is shared among the CERN 21 member states and additional 43 countries directly contributing to the experiments at CERN. The costs have therefore to be understood as split over many countries and over four decades. The overall cost-sharing scheme is further taking into account the economic strength of each participating member, such that rich and poor countries can equally participate and contribute. Indeed, physicists do not receive more funding for their research than scientists in other areas of research. Physicists however manage to concentrate resources to big common goals and structure their research worldwide in a coordinated effort. Costs are therefore being minimized and unnecessary parallelism otherwise occurring in many competing small-scale research teams is avoided.
Fundamental research has led to many applications, now being thought of as given in modern society. Prominent examples come from medical diagnostics and cures. Many scanning and imaging devices find their roots in particle detector technologies, also radiotherapy, hadron therapy, or even the production of special isotopes would not be thinkable without accelerator technologies – this forms a direct answer regarding the use of money in cancer treatment. Indeed, particle physics provides new tools and methods for medical treatment of cancer and more.
Many of the everyday materials, such as e.g. ordinary shrink-wrap used for packing food before placing it in an ordinary refrigerator, car tyres, cable isolations, etc., etc. need to undergo special treatment to obtain their needed structures, hardness, or softness depending on specific requirements and use cases. Such special treatment means that materials undergo radiation with electrons and sometimes also other particles accelerated using particle accelerators. Indeed, many tens of thousands of particle accelerators are operating almost unnoticed continuously for industrial purposes worldwide, whereas only a handful of pure research accelerators exist in the world. With better food storage, and in general with better materials available, an important contribution to curb world hunger is made. Sure in cases of urgent needs such as draughts, wars, and other catastrophes, resources must be made available for immediate help. For creating longer-term improvements of the overall situation, new applications and spin-offs from fundamental research activities will provide tools and methods to linger and help.

On applications based on new knowledge gained from fundamental research that may not only be used for the better of mankind:
Fundamental science and gaining new insights in the understanding of the Universe is per se free from qualifying it as good or bad. Knowledge and understanding in general can however be used in different ways, and here, a deep ethical question arises that needs broad discussion in society. Such questions, however, are not new to mankind, but are part of its entire history. This started probably when first tools were created and is nicely shown e.g. with the mastering of fire in prehistoric times. Indeed, fire can be used to warm up sheltering places, to prepare food, to treat materials and can also be misused to do harm to others. Nowadays, threats from misuse of applications can have global dimensions. With e.g. the construction of atomic bombs, that were only possible when applying new knowledge from fundamental research, a worldwide threat was created that clearly showcases where limits need to be set in the building and construction of applications – but not in the quest of fundamental research itself. We may miss new insights in the understanding of the Universe as a whole, and will prevent new applications in the benefit of society.

On whether mankind should even address scientifically a deeper understanding of the Universe:
Asking deep questions is paramount to mankind. It is part of humanity to try to know where we are coming from, what our world constitutes of, what the future will be, why the sky is blue, or why the grass is green. With a lack of understanding, and with a lack of tools and methods to address such deep questions, superstition and bad answers prevail in order to satisfy, and therefore also muzzle, curiosity. Without curiosity, however, no advances in society are possible. This may be seen as non-problematic, and indeed is seen as best solution in some societies. Indeed, inside small, isolated groups such a scheme can work well. On a global scale, however, only a global understanding of the world, and not superstition, can lead to societies that collaborate and are addressing global issues together.
Fundamental research activities, with their large-scale projects, are showcasing that common, complex goals can indeed be addressed across national, ethical, or religious boundaries, and showcasing a pathway leading to open societies that freely interact without borders.

3. Mini Black Holes, Apocalypse and CERN's honest response

The history of black holes at the European Centre of Nuclear Physics CERN in Geneva shows how particle physics reacted to the fears of the public initiated by a discussion on a possible universal doomsday in the media in an honest and transparent way. The starting point was the fact that the Large Hadron Collider LHC at CERN amongst many other topics seeks after microscopic black holes. They are predicted by some theories of quantum gravity to be possibly produced at the high energy densities reached in the particle collisions at the LHC and to decay immediately due to Hawking radiation predicted in the same context.
In the years before the commissioning of the LHC the worry came up in parts of the public and among interested laymen that microscopic black holes similar to massive macroscopic black holes could attract matter, swallow our Earth and finally the whole Universe. So in February 2008 a threatening simulation appeared on YouTube [7] in which a black hole created at CERN swallows the Earth. The video immediately found millions of watchers (more than 5 million till 2014) and was also shown in television. Concerned laymen in the United States and Switzerland raised lawsuits against CERN because of destruction of the whole world and tried to get the commissioning of the LHC prohibited by a court.
As a reaction to this accuse CERN before the LHC start-up in 2008 called its "LHC Safety Assessment Group" which updated an existing safety study [8] from 2003. CERN developed a clear chain of arguments:

- The energies of cosmic rays are billion times higher than the LHC energy.
- Nature performed at least one million LHC experiments with Earth.

- The Universe in total does a billion LHC experiments per second.

Nevertheless stars collapsed to black holes do not dominate the Universe. From this the CERN study clearly concluded: The LHC is safe [9]. CERN started a further campaign [10] in May 2009 at the premiere of the film „Illuminati“ produced after Dan Brown´s novel which partially takes place at CERN.
Also in Germany, a lawsuit was filed before the Federal Constitutional Court. Fortunately, the court dismissed it arguing that the applicant could not demonstrate conclusively why the Earth was threatened with destruction [11]. The judges declared in their verdict that basic research cannot be stopped just because some individuals do not believe in the established laws of physics.
This judgment was greeted in the press with much humour and relief:
”Who is afraid of a Black Hole? Karlsruhe rejects doomsday lawsuit“, the *Spiegel* [12] joked. The *Frankfurter Allgemeine Zeitung* on its title page commented the judgment of the court with two small black holes and the remark: ”Apocalypse ad acta“.
Outside Germany the *German Angst* [13] was ridiculed: ”Une Allemande craignant la fin du monde échoue à paralyser le CERN“.
However, on the day of the LHC start-up the *Frankfurter Allgemeine* presented on its title page a gigantic black hole with the question: ”Do we disappear in a Black Hole?“ and the moderator of the second German TV said good-bye forever to its viewers.
On the day of the first LHC collisions the *FOCUS* [14] asked: ”Doomsday now?“, and *Die Welt* stated with relief [15]: ”Big Bang experiment without Doomsday“.
The online edition of the *Scientific American* announced the fifth anniversary of the LHC start-up in September 2013 with the headline: ”LHC celebrates 5 years of not destroying the world“ [16].
So thanks to an open and professional reaction to the fears of the public CERN and the world-wide LHC communication could avoid a severe damage both to its research and to its reputation.
However, a few years later doomsday fears reappeared. In a brilliant popular article on the inflationary universe the Russian-American cosmologist Andrei Linde in 1994 had developed the idea how to initiate from a tiny amount of extremely dense matter an eternally self-reproducing inflationary universe:
“*Instead of watching the universe at the screen of a computer, one may try to create the universe in a laboratory. Such a notion is highly speculative, to say the least. But some people (including Alan H. Guth and me) do not want to discard this possibility completely out of hand. One would have to compress some matter in such a way as to allow quantum fluctuations to trigger inflation. Simple estimates in the context of the chaotic inflation scenario suggest that less than one milligram of matter may initiate an eternal, self-reproducing universe. We still do not know whether this process is possible*”[17].
Linde finally asked: “*Is it conceivable that our own universe was created by a physicist-hacker?*”
Linde did not discuss how far the possibility of such a phase transition endangers the existence of our Universe. This left room for deep fears. The nuclear age also began with an estimation of the energy released from nuclear fission by Lise Meitner and her nephew Otto Frisch.
Based on such scenarios and by a statement by Stephen Hawking in September 2014 worries spread in the media that the Higgs boson could cause the end of the Universe [18]: ”Stephen Hawking Believes Higgs Boson Particle May Destroy Universe“. The *Berliner Kurier* reported [19]: ”Stephen Hawking: Stay away from God particle ... it could trigger the doomsday“, and *Focus Online* warned [20]: “Hawking warns of space-time collapse: God Particle could destroy the Universe”.
Now, the US-American particle physics reacted properly and published a rectification in its online magazine *symmetry* [21]: ”If you’re a science enthusiast, this week you have likely encountered headlines claiming that physicist Stephen Hawking thinks the Higgs boson will cause the end of the universe. This is a jaw-dropping misrepresentation of science. The universe is safe and will be for a very long time - for trillions of years. To understand how abominably Hawking’s words have been twisted, first we need to understand his statement“. Having clarified the facts it concludes: “Returning to the original, overly hyped media stories, you can see that there was a kernel of truth and a barrel full of hysteria...”

4. International Particle Physics Masterclasses

This event for high school students is a good example of care and zeal which particle physicists put into bringing the excitement of cutting-edge particle physics research into classrooms. Particle Physics Masterclasses [22] started in Great Britain in 1996 and turned international in 2005 under the coordination of International Particle Physics Outreach Group [23]. It became a very popular activity for students who come each year in the spring to nearby universities or research centers to become “scientists for a day” [24]. Masterclasses [1] is a truly global undertaking. In 2016, more than 10 000 students in 47 countries took part in the event at one of 200 universities (Fig. 1) over 5 weeks.
The format of the day includes three key elements:
i) lectures from active scientists give insight on topics and methods of fundamental research on the building blocks of matter and the forces between them, ii) active participation of students in measurements on real data from LHC

Fig. 1: Masterclass participants at University of Zilina

1 In Switzerland Masterclasse for young pupils (ca. 17 - 19 years) take place every year in Zürich (ETHZ + Uni ZH jointly), Bern (Uni BE) and Geneva (Uni GE and CERN). The next edition will be in Spring 2018, detailed information will become available in January 2018.

experiments ALICE, ATLAS and CMS and iii) international video-conference moderated from CERN or Fermilab during which students compare and combine results with their peers in other countries and discuss physics with the moderators. The main purpose of Masterclasses is to expose students to the scientific process and share our excitement about physics with them.
In the key measurement part students learn to use event display programs and analysis methods used by experimental particle physicists. They first practice particle identification by exploiting the characteristic signals left by particles in various parts of the detector; electrons, muons, photons and jets of particles are then recognized. From here students reconstruct some known particles, such as the weak gauge bosons W and Z and a number of hadrons (J/ψ, Y, Λ, Ks). As a highlight of the day, they learn how to use the technique of invariant mass to search for the Higgs bosons and other so far hypothetical particles.
As our survey shows, about 50% of participants are interested to pursue career in natural science or engineering programs, the other half is interested in social sciences and humanities. We feel that it is of paramount importance that these future opinion makers in their field of interest take from our program a better appreciation and understanding of the role of science in modern society.

5. Cascade projects competition for high school teams

International Particle Physics Masterclasses are successful in motivating high school students. However, some students are ready for further adventure. Cascade projects competition is aimed at those who would like to spend some more time discovering the realm of particle physics. The format was developed at the University of Birmingham in 2006/2007. Teams of 3 - 6 high school students work for several weeks on projects from particle physics and cosmology and then make 15 to 20 minute long presentations in their schools. The teams are helped by mentors (volunteers from the high energy physics community) and their teachers. Teams then send videos of their presentations to the Cascade organizers and the jury selects the best teams.

Fig. 2: Cascade team in the Great Final

The best team wins a trip to CERN or similar prize. The format is a success. Students enjoy working in teams and presenting in public (Fig. 2). In Slovakia about 15 teams enrol in the competition every year. Masterclasses is a good springboard for Cascade. Most of the teams are formed from former Masterclass participants.
The competition is relatively easy to organize. The first round (presentations at schools) does not require presence of the organizers which is very important given their tight work schedule. The best Cascade projects have the qualities we had hoped for: a solid scientific content and fresh, entertaining presentations which are fun to watch. Team members are often interested in pursuing a scientific career. Students effectively become our ambassadors in their schools – disseminating / cascading what they learned to many more young people than physicists could on their own. For more details see [25].

6. Conclusion

Particle physics probes nature at its most fundamental level often requiring large scale infrastructure and experiments invented, constructed and operated by large international collaborations involving thousands of physicists and concentration of large funds. With such large-scale endeavours, public interest arises and critics questioning the pros and cons are natural in democratic societies that can be addressed in an open dialogue to the benefit of society of which science is an integral part.
Scientists should respond to fears, worries and ambiguities of the public on the cost and results of their research in a proactive, honest, transparent and enlightening way. In this spirit reaching out to the broad public, to teachers, policy makers, science communicators, and in particular to the young generation is important to keep the light of science shining brightly in the world.

References:

[1] ATLAS Collaboration, *Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC*, Phys. Lett. B 716 (2012) 1, 31 July 2012
[2] CMS Collaboration, *Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC*, Phys. Lett. B 716 (2012) 30, 31 July 2012
[3] LIGO Scientific Collaboration and Virgo Collaboration, *Observation of Gravitational Waves from a Binary Black Hole Merger*, Phys. Rev. Lett. 116, 061102 (2016), 12 February 2016
[4] Icecube Collaboration, *Constraints on ultra-high-energy cosmic ray sources from a search for neutrinos above 10 PeV with IceCube*, submitted to Phys. Rev. Lett., 20 July 2016, e-print archive arXiv: 1607.05886 [hep-ex]
[5] LUX Collaboration, *Dark-matter results from 332 new live days of LUX data,* presented at Identification of Dark Matter, The University of Sheffield, 21 July, 2016, talk online http://luxdarkmat.org
[6] Della Negra, M., Jenni, P., Virdee, T. S.: *Journey in the Search for the Higgs Boson: The ATLAS and CMS Experiments at the Large Hadron Collider*, Science, vol. 338, No. 6114, pp. 1560-1568, December 2012
[7] BrainReleaseValve, *The CERN black hole*, YouTube video, www.youtube.com/watch?v=BXzugu39pKM
[8] *Study of potentially dangerous events during heavy-ion collisions at the LHC*. Report of the LHC safety study group; CERN Report, CERN 2003–001, 28 February 2003. https://cds.cern.ch/record/613175/files/CERN-2003-001.pdf
[9] *The Safety of the LHC*, CERN backgrounder http://press.web.cern.ch/backgrounders/safety-lhc , John Ellis et al., LHC Safety Assessment Group, *Review of the Safety of LHC Collisions*, http://cern.ch/lsag/LSAG-Report.pdf
[10] CERN, *Angels & Demons: The Science behind the Story, Does CERN create black holes?*, http://angelsanddemons.web.cern.ch/faq/black-hole
[11] Decision of the 2nd Senate of the Federal Constitutional Court from 18.2.2010, AZ 2 BvR 2502/08, www. bundesverfassungsgericht.de/entscheidungen/rk20100218_2bvr250208.html: ,,Zur schlüssigen Darlegung möglicher Schadensereignisse, die eine Reaktion staatlicher Stellen erzwingen könnten, genügt es insbesondere nicht, Warnungen auf ein generelles Misstrauen gegenüber physikalischen Gesetzen, also gegenüber theoretischen Aussagen der modernen Naturwissenschaft zu stützen."
[12] *Spiegel Online*, 9. March 2010, „Wer hat Angst vorm Schwarzen Loch? Karlsruhe weist Weltuntergangsklage ab", www.spiegel.de/wissenschaft/technik/verfassungsgericht-karlsruhe-weist-weltuntergangsklage-ab-a-682514.html

[13] *La Dépèche*, 9. March 2010: www.ladepeche.fr/article/2010/03/09/793121-allemande-craignant-fin-monde-echoue-paralyser-cern.html
[14] *FOCUS Online*, 10. September 2008, „Geht heute die Welt unter?“, www.focus.de/wissen/technik/large-hadron-collider-geht-heute-die-welt-unter_aid_332205.html
[15] *Die Welt*, 30. March 2010: „Urknall-Experiment glückt ohne Weltuntergang“, www.welt.de/wissenschaft/urknallexperiment/article6990263/Urknall-Experiment-glueckt-ohne-Weltuntergang.html
[16] Harry Cliff and Rupert Cole, *LHC Celebrates 5 Years of not Destroying the World*, Scientific American, September 10, 2013, http://blogs.scientificamerican.com/guest-blog/2013/09/10/lhc-celebrates-five-years-of-not-destroying-the-world/
[17] Andrei Linde, *The Self Reproducing Inflationary Universe*, Scientific American, Vol. 271, Nr. 5, November 1994, p. 53.
[18] *MailOnline*, "Finding the ‘God’ particle could destroy the universe", www.dailymail.co.uk/news/article-2746727/Maybe-shouldn-t-looking-quite-hard-God-particle-destroy-universe-warns-Stephen-Hawking.html
Express, "‘Could happen at any time’. God particle could DESTROY universe", www.express.co.uk/news/nature/508102/End-of-the-world-Stephen-Hawking-God-particle-Higgs-boson-destroy-universe
Guardian Liberty Voice, "Stephen Hawking Believes Higgs Boson Particle May Destroy Universe", http://guardianlv.com/2014/09/stephen-hawking-believes-higgs-boson-particle-may-destroy-universe/
[19] *Berliner Kurier*, 9 September 2014: „Stephen Hawking: Finger weg vom Gottesteilchen…es könnte den Weltuntergang auslösen“, www.berliner-kurier.de/panorama/stephen-hawking-finger-weg-vom-gottesteilchen----es-koennte-den-weltuntergang-ausloesen,7169224,28358282.html
[20] *Focus Online*, 8 September 2014: „Katastrophaler Vakuum-Abfall. Hawking warnt vor Raum-Zeit-Kollaps: Gottesteilchen könnte Universum zerstören“, www.focus.de/wissen/technik/kollaps-von-raum-und-zeit-hawking-gottesteilchen-koennte- universum-zerstoeren_id_4115983.html
[21] Don Lincoln, "What Hawking really meant", *Symmetry*, 11 September 2014, www.symmetrymagazine.org/article/september-2014/what-hawking-really-meant
[22] International Particle Physics Masterclasses, www.physicsmasterclasses.org
[23] International Particle Physics Outreach Group, http://ippog.web.cern.ch/
[24] Johansson, K. E., Kobel, M. et al.: European Particle Physics Masterclasses Make Students Scientists for a Day, *Physics Education*, 42, 2007, 636
[25] More information on Cascade in IPPOG database: http://ippog.web.cern.ch/resources/2011/cascade-projects-slovakia

The SESAME light source officially opened

It was a great privilege to attend the official inauguration ceremony of SESAME on 16 May 2017 in Allan, outside Amman together with my colleague and friend Rüdiger Voss, the new EPS president.

View of some of the bending magnets of the storage ring in which the electron beam circulates for several hours.

SESAME, which stands for **S**ynchrotron-light for **E**xperimental **S**cience and **A**pplications in the **M**iddle **E**ast was officially opened by Jordanian King Abdulla II, with Khaled Toukan, the president of SESAME and Sir Chris Llewellyn Smith, president of the SESAME Council, in presence of about 300 international guests. The initial research programme is about to get underway: three beamlines will be operational this year, and a fourth in 2019. The research subjects likely to be studied will range from medicine and biology, through materials science, physics and chemistry to healthcare, the environment, agriculture and archaeology. The hope is that large numbers of scientists in the region will become interested in using this infrastructure, triggered

His Majesty King Abdulla II following the opening of SESAME, flanked by (left) the President of the SESAME Council, Prof. Sir Chris Llewellyn Smith, and (right) the Director of SESAME, Prof. Khaled Toukan.

by SESAME’s training programme. The opening ceremony was the occasion for representatives of SESAME’s Member countries (Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority and Turkey) and the 17 Observers (including Switzerland and the EU) to celebrate this new competitive regional facility. In 2000 Jordan was chosen as the seat of this center, and UNESCO approved in 2002 its establishment under its auspice. The first president of SESAME Council was Herwig Schopper, former CERN DG and Honorary member of the SPS. The new one is now Rolf Heuer, also past DG at CERN and president of the DPG. More information about the history of the facility, as well as of the properties of its machine and beamlines can be found under http://sesame.org.jo/sesame/.

Christophe Rossel

Physics and Society

Women physicists in Switzerland

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A shortage of highly qualified work force in the field of technical sciences and engineering has been a preoccupation in Switzerland since many years. In this context, it has been pointed out that the phenomenon has also a significant gender dimension, found to be particularly pronounced in Switzerland.

Twenty years ago, a national weekly ran the headline "Women in physics depression located in Switzerland !" (Meier-Rust / Weltwoche, 1998). With a share of female students in physics below 10% at the beginning of the 90s, figures at Swiss universities were low not only in absolute numbers, but also in an international perspective.

Drawing on results from a research on co-education in physics at Swiss high schools, the article stressed the low number of female high school teachers in physics (3% at the time), and the culturally dominant, stereotypical association between physics, technology and masculinity prevalent in Swiss society. These cultural patterns negatively influenced teacher-student and student-student interaction in physics classes. They also had a negative impact on the interest, self-confidence and expectations of girls towards physics education (Herzog et al., 1997).

Since the early 90's figures have slightly improved, but progress is remarkably slow. This is apparent in the today still very low number of girls in Switzerland who, when entering high school at about 14-15 years of age, opt for a curriculum with a focus on physics and applied mathematics. Only 23% of baccalaureates in 2015 with a focus on physics and applied mathematics were awarded to girls. The transition from lower secondary education to high school functions thus as an early and major filter in the educational and professional trajectory of girls and boys. As research has shown for Switzerland, stereotypes and gender bias in classroom interaction are still effective, working against young women's achievements and confidence in Mathematics and Physics. In an experimental study, secondary school physics teachers have been found to rate answers from girls with significantly lower degrees, than they were rating answers from boys (Hofer 2015). In a natural experiment, female students who were randomly assigned to a single-sex class, with their competences measured over a period of four years, outperformed girls in mathematics who were assigned to mixed classes but had the same teachers (Eisenkopf et al 2015).

Considering these findings, it is not wholly surprising that we can witness a drop in the share of women in physics between high school and university. In 2015, the share of female students in physics enrolled at Swiss universities was 19% at Bachelor level, 20% at Master level and 22% among PhD students (Figure 1). Also in 2015, 21% of Bachelor and Master Degrees at Swiss universities and 24% of PhDs were awarded to women. While these figures are low, they tend to indicate that student success rates in physics at Swiss universities overall are fairly equal for women and men.

Equal student success rates however do not necessarily lead to equal career trajectories. As has been shown by analysis from the Swiss federal statistical office, without the capacity of Swiss universities to attract an enhanced share of female PhD students from abroad, the percentage of women at the PhD level in technical sciences would likely be significantly lower (FSO, 2009 & 2011).

And how are women with a degree in physics welcomed on the Swiss labour market? Based on data from the surveys conducted by the federal statistical office among graduates one year after they obtained their diploma, hardly any differences in the employment situation of male and female graduates in physics can be noticed. According to Markus Diem, a researcher from the University of Basel, some differences appear in the motivation indicated for employment choices. Men with a diploma in physics seem to have a slightly higher tendency to privilege revenue over closeness to the field of study, whereas women seem to put higher weight on the latter. Also, results from these surveys indicate the average salary of male physicists one year after graduation to be higher than the average salary of female graduates (CSFO 2015).

No study in Switzerland, of which we are aware of, has specifically dealt with the career progression of women with a degree in physics from a Swiss university. From different studies on career trajectories of graduates in STEM fields we know however that career progression and the chances to achieve high ranking positions still vary considerably for men and women, both in academic and in non-academic careers. Confirming findings from international research, two Swiss studies on the careers of graduates from EPF Lausanne and ETH Zürich show that differences between men and women exist from the outset and increase already during the first five years of their trajectory (Conti & Visentin 2015; Umbach-Daniel & Gartmann 2013).

As the authors point out, to address the gender imbalance in physics, and in technical and engineering fields more generally, it will not be enough to try to increase the number of women from the bottom. The leaky pipeline must also – not to say foremost - be mended from its end, by improving career conditions for women, and by increasing their number in leading positions in technical and engineering domains. This, of course, is true also for academia, where a glass ceiling is also apparent. In physics departments, the share of female professors at Swiss universities just reached 10% in 2015 (FSO 2015).

Improving career conditions for women implies that institutions take responsibility to change the situation, and implement actions: define targets, actively search for and appoint women in leading positions, raise awareness among managers and employees about stereotypes and gender bias, and develop an institutional culture and practices adapted to the needs of a diverse work-force, which includes to encourage women and men to actively combine career and

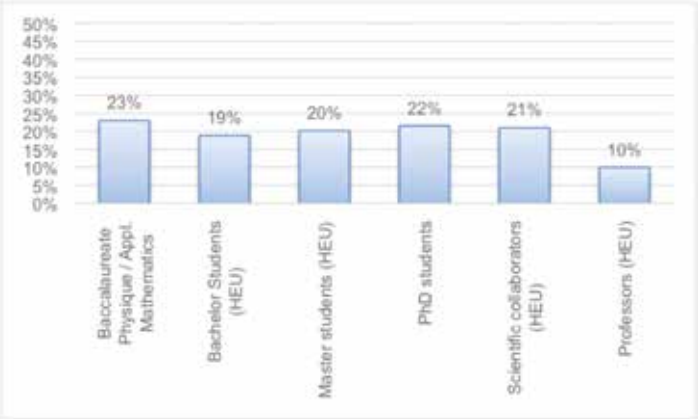

Figure 1: Percentage of women with a Baccalaureate in Physics and applied mathematics, and percentages of women in Physics at Swiss Universities, 2015. Source: FSO-SIUS.

family obligations. Today, most universities in Switzerland have gender action plans that support such measures [1]. For private companies, the Swiss Association of Women Engineers has developed a new consultation project to support private companies in the implementation of processes for institutional cultural change [2].

Representations associating physics, technology and masculinity not only shape the culture and practices in professional environments, but educational contexts too. They determine the way physics is taught at school and the degree to which girls feel that they are expected as much as boys to do well in physics, and will need these competences for their personal and professional achievement.

Today, most actions that aim to enhance the number of women in technical and engineering domains are directly targeted at girls themselves. Many of these actions promote STEM subjects in general. As has been pointed out by the Swiss Academy of Engineering Sciences (SATW), promoting STEM fields in general does not help to effectively address stereotypes about technical sciences, as girls will be mainly drawn to topics such as life sciences and chemistry. Actions for girls must specifically focus on technology and engineering subjects (SATW 2015). They must also strive to present new understandings of technology and engineering that relates them to issues relevant for society, the environment, etc. In line with these considerations, and the acknowledgement that our understanding about the role technical and engineering sciences play in our societies has to evolve, attention is increasingly focusing on schools, curricula development and teacher education and training. Thus, *swissuniversities* (swissuniversities.ch, https://www.swissuniversities.ch/fr/), the joint body for higher education policy of Swiss of higher education institutions, will fund a new project called MINT-Education, to develop the cooperation between technical and pedagogical universities in the field of training and further training of primary and secondary school teachers. To develop an enhanced and renewed understanding of technical sciences, devoid of gender stereotypes, is what this project aims to achieve [3].

Stereotypes about physics, technical and engineering sciences and professions are still deeply ingrained and incredibly effective. Nevertheless, raising awareness and new initiatives, if thoroughly implemented, can help to bring about much needed change.

References

CSFO, Premier emploi après les études. Edition 2015. (Figures on physicists were provided directly by Markus Diem, private communication)

Conti A, Visentin F (2015) Science and Engineering Ph.D. Students' Career Outcomes, by Gender. PLoS ONE 10(8). http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0133177

Eisenkopf G, et.al., Academic performance and single-sex schooling: Evidence from a natural experiment in Switzerland. Journal of Economic Behavior & Organization, Volume 115, July 2015, Pages 123–143. http://www.sciencedirect.com/science/article/pii/S0167268114002236

Federal Statistical Office (FSO) / Office fédéral de la statistique, Femmes et hommes dans les hautes écoles suisses. Indicateurs sur les différences entre les sexes, OFS, Neuchâtel, 2011. https://www.swissuniversities.ch/fileadmin/swissuniversities/Dokumente/Forschung/Chancengleichheit/F_und_M_Hochschulen_F.pdf

Federal Statistical Office (FSO) / Office fédéral de la statistique, Femmes et hommes dans le système de Bologne. Indicateurs reflétant les différences entre les sexes dans les hautes écoles universitaires, OFS, Neuchâtel, 2009.

Glass J L. et. al., What's So Special about STEM? A Comparison of Women's Retention in STEM and Professional Occupations, http://sf.oxfordjournals.org/content/early/2013/08/21/sf.sot092.abstract

Herzog, et al., (1997). Koedukation im Physikunterricht - Eine Interventionsstudie auf der Sekundarstufe II. In: Bildungsforschung und Bildungspraxis. 19. Jg. S. 132 -158.

https://www.swissuniversities.ch/fileadmin/swissuniversities/Dokumente/Kammern/Kammer_UH/Referenzdokumente/2009_Femmes_et_hommes_F.pdf

Hofer SI, Studying Gender Bias in Physics Grading: The role of teaching experience and country. International Journal of Science Education, 2015, 37: 2879-2905, doi: 10.1080/09500693.2015.1114190 http://www.tandfonline.com/doi/full/10.1080/09500693.2015.1114190

Labudde, Peter, Walter Herzog , et al, (2000) Girls and physics: teaching and learning strategies tested by classroom interventions in grade 11, International Journal of Science Education, 22:2, 143-157. Link to this article: http://dx.doi.org/10.1080/095006900289921

Meier-Rust, Kathrin, Das Frauen-Physik-Tief liegt in der Schweiz, Weltwoche Nr. 24/98, 11.6.1998. http://www.walterherzog.ch/app/download/12574631423/WELTWOCHE%201998.pdf?t=1467361478

2015 Schweizerische Akademie der Technischen Wissenschaften SATW (2015), MINT-Fachkräftemangel: Handeln! Aber wie?, SATW-Info 1/15, April. http://www.satw.ch/veranstaltungen/nachwuchs14/SATW-INFO_1-15_MINT.pdf

Umbach-Daniel A, Gartmann L., Are female engineers wanted and respected in the Swiss economy? (NFP 60), 2013. http://ruetter-soceco.ch/cm/en/project/education-and-employment/viewcategory/832-are-female-engineers-wanted-and-respected-in-the-swiss-economy-nfp-60

1 https://www.swissuniversities.ch/en/topics/promotion-of-young-talent/equal-opportunities/

2 http://svin.ch/cms/fr/activites/impulsprogramm-kultur-wegweiser.html

3 https://www.swissuniversities.ch/fileadmin/swissuniversities/Dokumente/Hochschulpolitik/Pgb_17-20/PA_10_MINT_Bildung.pdf

The March for Science, Geneva 22 April 2017

In the following we print two texts covering the international ***March for Science*** on 22 April 2017. The first one is an extract from a statement, published on the SPS web-page before the March.

The second text is a kind of testimony by two of the 15 organizers of the March for Science in Switzerland, *James Beacham* and *Courtney Thomas*. Its content results of the brainstorming and synthesis of a team of 15 people, who - how explained in the article - met numerous times to reach consensus on the motivations of the March in Geneva and the shape that it should take. Although the March in all the countries around the world was definitely triggered by the governmental actions in the US, the organizers were very attentive not to focus on a particular case, but rather to take this case as a stimulus for sustained an awaken attitude in front of all kind of actions fighting science and the hard facts science is producing. The ideas of this text were presented orally on 22 April in Geneva as an introduction to the March. In short it remembers us that "In order to continue to support science and be supported by the public, we must remain attentive". The accompanying photographs remember the good mood of the March in Geneva and highlight some of the ideas expressed on the banners of the participants. A lot more can be found on the site of the March of Science Geneva (*http://marchforsciencegeneva.org/*), like in particular the links to the dozen articles that appeared in the Swiss media before and after the March.

More than 600 participants gathered for the March for Science in Geneva. (Photos: A. Pochelon)

About research in general and with focus on Switzerland

In Switzerland, we, physicists, and specially those of us engaged in research, enjoy ideal conditions. The political level, be it at the governmental or at the parliamentary one, is fully convinced about the necessity to support both fundamental and applied research and has a full trust in the way we conduct our research. We perform our work, following our fundamental ethical rules: scientific facts and theories are the only driving forces. We also enjoy complete political freedom within our institution and no one is trying to impose on us any view on this or that issue, especially on scientific ones. Our colleagues are women and men from all countries in the world, encompassing their diversity, religion or race: we consider this as an enrichment both for science and for our own life.

The freedom we enjoy here in Switzerland, however, is not granted everywhere on our planet. Scientific core values of basic research, of decision taking based on all facts and knowledge available, of open discussion and exchange of ideas, are at threat even in modern societies. A threat so strong that scientific ethical rules that all stringently impact on the social life, not only of scientists, but of society as a whole are endangered and pose not only perceived dangers, but pose a real danger on the further prosperity of humankind in the generations to come. Thinking of climate change, energy research, health, food, clean water, etc., these dangers become evident.

We believe that collaboration is the condition for the advancement of science and for the establishment of peace between nations: CERN was established as a tool to promote peace between European nations after the Second World War and more recently SESAME followed the same ideal in the Middle East. Therefore, we shall always support and defend policies, which favour and strengthen collaboration.

Minh Quang Tran, SPS President,
Hans Peter Beck, SPS Vice President

Report of the organizers of the March for Science, Geneva, sharing the motivations that led to the March

James Beacham, CERN, Courtney Thomas, EPFL

On 22 April 2017, hundreds of people from around Switzerland gathered in Geneva for the March for Science, to affirm that science belongs to everyone and that facts are real.

Yes, it's completely bizarre that we had to march for something that seems so obvious.

But we live in bizarre times. We live in a time when major governments around the world are attempting to undermine the concept of objective, scientific truth — and the concept of the fact itself — to gain political and financial power. We live in a time when populist, anti-science movements are gaining strength through dishonest manipulation and by portraying scientists as elitists who make random declarations according to whim or as frivolous intellectuals wasting taxpayer money on useless, untrustworthy research. We live in a time when corporations and politicians are deliberately obfuscating the basic physics behind global warming due to human activity, which may lead to the literal extinction of the species.

Courtney Thomas, an American cancer researcher, is a postdoc in the Laboratory of Translational Oncology at EPFL. She is currently studying whether medications already available on the market can be repurposed for the treatment of colon cancer. She was, as James Beacham, one of the first in Switzerland who fought for the March for Science.
James Beacham is an American particle physicist with the ATLAS Experiment, a post-doctoral researcher with the Ohio State University, based full-time at CERN, where he searches for evidence of exotic Higgs bosons, dark matter, extra dimensions of space, and gravitons.

These enemies of science may seem laughable to scientists — but they're winning. And we wanted to start to figure out why. Why is France the country with the highest percentage of skepticism of vaccine safety among its citizens? Why do so many people continue to espouse the categorically erroneous idea that unscientific and ill-defined criteria such as race or ethnicity correlate with intelligence? Why are 70% of Americans unable to name an actual living scientist? The March for Science wasn't a self-congratulatory parade in the park but a mandatory response to an emergency situation.

We marched in Geneva because we no longer had a choice.

But at the same time, we marched in Geneva because Switzerland is a unique example of a great place to be a scientist, and we wanted this example to be shared with the world.

One of our primary goals with the March — attended by over 600 people from all corners of Switzerland, more than twice as many as we'd anticipated — was to demonstrate that science is not separate from the populace but is embedded in the fiber of community. We wanted to remind the world that biochemists and physicists are your neighbors; that you rely upon technological and medical breakthroughs every day; and that you began life as a curious little kid, so you are still secretly a scientist yourself.

Science belongs to everyone. Looking out over the crowd at the rally before the march, it was wonderful to see a sea of

many different faces — the parent who is also a climate researcher; the climber who happens to be a science communications professional; the drummer who does physics, as well. We wanted the March for Science, Geneva, as much as possible, to represent everyone who is affected by science.

James Beacham, CERN, listing the reasons to march in a speech before the March.

And since science belongs to everyone, this also means that science isn't controlled by only one person and derives its power through evidence and independent vetting of results by peers. One of the most impressive aspects of our Geneva march was how this attitude manifests in our organizing. The March for Science, Geneva, was organized by a grassroots committee — Tien-Tien Yu, John Warner, Giordon Stark, Clara Nellist, Robert Langenberg, Tova Holmes, Hannah Herde, Lukas Heinrich, Sabine Fleury, Babette Döbrich, Daphne Donis, Cari Cesarotti, and Elizabeth Brost, as well as the present authors — acting in our capacities as private, concerned citizens. Our major decisions were made slowly and deliberately, to ensure consensus and to facilitate as many perspectives and criticisms as possible.

Our first main task among the organizing team was to craft our mission and vision statements. We spent weeks examining every word, to ensure we had a message we could all support. It was not easy, given the multitude of voices, but it was an essential step in shaping the March for Science, Geneva, and demonstrating its difference from other marches around the world. This patience and deliberation not only ensured that our message was robust and represented us all, but accurately reflected both the cautiousness exercised in scientific research itself and the diplomacy and inclusiveness for which the Geneva region is renowned. And it was only possible to manage the practical aspects of organizing the march and the following "Celebration of Science" through a communal effort and a trust — built up over months of working together — that each person was supported by and could rely upon the other members of the committee.

This in itself was one of the greatest achievements of the March for Science, Geneva. Through our collective organization we successfully embodied the idea that science is a community, and that science belongs to everyone.

One message that was very important to us (and one that we spoke about to reporter Serena Tinari in the Italian-speaking region of Switzerland) was that everyone felt they could participate in the march. Inclusion was a key message in our planning meetings. While clearly there were political motivations for the march, we did our best to be as non-partisan as possible.

But it is inaccurate to say that science and politics have nothing to do with one another. Science is often used to motivate policy decisions, and politics impacts science research by, for example, determining funding levels and immigration

policies for skilled researchers. However, scientific fact has no political leaning. Science and politics are linked, but science and political persuasion do not need to be.

Switzerland is a wonderful place to be a scientist. There is public support for science and scientists in the form of funding, interest in research outcomes, and support of scientific and technological advancements. But even here we are not immune to the populist political and social attitudes that are driving anti-science movements around the globe. The Swiss government affirmed its commitment to a healthy research community by stepping in and arranging to compensate for some of the EU funding lost when the Swiss people voted to limit immigration levels in 2014, but the fact that the vote occurred at all indicates a need for diligence. In order for us to continue to support science and be supported by the public, we must remain attentive. We must ensure that we are communicating and interacting with the public, and we must examine new ways to reconnect the populace with not just the benefits of research that they enjoy every day but with the scientific ways of thinking and with the essential benefits inherent in the free flow of people and researchers, without which such benefits wouldn't have been possible.

Science belongs to everyone, but this also means that science is the responsibility of everyone. Another of the main components of the March for Science was to acknowledge and more fully understand why some groups of people would not necessarily agree that science belongs to them. History is filled with examples of atrocities committed — based on race, gender, religion, sexual identity, disability, and socio-economic class — in the name of or using the tools of science. But science is also filled with invisible and unspoken walls that prevent diversity. For example, women and persons of color face systematic barriers that keep them from career advancement and from attaining the highest ranks in research organizations and universities. There is an underrepresentation of women in science and technology enterprises. In academia, women receive less funding and less money to start their research labs. In science and technology, women make up less than 25% of the workforce. People of color make up even less of the scientific workforce (in and out of academia), and endure discrimination and hostility. For science to truly be for everyone, we need to acknowledge, confront, and remove the barriers — both explicit and structural — that perpetuate these biases. In many countries, the March for Science started as a political movement to shine a light on politicians who are seeking to harm the scientific process or limit transparency in scientific results. It is now time for us to hold up a mirror to ourselves and see how we can use this momentum to find better ways to communicate with the Swiss public and encourage a new, diverse generation of scientists who will shape the research of the future.

We're just now planning how to leverage the momentum from the March into continued advocacy for science, robust science funding, and to maintain the vital connections between science and the general population. This is, indeed, the best way to ensure that we are a citizenry who know how to resist authoritarian, anti-science political movements.

Political awareness among scientists is no longer optional, but is now simply part of global citizenship. The stakes are too high to remain passive or silent. If we encounter aggressive undermining of both the credibility of the scientific endeavor and the free flow of information and people that ensures a vibrant scientific community, our response must be similarly strong and sustained.

The March for Science, Geneva, may have begun on 22 April 2017, but to ensure that science remains a vital component of a healthy, open, and inclusive society, we're still marching today.
Join us (*contact@marchforsciencegeneva.org*) !

Swiss Academies: *http://akademienschweiz.createsend1.com/t/ViewEmail/d/0DBD554E68894A6B/65D074C1E21514DCC9C291422E3DE149*
The editorial of the EPS President in EPN 48-2: *http://www.europhysicsnews.org/articles/epn/pdf/2017/02/epn2017-48-2.pdf*
The editorial of the EPS President elect in eEPS: *http://www.epsnews.eu/2017/03/editorial-science-in-a-fragmenting-world/*

SATW Technology Outlook 2017

Über 20 ausgewiesene Fachleute beurteilen im "Technology Outlook 2017" der Schweizerischen Akademie der Technischen Wissenschaften SATW die Chancen und Risiken technischer Entwicklungen für die Schweiz. Themen sind unter anderem Industrie 4.0, künstliche Intelligenz, Robotik und neue Fertigungsverfahren.

Mit dem Internet der Dinge verschmelzen die digitale und die physische Welt. In dieser hybriden Welt haben Schweizer Firmen nahezu aller Branchen Nachholbedarf. Viele KMU tun sich mit der digitalen Beherrschung ihrer Prozesse schwer und bezüglich Fabrikautomatisierung oder Ressourcenplanung liegt die hiesige Industrie hinter dem Ausland zurück. Die Chancen, welche die enormen Fortschritte in den Bereichen künstliche Intelligenz und maschinelles Lernen eröffnen, müssen besser genutzt werden. Auch traditionelle Schweizer Schlüsselbranchen wie Banken, Versicherungen und Tourismus müssen sich auf digitale Geschäftsmodelle einstellen.

Fachkräfte sind gefragt
Um die vielfältigen Herausforderungen erfolgreich zu bewältigen, ist die Schweizer Volkswirtschaft auf Fachkräfte angewiesen, insbesondere IT-Fachleute. Um die steigende

Nachfrage decken zu können, sind zusätzliche Massnahmen nötig, beispielsweise in der Nachwuchsförderung. Wichtig sind auch ein unternehmerfreundliches Umfeld und langfristiges Risikokapital, damit sich Start-ups erfolgreich etablieren können.
Ein besonderes Augenmerk des Berichts gilt der MedTech-Branche, die von KMU geprägt ist. Diese leiden unter der Regulierungsdichte, strengen Marktzulassungsbedingungen, steigendem Preisdruck, Konkurrenz aus Billiglohnländern und einem erschwerten Zugang zu grossen Ausschreibungen. Gleichzeitig versprechen Operationsroboter und weitere Technologien neue Opportunitäten, welche die agilen Schweizer MedTech-KMU nutzen könnten.

Standortvorteile geschickt nutzen
Die Schweiz verfügt im Standortwettbewerb über viele Trümpfe, die es geschickt auszuspielen gilt. Sie weist beispielsweise die höchste Dichte qualifizierter Robotik-Nachwuchskräfte auf und verfügt über eine Vielzahl von kompetitiven Start-ups in diesem Bereich. Auch für etablierte Firmen der MEM-Industrie zeichnen sich grosse Chancen ab. Neue Verfahren wie additive Fertigung oder Prozessanalysetechnik sowie Photonik und Robotik haben grosses Potenzial. Werden die vorhandenen Kompetenzen, z.B. leistungsstarke Pulslaser und optische Messtechnik, geschickt kombiniert, kann die hiesige Industrie ihre Führungsposition auf diesen Gebieten gezielt ausbauen.

Für optimale Rahmenbedingungen sorgen
Die Politik muss für optimale Rahmenbedingungen sorgen, damit die Schweiz international konkurrenzfähig bleibt. Konkret fordern die Autoren höhere Investitionen in die Forschung, weitere Anstrengungen zur Bekämpfung des Fachkräftemangels sowie Massnahmen für höhere Cybersecurity oder die Zulassung von Drohnen für professionelle Einsätze. Gleichzeitig braucht es einen öffentlichen Diskurs über die Konsequenzen der vierten industriellen Revolution. Die Arbeits- und Lebensbedingungen werden sich radikal verändern, viele Stellen werden der maschinellen Automatisierung zum Opfer fallen. Finanzielle Ausgleichsmodelle und flankierende Massnahmen müssen diskutiert werden.

Der "Technology Outlook 2017" kann in Deutsch und Französisch über die Website der SATW bestellt werden: *www.satw.ch*

Plus de 20 experts confirmés évaluent dans le «Technology Outlook 2017» de l'Académie suisse des sciences techniques SATW les opportunités et les risques que présentent différents développements techniques pour la Suisse. Parmi les thèmes abordés: l'industrie 4.0, l'intelligence artificielle, la robotique ou les nouveaux procédés de fabrication.

Avec l'Internet des objets, les univers numérique et physique se fondent l'un dans l'autre. Dans ce nouveau monde hybride, les entreprises suisses présentent des retards dans quasiment tous les secteurs. De nombreuses PME peinent à assurer la maîtrise numérique de leurs processus, et l'industrie suisse doit rattraper sa concurrence étrangère en termes d'automatisation industrielle et de planification des ressources. Les opportunités qu'offrent les progrès en matière d'intelligence artificielle et d'apprentissage automatique doivent être mieux exploitées. Les secteurs clé traditionnels du pays tels la banque, l'assurance et le tourisme doivent eux aussi se mettre au diapason des modèles commerciaux numériques.

Afin de faire face aux nombreux défis qui se posent, l'économie suisse doit pouvoir se reposer sur des professionnels spécialisés, en particulier des spécialistes en informatique. Pour répondre à cette demande croissante, il faut mettre en place des mesures supplémentaires, par exemple en termes de promotion de la relève. Il faut également veiller à assurer un environnement favorable à l'esprit d'entreprise et la disponibilité de capital-risque à long terme afin que les start-ups puissent s'établir.

Le rapport accorde une attention particulière au secteur medtech, principalement constitué de PME. Ces dernières souffrent de la densité réglementaire, de conditions sévères d'accès au marché, d'une pression croissante sur les prix, de la concurrence en provenance de pays à bas salaires et d'une difficulté d'accès grandissante aux appels d'offres d'envergure. En même temps, les robots chirurgicaux et d'autres technologies ouvrent la voie à des opportunités nouvelles que l'agilité des PME suisses du secteur medtech pourrait leur permettre d'exploiter.

Valoriser ses atouts avec habileté
Dans le jeu de concurrence internationale, la Suisse dispose de nombreux atouts qu'il s'agit de valoriser. Elle possède par exemple la plus grande densité de jeunes talents qualifiés en robotique et de nombreuses start-ups concurrentielles dans ce domaine. De grandes opportunités se profilent également pour les entreprises établies de l'industrie MEM. De nouveaux procédés tels la fabrication additive ou la technique d'analyse de processus ainsi que la photonique et la robotique présentent un potentiel important. En combinant de manière judicieuse les compétences existantes, p.ex. les lasers pulsés à haute performance et la métrologie optique, l'industrie suisse peut consolider de manière ciblée sa position dominante dans ces domaines.

Assurer des conditions cadre optimales
La politique doit assurer des conditions cadre optimales afin de permettre à la Suisse de demeurer compétitive à l'international. Concrètement, les auteurs de l'étude appellent à des investissements accrus dans la recherche, des efforts plus poussés de lutte contre la pénurie de spécialistes, ainsi que l'amélioration de la cybersécurité ou l'autorisation de drones pour des missions professionnelles. Il faut également mener un débat public sur les répercussions de la quatrième révolution industrielle. Les conditions de travail et de vie vont évoluer de manière radicale et de nombreux emplois seront victimes des avancées en matière d'automatisation. Il faut discuter sérieusement de modèles de compensation financière et de mesures d'accompagnement.

Le «Technology Outlook 2017» peut être commandé en allemand et en français sur le site de la SATW: *www.satw.ch*

A look back at 40 years life in plasma physics and fusion research and its perspectives

On the 08.02.2017 the EPFL organized an international full day symposium to honor Prof. Minh Quang Tran. After a series of impressive talks, presented by experts from MIT, ITER and IPP Max Planck Institute and by Quang's former students, covering progress achieved in plasma physics and technology, we enjoyed as special highlight Quang's „Abschiedsvorlesung". After more than 40 years research, we asked Quang to summarize his experience and describe his expectations of further progress in this fascinating field of physics, where he contributed so much. And further will do!

In the spirit of the *SPG Mitteilungen*, which is a journal bringing together the experience of the members of the big family of physicists in Switzerland, our editor Bernhard Braunecker asked me to write a few words about my experience in plasma physics and fusion research. I hesitated for a while since, compared to other colleagues who had truly a marvellous career with profound contribution to their fields, I wondered what I could tell! Finally I accepted the challenge, not to highlight of my own contribution (which is close to none), but to say a few words on my own field for the future generations.

Your first question, and it is a question often asked by colleagues in other fields, is: "How could you maintain your enthusiasm, knowing that the realisation of fusion is beyond your life time?". Let me just answer through my own experience of the need for humanity to have a sustainable electricity supply. Having lived through period in my native country where electricity supply is scarce, I can insure you that, as it often said, "Bringing electricity to a population is bringing culture and development!". From this young age period, I had the luck that my curriculum at the EPFL included Plasma Physics with our late Honorary Member Prof. F. Troyon. For my PhD work, my supervisor was another famous plasma physicist, Prof. E. S. Weibel. Both of them (and numerous other senior scientists) taught me the many ingredients for a successful professional path: naturally plasma physics, but also what will be necessary to realize fusion as a practical electricity production scheme, i.e. the more technical aspects like material science and engineering science. Graduating from the EPFL as "Ingénieur Physicien" is also an asset.

In 1971, when I made my Semester Project in Plasma Physics under Prof Troyon, an article in the *Scientific American* set the scene of all different confinement schemes, from pinches to the tokamak and the stellerators. At the *Centre de Recherches en Physique des Plasmas* (CRPP), we were still engaged in pinches experiment, i.e. devices creating plasma lasting microseconds. A few years later we also had our tokamak, joining the mainstream of fusion research. For myself, after about 10 years in the study of basic phenomena in plasma (ranging from Korteweg–de Vries soliton, non linear generation of electromagnetic waves as observed in the so called Type III solar burst created by electron beam generated during a solar eruption, intrinsic stochasticity), my professional path took a more applied trajectory: development of high power (many hundreds of kW) millimetre wave sources for plasma heating at the electron cyclotron wave frequency. This opened up a fascinating field where physics, technology and a close collaboration with industry are the necessary ingredients for the production of the electron tube known as gyrotron. Through my responsibility at the CRPP, I also had to learn (as an autodidact) the complexity of superconductivity and material science, safety and the socio-economic aspect of fusion. I was lucky enough to have friends who were indulgent enough to welcome me in their community, in particular the one of material science for which I still enjoy to work for and attend the conferences.

So now after more than 40 years in the field, and having many time to answer the question: "Will fusion ever work?", my answer is a firm and without hesitation: "Yes". The progress made so far shows that the progress is immense. During my professional life, I saw the evolution from microseconds experiment to many seconds ones. We are building ITER, which will deliver 500 MW_{th} of fusion thermal power

A view of ITER in its building. ITER will be the first fusion reactor to be licenced as a nuclear reactor. It will produce, when operating in a 50%-50% D and T mixture, 500 MW of thermal power, i.e. 10 times more than the power required to heat its plasma (Q = 10). (© ITER IO)

and the plasma of which can last up to 3600 s. Having been directly involved in the scientific discussion throughout its various phases (Conceptual Design Activity, Engineering Design Activity, Construction phase) and committees (Technical Advisory Panel of the European Agency for ITER and ITER Science and Technology Advisory Committee), I am confident about the achievement of ITER objectives. In parallel with the effort to build ITER, many of its partners are preparing the next step, a DEMOnstration reactor capable of supplying many hundreds of MW_e electrical power to the grid and thus showing the realisation of a sustainable and environmental friendly source of energy. The European Fusion Road Map foresees the realisation of DEMO by the mid of this century and, for this objective, is implementing a full programme, the Power Plant Physics and Technology one, for the design of such DEMO. The present pre-conceptual design of the EU DEMO is based on a reactor delivering 500 MW_e of electricity to the grid.

The road towards the realisation of a fusion reactor will require the joined forces of physicists and engineers: one of the most challenging issues is indeed the integrated design of the whole reactor, where the technical and safety constraints are as important as physics requirements. As in many other fields of physics, the distinction between pure physics, applied physics and engineering sciences is blurring away and our field needs physicists and engineers who understand each other and, more over, a few bridge-makers between fields. This requires getting “out of the box” as well “out of our zone of comfort”, and accepting to seize opportunities as they come.

Benoît Deveaud and Minh Quang Tran

At the dusk of my professional life, I would like to acknowledge the numerous contributions of my students, my teachers, my colleagues. If I would like to cite them all, this paper would be like the kilo-authors type of papers but with the list of acknowledgement making the many tens of pages! Let me thank them collectively and anonymously with my deepest gratitude: I shall cherish forever the friendship they have so generously given to me throughout all these years!

The following speech of the president of the Swiss academies a+, Maurice Campagna, expresses in warm words his respect and appreciation of Quang:

08.02.2017 EPFL Minh Quang Tran - Symposium and „Abschiedsvorlesung“

- Dear President of ETHT Rat, dear Fritz Schiesser,
- Dear pres. of EPFL, dear Martin Vetterli,
- egregio signor direttore del centro di ricerca sulla fusione, Prof. Ambrogio Fasoli,
- M. le Prof. Benoit Deveaud,
- I shall summarize and just add, Ladies and Gentlemen, distinguished guests,
- and especially, Dear Prof. Tran, Dear Quang,

Today we enjoyed a large number of excellent presentations, and we just had the pleasure to listen to our skillful lecturer, Prof. Minh Quang Tran. I have now the pleasure and the honor to represent the Swiss academies of arts and sciences tonight in front of such a distinguished audience. I allow me to recall that I have spent half of my life in academia and the other half managing research in industry, involving especially excellent collaborators and large R&D projects, all over the world, Europe and the USA in particular.

Since my time in Jülich in the Energy Research Center I followed the activities of fusion research over the years, and the path of Quang, as a physicist, as a teacher and as manager, especially on an international level.

We know that many areas involving big infrastructure set ups, like space research, synchrotron radiation, free electron lasers, neutron spallation sources, high performance computing are generally accepted by the founding agencies and the public without many emotional discussions. In contrast, for **Fusion Research**, we need special efforts to convince the funding agencies and the politicians. The current energy debate is in fact dominated by emotions and often steered by media. And Fusion Research and its future is part of this discussion.

Quang has realized very early the eminent role of international collaborations when dealing with big machines. He realized also that in order to be able to work with such projects, students must get acquainted with complicated set up, get first local practice at home in Switzerland. To make it short: this is why we are here at EPFL today.

Dear Quang, we are going to recall you as a competent, transparent, objective and appreciated leader, especially at European level. And we must recall your leading role and support, your endeavour for the visibility and appreciated transdisciplinary approach within the Swiss Physical Society, including the international collaborations, see the cooperation with the Austrian Physical Society especially.

Dear Quang: today you are formally “stepping down”, we want to congratulate you in the name of a+ for your excellent achievements in science, education and management activities. What we can wish you is from now on to be able to enjoy a bit more your private life, while following your hobbies. This includes the progress in science overall, in times we can call revolutionary again. And we will come back to you, to have your valuable advice. Dear Quang, I would like to thank you in the name of all the member of the Swiss academies for your sincere friendship.

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