NCCR MUST

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Co-Directors NCCR MUST

SNF National Center of Compentence in Research
Molecular Ultrafast Science and Technology

nccr-must.ch

NCCR MUST Webpage: www.nccr-must.ch

must | Molecular Ultrafast Science and Technology

National Center of Competence in Research

- NCCR MUST
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  - MUST Meetings
  - MUST Support
  - Important dates of the network
- Who is who in MUST
- Research Themes
- Highlights
- Research Tools
- Publications
- FAST Initiative
- Awards, Fellowships and Honors
- Public Events
- Scientific Seminars
- Scientific Conferences
- Technology Transfer
- Education & Training
- Advancement of Women
- Video Podcast Press
- Intranet

About NCCR MUST

The NCCR MUST is an interdisciplinary research program launched by the Swiss National Science Foundation in 2010. It brings together 16 Swiss research groups working in Ultrafast Science across the fields of physics and chemistry.

The focus in MUST (Molecular Ultrafast Science and Technology) is to create new experimental and theoretical tools and to apply them to unravel the fastest processes in the physics and chemistry of natural and manmade matter. Experimental tools rely on ever-shorter sources of electromagnetic radiation, be it ultraviolet, visible, infrared or even bursts of X-rays. Currently, we are witnessing further huge steps forward in these technologies. New sources of femtosecond X-ray pulses, such as the slicing scheme at synchrotrons, or the X-ray free electron laser (XFEL), are built or planned - one of them at the PSI (SwissFEL). Electron diffraction reaches ultrafast time scales, techniques similar to NMR are extended into the IR and UV/VIS spectrum, attosecond pulses of light bring us to the time scales of electron motion, and intense THz pulses allow for direct excitation of structural modes. Improved, and even novel, theoretical tools emerge from constantly growing computational capabilities, which in turn enable us to tackle previously unsolved problems.

In Switzerland every modern aspect of Ultrafast Science is covered by the MUST network and Swiss researchers are among the leaders in the field. The research goals of MUST include

NCCR MUST / SNF
16 groups
ETH, EPFL, U Basel, U Bern,
U Geneva, U Zurich
Duration: 12 years in 3 Phases
Phase 1: 2010 – 2014, 17 Mio CHF

News

ACS Meeting in New Orleans
Ultrafast excited state dynamics in transition metal complexes, with MUST strongly represented.

PlanetSolar DeepWater expedition
Gap Biophotonics measures aerosol along the Gulfstream.

ERC Advanced Grant for Ursula Keller
Prof. Ursula Keller was awarded a 2012 ERC Advanced Grant for the Attoclock project: Clocking fundamental attosecond electron dynamics.

NCCR National Competence Center for Research
FNSNF Swiss National Science Foundation

CMS by onetook

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The National Centres of Competence in Research (NCCR) are a research instrument of the Swiss National Science Foundation

Our motivation

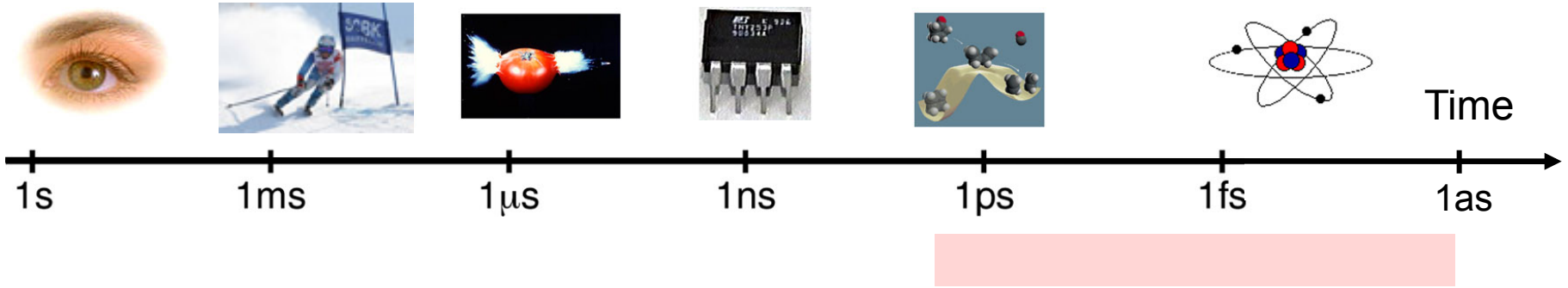
- Fast processes are important in engineering, physics, chemistry and biology

- Examples:
  - high-speed electronics, high data-rate communication
  - important biological reactions such as respiration, photosynthesis …
  - energy conversion and storage, artificial photosynthesis, fuel cells …

all involve ultrafast time-space events that enable and initiate the process
– we do not understand fully
– nor can we copy them all

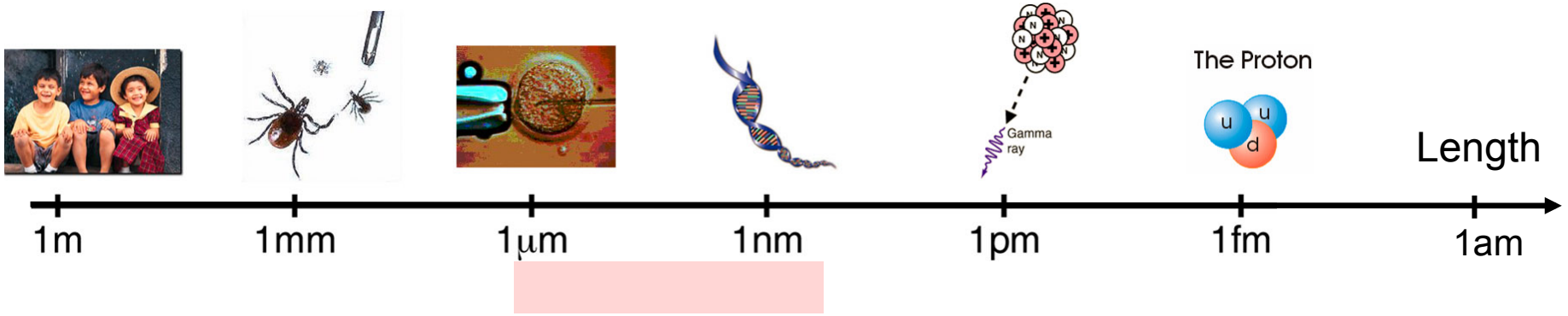
- We need to better understand, model and control atomic and molecular chemical reactions and energy transfer processes on an atomic and molecular level.
- Time scale: picosecond – femtosecond and even attosecond regime
  Length scale: micrometer to sub-nanometer regime

Time and length scales

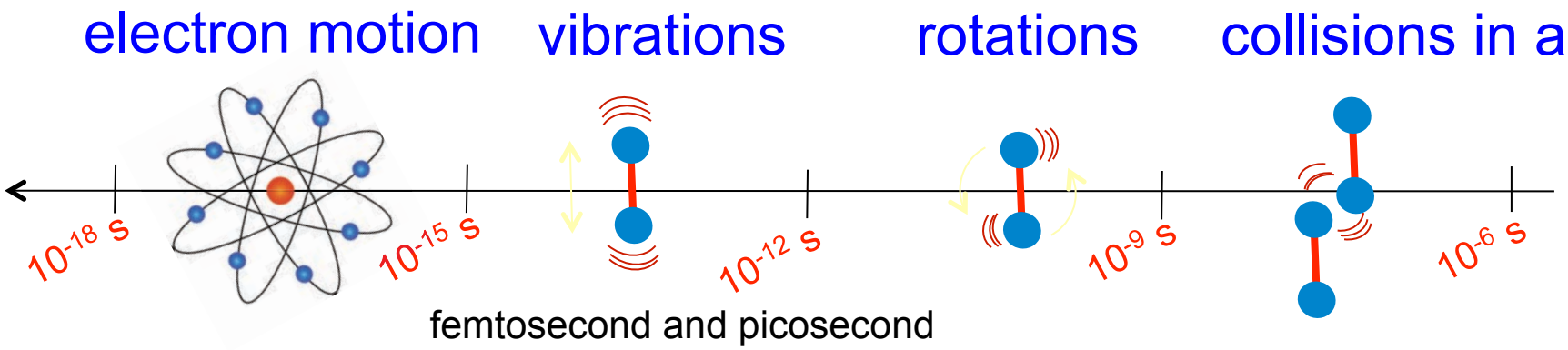


- 1 picosecond = 1 ps = 10^{-12} s = 0.000’ 000’ 000 ‘001 s
- 1 femtosecond = 1 fs = 1 ps / 1000 = 10^{-15} s = 0.000’ 000’ 000’ 000’ 001 s
- 1 attosecond = 1 as = 1 fs / 1000 = 10^{-18} s = 0.000’ 000’ 000’ 000’ 000’ 001 s

Fast processes are important in engineering, physics, chemistry and biology:
We need to better understand, model and control atomic and molecular chemical reactions and energy transfer processes on an atomic and molecular level.



Time and length scales



attosecond

femtosecond and picosecond

Nobel prize in chemistry

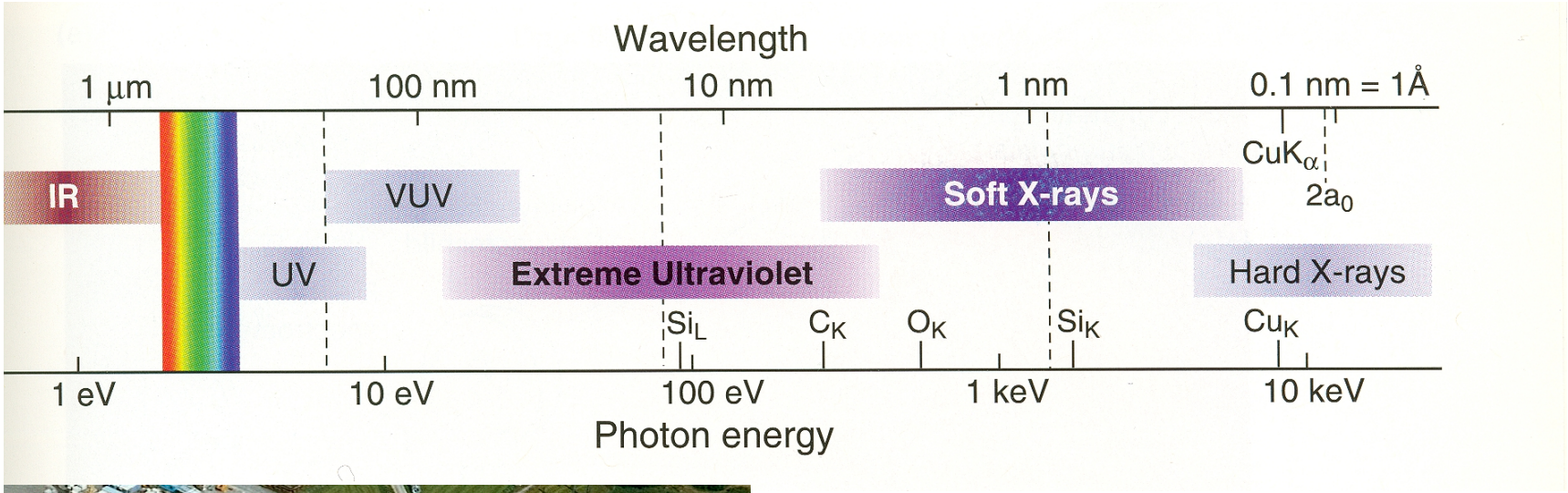
A. Zewail, 1999

- Measurements with attosecond resolution isolates purely electronic dynamics on short time scales.
- We can study time-dependent electronic and atomic structure for the first time.

Scientific questions addressed by SLS

Francis Crick (1962):

“if you want to understand function, study structure”



Synchrotron Light Source (SLS) (PSI in Villigen)

time “slow” 100 ps = 100’000 fs

length “fine” 20 nm – 0.1 nm

PAUL SCHERRER INSTITUT

PSI

Scientific questions addressed

Francis Crick (1962) – updated

"if you want to understand function, study time-dependent structure"

... how a structure evolves in time during a process (e.g. chemical reaction)

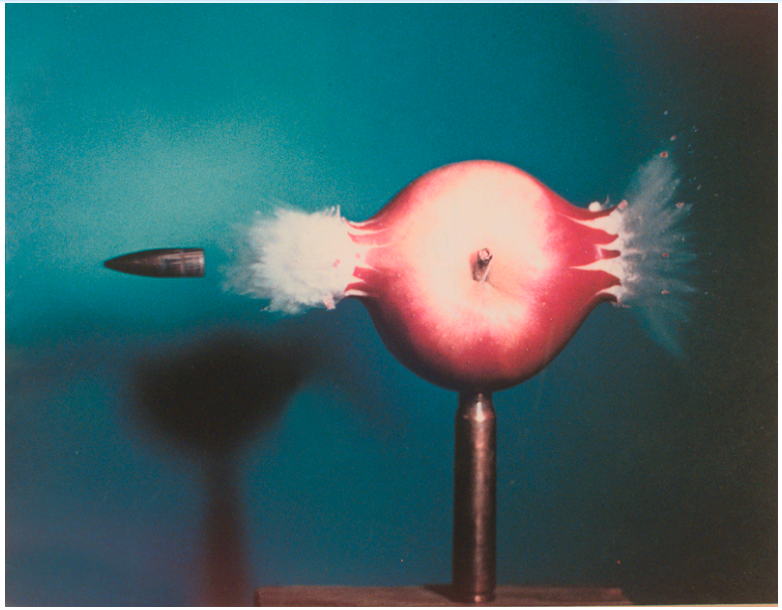
How do we do this?

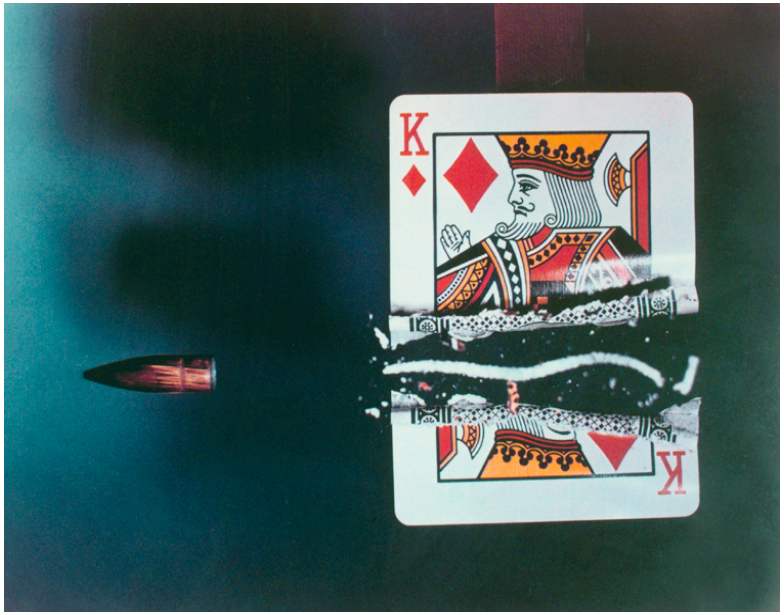
... with ultrafast science and technology

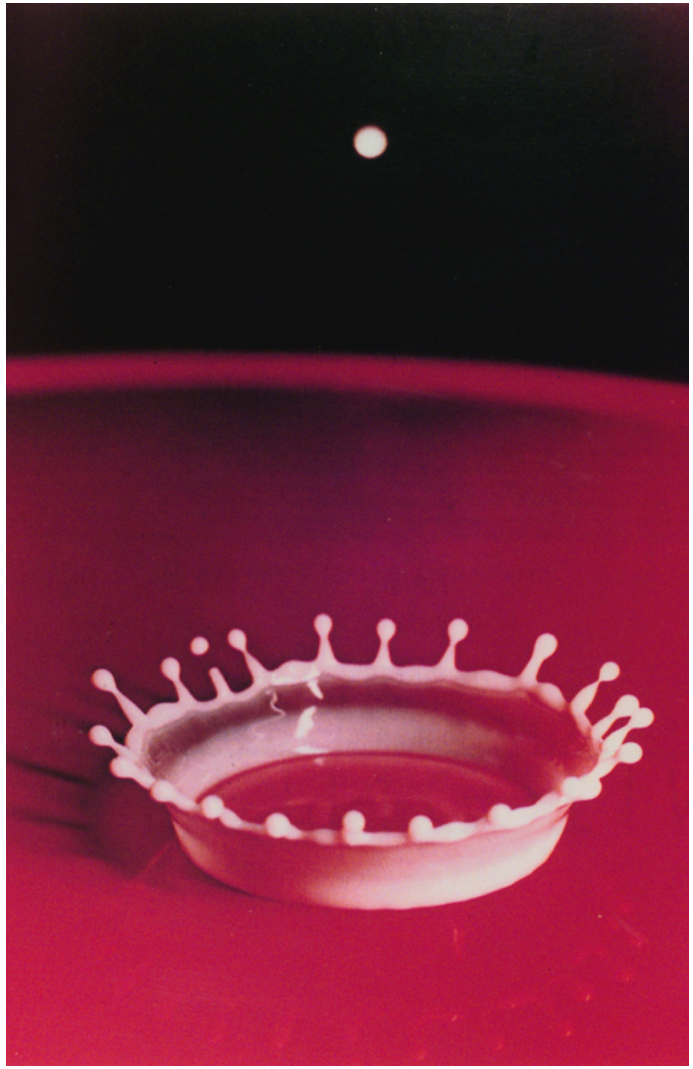
New tools that allow us to clearly see a process in real-time,

always bring real progress both in theory and application

Flash photography with 1-µs time exposure

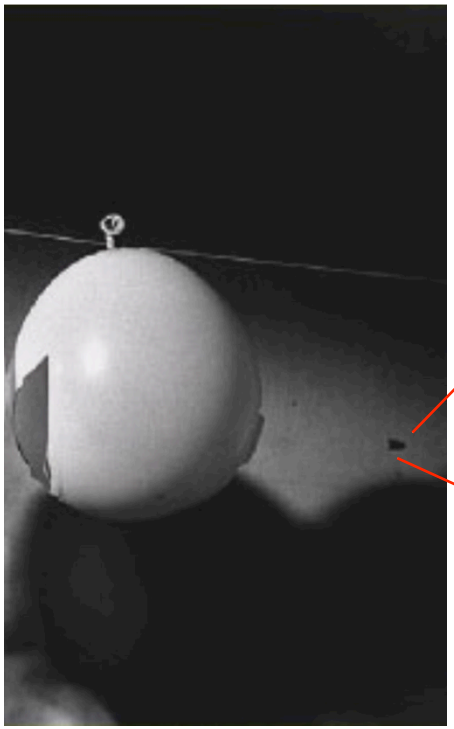






Harold E. Edgerton
MIT, USA
1903-1990

How to access the fast time scales?



Example:

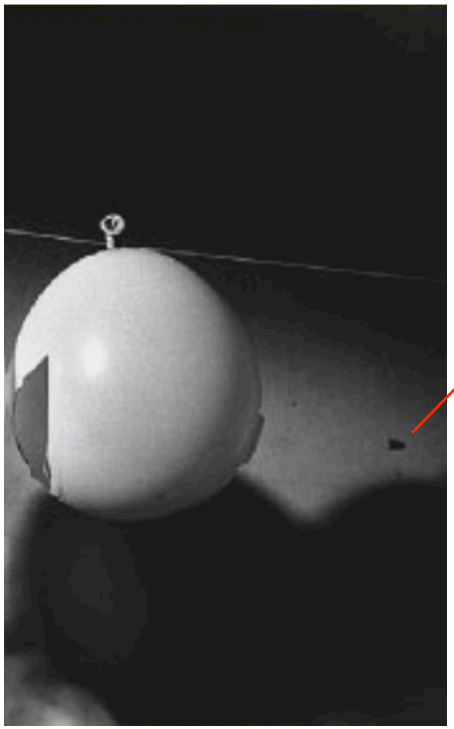
Fast process: balloon explosion

Fast process started with a “bullet”

Explosion observed with flash photography after a time delay Δt following the gun shot. (photo showing balloon with a hole)

How do I do this with ultrafast lasers?

How to access the fast time scales?



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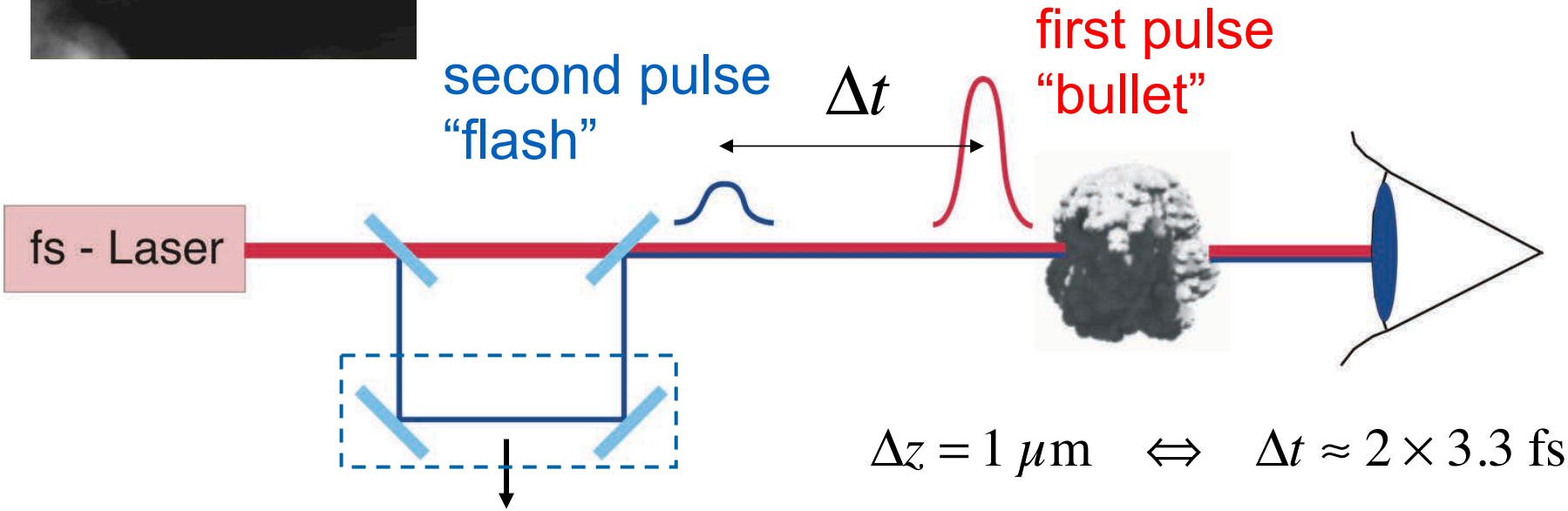
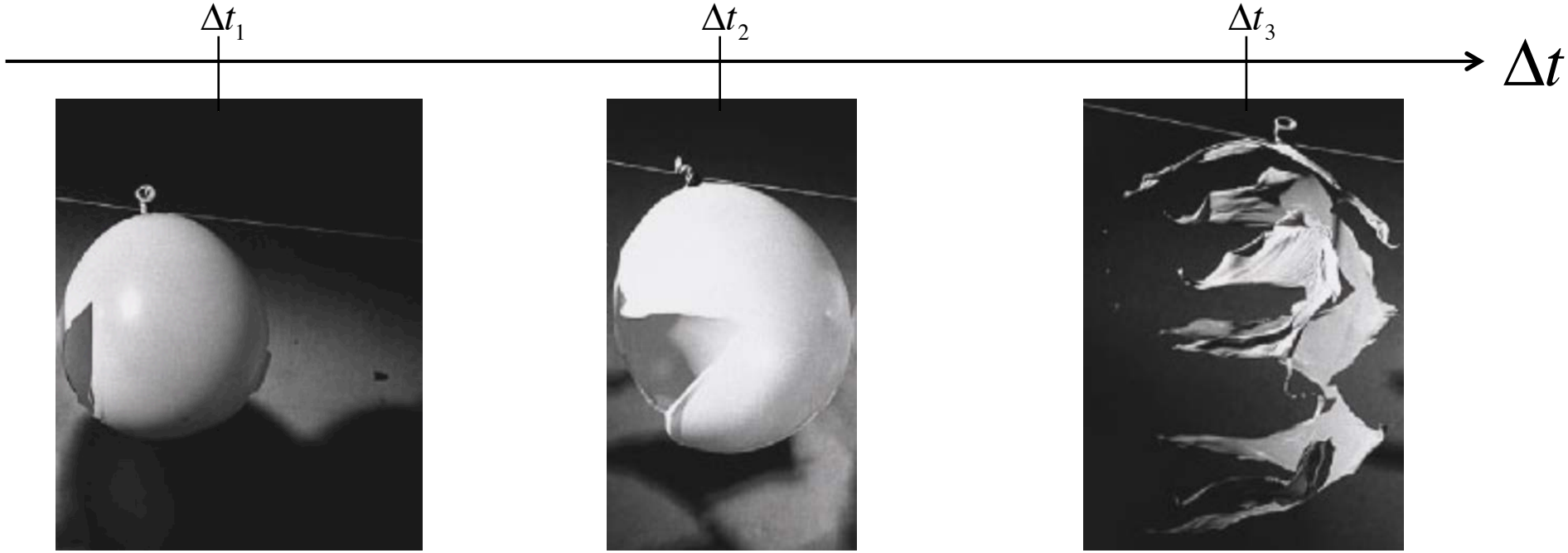
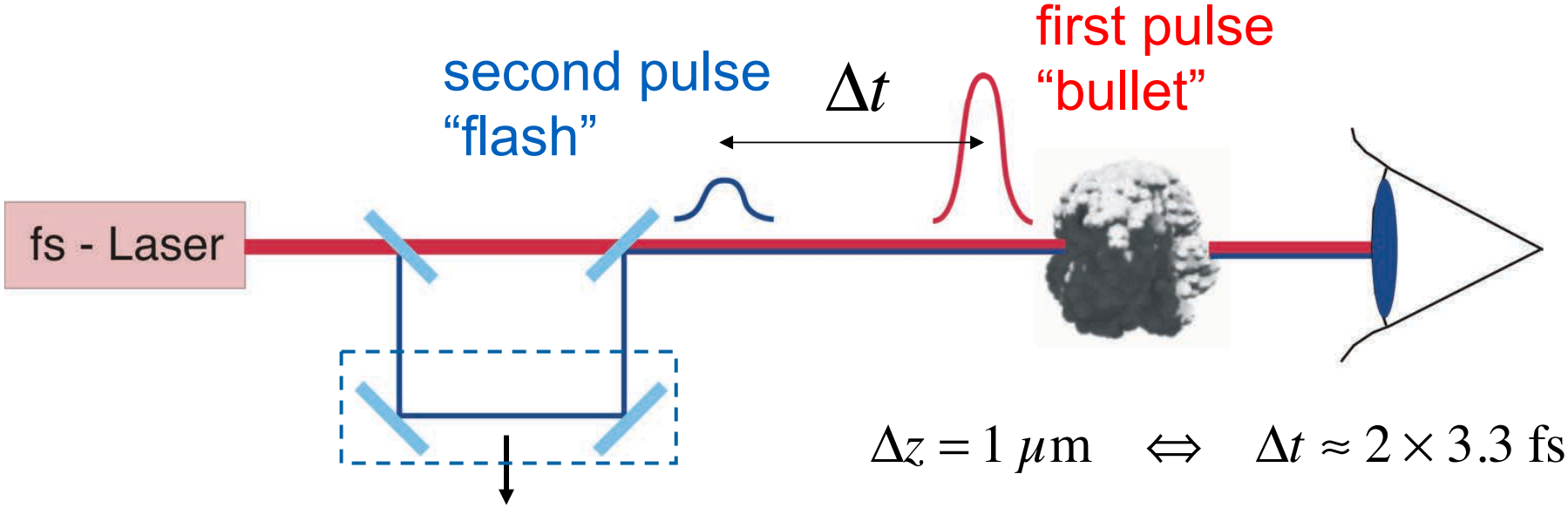


$$\Delta z = 1\,\mu\text{m} \quad \Leftrightarrow \quad \Delta t \approx 2 \times 3.3\ \text{fs}$$

How to access the fast time scales?





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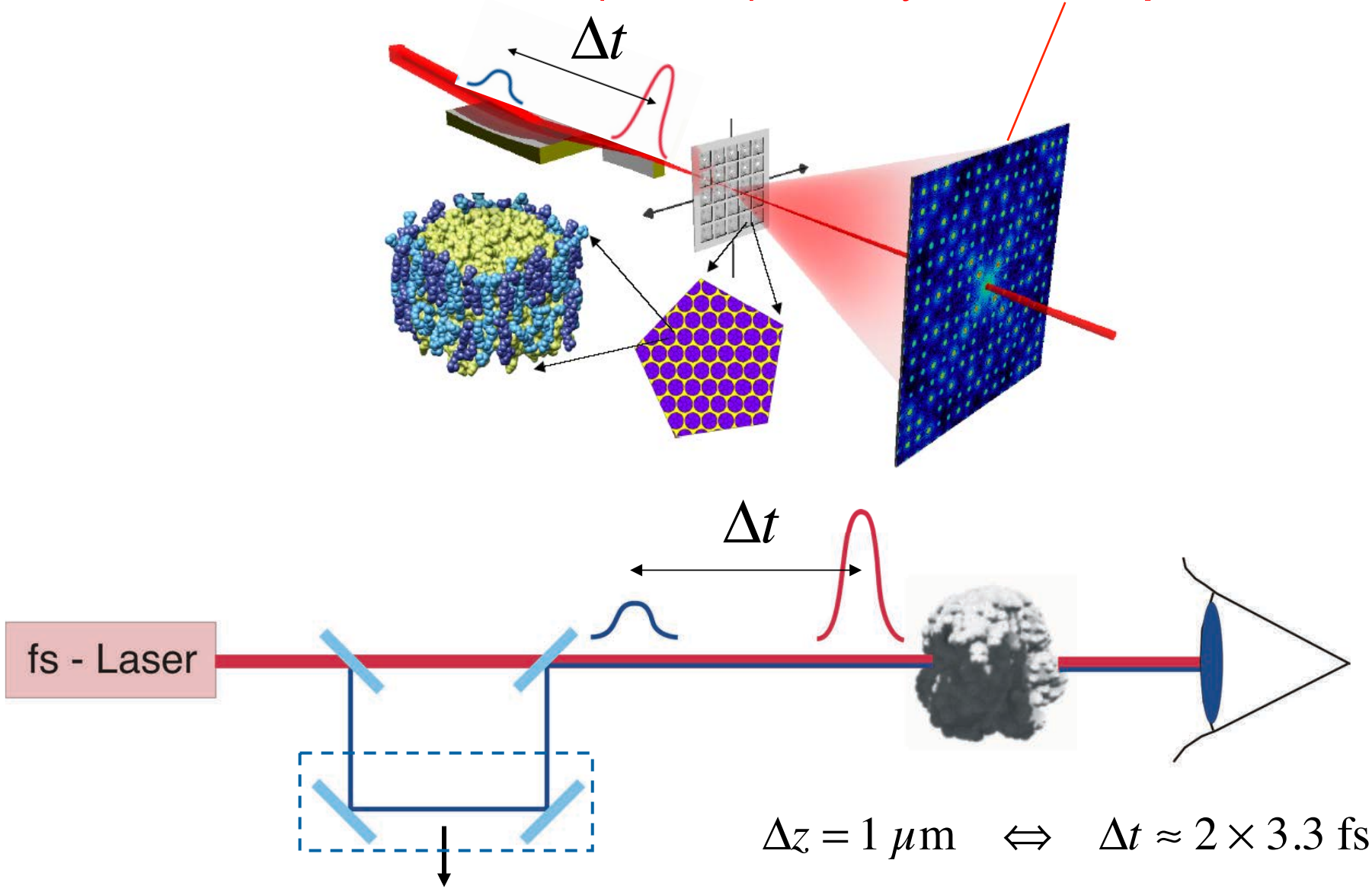
How to access the fast time scales?

Structure on atomic scale: flash photo replaced by **diffraction patterns**



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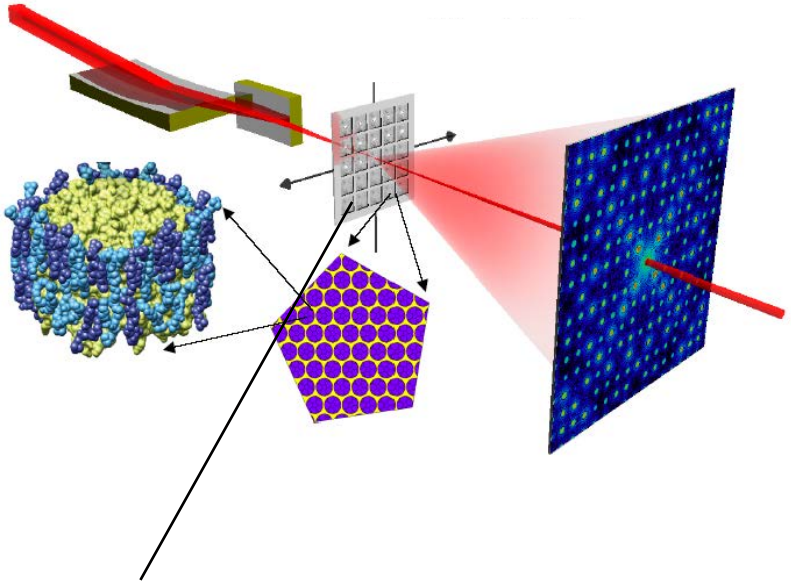
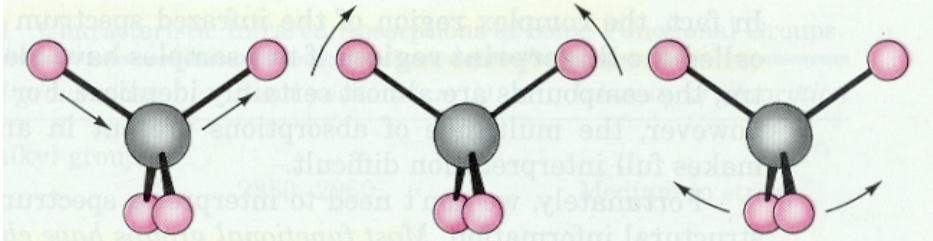
Scientific questions addressed

- Francis Crick (1962) – updated
  "if you want to understand function, study time-dependent structure"

One approach: diffraction



We want to follow the movements of atoms



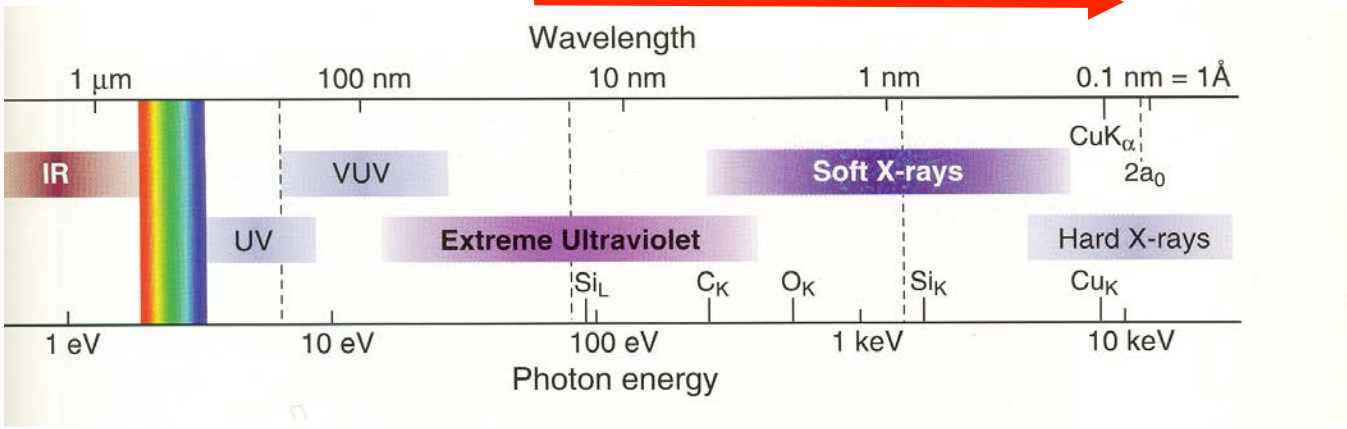
Atoms are small (<nm) and move very fast (fs)

1 nm = 0.000 000 001 m

1 fs = 0.000 000 000 000 001 s

- chemical reactions
- magnetic properties
- nanostructures
- biomolecules

PSI, SwissFEL



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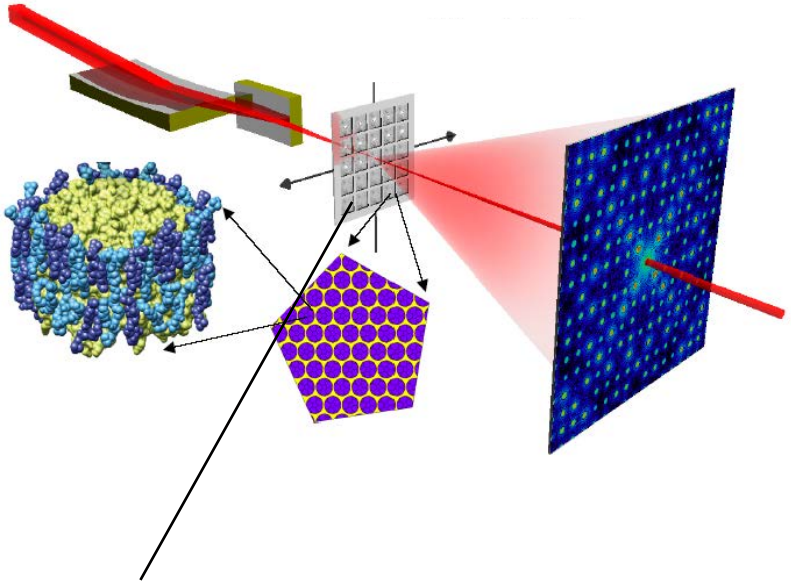

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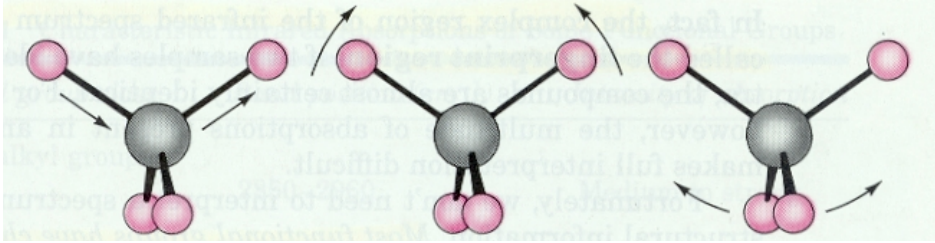

Atoms are small (<nm) and move very fast (fs)

1 nm = 0.000 000 001 m

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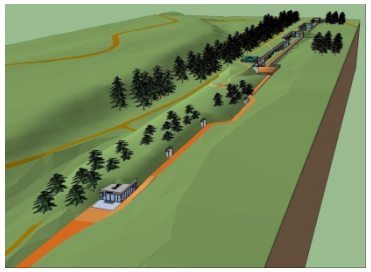
SwissFEL (PSI in Villigen)

Time "fast" ≈fs

Space "ultrafine" 20 nm – 0.1 nm

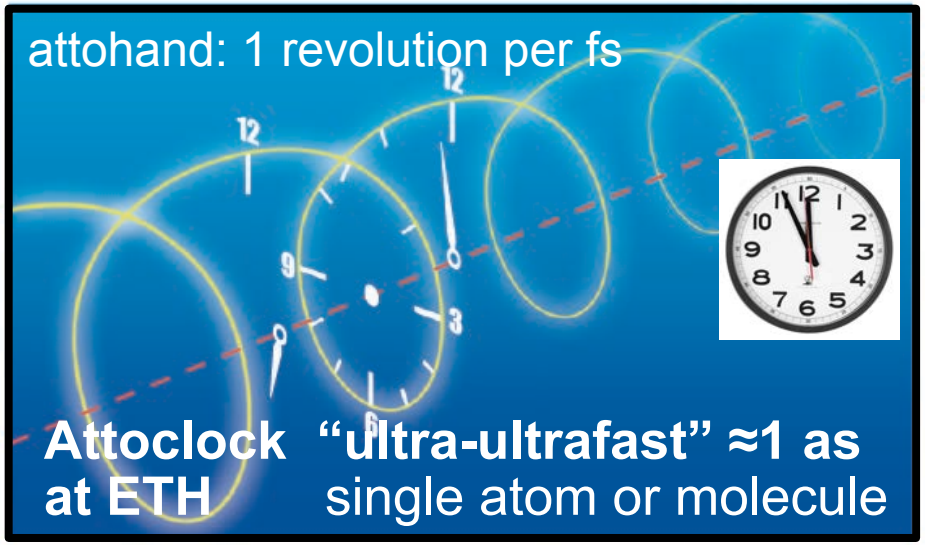


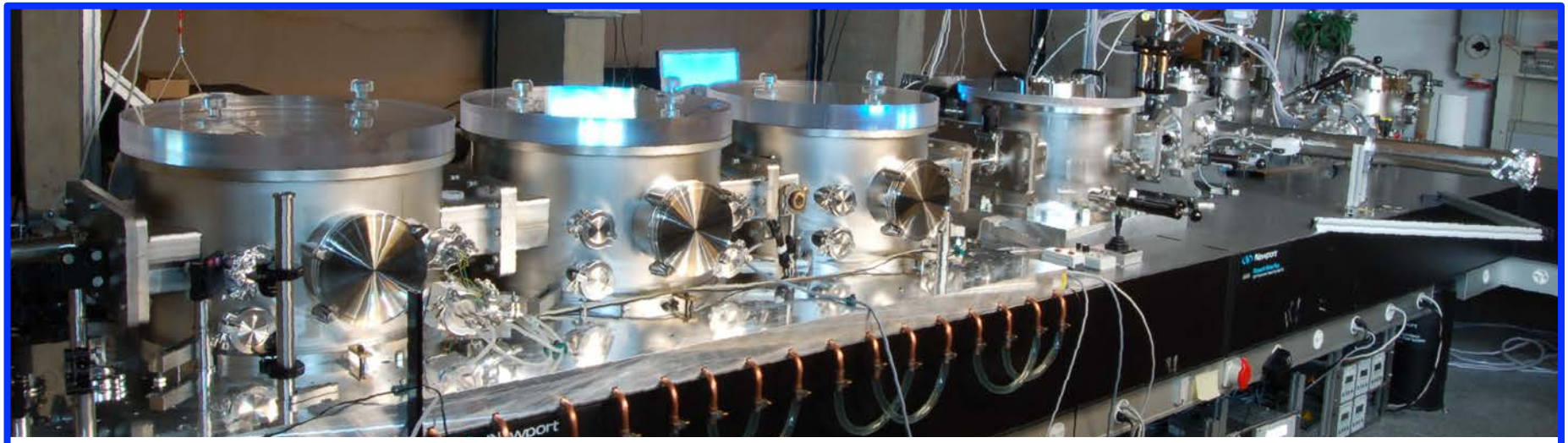
PAUL SCHERRER INSTITUT PSI

MUST brings additional tools and techniques

Ultrafast lasers in the UV, visible, IR, mid-IR, THz spectral regime with femtosecond pulses

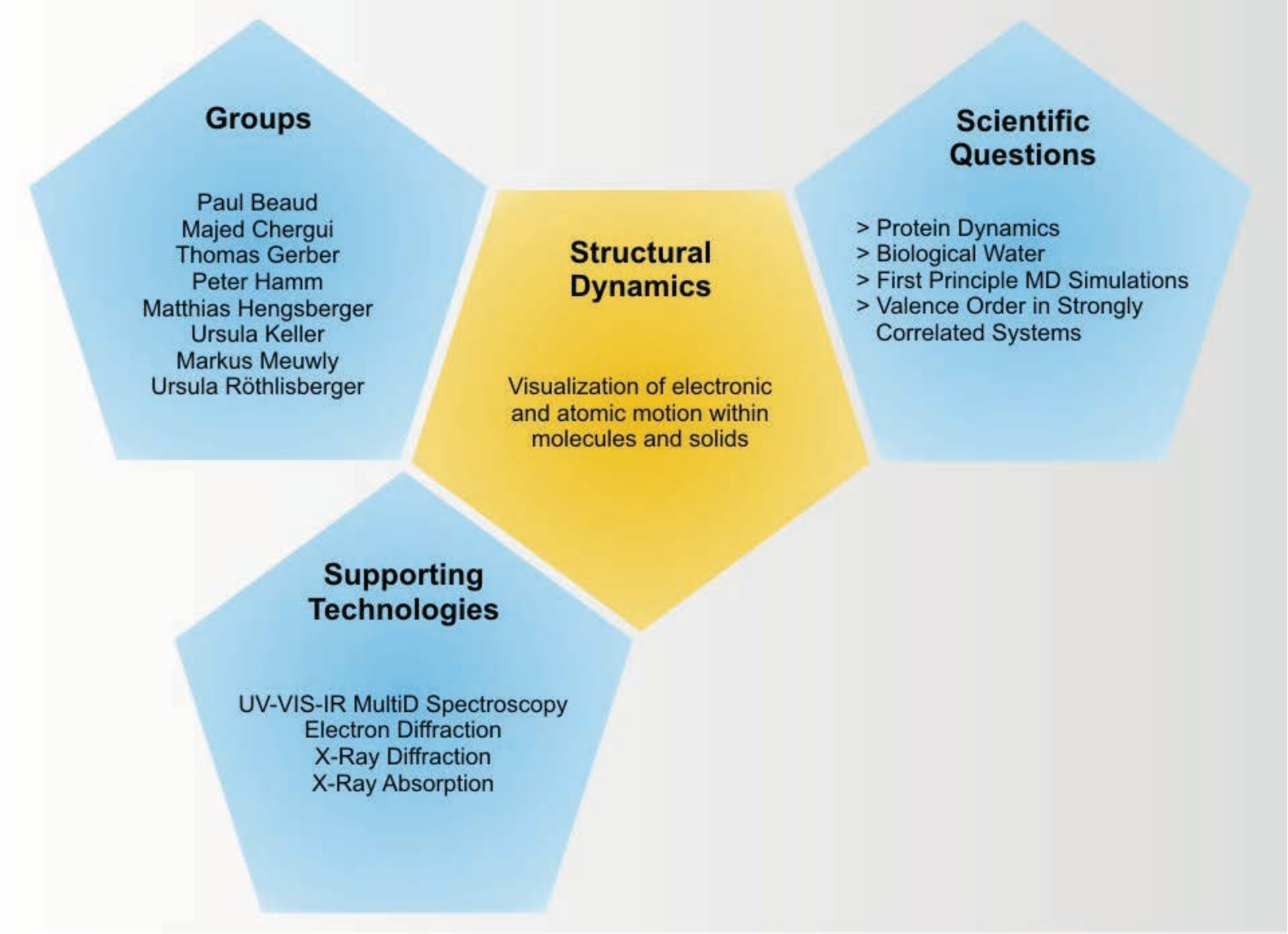
Ultrafast lasers
"fast" ≈5 fs
"rough" >100 nm



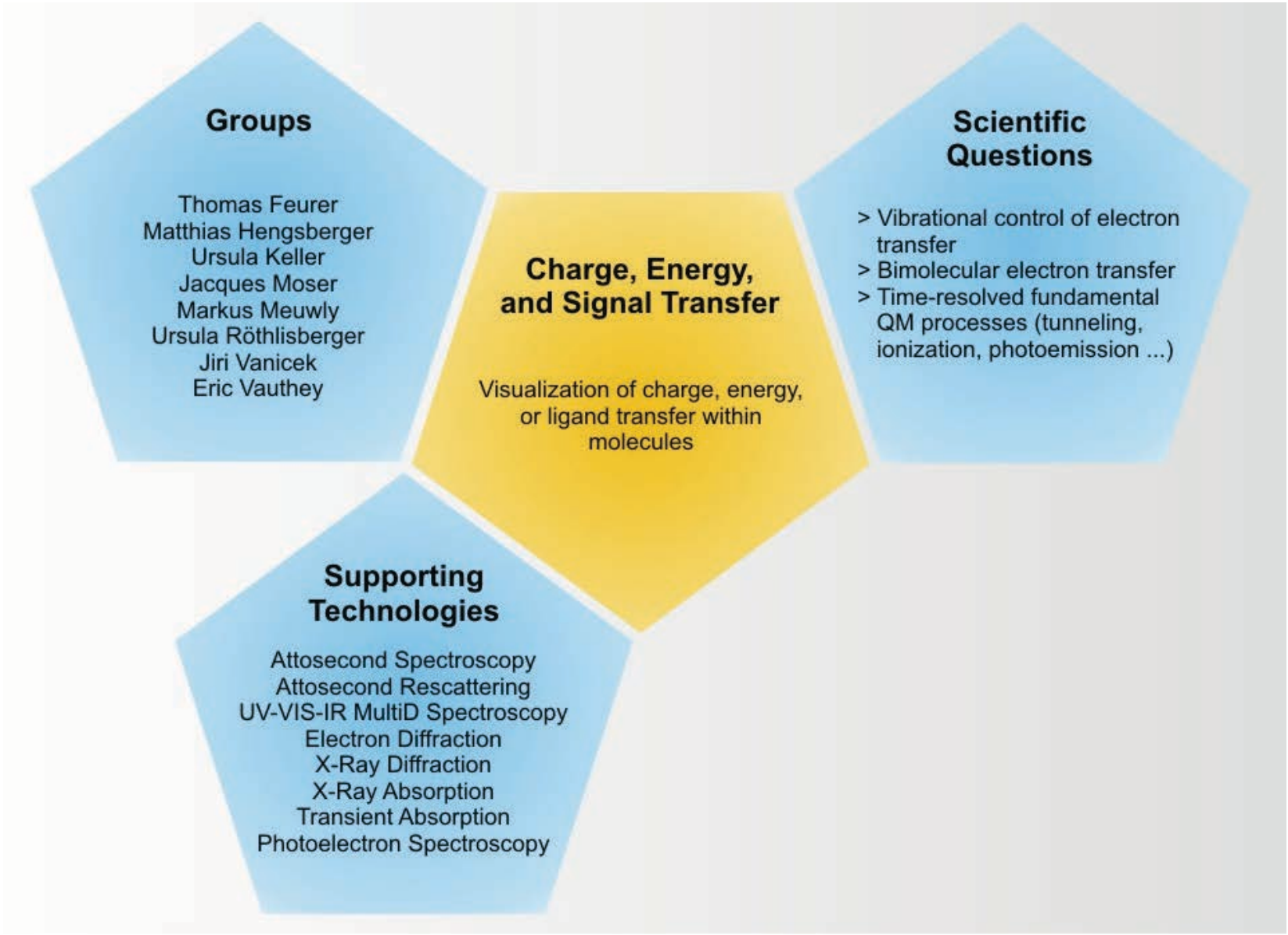


Attoline at ETH: **"ultrafast" ≈100 as**
"fine" > 10 nm (> 1 nm)

Scientific questions addressed

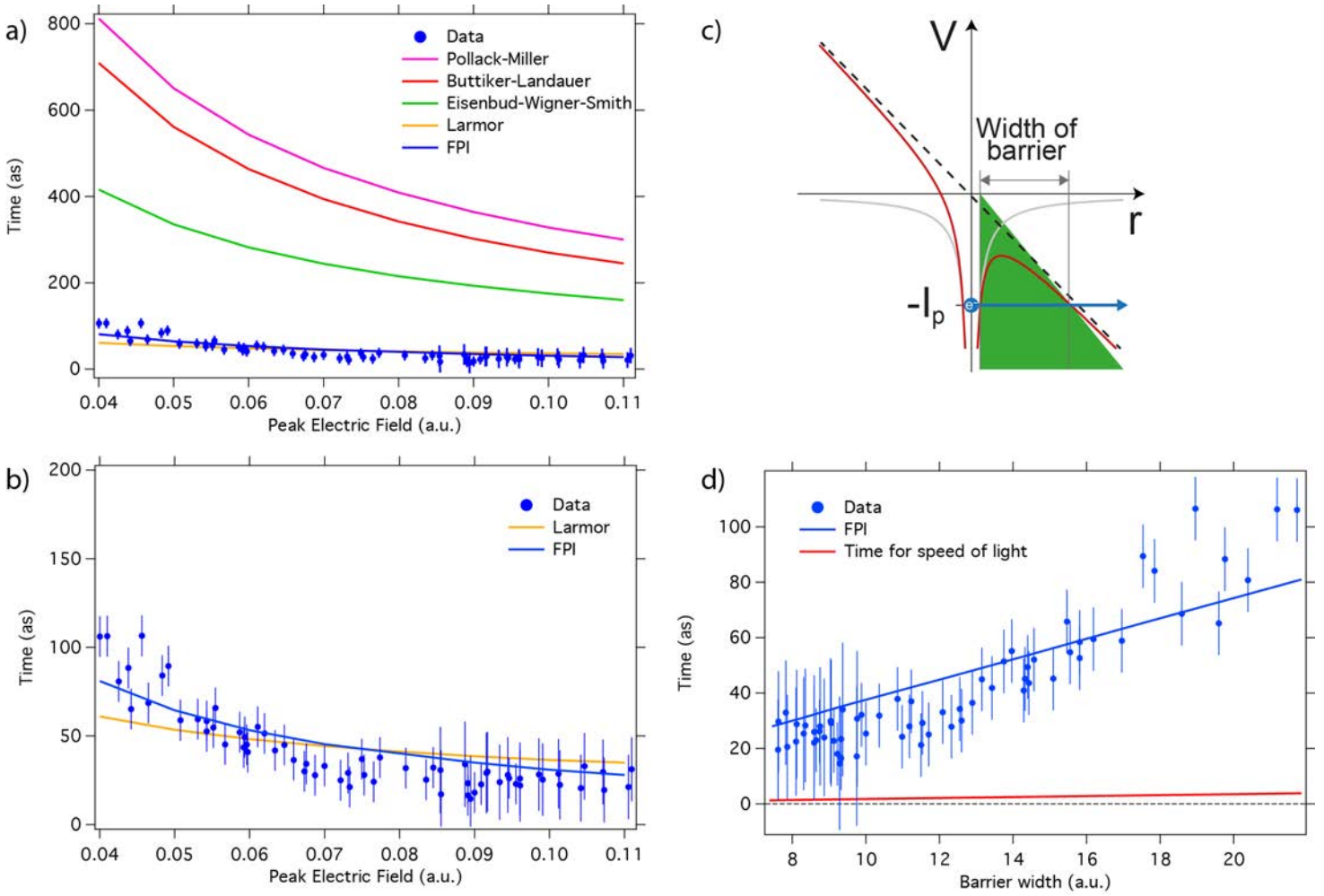


Scientific questions addressed

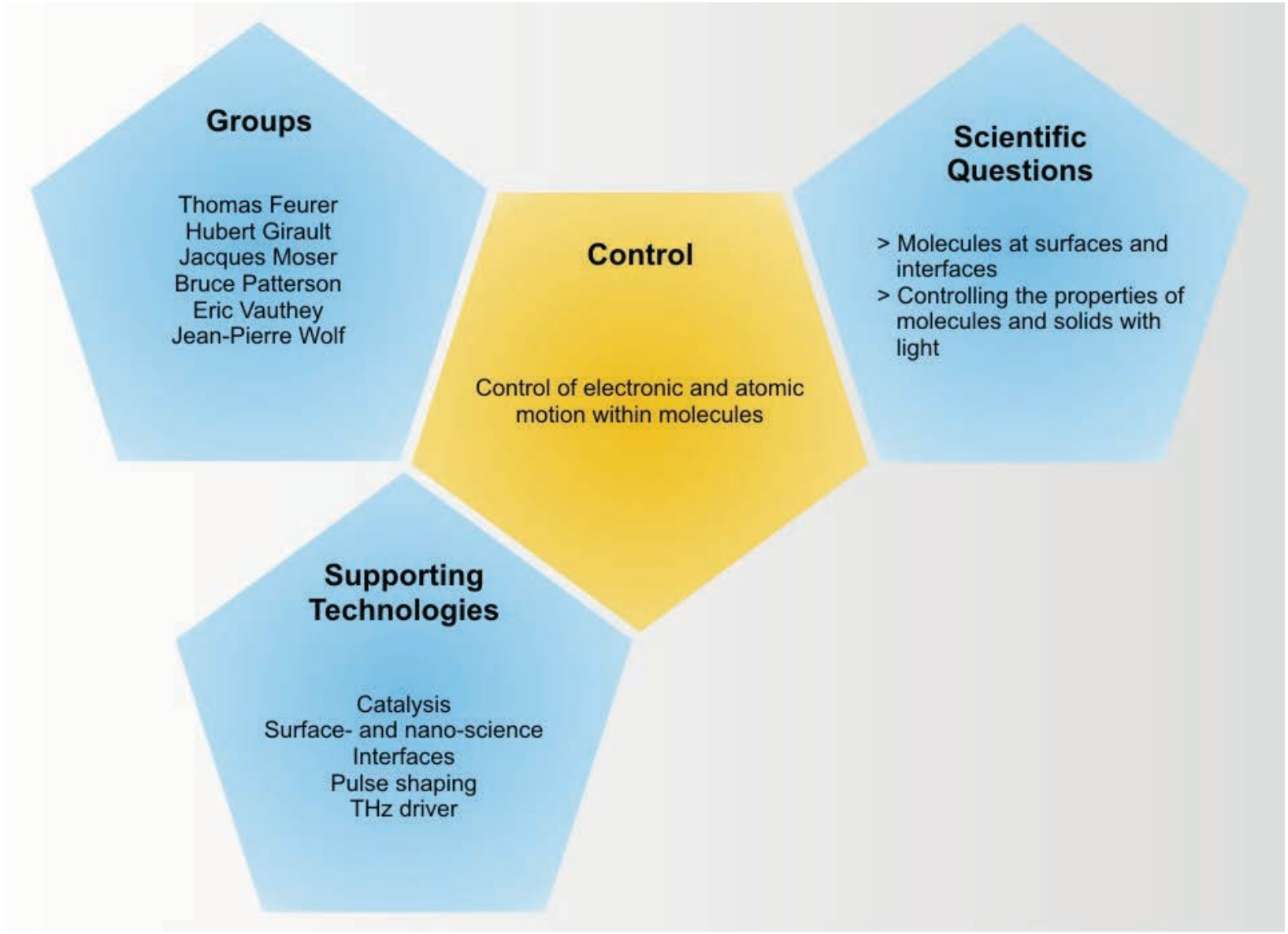


Attoclock resolves tunneling time

Attosecond electron tunneling time revealed with the attoclock 2013:
it is real, not instantaneous and has a probability distribution
(submitted to Nature, 11. March 2013)



Scientific questions addressed



Getting prepared for Phase II

Principle investigator (PI) MUST Phase I	Location	Principle investigator (PI) MUST Phase II	Location	Phase I junior PI	Phase II new PI?
Ursula Keller	ETH Zurich	Ursula Keller	ETH Zurich		
		Steve Johnson	ETH Zurich	x	x
		Hans Jakob Wörner	ETH Zurich	x	x
		Jeroen van Bokhoven	ETH Zurich and PSI		x
Bruce Patterson / Rafael Abela	PSI				
Thomas Gerber	PSI				
Paul Beaud	PSI	Paul Beaud	PSI		
		Urs Staub	PSI		x
Thomas Feurer	Uni Bern	Thomas Feurer	Uni Bern		
		Andrea Cannizzo	Uni Bern	x	x
Majed Chergui	EPFL	Majed Chergui	EPFL		
Ursula Roethlisberger	EPFL	Ursula Roethlisberger	EPFL		
Jacques-E. Moser	EPFL	Jacques-E. Moser	EPFL		
Jiri Vanicek	EPFL	Jiri Vanicek	EPFL		
Hubert Girault	EPFL				
		Fabrizio Carbone	EPFL	x	x
Matthias Hengsberger/Jürg Osterwalder	Uni Zurich	Matthias Hengsberger / Jürg Osterwalder	Uni Zurich		
Peter Hamm	Uni Zurich	Peter Hamm	Uni Zurich		
Markus Meuwly	Uni Basel	Markus Meuwly	Uni Basel		
Eric Vauthey	Uni Geneva	Eric Vauthey	Uni Geneva		
Jean-Pierre Wolf	Uni Geneva	Jean-Pierre Wolf	Uni Geneva		
		Thomas Südmeyer	Uni Neuchatel	x	x
Total 15 PI groups funded in Phase I		Total 19 PI groups for Phase II		5	7 new Pis

NCCR MUST – outreach projects

- Structural changes within the leading houses:

  FAST Initiative
  not only because of “fast processes”
  Femtosecond and Attosecond Science and Technology

- Advancement of women:

  ETH WPF
  ETH Women Professor Forum

ETH FAST Initiative: current members

must | Molecular Ultrafast Science and Technology

National Center of Competence in Research

- NCCR MUST
- Who is who in MUST
- Research
- Scientific Publications
- FAST Centers
  - ETH-FAST
    - ETH-FAST Members
    - ETH-FAST Fellows
    - ETH-FAST Lectures
    - ETH-FAST Projects
  - UniBE-FAST
- Honors Awards Fellowships
- Public Events
- Scientific Seminars
- Scientific Conferences
- Technology Transfer
- Education & Training

ETH-FAST Members

ETH FAST Members at ETH Zurich

Department of Physics and PSI
Prof Ursula Keller, Director NCCR MUST and ETH-FAST
Prof Andreas Vaterlaus
Prof Steve Johnson
Prof Joel Mesot, Director PSI
Prof Friso van der Veen

Department of Chemistry
Prof Jeroen van Bokhoven
Prof Hans Jakob Wörner, SNF Prof

Department of Biology
Prof Gebhard Schertler

Department of Material Sciences
Prof Manfred Fiebig

Interested to become a member?
Please contact

Prof Ursula Keller
Physics Department / Institute of Quantum Electronics
Phone: +41 44 633 21 46

4 Departments ETH Zurich
with 9 Professors

PSI

Interest from Uni Bern and Zürich

Centers and Strategic Partnerships

NCCR MUST / SNF
16 groups
ETH, EPFL, U Basel, U Bern,
U Geneva, U Zurich
Duration: 12 years in 3 Phases
Phase 1: 2010 – 2014, 17 Mio CHF

FAST Initiative

center of excellence
currently a “virtual” center of ETH and PSI (Phase 1, 1.2 Mio CHF)
support joint projects and interdisciplinary education (FAST Fellows, lectures)

4 departments and with 9 professors
Physics (3+2PSI), Biology (1), Chemistry (2), and Material Science (1)
Increasing interest, especially with newly hired professors

SwissFEL
PSI Villigen

Director of NCCR MUST: initiated FAST with the vision that FAST is broader than MUST

Research platform
benefits from common interest of the ultrafast laser technology

For a world leading effort a “virtual” center is not enough.
We need a “real” interdisciplinary research space (FAST Lab)

FAST Initiative reponds to global trends in scientific practice

- Global trends
  - Integration of different disciplines
  - Integration of various groups (e.g. PULSE at Stanford, focus on professors)
  - Integration of different institutes (e.g. CFEL in Hamburg, national focus)
  - ... more in Japan, China ...

- PULSE: independent laboratory at Stanford University
  - established in 2004
  - partnership of professors at Stanford
  - Scientific focus: Ultrafast dynamics in magnetism, molecular dynamics, chemistry
  - Shared laser technology will bring students and scientists from all departments to talk and interact
  - Infrastructure/technology: high power optical lasers, Linac Coherent Light Sources (LCLS)

- CFEL: Center for Free Electron Laser, Hamburg
  - established in 2006
  - Partners: Max Planck Society, DESY, University of Hamburg
  - Scientific focus: Ultrafast dynamics in nanocrystallography, materials in general, single molecule imaging, theory of correlated systems, imaging
  - Infrastructure/technology: high power optical lasers, electron microscopy, European XFEL

- We can learn from their experience and make it better for our FAST center.

Added value for a “real” FAST center (FAST Lab)

- Complements and enhances SwissFEL
  A “real” FAST center allows ETH to leverage on SwissFEL investment and effectively address future challenges in high-speed electronics, communication, energy sources, health ...
  No single department can do this!
- FAST center is more accessible and flexible than large centralized SwissFEL
  - FAST provides a larger spectral range, faster time resolution, but not the better spatial resolution (“ultrafine”)
  - FAST and SwissFEL complement each other, offer new synergies, and some pre-characterization studies
  - Additional space for PSI researchers supporting better synergies and collaborations with ETH
- A “real” FAST center should be on ETH Hönggerberg
  - ETH is a world-leading university that can attract the best minds
  - Easy access for students and for many departments at ETH is critical for the interdisciplinary nature of the FAST center
- Shared laser technology
  - will bring students and scientists from all departments to talk and interact
  - will be enhanced with interdisciplinary education
  - a research center with added benefits and beyond departmental structure
  - no permanent membership, evaluation based on continued excellence and return of investment
  - new laser development also be driven by the scientific questions
  - will more effectively use future investments
- New investment of laser development is beyond a single professor group
- FAST Lab infrastructure and single professors with a specific quest will need more than one expensive laser!

Added value for a “real” FAST center (FAST Lab)

- Incubator space for young scientists (SNF ass. Prof., ERC grants)
  - currently we have to turn away young people because of limited space
  - not enough resources and time to first build a larger laser infrastructure for their experiments
- Public outreach
  - integration of a public visiting and interaction center
  - Science city can help to get more people excited about science: “laser fascinates people”
  - show them how fast processes affect our life and technology
  - interaction center for school classes and “corporate outings”
- Inudstrial laser user facility:
  - ultrafast lasers are increasingly important for industrial applications in electronics, computing and material processing

Applications of ultrafast lasers

- **Good time resolution (short laser pulses)**

  Measurements of fast processes

- **High pulse repetition rates**

  Optical communication
  Interconnect
  Optical clocking

- **High peak intensity**

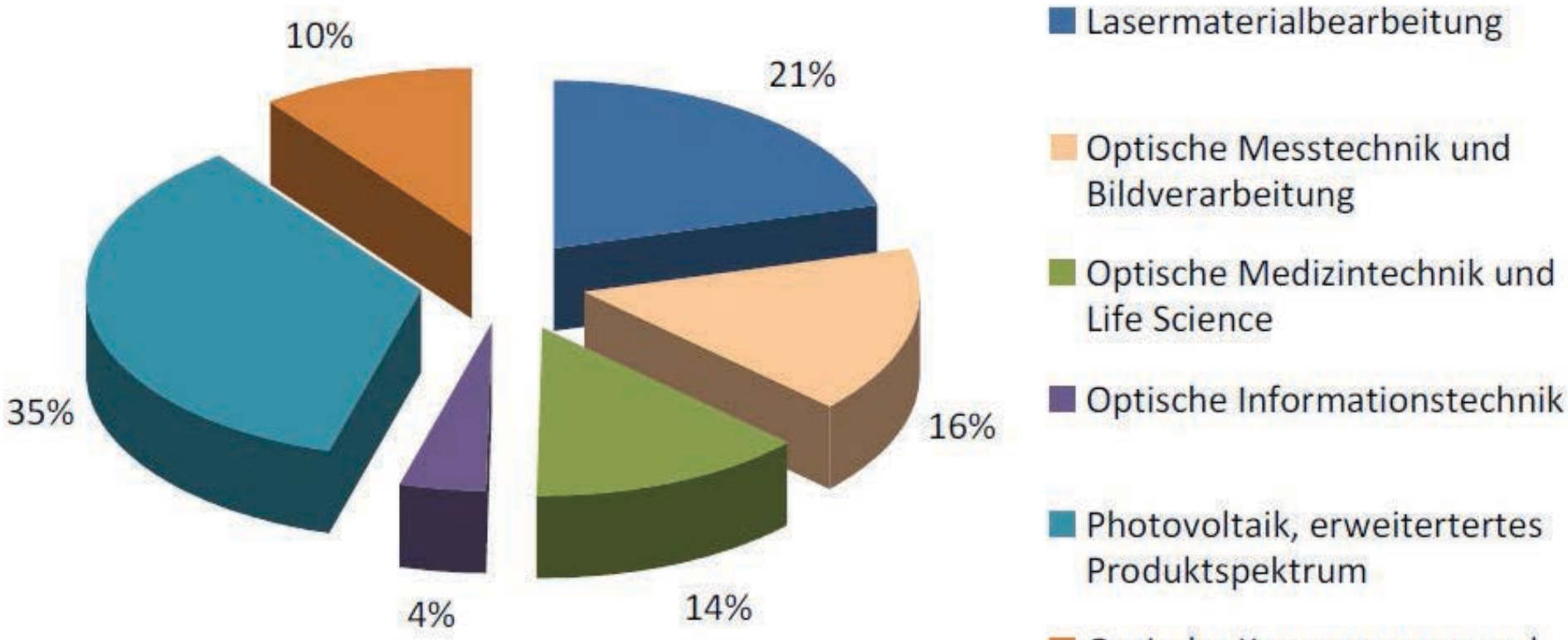
  Nonlinear Optics
  Precise material processing
  New energy souces (Laser fusion)

- **Broad optical spectrum**

  Frequency metrology (frequency comb)
  Optical clocks
  Optical coherence tomography (OCT)

Applications of ultrafast lasers

Photonik - Umsatz Unternehmen Standort Schweiz, 2011
Total: 4.1 Milliarden CHF

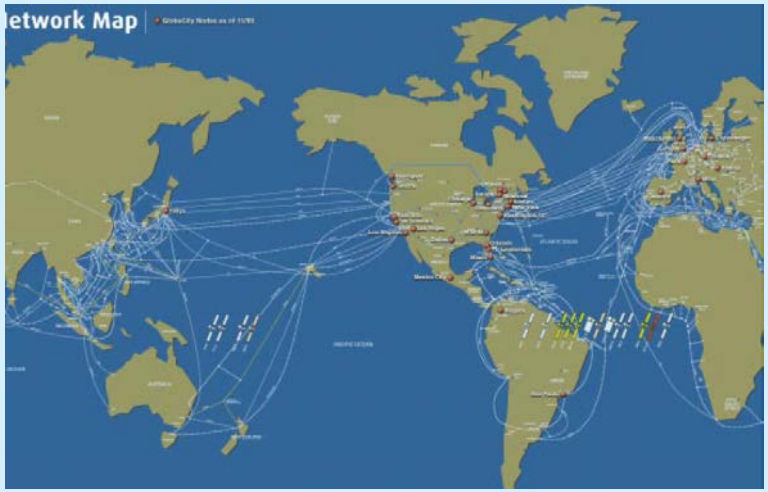


OPTECH CONSULTING

Applications of ultrafast lasers

- **Good time resolution (short laser pulses)**

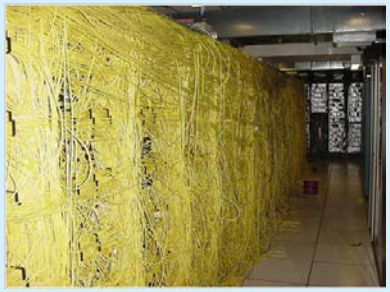
  Measurements of fast processes

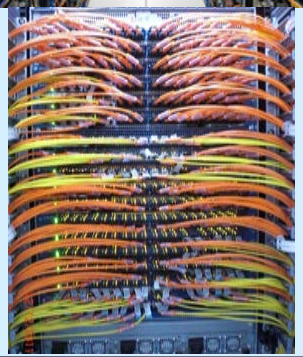


- **High pulse repetition rates**

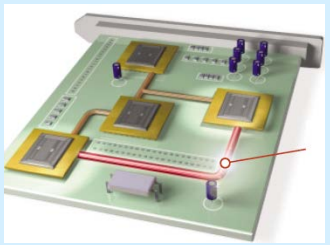
  Optical communication
  Interconnect
  Optical clocking

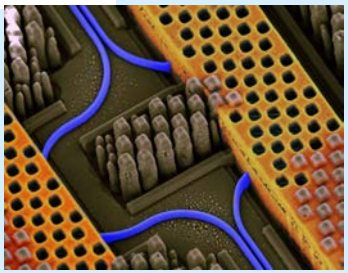
Optical interconnects in servers, data centers, supercomputers . . .





Future Application:





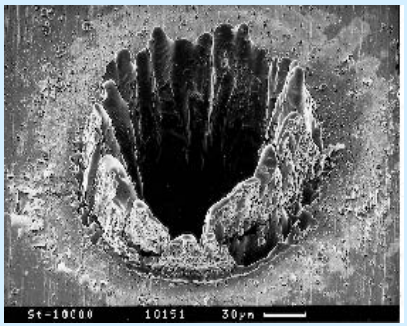
Intra-board & intra-chip interconnects

Applications of ultrafast lasers

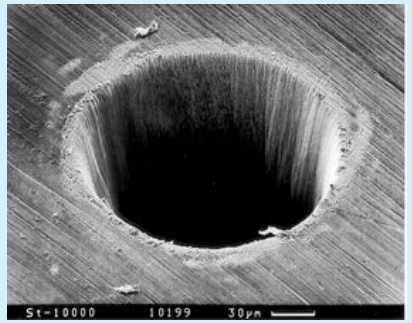
- **Good time resolution (short laser pulses)**
  - **Measurements of fast processes**
- **High pulse repetition rates**
  - **Optical communication**
  - **Interconnect**
  - **Optical clocking**
- **High peak intensity**
  - **Nonlinear Optics**
  - **Precise material processing**
  - **New energy souces (Laser fusion)**
- **Broad optical spectrum**
  - **Frequency metrology (frequency comb)**
  - **Optical clocks**
  - **Optical coherence tomography (OCT)**

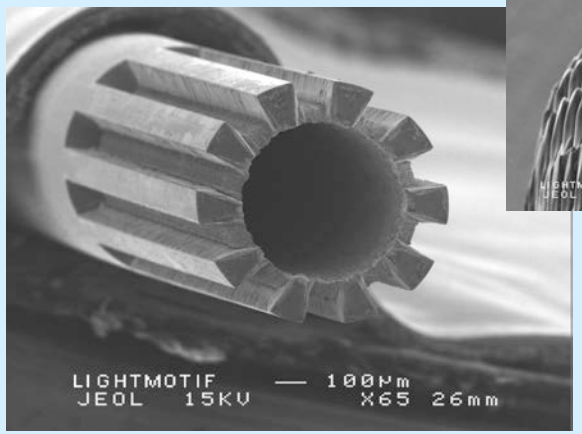
Precise material processing (cold ablation)

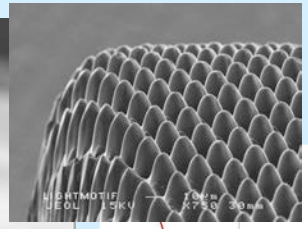
long pulse



short pulse







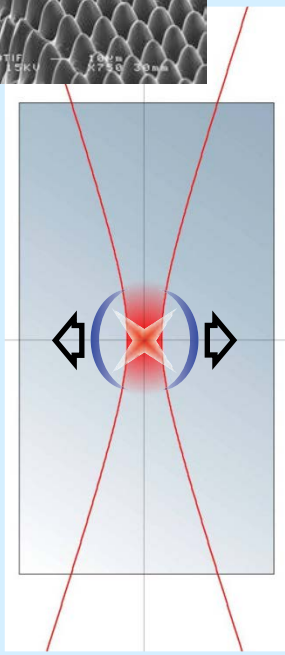
Precision

High surface quality

Functional surfaces

Inner glass micro marking

3D printing ...



FAST Initiative with a “real” research center

- **Scientific driver:** time-dependent structure and energy transfer

  Embedded in the vision that we can contribute to important challenges such as **alternative energy sources and improving health** …

- We need expertise in physics, chemistry, engineering, and biology

- FAST Initiative with a “real” research center. Why?
  “When we can combine these people under one roof, make it beneficial for them to talk to each other, we then can achieve a strong push forward in our research”

  A short summary also:
  Globe, Nr. 1, March 2013, p. 24

NCCR MUST – outreach projects

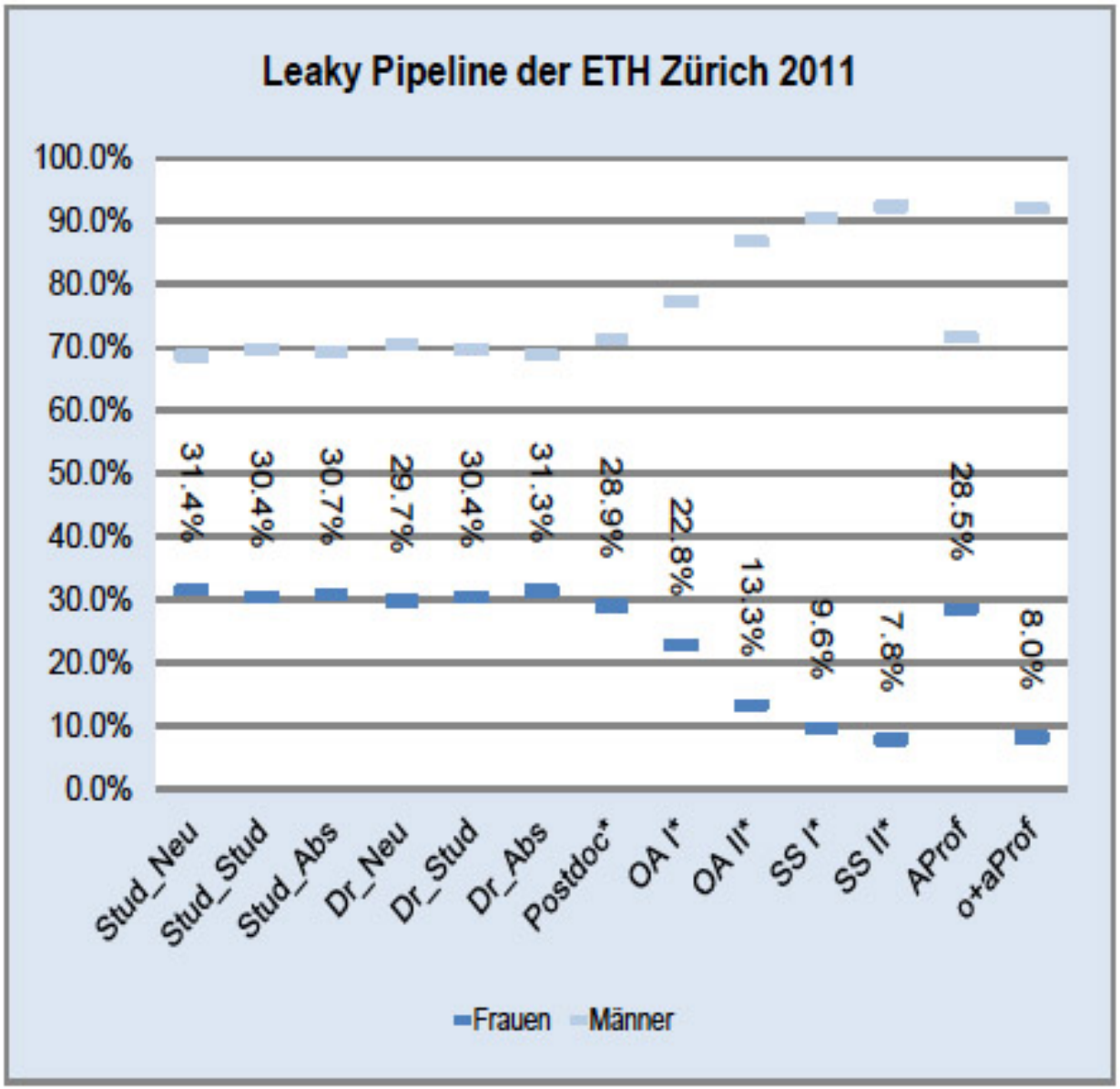
- Structural changes within the leading houses:

  FAST Initiative
  not only because of “fast processes”
  Femtosecond and Attosecond Science and Technology

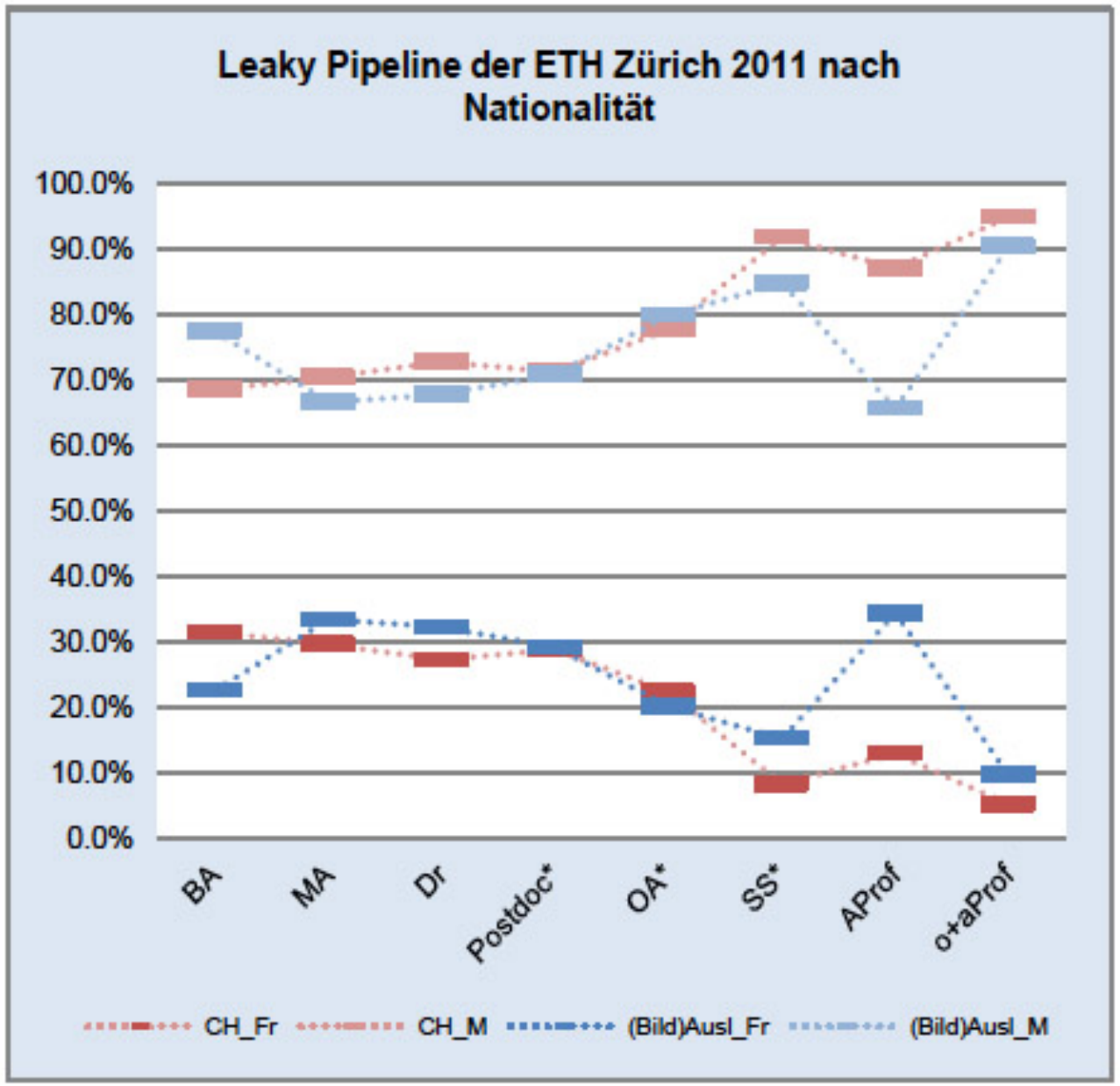
- Advancement of women:

  ETH WPF
  ETH Women Professor Forum

Gender monitoring 2011/12, equal



Gender monitoring 2011/12, equal



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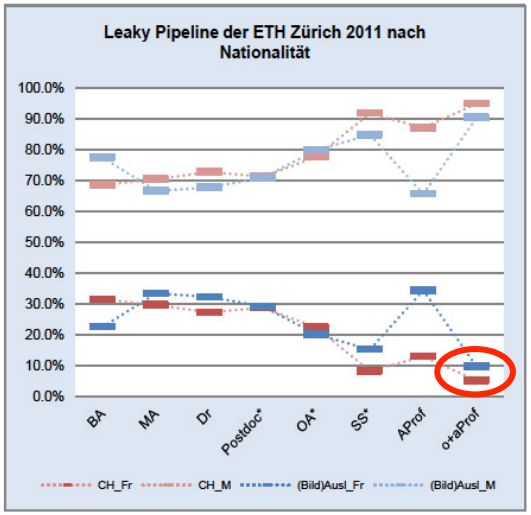
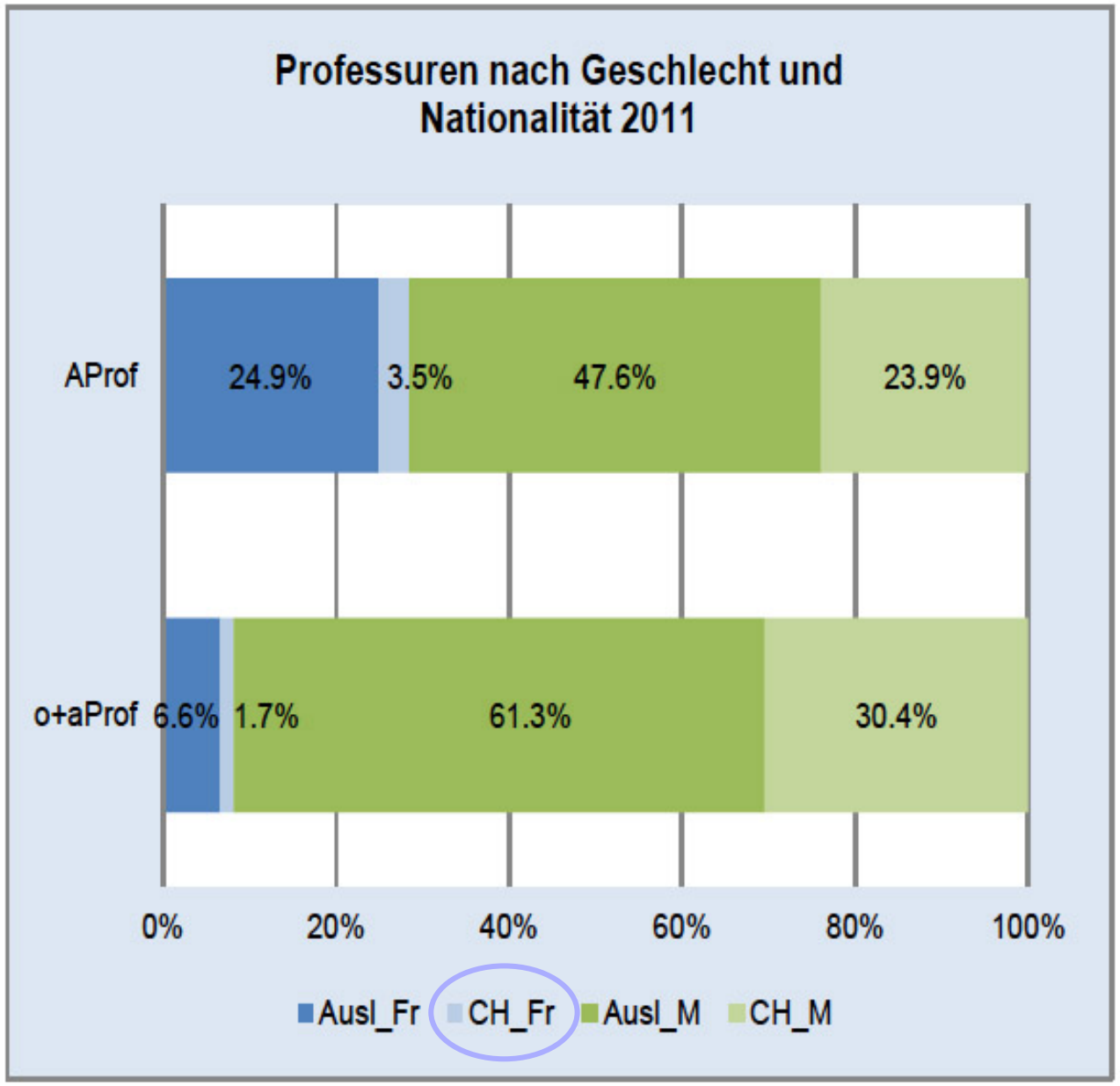


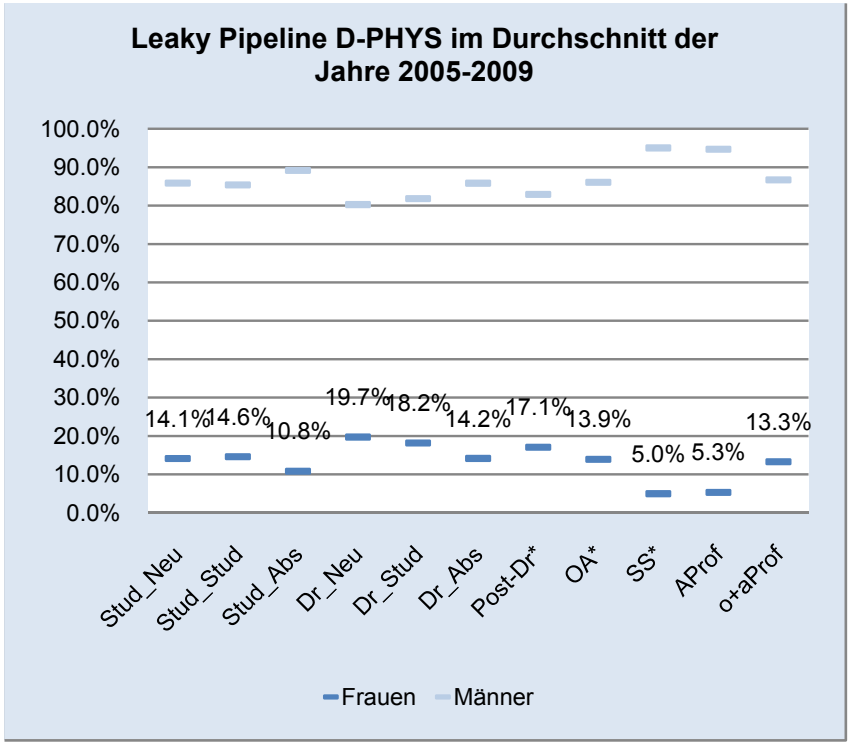


Gender Analysis two examples at ETH

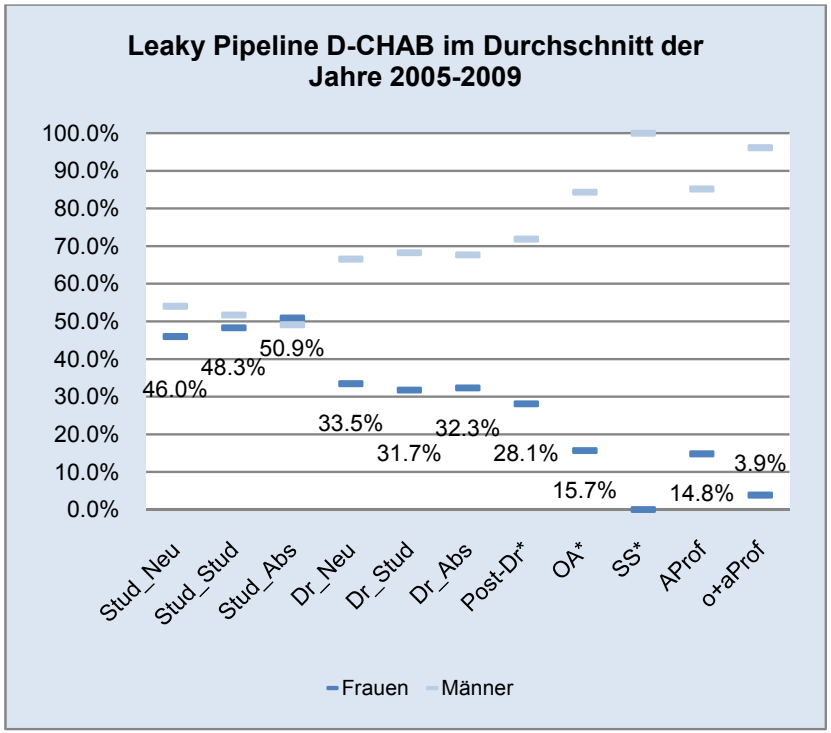
(ETH Equal Office, Gender Monitoring Report, 2009/2010, ETH Zurich)

Prof Dr Renate Schubert and Kristin Hoffmann, www.equal.ethz.ch

Gender stats Physics ETH Zurich



Gender stats Chemistry and Applied Biology ETH Zurich



ETH WPF

must | Molecular Ultrafast Science and Technology

National Center of Competence in Research

ETH Women Professors Forum (ETH WPF)

ETH Women Professors Forum (ETH WPF) -

The ETH Women Professors Forum was established in March 2012 and formally became an association/verein in May 2012. The seven member Executive committee was voted into office by a group of 20 professors at the first Assembly Meeting. The Forum aims to develop collegiality, make visible the scientific excellence of ETH women professors, organize scientific and social events, and gain influence within the ETH environment.

Of the 464 professors working at ETH, 56 are female professors (tenured, assistant professors and SNSF professors) - 12 % of the population (April 2012 figures). The WPF aims to contribute to ETH Zurich's ongoing efforts to attract, recruit, promote and retain female professors in our university.

History, Philosophy and Strategy of ETH WPF


Assembly Meeting, 7 March 2012

The members of the **Executive Board** are follows:

Ursula Keller, Physics **(President)**
Janet Hering, Director of EAWAG **(Vice President)**
Marcella Carollo, Physics
Silvia Dorn, Environmental Systems Science
Gudela Grote, Management, Technology and Economics
Renate Schubert, Delegate for Equal Opportunities to ETH President, Humanities, Social and Political Sciences
Viola Vogel, Health Sciences and Technology

Activities in 2012 - 2013

Scientific Lunch Program 2012 - 2013

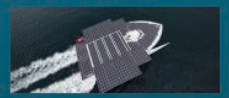
ETH WPF Executive Board Meeting program 2012 - 2013

ETH Women Professors Forum Retreat, April 8th, Uto Kulm, 9am - 6pm, 2013

ETH WPF Executive Board meeting with **ETH Schulleitung** May 28th 2013

News

ACS Meeting in New Orleans
Ultrafast excited state dynamics in transition metal complexes, with MUST strongly represented.



PlanetSolar DeepWater expedition
Gap Biophotonics measures aerosol along the Gulfstream.

ERC Advanced Grant for Ursula Keller
Prof. Ursula Keller was awarded a 2012 ERC Advanced Grant for the Attoclock project: Clocking fundamental attosecond electron dynamics.

NCCR National Competence Center for Research
FNSNF Swiss National Science Foundation

ETH Women Professors Forum (ETH WPF)

ETH WPF Executive Board (Elected during first assembly meeting, 7 March 2012):

Ursula Keller, Physics, **President**
Janet Hering, EAWAG Director, **Vice President**
Marcella Carollo, Physics
Silvia Dorn, Environmental Systems Science
Gudela Grote, Management Sciences
Renate Schubert, Delegate for Equal Opportunities to ETH President, Humanities, Social and Political Sciences
Viola Vogel, Health Sciences and Technology

ETH Zurich
61 women Prof.

as of Feb. 2013

75% are members
(i.e. 45 Profs.)

ETH WPF Goals

- to become the advisory board for the ETH “Schulleitung” for women in leadership position
- building membership and collegiality between ETH women professors: monthly scientific lunches, social events, etc.
- networking, support, exchange of experience, inter-disciplinary and inter-departmental information flow
- to nurture and promote excellence of women scientists
- to provide successful role models for our students and to encourage our mostly Swiss undergraduates to set and achieve higher goals for their careers
- to help to develop working “structures” for more diversity, for dual career couples and families
- to reach out to Swiss industry: board members, consultants
- to collaborate with other networks for women in leadership positions

NCCR MUST Webpage: www.nccr-must.ch

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National Center of Competence in Research

- NCCR MUST
  - News
  - MUST Meetings
  - MUST Support
  - Important dates of the network
- Who is who in MUST
- Research Themes
- Highlights
- Research Tools
- Publications
- FAST Initiative
- Awards, Fellowships and Honors
- Public Events
- Scientific Seminars
- Scientific Conferences
- Technology Transfer
- Education & Training
- Advancement of Women
- Video Podcast Press
- Intranet

About NCCR MUST

The NCCR MUST is an interdisciplinary research program launched by the Swiss National Science Foundation in 2010. It brings together 16 Swiss research groups working in Ultrafast Science across the fields of physics and chemistry.

The focus in MUST (Molecular Ultrafast Science and Technology) is to create new experimental and theoretical tools and to apply them to unravel the fastest processes in the physics and chemistry of natural and manmade matter. Experimental tools rely on ever-shorter sources of electromagnetic radiation, be it ultraviolet, visible, infrared or even bursts of X-rays. Currently, we are witnessing further huge steps forward in these technologies. New sources of femtosecond X-ray pulses, such as the slicing scheme at synchrotrons, or the X-ray free electron laser (XFEL), are built or planned - one of them at the PSI (SwissFEL). Electron diffraction reaches ultrafast time scales, techniques similar to NMR are extended into the IR and UV/VIS spectrum, attosecond pulses of light bring us to the time scales of electron motion, and intense THz pulses allow for direct excitation of structural modes. Improved, and even novel, theoretical tools emerge from constantly growing computational capabilities, which in turn enable us to tackle previously unsolved problems.

In Switzerland every modern aspect of Ultrafast Science is covered by the MUST network and Swiss researchers are among the leaders in the field. The research goals of MUST include

NCCR MUST / SNF
16 groups
ETH, EPFL, U Basel, U Bern,
U Geneva, U Zurich
Duration: 12 years in 3 Phases
Phase 1: 2010 – 2014, 17 Mio CHF

News

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CMS by onetook

NCCR MUST Office : ETHZ IQE/ULP-HPT H3 | Wolfgang-Pauli-Strasse 16 | 8093 Zurich | E-Mail | +41 44 633 36 02

The National Centres of Competence in Research (NCCR) are a research instrument of the Swiss National Science Foundation

Scientific questions addressed

- **Scientific driver:** time-dependent structure and energy transfer

- To understand how matter functions at the electronic, atomic, and molecular level:

  - how matter changes its structure during a reaction

  - how quanta of energy are transported on a microscopic spatial and ultrafast time scale

- **Embedded in the vision** that we can contribute to important challenges such as **alternative energy sources and improving health** …

We address these challenges through basic research
which we believe is essential for breakthrough progress in these areas.

History: ETH WPF

18. July 2011	8 senior women Professors – first meeting (including Heidi Wunderli and Sarah Springman)
2011	3 consultation lunches with 25 ETH women professors
Dec. 2011	Presidents Apero announced ETH WPF creation and ETH Schulleitungsbeschluss gave permission for ETH logo
7. March 2012	First Assembly Meeting: 20 attendees (with written support from 36 out of 52 women professors)
8. April 2013	2. Assembly Meeting and first one day retreat on Uto Kulm

First year activities: building up membership and collegiality

- organized scientific lunches
- social activities
- getting women professors into important leadership positions within ETH (e.g. Forschungskommission ...)
- first meeting with ETH president (getting to know each other ...)
- One day retreat meeting 8. April 2013 to develop recommendations for ETH executive meeting on 28. May 2013

Why so few women in high academic positions?

- Complicated ...
- Many studies done ... with well documented reasons
- This is also well documented by independent studies:

LERU Report, **Women research and universities: excellence without gender bias**, July 2012

Nature special issue: March 2013, http://www.nature.com/news/specials/women/index.html

Why so few women in high academic positions?

- **Mother**
- **Mate**
- **Daughter**
- **(Intellectual Spinster)**
- ~~**Female colleague**~~