

Energy, Sustainability and Environment

Tuesday, 19.08.2025, Room HS 30

Time	ID	ENERGY, SUSTAINABILITY AND ENVIRONMENT Chair: Robert Hauser, FH Kärnten; Christoph Reichl, AIT
16:00	501	<p style="text-align: center;">Nature-Inspired Nanopores for Osmotic Energy Conversion</p> <p style="text-align: center;"><i>Yunfei Teng, EPFL</i></p> <p>Osmotic energy, or blue energy, harnesses electricity from ion movement driven by salinity gradients. Reversed Electrodialysis (RED) utilizes selective membranes to convert this ionic flux into electrical potential, but optimizing both performance and scalability remains difficult. We present a solid-state membrane featuring stalactite-shaped HfO_2 nanopores formed via anisotropic deposition on silicon nitride. The asymmetric geometry enhances charge separation efficiency while maintaining structural robustness. Integrating with micro-fabrication, our approach enables pore densities up to 10^8 cm^{-2}, offering a scalable and stable platform for practical osmotic energy applications.</p>
16:30	502	<p style="text-align: center;">The Vienna Environmental Research Accelerator (VERA) for applications in Earth and Environmental sciences</p> <p style="text-align: center;"><i>Karin Hain, Stephanie Adler, Oscar Marchhart, Martin Martschini, Silke Merchel, Peter Steier, Carlos Vivo-Vilches, Andreas Wiederin, Alexander Wieser, Robin Golser University of Vienna, Faculty of Physics, Isotope Physics, Vienna, Austria</i></p> <p>VERA has been continuously upgraded to expand the range of radionuclides measurable with accelerator mass spectrometry (AMS) at low MeV ion beam energies. A major milestone was the implementation of Ion-Laser Interaction Mass Spectrometry (ILIAMS), which effectively removes isobaric background—previously a key limitation for AMS in the mid-mass range. Many of these radionuclides are crucial for applications in Earth and Environmental sciences e.g., surface exposure dating, tracing environmental mass transport (ice, water, sediments,...), identifying contamination sources, and supporting nuclear decommissioning. VERA's contributions to the search of the "golden spike" for the proposed geological age of the "Anthropocene" and to the identification of anthropogenic uranium sources using the new $^{233}\text{U}/^{236}\text{U}$ isotope signature, with applications in oceanography, will be highlighted.</p>
16:45	503	<p style="text-align: center;">High-Power, Low-Noise Mid-Infrared Optical Frequency Combs for Precision Spectroscopy</p> <p style="text-align: center;"><i>Vito Fabian Pecile¹, Filipp Lausch^{1,2}, Maximilian Prinz^{1,2}, Norbert Modsching³, Valentin J. Wittwer³, Thomas Südmeyer³, Oliver H. Heckl¹</i></p> <p>¹ <i>Optical Metrology Group, Faculty of Physics, University of Vienna, Boltzmannngasse 5, AT-1090 Wien,</i></p> <p>² <i>Vienna Doctoral School in Physics, University of Vienna, Boltzmannngasse 5, AT-1090 Wien,</i></p> <p>³ <i>Laboratoire Temps-Fréquence (LTF), Institut de Physique, Université de Neuchâtel, Avenue de Bellevaux 51, 2000 Neuchâtel, Schweiz</i></p> <p>Precision spectroscopy in the mid-infrared using optical frequency combs is a novel technique to investigate broadband spectral regions. It has gained significant attention over the past years due to its elevated importance for many practical, medical and industrial applications, ranging from human breath analysis to pollution monitoring. An ongoing challenge is to provide highly accurate reference data, as precision spectroscopy techniques have rigorous demands on the used light source in terms of high average powers and stability. Such sources remain technologically challenging and are currently unavailable. Here, we present a record-high power, low-noise frequency comb system operating in the 3 - 5 μm region, which has sufficient characteristics for a first-time performance of broadband cavity-enhanced saturation spectroscopy in the mid-infrared.</p>

17:00	504	<p style="text-align: center;">Data-Driven Fault Detection in PV Plants Based on IV Curve Analysis and Artificially Generated Fault Scenarios</p> <p style="text-align: center;"><i>Felix Korbelius, TU Wien</i></p> <p>The aim is to present a data-driven monitoring approach of PV plants to detect underperformance at string level of photovoltaic power plants. PV plants are monitored based on operational data (power, voltage, current, ...) and environmental data (irradiance, temperature, ...). Scans of the total IV-curve of different strings attached to an inverter contain information about the condition of the strings at specific moments. The methodology involves simulating a PV plant using software packages that model solar cells up until string level and inserting predefined artificially generated fault conditions based on the underlying Shockley Diode Model. A Machine Learning model is being trained on this artificially generated data set which allows classification of real-world errors to aid in operation maintenance of large scale commercial PV plants.</p>
17:15	505	<p style="text-align: center;">Enhancing Heat Pump Installation Through Frequency-Based Acoustic Directivity Information: An Open Database Initiative</p> <p style="text-align: center;"><i>Luisa Stöckl¹, Christoph Reichl¹, Francois Bessac², Georg Klein¹, Martin Czuka¹</i> ¹ AIT Austrian Institute of Technology, Vienna, Austria, ² CETIAT, Villeurbanne, France</p> <p>Heat pumps are gaining popularity due to their efficiency, carbon neutrality, and use of renewable energy. Air-to-water models are favored for low cost and easy installation. However, proper placement to reduce noise is essential. Current noise assessments lack detailed frequency and directivity data. Standard certification tests provide frequency-resolved partial sound power levels for five surfaces around the unit, offering basic directivity insights. As part of IEA HPT Annex 63, an anonymous database was created, combining heat pump dimensions, operating conditions, and surface types with their frequency spectra. Initially, it includes data from about 30 units measured at CETIAT and AIT, with expansion planned in 2025, inviting contributions from other laboratories. This contribution introduces the database and shows a first exploitation.</p>
17:30	506	<p style="text-align: center;">Decentralized heat pump solutions and their safety concepts for natural refrigerants in multi-family houses</p> <p style="text-align: center;"><i>Stephan Preisinger¹, Felix Hochwallner², Heinz Moisi¹, Christoph Reichl²</i> ¹ Ochsner Wärmepumpen GmbH, Amstetten, Austria, ² AIT - Austrian Institute of Technology, Vienna, Austria</p> <p>In large cities, for example Vienna, about one half of households in multi-family homes use gas boilers for heating or domestic hot water preparation. The aim of the FFG-project "Gasthermenersatz" was to tackle this problem by developing a prototype of a decentralized, sound-optimized heat pump solution. In this context, access to the heat source either from the outside air or geothermal heat is crucial and analyzed within this contribution. The recently started FFG-project "WISE" focusses on safety concepts to adhere to the limit of 150 g R290 releasable charge, while increasing the refrigerant circuit charge. In our talk, we will highlight the most important results of "Gasthermenersatz" and report on the current research activities in "WISE".</p>
17:45	507	<p style="text-align: center;">IEA HPT Annex 61 – Integration of Heat Pumps in Positive Energy Districts</p> <p style="text-align: center;"><i>Christoph Reichl⁴, Fabian Ochs¹, Carsten Wemhoener², Christoph Rohringer³</i> ¹ University of Innsbruck, Innsbruck, Austria, ² OST, University of Applied Science, Rapperswil, Switzerland, ³ AEE INTEC, Gleisdorf, Austria, ⁴ AIT - Austrian Institute of Technology, Vienna, Austria</p> <p>Cities contribute to 60 % of global greenhouse gas emissions. Districts and cities are highly complex, but unlike individual buildings, they allow for synergies, like load balancing or waste heat recovery. Therefore, districts appear to be a suitable application for integration of heat pump (HP) systems with the vision of future positive energy districts (PEDs). PED definitions and policy frameworks were identified, and technologies in existing PEDs, applied planning and simulation tools, and certification systems were analyzed. HPs are the main heating systems in PEDs, typically powered by on-site photovoltaics and supplemented with green electricity. We report on IEA HPT Annex 61, which examines HP integration concepts into PEDs as a future perspective for accelerating the energy transition in urban contexts.</p>
18:00		END

		Transfer to ÖAW <i>Doktor-Ignaz-Seipel-Platz 2, 1010 Wien</i>
19:00		Public Lecture

ID	ENERGY, SUSTAINABILITY AND ENVIRONMENT POSTER
521	<p style="text-align: center;">Automatic focusing system for laser thermal annealing setup: toward effective wafer back contact annealing.</p> <p style="text-align: center;"><i>Martin Buessler, Institut für Angewandte Physik, Wien, Austria</i></p> <p>Laser Thermal Annealing (LTA) is crucial for semiconductor fabrication, offering precise heating with minimal thermal spread. Unlike traditional furnace annealing, LTA uses high-intensity laser pulses for targeted heat application, enhancing dopant activation. This precision is vital for creating quality back contacts in devices like power electronics, CMOS, and solar cells. Conventional LTA setups lack real-time control over focus alignment and energy absorption, causing inconsistencies. To improve this, we introduced an automatic focusing routine to maintain wafer focus during LTA. Additionally, a reflectance-based monitoring system was implemented to measure the ratio of reflected to incident light, providing real-time feedback on absorbed energy. These advancements enable both geometric and energetic optimization, significantly improving back contact uniformity.</p>
522	→ <i>moved to 587</i>
523	<p style="text-align: center;">Extended aerosol optical depth (AOD) time series analysis in an alpine valley: a comparative study from 2007 to 2023</p> <p style="text-align: center;"><i>Jochen Wagner, Alma A. Ubele, Verena Schenzinger, Axel Kreuter Medical University of Innsbruck, Austria</i></p> <p>This study extends aerosol optical depth (AOD) measurements at 501 nm in Innsbruck, Austria, from 2007 to 2023 and compares them with data from Davos, Switzerland. Building on earlier work (Wuttke et al., 2012), we analyze 17 years of daily median AODs (requiring ≥ 3 measurements per day) and monthly geometric means (≥ 5 valid days), covering 83 % of months in Innsbruck and 79 % in Davos. Advanced statistical methods (Sayer et al., 2019) reveal significant negative AOD trends at both sites. For the first time, we also derive the diurnal AOD climatology for each station.</p> <p>Acknowledgments go to PMOD/WRC and AERONET-Europe/ACTRIS for sunphotometer maintenance; funding was provided by the Medical University of Innsbruck.</p>
524	<p style="text-align: center;">IEA HPT Annex 63 - Placement Impact on Heat Pump Acoustics - Overview and Austrias Contribution to the Network</p> <p style="text-align: center;"><i>Christoph Reichl¹, Christian Kaseß², Michael Wernhart³, Maximilian Noisser⁴, Fabian Ochs⁵</i> ¹ AIT Austrian Institute of Technology, Wien, Austria, ² Österreichische Akademie der Wissenschaften - Institut für Schallforschung, Vienna, Austria, ³ Technische Universität Graz, Institut für Wärmetechnik, Graz, Austria, ⁴ Technische Universität Wien, Institut für Werkstofftechnologie, Bauphysik und Bauökologie, Austria, ⁵ Universität Innsbruck, Institut für Konstruktion und Materialwissenschaften, Innsbruck, Austria</p> <p>IEA HPT Annex 63 builds on Annex 51 to address the growing impact of acoustic issues on heat pump deployment. While Annex 51 laid the groundwork, Annex 63 focuses on the influence of placement, aiming to reduce noise-related market barriers. It expands to include cooling mode acoustics, psychoacoustics, and specific use cases such as urban and building environments. Each installation scenario is unique, highlighting the need for revised guidelines and digitally supported placement tools. Annex 63 fosters international collaboration, standardizes data, and supports the continued growth of heat pumps as a leading renewable and energy-efficient HVAC solution. This contribution gives an overview of the activities within IEA HPT Annex 63 especially focussing on Austrias contribution within the network.</p>