Plenary Talk PV I Mon 9:00 ELP 6: HS 3+4

The role of the North Atlantic Ocean for European Climate — •Johanna Baehr — Uni Hamburg

The role of the North Atlantic ocean circulation in shaping European climate variations has hardly been overestimated in scientific or popular scientific discussions alike. In this contribution, I will examine the complex dynamics of the Atlantic Meridional Overturning Circulation (AMOC) and its pivotal role in the Earth's climate system for both the current and the potential future evolution of European climate. I will put these in context of our fundamental understanding as well as recent advances. I will further discuss the role of the North Atlantic circulation in the discussion of the concept of tipping points in the climate system.

Plenary Talk PV II Mon 9:45 ELP 6: HS 3+4

The role of plasma conversion technology in the greening of the chemical industry — •Richard van de Sanden — Dutch Institute for Fundamental Energy Research (DIFFER), P.O. Box 6336, 5600 HH, Eindhoven, The Netherlands — Eindhoven Institute for Renewable Energy Systems (EIRES), Eindhoven University of Technology, The Netherlands

The worldwide climate crisis has greatly driven the current deployment of sustainable energy sources, such as wind and solar to lower CO2 emissions. A next grand challenge is to develop effective and economical chemical conversion processes for green chemicals and fuels.

In this talk, after an introduction to the challenges facing the world in the next decades, I will discuss the opportunities of using plasmas, powered by renewable electricity, for scalable gas conversion of key molecules such as CO2 and N2. In particular I will address the use of microwave plasma to dissociate CO2 into CO and O2, and the formation of NOx from air and the possible, often claimed, role of nonequilibrium vibrational kinetics. A scheme to possibly exploit vibrational stimulation of chemical reactions by plasma, I will present a unique hybrid type reactor consisting of a plasma reactor and solid state water electrolysers with oxygen ion or proton conducting membranes. One aided benefit of this proposed approach is that both technologies, i.e. water electrolyser and plasma activation, utilize base molecules (N2 and H2O) and can be directly powered by renewable electricity. Such a scheme may be a stepping stone to zero carbon footprint processes.

Plenary Talk PV III Tue 9:00 ELP 6: HS 3+4

Physics as an environmental science: The case of climate history — •Richard Staley — University of Cambridge, United Kingdom — University of Copenhagen, Denmark

Environmental physics courses began to appear only from the late 1960s and largely treated their subject as the study of pollution, applying physics to the world's environmental problems, before more recently expanding to incorporate Earth System Sciences. This lecture explores instead what we can learn about physics by treating it as always an environmental science, as much grounded in understanding the earth and environment as in the search for the fundamental principles of matter. Drawing on the Leverhulme funded project "Making climate history", the emergence of the climate sciences and long history of temperature as a key climatic index will serve as my case studies. How is global knowledge achieved, practically, when the earth is the subject matter? I explore several key elements (and the relation between projection and achievement) in building the global arguments and long-term histories required to know that man has changed climate. When, why and how has the earth been treated as an instrument? How did natural philosophers first begin to think it had a temperature (and how did they try to measure that)? Why were the oceans understood to have climates, from the 1870s? How did ocean histories resolve the dilemmas of geological eras? And how have scientists constructed hemispheric or global arguments and million-year histories from foraminifera shells? This lecture aims to provide a historical orientation to physics as an environmental science.

Plenary Talk PV IV Tue 9:45 ELP 6: HS 3+4

Climate Crisis Education-Physics Instruction's Role in Ensuring a Sustainable Future — •Doug Lombardi — University of Maryland, United States

It might be as simple as one, two, three. One, the climate crisis is upon us; two, this crisis is impacting Earth's entire environment; and three, humans, who are intertwined in Earth's complex environmental system, are the culpable actors causing the climate crisis. However, addressing this crisis is no simple matter. Over many decades, the science community has characterized and forecasted climate change. Planners and policymakers now face the task of mitigating and adapting to extreme weather events, mass migrations, disease outbreaks, collapsing ecosystems, and social and economic injustice caused by the climate crisis. Despite these challenges, hope remains. Educators across many disciplines, including physics educators and physics education researchers, can help turn hopelessness into hope and despair into agency and action. Multidisciplinary collaborations involving physicists, physics education researchers, and physics instructors, along with other scientific disciplines, are needed to shape theoretical frameworks and methodologies that will facilitate innovation for a sustainable future. This presentation overviews my research team's efforts–in collaboration with a wide variety of scientists and educators–to design and rigorously test effective instructional interventions and strategies that facilitate students deep understanding of the climate crisis and how to adaptively respond.

Plenary Talk PV V Wed 9:45 ELP 6: HS 3+4

Nonlinear optical effects and their utilization in thin film interference coatings — •Morten Steinecke — Laser Zentrum Hannover e.V., Optical Components Department, Hanover, Germany

Nonlinear optical effects play a crucial role in modern optical systems. They are applied in mode-locking for the generation of ultrashort optical pulses and for unlocking measurements at new timescales. However, implementing the required nonlinear optical processes mainly relies on conventional optical systems comprising separate components and free-space constructions, which limits the possibilities for future applications and miniaturization. Contrary to this, optical coatings offer highly developed capabilities for combining optical functions into a monolithic stack of transparent materials. But, so far, the applications of optical coatings have generally been limited to the linear optical regime or for assisting the implementation of nonlinear processes, e.g., with chirped mirrors. This talk provides an overview of the combination of selected nonlinear optical effects with specially designed optical coatings aiming to create novel components as alternatives to established optical systems. Different effects are considered, e.g., the optical Kerr effect, which can be utilized to achieve all-optical switching of light, and the THG, where the concept can solve phase-matching issues and significantly increase conversion efficiency. The results for the THG, and especially the Kerr-based optical switches, show great promise for this novel field of optical components and indicate a large potential for further research into the fundamentals of nonlinear effects in different optical materials and the required manufacturing processes.

Evening Talk PV VI Wed 19:30 ELP 6: HS 3+4

Exotische Gasentladungen — •Holger Kersten — Institut für Experimentelle und Angewandte Physik, Universität Kiel

Der durch Irving Langmuir in die Physik eingeführte Begriff des Plasmas beschreibt ein elektrisch leitfähiges Gas, das aus freien Ladungsträgern (Elektronen und Ionen) sowie aus Neutralteilchen (Atome, Moleküle) besteht und das oftmals auffällige Leuchterscheinungen zeigt. Dieses manchmal auch als "vierter Aggregatzustand" bezeichnete Medium weist eine Reihe von besonderen Eigenschaften auf.

Während für den "Normalverbraucher" auf der Erde das Plasma einen recht exotischen Zustand der Materie darstellt, ist es im Universum die dominierende Daseinsform der Materie. Im Labor zeigen sich Plasmaerscheinungen z.B. in elektrischen Gasentladungen, deren Erforschung für eine Vielzahl von technologischen Anwendungen von Bedeutung ist. Denn wer weiß eigentlich schon, dass mittels Plasmaverfahren Computerchips hergestellt, Plastikflaschen beschichtet oder Brillengläser kratzfest gemacht werden. Im Automobilbau werden Bleche durch sog. Bogenplasmen verschweißt, Kunstgegenstände werden im Plasma gereinigt, Raumsonden werden durch Ionenstrahlen aus Plasmen beschleunigt - und in nicht allzu ferner Zukunft wird man hoffentlich mit Fusionsplasmen die Energieproblematik beherrschen können.

Im Rahmen des Abendvortrages, der durch einige eindrucksvolle und sehenswerte Experimente "exotischer" Gasentladungen ergänzt wird, soll auf unterhaltsame Weise eine Reise durch die faszinierende Welt der Plasmen unternommen werden.

Plenary Talk PV VII Thu 9:00 ELP 6: HS 3+4

Progress in solar flare modeling — •Rony Keppens — Centre for mathematical Plasma Astrophysics, KU Leuven, Belgium

A violent plasma process to study is the solar flare, which represents the most energetic explosion in our heliosphere. It involves a dramatic change - or reconnection - in the magnetic topology of the atmosphere, and the so-called "standard solar flare model" collects all observationally established info on flares in a cartoon. This cartoon emphasizes that macroscopic (magnetohydrodynamic) and microscopic (energetic particles) plasma physical processes dynamically interact, although most model efforts only simulate the large magnetohydrodynamic (MHD) or the small (kinetic) scales. I will present our first self-consistent model of a standard solar flare, where electron beam physics dynamically couples to a large-scale, multi-dimensional magnetohydrodynamic evolution of a flaring arcade. By varying the magnetic field strength, we explore the various flare classes, and we can compare with 1D flare models to point out the multi-dimensional aspects they lack. We continued simulating the hour-long postflare behaviour, to ensure that the hot meets the cold: the first numerical demonstration of post-flare coronal rain due to thermal instability! I will also show recent results on full 3D standard flare modeling, where we obtained Kelvin-Helmholtz induced turbulent looptops consistent with observed non-thermal broadenings, and where we find clear multi-phase behaviour in the gradual phase. All simulations use our open-source MPI-AMRVAC toolkit [amrvac.org], where grid-adaptivity is essential to zoom in on details that can be resolved by future observing facilities.

Plenary Talk PV VIII Thu 9:45 ELP 6: HS 3+4

Achieving target gain $>$ 1 from inertial confinement fusion implosions at the National Ignition Facility* — •Tilo Döppner — Lawrence Livermore National Laboratory, Livermore, USA — Indirect Drive Inertial Confinement Fusion Collaboration

Creating a controlled fusion reaction that produces more energy than supplied to initiate it (i.e. target gain >1) is a grand scientific challenge with broad societal implications. Predominantly, current approaches use the fusion of deuterium and tritium nuclei, which generates 17.6 MeV of energy released in a neutron and an alpha particle. The latter, carrying 1/5 of the energy, can further heat the fusion plasma. A plasma in which the alpha self-heating is greater than external heating is termed a burning plasma, and one in which the self-heating dominates over all loss mechanisms, leading to a run-away increase in temperature, is termed ignited. Inertial Confinement Fusion has pursued these scientific milestones using large laser drivers, notably the National Ignition Facility at LLNL. It provides laser energy up to 2.2 MJ to generate a hot x ray bath, which creates ablation pressures of hundreds of Mbar at the outer surface of a fuel-containing capsule. The ablation pressure implodes the capsule, with fuel pressures of several hundred Gbar generated as the fuel stagnates at the center to initiate fusion burn. In recent years several improvements in the scientific design and requisite technologies have enabled increasing performance of NIF experiments through the burning plasma and ignition regimes.

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