# EP 6 Kosmische Strahlung und Heliosphäre

Zeit: Samstag 14:00–16:15 Raum: TU BH349

## Hauptvortrag EP 6.1 Sa 14:00 TU BH349

**History of cosmic rays, solar variability and climate forcing derived from cosmogenic radionuclides.** — •Jürg Beer — EAWAG, Überlandstrasse 133, Postfach 611, CH-8600 Duebendorf

Cosmogenic radionuclides are produced continuously by the interaction of cosmic rays with the atoms of the Earth*s atmosphere. Their production rate reflects changes in the intensity of the GCR flux penetrating into the atmosphere. The GCR flux is subject to changes caused by e.g. nearby supernova explosions, heliomagnetic, and geomagnetic modulation. After production cosmogenic radionuclides behave differently depending on their geochemical properties. $^{14}C$ forms $^{14}CO_2$ and starts exchanging between atmosphere, biosphere and ocean. A small part of it gets built into tree rings where it is stored for many millennia. $^{10}Be$, on the other hand, becomes attached to aerosols and is removed from the atmosphere mainly by dry deposition within 1-2 years. Some of it gets incorporated into snowflakes and, subsequently, is stored in polar ice sheets which are formed layer by layer.

As a consequence measurements of cosmogenic radionuclides in well dated polar ice cores and tree rings offer the unique opportunity to derive information about changes in the cosmic ray intensity over the past 50 000-100 000 years. Although the interpretation of the measured signal in terms of the different production and transport processes is not straight forward, the data obtained so far are consistent with independent reconstructions of the geomagnetic dipole moment and reveal new insights into the long-tern history of solar variability and its potential influence on climate change. The last decades are characterized by high solar activity and there is growing evidence that solar forcing plays an important role in the pre-industrial period.

EP 6.2 Sa 14:45 TU BH349

**A heliospheric hybrid model: hydrodynamic plasma flow and kinetic cosmic ray transport** — •Klaus Scherer[1] and Stefan Ferreira[2] — [1]Institut fr̈ Astrophysik und Extraterrestrische Forschung der Universitẗ Bonn, Auf dem Hügel 71, D-53121 Bonn — [2]Unit for Space Physics, School of Physics, North-West University, 2520 Potchefstroom, South Africa

On the interaction of the solar wind and the interstellar environment not only low energy charged particles, like solar wind and interstellar protons, as well as neutral gas, i.e. hydrogen, take part, but also the pressure of high energy particles, like galactic cosmic rays, influence the dynamic of the heliospheric structure. Moreover, an additional high energy component is create at the termination, the anomalous cosmic rays, which are accelerated pickup ions. The latter are build by charge exchange processes by the solar wind protons and the inflowing interstellar hydrogen. The plasma processes of these interaction have been described by a hydrodynamical five fluid model, where the high energetic particles have been also treated as a fluid. On the other hand, the transport of cosmic rays, as well as the acceleration of the anomalous component have been described by kinetic models, which at best have used the input of a plasma model. Now we have combined both models selfconsistently: the hydrodynamic description of the protons, hydrogen and pick up ions, together with the kinetic modeling of the galactic and anomalous cosmic rays. This allows us also to dynamically model the solar cycle influences on the propagation and acceleration of high energy particles in the heliosphere. We present first results.

EP 6.3 Sa 15:00 TU BH349

**Cosmic Ray Modulation in an Asymmetrical Heliosphere** — •Ulrich Langner[1], Thorsten Borrmann[1], Horst Fichtner[1], and Marius Potgieter[2] — [1]Institut für Theoretische Physik IV: Weltraum- und Astrophysik, Ruhr-Universität Bochum — [2]North West University, Campus Potchefstroom, South Africa

With the approach of the solar wind termination shock by the Voyager spacecraft the need for a more realistic self-consistent heliospheric cosmic ray modulation model has become more urgent. In this light our previous two-dimensional solar wind termination shock model which was used to simultaneously demonstrate the heliospheric modulation for various galactic and anomalous species was extended to include an arbitrarily shaped heliospheric outer modulation boundary. In this work the model is used with an asymmetrically bounded heliosphere. Energetic particles are described kinetically using the Parker transport equation. The model includes the solar wind termination shock, drifts, adiabatic energy changes, diffusion, convection, and a heliosheath. This model was used to describe differences between the modulation solutions of a symmetrical and an asymmetrical heliosphere. The solutions are shown for solar minimum and moderate maximum conditions for both heliospheric magnetic field polarity cycles. These simulations can be of use for future missions to the outer heliosphere and beyond.

EP 6.4 Sa 15:15 TU BH349

**Die großskalige Struktur der Heliosphäre und des lokalen interstellaren Mediums unter Einfluß der Galaktischen Kosmischen Strahlung** — •Thorsten Borrmann und Horst Fichtner — Bochum, Ruhr-Universität Bochum

Die Modellierung der Struktur der Heliosphäre auf großen Skalen, hat in den letzten Jahren deutliche Fortschritte gemacht. Von puren Flüssigkeitsmodellen für die Protonen und den neutralen Wasserstoff, in welchem noch die Pick-Up Ionen und Kosmischen Strahlen eingebunden wurden, bis hin zu magnetohydrodynamischen Modellen. Trotzdem sind die vorhandenen Modelle noch nicht in der Lage eine realistische dreidimensionale Heliosphäre zu beschreiben, in der mehrere Teilchenpopulationen miteinander wechselwirken. Wir informieren über eine neue Modellrechnungen, die auf dem ZEUS-3D Code basieren . Basierend auf einer vollen dreidimensionalen hydrodynamischen Beschreibung der Heliosphäre werden Ergebnisse vorgestellt, welche die Protonenpopulation, die Wasserstoffpopulation als auch den Einfluß der Galaktischen Kosmischen Strahlung als Wechselwirkungspartner berücksichtigen. Zusätzlich werden Resultate gezeigt, welche die Auswirkungen auf die Struktur der Heliosphäre durch einen vorgegebenen Sonnenzyklus als auch durch Konfigurationsänderungen am LISM zeigen.

EP 6.5 Sa 15:30 TU BH349

**Time-dependent energetic neutral atom fluxes from the heliosheath** — •Klaus Scherer and Hans-Jörg Fahr — Institut für Astropphysik und extraterrestrische Forsachung der Universität Bonn, Auf dem Hügel 71, 53121 Bonn

In the heliospheric interface energetic neutral atoms (ENA's) are produced, which can be used to remotely investigate this highly interesting, but poorly known region, improving our knowledge of the interaction between the interstellar medium and the solar wind in the Outer Heliosphere. Not only, ENAs produced in the heliosheath by the charge exchange processes between shocked solar wind protons and interstellar hydrogen are observed with a spacecraft at Earth, for example the upcoming IBEX mission. But there is a contribution from the decharging of pickup ions and from the supersonic solar wind protons inside the termination shock. here we will discuss on the basis of of the five-fluid Bonn model the time-dependent ENA fluxes that are connected with these three sources and compare them. We will show that the ENA fluxes from the heliosheath dominate at low energies in nearly all directions over the background contribution, while for higher energies the changes to disentangle the background contributions are in the up- and downwind direction at specific periods of the solar activity cycle.

EP 6.6 Sa 15:45 TU BH349

**Variability of the Nitrogen Abundance in the Solar Wind and Implications for Past Solar Activity** — •Robert F. Wimmer-Schweingruber[1], Peter Bochsler[2], Peter Wurz[2], George Gloeckler[3,4], Johannes Geiss[5], Reinald Kallenbach[5], and Thomas H. Zurbuchen[4] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Leibnizstr. 11, Kiel, 24118 Germany — [2]Physikalisches Institut,, University of Bern, Sidlerstr. 5, Bern, 3012 Switzerland — [3]Dept. of Physics, University of Maryland, College Park, MD 20742 United States — [4]University of Michigan, 2455 Hayward St., AOSS, Ann Arbor, MI 48109 — [5]International Space Science Institute, Hallerstr. 6, Bern, 3012 Switzerland

The abundance of nitrogen in the heliosphere is an enigma. Laboratory analysis of lunar soils shows that trapped nitrogen is overabundant in them by about one order of magnitude relative to all noble gases, which in turn are efficiently trapped in the lunar regolith. On the other hand, the Solar Wind Ion Mass Spectrometer (SWIMS) on ACE has successfully measured the elemental abundance of nitrogen in the solar wind, N/O $\approx 0.121 \pm 0.014$, in good agreement with the photospheric value of N/O $\approx 0.123$ and with the SEP-dervied coronal value. In this work we determine the abundance ratio N/Ne and investigate the variability of N/O and of N/Ne in the solar wind from 1998 to 2004. The ratios N/O and N/Ne are consistent with a constant value throughout this period of dramatically changing solar activity.

EP 6.7 Sa 16:00 TU BH349

**Diamagnetic solar wind ions and their influence on the MHD termination shock conditions** — •Hans Fahr and Klaus Scherer — Institut für Astrophysik und Extraterrestrische Forschung

At heliospheric distances covered by the VOYAGER spaceprobes at present it not only is of interest to study the changing particle environments but as well to study changes in the interplanetary magnetic fields. In this respect it is interesting to recognize the up to now forgotten fact that hot ions, especially ions of the pick-up ion type, act in a diamagnetic form on the local magnetic fields by partly compensating the local frozen-in magnetic field due to diamagnetic magnetic moments. We consider this effect in detail and analyse the effect this plasma diamagnetism has on the MHD shock relations considered to be valid at the solar wind termination shock. As it turns out we derive a magnetic field compression ratio which, depending on upstream Alfvenic and sonic Mach numbers of the solar wind flow, differ substantially from the predictions given by the classical MHD shock relations. This new fact may naturally explain why at the most recently claimed shock passage of VOYAGER-1 a change of the particle environments was detected as claimed by the classical theory, but nearly no change in the magnetic field magnitude was found.