EP 14: Poster Sonne und Heliosphäre

Time: Wednesday 16:30–19:00 Location: Poster.V

EP 14.1 Wed 16:30 Poster.V

Numerische Simulation von Teilchendiffusion in turbulenten Plasmen — •Felix Spanier[1], Martina Wisnieswski[1] und Ralph Kissmann[2] — [1]Lehrstuhl für Astronomie, Uni Würzburg, Emil-Fischer-Str. 31, 97074 Würzbzrg — [2]Institute of Astro and Particle Physics, Leopold Franzens Universität Innsbruck Technikerstraße 25, A-6020 Innsbruck, Österreich

Der Transport geladener Teilchen in turbulenten Magnetfeldern ist relevant für das Verständnis kosmischer Strahlung und solarer energetischer Teilchen. Für beide Fälle wird der Transport dominiert durch die Streuung der Teilchen an magnetischen Irregularitäten eines Hintergrundplasma. Jokipii hat 1966 die quasilineare Theorie als theoretisches Model vorgestellt, das vereinfachende Annahmen über die Turbulenz und die Bewegung der Teilchen macht. Auch nachfolgende Theorien können sich von diesen Beschränkungen nicht vollständig lösen, da das zu Grunde liegende Problem eine hohe mathematische Komplexität aufweist. Der natürliche Weg aus diesem Dilemma besteht in der Verwendung numerischer Simulationen, wie z.B. von Qin et al. (2002) vorgestellt wurden. Allerdings wurden auch in diesen Modellen künstliche Turbulenzmodelle verwendet.

In dem hier vorgestellten Ansatz wird ein hybrider Lösungsweg vorgestellt, der einerseits eine direkte Simulation von Turbulenzspektren verwendet, andererseits aber auch die Bahnen geladener Teilchen in diesem Plasma verfolgt. Hier soll neben den Ergebnissen für solare energetische Teilchen auch auf die speziellen Probleme dieses Ansatzes und die Unterschiede zur quasilinearen Theorie eingangen werden.

EP 14.2 Wed 16:30 Poster.V

The 'step feature' of suprathermal ion distributions in the solar wind — Horst Fichtner[1] and •Hans Fahr[2] — [1]Ruhr-Universität Bochum — [2]Universität Bonn

The discussion of exactly which process is causing the preferred build-up of v^{-5}- power law tails of the velocity distribution of suprathermal particles in the solar wind is still ongoing. Criteria allowing one to discriminate between the various suggestions that have been made would be useful in order to clarify the physics behind these tails. With this study we draw the attention to the so-called step feature of the velocity distributions and offer a criterion that allows one to distinguish between those scnearios that employ velocity diffusion, i.e. second-order Ferm processes, which are prime candidates in the present debate. With an analytical approximation to the self-consistently obtained velocity diffusion coefficient, we solve the transport equation for suprathermal particles. The numerical simulation reveals that this form of the diffusion coefficient naturally leads to the step feature of the velocity distributions. This finding favours – at least in regions of the appearance of the step feature, i.e. for heliocentric distances up to about 11 AU – the standard velocity diffusion as a consequence of the particle's interactions with the plasma wave turbulence as opposed to that caused by velocity fluctuation-induced compressions and rarefactions.

EP 14.3 Wed 16:30 Poster.V

On Cosmic Ray Modulation in the Heliosheath and beyond the Heliopause — •Klaus Scherer[1], Horst Fichtner[1], DuToit Strauss[2], Stefan Ferreira[2], MArius Potgieter[2], and Hans-Jörg Fahr[3] — [1]Institut für Theoretische Physik IV, Ruhr-Universität Bochum, D-44780 Bochum, Germany — [2]Centre for Space Research, North-West University, 2520 Potchefstroom,South Africa — [3]Argelander Institute, Universität of Bonn, D-53121 Bonn, Germany

Two of the paradigms in modeling the transport of galactic cosmic rays are that the modulation boundary is the heliopause and that the local interstellar spectra are identical to the galactic cosmic ray spectra. Here we demonstrate, that the proton spectrum is already modulated, due to an altered interstellar diffusion in the outer heliosheath as a consequence of the heliospheric "obstacle" in the interstellar flow. The main modulation effect however is adiabatic energy losses during a "confinement time" of cosmic rays inside the heliosphere. Additionally, we show that the anomlaous cosmic rays diffuse beyond the heliopause and contribute to the galactic cosmic ray spectrum in the lower energy range.

EP 14.4 Wed 16:30 Poster.V

A stochastic approach to heliospheric propagation — •Andreas Kopp[1,2], Roelf Du Toit Strauss[2], Ingo Büsching[3,2], and Marius S. Potgieter[2] — [1]IEAP, Christian-Albrechts-Universität zu Kiel, Leibnizstrasse 11, 24118 Kiel, Germany — [2]Centre for Space Research, North-West University, Potchefstroom, 2520, South Africa — [3]Theoretische Physik, Lehrstuhl IV, Ruhr-Universität Bochum, 44780 Bochum, Germany

A newly developed numerical code is presented that solves general Fokker-Planck type transport equations by means of stochastic differential equations (SDEs) in four dimensions (space and momentum) and time. Besides propagation the code is capable of describing the full diffusion tensor as well as particle sources and linear loss terms. The approach was to design the code very general and flexible, so that it can be applied to a large variety of physical problems. Adaption to graphics cards within the CUDA framework significantly improves the performance. Here, we present applications to the propagation of energetic particles, in particular to Jovian electrons, in the heliosphere. Our results can be shown to be consistent with previous models and, moreover, to provide additional informations not accessible for traditional finite-difference approaches.

EP 14.5 Wed 16:30 Poster.V

Evidence for Jupiter's 10 h Periodicity in the Jovian Electron Spectrum at 1.2 AU From the Planet — Phillip Dunzlaff, •Bernd Heber, Andreas Klassen, and Andreas Kopp — Institut für Experiementelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

SSince the Pioneer 10/11 mission, Jupiter is known as a dominant and almost constant source of MeV electrons in the inner heliosphere. This picture has been confirmed later by the flybys of the Voyager 1/2 and Ulysses spacecraft. An interesting feature of the Jovian electron source is the fact that Jupiter's rotation period ($\sim$ 10 h) can frequently be recovered in the energy spectrum of Jovian electrons in the vicinity of the planet. However, these modulation has never been convincingly reported to exist well beyond $\sim$0.5 AU upstream from the planet. In order to search for the 10 h modulation in the heliosphere, we re-examined Ulysses data for the second Jupiter flyby using the Lomb-Scargle spectral analysis. From day 143 to day 147 of 2004, when Ulysses was 1.2 AU away from the planet at low latitudes, a 10 h modulation was found when electrons were streaming away from Jupiter, including a so-called Jovian jet on day 145. Here we present the analysis and discuss implications for particle propagation in the IMF.

EP 14.6 Wed 16:30 Poster.V

Self-consistent wave heating of the solar wind and its inclusion into a 3-D MHD model — •Jens Kleimann — Ruhr-Universität Bochum, Germany

The interaction of outward-travelling Alfvén waves with the interplanetary medium has been identified as a major heating agent for the solar wind. Past attempts to model this non-linear fluid-wave interaction, which consists of both an accelerating wave pressure gradient and a direct heating by ion-cyclotron dissipation at larger heliospheric distances, have either employed purely radial models, or have condensed the waves' spectral information into one or two single scalar fields. We present first results of our recent attempts to self-consistently include this interaction into a numerical 3-D MHD solar wind model, which ultimately aims at the study of transients such as coronal mass ejections. We follow the waves' spectral shape as the system settles into a configuration reminiscent of solar minimum conditions. Questions and problems related to the model's extension to more than one spatial dimensions are discussed.

EP 14.7 Wed 16:30 Poster.V

STEREO observations of unusual wide-spread SEP events — •Nina Dresing[1], Raúl Gómez-Herrero[1], Andreas Klassen[1], Bernd Heber[1], Yulia Kartavykh[2,3], and Wolfgang Dröge[2] — [1]IEAP, University of Kiel, Germany — [2]Institut für Theoretische Physik und Astrophysik, University of Würzburg, Germany — [3]Ioffe Physical-Technical Institute, St. Petersburg, Russian Federation

With the end of 2009 after the prolonged solar minimum of cycle 23 solar activity finally increased. The meanwhile well separated STEREO

spacecraft in combination with further observers located at L1 provide a unique platform to investigate the longitudinal spread of solar energetic particle (SEP) events at 1 AU. Several event showing longitudinal particle distributions larger than 100 degrees have been observed. Some extreme cases even show energetic particle spreads almost all around the Sun as the January 17, 2010 or the November 3, 2011 SEP events. While large longitudinal SEP distributions are commonly explained by the existence of a large CME driven shock, events with an almost 360 degree spread are hardly described by only one overall process. The unusual wide-spread multi-spacecraft observations will be presented and discussed in terms of source mechanisms and particle transport through the interplanetary medium.

EP 14.8 Wed 16:30 Poster.V

Neutron monitor measurements of the cosmic ray maximum at the end of solar cycle 23 — •Christian Steigies[1], Karl-Ludwig Klein[2], Nicolas Fuller[2], and Rolf Bütikofer[3] — [1]Christian-Albrechts-Universität zu Kiel, Germany — [2]Observatoire de Paris, France — [3]University of Bern, Switzerland

During the unusually long solar minimum at the end of solar cycle 23 the cosmic ray intensities as measured by several ground-based neutron monitor stations reached record intensities. In this presentation we study the long term evolution of neutron monitor data which is made available via the neutron monitor database (www.NMDB.eu). NMDB currently holds real-time data and historical data from neutron monitors in Europe and several other countries. This study takes into account the variation of cutoff rigidities at the different stations and possible other effects such as a change of the barometric coefficients for the pressure correction of neutron monitor data.

EP 14.9 Wed 16:30 Poster.V

A High-Energy Telescope for Solar Orbiter Mission: Initial Results of Prototype of High-Energy Telescope — •Jan Grunau, Shrinivasrao R. Kulkarni, Cesar Martin, Robert F. Wimmer-Schweingruber, Stephan Boettcher, Eckart Böhm, Lars Seimetz, Björn Schuster, Alexander Kulemzin, and Toni Krüger — IEAP, University of Kiel, Leibnizstrasse 11, Kiel, D-24118, Germany

The High-Energy Telescope (HET) on ESA's Solar Orbiter mission, will measure electrons from 300 keV up to about 30 MeV, protons from 10 to 100 MeV and heavy ions from approximately 20 to 200 MeV/nuc. Thus, HET covers the energy range which is of specific interest for studies of the space environment and will perform the measurements needed to understand the origin of high-energy events at the Sun which occasionally accelerate particles to such high energies that they can penetrate the Earth's atmosphere and be measured at ground level (ground-level events). These measurement capabilities are reached by a combination of solid-state detectors and a scintillator calorimeter which allows use of the dE/dx vs total E technique for particle identification and energy measurement. The upper limits on energy listed above refer to particles (ions) stopping in the scintillator and careful modeling of HET properties will allow discrimination of forward/backward penetrating particles in a wider energy range. Here we will present initial calibration results of the HET prototype and compare them with GEANT4 simulations.

EP 14.10 Wed 16:30 Poster.V

Development of a beam deflector for the Kiel solar wind laboratory — •Jan Kristoffer Appel, Lauri Panitzsch, Thies Peleikis, Jan Steinhagen, and Robert Wimmer- Schweingruber — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts- Universität, Kiel

The Kiel solar wind laboratory will be used for calibrating space flight instrumentation for solar wind studies and for studying solar wind interaction with matter, e.g. regolith. For that purpose, two different target vacuum chambers are needed to allow testing flight hardware in space conditions and still allow for relatively dusty matter interaction experiments. To switch the ion beam between the two vacuum chambers, an electrostatic beam deflector is needed. A method for simulating ion trajectories inside such a deflector is presented and some simulation results are shown. From these results, the properties and construction of the final deflector design are derived and presented. In order to later quickly assess the beam properties to be expected, the transfer matrix of the deflector can be used. A method for deriving the transfer matrix from simulation data is shown and the predicted beam properties are compared to simulation results.

EP 14.11 Wed 16:30 Poster.V

Ionenoptik und Abschätzung der Strahlenbelastung am Beschleunigungsrohr des Kieler Sonnenwindlabors — •Jan Steinhagen, Jan Appel, Lauri Pantitzsch, Thies Peleikis und Robert Wimmer-Schweingruber — Institut für Experimentelle und Angewannte Physik, CAU Kiel

Die extraterrestrische Abteilung der Universität zu Kiel richtet zur Zeit ein Sonnenwindlabor ein, das die Möglichkeit bieten soll, für die Messung von Sonnenwindteilchen konstruierte, satellitengestützte Messinstrumente zu kalibrieren. Dazu werden hochgeladene Teilchen in einer ECR-Ionenquelle erzeugt und über zwei Beschleunigungsstrecken auf Sonnenwindenergie gebracht.
Die wesentliche Beschleunigung erfolgt dabei über einen elektrostatischen Linearbeschleuniger. Hierbei ist eine genaue Kenntnis von Form und Stärke der herrschenden elektrischen Felder Voraussetzung für die Simulation von Teilchenbahnen, die es letztendlich ermöglicht, den Strahlengang zu optimieren und so eine entsprechende Strahlqualität zu gewährleisten. Neben den technischen und physikalischen Gesichtspunkten müssen auch Sicherheitsaspekte berücksichtigt werden. Bei Betrieb entstehen Sekundärelektronen im Restgas, die in die entgegengesetzte Richtung beschleunigt werden und beim Auftreffen auf den Wänden Röntgenstrahlung erzeugen.
Eine genaue Abschätzung der Strahlenbelastung und die Ergreifung von eventuellen Schutzmaßnahmen ist somit unabdingbar und lässt sich ebenfalls mit Hilfe der gewonnenen Simulationsergebnisse abschätzen. Der aktuelle Stand dieser Untersuchungen soll vorgestellt werden.