EP 7: Sonne und Heliosphäre

Zeit: Donnerstag 8:30–10:30 Raum: G.10.02 (HS 9)

EP 7.1 Do 8:30 G.10.02 (HS 9)

Variations of ^{14}C around AD 775 and AD 1795 – due to solar activity — •Ralph Neuhäuser and Dagmar L. Neuhäuser — AIU, U Jena, Schillergäßchen 2, 07745 Jena, Germany

The strong ^{14}C increase in data with 1-yr time resolution in the AD 770s (e.g. Miyake et al. 2012) is still a matter of debate. In the last three millenia, there were two more strong rapid rises in ^{14}C – around BC 671 and AD 1795. All three ^{14}C variations are embedded in similar evolution of solar activity, as we can show with various solar activity proxies; secular evolution of solar wind plays an important role. The rises of ^{14}C – within a few years each – can be explained by a sudden strong decrease in solar modulation potential leading to increased radioisotope production.

For the AD 770s, we critically review all known oriental and occidental aurora reports from AD 731 to 825 and find 39 likely true aurorae. There were two aurorae in the early 770s observed near Amida (now Diyarbakır in Turkey near the Turkish-Syrian border). which were not only red, but also green-yellow – being at a relatively low geo-magnetic latitude, they indicate a relatively strong solar storm. However, it cannot be argued that those aurorae (geo-magnetic latitude 43 to 50°) could be connected to solar super-flares causing the ^{14}C: There are several reports about low- to mid-latitude aurorae at 32 to 44° in the 760s and 790s in China and Iraq – always without ^{14}C peaks.

EP 7.2 Do 8:45 G.10.02 (HS 9)

Improved ^{3}He/^{4}He isotope separation in EPHIN data based on simulations — •Cedric Berndt, Sascha Banjac, Bernd Heber, and Patrick Kühl — Institut für Experimentelle und Angewandte Physik, Universität Kiel, 24118 Kiel, Germany

Abstract. In order to improve the separation of helium isotopes ^{3}He and ^{4}He measured by the Electron Proton Helium Instrument (EPHIN) aboard the Solar and Heliospheric Observatory (SOHO), we used Monte Carlo simulations to understand the instrument's response to incoming particles. The identification of different isotopes is based on the dE/dx-E-method. For an ideal telescope with the energy loss ΔE much smaller than the energy E: $\Delta E * E \propto Z^2 * m * \Delta x$. Herein Z, m are the charge and mass of the particle and Δx the path length in the detector. In order to separate isotopes form each other, it is mandatory to know Δx with a high precision and to correct for a non-ideal telescope. Our simulations allow to determine the above mentioned effects and have been used to develop a correction method and thus improve the resolution significantly. Furthermore, we examine the ratio of the aforementioned isotopes during solar events and in the cosmic background using this new method.

EP 7.3 Do 9:00 G.10.02 (HS 9)

The chemical composition of galactic cosmic rays during solar minimum of solar cycle 20/21 - Helios E6 results — •Johannes Marquardt, Bernd Heber, Malte Hörlöck, Patrick Kuehl, and Robert Wimmer-Schweingruber — Christian-Albrechts-Universität zu Kiel

Helios 1 and 2 were launched in December 1974 and January 1976, respectively. They both explored the inner heliosphere to distances of less than 0.3 AU from the Sun. The University of Kiel experiment on board the solar probe Helios measured high energy charged cosmic ray particles of solar, planetary and galactic origin. The cosmic ray telescope consists out of five semiconductor detectors, one Cerenkov and one scintillation counter. Electrons with energies between 0.3 and 4 MeV, protons and heavier nuclei up to neon with energies of more than 1.3 MeV/nucleon can be separated. Here we present the chemical composition of galactic cosmic rays during the minimum period of solar cycle 20 and 21 from launch in 1974 to the end of 1977.

EP 7.4 Do 9:15 G.10.02 (HS 9)

Forbush decreases associated to Stealth Coronal Mass Ejections — •B Heber[1], D. Galsdorf[1], C. Herbst[1], P. Kuehl[1], C. Wallmann[1], M. Dumbovic[2], B. Vršnak[2], A. Veronig[3], M. Temmer[3], C. Moestl[3], and S. Dalla[4] — [1]Christian-Albrechts-Universität zu Kiel — [2]Hvar Observatory, Faculty of Geodesy, University of Zagreb — [3]Kačićeva 26, HR–10000 Zagreb, Croatia [3]*Institute of Physics/Kanzelhöhe Observatory, University of Graz, Austria* — [4]*Jeremiah Horrocks Institute, University of Central Lancashire, Preston, PR1 2HE, UK*

Interplanetary coronal mass ejections (ICMEs) are structures in the solar wind that are the counterparts of coronal mass ejections (CMEs) at the Sun. It is commonly believed that enhanced magnetic fields in interplanetary shocks and solar ejecta as well as the increased turbulence in the solar wind sheath region are the cause of Forbush decreases (FDs). Stealth CMEs i.e. CMEs with no apparent solar surface association have become a subject in recent studies of solar activity. Whether all of such stealth CMEs can drive a FD is difficult to investigate on the basis of neutron monitor NM measurements because these measurements not only reflect the GCR intensity variation in interplanetary space but also the variation of the geomagnetic field as well as the conditions in the Earth atmosphere. Single detector counter from spacecraft instrumentation exceed counting statistic of NMs allowing to determine intensity variation of less than 0.1% in interplanetary space. Here we present the ongoing analysis and a simple model that qualitatively describes the FDs associated to such MC.

EP 7.5 Do 9:30 G.10.02 (HS 9)

Nahe-relativistische Elektronenanstiege an In-Situ-Schocks im interplanetaren Raum — •Solveig Theesen, Nina Dresing, Bernd Heber und Andreas Klassen — IEAP Universität Kiel, Deutschland

In der Sonnenkorona und im interplanetaren Raum existieren eine Vielzahl an Aktivitäten, die für Teilchenbeschleunigung sorgen können. So können Teilchen beispielsweise an einer Stoßwelle eines koronalen Massenauswurfes (CME) oder an den Stoßwellen von korotierenden Wechselwirkungsregionen (CIR) beschleunigt werden. In-situ-Protonen-Messungen von Raumsonden zeigen häufig sogenannte Shock-Spikes zum Zeitpunkt einer Schockpassage, die lokal-beschleunigte Protonen markieren. Um herauszufinden, ob auch Elektronen effektiv an Schockfronten auf nahe-relativistischen Energien beschleunigt werden können, wurden In-situ-Messungen der SEPT-Instrumente auf den beiden STEREO-Sonden im Zeitraum von 1.1.2007 bis 31.12.2012 untersucht. Mit einer Schockliste, die die genauen Zeitpunkte der Stoßwellen an den Sonden angibt (Jian et al., 2009), konnten die Intensitäten von Protonen und Elektronen zu dem jeweiligen Schockzeitpunkt untersucht werden. Die Ereignisse wurden dementsprechend in verschiedene Klassen unterteilt um eine Statistik zu erstellen und Ereignisse mit echten Elektronenanstiegen herauszufiltern. Hierbei musste vor allem das Problem einer möglichen Ionenkontamination in den Elektronenkanälen des SEPT-Instruments beachtet werden. Die Statistik zeigt an, dass in nur $< 2\%$ der Fälle schockbeschleunigte Elektronen gemessen werden konnten.

EP 7.6 Do 9:45 G.10.02 (HS 9)

Generating energetic electrons during solar flares — •Gottfried Mann — Leibniz-Institut fuer Astrophysik Potsdam, An der Sternwarte 16, D-14482 Potsdam

A flare is defined as an sudden enhancement of the emission of electromagnetic radiation of the Sun covering a broad range of the spectrum from the radio up to the gamma-ray range. That indicates the generation of energetic electrons during flares, which are considered as the manifestation of magnetic reconnection. According to this model, the inflow region of the reconnection region is separated from the outflow one by pairs of slow mode shocks. At them, the magnetic field energy is efficiently annihilated and transfered into a strong heating of the outflow plasma leading to the generation of energetic electrons as needed for the hard X-ray radiation at large flares.

The slow mode shocks are studied in terms of the Rankine-Hugoniot relationships. Especially, the jump of the temperature and the magnetic field across the shock is evaluated to study the heating of the plasma in the outflow region. The resulting fluxes of energetic electrons in the outflow region are calculated in a fully relativistic manner. Due to the strong heating of the plasma at the slow mode shocks, enough electrons with energies > 30keV are generated in the outflow region as required for the hard X-ray radiation. The theoretically obtained fluxes of energetic electrons agree well with those as measured by RHESSI during large flares.

EP 7.7 Do 10:00 G.10.02 (HS 9)

Dissipation Model for Solar Wind Turbulence by Kinetic

Alfvén Waves at Electron Scales — •Anne Schreiner and Joachim Saur — Universität zu Köln, Köln, Deutschland

Similar to fluids and gases on Earth, magnetic fluctuations in the solar wind develop characteristic turbulent features. In contrast to hydrodynamic fluids, the solar wind is not dominated by direct collisions. Hence, particle collisions can not be responsible for dissipation of turbulent energy and particle heating. To reveal the physical mechanisms of the dissipation process in solar wind turbulence, we develop a model that describes magnetic energy spectra at the electron scales. Our model combines the energy transport process from large to small scales and collisionless damping processes, which extract energy from the magnetic fluctuations in the kinetic regime. We assume wave-particle interactions to be the main damping process and focus on the role of kinetic Alfvén waves. Therefore, we include the imaginary part of the kinetic Alfvén wave frequency as a damping rate. We find that damping by kinetic Alfvén waves can explain the observed quasi-exponential shape of magnetic spectra in the dissipation range. Our dissipation model provides the possibility to investigate the influence of different damping rate processes and varying solar wind parameters on the dissipation range.

EP 7.8 Do 10:15 G.10.02 (HS 9)

Incorporating Turbulence Transport in the CRONOS MHD Framework — •Tobias Wiengarten and Horst Fichtner — Theoretische Physik IV, Ruhr-Uni Bochum

We will present recent advances in extending our state-of-the-art MHD code CRONOS to account for a description of the solar wind turbulence levels. The equations for these small-scale fluctuations are coupled with those for the large-scale solar wind quantities. Therefore, a self-consistent treatment of turbulence generation (e.g. via shear streams) on the one hand, and of solar wind heating via dissipation of turbulence on the other hand, is introduced. We validate our implementation by comparing with previous models before applying the model to CMEs. Our model provides the essential parameters required for Cosmic Ray transport models in the heliosphere.