EP 12: Near-Earth Space II

Time: Thursday 15:45–17:15 Location: ZEU/0160

Invited Talk EP 12.1 Thu 15:45 ZEU/0160

Ultra-relativistic Electrons in the Earth's Van Allen Radiation Belts — •Yuri Y. Shprits[1,2,3], Hayley Allison[1], Nikita Aseev[1], Dedong Wang[1], and Alexander Drozdov[3] — [1]Department of Geophysics, German Research Center for Geociences, GFZ, Potsdam, Germany — [2]Institute of Physics and Astronomy, University of Potsdam, Germany — [3]Department of Earth, Planetary, and Space Sciences, UCLA

New measurements from the NASAs Van Allen Probes demonstrate that the Earth radiation belts cannot be considered as a bulk population above approximately electron rest mass, but ultra-relativistic electrons form a new population that shows a very different morphology and behavior. We show that acceleration to multi-MeV occurs locally due to energy diffusion by whistler mode waves. Local heating appears to be able to transport electrons in energy space from 100s of keV all the way to ultra-relativistic energies. Acceleration to such high energies occurs only for the conditions when cold plasma in the trough region shows extreme depletions. The difference between the loss mechanisms at MeV and multi-MeV energies is due to EMIC waves that can very efficiently scatter ultra-relativistic electrons but leave MeV electrons unaffected. We also present how the new understanding can be used to produce the most accurate data-assimilative forecast. Under the recently funded EU Horizon 2020 Project Prediction of Adverse effects of Geomagnetic storms and Energetic Radiation (PAGER), we will study how ensemble forecasting from the Sun can produce long-term probabilistic forecasts of the radiation environment.

EP 12.2 Thu 16:15 ZEU/0160

Magnetospheric formation processes of the diffuse aurora: Sensitivity of wave-induced electron scattering to the hot electron distribution — •Katja Stoll[1,2], Leonie Pick[1], Dedong Wang[3], and Yuri Shprits[2,3,4] — [1]DLR Institute for Solar-Terrestrial Physics, Neustrelitz, Germany — [2]University of Potsdam, Potsdam, Germany — [3]GFZ Potsdam, Potsdam, Germany — [4]University of California, Los Angeles, CA, USA

Resonant wave-particle interactions in the Earth's magnetosphere can lead to the scattering of plasma sheet electrons which in turn cause the optical phenomenon of diffuse aurora. Specifically, electrostatic electron cyclotron harmonic (ECH) waves can effectively precipitate hundreds of eV to tens of keV electrons into the upper atmosphere. This process can generally be treated as a diffusion problem, requiring the numerical calculation of bounce-averaged quasi-linear diffusion coefficients.

ECH waves are thought to be generated by the loss cone instability of the ambient hot electron distribution. Therefore, the determination of ECH wave-induced scattering rates requires information about the properties of the hot plasma sheet electrons responsible for the wave excitation. We report our progress on analysing the sensitivity of ECH wave-induced electron scattering effects to the temperature of the hot electron components, which has an influence on the growth rate of the waves.

EP 12.3 Thu 16:30 ZEU/0160

Measurements of cosmic rays by a mini neutron monitor aboard the German research vessel Polarstern. — •Bernd Heber[1], Sönke Burmeister[1], Hanna Giese[1], Konstantin Herbst[1], Lisa Romaneehsen[1], Carolin Schwerdt[2], Dutoit Strauss[3], and Michael Walter[2] — [1]Christian-Albrechts-Universität Kiel, D — [2]Deutsches Elektronen-Synchrotron DESY in Zeuthen, D — [3]Center for Space Research, NWU Potchefstroom, SA

Neutron monitors are ground-based devices that measure the secondary particle population, i.e., neutrons produced by, e.g., galactic cosmic rays (GCRs). Due to their functionality, they are integral counters whose flux is proportional to the variation of the input spectrum. However, the measured flux also depends on the geomagnetic position and the pressure at the monitor's location. To better understand the NM response regular monitoring of the GCR intensity as a function of latitude is needed. Therefore a portable NM was installed aboard the German research vessel Polarstern in 2012. The vessel is ideally suited for this research campaign because it covers extensive geomagnetic latitudes (i.e., goes from the Arctic to the Antarctic) at least once per year. Since the installation aboard the vessel, 12 latitude scans were performed, allowing us to compute the so-called yield function by experimental means presented in this contribution.

The Kiel team received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 870405. The team would like to thank the crew of the Polarstern and the AWI for supporting our research campaign.

EP 12.4 Thu 16:45 ZEU/0160

Yield function of the DOSimetry TELescope (DOSTEL) count and dose rates aboard an aircraft — •Lisa Romaneehsen, Hanna Giese, Bernd Heber, Konstantin Herbst, and Sönke Burmeister — Christian-Albrechts-Universität Kiel

The Earth is continuously exposed to galactic cosmic rays. The magnetized solar wind in the heliosphere and the Earth's magnetic field alters the flux of these particles. If cosmic rays hit the atmosphere, they can form secondary particles. The total flux measured within the atmosphere depends on the atmospheric density above the observer. Therefore, the ability of a particle to approach an aircraft depends on its energy, the altitude, and the position of the plane. The cutoff rigidity describes the latter.

The radiation detector of the detector system NAVIDOS (NAVIgation DOSimetry) is the DOSimetry Telescope (DOSTEL), measuring the count and dose rates in two semiconductor detectors. From 2008 to 2011, two instruments were installed in two aircraft. First, we corrected the data for pressure variation by normalizing them to one flight level and determined their dependence on the cutoff rigidity by fitting a Dorman function to the observation. The latter was used to compute the yield function, which describes the ratio of incoming primary cosmic rays, approximated by a force field solution, to the measured count and dose rate for a particular instrument.

We received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 870405.

EP 12.5 Thu 17:00 ZEU/0160

Development of a plasmapause model derived from Van-Allen-Probe data and IMAGE RPI data via automatic detection — •Daniela Banyś[1], Joachim Feltens[1,2], Norbert Jakowski[1], Mainul Hoque[1], Rene Zandbergen[3], and Werner Enderle[4] — [1]Institute for Solar-Terrestrial Physics, DLR, Germany — [2]Telespazio-VEGA Deutschland GmbH c/o European Space Operations Centre, Germany — [3]European Space Operations Centre, Germany - retired — [4]European Space Operations Centre, Germany

The outer boundary of the plasmasphere, the plasmapause, is characterised by a sharp electron density gradient which changes under varying space weather conditions. With NEPPM (Neustrelitz ESOC Plasmapause Model), we introduce a new model of the plasmapause location Lpp based on electron density measurements made by the Van Allen probes from 2012 to 2016 and the IMAGE satellite from 2000 to 2005 that were automatically processed, yielding an improved performance for plasmapause detection. Applying a dipole based transformation of measurements, NEPPM is described by a simple elliptical approach in the equatorial plane determined by the semi-major axis, the eccentricity, and the orientation angle. The Lpp varies as a function of Dst index and magnetic local time (MLT), resulting in a tighter fit compared to the GCPM (Global Core Plasma Model). The distinctive bulge in the evening hours follows the level of solar activity. By extending the ellipse fitting from the equatorial plane to a 3D approach, the NEPPM also allows non-dipole B vectors, providing 3D positions on the plasmapause torus for given latitude, longitude, epoch and Dst.