EP 1 Magnetosphäre und Ionosphäre

Zeit: Freitag 10:00–12:30 Raum: TU BH349

EP 1.1 Fr 10:00 TU BH349

Anomalous resistivity due to strongly nonlinear waves — •Jörg Büchner — Max-Planck-Institut, für Sonnensystemforschung, Max-Planck-Str.2, 37191 Katlenburg-Lindau

In collisionless plasmas anomalous transport due to the interaction of particles and electromagnetic field fluctuations outweighs the classical direct particle-particle interaction. For almost four decades the quasi-linear theoretical approach of Sagdeev, Dupree and others has dominated the field. Due to the necessarily low excitation level of the fluctuations, necessary in the quasilinear theory, the achieved anomalous transport is often too weak to explain observed dissipative phenomena. In particular we found obtained very high effective collision rates in CLUSTER experiments, which exceed the rates predicted by the quasilinear theory (see Poster by Panov et. al.).

We derived an analysis technique, which allows to consider strongly (as compared to the classical quasi-linear) non-linear wave-particle interactions and to derive the consequent anomalous resistivity for the lower hybrid plasma turbulence.

EP 1.2 Fr 10:15 TU BH349

The Diffusion Mean Free Path Upstream of Earth's Quasi-Parallel Bow Shock — •M. Scholer[1], A. Kis[1], B. Klecker[1], E. Möbius[2], E. A.. Lucek[3], H. Reme[4], J. M. Bosqued[4], L. M. Kistler[2], and H. Kucharek[2] — [1]Max-Planck-Inst. extr. Physik, Garching, Germany — [2]University of New Hampshire, Durham, USA — [3]Imperial College, London, England — [4]CESR, Toulouse, France

We have analyzed a number of diffuse upstream particle events observed by Cluster when the spacecraft separation was between 1 and 1.5 Earth radii. The spatial gradient of the partial ion densities parallel to the magnetic field has been determined in several energy bands as a function of distance from the bow shock. For the events investigated the e-folding distance increases with decreasing solar wind speed. Assuming that upstream diffusion is balanced by downstream convection we can determine the spatial diffusion mean free path as a function of energy. Since the mean free path is proportional to the e-folding distance and proportional to the solar wind speed the mean free path is approximately independent of solar wind velocity. We have also determined the magnetic field power spectra during these upstream events and compare the spatial development of the power spectra with distance from the shock with the spatial development of the energetic particle density.

EP 1.3 Fr 10:30 TU BH349

Solitary waves in ion-beam plasmas: Application to CLUSTER foreshock observations — •Konrad Sauer and Eduard Dubinin — Max-Planck-Institut für Sonnensystemforschung, 37191 Katlenburg-Lindau, Germany

Hall-MHD solitons have recently been studied in a single-ion plasma with respect to the interpretation of "magnetic holes". In case of oblique propagation to the ambient magnetic field they appear in the "gap region" of the phase velocity versus wavenumber diagram, in which only evanescent waves ($k^2 < 0$) exist. In plasmas with two or more ion populations the picture becomes more complex, and a new type of stationary, nonlinear wave appears which has a soliton-type structure superimposed by spatial oscillations ("oscillitons"). If a beam is present, both types of stationary waves may develop from the linearly unstable configuration. In addition, the soliton/oscilliton profiles may experience significant modifications of their basic structure if one of the wave modes of the multi-ion plasma is in resonance with the nonlinear wave. As consequence, strongly rippled solitary structures may be generated. Analysis of the magnetic field and plasma data from the CLUSTER spacecraft measurements shows that a great variety of coherent wave events can be isolated which seem to belong to different classes of solitary waves found in searching stationary, nonlinear solutions of the Hall-MHD equations of an ion-beam plasma system. It has been found that the polarization of the measured waves is of great significance for their classification. Arc-polarization ,e.g., arises if a "bright" and "dark" soliton merge due to coupling with a beam.

EP 1.4 Fr 10:45 TU BH349

Cluster observations of almost monochromatic whistler wave packets and the mechanism of their formation — •Eduard Dubinin[1], K. Sauer[2], M. Maksimovic[1], N. Cornilleau-Werhlin[3], A. Balogh[4], and D. Fontaine[3] — [1]MPS, Katlenburg-Lindau, Germany — [2]DESPA, Observatoire de Paris, France — [3]CETP/UVSQ, Velizy, France — [4]Imperial College, London, UK

The STAFF-SC measurements on Cluster show that whistler turbulence observed in the distant magnetosphere often consists of almost monochromatic wave packets at frequency of few tenth of electron gyrofrequency. Analysis of mechanism of their formation based on the assumption that these nonlinear coherent structures are oscillatory waves (kind of solitary waves) generated by electron anisotropy or loss-cone distribution is made. It is shown that the main wave characteristics can be understood in the terms of this mechanism.

EP 1.5 Fr 11:00 TU BH349

ESTIMATION OF FIELD-ALIGNED CURRENTS WITH A MULTI-SATELLITE MISSION (*SWARM*) — •Patricia Ritter and Hermann Lühr — GFZ Potsdam, Telegrafenberg, D-14473 Potsdam

The multi-satellite mission *Swarm* is conceived to investigate the dynamics of the Earth's magnetic field and its interaction with the Earth system in unprecedented detail. The instrumentation on board will provide high precision vector data of the electric and magnetic fields. With the planned constellation of satellites at different heights, one at 530 km and two at initially 450 km, the mission is particularly well suited to study the complex current systems of the polar ionosphere. The lower pair shall fly side-by-side separated by only 100 km in E/W direction. This will allow for the first time to determine ionospheric field-aligned currents unambiguously by directly employing the curl-B relation.

As part of an ESA-funded science study auroral current systems were generated by a global MHD code of GGCM for different degrees of activity. The new technique is applied to this set of consistent magnetic field and current data. By using realistic satellite trajectories and instrument performances we recovered the field-aligned current distributions from the magnetic field deflections. The agreement between input model and recovered field-aligned currents is satisfying and much improved compared to the single-satellite estimates.

EP 1.6 Fr 11:15 TU BH349

From normal state to magnetic storms in terms of fractal dynamics — •Georgios Balasis[1], Panayiotis Kapiris[2], and Konstantinos Eftaxias[2] — [1]GeoForschungsZentrum Potsdam, Telegrafenberg, D-14473, Potsdam, Germany — [2]Faculty of Physics, University of Athens, Panepistimiopolis, Zografos, 15784 Athens, Greece

By monitoring the temporal evolution of fractal spectral characteristics in D_{st} time series we find distinctive symptoms indicating the approach to a major magnetic storm: (i) Emergence of long-range correlations. (ii) Gradual increase of the spatial correlation. (iii) Decrease of the fractal dimension with time, indicating strong anisotropy in substorm activity. (iv) Strong anti-persistent behavior in the first epoch of the precursory geomagnetic activity. (v) Decrease of the anti-persistent behavior with time. (vi) Emergence of persistency in the "tail" of the precursory epoch. (vii) Predominance of large geomagnetic events with time coupled with the appearance of higher frequencies in the spectrum. (viii) Significant acceleration of the energy release, i.e., increase of the susceptibility of the system with time. The question whether the evolution towards global instability is inevitable after the appearance of distinctive symptoms is discussed. The results could be studied in terms of "Intermittent Criticality". The analysis suggests that the continuous scale invariance is partially broken into a discrete scale invariance symmetry.

EP 1.7 Fr 11:30 TU BH349

Energy Conversion in the Auroral Magnetosphere — •Octav Marghitu[1,2], Maria Hamrin[3], Berndt Klecker[1], Mats André[4], Stephan Buchert[4], James McFadden[5], and Hans Vaith[1] — [1]Max-Planck-Institut für extraterrestrische Physik, Garching, Germany — [2]Institute for Space Sciences, Bucharest, Romania — [3]Physics Department, University of Umeå, Sweden — [4]Swedish Institute of Space Physics, Uppsala, Sweden — [5]Space Sciences Lab., University of California at Berkeley, USA

The energy dissipated in the auroral ionosphere is believed to come from generator regions located far away in the magnetosphere. Several studies have addressed the auroral generator by using analytical, semi-analytical, and numerical tools. However, in the literature there is a lack of observational investigations of the generator region; for example, to our knowledge, an analysis of the power density, **E**·**J** (with **E** the electric field and **J** the current density vector), is missing.

In this paper we examine conjugated night-side data from the four CLUSTER satellites (in the magnetotail, at an altitude of ∼20 R_E) and the FAST satellite (above the auroral oval, at ∼0.5 R_E). Because of its four simultaneous measuring points, CLUSTER makes possible the complete evaluation of **J**; in addition, we use estimates of **E** from two different instruments, which improves on the reliability of these data. At the same time FAST offers a 'snapshot' over the electron precipitation and energy flux into the ionosphere.

EP 1.8 Fr 11:45 TU BH349

Sehr intensive, kleinskalige feld-parallele Ströme, ihre Eigenschaften und Verteilung in auroralen Breiten — •Martin Rother und Hermann Lühr — GeoForschungsZentrum Potsdam

Das Vektor-Magnetometer des LEO Satelliten CHAMP liefert Messungen mit einer zeitlichen Auflösung von 50 Hz. Diese Daten erlauben es, die Eigenschaften von feld-parallelen Strömen (FACs) bis zu ihren feinsten Skalen (einige 100m) zu untersuchen. Gelegentlich beobachten wir Bursts feinskaliger FACs, deren Amplitude zwei Größenordnungen über dem der groß-skaligen (≈100km) liegen. Die Ereignisse befinden sich bevorzugt in auroralen Breiten auf der Tagseite. Für diese Studien werden Vektordaten von CHAMP aus zwei vollen Jahren, 2002 und 2003, herangezogen. Die berechneten 'FAC' Bursts, mit Schwellwerten und Formkriterien klassifiziert und zu Einzelereignissen zusammengefaßt, werden hinsichtlich ihrer zeitlichen und räumlichen Verteilung, ihres Spektralgehaltes und ihrer Korrelation mit anderen Parametern untersucht. Kleinskalige FACs scheinen eine Rolle zur Erklärung der Temperaturverteilung in und um die Cusp zu spielen. Insbesondere bei den ebenfalls von CHAMP bestimmten und für die Jahre 2002 und 2003 verfügbaren Elektronendichten und abgeleiteten -temperaturen werden die Zusammenhänge in einer Superposed Epoch Analyse über der magnetischen Breite und der Lokalzeit herausgearbeitet.

EP 1.9 Fr 12:00 TU BH349

Strong Disturbance of the Upper Thermospheric Density due to Magnetic Storms: CHAMP Observation — •Huixin Liu and Hermann Lühr — GFZ Potsdam, Telegrafenberg, 14463 Potsdam

Strong enhancement of the upper thermospheric total mass density was observed by the CHAMP satellite at about 400 km altitude during three geomagnetic super storms occurring on October 29-30, 2003, October 30-31, 2003, and November 20-22, 2003. The corresponding density enhancement reached about 400 percent, 500 percent, and 800 percent of the quiet-time values in both noon and midnight sectors. The disturbance showed strong day-night and seasonal asymmetry. On the dayside, the average density enhancement was stronger in summer than in winter. This applies to the density enhancement expressed both in absolute (storm-quiet) and in percentage (storm-quiet/quiet) terms. On the nightside, however, no general rule can be drawn about the seasonal effect. Stronger density enhancement occurred in the summer hemisphere during the second and third storm events, but in the winter hemisphere during the first storm event. The relative intensity of the disturbance between day and night depends on the term we choose to describe it. When expressed in absolute terms, the density enhancement on the nightside was generally less than half of that on the dayside during all three storms. But the enhancement expressed in percentage terms on the nightside was comparable to or even larger than that on the dayside. The propagation of the disturbance from high to low latitudes was slower on the nightside in comparison to the dayside, The MSIS90 model was unable to reproduce most of the observed features during these storms.

EP 1.10 Fr 12:15 TU BH349

Eigenschaften und Verteilung von Plasmainstabilitäten in der ionosphärischen F-Schicht — •Hermann Lühr, George Balasis und Martin Rother — GeoForschungsZentrum Potsdam

Auf seinem niedrigen Orbit durchquert der Satellit CHAMP häufig Gebiete mit stark schwankender Plasmadichte. Diese Gebiete sind nicht nur wegen der Prozesse zu ihrer Erzeugung von Interesse, sondern neuerdings auch wegen der Störungen, die sie in der satellitengestützten Navigation erzeugen. Besonders markant sind in diesem Zusammenhang die lokalen Dichtelöcher, bekannt unter dem Namen Plasma Bubbles. Bei ihnen beobachtet man Dichteabfälle von mehr als zwei Zehnerpotenzen über Skalenlängen von wenigen 10 Kilometern. Mit CHAMP konnte erstmalig gezeigt werden, dass mit den Plasma Bubbles auch Magnetfeldsignaturen verbunden sind. In erster Näherung wird der fehlende Plasmadruck durch einen zusätzlichen Magnetfelddruck kompensiert. Als aufsteigende Strukturen erzeugen die Bubbles auch elektrische Felder. Diese treiben Alfven-Wellen an, die sich entlang der Feldlinien ausbreiten. Basierend auf ca. drei Jahren von CHAMP Beobachtungen zeigen wir die statistische Verteilung dieses Phänomens in geographischer Länge und Breite und in der Lokalzeit. Es wird auch auf die jahreszeitliche Abhängigkeit eingegangen.