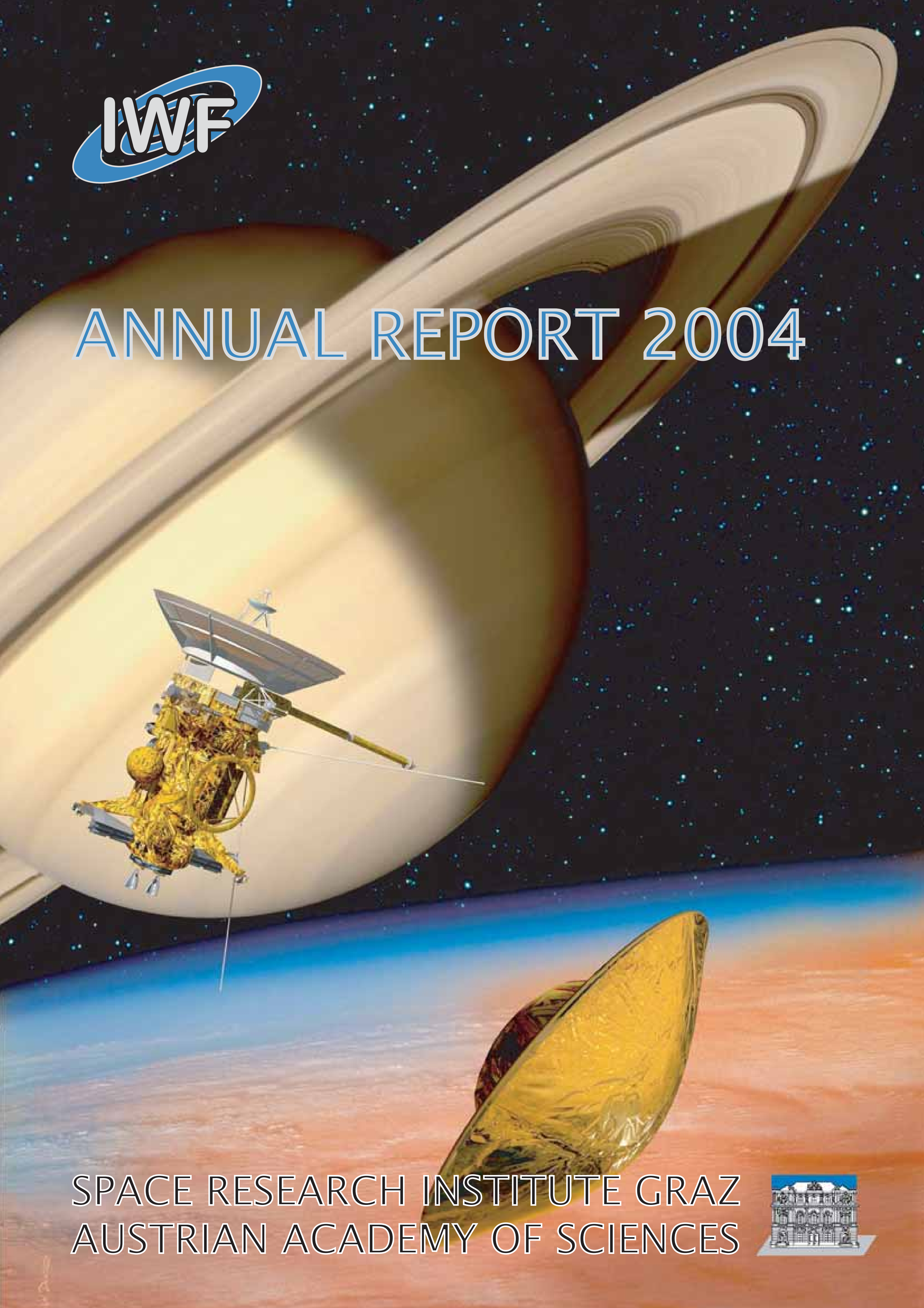
IWF

ANNUAL REPORT 2004



SPACE RESEARCH INSTITUTE GRAZ
AUSTRIAN ACADEMY OF SCIENCES

ANNUAL REPORT 2004

SPACE RESEARCH INSTITUTE GRAZ
AUSTRIAN ACADEMY OF SCIENCES

Institut für Weltraumforschung
Österreichische Akademie der Wissenschaften
Schmiedlstraße 6
8042 Graz, Austria
Tel.: +43 316 4120-400
Fax: +43 316 4120-490
pr.iwf@oeaw.ac.at
www.iwf.oeaw.ac.at

Cover Image:

On 25 December 2004 the *Cassini* Orbiter has released the *Huygens* probe towards its target: Saturn's largest moon Titan with its dense atmosphere (see p. 20, Photo: ESA).

Table of Contents

1 Introduction 1

2 Solid Earth 3
- 2.1 Gravity Field 3
- 2.2 Geodynamics 5

3 Near-Earth Space 9
- 3.1 Missions 9
- 3.2 Physics 11

4 Solar System 15
- 4.1 Sun 15
- 4.2 Mercury 16
- 4.3 Venus 17
- 4.4 Mars 18
- 4.5 Jupiter 20
- 4.6 Saturn and Titan 20
- 4.7 Comets 22
- 4.8 Exoplanets 23

5 Engineering & Testing 25
- 5.1 Test Facilities 25
- 5.2 New Instruments 27

6 Publications & Talks 29
- 6.1 Refereed Articles 29
- 6.2 Proceedings & Book Chapters 32
- 6.3 Books & Special Issues 34
- 6.4 Other Publications 34
- 6.5 Invited Talks 35
- 6.6 Oral Presentations 36
- 6.7 Posters 40
- 6.8 Co-Authored Presentations 42

7 Teaching & Workshops 47
- 7.1 Lecturing 47
- 7.2 Theses 47
- 7.3 Science Meetings 48
- 7.4 Project Meetings 48
- 7.5 Public Outreach 48

8 Personnel 49

1 Introduction

The Space Research Institute (Institut für Weltraumforschung, IWF) of the Austrian Academy of Sciences (Österreichische Akademie der Wissenschaften, ÖAW) understands itself as a focus of Austrian space activities. It cooperates closely with space agencies all over the world, with universities located in Graz, and with numerous other national and international institutions. A particularly intense cooperation exists with the European Space Agency (ESA). IWF participates in various interplanetary missions as well as in missions dedicated to the exploration of our own planet Earth and its neighborhood:

- *Cassini/Huygens* arrived at Saturn in July 2004 and is now exploring the Saturnian system.
- *Cluster*, the first four-spacecraft mission ever flown, is exploring the space-time structure of the terrestrial magnetic field and the magnetospheric plasma in unprecedented detail.
- *Envisat's* radar altimeter is being calibrated by an IWF transponder system at a cross-over site on the Greek island Gavdos.
- *Mars Express* will search for the existence of subsurface water on Mars by an on-board radar system.
- *Double Star*, the first European-Chinese space mission, will corroborate the *Cluster* mission. The equatorial satellite was launched in December 2003, the polar satellite in July 2004 (Fig. 1.1).
- *Rosetta*, launched in March 2004, will investigate the coma and the nucleus of comet 67P/Churyumov-Gerasimenko. For the first time a soft landing on a cometary nucleus will be tried.

Fig. 1.1: Double Star 'Tan Ce 2' satellite was successfully launched on 25 July 2004.

- *Venus Express* will investigate the atmosphere and ionosphere of the Earth's nearest planetary neighbor, Venus. Its launch is planned for October 2005.
- *COROT* will search for extra-solar planets and analyze the oscillation modes of stars.
- *GOCE* will determine the structure of the terrestrial gravitational field to better understand the Earth's interior, to map ocean currents, and to contribute to a unification of regional height systems.
- *THEMIS* will fly five identical microsatellites to probe the causal relationship in the chain of processes called magnetospheric

substorm and the origin of auroral phenomena.

- *BepiColombo* will investigate in detail the innermost planet Mercury, using two orbiters: one with instruments specialized for magnetospheric studies and the other for remote sensing of the planet.

Highlights in 2004 were clearly the launches of *Rosetta* in March (Fig. 1.2) and of the second *Double Star* satellite TC-2 in July. Together with the two IWF instruments put into orbit on *Double Star* TC-1 at the very end of 2003, eight instruments with hardware built in Graz have been successfully tested in space and commissioned for scientific operation during this year.

Fig. 1.2: Rosetta was launched aboard an Ariane 5 G+ rocket on 2 March 2004.

The institute, of course, is also very much engaged in analyzing data from these and other space missions. This analysis is supported by theory, simulation, and laboratory experiments. Moreover, at the Lustbühel Observatory in Graz, one of the most accurate laser ranging stations of the world is operated. Its data are used to determine the orbits of more than 30 satellites. Also located at Lustbühel Observatory is a system of antennas used to test new radiowave equipment. Finally, a network of nine permanent GPS stations is operated by IWF to monitor geodynamical movements in Austria and its vicinity.

IWF is structured into three departments:

- Experimental Space Research
  (Head: Prof. Dr. Wolfgang Baumjohann)
- Extraterrestrial Physics
  (Head: Prof. Dr. Helmut O. Rucker)
- Satellite Geodesy
  (Head: Prof. Dr. Hans Sünkel)

Its managing director is Prof. Dr. Wolfgang Baumjohann.

The bulk of financial support for our research comes from ÖAW. Substantial support is also provided by other national institutions, the Austrian Research Promotion Agency (Österreichische Forschungsförderungsgesellschaft, FFG), the State of Styria, the Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung, FWF), and by the Austrian Academic Exchange Service (Österreichischer Akademischer Austauschdienst, ÖAD) and its partner institutions in other countries. Last but not least, European institutions like ESA and the European Union contribute substantially.

2 Solid Earth

Understanding the dynamics of the solid Earth is critical for developing an interconnected view of Earth science. Experiments conducted over the past decade have shown that it is possible to study the dynamic behavior of the Earth from space. Satellite-based measurements are among the most practical and cost-effective techniques for producing systematic data sets, over a wide range of spatial and temporal scales.

For example, the precise knowledge of the Earth's gravity field and its time variations, based on ongoing dedicated satellite missions, can contribute to the detection and better understanding of the mechanisms leading to the building of the Earth's crust and the flow of ocean currents. The repeated precise determination of the station coordinates via GPS and Satellite Laser Ranging leads to the determination of a velocity field changing in time, giving us clues about the driving forces and the energy transport in the Earth's interior.

2.1 Gravity Field

Gravitation, the universal force of attraction exists between all mass particles in the universe. Its resultant on the Earth's surface forms the gravity field of the Earth, which is the direct response to its interior mass density distribution and the centrifugal force caused by its rotation. The inhomogeneous distribution of mass in the Earth's interior, the slightly ellipsoidal flattened shape of the rotating Earth, and the ruggedness of the topography are the main causes for irregularities in a global gravity field map of the Earth.

This gravity field shapes a virtual surface at mean sea level called the geoid. This is the surface of equal gravity potential of a hypothetical ocean at rest in its first approximation, and serves as the classical reference for all topographical features. The accuracy of its determination is important for surveying, geodesy, oceanography and solid Earth physics alike e.g. for the unification of height systems, the study of physical and dynamical processes in the Earth's interior, the modeling of large scale ocean circulation, and monitoring ice motion and sea-level changes.

Fig. 2.1: Pre-flight model of the GOCE satellite at ESA.

GOCE

The satellite gravity mission *GOCE* (Gravity field and steady-state Ocean Circulation Explorer), the first core mission of ESA's Living Planet Programme, strives for a high-accuracy, high-resolution model of the Earth's static gravity field. *GOCE* (Fig. 2.1) is based on a sensor fusion concept: the satellite's orbit information is exploited applying satellite-to-satellite tracking in high-low mode (hl-SST) using GPS, delivering the long and medium wavelengths of the Earth's gravity field, while satellite gravity gradiometry (SGG) will provide its detailed structure. Scheduled launch of *GOCE* is August 2006.

Processing Facility

The project "*GOCE* High-Level Processing Facility" (HPF) is an assignment by ESA for the installation of a de-centralized operable software system for the official scientific processing of *GOCE* data. This work is done by the European *GOCE* Gravity Consortium, a cooperation of 10 European research institutions. In the framework of the HPF, the *GOCE* team Graz will be responsible for the implementation of an operable software system for the processing of *GOCE* data into a high-accuracy, high-resolution gravity field model.

In the framework of this challenging project, the *GOCE* team Graz, which is a close co-operation of IWF with the Institute of Navigation and Satellite Geodesy of the Graz University of Technology (TUG), will lead the computation of the *GOCE* gravity field model based on the time-wise approach.

Two strategies will be used to compute the *GOCE* geoid model, a direct, rigorous solver approach, which solves the huge linear equation systems using parallel software and hardware facilitating "Scientific Supercomputing" on a PC cluster of TUG, as well as a fast "approximative" solution strategy, which is shortly described in the next section.

Gravity Field Analysis

An efficient way to handle the *GOCE* type normal equation systems is the so-called semi-analytic approach. In this method a block-diagonal approximation of the very large normal equation matrix is used, and Fast Fourier Transform (FFT) techniques are employed for an extremely fast solving. The Quick-Look Gravity Field Analysis (QL-GFA) tool is based on this method, and its purpose is to analyze sets of SGG and hl-SST data, in order to derive a fast diagnosis of the *GOCE* system performance, by detecting potential distortions of statistical significance (e.g. systematic errors) in the input data, and to give a fast feedback to *GOCE* mission control. In this context, QL-GFA will play a dual role: It will check the reasonability of the input SGG and hl-SST data and detect potential insufficiencies before the data are incorporated into the rigorous processing. It will provide important information about the noise characteristics of the SGG time series, which can be checked against the *GOCE* error power spectral density (PSD). Thus it will be used as prior information for the design of optimum filters for the rigorous solver.

QL-GFA solutions (Fig. 2.2) consist of spherical harmonics up to order 250. This requires the solution of a normal equation system composed of ~63,000 parameters describing the Earth's gravity field. The processing can be accomplished within one hour on a standard PC. At this point the development of the software is in a final stage.

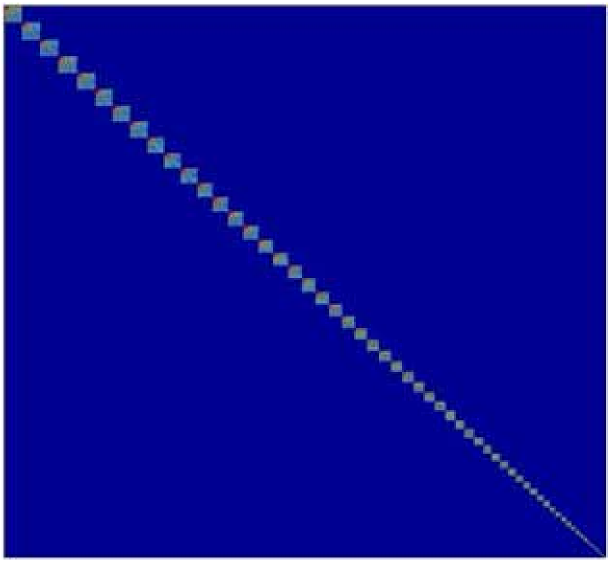


Fig. 2.2: The block-diagonal normal equation matrix used within the QL-GFA tool. Only the small blocks along the diagonal are non-zero which is approx. less than 0.1% of elements compared to the full system.

Also, it is known that other gravity field dedicated missions are already in orbit, such as *CHAMP* and *GRACE*. Possible ways of combining the data from these missions are being investigated with the ultimate goal of a high power gravity field computation.

2.2 Geodynamics

Disaster prevention is one of the most important challenges nowadays. Satellite Geodesy disposes of very precise coordinates for terrestrial points, continuous information on the sea level as well as real time data for weather forecast and climate research. The final aim is to compute velocity vectors, to develop hazard indicators for geodynamic changes, to monitor sea surface changes in coastal regions, and to contribute to real time weather data services and climate research.

Reference Frames

The steady update of the coordinates of selected global terrestrial stations (International GPS Service IGS; Austria: Graz and Hafelekar) and the European Network EUREF (Austria: Graz, Hafelekar, Pfänder, Salzburg, Trafelberg) gives the representation of a timely varying frame of millimeter accuracy which allows for the derivation of velocities and their changes in space and time. Prerequisite is the permanent operation of these stations and the weekly computation of precise coordinates.

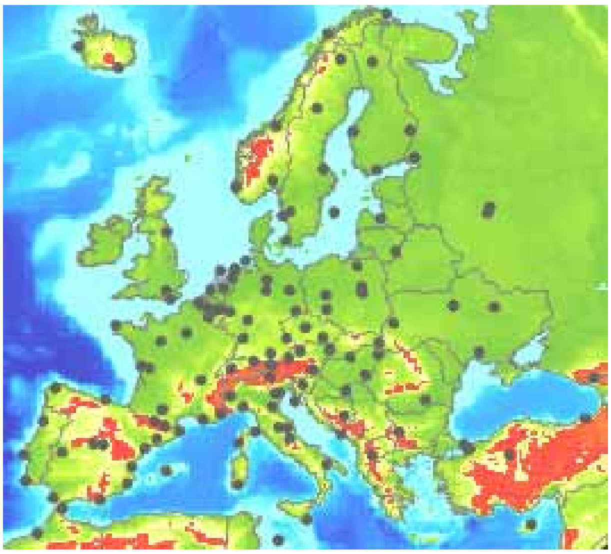


Fig. 2.3: Current EUREF station distribution.

Graz acts as the data center for all Austrian stations, mirrors the EUREF data center in Frankfurt and computes weekly coordinates of about 60 European stations (Fig. 2.3).

ISDR

The project ISDR (International Strategy of Disaster Reduction) provides a part of the required funding for maintaining and updating the Austrian station array which was established jointly with the Federal Office for Metrology, Vienna (Fig. 2.4).

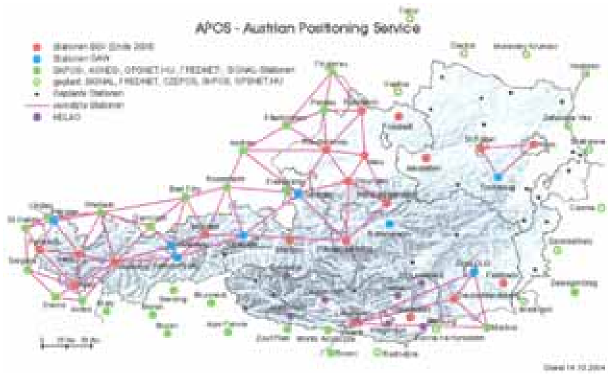


Fig. 2.4: Austrian network as of 2004.

The demand for real time data access required the installation of new receivers at some sites to reduce the delay time. Seasonal horizontal displacements of up to 2 cm at Hafelekar, Innsbruck were investigated and found to be a local effect which has to be eliminated for regional geodynamic research with millimeter accuracy.

CERGOP-2/Environment

The aim of this project is the establishment, maintenance and monitoring of a reference frame for current geodynamic research and later hazard mitigation.

Local investigations in seismic active regions of Eastern Europe supplement the overall objectives. The final output is a time-varying velocity field to be used as a backbone for geodynamic research during the next six years, i.e., allocation of sudden velocity changes for explaining the nature of the underlying forces and the energy transfer leading to seismic events and earthquakes. Thirteen countries covering 15% of the European area, combined in the Central European Initiative (mainly the central and east-European region) contribute to this project coordinated by the institute.

Considerable progress has been made, e.g.:

- Continuation of permanent measurements and station update
- Establishment of a data base in Graz for storing all data, results, and reports
- Finalization of the computation of the first CEGRN-2003 campaign
- Establishment of a pilot station scheme: monitoring of station time series and landslides
- Investigation of the security of CEGRN stations (monument stability, interferences, communication)
- Local campaigns in Bulgaria, Romania, Slovenia, and Slovakia
- Building up new stations in Romania, Italy, Slovakia, and Ukraine.

Austria contributed to the installation of a new station in Costanta (Romania) with hard- and software (Fig. 2.5) and established close contacts to the Bulgarian Academy of Sciences and the university in Sarajevo.

Fig. 2.5: Tide gauge station in Constanta.

GAVDOS

Gavdos combines different space geodetic techniques in order to establish a European radar altimeter calibration and monitoring site for *Jason-1*, *Envisat* and *EURO-GLOSS* on the Greek island of Gavdos.

One of the techniques used for altimeter calibration is satellite altimetry in combination with a dedicated ground-based microwave transponder belonging to IWF. End of 2003 we deployed the transponder on Gavdos at a crossover point of the *Jason-1* spacecraft which is about 4 km away from *Envisat's* ascending ground track.

Fig. 2.6: Transponder site at the Jason-1 crossover point on Gavdos.

Different approaches for data analysis for both satellites were investigated, but for the *Jason-1* data none of them showed clear transponder signals which are essential for a precise range computation. Therefore, it was decided to concentrate on *Envisat*, the analysis of which showed clear transponder signatures. Based on these so-called waveforms extensive analyses were performed as well as post-processing methods to correct the raw data in order to compute absolute slant ranges and consequently the altimeter calibration parameters.

During 2004 also some station upgrades were performed, i.e., the installation of solar panels to ensure a reliable power supply (Fig. 2.6). Some complementary GPS campaigns were carried out on Gavdos and the precise ellipsoidal height of the site necessary for the altimeter instrument calibration was determined. The transponder has been programmed for the upcoming satellite passes covering the next six months and will be kept operational beyond the official term of the *Gavdos* project for further scientific studies according to an agreement with the project partners.

Satellite Laser Ranging

The kHz satellite laser ranging system in Graz: This new satellite laser ranging system is fully operational since October 2003. During the last year several parts of the system were optimized in order to ensure both a stable and accurate ranging operation. The result of this ongoing effort can be seen in Fig. 2.7, which shows the average number of returns per normal point (NP). The SLR station Graz now measures more than three times the returns from *Lageos-1* as all other (40) SLR stations combined.

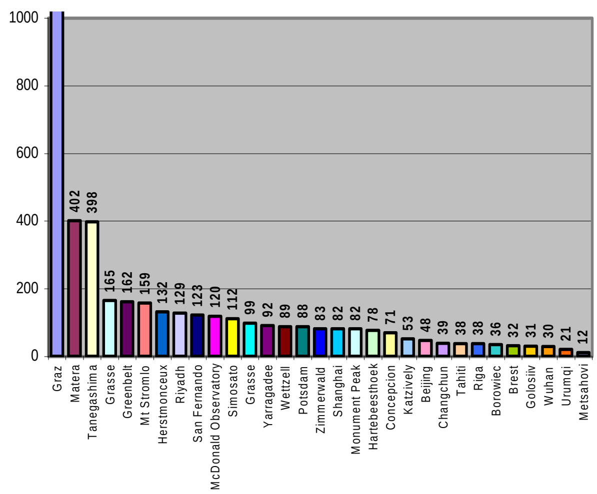


Fig. 2.7: Lageos-1, 2004: more than 10,000 average points/NP in Graz (only 10% of Graz bar plotted).

For satellites at lower altitudes, the difference between the new 2 kHz results of Graz and the other 10 Hz SLR stations is even higher. From *Envisat*, *ERS-2*, and other Earth-observation satellites an almost 100% return quote is reached. The increase in efficiency is simply given by the ratio of the repetition rates (2000 Hz versus 10 Hz).

For high orbiting satellites like *GPS-35* this is not so obvious due to the distance and small retro panels of the spacecraft. Only about 50% of all SLR stations are able to detect returns from *GPS-35* – some of them only during night time measurements. Although the laser energy per pulse is only 400 µJ (about 100 times less compared to the other 10 Hz stations), measurements to *GPS-35* during day and night time bring more returns than at any other SLR station. This increase of the number of single shots per NP results in a much better definition and accuracy of these NPs, with a theoretical accuracy far below the 1 mm level. These new circumstances allow improved statistics for each NP-bin (the time interval to represent the satellite position by means of statistically found representative measurements) such as the definition of the mean reflection points or the center-of-mass corrections (CoM) for each bin. These new prospects are especially useful for satellites with significant signatures, like *Lageos*. This is just an excerpt of major improvements of the kHz laser, but not at all the end of a long list of advantages, resulting from kHz repetition rates, DPSSL (Diode Pumped Solid State Lasers) and short laser pulses (10 ps in Graz).

Detecting single corner cubes of a retro-reflector: The kHz laser system now allows for identifying single retro-reflectors, i.e., individual corner cubes of the laser retro-reflectors for most of the satellites. This identification can be done on the basis of the distribution pattern of the return signals (Fig. 2.8), which is significantly different from the pattern of special satellites, like e.g. the Russian *LaRetC*, *CHAMP*, *GRACE-A* and *GRACE-B*, which have been designed specifically with only 1 retro being active at any time.

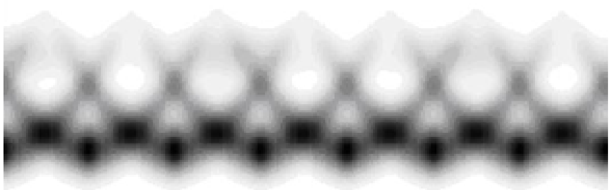


Fig. 2.8: ERS-2 simulated return signal pattern (David Arnold).

A full 360° simulation of single photon reflections from the *ERS-2* retros (Fig. 2.9) was made. The CoM correction of the returns is not constant, but shows a variation of about 4 mm (oscillation of the bottom edge of simulation in Fig. 2.8) strictly according to the geometry of the retros. These CoM variations can now be measured, modeled and applied as corrections to achieve real mm accuracy.

Fig. 2.9: ERS-2 retro-reflectors.

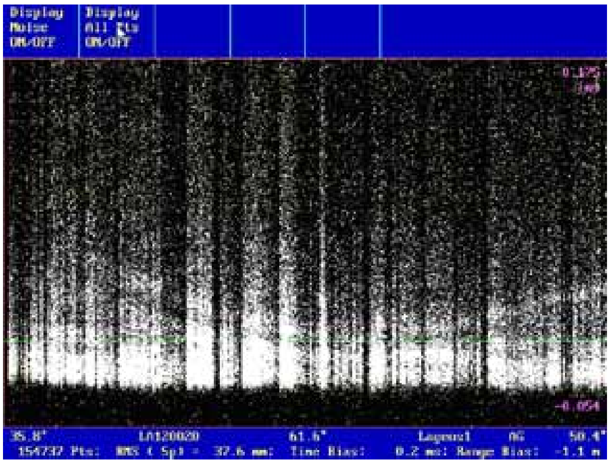


Fig. 2.10: Lageos-1 retros clearly visible.

Such single retro reflections were investigated for *ERS-2*, *Envisat*, *Starlette*, *Stella*, *GFO*, etc. Very clear, rather complex patterns were observed from the retro rings of *Topex/Poseidon* and even single retros were detected from the spherically shaped *Lageos-1* satellite (Fig. 2.10). The latter is only possible because *Lageos-1*, which is in orbit since 1976, has nearly stopped its rotation. Consequently, such patterns are not visible from *Lageos-2* returns, since this spacecraft is in orbit since 1992 and still rotating.

3 Near-Earth Space

The physics of the Earth's space environment is dominated by the interaction between the solar wind and the terrestrial magnetic field. The structures that are created in this interaction are the bow shock, in which the supersonic solar wind is decelerated, a transition layer called the magnetosheath, the magnetopause (the boundary of the magnetosphere) and the magnetosphere itself, where the magnetic field from the Earth's dipole is dominating, and the ionosphere. In principle all these structures are magnetoplasmas, i.e., electrically charged particles (ions and electrons), where electric and magnetic fields dominate the physical processes.

3.1 Missions

In near-Earth space physics IWF is deeply involved in the *Cluster* mission, which was launched in 2000 and still yields a wealth of new and exciting data. The data from the recently launched *Double Star* mission corroborates the *Cluster* data. In addition, IWF is presently involved in building instruments for another magnetospheric mission, called *THEMIS*.

Double Star

Within the *Double Star Project (DSP)*, two satellites are observing the Earth's magnetosphere on near-equatorial and polar orbits. The equatorial satellite (TC-1) was launched successfully in December 2003, the polar spacecraft followed on 25 July 2004. *DSP* is a joint effort by China and ESA. More than half of the *DSP* payload has been provided by European PIs.

IWF participates in this mission with two experiments, *DSP-ASPOC* to control the electric potential of the equatorial spacecraft, and *DSP-FGM* to measure the magnetic field on both satellites. IWF is also Co-Investigator for the European *PEACE*, *HIA* and *STAFF* instruments and various Chinese experiments. In addition, IWF hosts the European Data Distribution Center for the mission.

Following the successful launch of TC-1, the spacecraft systems, the instruments and the ground segment have been commissioned during January and February. The performance of the spacecraft and the instruments has been reviewed and TC-1 was declared ready to start its nominal operation phase.

The environmental test program with TC-2 was completed in May 2004. A difficult and challenging issue was the magnetic contamination of the spacecraft detected on TC-1. With extreme efforts from the Chinese Academy of Space Technology and with support from European colleagues, the problem has been corrected on TC-2. In June 2004, the TC-2 launcher, spacecraft and ground system were reviewed by the Chinese Space National Administration (CNSA) and ESA and declared ready for shipment to the Taiyuan Satellite Launching Centre south-west of Beijing. After successful launch, the commissioning of both space and ground segments was performed from July through September. In October 2004, TC-2 was declared ready for its nominal operation phase.

Flux-Gate Magnetometer (FGM): Unlike most of the other European instruments for *DSP*, *FGM* has been re-designed to accommodate the ITAR (International Traffic in Arms Regulations) requirements and has been built from scratch. In January 2004, the Flight Model (FM) was delivered to China and was integrated successfully into the TC-2 spacecraft. Until now, both *FGM* on TC-1 and TC-2 are operating nominally.

Active Spacecraft Potential Control (ASPOC): The commissioning of *ASPOC* was carried out in two steps. On 5 January, the covers of the emitter modules were opened, and the instrument was turned on without high voltage for monitoring and check-out of the heater elements and digital electronics. After a three week pause to allow for outgassing on board the high voltage and emitter commissioning was carried out to verify the performance of the emitters and to define the operational parameters for the ion beam and the heaters. All four emitters performed excellently, working well below 6 kV and with 100% efficiency. The routine operation of *ASPOC* started on 23 February. During the first weeks of operation, *ASPOC* was turned on for about 7 hours twice at each orbit. During this period the best heater temperatures and the optimum ion current to control the spacecraft potential were established, based on electron data from *PEACE*. In April 2004 the work pattern was changed to operations throughout every second orbit except during passages through the radiation belts. By 20 November, 2200 hours of active operation had been achieved in 175 sessions, the average beam current being 15 μA.

The control of the spacecraft potential by *ASPOC* leads to a big improvement of the *PEACE* electron data, since the disturbance of the electron measurements by photo-electrons is significantly reduced. Fig. 3.1 shows an energy spectrogram of electrons measured by *PEACE* in the plasmasheet. At 2324 UT, the *ASPOC* ion beam was turned on at 30 μA current and reduced the spacecraft potential by several volts, sufficient to suppress the photo-electrons. Features of the ambient electrons at low energy become visible.

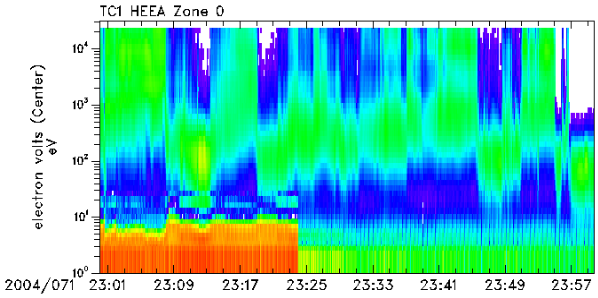


Fig. 3.1: Quicklook data from the electron spectrometer PEACE/TC-1, showing the suppression of photo-electrons after the turn-on of ASPOC at 23:24 UT.

European Double Star Data Distribution System (EDDS): As part of its commitments for *Double Star*, IWF took responsibility for the implementation of a Data Distribution System as a service for the European investigators. *EDDS* operates as the central node for raw data disposition by collecting raw science data from China and by providing an interface for convenient automated or manual data retrieval to the European instrument teams, with some similarities to the *Cluster* data facilities. *EDDS* also operates DSDSweb, providing on-line access to quicklook plots of the latest *Double Star* data (Fig. 3.2).

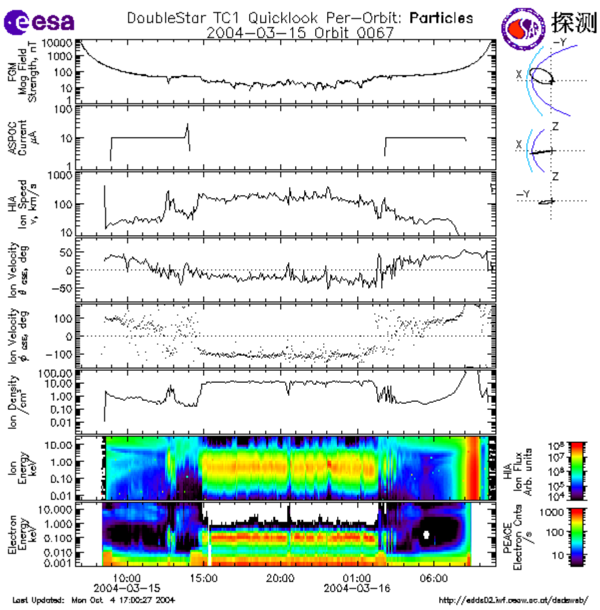


Fig. 3.2: DSDSweb per-orbit particle data page for TC-1 (http://edds02.iwf.oeaw.ac.at/dsdsweb).

Similarly to *EDDS* the *Austrian Double Star Data Center (ADDC)* is the central point for the exchange of the *DSP* standard data products, i.e., the prime parameter (PP) and summary parameter (SP) files, which are spin and minute averaged science data, and various auxiliary parameter files. In particular, *ADDC* is responsible for the production of PP and SP files for *FGM* and *ASPOC* as well as for the generation of a part of the auxiliary parameter files.

THEMIS

THEMIS (Time History of Events and Macroscale Interactions during Substorms) is a NASA mission designed to give the ultimate answer to the long-standing question about the causal relationships in one of the most dynamic chain of processes in the Earth's magnetosphere, the substorm, and to the origin of auroral phenomena. In March 2003 it was selected as the next mission in NASA's Medium-class Explorer (MIDEX) program. *THEMIS* will be launched in autumn 2006 and fly five identical microsatellites through different regions of the magnetosphere.

Fig. 3.3: Test of the magnetometer qualification board at UC Berkeley.

IWF participates in *THEMIS* by providing a magnetometer, which is developed under the leadership of TU Braunschweig. Within the magnetometer team, IWF is responsible for the development of the interface electronics to the instrument processor as well as for the magnetometer calibration, qualification and integration jointly with TU Braunschweig. In early 2004, the development, testing and integration of the qualification unit were successfully finished (Fig. 3.3). Full assembly and calibration of the first two flight units were finished by the end of 2004.

3.2 Physics

A fleet of spacecraft within the terrestrial magnetosphere and in near-Earth interplanetary space, like *Cluster*, *Geotail*, and *Double Star* provides us with an enormous amount of data representing the plasma and magnetic field behavior in this region. Data were analyzed and various theoretical models were developed to describe the physical processes, which are responsible for the formation of structures and phenomena in near-Earth space.

Solar Wind

The solar wind is the main driver for the dynamics of the Earth's magnetosphere. In order to understand which influence the solar wind has, its processes have to be studied. Of great importance are magnetic clouds and turbulence in the interplanetary medium.

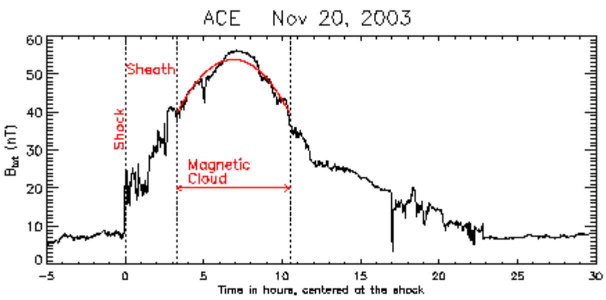


Fig. 3.4: Least square fit (red trace) to the magnetic cloud on 20 November 2003, which caused the largest geomagnetic storm of the present solar cycle.

Magnetic clouds are strong rotational magnetic field structures at mesoscale (fraction of 1 AU). These objects cause strong magnetic disturbances on Earth if they contain a strong southward pointing magnetic field. Key magnetic and plasma parameters can be obtained through a least-squares fitting scheme of data from e.g. *Helios*, *Wind*, *ACE*, *ISEE*, and *IMP*, to a force-free model (Fig. 3.4).

The stand-off distance of the shock driven by fast magnetic clouds is addressed, using a hydrodynamic approach appropriate to our problem. The effect of the Earth's magnetic field is cancelled by a proper calibration curve. Then the thickness of the magnetosheath can be estimated. The evolution of these solar ejecta is also studied with respect to scaling parameters of the field components and aging of the clouds. The structures are studied for several solar cycles, allowing for cross-studies of cycles and dependence on solar cycle phase.

Solar wind turbulence: The non-extensive thermo-statistical properties of solar wind fluctuations were analyzed by fitting bi-kappa distributions to the probability density functions (PDF) of differenced velocity, density and magnetic field data from *ACE* and *Wind*. The experimentally obtained PDFs, for slow solar wind conditions, exhibit strong scale dependence. Nevertheless the fitting procedure involves only one parameter κ.

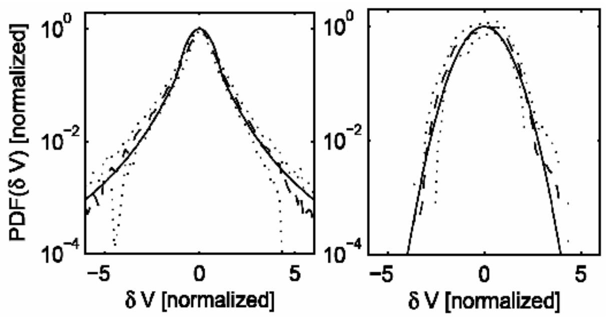


Fig. 3.5: The probability density function of the solar wind velocity magnitude fluctuations (dotted) compared to the bi-kappa function (solid line); left panel: time scale = 0.3 h, κ=2; right panel: time scale = 23 h, $\kappa \to \infty$.

It was found that, strong non-Gaussianity and non-locality are characteristic for correlated, short time-lag solar wind observations, corresponding to small-scale spatial separations (κ=2). For large scales the non-correlated differences turn into a Gaussian normal distribution ($\kappa \to \infty$, Fig. 3.5). Highly correlated, quasi-stationary turbulent conditions characterized by bi-kappa distributions can be regarded as stationary states far from equilibrium where, at a certain nonlinear stage, turbulence may reach a high energy level balanced by turbulent dissipation. It was proposed that equilibrium statistics can be extended to dissipative systems. κ appears to be an ordering parameter accounting for nonlinear and long-range correlations.

Magnetotail

Processes within and driven by the solar wind ultimately find their apotheosis in the dynamics of the Earth's magnetotail. This elongated structure of magnetic field and plasma, behind the Earth with respect to the Sun, intermediately stores energy put in by the solar wind. Any changes in the latter may release the stored energy explosively, with the grandeur of the northern lights, or aurora, as a result.

At IWF, one of the main research areas is the study of this dynamics of the Earth's magnetotail, with special interest in the transport processes. Data from the four *Cluster* satellites are at the center of interest. New theoretical models relevant also to the *Cluster* observations are developed. Combining these results from data analysis and theory gives new insight into magnetotail dynamics.

Cluster traverses the plasma sheet at its apogee from north to south at a radial distance of about 19 R_E. The strength of the four spacecraft is the ability to differentiate spatial from temporal disturbances. During the past three summer seasons in 2001, 2002 and 2003, the tetrahedron scale changed from 2000 km to 4000 km and then 250 km so that processes with different scales can be studied.

Theories on magnetic reconnection: Magnetic reconnection is an essential energy conversion process in the magnetosphere, both at the day side and the night side. During periods of southward interplanetary magnetic field, reconnection is initiated at the day side magnetopause, leading to a connection between the interplanetary and the magnetospheric plasmas. The transported magnetic field lines reconnect in the magnetotail resulting in fast plasma jets and dynamic changes in the magnetotail configuration. One of the essential parameters to understand the reconnection process is the reconnection rate determining the efficiency of this process. A model based on the theory of inverse problems was used to calculate the reconnection rate out of satellite measurements.

In a first step, a two-dimensional model for incompressible plasma was applied, giving satisfying results for the reconstruction of the reconnection electric field and the z-component of the magnetic field observed by *Cluster* in the magnetotail lobe associated with a substorm plasma sheet expansion. The x-component of the fields, on the other hand, was overestimated by the model mainly because of the incompressibility of the plasma in the model. Thus, a two-dimensional model for compressible plasma is under development.

Furthermore, a new theoretical approach based on time-dependent reconnection was applied at the day side to calculate the earthward motion of the magnetopause resulting from each reconnection pulse. It was found that the motion of the magnetopause also leads to a displacement of the bow shock.

Magnetotail current sheet structure: Cluster frequently observes large-amplitude variations of the magnetic field in the magnetotail. These variations, interpreted as up-down oscillation of the current sheet, are known as the current sheet flapping motion. During rapid crossing of the magnetotail current sheet due to flapping motion, the *Cluster* quartet scans the internal structure of the sheet. By applying the gradient/curl estimator technique, using four-point measurements of the magnetic field, the current density distribution within the flapping current sheet was examined. Characteristic scales, such as the flapping amplitude and the sheet half-thickness, were estimated.

Fig. 3.6 shows the distribution of these quantities resulting from the analysis of 78 current sheet crossings during July – October 2001. It was found, that flapping amplitude at geocentric distance ~19 R_E varies between ~0.2 and ~2.0 R_E, and the current sheet half-thickness varies from ~1500 km or several ion thermal gyroradii to 6000 km ~10 ion gyroradii. Both values have a tendency to increase toward flanks.

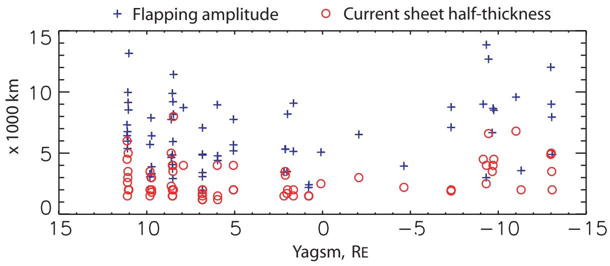


Fig. 3.6: Distribution of the flapping amplitude (crosses) and the current sheet half-thickness versus abberated coordinate $Y_{a,gsm}$=X_{gsm} sin(3.5°)+Y_{gsm} cos(3.5°).

Occurrence of non-Harris current sheets: Recent satellite observations show that the tail current sheets can differ significantly from the theoretical Harris model structure. In order to examine how often such atypical current sheet structures are formed, current densities (j_y) in the neutral sheet and in the off-equatorial region at the same instance were examined statistically. Using two pairs of the *Cluster* satellites, current densities were calculated from the gradient of the magnetic field when the current sheet was relatively thinner than usual, a few times the ion inertial length.

Fig. 3.7 shows the distribution of j_y in the neutral sheet and in the off-equatorial region. The result showed that the ratio between the two frequently deviates significantly from the theoretical Harris ratio shown as the red line. The current density in the neutral sheet is often larger than expected from the Harris model, suggesting that the current is concentrated in the neutral sheet embedded in a lower j_y region. On the other hand, for 17% of the cases j_y in the center becomes lower than j_y in the off-equatorial region. This suggests that the current sheet was bifurcated instead of one peak at the center (neutral sheet).

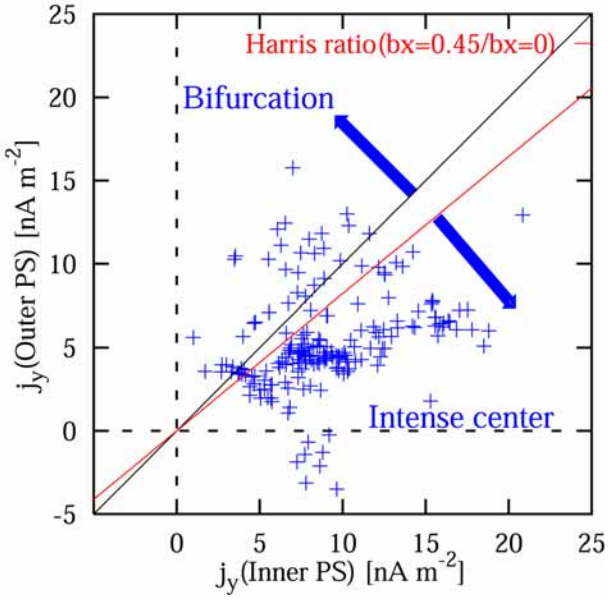


Fig. 3.7: Distribution of the current densities in the neutral sheet (horizontal axis) and in the off-equatorial region (vertical axis) in the magnetotail observed by the 2 pairs of the Cluster satellites.

Thin current sheets: The small scale separation of *Cluster* in 2003 allows determination of the current density using the curlometer technique and examination of the characteristics of thin current sheets with a scale less than the ion inertia length.

An example of two intense current sheet crossings during a substorm on 24 August 2003 is shown in Fig. 3.8. The current densities were more than ~10 times the average values. The profile of j_y shows that in both cases, the current sheet was very thin comparable to the ion inertia length. The current sheet crossing shown at the left (right) panel took place during a fast tailward (Earthward) flow indicating that the spacecraft was located tailward (Earthward) of the reconnection region as is illustrated at the bottom drawing. The profile of j_x is consistent with those near the reconnection region associated with the closure of the Hall-current in the reconnection region.

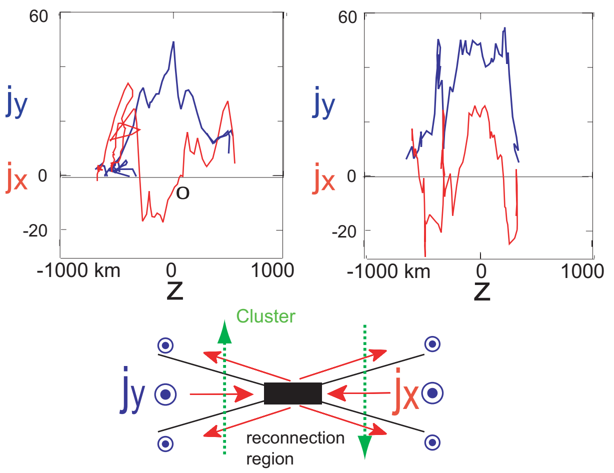


Fig. 3.8: Top two panels show the X (sunward) and Y (dawn-to-dusk) components of the electric current profile determined for two rapid current sheet crossings near the reconnection region. The bottom drawing illustrates how the observed current patterns are likely positioned relative to the reconnection region.

4 Solar System

IWF is engaged in many missions, experiments and corresponding data analysis addressing a multitude of solar system phenomena. The physics of the Sun with the so-called solar wind, its interaction with solar system bodies, and various kinds of planetary atmosphere/surface/subsurface interactions are under detailed investigation.

4.1 Sun

The Sun, our parent star, was observed and investigated as an emitter of radio waves. Additionally specific parts of the complex dynamics within the low solar corona have been modeled and simulated by a magnetohydrodynamic approach.

STEREO

The *SWAVES* experiment onboard the *STEREO* spacecraft will measure the non-thermal radio spectrum originating from the solar environment and ranging from a few kHz up to about 16 MHz. Three orthogonal, 6 m long antennas are capable of direction finding. For an accurate direction finding the receiving properties of the antennas, described mainly by the effective antenna lengths and axes, have to be known. These quantities are significantly changed by the spacecraft body, which makes detailed analyses based on the whole antenna-spacecraft system necessary. Our preliminary studies with a design model show a strong influence of the solar panels and the instrument boom (Fig. 4.1).

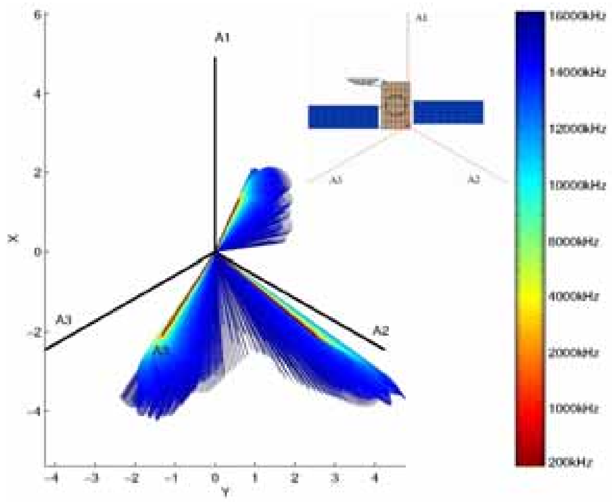


Fig. 4.1: Computed real parts of effective length vectors of SWAVES antennas as a function of frequency; insert: wire-grid model.

Physics

Solar drift pair radio emissions: The Ukranian radio telescope UTR-2 in combination with the institute's digital spectropolarimeter has detected a number of new features in sporadic solar radio emissions. During three days more than 700 solar drift pair bursts were detected with positive (Fig. 4.2) and negative drift rates. Some of their usually similar parameters are different: The absolute average value of the drift rates for negatively drifting bursts is 0.8 MHz/s, while for positively drifting ones it is 2 MHz/s. The obtained functional dependencies "drift rate vs. frequency" and "flux density vs. frequency" are found to be different from current knowledge. Unusual variants of drift pair bursts, so-called "hook" bursts and bursts with fine structure were also observed.

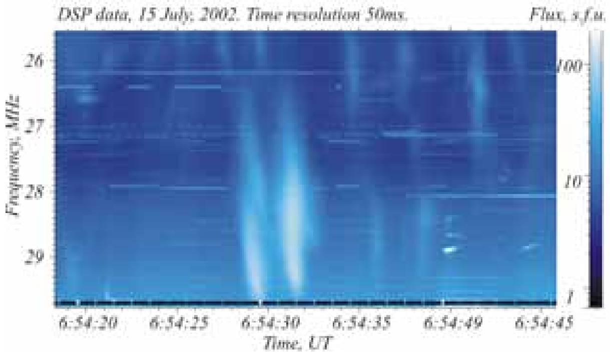


Fig. 4.2: Dynamic spectra of a drift pair burst with positive drift and fine structure.

Solar Type III decametric bursts: Based on Lustbühel radio station observations in the decametric range (from 42 MHz to 30 MHz), it is found that the electron density of the solar corona is in the range from 2.1-1.1 10^{13} m^{-3}. The estimated source height varies between 1.56 and 1.41 solar radii. The study of the frequency drift rates (DR) of Type III bursts requires a combination of measurements and DR empirical models. Direct measurements of Solar Type III DR can be applied to remotely sense the outer part of the solar corona, the key region between the interplanetary medium and the deeper and denser area of the solar corona.

Damping of MHD waves in partially ionized solar plasmas: MHD waves are supposed to play an important role in energy and momentum transport processes in solar plasmas. The heating effect of MHD waves is connected with a dissipation mechanism which converts the energy of damped waves into the energy of the background plasma. The main energy dissipation mechanisms are collisional dissipation and viscosity. A quantitatively comparative study of efficiency of both these mechanisms in the corresponding parts of the solar atmosphere was performed. All MHD modes, Alfvén, fast magneto-acoustic and slow magneto-acoustic/acoustic waves, were considered within a model atmosphere of the quiet Sun. Analysis indicates the dominance of collisional friction damping mechanisms in the photosphere and low chromosphere as well as in the majority of prominences. In the upper solar chromosphere collisional and viscous damping of MHD waves appear to be equally important.

Inductive interaction of coronal loops: Low-frequency (LF) pulsations modulating the microwave radiation (37 GHz) of solar flares recorded at the Metsaähovi Radio Observatory were studied using Fourier analysis. Since the intensity of the electron synchrotron radiation of solar flares is proportional to a moderately high power of the background magnetic field, the LF modulations of the solar microwave radiation can be a tool for diagnostics of the electric currents in a radiating source. We consider the multi-track features of the LF spectra (Fig. 4.3) as an indication that the microwave radiation is produced within a system consisting of several neighboring magnetic loops.

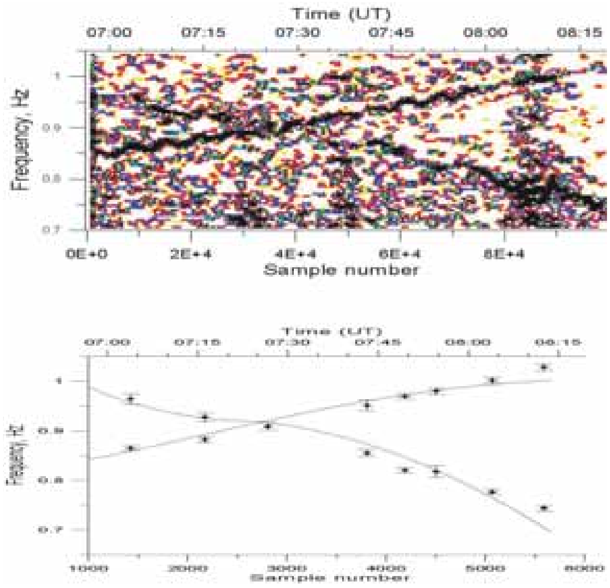


Fig. 4.3: Dynamic spectra of microwave bursts LF modulation and simulation using the model of two inductively connected magnetic current-carrying loops.

4.2 Mercury

Mercury is the planet nearest to the Sun. It is a significantly dense planet, which suggests a large iron core and possesses a weak global magnetic field. ESA's mission *BepiColombo* to Mercury will explore the planet in detail and over a longer period.

BepiColombo

BepiColombo is new and special in several ways. Not only is it the first joint European-Japanese space project, it is also the first time that two orbiters are flying to this innermost planet. Within the scope of the European-Japanese *MERMAG Consortium*, IWF participates in the magnetometer teams on both spacecraft and is in charge of the *MERMAG-M* magnetometer on the Japanese-built *Magnetospheric Orbiter*. IWF also participates in the *SERENA-PICAM* consortium that builds a particle analyzer for ESA's *Planetary Orbiter*.

Physics

Mercury exosphere and surface: A 1-D Monte Carlo exospheric model was extended to a complex 3-D model. It includes various surface particle release processes, based on thermal release, sputtering (Fig. 4.4), photon-simulated desorption and micrometeorite impact evaporation.

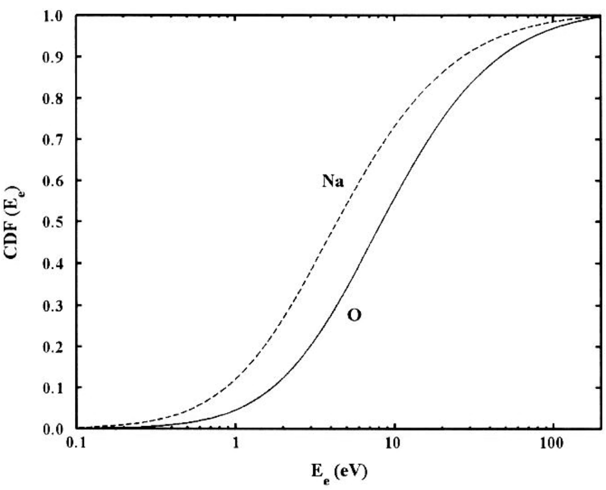


Fig. 4.4: Normalized integral of the energy distribution of sputtered Na and O atoms for incident 1 keV solar wind protons, as a function of their ejection energy E_e.

Particle release processes from Mercury's surface and the formation of the exosphere depend on various parameters: regolith porosity, binding energies, and elemental fractionation of the surface minerals. A study was initiated, using the better known Lunar surface regolith as a "test bed" for Mercury's surface, to estimate the binding energies of various sputtered elements by reproducing the observed Lunar exospheric column densities. Later, the obtained surface parameters will be used for simulations of Mercury's exosphere and the determination of its mineralogical surface composition.

4.3 Venus

Venus, like other planets in the solar system, is under the influence of a continuous flow of charged particles from the Sun, the solar wind. However, the lack of an intrinsic magnetic field makes Venus a unique object to study the interaction between solar wind and the planetary body. This year, for the first time in 118 years, Venus performed a so-called transit (Fig. 4.5), passing in front of the solar disk, as seen from Earth.

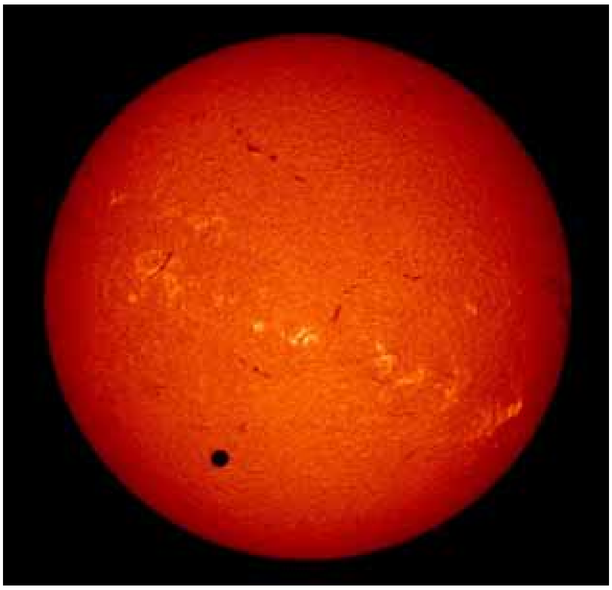


Fig. 4.5: Venus transit observed at Kanzelhöhe.

Venus Express

Venus Express is ESA's mission to Venus. IWF takes the lead on one of the seven payload instruments, the magnetometer *VEX-MAG*. *VEX-MAG* will map the magnetic properties in the magnetosheath, the magnetic barrier, the ionosphere, and the magnetotail. It is instrumented to identify the plasma boundaries between the various plasma regions and to study the solar wind interaction with the Venus' atmosphere.

Parallel to the hardware activities, data processing preparation for the magnetic field measurements has started. A neural network algorithm has been built to automatically recognize patterns of disturbed magnetic field caused by spacecraft stray fields. Good progress has been made by testing the model against simulated data.

In 2004, the manufacturing of the Flight Model was completed (Fig. 4.6). It was delivered in June, and, after stand-alone tests, *VEX-MAG* was integrated onto the spacecraft for further tests. The integrated *Venus Express* spacecraft is now undergoing various functional and environmental tests. *VEX-MAG* has so far passed all tests.

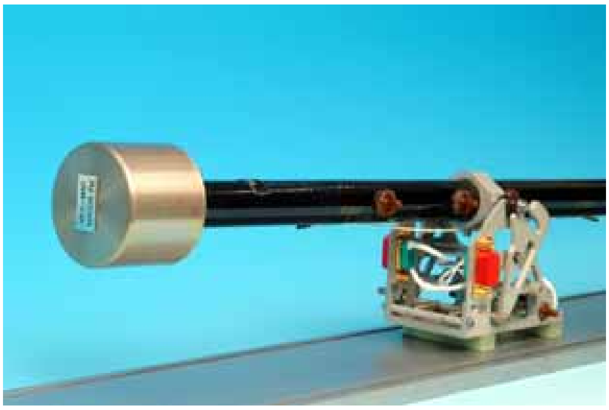


Fig. 4.6: Venus Express magnetometer boom.

Physics

Atmospheric loss on Venus: Various atmospheric erosion processes from Venus' ionosphere-exosphere environment, were studied and total O^+ loss rates in orders of 10^{25} s^{-1} were calculated. Studies indicate that photochemically produced hot hydrogen atoms are also a very efficient loss mechanism for H atoms on Venus with a global average total loss rate of about 3.8×10^{25} s^{-1}. This is slightly less than the H^+ ion outflow estimated from the Venus night side (7.0×10^{25} s^{-1}). There, outflow is due to acceleration by an outward electric polarization force related to variable ionospheric conditions. One should note that this high loss rate depends on the modelled hydrogen density profiles, and on the occurrence and numbers of ionospheric holes. The present uncertainties in heavy and light ion acceleration processes on the night side and the appearance or non-appearance of ionospheric holes during low solar activity will be studied using *VEX-ASPERA* and *-MAG* data, so that more accurate hydrogen loss estimates will be obtained during the mission.

4.4 Mars

Mars was an important research topic in 2004, as it was the first year that ESA's *Mars Express* satellite observed the planet. IWF studies included surface science, theoretical studies about the evolution of the Martian atmosphere, and final calculations regarding the characteristics of the *MARSIS* antenna system, which is still waiting for its deployment.

Mars Express

Analysis of the MARSIS antenna system: The *MARSIS* (Mars Advanced Radar for Subsurface and Ionosphere Sounding) experiment aboard *Mars Express* is dedicated to the investigation of the Martian surface and ionosphere. The primary goal is to map underground water and ice. Signals returning later than the main radar echo from the surface are either clutter (off-nadir points) or result from underground reflections. The clutter returns disturb the analysis of the essential subsurface echoes. Therefore, a secondary passive monopole is used to identify the clutters so that they can be subtracted from the main signal.

Previous analysis of the *MARSIS* antenna system had shown that the polarization mismatch between the echoes and the secondary monopole are favorable to the clutter cancellation technique. Further investigations have been performed concerning the coupling between monopole and dipole. The influence of the monopole deployment on the reception properties of the dipole must be very small for the synthetic aperture radar technique to work accurately. The nominal situation (all antenna elements deployed) was compared, with the same configuration but the monopole absent (Fig. 4.7a). The resulting relative change in dipole gain is below -40 dB within 30 degrees around nadir. A potential monopole bend (due to imprecise deployment or solar heating) does not change this assessment (Fig. 4.7b). The influence of similar dipole bending is even smaller, as is cross-talk from dipole to monopole. It was concluded that the monopole has only a minor influence on the dipole properties.

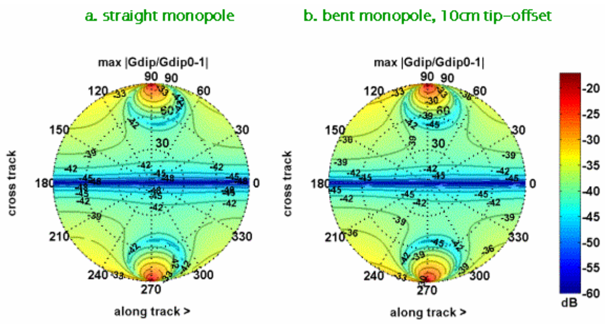


Fig. 4.7: Polar diagrams showing the deviation of dipole gain due to deployment of the monopole: (a) straight monopole, (b) bent monopole.

Physics

Martian atmosphere evolution: The development of magnetohydrodynamic instabilities at the Martian ionopause was investigated, since the ionospheric plasma can detach in form of clouds which has an influence on the atmosphere evolution. It was shown that only the whole Martian ionopause can be unstable with respect to the Kelvin-Helmholtz instability. Additionally, the influence of localized, remnant crustal magnetism in the Southern Highlands of Mars promotes the occurrence of the interchange instability, since it leads to a strong local curvature of the ionopause. A 2-D global hybrid model of the solar wind interaction with the planetary obstacle was used to study the evolution of the Martian atmosphere 3.5-4 Gyr ago.

Results (Fig. 4.8) indicate that ion loss caused by viscous processes at the ionopause should have played a significant role during early periods before 2.5 Gyr. The loss of water from Mars over the past 3.5 Gyr is estimated to be equivalent to a global ocean layer (depth of about 10 m) in agreement with previous studies. These results cannot explain the amount of liquid water needed to explain the geological surface features. Therefore, a photochemical model was applied to investigate the thermospheric heating by the young Sun during the early stages. Preliminary results yield high exospheric temperatures during the first 100-500 Myr, causing a strong thermal evaporation of the atmosphere and water loss.

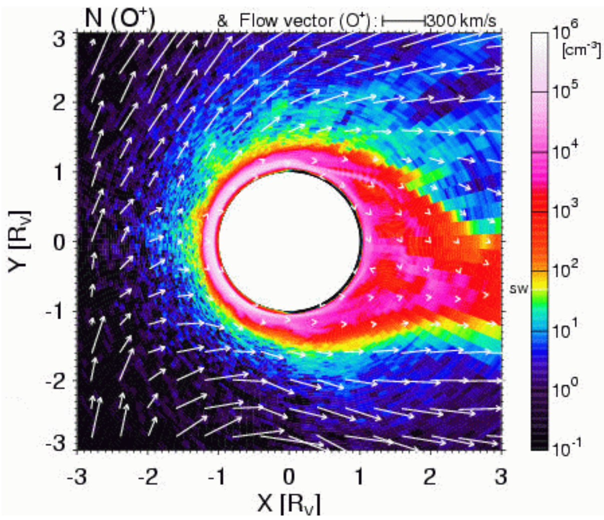


Fig. 4.8: Atomic oxygen ion distributions and tailward fluxes on Mars 3.5 Gyr ago.

Surface science: The chemical composition of sediments and rocks, as well as their distribution at the Martian surface, represent a long term archive of processes, which have formed the planetary surface. These processes are dominated by oxidation, which reduces the amount of oxygen in the atmosphere. The capability of the Martian soil to irreversibly sequester atmospheric oxygen depends, among others, on the kind of precursing materials. The chemical information on these materials is stored in the chemistries of the soils.

Data reduction was done by applying factor analysis in the simplex vector space under consideration of closure effects on data and visualization by means of biplots (Fig. 4.9) which are crucial for the understanding of weathering processes as well as for unravelling the role of meteoritic matter in the Martian soil.

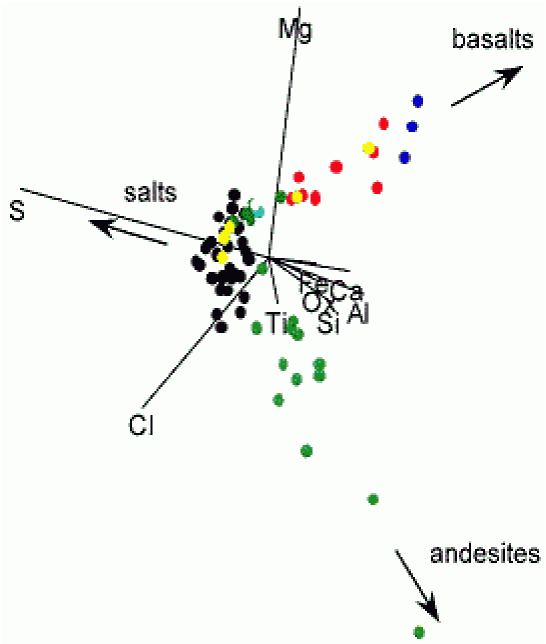


Fig. 4.9: Biplot of Martian surface samples. Black dots: Mars Pathfinder and Viking soils, green dots: Mars Pathfinder rocks, other dots: Mars Exploration Rover A.

4.5 Jupiter

Among the solar system radio planets, Jupiter provides the strongest non-thermal radio emission as a result of the electrodynamical interaction with its satellite Io. Specific investigations focused on the polarization of Io-triggered radio bursts.

S-bursts: Radio observations at Lustbühel observatory of Jovian S-burst emission using the newly developed Waveform Receiver allow to determine all four Stokes parameters as a function of time and frequency with sub-milli-second time and kilohertz frequency accuracy. Excellent S-burst activity (Io-B storm on 17 February 2004) enabled the determination of the state of polarization. The Faraday effect is visible as a continuous rotation of the polarization ellipse angle measured between the semi-major axis of the polarization ellipse and the East antenna direction as a function of frequency (Fig. 4.10).

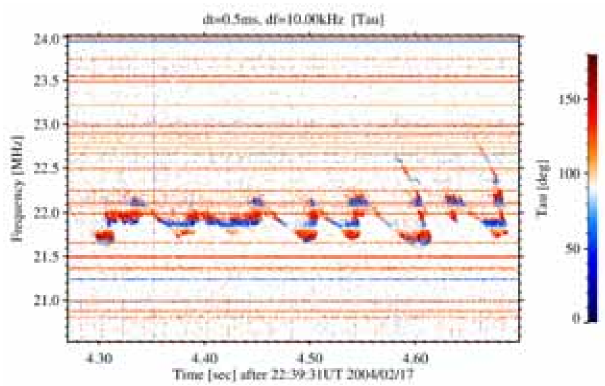


Fig. 4.10: Angle between the semi-major axis of the polarization ellipse and the antenna system for Jupiter narrow-band bursts.

LOFAR: In cooperation with Ukrainian, French and Russian organizations, IWF used the world's largest decameter wavelengths radio telescopes to probe the concept of the LOFAR (Low Frequency Array) project. Besides investigations of galactic and extragalactic radio emitters, the present project essentially contributes to simultaneous and coordinated ground-based and space-borne observations like *Cassini/RPWS* in the Saturnian system and *STEREO/WAVES* observing solar radio emission.

4.6 Saturn and Titan

After *Cassini/Huygen's* arrival, Saturn, the ringed planet, and its biggest satellite Titan will be one of the main scientific targets for IWF in the upcoming years.

Cassini/Huygens

On 1 July 2004, the joint NASA/ESA mission *Cassini/Huygens* performed successfully the Saturn Orbit Insertion (SOI), which brought the spacecraft as close as 20,000 km to the cloud tops of Saturn. Until the end of 2004 *Cassini/Huygens* has made its first two orbits around the ringed gas planet with more than 70 orbits to follow until the end of the nominal mission in 2008. Besides *RPWS* (Radio and Plasma Wave Science Experiment) onboard of the *Cassini* orbiter, IWF is strongly involved in *HASI* (Huygens Atmospheric Structure Instrument), *ACP* (Aerosol Collector and Pyrolyser), and *GCMS* (Gas Chromatograph and Mass Spectrometer) of the *Huygens* probe. *Cassini/Huygens* has already performed two close Titan flybys in 2004, and after separation from the *Cassini* orbiter on 25 December 2004, the *Huygens* probe successfully descended and landed on Titan's surface on 14 January 2005.

Physics

Lightning on Saturn: The so-called Saturn Electrostatic Discharges (SEDs) are bursty HF radio emissions. These are thought to originate from lightning of thunderstorms in Saturn's atmosphere. The spatial and temporal appearance of SEDs recorded so far by the *Cassini/RPWS* instrument is significantly different from the *Voyager* era: SEDs were already detected in June 2003 from a distance of more than 1 AU (*Voyager 1* detection distance was only several tens of Saturn radii).

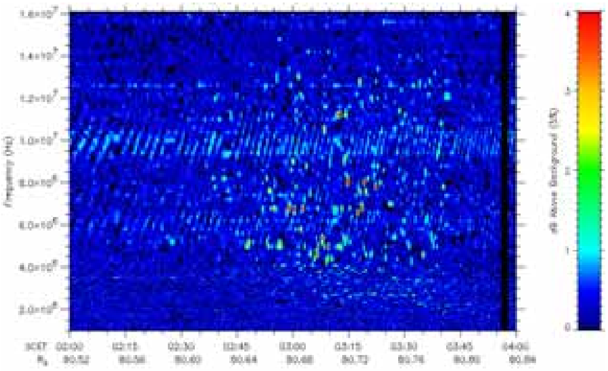


Fig. 4.11: SED episode on 13 July 2004, recorded by Cassini/RPWS.

Since then, SED episodes (Fig. 4.11) have continued sporadically. The periodicity of the SED episodes has changed at least twice with periods ranging from 10 to 10.75 h, the latter suggesting storm systems at higher latitudes. The differences between the *Voyager* and *Cassini* observations are currently attributed to seasonality, i.e., a varying broadness of the ring shadow on the day side of Saturn, where temperature gradients might cause atmospheric storms. Algorithms have been developed for computer-aided SED detection of events and statistical studies have been made about flash occurrence with respect to time, frequency, signal strength and duration.

Lightning on Titan: At IWF several studies have been done about the possibility of lightning discharges on Titan. During the first close Titan flyby on 26 October 2004, the *Cassini/RPWS* instrument detected no clear evidence for lightning on Titan. The few very weak radio signals registered could also be SEDs. Lightning flashes on Titan might be rare events. They might be detected with *RPWS* during the numerous (~40) Titan flybys of *Cassini*, or in the data of *HASI-PWA* (HASI Permittivity, Wave, and Altimetry Experiment) obtained during the descent of *Huygens* (e.g. via Schumann resonances or radio emissions in the kHz-range).

Huygens' descent: In order to prepare for the *Huygens* data analysis the results of a terrestrial balloon test flight have been analyzed with a major emphasis on ELF (extremely low frequency) phenomena. The Schumann frequency lines observed during ascent and descent of the probe mockup have been compared with the angular motion of the mockup. The correlation between the 9 and 15 Hz frequency line and the rotation around the horizontal and vertical axes indicates the importance of attitude determination during the descent of the *Huygens* probe. Spectral features observed during the balloon flight have been correlated with lightning phenomena at a distance of about 800 km.

Additional theoretical investigations for the ELF wave propagation on Titan have been performed and show a rather strong dependence of the resonances on the atmospheric conductivity profile and a dependence of the eigenfrequencies on altitude. Depending on the actual conductivity profile a reduction of the resonance frequency up to 10% may be expected.

Reconstruction of the Huygens entry and descent trajectory: The primary goal of the Huygens Descent Trajectory Working Group (DTWG) is to provide a single, common descent profile that is consistent with all the available data. This trajectory will then be made available to each instrument team for the analysis of their experiment measurements. IWF has developed, implemented, and validated a methodology which reconstructs the *Huygens* probe entry and descent trajectory using data from various instruments. An initial determination of the probe entry and descent trajectory will be made available by the DTWG.

The *Huygens* probe's hypersonic entry trajectory was simulated and deviations of the probe trajectory for extreme atmosphere conditions were compared to a simulation based on the nominal one. It could be confirmed that the difference in aerodynamic drag is of an order of magnitude that can be measured by the *HASI* accelerometers. Additionally, atmospheric torques were calculated on the *Cassini* spacecraft during close Titan flybys due to aerodynamic drag, which can be twice as high for the new temperature profile as for the previous one (Fig. 4.12).

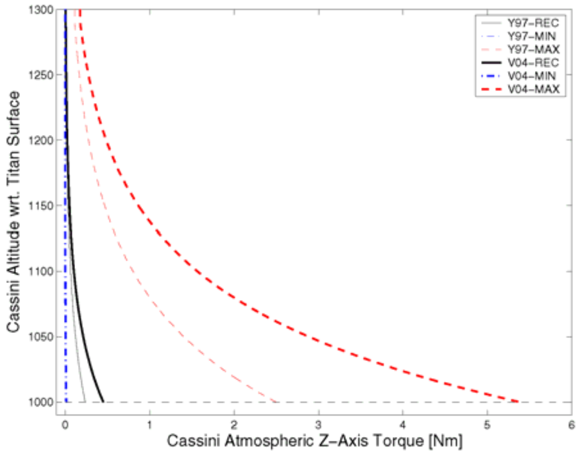


Fig. 4.12: Simulated atmospheric torque about Cassini's Z-axis during a low-altitude flyby for different density profiles.

Titan's upper atmosphere and evolution: Also aspects of the evolution of Titan's atmosphere were studied. It was found that, during most of its lifetime, Saturn's magnetosphere was highly compressed to distances smaller than Titan's orbital radius (~20 Saturn radii). The early Sun had a much higher solar wind mass flux than today. The ion pick up and sputter loss over Titan's history were simulated and it was found that non-thermal atmospheric loss cannot explain the observed enrichment in ^{15}N isotopes in Titan's atmosphere. Therefore, hydrodynamic blow off was investigated, because the exospheric temperature could have reached the critical temperature of molecular nitrogen during the early evolutionary stages of the satellite. The results indicate that Titan's atmospheric isotope anomalies can be explained if the atmosphere experienced hydrodynamic blow off for at least 50 Myr after the satellite's origin.

Temperature variations of Titan's thermosphere due to the plasma interaction with Saturn's magnetosphere and Titan's high altitude monomer haze particles may imply temperature variations of ±30 K from currently estimated density profiles. These temperature uncertainties were integrated in the current engineering models for the *Huygens* re-entry.

4.7 Comets

Rosetta

ESA's *Rosetta* mission will monitor the evolution of a comet during its approach to the Sun over a long period of time from an orbiter. In addition, a lander will be dropped on the surface of the nucleus. *Rosetta* was launched on 2 March 2004 and will reach its target, comet 67P/Churyumov-Gerasimenko, in 2014. IWF participates in five experiments in this key mission. It is leading the investigation of dust particles collected in the coma by means of an atomic force microscope. This instrument *MIDAS* on the *Rosetta* orbiter is to investigate the structure, flux and magnetic properties of the grains. IWF also contributes to the mass spectrometer *COSIMA* and to the magnetometer *RPC-MAG* on the orbiter.

The lander instrumentation has contributions by IWF to the *MUPUS* and *ROMAP* experiments and to the development of the *Rosetta* lander anchoring system. *MUPUS* consists of a group of sensors to measure the thermal and mechanical properties of layers near the surface. *ROMAP* is a magnetometer to investigate the magnetic field during the descent to the surface and of possible variations after the touchdown.

All these instruments have been tested in space and commissioned successfully between April and September 2004. For example *MIDAS* was tested in three steps. First, all mechanisms which had been clamped during launch were released. A variety of scans at the calibration targets were performed in the second part, and the last period was dedicated to fine-tuning the scanning parameters. The commissioning of *MIDAS* was very successful, and the instrument is fully operational. The noise environment which is relevant for image quality is more benign than expected, the reproducibility of the scanner position is very high, and the image resolution exceeds scientific requirements to resolve micro-texture of dust grains. This is demonstrated by the first test image of a calibration surface containing 1.1 µm wide square structures at 3 µm pitch in Fig. 4.13.

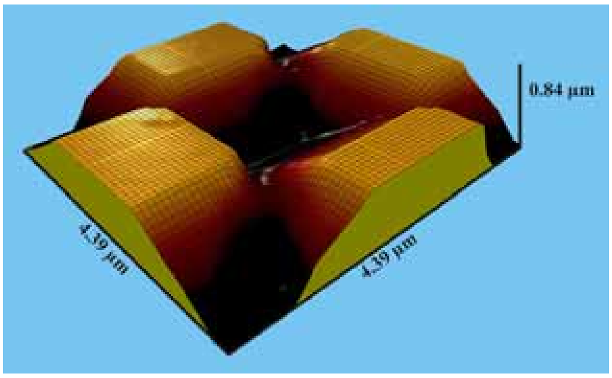


Fig. 4.13: Image of the MIDAS calibration target 2.

The Solid State Greenhouse Effect (SSGE): This is a phenomenon based on the same physical principals as the atmospherical greenhouse effect: a subsurface temperature maximum, due to solar radiation, is generated in a transparent medium. This effect is of interest in the thermodynamics of icy bodies like comets and icy satellites. Investigations of this effect have been done on various samples like clear compact H_2O-ice, glass beads and layered samples consisting of different materials.

Measurements with different samples were done under atmospheric pressure and/or cryo-vacuum conditions. Fig. 4.14 shows the results of a test made with glass beads. In addition to the experimental work numerical models describing the heat transfer inside such samples were developed.

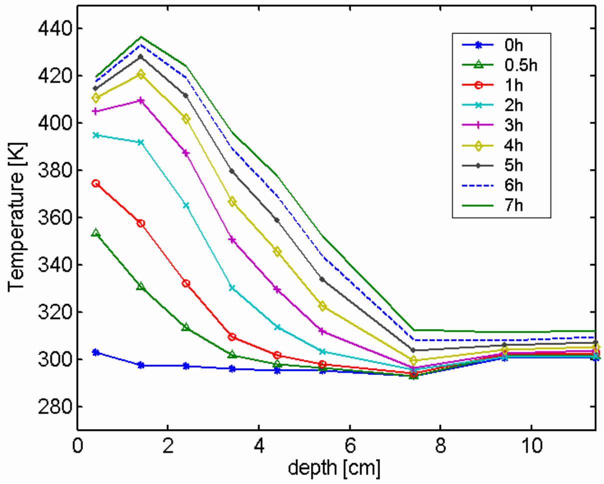


Fig. 4.14: Measured temperature distribution inside a sample consisting of glass beads showing the characteristic subsurface temperature maximum.

4.8 Exoplanets

Exoplanets, i.e., planets around stars other than our Sun, have become a new and exciting research topic since their discovery in the late 1990s. Many have been found now (up to 200), it started with "super Jupiters" in close orbits around their star, but as techniques improved, smaller and more distant planets have been observed.

COROT

In co-operation with the Institute for Astronomy, University of Vienna, IWF contributes to the French space telescope *COROT* (Convection, Rotation and Planetary Transit). The scientific goal is the investigation of dynamic processes in the interior of stars and the search and survey of extrasolar planets. In both areas, astroseismology and exoplanetology, the variation of the brightness of stars is the key parameter. The determination of these variations is done by high precision photometry, with a resolution better than 10 ppm. In astroseismology, the amplitude and frequency of brightness variations is used to derive the oscillation mode and, furthermore, to determine the physical and chemical processes in the interior. Variations in the brightness can be caused by bypassing planets, too. To distinguish variations due to oscillations from bypassing planets, spectral analysis in the red and blue zone is performed.

IWF develops and builds the so-called extractor *BEX* (Boîtiers Extracteur), a computer system with dedicated pre-processors for the selection and classification of image data (Fig. 4.15). The in-house developed pre-processors allow the identification of pixels, which are part of pre-defined image areas. The essential technology is hardware supported data mining under the constraints for real-time operation.

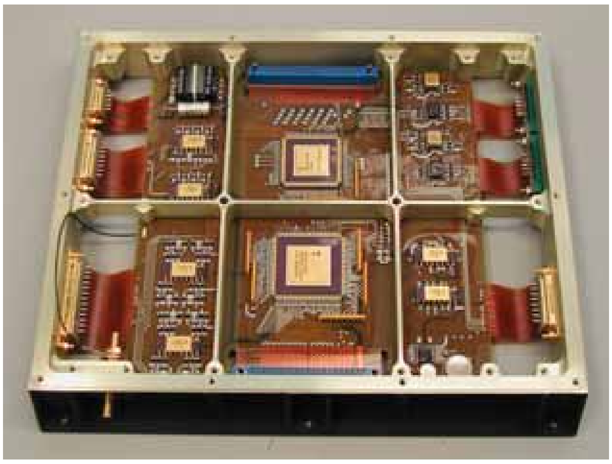


Fig. 4.15: Interior of BEX Qualification Model.

The qualification model passed all environmental tests with success and was integrated in the instrument mock-up at Meudon. Presently the team concentrates on manufacturing and testing the flight models.

Physics

Evaporation of close-in giant exoplanets: Preliminary results of hydrodynamic conditions of close-in exoplanets indicate that evaporation of hydrogen-rich exoplanets with initial masses below a critical value lead to a rapid expansion of outer planetary layers and of the total planetary radius, such that the evaporation process is sped up and the planet may not survive (Fig. 4.16).

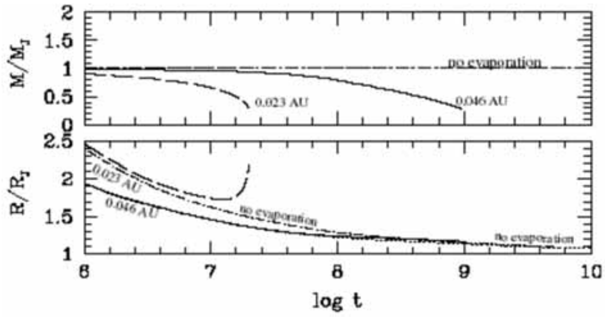


Fig. 4.16: Evolution of an evaporating planet with initial mass 1 M_{Jup} (Jupiter's mass) at different orbital distances (0.023 and 0.046 AU). The upper panel shows the evolution of the mass and the lower panel the radius.

Furthermore, different plasma interaction regimes around close-in planetary obstacles for different stellar wind parameters were also studied. The results show that the stellar wind parameters like plasma temperature, interplanetary magnetic field, particle density and velocity near obstacles at orbital distances closer than 0.1-0.2 AU are such that no bow shocks evolve. This is comparable to the magnetospheric plasma interaction of the inner satellites of Jupiter and Saturn. The ion production and loss rates of the ionized atmospheric population was calculated by a test particle model, and loss rates representative for giant exoplanets were found to be of the order of 10^8-10^9 g s^{-1}. The dominating component of particle loss of short-periodic Jupiter-class exoplanets is neutral hydrogen.

5 Engineering & Testing

Instruments onboard spacecraft are exposed to harsh environments, e.g. vacuum, large temperature ranges, radiation and high mechanical loads during launch. Furthermore, these instruments are expected to be highly reliable, providing full functionality over the entire mission time, which could last for even more than ten years.

The development of space born instruments typically starts with a laboratory model, to verify the general concept. The next step is the engineering model, the first model fulfilling the main parameters as dimension, mass and power consumption.

A dedicated model, the so-called qualification model, is tested in a simulated space environment to demonstrate the compliance with these specified conditions. IWF owns several test chambers for simulating thermal and vacuum conditions. Finally, following the completion of all design and test activities, the flight models, which will be integrated on the spacecraft, are built, using especially hardened electronic components.

5.1 Test Facilities

Vacuum Chambers

For simulating the stress on space instruments due to environmental conditions, a dedicated test chamber providing vacuum and extreme temperatures is available at IWF. The thermally controlled mounting plate and the surrounding mantle can be either electrically heated or cooled by liquid nitrogen. The test chamber supports a temperature range between −80 °C and +120 °C at a pressure level of 10^{-5} mbar. Automatic test sequences are controlled by a computer program and supervised by two independent safety protection systems.

For the development and testing of particle analyzers and active electron or ion sources a large vacuum chamber (Fig. 5.1) was installed. The inbuilt numerically controlled manipulator with three degrees of freedom is mainly used for sensor calibration. The large dimensions (length almost 2 m) are very helpful when the beam profile of particle sources are to be investigated.

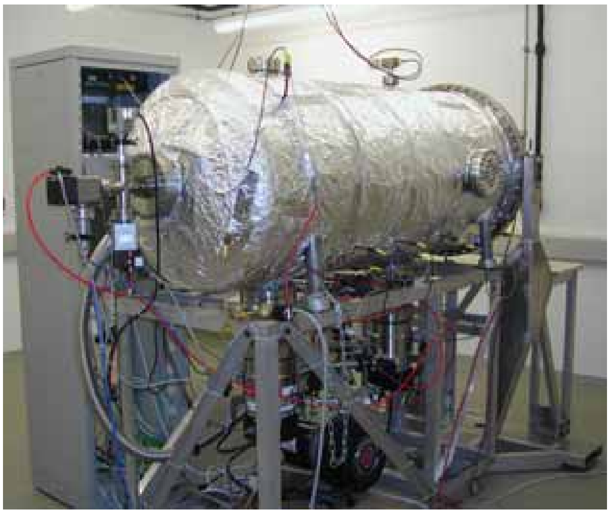


Fig. 5.1: One of the in-house vacuum chambers.

The third vacuum chamber is mainly used for studies on the solid state greenhouse effect and for some experiments associated with the development of a melting probe for planetary applications. Aside of this, combined with a solar simulator, it served as a facility for several other tasks, e.g. thermal tests for the *Venus Express* payload and exobiology experiments.

Penetrometry Test Stand

A penetrometry test facility designed to measure mechanical soil properties, like e.g. bearing strength, is available since January 2004. For the numerical modeling of the penetration tests a software based on the Finite Element Method is used. This program enables axis-symmetric and disconnected modeling of the penetrating cone and the sample (Fig. 5.2).

A frictional contact interface utilizing Mohr-Coulomb's theory was chosen to represent the interaction between the surface of the cone and the soil. To specify the behavior of the sample, different soil models, e.g. a Mohr-Coulomb model with hardening approach or a hypoplastic model can be used. Additionally, the penetrometer rig was used in conjunction with the calibration of the penetration sensor of the *Huygens Surface Science Package*.

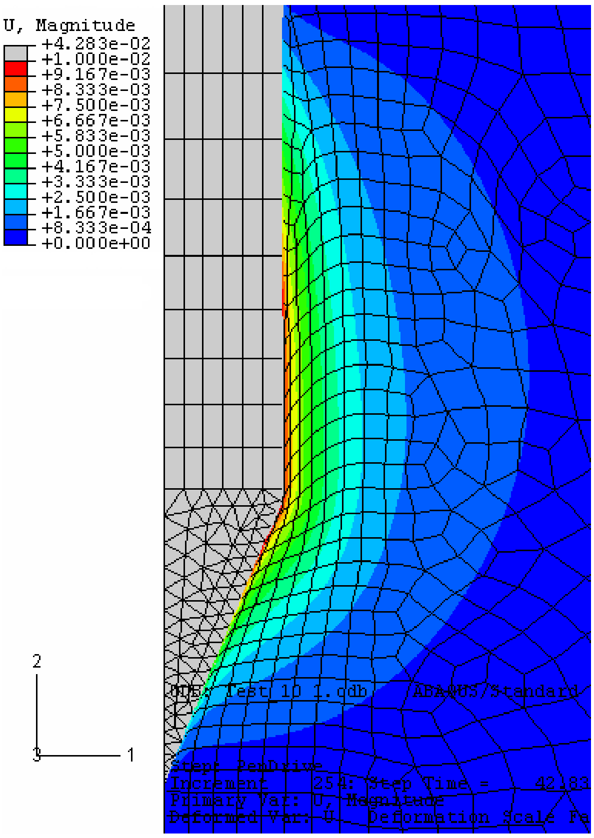


Fig. 5.2: Contour plot of the absolute displacements and deformed mesh after 4 cm of penetration.

UV Exposure Facility

A special UV exposure facility was developed, which can reproduce the Martian UV surface spectra of 200-800 nm, using a Xe-lamp and a special filter and mirror configuration. The spectra verification tests of the UV simulator were experimentally controlled by radiometer measurements (Fig. 5.3).

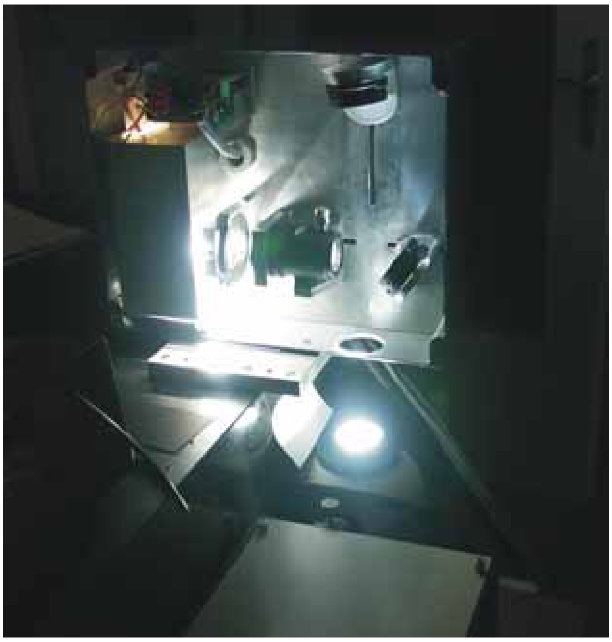


Fig. 5.3: Verification tests of the Mars UV simulator.

THEMIS Calibration Unit

The magnetometers for the *THEMIS* mission are assembled and calibrated at TU Braunschweig and IWF Graz. Further testing and integration onto the instrument package, as well as onto the spacecraft, is done at Berkeley and Swales in the US. Thus, it is necessary to have identical and mobile calibration and test units for the sensors at all these places.

The calibration unit consists of a three-layer magnetic shielding set for low noise and field environment and an additional set of calibration coils so that the sensor can be tested three-dimensionally with fields applied within the shielding without changing the sensor mounting (Fig. 5.4).

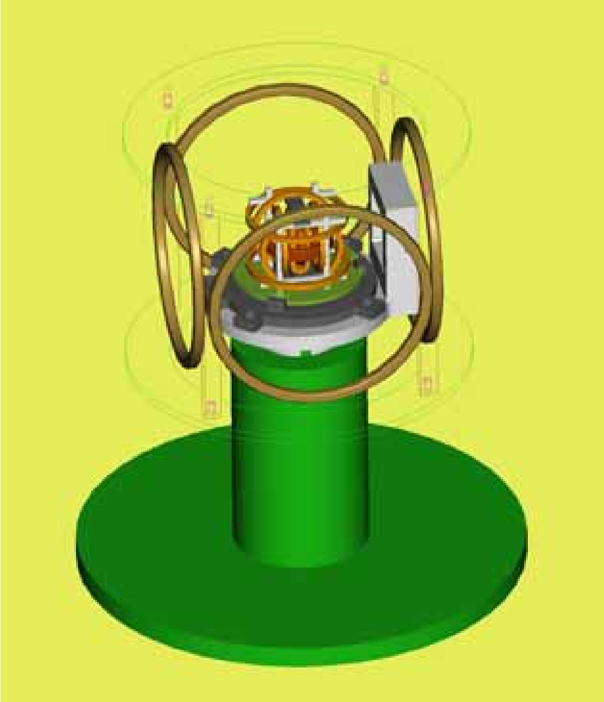


Fig. 5.4: 3-axes coil system in the THEMIS calibration unit with the fluxgate sensor mounted inside.

Temperature Test Facility

During space missions, scientific sensors mounted outside of the spacecraft are usually exposed to extreme temperature conditions. It can be very hot for missions going closer to the Sun (Venus and Mercury) and very cold when being in eclipse or somewhere in the outer solar system. With the temperature test facility at IWF, magnetic field sensors can be tested over an extended temperature range from −170 °C up to +200 °C in a low field environment.

During 2004, the flight sensors of *Double Star* TC-2 (two sensors), *Venus Express* (two sensors) and *THEMIS* (two sensors) have been tested and calibrated with the IWF temperature test facility.

5.2 New Instruments

Magnetometer Chip

One possible aspect to reduce costs of planetary exploration and hence allowing for more frequent missions is to reduce the instrument and spacecraft size and bring required launch masses down. Future planetary exploration missions must use smaller spacecraft to achieve the science objectives in a cost-effective manner.

This is why an instrument front-end ASIC (Application Specific Integrated Circuit) for magnetic field sensors (fluxgate principle) is being developed by IWF in cooperation with the Fraunhofer Institute for Integrated Circuits and the Institute of Geophysics and Planetary Physics/UCLA. It is based on an innovative combination of the conventional fluxgate magnetometer readout electronics with the control loop of a sigma-delta (SD) modulator (Fig. 5.5). This is done in order to achieve a further miniaturized, robust (especially in terms of radiation hardness) and highly sensitive triaxial magnetometer, which will provide direct digital output without the use of a separate analog-to-digital converter chip. It is aimed for a reduction of the power consumption of the readout electronics part from 500 mW to 50 mW and to achieve a radiation hardness (total ionizing dose) of more than 100 krad.

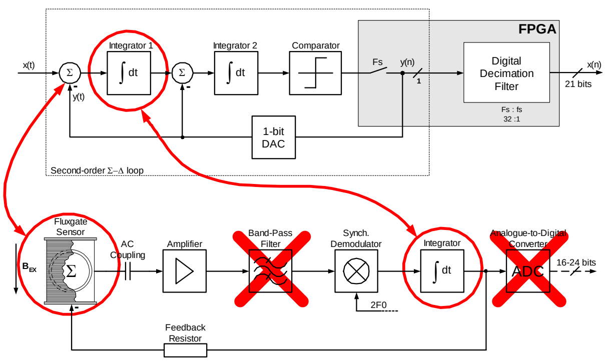


Fig. 5.5: Merging of second-order sigma-delta and fluxgate control loops.

The favorite ASIC process (AMS 0.35 µm CMOS process) was tested to be radiation hard for more than 100 krad in October 2004 at ESA/ESTEC. The system level development is going on and the first chip is expected for testing in summer 2005.

Melting Probe

A new technical development, for which the small cryo-vacuum chamber was extensively used, is a so-called melting probe to explore planetary ice layers. While such instruments exist and have been used since the 1960s for terrestrial glacier research, they behave quite different under vacuum/space conditions. The principle of such a probe is that ice is melted or evaporated by a hot tip at the front side. This allows the probe to penetrate deeply into an ice sheet without using mechanical devices like drillers or hammers.

The preliminary experiments performed in 2004 were focused on the penetration behavior of a brass sphere in compact and porous ice in a cryo-vacuum environment (Fig. 5.6). The thermal behavior and the sink speed of the probe in various ice and snow samples was measured and compared with simple model calculations.

The final aim is to provide an instrumented probe suitable for exploring the subsurface ices of the Mars polar areas and/or the Jovian satellite Europa.

Fig. 5.6: Penetration of a brass sphere into a compact ice layer under vacuum conditions.

6 Publications & Talks

6.1 Refereed Articles

Arshukova, I.L., N.V. Erkaev, H.K. Biernat: Interchange instability of a curved current layer convecting in the magnetosheath from the bow shock towards the magnetopause, *Ann. Geophys.*, 22, 993–999 (2004)

Arshukova, I.L., N.V. Erkaev, H.K. Biernat, D.F. Vogl: Interchange instability of the Venusian ionopause, *Adv. Space Res.*, 33, 182–186 (2004)

Asano, Y., T. Mukai, M. Hoshino, Y. Saito, H. Hayakawa, T. Nagai: Current sheet structure around the near-Earth neutral line observed by Geotail, *J. Geophys. Res.*, 109, doi:10.1029/2003JA010114 (2004)

Asano, Y., T. Mukai, M. Hoshino, Y. Saito, H. Hayakawa, T. Nagai: Statistical study of thin current sheet evolution around substorm onset, *J. Geophys. Res.*, 109, doi:10.1029/2004JA010413 (2004)

Baraffe, I., F. Selsis, G. Chabrier, T.S. Barman, F. Allard, P.H. Hauschildt, H. Lammer: The effect of evaporation on the evolution of close-in giant planets, *Astron. & Astrophys.*, 419, L13–L16 (2004)

de Pater, I., N. Kassim, H.O. Rucker: The Low Frequency Array (LOFAR) and (Extra-)Solar System Science, *Planet. Space Sci.*, 52, 1339–1341 (2004)

Deng, X.H., H. Matsumoto, H. Kojima, T. Mukai, R.R. Anderson, W. Baumjohann, R. Nakamura: Geotail encounter with reconnection diffusion region in the Earth's magnetotail: Evidence of multiple X lines collisionless reconnection?, *J. Geophys. Res.*, 109, doi:10.1029/2003JA010031 (2004)

Dorotovic, I., Z. Vörös: Examining the role of turbulence in the solar wind – magnetosphere interaction processes, *IAU Proc.*, 223, doi: 10.1017/S1743921304006763 (2004)

Erkaev, N.V., C.J. Farrugia, H.K. Biernat, D. Langmayr: Variations of magnetic field and plasma parameters in the magnetosheath related to reconnection pulses, *Adv. Space Res.*, 33, 784–788 (2004)

Fekete, A., Gy. Rontó, M. Hegedüs, K. Módos, A. Bérces, G. Kovács, H. Lammer, C. Panitz: Simulation experiments of the effect of space environment on bacteriophage and DNA thin films, *Adv. Space Res.*, 33, 1306–1310 (2004)

Fischer, G., T. Tokano, W. Macher, H. Lammer, H.O. Rucker: Energy dissipation of possible Titan lightning strokes, *Planet. Space Sci.*, 52, 447–458 (2004)

Friedrich, M., K.M. Torkar, R.J. Steiner: Empirical recombination rates in the lower ionosphere, *Adv. Space Res.*, 34, 1937–1942 (2004)

Friedrich, M., M. Harrich, K.M. Torkar, S. Kirkwood: The disturbed auroral ionosphere based on EISCAT and rocket data, *Adv. Space Res.*, 33, 949–955 (2004)

Friedrich, M., M. Harrich, R.J. Steiner, K.M. Torkar, F.J. Lübken: The quiet auroral ionosphere and its neutral background, *Adv. Space Res.*, 33, 943–948 (2004)

Galopeau, P.H.M., M.Y. Boudjada, H.O. Rucker: Evidence of jovian active longitude: 1. Efficiency of cyclotron maser instability, *J. Geophys. Res.*, 109, doi:10.1029/2004JA010459 (2004)

Grachev, E.A., O.R. Grigoryan, W. Riedler, K. Schwingenschuh, W. Magnes, G. Berghofer, W. Koren, T.L. Zhang, K.-H. Glaßmeier, H.-U. Auster, K.-H. Fornacon, J. Rustenbach, V.A. Grushin, S.I. Klimov: The magnetometric system of the SPRUT-VI instrument package, *Instr. Exp. Tech.*, 47, 113–118 (2004)

Grießmeier, J.M., U. Motschmann, A. Stadelmann, T. Penz, H. Lammer, F. Selsis, I. Ribas, E.F. Guinan, H.K. Biernat, W.W. Weiss: The effect of tidal locking on the magnetospheric and atmospheric evolution of “Hot Jupiters”, *Astron. Astrophys.*, **425**, 753–762 (2004)

Grocott, A., T.K. Yeoman, R. Nakamura, S.W.H. Cowley, H.U. Frey, H. Rème, B. Klecker: Multi-instrument observations of the ionospheric counterpart of a bursty bulk flow in the near-Earth plasma sheet, *Ann. Geophys.*, **22**, 1061-1075 (2004)

Gubchenko, V.M., M.L. Khodachenko, H.K. Biernat, V.V. Zaitsev, H.O. Rucker: On plasma kinetic model of a 3D solar corona and solar wind at the heliospheric sheet, *Hvar Obs. Bull.*, **23**, 127–138 (2004)

Gurnett, D.A., W.S. Kurth, D.L. Kirchner, G.B. Hospodarsky, T.F. Averkamp, P. Zarka, A. Lecacheux, R. Manning, A. Roux, P. Canu, N. Cornilleau-Wehrlin, P. Galopeau, A. Meyer, R. Boström, G. Gustafsson, J.-E. Wahlund, L. Ahlen, H.O. Rucker, H.P. Ladreiter, W. Macher, L.J.C. Wooliscroft, A. Alleyne, M.L. Kaiser, M.D. Desch, W.M. Farrell, C.C. Harvey, P. Louarn, P.J. Kellog, K. Goetz, and A. Pedersen, The Cassini radio and plasma wave investigation. *Space Sci. Rev.*, **114**, 395–463, (2004)

Kazeminejad, B., M. Pérez-Ayúcar, J.-P. Lebreton, M. Sanchez-Nogales, M. Belló-Mora, N. Strange, D. Roth, L. Popken, K. Clausen, P. Couzin: Simulation and analysis of the revised Huygens probe entry and descent trajectory and radio link modelling, *Planet. Space Sci.*, **52**, 799–814 (2004)

Khodachenko, M.L., D. Arber, H.O. Rucker, A. Hanslmeier: Comparative analysis of collisional and viscous damping of MHD waves in partially ionized solar plasmas, *Hvar Obs. Bull.*, **23**, 115-126 (2004)

Khodachenko, M.L., H.O. Rucker: MHD effects triggered by beams of fast particles in magnetic tubes and their possible relation to plasma heating and dynamics during solar flares, *Astrophys. Space Sci.*, **289**, 111–136 (2004)

Khodachenko, M.L., T.D. Arber, H.O. Rucker, A. Hanslmeier: Collisional and viscous damping of MHD waves in partially ionized plasmas of the solar atmosphere, *Astron. Astrophys.*, **422**, 1073–1084 (2004)

Konovalenko, A.A., I.S. Falkovich, N.N. Kalinichenko, A.A. Gridin, I.N. Bubnov, A. Lecacheux, C. Rosolen, H.O. Rucker: Active antenna array for radio astronomy, *Radio Phys. & Radio Astron.*, **9**, 248–260 (2004)

Kömle, N.I., M. Treffer, G. Kargl, E. Kaufmann, M. Steller: Development of melting probes for exploring ice sheets and permafrost layers, *J. Glac. Geocr.*, **26**, 310–318 (2004)

Lammer, H., I. Ribas, J.M. Grießmeier, T. Penz, A. Hanslmeier, H.K. Biernat: A brief histroy of the solar radiation and particle flux evolution, *Hvar Obs. Bull.*, **28**, 139–155 (2004)

Langmayr, D., N.V. Erkaev, V.S. Semenov, W. Macher, H.K. Biernat, H.O. Rucker: Analysis of a pressure disturbance in a homogeneous magnetic field, *Adv. Space Res.*, **33**, 780–783 (2004)

Lecacheux, A., A.A. Konovalenko, H.O. Rucker: Using large radio telescopes at decametre wavelengths, *Planet. Space Sci.*, **52**, 1357–1374 (2004)

Léger, A., F. Selsis, C. Sotin, T. Guillot, D. Despois, D. Mawet, M. Ollivier, A. Labèque, C. Valette, F. Brachet, B. Chazelas, H. Lammer: A new family of planets? "Ocean-Planets", *Icarus*, **169**, 499–504 (2004)

Leubner, M. P.: Core-halo distribution functions: A natural equilibrium state in generalized thermostatics, *Astrophys. J.*, **604**, 469–478 (2004)

Leubner, M.P.: Fundamental issues on kappa-distributions in space plasmas and interplanetary proton distributions, *Phys. Plasmas*, **11**, 1308-1316 (2004)

Lichtenegger, H., H. Lammer, D.F. Vogl, S.J. Bauer: Possible temperature effects of energetic neutral hydrogen atoms on the Martian exosphere, *Adv. Space Res.*, **33**, 140–144 (2004)

Litvinenko, G.V., H.O. Rucker, V.V. Vinogradov, M. Leitner, V.E. Shaposhnikov: Internal structure of the Jovian simple S-burst obtained with the wavelet analysis technique, *Astron. Astrophys.*, **426**, 343–351 (2004)

Marczewski, W., K. Schroer, K. Seiferlin, B. Usowicz, M. Banaszkiewicz, M. Hlond, J. Grygorczuk, S. Gadomski, J. Krasowski, W. Gregorczyk, G. Kargl, A. Hagermann, A.J. Ball, E. Kuhrt, J. Knollenberg, T. Spohn: Prelaunch performance evaluation of the cometary experiment MUPUS-TP, *J. Geophys. Res.*, **109**, E07S09 (2004)

Mazelle, C., D. Winterhalter, K. Sauer, J.G. Trotignon, M.H. Acuña, K. Baumgärtel, C. Bertucci, D.A. Brain, S.H. Brecht, M. Delva, E. Dubinin, M. Øieroset, J. Slavin: Bow shock and upstream phenomena at Mars, *Space Sci. Rev.*, **111**, 115-181 (2004)

Meishan-Goh, G., B. Kazeminejad: Mars through the looking glass: An interdisciplinary analysis of forward and backward contamination, *Space Policy*, **20**, 217-225 (2004)

Melnik, V.N., A.A. Konovalenko, A.A. Stanislavsky, H.O. Rucker, E.P. Abranin, V.V. Dorovskii, V.V. Zaharenko, V.N. Lisachenko, M.Y. Boudjada, A. Lecacheux, V.V. Zaitsev, M.G. Rosolen: Solar Type II bursts detected at decameter wavelengths, *Radio Phys. & Radio Astron.*, **9**, 237-247 (2004)

Melnik, V.N., A.A. Konovalenko, H.O. Rucker, A.A. Stanislavsky, E.P. Abranin, A. Lecacheux, G. Mann, A. Warmuth, V.V. Zaitsev, M.Y. Boudjada, V.V. Dorovskii, V.V. Zaharenko, V.N. Lisachenko, C. Rosolen: Observations of Solar Type II bursts at frequencies 10-30 MHz, *Solar Phys.*, **222**, 151-166 (2004)

Molina-Cuberos, G.J., J. Porti, B.P. Besser, J.A. Morente, J. Margineda, H.I.M. Lichtenegger, A. Salinas, K. Schwingenschuh, H.U. Eichelberger: Schumann resonances and electromagnetic transparence in the atmosphere of Titan, *Adv. Space Res.*, **33**, 2309-2313 (2004)

Morente, J.A., J.A. Portí, A. Salinas, G.J. Molina-Cuberos, H.I.M. Lichtenegger, B.P. Besser, K. Schwingenschuh: Do Schumann resonance frequencies depend on altitude?, *J. Geophys. Res.*, **109**, doi:10.1029/2003JA010305 (2004)

Mühlbachler, S., V.S. Semenov, H.K. Biernat, N.V. Erkaev, I.V. Kubyshkin, C.J. Farrugia, D. Langmayr, D.F. Vogl: A reconnection model describing erosion of the magnetopause and the associated bow shock motion, *Adv. Space Res.*, **33**, 2103-2107 (2004)

Nakamura, R., W. Baumjohann, C. Mouikis, L.M. Kistler, A. Runov, M. Volwerk, Y. Asano, Z. Vörös, T.L. Zhang, B. Klecker, H. Rème, A. Balogh: Spatial scale of high-speed flows in the plasma sheet observed by Cluster, *Geophys. Res. Lett.*, **31**, doi:10.1029/2004GL019558 (2004)

Nakamura, R., W. Baumjohann, T. Nagai, M. Fujimoto, T. Mukai, B. Klecker, R. Treumann, A. Balogh, H. Rème, J.A. Sauvaud, L. Kistler, C. Mouikis, C.J. Owen, A.N. Fazakerley, J.P. Dewhurst, Y. Bogdanova: Flow shear near the boundary of the plasma sheet observed by Cluster and Geotail, *J. Geophys. Res.*, **109**, doi: 10.1029/2003JA010174 (2004)

Patel, M.R., A. Bérces, T. Kerékgyárto, Gy. Rontó, H. Lammer, J.C. Zarnecki: Annual solar UV exposure and biological effective dose rates on the Martian surface, *Adv. Space Res.*, **33**, 1247-1252 (2004)

Penz, T., N.V. Erkaev, H.K. Biernat, H. Lammer, U.V. Amerstorfer, H. Gunell, E. Kallio, S. Barabash, S. Orsini, A. Milillo, W. Baumjohann: Ion loss on Mars caused by the Kelvin-Helmholtz instability, *Planet. Space Sci.*, **52**, 1157-1167 (2004)

Pesec, P., I. Fejes: CERGOP-2/Environment, Summary of the first year, *Rep. Geodesy,* **69**, 105-114 (2004)

Rontó, Gy., A. Bérces, A. Fekete, G. Kovács, P. Gróf, H. Lammer: Biological UV dosimeters in simulated space conditions, *Adv. Space Res.*, **33**, 1302-1305 (2004)

Runov, A., V. Sergeev, R. Nakamura, W. Baumjohann, Z. Vörös, M. Volwerk, Y. Asano, B. Klecker, H. Rème, A. Balogh: Properties of a bifurcated current sheet observed on 29 August 2001, *Ann. Geophys.*, **22**, 2535-2540 (2004)

Schmieder, B., B. Vincent, W. Baumjohann, T. Ono, S. Basu, J. Lean: Climate and weather of the Sun-Earth system: CAWSES, *Adv. Space Res.*, **34**, 443-448 (2004)

Sergeev, V., A. Runov, W. Baumjohann, R. Nakamura, T.L. Zhang, A. Balogh, P. Louarn, J.-A. Sauvaud, H. Rème: Orientation and propagation of current sheet oscillations, *J. Geophys. Res.*, **31**, doi:10.1029/2003GL019346 (2004)

Treumann, R.A., C.H. Jaroschek, O.D. Constantinescu, R. Nakamura, O.A. Pokhotelov, E. Georgescu: The strange physics of low frequency mirror mode turbulence in the high temperature plasma of the magnetosheath, *Nonlin. Proc. Geophys.*, **11**, 647-657 (2004)

Vellante, M., H. Luhr, T.L. Zhang, V. Wesztergom, U. Villante, M. De Lauretis, A. Piancatelli, M. Rother, K. Schwingenschuh, W. Koren, W. Magnes: Ground-satellite signatures of field line resonance: A test of theoretical predictions, *J. Geophys. Res.*, **109**, A06210 (2004)

Verigin, M.I., J. Slavin, A. Szabo, G.A. Kotova, A.P. Remizov, H. Rosenbauer, S. Livi, K. Szegö, M. Tátrallyay, K. Schwingenschuh, T.L. Zhang:

Unusually distant bowshock encounters at Mars: Analysis of March 24, 1989 event, *Space Sci. Rev.*, 111, 233–243 (2004)

Villante, U., M. Vellante, A. Piancatelli, A. Di Cienzo, T.L. Zhang, W. Magnes, V. Wesztergom, A. Meloni: Some aspects of man-made contamination on ULF measurements, *Ann. Geophys.*, 22, 1335–1345 (2004)

Vogl, D.F., B. Cecconi, W. Macher, P. Zarka, H.P. Ladreiter, P. Fédou, A. Lecacheux, T. Averkamp, G. Fischer, H.O. Rucker, D.A. Gurnett, W.S. Kurth, G.B. Hospodarsky: In-flight calibration of the Cassini-Radio and Plasma Wave Science (RPWS) antenna system for direction-finding and polarization measurements, *J. Geophys. Res.*, 109, doi:10.1029/2003JA010261, 2004 (2004)

Volwerk, M., K.-H. Glaßmeier, A. Runov, R. Nakamura, W. Baumjohann, B. Klecker, I. Richter, A. Balogh, H. Rème, K. Yumoto: Flow burst-induced large-scale plasma sheet oscillation, *J. Geophys. Res.*, 109, doi:10.1029/2004JA010533 (2004)

Volwerk, M., W. Baumjohann, K.-H. Glaßmeier, R. Nakamura, T.L. Zhang, A. Runov, Z. Vörös, B. Klecker, R.A. Treumann, Y. Bogdanova, H.-U. Eichelberger, A. Balogh, H. Rème: Compressional waves in the Earth's neutral sheet, *Ann. Geophys.*, 22, 303–315 (2004)

Volwerk, M., Z. Vörös, W. Baumjohann, R. Nakamura, A. Runov, T.L. Zhang, K.-H. Glaßmeier, R.A. Treumann, B. Klecker, A. Balogh, H. Rème: Multi-scale analysis of turbulence in the Earth's current sheet, *Ann. Geophys.*, 22, 2525–2533 (2004)

Vörös, Z., W. Baumjohann, R. Nakamura, A.V. Runov, M. Volwerk, T.L. Zhang, A. Balogh: Wavelet analysis of magnetic turbulence in the Earth's plasma sheet, *Phys. Plasmas*, 11, doi:10.1063/1.1667499 (2004)

Vörös, Z., W. Baumjohann, R. Nakamura, M. Volwerk, A.V. Runov, T.L. Zhang, H.-U. Eichelberger, R. Treumann, E. Georgescu, A. Balogh, B. Klecker, H. Rème: Magnetic turbulence in the plasma sheet, *J. Geophys. Res.*, 109, 1–16 (2004)

Zhang, T.L., K.K. Khurana, C.T. Russell, M.G. Kivelson, R. Nakamura, W. Baumjohann: On the Venus bow shock compressibility, *Adv. Space Res.*, 33, 1920–1923 (2004)

6.2 Proceedings & Book Chapters

Amerstorfer, U.V., T. Penz, N.V. Erkaev, H.K. Biernat, H. Lammer: Instability induced momentum transfer at the Martian ionopause. In: *Proc. of the Workshop on Auroral Phenomena*, Ed. Polar Geophysical Institute, Russian Academy of Sciences, Apatity, 61–64 (2004)

Amerstorfer, U.V., H. Lammer, T. Tokano, F. Selsis, C. Kolb, A. Bérces, G. Kovács, M.R. Patel, C.S. Cockell, Gy. Rontó, T. Penz, N. Erkaev, H.K. Biernat: Evolution of the Martian Surface Pressure: Implications for the Planetary Surface Environment. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 165–166 (2004)

Baumjohann, W.: The Sun-Earth plasma environment: Space weather. In: *Proc. 21st Century Earth Science COE Symp.,* Ed. T. Yamagata, Univ. of Tokyo, 220–231 (2004)

Belisheva, N.K., T.L. Kachanova, S.A. Chernouss, H. Lammer, H.K. Biernat: The Connection of ozone variations with geocosmical agents and human organism state on the basis of systems reconstruction technology, *Proc. 20th Quadrennial Ozone Symp.*, 20, 811 (2004)

Chernouss, S.A., H. Lammer, N.K. Belisheva, H.K. Biernat: The problem of assessment of biological effectivity of UV radiation and ozone is solved by coupled dosimetry. In: *Proc. 20th Quadrennal Ozone Symp.*, Ed. C.S. Zereforos, Univ. of Athens, 1069 (2004)

Dorotovic, I., Z. Vörös: Examining the role of turbulence in the solar wind – magnetosphere interaction processes. In: *Multi-Wavelength Investigations of Solar Activity, Proc. IAU Symp. No. 223*, Eds. A.V. Stepanov, E.E. Benevolenskaya, A.G. Kosovichev, International Astronomical Union, Paris, doi:10.1017/S1743921304006763 (2004)

Draper, N.C., M. Lester, J.A. Wild, S.E. Milan, G. Provan, A. Grocott, S.W.H. Cowley, A.N. Fazakerley, A. Lahiff, J.A. Davies, J.-M. Bosqued, J.P. Dewhurst, R. Nakamura, C.J. Owen: Simultaneous SuperDarn and Cluster observations of the growth and expansion phases of a substorm. In: *Proc. 7th Int. Conf. Substorms*, Eds. N. Ganushkina and T. Pulkkinen, Finnish Meteorological Inst., Helsinki, 103-106 (2004)

Fomin, B.F., T.L. Kachanova, M.L. Khodachenko, N.K. Belisheva, H. Lammer, A. Hanslmeier, H.K. Biernat, H.O. Rucker: Prediction of solar flaring and CME activity by means of COnceptual MODelling (COMOD) technology for the reconstruction of complex systems. In: *Communications, Information and Control Systems, Technologies and Applications*, Ed. Jose Aguilar, Int. Inst. Informatics and Systemics, Orlando, 161-166 (2004)

Gubchenko, V.M., V.V. Zaitsev, H.K. Biernat, M.L. Khodachenko, H.O. Rucker: To kinetic modeling of solar wind over magnetoactive regions and beyond. In: *IAU Symp. 223*, Russ. Acad. of Sciences, St. Petersburg, 85-86 (2004)

Hyden, W., W. Macher, G. Kargl, C. Kolb, H. Lammer, H.O. Rucker: Implications of Dielectric Properties of the Martian Surface Soil on the Search for Subsurface Liquid Water or Ice Reservoirs. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 209-210 (2004)

Kolb, C., P. Stimpfl, H. Krenn, H. Lammer, G. Kargl, C.S. Cockell, M.R. Patel, Gy. Rontó, R. Abart: Simulation of the UV-irradiation at the Martian Surface for Exobiology Experiments. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 223-224 (2004)

Kolb, C., R. Abart, E. Wappis, T. Penz, H. Lammer, E.K. Jessberger: The Meteoritic Input on Mars – Influence on Organic Geochemistry. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 225-226 (2004)

Kovács, G., A. Fekete, K. Módos, M. Hegedus, Gy. Rontó, C. Panitz, H. Lammer: Experiments of the Effects of Space Environmental Factors on DNA and Nucleoproteins. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 229-230 (2004)

Lammer, H., F. Selsis, I. Ribas, E.F. Guinan, S.J. Bauer, W.W. Weiss: Hydrodynamic escape of exoplanetary atmospheres. In: *2nd Eddington Workshop – Stellar Structure and Habitable Planet Finding*, Eds. F. Favata and S. Aigrain, ESA-SP-538, 339-342 (2004)

Lammer, H., F. Selsis, T. Penz, U.V. Amerstorfer, H.I.M. Lichtenegger, C. Kolb, I. Ribas: Atmospheric evolution and the history of water on Mars. In: *Water on Mars and Life*, Ed. T. Tokano, Springer-Verlag, Berlin, 25-44 (2004)

Lammer, H., H.I.M. Lichtenegger, A. Hosseinmardi: Evolution of the Martian water inventory. In: *Origins*, Ed. J. Seckbach, Kluwer Academic Publishers, Amsterdam, 633-643 (2004)

Lammer, H.: Estimation of the present and past water-ice reservoirs on Mars by constraints on exchange between the atmosphere and the surface. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 3-6 (2004)

Leblanc, F., D. Delcourt, H. Lammer, K.M. Torkar, J.-J. Berthelier, O. Vaisberg, J. Woch: Ion of planetary origins at Mercury: Some estimates, *Notes du Pole de Planétologie*, **5**, 15 (2004)

Mazelle, C., D. Winterhalter, K. Sauer, J.G. Trotignon, M.H. Acuña, K. Baumgärtel, C. Bertucci, D.A. Brain, S.H. Brecht, M. Delva, E. Dubinin, M. Øieroset, J. Slavin: Bow shock and upstream phenomena at Mars. In: *Mars' Magnetism and its Interaction with the Solar Wind*, Eds. D. Winterhalter, M. Acuna, A. Zakharov, ISSI, Kluwer Academic Publishers, Dordrecht, Netherlands, 115-181 (2004)

Nagai, T., R. Nakamura, T. Hori, S. Kokubun: The loading-unloading process in the magnetotail during a prolonged steady southward IMF Bz period. In: *Frontiers in Magnetospheric Plasma Physics*, Eds. M. Hoshino et al., Elsevier-Pergamon, Amsterdam, 190-193 (2004)

Nakamura, R., C. Mouikis, L. Kistler, W. Baumjohann, A. Runov, Y. Asano, M. Volwerk, B. Klecker, A. Balogh, H. Rème: Plasma sheet fast flows and their relationships to tail current sheet dynamics: Cluster observation. In: *Proc. 7th Int. Conf. Substorms*, Eds. N. Ganushkina and T. Pulkkinen, Finnish Meteorological Inst., Helsinki, 133-139 (2004)

Nakamura, R., W. Baumjohann, H. Noda, K.M. Torkar, T. Nagai, M. Fujimoto, T. Mukai, B. Klecker, G. Paschmann, P. Puhl-Quinn, H. Vaith, J. Bogdanova, A. Balogh, H. Rème, J.A. Sauvaud, J. Quinn, R. Torbert, L. Kistler: Plasma sheet expansion observed by Cluster and Geotail. In: *Frontiers in Magnetospheric Plasma Physics*, Eds. M.

Hoshino et al., Elsevier-Pergamon, Amsterdam, 177-185 (2004)

Penz, T., H. Lammer, N.V. Erkaev, J.-M. Grießmeier, D.F. Vogl, H.K. Biernat, A. Hanslmeier, W.W. Weiss: Plasma and magnetic field parameters at bow shocks of short period extrasolar gas giants. In: *Proc. of the Workshop on Auroral Phenomena*, Ed. Polar Geophysical Institute, Russian Academy of Sciences, Apatity, 39-42 (2004)

Penz, T., V.S. Semenov, V.V. Ivanova, I.B. Ivanov, V.A. Sergeev, R. Nakamura, M.F. Heyn, I.V. Kubyshkin, H.K. Biernat: Application of a reconstruction method for the reconnection rate applied to Cluster data from the Earth magnetotail. In: *Proc. of Problems of Geocosmos 5*, Ed. Institute of Physics, State University St. Petersburg, Russia, 109-112 (2004)

Runov, A., Y. Asano, Z. Vörös, R. Nakamura, W. Baumjohann, G. Paschmann, J. Quinn, C. McIlwain, A. Balogh, H. Rème: Cluster magnetotail probe during the 13 September 2002 substorm. In: *Proc. 7th Int. Conf. Substorms*, Eds. N. Ganushkina and T. Pulkkinen, Finnish Meteorological Inst., Helsinki, 188-194 (2004)

Sacher, S., C. Kolb, G. Krammer, H. Lammer, G. Kargl, C.S. Cockell, A. Bérces, R. Abart: Simulation of the Martian Atmosphere for Exobiology Experiments with Special Emphasis on the Water Content. In: *Proc. 3rd European Workshop on Exo/Astrobiology*, Eds. R.A. Harris and L. Ouwehand, ESA SP-545, 283-284 (2004)

Scherr, A.: IWF Graz - Zentrum der österreichischen Weltraumforschung. In: *Graz hat alles...*, M+N Medienverlag, Graz, 177-181 (2004)

Scherr, A.: Raumsonde Rosetta auf Kometenjagd, *Mitt. Österr. Phys. Ges.*, 1, 4-6 (2004)

Semenov, V.S., I.V. Kubyshkin, R.P. Rijnbeek, H.K. Biernat: Analytical theory of unsteady Petschek-type reconnection. In: *Physics of Magnetic Reconnection in High-Temperature Plasmas*, Ed. M. Ugai, Research Signpost, Keralia, 35-38 (2004)

Semenov, V.S., T. Penz, M.F. Heyn, I.B. Ivanov, I.V. Kubyshkin, H.K. Biernat, V.V. Ivanova: Reconstruction of the reconnection rate from perturbations in the ambient magnetic field. In: *Proc. of the Workshop on Auroral Phenomena*, Ed. Polar Geophysical Institute, Russian Academy of Sciences, Apatity, 47-50 (2004)

Sünkel, H.: Weltraumforschung "made in Graz". In: *Steiermark Innovation 2004*, Eds. K. Brunner et al., Leykam, Graz, 144-145 (2004)

Weiss, W.W., C. Aerts, S. Aigrain, G. Alecian, E. Antonello, A. Bagalin, M. Bazot, A. Collier-Cameron, S. Charpinet, A. Gamarova, G. Handler, A. Hatzes, A.-M. Hubert, H. Lammer et al.: Additional science potential for COROT. In: *Proc. 2nd Eddington Workshop*, Eds. F. Favata and S. Aigrain, ESA SP-538, 435-445 (2004)

6.3 Books & Special Issues

Bauer, S.J., H. Lammer: Planetary Aeronomy, Springer-Verlag, Berlin, 207 pages (2004)

Besser, B.P.: Austria's History in Space, ESA Publications Division, Noordwijk, 70 pages (2004)

de Pater, I., N. Kassim, H.O. Rucker (Eds.): The Low Frequency Array (LOFAR) and (Extra-)Solar System Science, Planet. Space Sci. Special Issue, 153 pages (2004)

6.4 Other Publications

Amerstorfer, U.V., H.K. Biernat, H. Lammer, N.V. Erkaev, T. Penz, R. Kleindl: The solar wind interaction with Venus and Mars with regard to atmospheric evolution, IWF 154, 88 pages (2004)

Aydogar, Ö.: Fluxgate Magnetometer Offset Calibration for DoubleStar FGM, FM2, IWF 2004/02, 6 pages (2004)

Boudjada, M.Y., P.H.M. Galopeau: Jovian "substorm" and its influence on the hectometric (HOM) and kilometric (KOM) emissions, IWF 152, 25 pages (2004)

Eichelberger, H.-U., et al.: DoubleStar FGM FM2 Sample Rate and Frequency Response Analysis, IWF 2004/01, 39 pages (2004)

Eichelberger, H.-U., T.L. Zhang, Ö. Aydogar, K. Schwingenschuh: DSP TC1 Progress Report: Spike removing and Spin Average Disturbance (SAD) correction, IWF 2004/03, 9 pages (2004)

Fischer, G.: Energy dissipation and HF radiation of lightning on Titan and Earth, IWF 155, 160 pages (2004)

Hütter, E.S.: Universal Logger Dokumenation, IWF 157, 28 pages (2004)

Oswald, T., W. Macher, G. Fischer, H.O. Rucker: First results of STEREO/WAVES Antenna calibration, IWF 160, 51 pages (2004)

Steiner, J., H.K. Biernat, D. Langmayr, N.V. Erkaev, H.O. Rucker: Investigation of MHD-modes in an anisotropic medium, IWF 156, 101 pages (2004)

Taubenschuss, U., H.O. Rucker, W. Macher: Jupiter S-burst polarization measurements using the Waveform Receiver, IWF 159, 22 pages (2004)

Treffer, M.: Melting probes for exploring ice layers on planets and moons, IWF 153, 93 pages (2004)

6.5 Invited Talks

Asano, Y., T. Mukai, M. Hoshino, Y. Saito, H. Hayakawa, T. Nagai: Statistical study of thin current sheet evolution around substorm onset (Geotail observations), *2nd Workshop on Thin Current Sheets*, College Park, Apr 2004.

Baumjohann, W.: The Sun-Earth plasma environment: Space weather, *Int. Symp. on "Predictability of the Multi-scale Earth System"*, Tokyo, Jan 2004.

Baumjohann, W.: Bifurcated and thin current sheets: Cluster results, *EGU General Assembly*, Nice, Apr 2004.

Baumjohann, W.: Future multi-spacecraft magnetospheric missions, *Regional Cospar Workshop*, Beijing, May 2004.

Baumjohann, W.: Hermean magnetospheric physics, *EGU General Assembly*, Nice, Apr 2004.

Baumjohann, W.: Magnetotail transport, *Magnetic Reconnection in the Sun and Magnetosphere*, Cambridge, Aug 2004.

Baumjohann, W.: Magnetotail Transport and Substorms, *EGU General Assembly*, Nice, Apr 2004.

Baumjohann, W.: Solar system themes, *ESA Workshop Cosmic Vision 2015-2025*, Paris, Sep 2004.

Baumjohann, W.: Solar-terrestrial plasma environment, *UN-COPUOS Meeting*, Vienna, Feb 2004.

Baumjohann, W.: The Cluster and DoubleStar Missions, *Regional Cospar Workshop*, Beijing, May 2004.

Baumjohann, W.: The magnetosphere of Mercury and its solar wind environment, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Besser, B.P.: Die Geschichte der bemannten Raumfahrt: Die ersten Helden (von Gagarin - Cernan), *Quo vadis bemannte Raumfahrt?* Vienna, Nov 2004.

Besser, B.P.: Early Pioneers of Space Activities in Austria, *Austria's History in Space / Österreichs Geschichte im Weltraum*, Graz, Apr 2004.

Besser, B.P.: History of scientific collaboration between Russia (Soviet Union) and Austria in geophysics and space research with some examples, *Problems of Geocosmos 5*, St. Petersburg, May 2004.

Kaufmann, E., N.I. Kömle, G. Kargl: The solid-state greenhouse effect, *EGU General Assembly*, Nice, Apr 2004.

Lammer, H., F. Selsis, T. Penz, E.V. Erkaev, H.K. Biernat: Evolution of exoplanetary atmospheres, *6th Humboldt Coll. for Celestrial Mechanics*, Bad Hofgastein, Mar 2004.

Lammer, H.: From Bremen to Spitsbergen via Mars, *Scientific Symp. "UV-Radiation: Interaction with the Environment and Humans"*, Budapest, May 2004.

Lammer, H.: The production of Mercury's exosphere environment, *Modelling of the Mercury Environment: Where are we before BepiColombo?* Kiruna, Aug 2004.

Lammer, H.: Titan: Vor der Ankunft der ESA Landesonde Huygens, Jahrestagung der Wiener Arbeitsgemeinschaft für Astronomie, Vienna, Dec 2004.

Leubner, M.P., Z. Vörös: A non-extensive entropy approach to astrophysical plasma turbulence tested on solar wind probability distributions, *EGU General Assembly*, Nice, Apr 2004.

Leubner, M.P., Z. Vörös: Long-range interactions determined from bi-kappa distributions in solar wind turbulence, *Int. Conf. Asia Oceania Geosciences Society,* Singapore, Jul 2004.

Leubner, M.P.: A non-extensive entropy path to interplanetary core-halo velocity space characteristics and scale dependent probability distributions, *Alfvén Workshop 2004*, Beaulieu sur Mer, Apr 2004.

Nakamura, R., et al.: Current sheet structure and particle properties near the tail reconnection region, *8th Cluster Workshop*, Durham, Sep 2004.

Nakamura, R., et al.: Plasma sheet fast flows and their relationships to pseudo onset/substorms: Cluster observation, *ICS-7*, Levi, Mar 2004.

Nakamura, R., W. Baumjohann, A.V. Runov: Current sheet dynamics observed by Cluster, *2nd Workshop on Thin Current Sheets*, College Park, Apr 2004.

Pesec, P., I. Fejes: CERGOP-2/Environment: Summary of the first year, *EGU General Assembly*, Nice, Apr 2004.

Rucker, H.O.: The EUROPLANET project and its connections to RadioNet, *2nd Int. RadioNet Board Meeting*, Jodrell Bank, Nov 2004.

Runov, A.V. et al.: Cluster multi-point observations in the magnetotail: Results, perspectives, and open questions, *ISRADYNAMICS 2004*, Beer-Sheva, Mar 2004.

Runov, A.V., et al.: Active-time magnetotail current sheet structure reconstructed from Cluster multipoint observations, *ICS-7*, Levi, Mar 2004.

Stangl, G., C. Bruyninx: Recent Monitoring of Crustal Movements in the Eastern Mediterranean, *The Adria Microplate*, Veszprem, Apr 2004.

Torkar, K.M., et al.: First results of active spacecraft potential control for the Double Star TC-1 spacecraft, *2nd Double Star Cluster workshop*, Beijing, Nov 2004.

Volwerk, M.: Fast flows in the current sheet: Wave activity and turbulence, *Alfvén Workshop 2004*, Beaulieu sur Mer, Apr 2004.

Vörös, Z., et al.: Multi-scale magnetic turbulence in the Earth plasma sheet, *Conf. on Sun-Earth Connections*, Kona, Feb 2004.

Vörös, Z.: Multi-spacecraft methods, *Analysis techniques for turbulent plasmas*, Copanello, Sep 2004.

Zhang, T.L.: Magnetic field investigation of the venus plasma environment: What do we expect from the Venus express mission, *EGU General Assembly*, Nice, Apr 2004.

Zhang, T.L.: Night-side magnetosphere observed by DSP in conjunction with Cluster, *2nd Double Star Cluster workshop*, Beijing, Nov 2004.

Zhang, T.L.: The contribution of planetary missions to the space weather study, *5th Chinese Space Weather Symp.*, Fujian, Sep 2004.

6.6 Oral Presentations

Arsov, K. Pail, R.: One possible treatment of temporal variations of the Earth's gravity field in the course of GOCE mission, *Gravity, Geoid and Space Missions*, Porto, Sep 2004.

Asano, Y., et al.: A clear substorm even with flow reversal, *7th Cluster Workshop*, Holmbury St. Mary, Mar 2004.

Asano, Y., et al.: Observation of short-time scale PSBL beams using EDI and FGM data, *7th Cluster Workshop*, Holmbury St. Mary, Mar 2004.

Asano, Y., et al.: Relative occurence of bifurcated current sheet in the magnetotail observed by Cluster, *116th SGEPSS Fall Meeting*, Matsuyama, Sep 2004.

Asano, Y., R. Nakamura, W. Baumjohann, A.V. Runov, A. Balogh, B. Klecker, H. Rème: Relative occurrence of bifurcated current sheets, *2nd Workshop on Thin Current Sheets*, College Park, Apr 2004.

Asano, Y., R. Nakamura, W. Baumjohann, A.V. Runov, Z. Vörös, M. Volwerk, T.L. Zhang, A. Balogh, B. Klecker, H. Rème: Statistical study of electric current in the magnetotail observed by Cluster, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Baumjohann, W., et al.: The magnetic field experiment (MERMAG-M/MGF) for Bepi-Colombo MMO, *11th IAGA Workshop on Geomagnetism*, Kakioka, Nov 2004.

Baumjohann, W.: Weltraumforschung made in Graz, Rotary Klub Graz, Mar 2004.

Besser, B.P., H.I.M. Lichtenegger, J.A. Morente, A.P. Nicholaenko; G.J. Molina-Cuberos, K. Schwingenschuh, J. Porti, A. Salinas: Comparison of Schumann resonance calculations for the atmosphere of Titan, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Besser, B.P., O. Zellhofer: Österreichs Geschichte im Weltraum, Interuniversitäres Forschungszentrum für Technik, Graz, May 2004.

Besser, B.P.: Saturn und sein rätselhafter Mond Titan, Katholisches Bildungshaus Tainach, Nov 2004.

Besser, B.P.: Titan - ein unwirtlicher Saturnmond, URANIA für Steiermark, Graz, Mar 2004.

Biernat, H.K., H.I.M. Lichtenegger, H. Lammer: Magnetospheric coupling mechanisms, *III Int. Conf. "Solar Terrestrial Bonds and Electromagnetic Precursors of Earthquakes"*, Kamchatka, Aug 2004.

Boudjada, M.Y., A. Stangl, S. Sawas, A. Lecacheux, H.O. Rucker, W. Voller and the Cassini RPWS team: Quantitative approach to derive the spectral features of Solar Decametric Type III bursts, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Boudjada, M.Y., P.H.M. Galopeau, H.O. Rucker: Jovian Active Longitudes Inferred From the Cyclotron Maser Instability, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Boudjada, M.Y., W. Macher, H.O. Rucker, G. Fischer: Solar Orbiter: Physical aspects towards a better knowledge of the Solar Corona, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Cristea, E., C. Haslinger, G. Stangl: Seasonal Monitoring of Hafelekar GPS Permanent Station, *EGU General Assembly*, Nice, Apr 2004.

Cristea, E., W. Hausleitner: ENVISAT - Range Calculation using a Transponder, *ENVISAT Symp.*, Salzburg, Sep 2004.

Delva, M.: Unter den Wolken der Venus, URANIA für Steiermark, Graz, Feb 2004.

Jernej, I., M.B. Steller: Raumsonde Cassini/Huygens: Auf dem Weg zu Saturn und Titan, *Lange Nacht der Sterne*, Graz, Sep 2004.

Kargl, G.: The evolution of icy regions in our solar system, The Open University, Milton Keynes, Oct 2004.

Kaufmann, E., N.I. Kömle, G. Kargl: Laboratory simulation and theoretical modeling of the Solid-State Greenhouse Effect, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Khodachenko, M.L., H.O. Rucker, T.D. Arber, A. Hanslmeier: On the mechanisms of MHD wave damping in the partially ionized solar plasmas, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Khodachenko, M.L., H.O. Rucker: Solar plasma theoretical models for STEREO and Solar-B, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Khodachenko, M.L.: Theoretical solar physics studies at IWF Graz, Russian Academy of Sciences, Nizhny Novgorod, Aug 2004.

Kirchner, G., D. Arnold, F. Koidl: Identifiying Single Retro Tracks With A 2 kHz SLR System, *14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Kirchner, G., F. Koidl: Graz kHz SLR System: Design, Experiences and Results, *14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Kirchner, G., F. Koidl: 2 kHz Photon Counting Satellite Laser Ranging System Graz, *AMOS Tech 2004*, Maui, Sep 2004.

Kolb, C., R. Abart, H. Lammer: Regolith mixing relationships on the surface of Mars: mathematical and statistical tools, Dept. for Informatics and Applied Mathematics, Girona, Oct 2004.

Kolb, C., R. Abart, W. Lottermoser, R. Kaindl, H. Lammer: Importance of weathered meteorites for Mars: data on VNIR reflectance-spectroscopy, Raman-spectroscopy and Mössbauer-spectroscopy, *European Conf. on Mineralogy and Spectroscopy*, Vienna, Sep 2004.

Kolb, C., W. Hohenau, H. Krenn, H. Lammer, G. Kargl, C.S. Cockell, M.R. Patel, A. Bérces, R. Abart: A simulator for the incident UV-radiation at the Martian surface - calibration and performance, *4th European Workshop on Exo/Astrobiology*, Milton Keynes, Nov 2004.

Kömle, N.I., M. Treffer, G. Kargl, E. Kaufmann, M.B. Steller: Development of melting probes for exploring ice sheets and permafrost layers, *The 6th Int. Symp. on Permafrost Engineering*, Lanzhou, Sep 2004.

Kömle, N.I.: Thermal probes for exploring the vertical structure of ice sheets: Applications to Mars and Europa, Hong Kong Polytechnic University, Hong Kong, Sep 2004.

Koren, W.: Industrial Network, Wirtschaftskammer Steiermark, Graz, Feb 2004.

Lammer, H., A. Bérces, P. Rettberg, S.A. Chernouss, N.K. Belisheva, H.I.M. Lichtenegger: Monitoring

UV radiation by bio-dosimeters over wide geographical areas, *Geophysical Research in Spitsbergen Archipelago*, Barentsburg, May 2004.

Lammer, H., C. Kolb, T. Penz, H.K. Biernat, Yu.N. Kulikov: The first billion years: water loss on early Mars, IRF, Kiruna, Aug 2004.

Lammer, H., F. Selsis, Yu.N. Kulikov, I. Ribas, T. Penz, J.-M. Grießmeier, M. Leitner, N.V. Erkaev, H.K. Biernat: Atmospheric stability of Earth-like planets in close-in habitable zones of M stars, *Bioastronomy 2004*, Reykjavik, Jul 2004.

Lammer, H., M.Y. Boudjada, H.K. Biernat, E. Cristea, C. Kolb, H.I.M. Lichtenegger: Generation of short term EM-wave variations triggered by plasma disturbances in the upper atmosphere: Space based seismo-ionospheric signature monitoring correlated with GPS arrays, *3rd Int. Conf. "Solar Terrestrial Bonds and Electromagnetic Precursors of Earthquakes"*, Kamchatka, Aug 2004.

Lammer, H., Yu.N. Kulikov, N.V. Erkaev, H.I.M. Lichtenegger, H.K. Biernat: Stellar radiation and particle interaction with short periodic giant exoplanets, *Planet Workshop: The star-planet connection*, Orsay, May 2004.

Lammer, H.: Evolution of habitable planets, Inst. for Astronomy, University of Vienna, Mar 2004.

Lammer, H.: Evolution von Planetenatmosphären, Steirischer Astronomenverein, Kepler Gymnasium, Graz, Aug 2004.

Lammer, H.: Mars Express – Europa erforscht den Roten Planeten, Oberösterreichischer Astronomenverein, Linz, Mar 2004.

Lammer, H.: Saturn's ionosphere and Titan's atmosphere, ESOC, Amorbach, Nov 2004.

Leitner, M., H.K. Biernat, C.J. Farrugia, H. Lammer, A. Hanslmeier: Effect of "CMEs-Magnetic clouds" on exoplanets close to their host stars, *Planet Workshop: The star-planet connection*, Orsay, May 2004.

Leubner, M.P., Z. Vörös: A non-extensive entropy path to probability distributions in solar wind turbulence, *Int. Conf. on Sun-Earth Connections: Multiscale Couplings of Sun-Earth Processes*, Kona, Feb 2004.

Leubner, M.P.: Long-range interactions and probability distribution functions in the interplanetary medium, Goddard Space Flight Center, Greenbelt, Feb 2004.

Lichtenegger, H.I.M., H. Lammer, H.K. Biernat: Propagation of ELF-waves in planetary atmospheres: Lightning and seismic generated emissions, *3rd Int. Conf. "Solar Terrestrial Bonds and Electromagnetic Precursors of Earthquakes"*, Kamchatka, Aug 2004.

Lichtenegger, H.I.M., H.K. Biernat, U.V. Amersdorfer, T. Penz, W. Baumjohann, N.V. Erkaev, Y.P. Maltsev, H. Lammer: The solar wind interaction with magnetic and non-magnetic bodies, *Geophysical Research in Spitsbergen Archipelago*, Barentsburg, Jun 2004.

Lichtenegger, H.I.M., J.A. Morente, B. Besser, K. Schwingenschuh, G.J. Molina-Cuberos, J. Porti: Numerical modelling of Schumann Resonances at Titan, *27th Annual Seminar*, Apatity, Mar 2004.

Lichtenegger, H.I.M.: Der Mars – ein erdähnlicher Planet? Katholisches Bildungshaus Tainach, Nov 2004.

Lichtenegger, H.I.M.: Der Mars – ein erdähnlicher Planet? URANIA für Steiermark, Graz, Jan 2004.

Nakamura, R., et al.: Flow reversal event with multiple current sheet crossings, *7th Cluster Workshop*, Holmbury St. Mary, Mar 2004.

Nakamura, R., et al.: Thin current sheet development during substorm growth and onset, *7th Cluster Workshop*, Holmbury St. Mary, Mar 2004.

Nakamura, R., W. Baumjohann, A.V. Runov, Y. Asano, A. Balogh, C. Mouikis, L. Kistler, B. Klecker, H. Rème: Observations of thin current sheets in the Earth's magnetotail, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Nakamura, R., W. Baumjohann, A.V. Runov, Y. Asano, A. Balogh, C. Mouikis, L.M. Kistler, B. Klecker, H. Rème: Cluster multi-point observation of the thin current sheets in the magnetotail, *AGU Fall Meeting*, San Francisco, Dec 2004.

Nakamura, R., W. Baumjohann, A.V. Runov, Y. Asano, A. Balogh, H. Rème: Thin Current sheets measured by Cluster at 200 km tetrahedron scale, *2nd Workshop on Thin Current Sheets*, College Park, Apr 2004.

Ottacher, H.: Beobachtung extrasolarer Planeten durch Satelliten, Katholisches Bildungshaus Tainach, Nov 2004.

Ottacher, H.: Satellitengestütze Aufspürung extrasolarer Planetensysteme, URANIA für Steiermark, Graz, Mar 2004.

Penz, T., H. Lammer, H.K. Biernat: Evolution of Titan's atmosphere due to the solar wind interaction, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Penz, T., V.S. Semenov, V.V. Ivanova, I.B. Ivanov, V.A. Sergeev, R. Nakamura, M.F. Heyn, I.V. Kubyshkin, H.K. Biernat: Application of a reconstruction method for the reconnection rate to Cluster data from the Earth magnetotail, *Problems of Geocosmos 5*, St. Petersburg, May 2004.

Penz, T., V.S. Semenov, V.V. Ivanova, I.B. Ivanov, V.A. Sergeev, I.V. Kubyshkin, R. Nakamura, M.F. Heyn, H.K. Biernat: A reconstruction method for the reconnection rate applied to Cluster magnetotail measurements, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Pesec, P., G. Stangl: Development of the CERGOP2 database - Progress report work package 1, *EGU General Assembly*, Nice, Apr 2004.

Pesec, P., G. Stangl: Development of the CERGOP2 database, *EGU General Assembly*, Nice, Apr 2004.

Pesec, P.: Erdüberwachung aus dem All, URANIA für Steiermark, Graz, Mar 2004.

Rucker, H.O., W. Macher, G. Fischer, J.L. Bougeret, M.L. Kaiser, K. Goetz: Analysis of spacecraft antenna systems: implications for STEREO/WAVES, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Rucker, H.O.: Coordinated ground-based observations and the Cassini/Huygens mission, TUG, Graz, Jun 2004.

Rucker, H.O.: Facetten der Physik. Cassini/Huygens im Saturn System: Beiträge des Instituts für Weltraumforschung, KFU, Graz, May 2004.

Rucker, H.O.: Planetary Radio Astronomy and the Cassini RPWS Experiment, ETH, Zürich, Apr 2004.

Runov, A., R. Nakamura, W. Baumjohann, V. Sergeev, A. Balogh, H. Rème: Active-time magnetotail current sheet structure reconstructed from Cluster multi-point observations, *ICS-7*, Levi, Mar 2004.

Runov, A.V., et al.: Kink-like oscillations of the magnetotail current sheet, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Stangl, G., C. Bruyninx, H. Habrich: Alternative EPN Data Flow, TWG, Budapest, Mar 2004.

Stangl, G., C. Bruyninx, H. Habrich: Alternative EPN Data Flow 2, TWG, Bratislava, May 2004.

Stangl, G., P. Pesec, C. Haslinger: Development of the CERGOP2 database 2, *CERGOP2 Working Conf.*, Sofia, Sep 2004.

Takada, T., K. Seki, M. Hirahara, M. Fujimoto, Y. Saito, H. Hayakawa, T. Mukai: Statistical properties of low-frequency waves and ion beams in the plasma sheet boundary layer: Geotail observations, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Taubenschuss, U., H.O. Rucker: Simultaneous observations of Jovian radio emission by WIND satellite and Galileo spacecraft, *EGU General Assembly*, Nice, Apr 2004.

Torkar, K.M.: Active Spacecraft Potential Control for Double Star TC-1, *7th SPINE Meeting*, Toulouse, Jun 2004.

Torkar, K.M., G. Fremuth, W. Steiger, B.T. Narheim, K. Svenes, C.P. Escoubet, M. Fehringer, H. Arends, A.N. Fazakerley: First results of ion emitter operation to control the spacecraft potentioal of Double Star TC-1, *EGU General Assembly*, Nice, Apr 2004.

Torkar, K.M., H. Jeszenszky, W. Riedler, M.B. Steller, J. Romstedt, H. Arends, B. Butler: The MIDAS atomic force microscope for Rosetta: status and perspectives after instrument commissioning, *EGU General Assembly*, Nice, Apr 2004.

Volwerk, M., C. Paranicas, M.G. Kivelson, K.K. Khurana: Europa's Interaction With Jupiter's Magnetosphere: The Wake Region, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Volwerk, M., et al.: Flow Burst Induced Large Scale Plasma Sheet Oscillation on August 12, 2001, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Volwerk, M., K.H. Glaßmeier, A.V. Runov, R. Nakamura, W. Baumjohann, A. Balogh, H. Rème: Bursty Flow Induced Low Frequency Waves in the Plasma Sheet, *EGU General Assembly*, Nice, Apr 2004.

Volwerk, M.: Fast flows in the currentsheet: Wave activity and turbulence, *Problems of Geocosmos 5*, St. Petersburg, May 2004.

Vörös, Z., W. Baumjohann, R. Nakamura, A.V. Runov, M. Volwerk, Y. Asano, A. Balogh, B. Klecker, H. Rème: Anisotropy patterns of magnetic fluctuations in the Earth plasma sheet, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Zhang, T.L.: Planet Venus, CSSAR, Beijing, Jun 2004.

Zhang, T.L.: Venus, Peking University, Beijing, Nov 2004.

6.7 Posters

Asano, Y., et al.: Detailed analysis of the magnetotail around the near-Earth neutral line region during a substorm, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Baumjohann, W., R. Nakamura, C.M. Carr, M. Volwerk, T.L. Zhang, Y. Asano, H.-U. Eichelberger, A. Balogh, K.-H. Glaßmeier, C. Mouikis, L. Kistler, B. Klecker, H. Rème: Cluster/Double Star Observations of Substorm Dipolarization, *AGU Fall Meeting*, San Francisco, Dec 2004.

Baumjohann, W., W. Magnes, A. Matsuoka, H.-U. Auster, K.-H. Glasseier: The magnetic field experiment (MERMAG-M /MGF) for BepiColombo MMO, *XIth IAGA workshop on geomagnetic observatory instruments, data acquisition and processing*, Tsukuba, Nov 2004.

Besser, B.P., V.V. Lebedeva, C.-V. Meister, R.P. Rijnbeek: Model of solar wind flow in the Earth's magnetosheath, *Problems of Geocosmos 5*, St. Petersburg, May 2004.

Boudjada, M.Y., P. Galopeau, H.O. Rucker: Jovian active longitudes inferred from the cyclotron maser instability, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Boudjada, M.Y., P.H.M. Galopeau: Study of the enhancement phase of the Jovian hectometric radio emissions, *EGU General Assembly*, Nice, Apr 2004.

Cristea, E., C. Haslinger, G. Stangl: Hafelekar GPS Permanent Station Seasonal Monitoring, *IGS Analysis Workshop*, Bern, Mar 2004.

Delva, M., C. Bertucci, C. Mazelle, K. Schwingenschuh: Magnetic field draping and pile up boundary at Comet Halley from Vega-1 observations, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Kargl, G., A. Zöhrer, N.I. Kömle: Comparative characterization of Martian soil analogue materials, *EGU General Assembly*, Nice, Apr 2004.

Khodachenko, M.L., H.O. Rucker, T.D. Arber: On the mechanisms od MHD wave damping in the partially ionized solar plasmas, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Khodachenko, M.L., H.O. Rucker, V.V. Zaitsev, A.G. Kislyakov, S. Urpo: Inductive interaction of coronal magnetic loops as a modulating factor for the solar microwave radiation, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Kolb, C., P. Stimpfl, H. Krenn, H. Lammer, G. Kargl, R. Abart, M.R. Patel: Simulation of the UV-radiation at the Martian surface, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Kolb, C., R. Abart, H. Lammer: Weathered meteorites on Mars: evidence for a global dust unit and implications for oxidation states of the Martian surface, *32nd Int. Geological Congress*, Florence, Aug 2004.

Kolb, C., R. Abart, H. Lammer: Weathered meteorites on Mars: evidence from unmixing calculations and spectroscopy, *PANGEO Austria*, Graz, Sep 2004.

Koren, W.: Temperatursimulator für Weltraummagnetometer, *Innovation of Automation 2004*, Graz, Feb 2004.

Lammer, H., G.F. Jaritz, D.F. Vogl, N.V. Erkaev, H.K. Biernat, W.W. Weiss: XUV-driven hydrodynamic atmospheric expansion of hydrogen-rich giant exoplanets, *27th Annual Seminar*, Apatity, Mar 2004.

Lammer, H., N. Terada, T. Penz, H. Shinagawa, S. Machida, C. Kolb, H.I.M. Lichtenegger, H.K. Biernat: Simulation of the total ion loss evolution an Mars with a global hybrid model: Implications for the planet's hydrosphere, *EGU General Assembly*, Nice, Apr 2004.

Leitner, M., C.J. Farrugia, H.K. Biernat: Interplanetary magnetic clouds observed by Wind and Helios 1 & 2: Influence of the magnetic field on the stand-off distance, *New England APS/AAPT Meeting*, Exeter, Mar 2004.

Leitner, M., C.J. Farrugia, H.K. Biernat, H. Lammer, A. Hanslmeier: Effect of "CMEs-Magnetic clouds" on exoplanets close to their host stars, *COROT Week 6*, Orsay, May 2004.

Lichtenegger, H.I.M., et al.: Thermal and non-thermal escape of planetary ions at Venus, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Macher, W., H.O. Rucker, G. Fischer and the MARSIS team: Analysis of the MARSIS antenna system onboard Mars Express, *EGU General Assembly*, Nice, Apr 2004.

Nakamura, R., W. Baumjohann, A.V. Runov, Y. Asano, M. Volwerk, Z. Vörös, T.L. Zhang, A. Balogh: Spatial and temporal variation of the tail current sheet, *ICS-7*, Levi, Mar 2004.

Penz, T., H. Lammer, C. Kolb, Yu.N. Kulikov, H.K. Biernat: Geochemical and astrobiological constraints on fast evolution of complex life on exoplanets, *PANGEO Austria*, Graz, Sep 2004.

Penz, T., H. Lammer, J.-M. Grießmeier, U.V. Amerstorfer, F. Selsis, I. Ribas, H.K. Biernat: Atmospheric evolution of non-magnetized terrestrial exoplanets, *Bioastronomy 2004*, Reykjavik, Jul 2004.

Penz, T., H. Lammer, W. Piller, Yu.N. Kulikov, U.V. Amerstorfer, H.K. Biernat: Venus early water inventory: Could life evolve? *4th European Workshop on Exo/Astrobiology*, Milton Keynes, Nov 2004.

Penz, T., N.V. Erkaev, H.K. Biernat, I.L. Arshukova, H. Lammer: Comparison of magnetohydrodynamic instabilities at the Martian ionopause, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Rucker, H.O., G. Litvinenko, U. Taubenschuss, M. Leitner, A. Lecacheux, A.A. Konovalenko: Superfine structure of Jovian millisecond radio bursts, *AGU*, Montreal, May 2004.

Rucker, H.O., W. Macher, G. Fischer, J.L. Bougeret, M.L. Kaiser, K. Goetz: Analysis of spacecraft antenna systems: implications for STEREO/WAVES, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Runov, A.V., et al.: Cluster magnetotail probe during an isolated substorm on 13 September 2002, *ICS-7*, Levi, Mar 2004.

Stangl, G., P. Pesec, E. Cristea: The CERGOP2 Database, *IGS Analysis Workshop*, Bern, Mar 2004.

Takada, T., M. Volwerk, R. Nakamura, W. Baumjohann, T.L. Zhang, T. Uozumi, K.-H Glaßmeier, B. Klecker, A. Balogh, H. Rème: Pi2 Observations by Cluster and Ground Stations, *AGU Fall Meeting*, San Francisco, Dec 2004.

Taubenschuss, U., H.O. Rucker: Recent Jupiter S-burst observations at Lustbuehel observatory using the Waveform Receiver, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Torkar, K.M., W. Steiger, B.T. Narheim, K. Svenes, M. Fehringer, C.P. Escoubet, A.N. Fazakerley, H. Zhao: Active ion emission onboard the Double Star TC-1 spacecraft - results from initial science operations, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Volwerk, M., M. Kivelson, K. Khurana: Europa's Alfvén Wing: Shrinking and displacement by an induced magnetic field, *AGU Fall Meeting*, San Francisco, Dec 2004.

Vörös, Z., W. Baumjohann, M. Volwerk, R. Nakamura, A.V. Runov, T.L. Zhang, Y. Asano, A. Balogh: Statistical properties of mulit-scale magnetic turbulence in the near-Earth plasma sheet, *EGU General Assembly*, Nice, Apr 2004.

Vörös, Z., W. Baumjohann, R. Nakamura, M. Volwerk, A.V. Runov, A. Balogh, B. Klecker, H. Rème: Scaling Properties of Magnetic Fluctuations in the Earth's Plasma, *AGU Fall Meeting*, San Francisco, Dec 2004.

Zhang, T.L., R. Nakamura, M. Volwerk, A.V. Runov, W. Baumjohann, H.-U. Eichelberger, V. Sergeev, C.M. Carr, A. Balogh, K.-H. Fornacon: Cluster/DSP observation of current sheet oscillations, *AGU Fall Meeting*, San Francisco, Dec 2004.

Zhang, T.L., W. Baumjohann, G. Berghofer, W. Magnes, M. Delva, R. Nakamura, U. Auster, K-H. Glaßmeier, C.M. Carr, A. Balogh: Venus Express magnetic field investigation, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Zhang, T.L., W. Baumjohann, R. Nakamura, A.V. Runov, M. Volwerk, Z. Vörös, H.-U. Eichelberger, V. Sergeev, A. Balogh: A statistical survey of the neutral sheet, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Zöhrer, A., G. Kargl, N.I. Kömle: Laboratory Experiments and Numerical Modelling of Cone Penetra

tion Tests into Martian Analogue Materials, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Zöhrer, A., G. Kargl, N.I. Kömle: Numerical simulation of penetration tests into Martian analogue material, *EGU General Assembly*, Nice, Apr 2004.

6.8 Co-Authored Presentations

Amerstorfer, U. V., T. Penz, N.V. Erkaev, H.K. Biernat, H. Lammer: Instability induced momentum transfer at the Martian ionopause, *27th Annual Seminar*, Apatity, Mar 2004.

Amerstorfer, U.V., H. Lammer, T. Penz, C. Kolb, N.I. Erkaev, H.K. Biernat: Are Mars-size exoplanets on the limit for planetary habitability? *Bioastronomy 2004*, Reykjavik, Jul 2004.

Amm, O., R. Nakamura, A. Balogh, H.U. Frey, M. Lester, P. Ponomarenko, H. Rème, J.F. Watermann: Cluster observations of fast flow events and related ground-based observations during a period of rapidly changing IMF conditions, *EGU General Assembly*, Nice, Apr 2004.

Arnold, D., G. Kirchner, F. Koidl: Identifying Single Retro Tracks with a 2 kHz SLR System, *Proc. 14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Belisheva, N.K., H. Lammer, H.K. Biernat: Joint contributions of cosmic rays and Earth's magnetosphere in origin and evolution of terrestrial life, *Bioastronomy 2004*, Reykjavik, Jul 2004.

Belisheva, N.K., T.L. Kachanova, H. Lammer, H.K. Biernat: Variations of geocosmic agents and the growth of microflora in human organisms, *27th Annual Seminar*, Apatity, Mar 2004.

Belisheva, N.K., T.L. Kachanova, S.A. Chernouss, H. Lammer, H.K. Biernat, N.V. Kobysheva: The analysis of ozone variations and connections with local and global geocosmical agents and the functional state of human organisms by systems reconstruction technology, *27th Annual Seminar*, Apatity, Mar 2004.

Belisheva, N.K., T.L. Kachanova, S.A. Chernouss, H. Lammer, H.K. Biernat: The Connection of ozone variations with geocosmical agents and human organizm state on the basis of systems reconstruction technology, *XX Quadrennial Ozone Symp.*, Kos, Jul 2004.

Bercés, A., H. Lammer, C.S. Cockell, G. Kovács, Gy. Rontó: UV surface exposure on oxygen-free Earth-like exoplanetary environments, *4th European Workshop on Exo/Astrobiology*, Milton Keynes, Nov 2004.

Bérces, A., C.S. Cockell, H. Lammer, G. Kovács: Impact of photo-reversion on oxygen-free planetary environments exposed by the UV radiation of F, G, and K main sequence stars, *Bioastronomy 2004*, Reykjavik, Jul 2004.

Bérces, A., G. Kovács, G. Kargl, C. Kolb, C. Panitz, H. Lammer, G. Rontó: Simulation of the environmental conditions for exobiology experiments, *EGU General Assembly*, Nice, Apr 2004.

Bérces, A., H. Lammer, G. Kovács, Gy. Rontó, N.K. Belisheva, C.S. Cockell, G. Kargl, N.I. Kömle, H.K. Biernat: Photo-reversion caused by UV radiation: Life and the solar radiation on planetary environments with low ozone contents, *27th Annual Seminar*, Apatity, Mar 2004.

Bodiselitsch, B., H. Lammer: Do SNC noble gas and deuterium data provide evidence for a large cometary impact in the time between 1300 – 300 Ma on Mars? *12th Ocean Sciences Meeting*, Portland, Jan 2004.

Bruyninx, C., H. Habrich, G. Stangl: Status of BKG RDC mirroring, TWG, Prague, Nov 2004.

Chernouss, S.A., H. Lammer, A. Bérces, N.K. Belisheva, G. Kovács, H.K. Biernat: Coupled dosimetry as a powerful tool for the study of the biological affectivity due to solar UV and atmospheric ozone variations, *27th Annual Seminar*, Apatity, Mar 2004.

Chernouss, S.A., H. Lammer, A. Bérces, N.K. Belisheva, G. Kovács, H.K. Biernat: The study of the biological affectivity due to solar UV and atmospheric ozone variations, *Conf. on Antarctic Peninsula: key region for the environment change study*, Kiev, Jun 2004.

Chernouss, S.A., H. Lammer, N.K. Belisheva, H.K. Biernat: The problem of assessment of biological effectivity of UV radiation and ozone is solved by coupled dosimetry, *XX Quadrennial Ozone Symp.*, Kos, Jun 2004.

Deng, X.H., H. Matsumoto, W. Baumjohann, J.S. Pickett, A.N. Fazakerley, R. Nakamura, H. Kojima,

D.A. Gurnett: Collisionless reconnection at day side magnetopause and in the magnetotail: cluster and geotail observation, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Deng, X.H., H. Matsumoto, H. Kojima, W. Baumjohann, J.S. Pickett, D.A. Gurnett, A.J. Coates, A.N. Fazakerley: Characteristics of Electrostatic Solitary waves near the diffusion region associated with reconnection: Cluster and Geotail observations, *AGU Fall Meeting*, San Francisco, Dec 2004.

Desch, M., M. Kaiser, W. Farrell, W. Kurth, D. Gurnett, P. Zarka, A. Lecacheux, G. Fischer, C. Porco, A. Ingersoll: Cassini RPWS observations of Saturn lightning, *AGU Fall Meeting*, San Francisco, Dec 2004.

Dorotovic, I., Z. Vörös: Examining the role of turbulence in the solar wind - magnetosphere interaction processes, *IAU Symp. 223*, St. Petersburg, Jun 2004.

Erkaev, N.V., T. Penz, H. Lammer, H.I.M. Lichtenegger, P. Wurz, J.-M. Grießmeier, H.K. Biernat, W.W. Weiss: Plasma and magnetic field parameters in the vicinity of short periodic giant exoplanets: Implication for ion loss, *COROT Week 7*, Granada, Dec 2004.

Erkaev, N., V. Shaidurov, V. Semenov, H.K. Biernat: Magnetohydrodynamic wave pulses propagating along nonuniform magnetic flux tubes, *EGU General Assembly*, Nice, Apr 2004.

Farrugia, C.J., M. Leitner, H.K. Biernat, D. Berdichevsky, R. Schwenn, H. Matsui, H. Kucharek, R. Torbert: Evolution of parameters of interplanetary magnetic clouds from ~0.3 AU to 1 AU as inferred from Helios and Wind measurements, *New England APS/AAPT Meeting*, Exeter, Mar 2004.

Fekete, A., G. Kovács, M. Hegedüs, K. Módos, Gy. Rontó, H. Lammer, C. Panitz: DNA damage under simulated extraterrestrial conditions in bacteriophage T7, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Fekete, A., K. Módos, M. Hegedüs, G. Kovács, Gy. Rontó, H. Lammer, C. Panitz: The effect of simulated extraterrestrial conditions on bacteriophage and DNA thin films, *33rd Ann. Meeting Eur. Society for Radiation Biology*, Budapest, Aug 2004.

Friedrich, M., K.M. Torkar, G. Egger: First results of polar F-region behaviour based on EISCAT Svalbard, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Frischauf, N., E. Reichl, M.B. Steller: Cassini/Huygens: Countdown zur Landung auf einer rätselhaften Welt..., Planetarium Wien, Vienna, Dec 2004.

Grießmeier, J.-M., A. Stadelmann, H. Lammer, F. Selsis, U. Motschmann: Tidal locking and ist influence on planetary habitability, *Bioastronomy 2004*, Reykjavik, Jul 2004.

Grießmeier, J.-M., A. Stadelmann, H. Lammer, U. Motschmann: Tital locking and its influence on exomagnetospheres, *Planet Workshop: The star-planet connection*, Orsay, May 2004.

Grießmeier, J.-M., A. Stadelmann, S. Preusse, H. Lammer, T. Penz, F. Selsis, U. Motschmann: Extrasolar magnetospheres under different stellar wind conditions, *3. Workshop Planetenbildung: Das Sonnensystem und extrasolare Planeten*, Münster, Oct 2004.

Grießmeier, J.-M., U. Motschmann, A. Stadelmann, T. Penz, H. Lammer: Der Einfluss gebundener Rotation auf Magnetosphären und Atmosphären von Exoplaneten, *AEF 2004*, Kiel, Mar 2004.

Grießmeier, J.M., U. Motschmann, K.-H. Glaßmeier, G. Mann, H.O. Rucker: Discrimination of exoplanetary and stellar radio flux for different stellar wind conditions, *EGU General Assembly*, Nice, Apr 2004.

Gubchenko, V., V. Zaitsev, H.K. Biernat, M.L. Khodachenko, H.O. Rucker: 3d solar corona at heliospheric sheet and structures in current carrying plasma with flows, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Gubchenko, V., V. Zaitsev, H.K. Biernat, M.L. Khodachenko, H.O. Rucker: On kinetic approach to modeling of 3d solar corona and slow solar wind at heliospheric current sheet plasma, *EGU General Assembly*, Nice, Apr 2004.

Gubchenko, V.M., V.V. Zaitsev, H.K. Biernat, M.L. Khodachenko, H.O. Rucker: 3D solar corona at heliospheric sheet and structures in current carrying plasma with flows, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Gubchenko, V.M., V.V. Zaitsev, H.K. Biernat, M.L. Khodachenko, H.O. Rucker: To kinetic modeling of solar wind over magnetoactive regions and beyond, *IAU Symp. 223*, St. Petersburg, Jun 2004.

Gunell, H., M. Holmström, H.K. Biernat, H. Lammer, H.I.M. Lichtenegger, T. Penz, N.V. Erkaev: Simulation of Energetic Neutral Atom Images at Venus, *EGU General Assembly*, Nice, Apr 2004.

Gurnett, D., H.O. Rucker and the Cassini RPWS Team: Initial results from the Cassini radio and plasma wave science investigation at Saturn, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Iorio, L., H.I.M. Lichtenegger: On the possibility of measuring the gravitomagnetic clock effect in an Earth based experiment: an updated error budget, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Jankovicova, D., Z. Vörös: On the role of intermittence in solar wind – magnetosphere coupling processes, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Jaritz, G.F., S. Endler, H. Lammer, N.V. Erkaev, H.K. Biernat: Theoretical aspects of atmospheric expansion of short-periodic giant exoplanets under the influence of tidal forces, *COROT Week 6*, Orsay, May 2004.

Kallio, E., P. Janhunen, S. Barabash, T.L. Zhang: Modelling of the Venus-solar wind interaction and the energetic neutral atoms, *EGU General Assembly*, Nice, Apr 2004.

Konovalenko, A.A., H.O. Rucker, A. Lecacheux, V. Melnik, I. Falkovich, J. Bougeret, G. Mann, B. Thide, P. Rodriguez, Y. Tokarev: The world largest decameter radiotelescopes as probe and basis for developing of LOFAR concept, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Konovalenko, A.A., H.O. Rucker, V.N. Melnik, I.S. Falkovich, A. Lecacheux, J.L. Bougeret, G. Mann, B. Thide, P. Rodriguez, Yu.V. Tokarev: Solar system study by new methods of the decameter radio astronomy, *EGU General Assembly*, Nice, Apr 2004.

Konovalenko, A.A., H.O. Rucker, V.N. Melnik, I.S. Falkovich, A. Lecacheux, J.L. Bougeret, G. Mann, B. Thide, P. Rodriguez, Yu.V. Tokarev: Solar system studies by new methods of decameter radio astronomy, *EGU General Assembly*, Nice, Apr 2004.

Kovács, G., P. Gróf, A. Bérces, M.R. Patel, H. Lammer, Gy. Rontó: Kinetic parameters of uracil dosimeter in simulated extraterrestrial UV radiation, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Kral, L., I. Prochazka, G. Kirchner, F. Koidl, W. Voller: Atmospheric Contribution to the Laser Ranging Jitter, *14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Kurth, W., D. Gurnett, G. Hospodarsky, P. Zarka, A. Lecacheux, B. Cecconi, A. Roux, P. Canu, N. Cornilleau-Wehrling, P. Galopeau, R. Bostrom, G. Gustafsson, J. Wahlund, H.O. Rucker, G. Fischer, H. Alleyne, M. Kaiser, M. Desch, W. Farrell, C.C. Harvey, P. Louarm, P. Kellogg, A. Pedersen, S. Bolton: Radio and plasma wave results from the Cassini Radio and Plasma Wave Science investigation: The First Pass through Saturn´s Magnetosphere, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Litvinenko, G., H.O. Rucker, V. Vinogradov, V. Shaposhnikov: Jovian S-burst internal structure investigation and some criteria for the microsecond pulses identification, *EGU General Assembly*, Nice, Apr 2004.

Litvinenko, G., H.O. Rucker, V.V. Vinogradov, M. Leitner, A.A. Konovalenko, U. Taubenschuss: Internal microsecond structure of Jovian S-bursts, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Melnik, V.N., H.O. Rucker, A.A. Konovalenko, E.P. Abranin, V.V. Dorovskyy, A.A. Stanislavskyy, V.N. Lisachenko, M.Y. Boudjada, A. Lecacheux: Type III bursts with fine structures, *EGU General Assembly*, Nice, Apr 2004.

Melnik, V.N., H.O. Rucker, A.A. Konovalenko, V.V. Dorovskyy, E.P. Abranin, K.M. Sydorchuk, V.N. Lisachenko, A.A. Stanislavskyy, M.Y. Boudjada, A. Lecacheux: Observations of solar drift pair bursts at the decameter wavelenghts, *EGU General Assembly*, Nice, Apr 2004.

Morente, J.A., K. Schwingenschuh, I. Jernej, H.-U. Eichelberger, H.I.M. Lichtenegger, B.P. Besser, G.J. Molina-Cuberos, J.J. Lopez-Moreno, M. Hamelin, G. Colombatti et al.: ELF waves on Titan – Lessons from a Huygens terrestrial balloon flight, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Motschmann, U., J.M. Grießmeier, E. Kührt, G. Mann, H.O. Rucker: Extrasolare Planeten im Lichte der Radiostrahlung, *Int. Workshop "Planetenbildung: Das Sonnensystem und extrasolare Planeten"*, Münster, Oct 2004.

Mühlbachler, St., et al.: Convection in the Near Earth Tail Lobe - Cluster/EDI Observations 2001-2003, *8th Cluster Workshop*, Durham, Sep 2004.

Mulacová, J., K. Hamal, G. Kirchner, F. Koidl: Effects of the atmosphere on the SLR precision, *14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Prochazka, I., G. Kirchner: Numerical Noise in Satellite Laser Ranging Data Processing, *14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Romstedt, J., K.M. Torkar, W. Riedler, H. Jeszenszky, H. Arends, B. Butler, M.B. Steller: MIDAS - first results from Rosetta's commissioning phase, *EGU General Assembly*, Nice, Apr 2004.

Roux, A., W. Baumjohann, J. Birn, M. Hoshino, O. Le Contel, A.T. Lui, R. Nakamura, C. Owen, J.A. Sauvaud, A. Vaivads: Comparative interpretation of Cluster observations during substorms, *ICS-7*, Levi, Mar 2004.

Russel, C.T., R. Strangeway, T.L. Zhang: Lightning detection on the Venus Express mission, *EGU General Assembly*, Nice, Apr 2004.

Sacher, S., C. Kolb, G. Krammer, H. Lammer, G. Kargl, R. Abart: Simulation of the Martian atmosphere in simulation chambers, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Selke, C., F. Koidl, G. Kirchner, L. Grunwaldt: Tests of the Stability and Linearity of the A031et Event Timer at Graz Station, *14th Int. Workshop on Laser Ranging*, San Fernando, Jun 2004.

Semenov, V. S., T. Penz, M. F. Heyn, I. B. Ivanov, I. V. Kubyshkin, H.K. Biernat, V.V. Ivanova: Reconstruction of the reconnection rate from magnetic field perturbations in an incompressible plasma, *27th Annual Seminar*, Apatity, Mar 2004.

Sergeev, V., M. Kubyshkina, W. Baumjohann, R. Nakamura, O. Amm, T. Pulkkinen, V. Angelopoulos: Tansition from Substorm Growth to Substorm Expansion Phase as observed with a Radial Configuration of ISTP and Cluster Spacecraft, *AGU Fall Meeting*, San Francisco, Dec 2004.

Sergeev, V., V. Angelopoulos, S.B. Mende, J. Slavin, J. Scudder, W. Baumjohann, R. Nakamura, T. Nagai, T. Mukai, M. Kubyshkina; T. Pulkkinnen, A. Viljanen: Transition from substorm growth to the substorm expansion phase, *ICS-7*, Levi, Mar 2004.

Shaposhnikov, V.E., V.V. Zaitsev, H.O. Rucker: Charge acceleration mechanism in the Io-Jupiter system and occurence of "active longitudes" in the Jovian decametric emission, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Shi, J.K., K.M. Torkar, T.L. Zhang, Z.X. Liu: The Magnetotail Ions Acceleration and Earthward Injection, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Shi, J.K., K.M. Torkar, T.L. Zhang, Z.X. Liu: The Magnetotail Ions Acceleration and Earthward Injection, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

Terada, N., H. Lammer, T. Penz, H. Shinagawa, S. Machida, C. Kolb, H.I.M. Lichtenegger, H.K. Biernat, I. Ribas: Total ion loss evolution on Mars simulated with a global hybrid model, *The joint AOGS 1st Annual Meeting and APHW 2nd Conf.*, Singapore, Jul 2004.

Terada, N., H. Lammer, T. Penz, H. Shinagawa, S. Machida, C. Kolb, H.I.M. Lichtenegger, H.K. Biernat, I. Ribas: Simulation of the total ion loss evolution on Mars with a global hybrid model, *Western Pacific Geophysics Meeting*, Honolulu, Aug 2004.

Terada, N., H. Lammer, T. Penz, H. Shinagawa, S. Machida, H.I.M. Lichtenegger, H.K. Biernat, I. Ribas: Simulation of the total ion loss evolution on Mars with a global hybrid model, *Japan Earth and Planetary Science Joint Meeting*, Chiba, May 2004.

Treffer, M., N.I. Kömle, G. Kargl, E. Kaufmann: Laboratory tests concerning the operation of melting probes under space conditions, *EGU General Assembly*, Nice, Apr 2004.

Treumann, R.A., C.H. Jaroschek, W. Baumjohann, R. Nakamura, A.V. Runov, M. Scholer: The Hall Physics of Reconnection, *ISRADYNAMICS 2004*, Beer-Sheva, Mar 2004.

Vogl, D.F., T. Penz, J.-M. Grießmeier, H. Lammer, N.V. Erkaev, G.F. Jaritz, H.K. Biernat, A. Hanslmeier, W.W. Weiss: Plasma and field parameters at bow shocks of short period extrasolar gas giants, *27th Annual Seminar*, Apatity, Mar 2004.

Vogl, D.F., T. Penz, J.M. Grießmeier, H. Lammer, N.V. Erkaev. G.F. Jaritz, M.G. Therany, H.K. Biernat, A. Hanslmeier, W.W. Weiss: Are there bow shocks around short period extrasolar gas giants? *EGU General Assembly*, Nice, Apr 2004.

Wurz, P., U. Rohner, J. Whitby, H. Lammer, S. Massetti, S. Orsini: Deriving the surface composition from particle measurements in orbit around Mercury, *35th COSPAR Scientific Assembly*, Paris, Jul 2004.

7 Teaching & Workshops

7.1 Lecturing

IWF members are actively engaged in teaching at three universities. In summer 2004 and in the current winter term 2004/2005 the following lectures are given:

KFU Graz

Magnetospheric Coupling (Biernat)

Plasma Theory (Basics) (Biernat)

Solar wind – Magnetosphere Modeling (Biernat)

Special Lecture to Theoretical Physics: Plasmaphysics (Biernat)

Ice, Water, Air: Earth in Comparison with Mars (Kömle)

Introduction to Planetology (Kömle)

Cosmic Rays (Rucker)

Measurement Methods of Space Physics and Aeronomy 1+2 (Rucker et al.)

Planetary Radio and Plasma Waves (Rucker)

TU Graz

Space-Time Reference Systems (Arsov)

Space Plasma Physics (Baumjohann)

Advanced Space Plasma Physics (Baumjohann)

Signal Processor Techniques (Magnes)

HF-Engineering 1+2 (Riedler)

Theory and Practice of Active Plasma Experiments in Space (Torkar)

JKU Linz

Mathematics for Students of Computer Sciences in Economics I+II (Hausleitner)

Advanced Course

The new two-year post-graduate university course Space Sciences in cooperation with both Karl-Franzens University of Graz (KFU Graz) and Graz University of Technology (TU Graz) continued in 2004 with its second and third semester, leading to the internationally acknowledged Master of Science (MSc). Several members of IWF are lecturers of this inter-university course led by H.O. Rucker.

The first course was finalized by four candidates accepting their grade "Master of Advanced Studies" during the Graduation Ceremony held at KFU Graz in March 2004.

Summer University

The Summer University "Graz in Space" was organized by IWF from 6-8 September 2004 in cooperation with lecturers from KFU Graz, TU Graz, Joanneum Research and FH Joanneum. The presentations provided an extensive overview on space physics, remote sensing, space communication and navigation, with emphasis on Mars research. Main coordinator and organizer was H.O. Rucker.

7.2 Theses

Besides lecturing, members of the Institute are supervising Diploma and Doctoral Theses. In 2004, the following theses have been completed:

Amerstorfer, U.V.: Solar wind flow past Venus and Mars and implications for the atmospheric evolution, Diploma Thesis, KFU Graz, 88 pages (2004)

Fischer, G.: Energy dissipation and HF radiation of lightning on Titan and Earth, Doctoral Thesis, KFU Graz, 155 pages (2004)

Hyden, W.: Radar Wave Measurements on Mars, Diploma Thesis, KFU Graz, 73 pages (2004)

Stangl, A.: Remote Sensing of the Solar Corona: Type III Decametric Radio bursts, Diploma Thesis, KFU Graz, 136 pages (2004)

Steiner, J.: Investigation of MHD-Modes in an anisotropic medium, Diploma Thesis, KFU Graz, 102 pages (2004)

Temmer, M.: Solar activity patterns – hemisphere-related studies, Doctoral Thesis, KFU Graz, 105 pages (2004)

Treffer, M.: Melting probes for exploring ice layers on planets and moons, Diploma Thesis, KFU Graz, 93 pages (2004)

7.3 Science Meetings

From 19-20 April 2004 IWF hosted a workshop on "Austria's History in Space / Österreichs Geschichte im Weltraum". This workshop was organized by ASA and IWF on the occasion of the completion of a booklet on the history of Austria in space, researched and authored by B.P. Besser of IWF Graz. More than 80 participants attended this workshop.

From 13-16 September 2004 IWF hosted the UN/Austria/ESA Symposium "Water for the World: Space Solutions for Water Management" with more than 70 participants from all over the world.

In addition, H.O. Rucker organized a session at the Western Pacific Geophysics Meeting in Honolulu, Hawaii, and R. Nakamura organized a session at the AGU Fall Meeting in San Francisco, USA.

7.4 Project Meetings

Besides several meetings with less than ten participants, six larger meetings with international participation were organized at IWF in 2004.

From 30-31 March 2004, the *PICAM* Meeting was held at IWF. 13 participants from seven countries discussed about team responsibilities, instrument concept and scientific focus.

From 13-15 September 2004 the Critical Design Review for *BEX/COROT* was held at IWF. The instrument design was analyzed by a team of 11 experts from CNES, ESTEC, DLR, and IWF.

From 27-29 October 2004, the kHz SLR Meeting was held at IWF. 39 participants from 13 countries learned about the advantages of the new IWF 2 kHz laser system and had the opportunity to see it operate.

From 11-13 October 2004, the 5th Science Working Team (SWT) Meeting of the *Venus Express* mission was held at IWF. About 30 participants from all instrument teams, from ESA, and from Astrium attended the meeting.

From 20-21 October 2004, the 2nd *Double Star* Magnetometer Data Processing Meeting was held at IWF with 14 participants, including people from China, UK, and Germany.

From 22-24 November 2004 the first INTAS Meeting on "Using world largest decameter radio telescopes as probe and basis for developing the LOFAR concept" was held at IWF with 11 participants from France, Ukraine, and Russia.

7.5 Public Outreach

In 2004 IWF participated in numerous space exhibitions: Mariazell, MAXOOM Hartberg, ScienceWeek@Austria, Juwelier-Uhren Weikhard, "Zwischen Himmel und Erde" at TU Graz, and "Lange Nacht der Sterne" at BRG Kepler.

The *Rosetta* launch in March, the Venus Transit in June, and the arrival of *Cassini* at Saturn in July marked highlights in 2004, which have been covered by corresponding PR events at IWF and attended by a great number of interested people.

8 Personnel

Arsov, Kirčo, Dr. (S)
Asano, Yoshihiro, Dr. (E)
Aydogar, Özer, Mag. Dipl.-Ing. (E)
Baumjohann, Wolfgang, Prof. (E)
Berghofer, Gerhard, Ing. (E)
Besser, Bruno P., Dr. (E)
Biernat, Helfried K., Prof. (P)
Boudjada, Mohammed Y., Dr. (P)
Chwoika, Rudolf (S)
Crailsheim, Hartwig (E, ESA)
Cristea, Elena, Dipl.-Ing. (S, part. UN)
Delva, Magda, Dr. (E)
Eichelberger, Hans U., Dipl.-Ing. (E, BMVIT)
Fischer, Georg, Dr. (P)
Flock, Barbara, Mag. (E)
Fremuth, Gerhard, Dipl.-Ing. (E)
Giner, Franz, Dipl.-Ing. (E)
Graf, Christian, Ing. (S)
Haslinger, Cornelia, Dipl.-Ing. (S, EU)
Hausleitner, Walter, Dr. (S)
Heihsler, Johann, Dipl.-Ing. (E, ASAP)
Höck, Eduard, Dipl.-Ing. (S)
Jernej, Irmgard, Ing. (E)
Jeszenszky, Harald, Dipl.-Ing. (E)
Jetzl, Ilse, Dr. (P)
Kargl, Günter, Dr. (P)
Kaufmann, Erika, Mag. (P, FWF)
Kazeminejad, Bobby, Mag. Dipl.-Ing. (P, ESA)
Khodachenko, Maxim L., Dr. (P, FWF)
Kirchner, Georg, Dr. (S)
Kögler, Gerald (A)
Kömle, Norbert I., Univ.-Doz. (P)
Koidl, Franz, Ing. (S)
Kolb, Christoph, Mag. (P)
Kürbisch, Christoph, Ing. (E)
Laky, Gunter, Dipl.-Ing. (E)
Lammer, Helmut, Dr. (P)
Langmayr, Daniel, Dr. (P)
Leitner, Martin, Mag. (P, FWF)
Lichtenegger, Herbert I.M., Dr. (E)
Macher, Wolfgang, Dipl.-Ing. (P)
Magnes, Werner, Dr. (E)
Močnik, Karl, Dr. (E)
Nakamura, Rumi, Dr. (P)
Neukirchner, Sonja, Ing. (E)
Ottacher, Harald, Mag. (E)
Penz, Thomas, MMag. (P, FWF)
Pešec, Peter, Dr. (S)
Preimesberger, Thomas, Dipl.-Ing. (S, ASAP)
Riedler, Willibald, Prof. em. (E, BMBWK)
Rucker, Helmut O., Prof. (P)
Runov, Andrei V., Dr. (E)
Scherr, Alexandra, Mag. (A)
Schwingenschuh, Konrad, Dr. (E)
Slamanig, Herwig, Dipl.-Ing. (A, BMBWK)
Stachel, Manfred, Ing. (E, part. ESA)
Stangl, Günter, Dipl.-Ing. (S, BEV)
Steller, Manfred B., Dr. (E)
Stieninger, Reinhard, Ing. (S, Stmk.)
Stock, Daniel (E)
Sucker, Michael, Dipl.-Ing. (S)
Sünkel, Hans, Prof. (S, BMBWK)
Takada, Taku, Dr. (E, part. ESA)
Taubenschuss, Ulrich, Mag. (P, FWF)
Torkar, Klaus M., Univ.-Doz. (E)
Valavanoglou, Aris, Dipl.-Ing. (E, ASAP)
Voller, Wolfgang G., Mag. (P)
Volwerk, Martin, Dr. (E, MPE)
Vörös, Zoltán, Dr. (E)
Wallner, Robert, Ing. (E)
Zambelli, Werner (E, ESA)
Zehetleitner, Sigrid (S & A)
Zhang, Tie-Long, Dr. (E)
Zöhrer, Alexander, Dipl.-Ing. (P, ASAP)

As of 31 December 2004

E: Experimental Space Research, P: Extraterrestrial Physics, S: Satellite Geodesy, A: Administration.
Most positions are directly funded through ÖAW, others as indicated by: ASAP: Austrian Space Applications Programme, BEV: Federal Office for Metrology and Surveying, BMBWK: Federal Ministry for Education, Science and Culture, BMVIT: Federal Ministry of Transport, Innovation and Technology, ESA: European Space Agency, FWF: Austrian Science Fund, EU: European Union, MPE: Max Planck Institute for Extraterrestrial Physics, Stmk.: State of Styria, UN: United Nations.