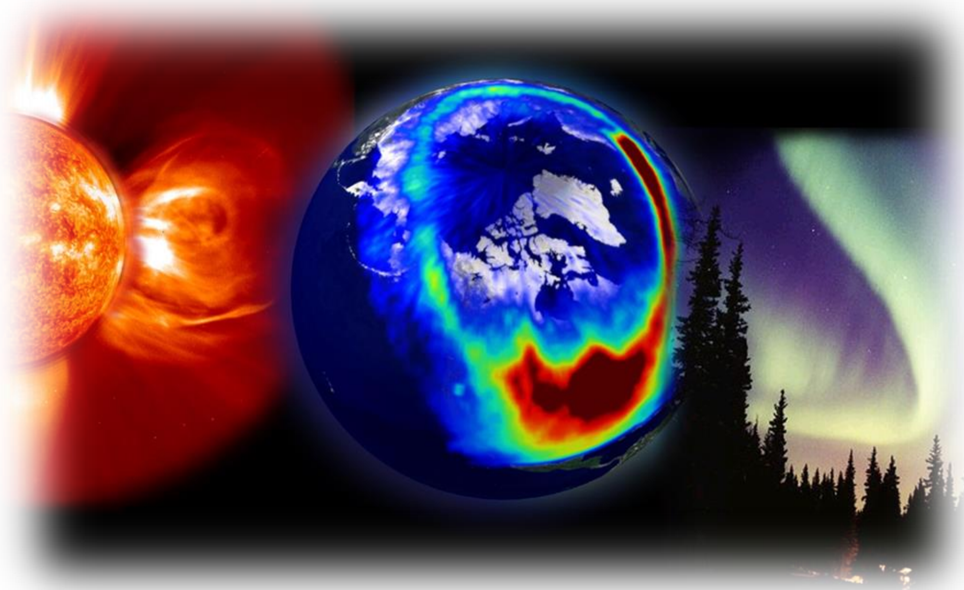
JOINT SPACE WEATHER SUMMER_CAMP 2014



July 16 - August 06, 2014

German Aerospace Center (DLR)

Leibniz-Institute of Atmospheric Physics (IAP)

The University of Alabama in Huntsville

The University of Rostock

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

DLR

LEIBNIZ-INSTITUT FÜR ATMOSPHÄREN PHYSIK IAP

Universität Rostock

Traditio et Innovatio

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Welcome to the Joint Space Weather Summer_Camp 2014

The Joint Space Weather Summer Camp is a partnership between UAHuntsville, the DLR and the University of Rostock. Because of the considerable historical ties between Huntsville and the state of Mecklenburg-Vorpommern (Germany) in the development of rockets, missiles, and eventually manned space flight, the Joint Space Weather Summer Camp was created to forge ties and develop communication between these two regions that have had such an impact on the 20th century.

During the three week series of lectures, hands-on projects, experiments, and excursions you will be given an understanding of both the theoretical underpinnings and practical applications of Space Weather and solar and space physics.

In the first part in Northern Germany we will focus on the upper atmosphere and ionosphere. Besides the lectures there will also be practical project work and we will visit the University of Rostock and the Leibniz-Institute of Atmospheric Physics e.V. at the University of Rostock (IAP) in Kühlungsborn.

In the second half of the Summer_Camp in Huntsville, the focus will lie on the sun as the primary cause of space weather in the entire solar system. There will be the opportunity to participate in either data or practical-based project work, enabling you to gain a practical understanding of the topic.

The Joint Space Weather Summer Camp is much more than just lectures, projects and experiments. It also provides a wonderful opportunity for cultural exchanges between the US and Germany in an academic setting. The visit of the 'Historical Technical Museum in Peenemünde' in the Northeast of Germany or the visit of the US Space and Rocket Center in Huntsville, USA, are just two further examples of a program that goes beyond.

We hope that the Joint Space Weather Summer Camp will be an interesting introduction to the theoretical and practical aspects of Space Weather combined with a cultural exchange between the US and Germany!

The Joint Space Weather Summer Camp 2014 Committee

Schedule Germany

	16. Jul Wednesday	17. Jul Thursday	18. Jul Friday	19. Jul Saturday	20. Jul Sunday	21. Jul Monday	22. Jul Tuesday	23. Jul Wednesday	24. Jul Thursday	25. Jul Friday	26. Jul Saturday
9:00-09:45	Arrival - US		09:00 Start of a ballon 09:30 A. Gaßmann Theoretical aspects of atmospheric dynamics	Freetime	Freetime	H. Maass Welcome to the Summer Camp with tour through DLR site Neustrelitz	Kl. Scherer Space Weather in the past and its implications	Chr. Jacobi Vertical coupling processes and thermospheric/ ionospheric variability	Z. Katamzi Space Weather in South Africa	Peenemünde	Transfer to Berlin Departure to Huntsville
09:45-10:00			10:30 M. Gerding 1st results from ballon				Coffee Break	Coffee Break	Coffee Break		
10:00-10:15						Coffee Break					
10:15-10:45		Sightseeing	10:45-12:00 Visit of labs at IAP M. Gerding, B. Strelnikov, M. Zecha			N. Jakowski History of Ionospheric research at DLR	M. Rietveld Incoherent Scatter Radars	J. Lichtenberger Remote sensing and modeling of the Earth's plasmasphere	G. Mann The Radio Emission of the Sun		
10:45-11:15							Project work: - SDR-receiver - Radiation Protection in Aviation - Cosmic rays	E. Flückiger Cosmic Rays and Space Weather	K. de Jong The effects of space weather on precise GNSS positioning		
11:15-11:30											
11:30-12:15						Introduction to project work Project work		G. Reitz Radiation Exposures in Space and Aviation Altitudes	C. Borris Ionospheric Storms Observed in the TEC over Europe		
Lunch 12:15-13:00			12:00 Lunch			Lunch	Lunch	Lunch	Lunch		
13:00-14:00		Transit HRO 12-15:00	Departure to Rostock			Project work: - SDR-receiver - Radiation Protection in Aviation - Cosmic rays	Project work: - SDR-receiver - Radiation Protection in Aviation - Cosmic rays	Project work: - SDR-receiver - Radiation Protection in Aviation - Cosmic rays	Presenting results of the project work		
14:00-15:00		15:00 Introduction E. Becker	14.00-15.30 R. Redmer/A. Becker Progress in warm dense matter and planetary physics								
15:00-16:00		15:30-16:15 G. Baumgarten Application of Lidars for atmospheric research		Transit NZ 15-18:00	15:00 Sightseeing Neustrelitz						
		Coffee Break	Coffee Break								
16:00-17:00		16:45-17:30 G. Stober Mesospheric and lower thermospheric studies with radars	16.00-17.30 V. von Oeynhausen Laborführung								
Evening	Dinner	18:30 BeachParty	18:30 Harbor Cruise		17:30 Orangerie				BBQ		

Joint Space Weather Summer_Camp

July 16 – July 26, 2014 in Neustrelitz and Rostock

Abstracts

Thursday, July 17

Welcome/Introduction to Atmospheric Science at IAP

Erich Becker
Leibniz-Institute of Atmospheric Physics (IAP), Kühlungsborn, Germany

The major task of the IAP is the experimental and theoretical exploration of the atmosphere from the ground to the lower thermosphere (≈10 – 120 km). The focus of the activities is on the thermal and dynamical state of the mesosphere (50-100 km) at middle and polar latitudes, the coupling between various atmospheric layers, and long-term changes in the upper atmosphere. Experimental studies at IAP concentrate on highly sophisticated observations of temperatures and winds by ground based lidars and radars, and on measurements of turbulence and meteoric smoke particles on sounding rockets. More recently, turbulence detection on balloons in the stratosphere and ground based measurements of water vapor by microwave technique have been developed. Theoretical investigations include the role of dynamical processes (gravity waves, turbulence etc.) for the energy and momentum budget of the atmosphere, as well as the role of ice layers (noctilucent clouds, NLC) at≈83 km for the detection of climate change. Our understanding of the middle atmosphere is still rudimentary which is partly caused by the fact that this region is experimentally difficult to access and that the theoretical description of the most relevant physical processes changes fundamentally in the upper mesosphere/lower thermosphere. Some worldwide unique experimental and theoretical expertise has been developed at IAP to fill this gap. The activities of IAP concentrate on the headquarter in Kühlungsborn (54°N) and on the ALOMAR observatory (Arctic Lidar Observatory for Middle Atmosphere Research) being located at 69°N in Northern Norway. Furthermore, IAP runs a mobile lidar which is currently located in Davis, Antarctica. The IAP is member of the Leibniz-Society and has 80-90 employees. The institute is funded by the local government of

Mecklenburg-Vorpommern, by the federal government in Berlin, and by research grants from various organizations.

Application of Lidars for Atmospheric Research

G. Baumgarten
Leibniz-Institute of Atmospheric Physics (IAP), Kühlungsborn, Germany

Remote sensing of the atmosphere using electromagnetic waves from the UV to radio waves is a widely used technique to acquire information from the atmosphere. Amongst others clouds, precipitation, temperatures and dynamics can be studied. Active remote sensing by light detection and ranging (lidar) makes use of light specifically generated in the laboratory for studying trace constituents, state of matter, temperature or wind in altitude ranges and on timescales that have not been accessible before. Current lidar systems at the Leibniz-Institute of Atmospheric Physics allow to study the atmosphere from the troposphere to the edge of space close to the mesopause and above. The basic concept and their application will be shown with examples covering Rayleigh and resonance scattering as well as Doppler methods used to derive temperature and wind.
The observation of noctilucent clouds (NLC) at the edge of space, which are visible manifestations of ice particles persistently present in the polar summer mesopause region, provides information about processes in the upper atmosphere that are often not observable by any other method. From single color measurements (532nm) basic cloud parameters like brightness, altitude and occurrence frequency are derived. From three widely separated wavelengths (355nm, 532nm, 1064nm) vertically resolved size, width of size distribution and number density allow detailed studies of the properties of particles forming NLC which helps to understand the behavior of the tracer. We discuss differences of the lidar technique to other remote sensing instruments and present observations of processes with time scales from seconds to several years.

Studies of the mesosphere and lower thermosphere with radars

Gunter Stober
Leibniz-Institute of Atmospheric Physics (IAP), Kühlungsborn, Germany

The mesosphere and lower thermosphere regions are too high to be studied by standard meteorological balloons and too low to be studied with satellites. This region can be only studied with radars, lidars, and instruments on board rockets. In this talk we present an overview of the research conducted in this region with radars, with a particular emphasis on mid and high latitudes processes, where the Institute of Atmospheric Physics in Kühlungborn has unique radar instrumentation Worldwide. We present recent results on two specific research topics: (a) atmospheric coupling during stratospheric warming events, and (b) the influence of charged meteor dust in the lifetime of meteor trail echoes.

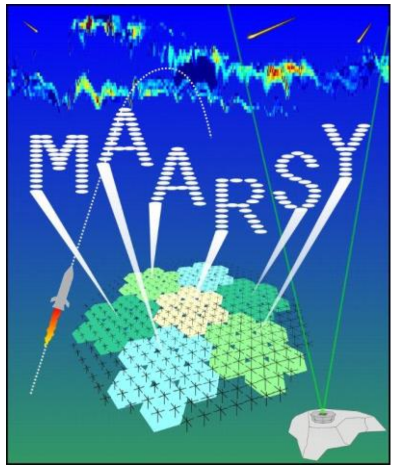

Figure 1 Schematic of view of the IAP radar in northern Norway (MAARSY) and its atmospheric targets

Friday, July 18

Theoretical aspects of atmospheric dynamics

Almut Gassmann
Leibniz-Institute of Atmospheric Physics (IAP), Kühlungsborn, Germany

This presentation introduces the mechanism of the general circulation of the atmosphere. Particularly, I will explain the thermal and dynamical structure of the middle atmosphere.
As physical foundation, the first part of the talk will be devoted to the interaction of the atmosphere with shortwave and longwave radiation, and to main principles of atmospheric dynamics.
In the second part, it will be explained how different kinds of waves transport heat and how they shape the vertical thermodynamic structure of the atmosphere.
Those waves give rise to deviations of the wind from the balanced (inactive) wind and in turn to deviations of the temperature from radiative equilibrium. We will learn why the polar summer mesopause is the coldest place in the atmosphere and why the summer and winter hemispheres feature such remarkable differences.

Progress in warm dense matter and planetary physics

Andreas Becker, Ronald Redmer
University of Rostock, Rostock, Germany

The behavior of matter under extreme conditions (megabar pressures, temperatures of several 1000 K up to about 100.000 K) is important for interior models of giant planets. Surprisingly, the high-pressure phase diagram of even the simplest and most abundant elements hydrogen and helium is not well known (Jupiter, Saturn). Interesting phenomena such as proton conduction and demixing are expected when studying the behaviour of oxygen, carbon, nitrogen, their hydrides and mixtures at high pressures (Uranus, Neptune). A large number of planets has been found around other stars since 1995 which show a strong variation in mass, chemical composition, and distance to their parent star so that solar and extrasolar giant planets are perfect laboratories for the study of matter under extreme conditions. In the first part we will review the main properties of the solar planets and introduce detection methods for extrasolar planets and their properties.

In the second part we will give an introduction into the physics of matter under extreme conditions. Because simple plasma models based on perturbation theory fail to describe strongly correlated systems, ab initio methods have been applied to derive physical properties. For instance, molecular dynamics simulations based on finite-temperature density functional theory were used to calculate the equation of state, the electrical and thermal conductivity of H, He, their mixtures, and of molecular systems such as H2O for a wide range of densities and temperatures. Most interestingly, the equation of state data for hydrogen predict a first-order liquid-liquid phase transition with a critical point at 1400 K, 1.32 Mbar and 0.79 g/cm3 which is connected with a nonmetal-to-metal transition [1,2]. The behavior of the electrical and thermal conductivity and of their ratio (Lorenz number) is analyzed along this transition, especially the deviations from the well-known Wiedemann-Franz relation [3] which might be important for the operation of planetary dynamos. Furthermore, we have identified the parameters for demixing of helium from hydrogen [4,5] which match the conditions in the interior of Saturn as long has been predicted. Finally, we have calculated the interior structure and composition of solar [6] and some extrasolar planets (GJ 436b [7], GJ 1214b [8]) within three-layer models. We will give exemplary results for the density and temperature profile, the metallicity and size of the planetary cores, and for the slope of the material properties along planetary isentropes [9,10].

[1] W. Lorenzen, B. Holst, R. Redmer, Phys. Rev. B 82, 195107 (2010).
[2] M.A. Morales et al., PNAS 107, 12799 (2010).
[3] B. Holst, M. French, R. Redmer, Phys. Rev. B 83, 235120 (2011).

[4] W. Lorenzen, B. Holst, R. Redmer, Phys. Rev. Lett. 102, 115701 (2009).
[5] M.A. Morales et al., PNAS 106, 1324 (2009).
[6] J.J. Fortney, N. Nettelmann, Space Sci. Rev. 152, 423 (2010).
[7] N. Nettelmann et al., Astron. & Astrophys. 523, A26 (2010).
[8] N. Nettelmann et al., Astrophys. J. 733, 2 (2011).
[9] N. Nettelmann, A. Becker, B. Holst, R. Redmer, Astrophys. J. 750, 52 (2012).
[10] M. French et al., Astrophys. J. Suppl. Ser. 202, 5 (2012).

Monday, July 21

Welcome and Visit DLR Neustrelitz

Holger Maass
German Aerospace Center (DLR), Neustrelitz, Germany

The Neustrelitz site of the German Aerospace Center (DLR) is located in Mecklenburg-Vorpommern, approximately 100 km north of Berlin. More than 60 employees are working in three institutes the

- Earth Observation Centre
- Institute for Communications and Navigation
- Institute for Remote-sensing Methods

and the Technology Marketing section. In addition a school-lab is just established for educating students in space sciences and related innovative technologies. DLR Neustrelitz site has access to modern technological systems suitable for the demands of a real-time data centre for GMES and Galileo related research tasks.
The national ground segment is a department of the Earth observation center (EOC) and takes care for reception of numerous remote sensing and scientific satellites. Thus, DLR Neustrelitz, as one of the four stations belong-ing to the Real Time Solar Wind (RTSW) network of NOAA, contributes essentially to the permanent availability of solar wind data measured onboard NASA’s ACE satellite. Huge remote sensing data volume is success-fully managed in the EOC by using the Data Information Management System (DIMS).

Research activities in the Institute for Remote sensing Methods focus on studying scattering and radiative transfer in the Earth's atmosphere for improving atmospheric corrections of remote sensing data.

In the field of satellite navigation, the research is focused on developing algorithms for precise and safe navigation in particular in the maritime application sector. Thus, technological developments have been carried out for the Rostock Research Harbour.

To correct and the impact of space weather effects on GNSS applications, the ionosphere is permanently monitored and modelled in near real time. Research activities focus on developing methods to detect, forecast and mitigate ionospheric perturbations having the capability to degrade GNSS systems. Derived Data products are disseminated via the Space Weather Application Center Ionosphere (SWACI), a project which is essentially sup-ported by the state government of Mecklenburg Vorpommern.

History of Ionospheric Research at DLR

Norbert Jakowski

German Aerospace Center (DLR), Neustrelitz, Germany

The Neustrelitz site of the German Aerospace Center (DLR) has a nearly 100 years old history of space weather related observations and research. Activities were always focussed on observations of the propagation characteristics of radio waves and studies of the ionospheric impact. After the launch of the first satellite, Sputnik 1, in 1957 the focus of research shifted rapidly from terrestrial HF to transionospheric radio wave propagation.

Nowadays, when considering modern space based radio systems of telecommunication, navigation and remote sensing, our modern society depends strongly on reliability of used transionospheric signals. This is a strong motivation to study the ionosphere and associated space weather phenomena. Fortunately, dual frequency signals of Global Navigation Satellite Systems (GNSS) such as GPS, GLONASS or Galileo can effectively be used for monitoring and modelling the ionosphere for research and establishing ionospheric data and information services. Ground based GPS data have been routinely utilized for ionospheric monitoring since GPS became operational in 1995. Such a GNSS based ionospheric monitoring service may provide crucial information and data in particular to GNSS customers to warn them against space weather storms or to enable ionospheric corrections/mitigation of erroneous radio signals.

Based on long-term experience in monitoring, studying and modelling the ionosphere, in receiving, processing and management of satellite data and thanks to essential support provided by the state government of Mecklenburg-Vorpommern, DLR Neustrelitz has realized

the project 'Space Weather Application Center –Ionosphere' (SWACI) since 2004. The achievements of the SWACI project are nowadays the basis for establishing an 'Ionosphere Monitoring and Prediction Center' (IMPC) at DLR Neustrelitz.
The strong relationship of ionospheric behaviour with space weather phenomena explains our interest in organizing the Space Weather Summer Camp in close cooperation with the University of Alabama Huntsville.

Tuesday, July 22

Space Weather in the past and its implications

Klaus Scherer
Ruhr-University Bochum, Germany

The solar activity in the past can be reconstructed by cosmogenic isotopes, which are deposited in terrestrial archives.
The processes which lead to the creation and deposition of cosmogenic isotopes are reviewed. The cosmogenic isotope flux is a direct consequence of the cosmic ray flux in the atmosphere. These energetic particles are modulated in the heliosphere, which varies with solar activity and the state of the interstellar medium. The latter is recently discussed to be inhomogeneous on timescale of decades or centuries.
An overview of the relevant physical processes will be given.

Incoherent Scatter Radars for Studying the High Latitude Ionosphere

Michael Rietveld
EISCAT Scientific Association, Ramfjordmoen, Norway

Incoherent Scatter Radars (ISR) are powerful radars with large antennas operating in the VHF and UHF bands with the ability to provide detailed ionospheric parameters from altitudes as low as 50 km to over 1000 km. The principles of their operation, some of the background theory, and the resulting measurements will be described. The two EISCAT radars (at 224 and

931 MHz) operating in northern Scandinavia and a third (at 500 MHz) operating on Svalbard will be used as primary examples but newer radar systems in north America will also be described. Although primarily used to study the natural ionosphere and upper atmosphere, they can also be used to study the effects of artificial perturbations (often similar to space weather effects) produced by radio-wave heating from specialized powerful HF transmitters, which will also be illustrated using the HF-facility operated by EISCAT.

The limitations of the present second-generation 20 to 30 year old radars, particularly in the inability to observe different directions of the sky simultaneously, and the difficulties associated with running these radars continuously, have led to proposals to build new types of radar based on phased-array antennas instead of the traditional dish antennas. In north America some radars based on this technology (AMISR) are now operating in the auroral zone and polar cap. In northern Europe a more advanced, more powerful radar with remote stations will be built. The new radar, with thousands of small antennas and transmitters, called EISCAT_3D is a three-dimensional imaging radar. It will make continuous measurements of the geospace environment and its coupling to the Earth's atmosphere from its location in the auroral zone at the southern edge of the northern polar vortex.

Wednesday, July 23

Vertical coupling processes and thermospheric/ionospheric variability

Christoph Jacobi
University of Leipzig, Germany

Changes of the thermosphere/ionosphere (T/I) system at different time scales are mainly due to solar and extraterrestrial variability. However, the T/I is also influenced by forcing from the neutral atmosphere below, which may, e.g., lead to additional uncertainty in navigation and communication systems. This forcing is mainly due to atmospheric waves at different temporal and spatial scales. Waves originating from the lower atmosphere may propagate to the upper atmosphere directly or indirectly.

An overview of neutral atmospheric waves – such as gravity waves, tides, and planetary waves – is given, including their forcing mechanisms and climatology. Some of these waves cannot directly propagate to the ionosphere, thus indirect mechanisms leading to their signature in the upper atmosphere are discussed. Some examples of such lower atmosphere wave signatures in the ionosphere are shown.

Another source of T/I variability is long-term greenhouse cooling due to changes of minor atmospheric constituents like carbon dioxide and ozone. Results of observations and modelling are presented, including recent changes of trends probably connected with ozone recovery in the stratosphere.

Remote sensing and modeling of the Earth's plasmasphere for Space Weather investigations

János Lichtenberger
Eotvos University, Hungary

Space weather models are in front of recent research to improve specification and prediction capabilities, with emphasis on the linkage of the different physical processes that occur simultaneously or sequentially in many domains. This modeling is a major step to improve capacity to estimate and prevent damage of space assets from space weather events as well as to improving forecasting and predicting of disruptive space weather events.

The dynamics of the energetic particles is the result of a complex interplay of acceleration, loss and transport processes; and for all these processes the underlying mechanism has a strong dependence on the distribution of the overlapping background cold plasma in the plasmasphere: Acceleration and loss are due to resonances with variety of plasma waves – both the generation of these waves and the resulting resonance conditions depend on the ambient plasma density and composition. Transport is due to resonances with ULF wave modes, which depend on mass loading of field lines and thus also on the ambient plasma density.

The cold plasma density can be measured by in-situ observations (satellite measurements) suffer from inherent weaknesses: the data availability is very often limited in space and time; at best there will be a handful of observations of a given parameter at any given time throughout all of geospace.

However, ground based wave measurements can overcome these bottlenecks. Lightning generated VLF whistlers can be used to estimate the equatorial electron densities, while field line resonances (FLRs) can be used to estimate the plasma mass densities. The details of these two ground based remote sensing methods will be given in this lecture.

Cosmic Rays and Space Weather

Erwin O. Flückiger
University of Bern, Switzerland

In all space weather scenarios cosmic ray measurements are included as a monitoring and alert instrument, as an additional forecasting tool, and as a provider of key input parameters for real time applications and post-event analysis. The energy input from cosmic rays into the system Earth is small, roughly the same as that of starlight. However, continuous galactic and sporadic solar cosmic rays have a multitude of effects on terrestrial, biological, and technological systems. The first part of the talk consists of a summary of relevant fundamentals of cosmic rays and of their interaction with the geospace environment. Emphasis is given to the role of cosmic ray measurements taken by the global network of ground-based detectors, such as neutron monitors. The second part of the lecture, after a general overview of established and assumed cosmic ray space weather effects, then illustrates with selected examples the significance of cosmic ray data within space weather programs. The examples include the role of real time ground based cosmic ray observations and advanced analysis methods as an alert and monitoring instrument for substantial changes in the Earth's particle radiation environment, as a forecasting tool for geomagnetic storms, and as a key element in the assessment of the radiation dose at aircraft altitude, in particular during large solar particle events.

Radiation Exposures in Space and Aviation Altitudes

Günther Reitz
German Aerospace Center (DLR), Cologne, Germany

For long term human missions the main concerns are the human physiological responses to microgravity and radiation. For missions outside the magnetosphere ionising radiation is recognized as the key factor through its impact on crew health and performance. Of major concern is the exposure of humans by Galactic Cosmic Rays (GCR), because of the still in large parts unresolved questions about unique radiobiological aspects of irradiation by heavy ions, which results in high uncertainties of radiation risk estimates for late radiation effects, like cancer. Solar energetic particles released in coronal mass ejections are a further concern because exposures are possible which can be life threatening if no appropriate countermeasures are performed. In aviation altitudes the exposure is dominated by the secondary radiation produced in interactions of the incoming protons with the molecules of the atmosphere, such as neutrons, secondary protons, electrons and gamma rays.

On the ISS a huge set of radiation instruments is used to monitor the radiation environment for a fixed inclination in dependence on altitude, solar activity and shielding distribution. Besides environmental dosimetry also personal dosimetry for the astronauts is a mandatory part of the measurement program, which besides the physical characterisation of the radiation field has as main task provision of radiation protection measures for the astronaut. The measurements are completed by the use of phantoms (spherical and anthromorphic) to relate the quantities measured by environmental and personal dosemeters to radiation protection quantitites. The ESA multi-user facility MATROSHKA was designed to provide accurate information on the radiation doses in human organs. The key part of MATROSHKA is a human phantom upper torso, equipped with numerous radiation detectors at the surface and inside the phantom. The facility therefore allows the determination of the empirical relations between measurable absorbed doses at the skin and the tissue absorbed doses in different depth inside the phantom.

Calculation of radiation risks in the ISS orbits is therefore based on quite reliable data. This is not the case for interplanetary missions where the exposure rates for planned future missions are mostly based on calculations so far. Most recently, the radiation assessment detector has provided first measurements on the cruise to Mars which no allow to benchmark calculations.

Whereas in space radiation exposures can approach or even exceed radiation limits set for radiation workers on Earth, in aviation altitudes we are far away from such limits, although civil aircrew is the highest exposed cohort at all. Exposures here are strongly depending on flight altitudes and latitudes and on the solar activity.

The presentation reviews the physical features of the radiation field as far as they relevant for radiation protection followed by an overview on exposure data gathered mainly on the ISS and with the Radiation Assessment Detector of the Mars Science Laboratory (MSL) together with calculations for future human missions. Finally, the unique features of heavy ions will be described, radiobiological effects observed from space radiation and radiation risks for different mission profiles are shown.

Space Weather in South Africa

Zama Katamzi
South African National Space Agency (SANSA), South Africa

South Africa is home to the Space Weather Regional Warning Center for Africa which operates as part of the International Space Environment Service (ISES). The Space Weather Center is operated within the Space Science Directorate of the South African National Space Agency (SANSA) and provides important services to the nation such as early warnings and forecasts on space weather conditions. In addition, SANSA has a team of researchers who conduct research on space weather in collaboration with various national and international institutes. South Africa also has a suite of ground based instruments around South Africa, neighbouring countries (such as Namibia) and in remote areas (e.g. Antarctica, Gough and Marion islands). South Africa is also branching into designing and developing satellites with space weather payloads (e.g. ZACUBE-1). The presentation will give a brief overview of SANSA Space Science, the Space Weather Center and its services, and current space weather research.

The Radio Emission of the Sun

Gottfried Mann
Leibniz-Institute for Astrophysics Potsdam (AIP), Potsdam, Germany

The Sun is the most intense radio source in sky. The Sun is an active star. That manifests not only in Sun spots and the famous 11-year cycle, but also in short term eruptions as flares. These eruptions are often accompanied with a strong enhancement of the Sun's emission of radio waves. With the novel European LOFAR (LOw Frequency ARray) we have the opportunity to observe these phenomena with a high accuracy.
In the talk, we will present examples of radio phenomena of the active Sun as recently observed.

The effects of space weather on precise GNSS positioning

Kees de Jong
Fugro Intersite B.V., Netherlands

Fugro acquires and interprets earth and engineering data and provides associated consulting services to support clients with their design and construction of infrastructure and buildings. Fugro also supports clients with the installation, repair and maintenance of their subsea infrastructure. Fugro works around the globe, predominantly in energy and infrastructure markets offshore and onshore.

These activities require precise and reliable real-time positioning. Therefore, Fugro provides a number of GNSS (Global Navigation Satellite System) positioning services, mainly for use offshore. In the early 2000's it introduced the differential, carrier based HP service, followed by XP, a GPS only Precise Point Positioning (PPP) service, a few years later. In 2009 G2, based on integrated use of GPS and Glonass, became operational. G2 currently provides accuracies of the order of 5-10 cm worldwide.

Current research at Fugro focuses on including the Chinese BeiDou and the European Galileo systems in its PPP services. Once these systems are operational, more than 100 satellites will be available for high precision positioning applications.

Precision can be further improved to the 1-3 cm level globally once the ambiguities of the GNSS carrier observations can be fixed to their integer values. Fugro has set up several test beds to investigate the feasibility of this concept, usually referred to as PPP RTK (Real-Time Kinematic) or PPP IAR (Integer Ambiguity Resolution).

Apart from the GNSS signals themselves, the services also rely on correction signals, broadcast e.g. by geostationary satellites, using frequency bands similar to GNSS.

A significant part of Fugro's activities take place in areas at or near the geomagnetic equator, such as Brazil, West Africa and Southeast Asia. As a result, the GNSS and correction signals are often disturbed or even completely lost, due to e.g. ionospheric scintillations. Using more satellite systems, such as GPS, Glonass, Galileo and BeiDou, may help to mitigate the effects of scintillation. Recently, Fugro developed a scintillation monitoring and prediction service for its clients, to assist them in planning their activities around periods of strong scintillation.

In this presentation we will give an overview of Fugro's current and future positioning services. We will have a closer look at some recent events which occurred due to strong scintillations and other space weather effects. Finally, some results of the new scintillation monitoring and prediction service will be shown.

Characterisation and Source Mechanisms of Ionospheric Storms Observed in the Total Electron Content over Europe

Claudia Borries
German Aerospace Center (DLR), Neustrelitz, Germany

Temporal and spatial gradients in the ionosphere can cause major threats on communication and navigation satellite systems, because the propagation of transionospheric radio signals is influenced by the ionospheric electron content. Space weather events are often the source of strong ionospheric disturbances. Forecasting ionospheric perturbations related to space weather events is therefore a crucial task being of special interest for GNSS users.
The climatology of ionospheric storms seen in the Total Electron Content (TEC) over Europe as a response of the ionosphere towards Earth oriented space weather events is well known. It depends on season, elapsed time from event arrival, location and local time. However, the deviation of a single storm to the mean behavior can be large. A good correlation between strength of the ionospheric storm, i.e. the maximum deviation of the TEC to 27 day median, to solar wind or geomagnetic activity indices is hard to detect.
Special focus of this presentation will be the source mechanisms of positive ionospheric storms. It will be discussed how thermospheric, magnetospheric and ionospheric perturbations interact and how this can be estimated. This can be a valuable contribution to forecasting ionospheric perturbations.

Project Works

Development and test of a SDR-receiver for receiving local meteorological data

Lutz Heinrich, Wolfgang Andree
DLR_Project_Lab, Neustrelitz, Germany

Meteorological services like the “Deutscher Wetterdienst (DWD)” and “Seewetterdienst Hamburg” provide meteorological data via a terrestrial observational network. They can be received by a Software Defined Radio (SDR) in a quite simple way – a commercial DVB-T flash drive (Digital Video Broadcasting — Terrestrial), which is used for broadcasting digital terrestrial television in Europe.

This project offers participants to set up their own SDR receiver with professional guidance and supervision. The DVB-T flash drive will be converted and extended with a 20 dB input amplifier for UHF/VHF range, as well as a 110 MHz mixer for short and long wave bands on a printed circuit board (PC-board). Each component of the receiver and its specific use will be presented in detail. One main point is the proper integration of all the components to the printed circuit board (PC-board) of the receiver. The required solder techniques will be trained and applied. After all components are adjusted, the whole instrument is put into operation.

In particular, there can be received data of radiosondes VAISALA RS-92 SGP started from Greifswald and Bergen (near Hannover) daily at 12:00 UTC, as well as meteorological data in RTTY and APT FAX on short and long wave bands of the “Seewetterdienst Hamburg”. Besides the set up and the data reception, the project will show how the received data and isobaric contour charts can be visualized with share and freeware.

Radiation Protection in Aviation

Tomas Forkert
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The determination of the radiation exposure of aircrew at aviation altitudes, generated by interactions of primary high-energetic particles of cosmic origin with atoms in upper layers of the Earth’s atmosphere, has been part of the radiation protection standards in the EU for more than ten years. The corresponding radiation field is very complex in both particle composition and energy distribution. The corresponding intensity depends on altitude, geomagnetic latitude and solar activity. Furthermore, Solar Particle Events (SPEs) can temporarily lead to increased dose rates at aviation altitudes, as well. Today, the radiation field and its modulating parameters can be represented by numerical models very well and, therefore, the operational dose assessment of aircrews relies on numerical calculations. Nevertheless, the results of these calculations need to be verified and improved regularly by concomitant measuring flights that allow spot checks of the calculated doses by measuring the actual radiation field with different types of detectors.

This project work will give an insight into the measurement of radiation fields in aviation by evaluating the data of a real measurement flight. The students learn which dosimetric quantities can be measured by various detectors and determine the relevant characteristics of the radiation field at cruising altitudes. Finally, the space weather situation during the flight is to be considered.

Cosmic rays in the heliosphere and on their route through the magneto and atmosphere – Theory and Experiment

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Conditions on the Sun and in the helio-, magneto-, iono-, and atmosphere that can influence the performance and reliability of space-borne and ground-based technological systems and can endanger human life or health are subject to space weather research. Besides the understanding of the underlying physical processes a major objective is to forecast dangerous processes in the Earth's environment. The radiation field as measured in near Earth space and in the Earth atmosphere is determined by the primary distribution of energetic particles outside the Earth magnetosphere and the interactions of energetic particles with electromagnetic fields and matter.

This project is dedicated to shed some light on the different particle populations i.e. galactic and solar cosmic rays that dominates the near Earth environment, how these particles can be measured by different technologies and how the intensity spectrum is altered on their way through the Earth magneto- and atmosphere.

Cosmic rays coming from outside will due to the Lorentz force undergo complicated trajectories in the magnetic field and may even be prevented from getting access to the atmosphere. PLANETOCOSMICS is a GEANT 4 based tool that was developed to investigate the charged particle propagation in the near Earth space and their interaction with the atmosphere. After discussing the underlying physics we will make use of this program to calculate the altered galactic cosmic ray spectrum for different locations at a height of 600 km. The result will be compared to energy spectra measured with PAMELA from 2006 to 2010.

When energetic particles enter matter they interact with the atoms, loosing energy and may even produce secondary particles. Based on the different processes, particle type, energy, and momentum can be derived. The second block of the project is thus dedicated to measurements of energetic particles in interplanetary space. We will analyze data from different instrumentation and learn how to identify different chemical elements and isotopes.

If we follow the path of energetic particles that enter the Earth's atmosphere to the ground we recognize that collisions with the atmosphere atoms and molecules will create secondary particles of different energies. Some of the secondary particles in the atmosphere may reach the ground, where one can measure them by e.g. a neutron monitor or other detectors. Despite their decades of tradition, ground based neutron monitors (NMs) remain the state-of-the-art instrumentation for measuring cosmic rays, and they play a key role as a research tool in the field of space physics, solar-terrestrial relations, and space weather applications. A third block is dedicated to neutron monitor measurements and comparisons to measurements with our own device.

Information

Locations - Neustrelitz

Housing in NZ

Freetime in NZ

Locations – Besides of Neustrelitz

Site	Link	QR
Berlin Ibis Hotel	https://goo.gl/maps/21Rcl	
Kühlungsborn Pension Seeblick	https://goo.gl/maps/nUC2g	
Kühlungsborn IAP	https://goo.gl/maps/23lwW	
Peenemünde Historisch-Technisches Museum	https://goo.gl/maps/tVbxl	

Phone Numbers

Emergency numbers

110 ← police

Or

112 ←ambulance service

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Housing students

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Housing referees/escorts

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