Report on Czech COSPAR-related activities in 2017

This report summarizes selected results of five Czech institutions represented in the Czech National Committee of COSPAR, the Institute of Atmospheric Physics (IAP) of the Czech Academy of Sciences (CAS), the Astronomical Institute (AI) of CAS, the Faculty of Mathematics and Physics of the Charles University (FMP CU), BBT - Materials Processing, and the Czech Space Office. Both selected scientific results and Czech participation in space experiments are treated. There are also significant outreach/PR activities, run mainly (but not only) by the Czech Space Office but these are not reported here.

Participation in space experiments

<u>Solar Orbiter (AI CAS, partly IAP CAS)</u>

Solar Orbiter project of ESA is in its final integration and testing phase, to be ready for launch in 2019 or 2020. The AI CAS, participating on the STIX scientific instrument (hard X-ray telescope for flare studies), was managing the delivery of power supply unit and flight software for the instrument. Both components were delivered in time - the instrument was integrated during summer 2017 (see photo). The Czech flight power supply unit as well as the flight software is now correctly working on the satellite while tested by the Airbus satellite manufacturer. The spare flight power supply unit will be delivered in March 2018. Another instrument on board the Solar Orbiter is the coronagraph Metis led by Italian PI, with Germany and Czech Republic as Co-PIs. Metis will observe the solar corona in UV in the hydrogen Lyman-α line and simultaneously in the visible light. The main optics (two mirrors) were designed and manufactured in the Czech Republic by TOPTEC (section of the Institute of Plasma Physics of CAS). The third instrument called RPW has PI in France, with participation of the AI and IAP CAS. The team at AI CAS has developed and manufactured the low voltage power supply and the corresponding power distribution unit (see figure) for the experiment Radio and Plasma Waves (RPW) led by the French CNES. Both flight models of the power supply were successfully tested and delivered. French collaborators asked for the assembly of one more spare power supply which would serve here at ground during the operational phase of the Solar Orbiter. This flight spare will be manufactured during 2018.

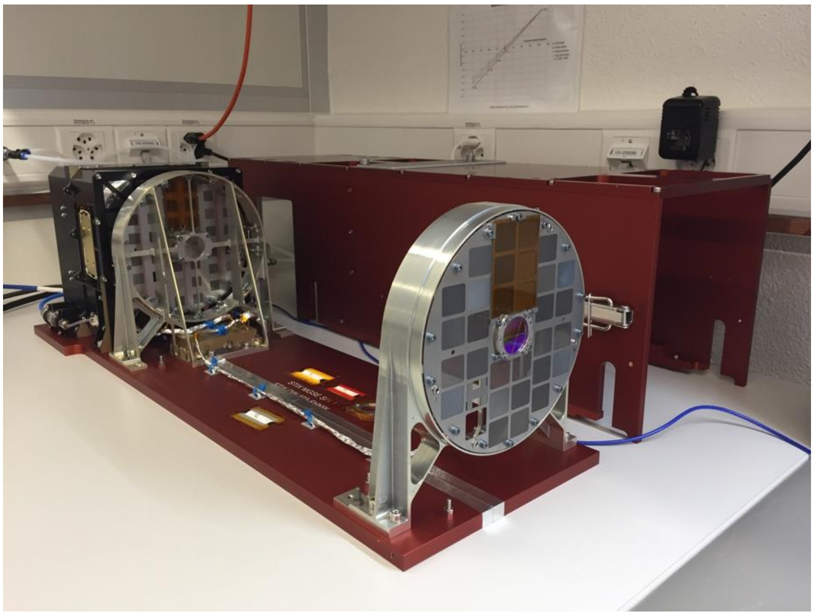


Figure: STIX telescope

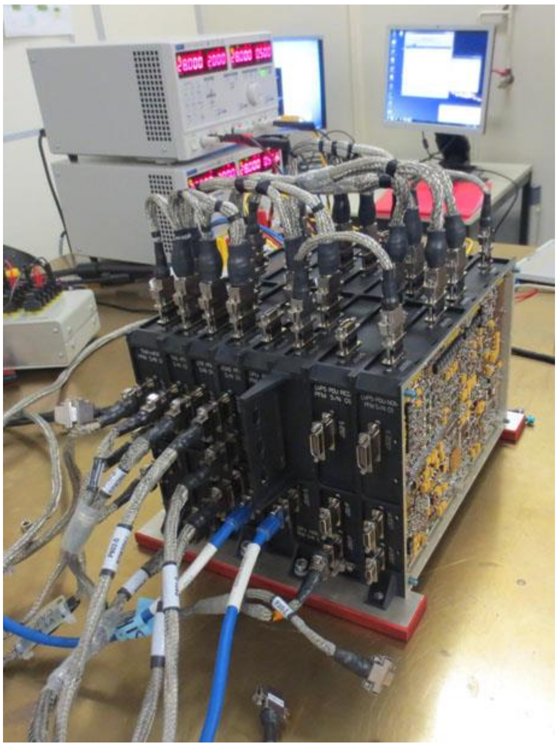


Figure: Flight model of the electronics box for the RPW experiment of the Solar Orbiter. Two of the electronics boards correspond to the two power supply units (primary and backup units) delivered by our team and are located at the right side of the RPW electronics box.

<u>ESA Proba-3</u> (AI CAS)

The AI CAS is also involved in the ESA Proba-3 mission preparation, and namely TOPTEC designs and manufactures the optics for the ASPIICS coronagraph, while the SERENUM company is responsible for the front door mechanism. This large space coronagraph is a unique mission aimed at testing the formation flight of two satellites.

<u>X-ray investigations</u> (AI CAS)

The research group at AI CAS is involved in several scientific teams for future X-ray missions, including the large ESA mission Athena to study hot and energetic universe and proposed ESA/NASA/Chinese space missions with a planned X-ray polarimeter on-board. The group was responsible for preparation of the part “Strong Gravity” of the Yellow Book for a proposed medium-class ESA mission XIPE. It was also involved in the scientific team of already approved NASA small explorer-class mission IXPE and in the proposed international Chinese-led mission eXTP. For the Athena and the eXTP mission, the hardware contribution was proposed in collaboration with Czech industrial partners. The role of the Czech Republic in developing the Magnetic Diverter for Athena is being discussed with ESA. Preparations for design proposal of the Detector Tray for LAD instrument of the eXTP mission and following manufacturing of the detector as well as collimator frames are under current activities.

<u>Project JUICE</u> (IAP CAS + AI CAS)

Project JUICE (JUpiter ICy moons Explorer) was selected by ESA as the first of the largest (L class) missions of the Cosmic Vision programme. The anticipated launch is in 2022, arrival to Jupiter in 2030. IAP CAS is one the the six Co-PI institutions coordinating work on preparation of the RPWI (Radio and Plasma Wave Instrument) which is distributed between 25 scientific institutions from 9 countries, led by Swedish IRF-U. IAP CAS is developing the low frequency (LF) subsystem of the instrument (see http://okf.ufa.cas.cz/juice) which will measure electromagnetic waves in the vicinity of Jupiter and its moons, especially Ganymede.

AI CAS is developing a power supply unit for the instrument. Conceptually, this power supply represents completely different design which has been prepared. It must sustain harsh radiation conditions at Jupiter. Currently the AI CAS works on four engineering models of the power supply which are tested and prepared for internal system design review in 2018.

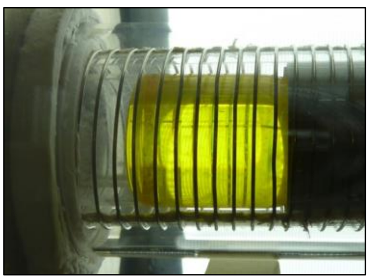
Figure: Left: Engineering model of the LF module for JUICE RPW1 which will analyze measurements of the electric and magnetic field. Right: Electronics board of the power supply for the RPWI experiment on JUICE space probe during one of the ground tests. Depicted is engineering model 2B.

IAPETHOS: Infrared Advanced Polarizer for Space and Other Applications (BBT)

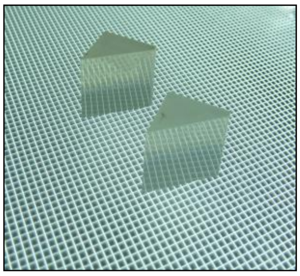
The IAPETHOS project - Infrared Advanced Polarizer for Space and Other Applications – has been devoted to the development of an infrared polarizer design incl. the Calomel crystal boules growth, manufacturing of relevant optical crystal components, as well as preliminary testing of the first polarizer breadboards, selection of the final candidate and its manufacturing including the protective housing and the final detail test campaign of the product.

Polarization optical elements based on Calomel represent the possibility to realize polarizers with a high degree of polarization, especially for MIR and TIR regions, where (currently) only grid polarizers with a relatively low degree of polarization are available. The high birefringence value of Calomel also allows a realization of phase elements such as λ/2, λ/4 plates and polarization scramblers. The planned applications are addressed to areas such as polarization analysis for remote sensing of Earth and other Solar system objects surfaces as well as their atmospheres, astronomy and the like. Phase elements are suitable for laser processing technologies, laser simulation etc.

Calomel as a birefringence material with a broadband transmittance range up to 20 μm is a perfect candidate for the new type of polarizers for the infrared thermal region. The present optical market offers only wire-grid or holographic type IR polarizers with very low or limited extinction ratios which limits the final performance of the product. From this point of view, the Calomel crystals (produced exclusively by BBT-Materials processing, Ltd.) seem to be the best candidate for this type of application.



So far, the following types of polarizers have been realized and breadboarded: Glan-Foucalt, Glan-Taylor, Dove, and BBT´s version of a modified Glan-Foucalt polarizer. All these polarizers are based upon the wedges of 27° (air-gap configuration) in order to utilize the total reflection angle of the extraordinary beam.

Figures: Growing and annealed Calomel crystal and polished Calomel optical components.

At the beginning of the project the minimum acceptable limits required by ESA were specified as follows: Extinction ratio **(ER) = 1:100** and Angular field of view **(AFOV) = 1deg**. Both of these limits have been highly exceeded, achieving **ER = 1:3000 to 1:9000 (He-Ne laser)** for Glan-Foucalt and Glan-Taylor polarizers, depending on the measurement spots in the optical aperture. The angular aperture (or angular field of view) for Glan-type polarizers mounted inside the protective housing are relatively large: for Glan-Foucalt polarizer **AFOV = -30deg/+11deg** and for Glan-Taylor one **AFOV = -0.5deg/+4deg**. From the acquired data mentioned above we can conclude that **all of the planned parameters required by ESA were successfully achieved and even exceeded.**

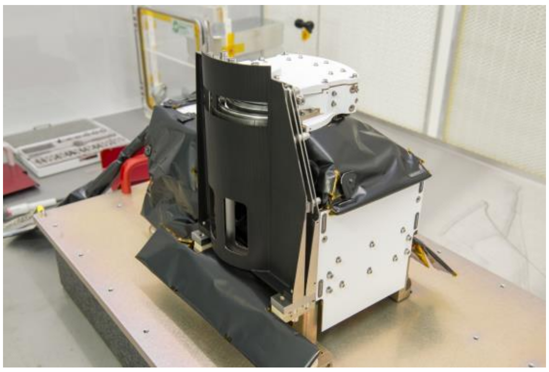
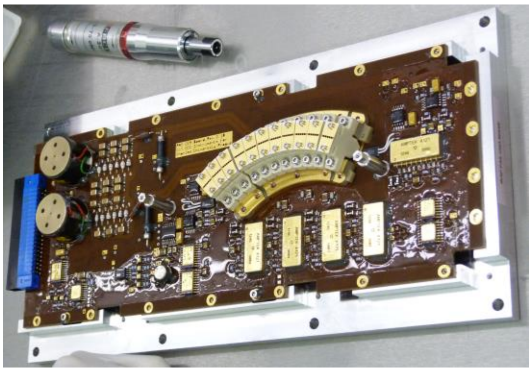
We believe that the Calomel-based infra-red polarizers offer a competitive advantage to the common grid polarizers in terms of their performance and therefore it would be advisable to continue their further development and improvement, as well as their qualification for space purposes.

Telemetry station Panska Ves (IAP CAS)

The Czech telemetry station Panska Ves is receiving data from the ESA Cluster mission (four satellites, part of information) and space weather information from the NASA two-spacecraft mission Van Allen Probes. The data from the WBD instruments onboard Cluster were processed at IAP and submitted to the Cluster Science Archive at ESA.

Activities of FMP CU

In 2017 we assisted to the assembly, integration, and testing of flight components we had delivered for the Solar Orbiter SWA/PAS and TARANIS/IDEE instruments in 2015-16.

Figures: Solar Orbiter SWA/PAS flight model (left). PAS flight detector board provided by FMP CU (right).

Figure: Flight model of the TARANIS IDEE DZA data processing unit (FMP CU delivered two flight models). The DZA and DNA units are part of the MEXIC-1 electronic box.

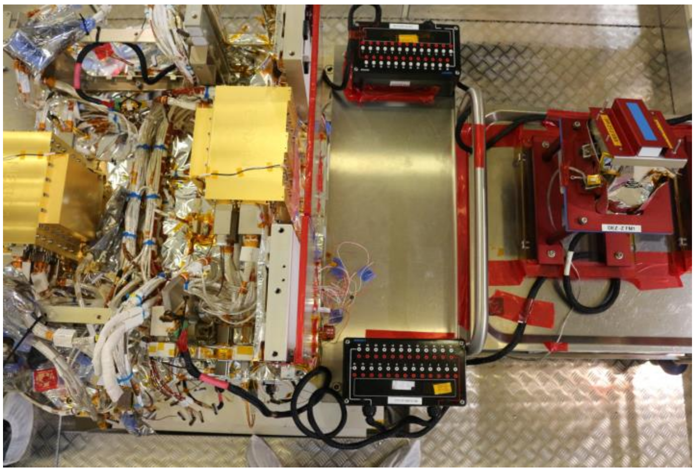


Figure: Integration of the IDEE flight sensor units (at right) with the MEXIC-1 (at left) mounted on the TARANIS satellite instrument platform.

We were involved in the A-phase study for the THOR mission (FAR instrument) and we worked on a prototype of a new Faraday-cup based solar wind monitor BMSW-LG for the Russian Luna-Resurs-1 OA mission.

Figure: Mechanical prototypes of the BMSW-LG detector blocks (a heritage of the Spektr-R BMSW instrument working in orbit since 2011).

<u>Activities of IAP CAS</u>

We have participated on the delivery, assembly, integration, and testing of FM TDS module of the RPW instrument of the ESA Solar Orbiter mission, FM of the IME-HF instrument for the CNES TARANIS mission (http://okf.ufa.cas.cz/taranis/). We have prepared engineering model of the low frequency analyser for JUICE/RPWI. We were also involved in the A-phase study for the THOR mission and we started to prepare a prototype of the LEMRA-L instrument for the Russian Luna-Resurs-1 OA mission.

Selected scientific results

An improved model of ion composition and its inclusion into IRI (IAP CAS)

We have improved model of relative ion densities. This model describes concentrations of main ions in the upper and topside ionosphere and lower plasmasphere in dependence on solar activity especially for extreme low solar activity conditions. The improved model was included into the latest version of the International Reference Ionosphere (IRI). For comparison of the new IRI with previous versions see Figs 1 and 2.

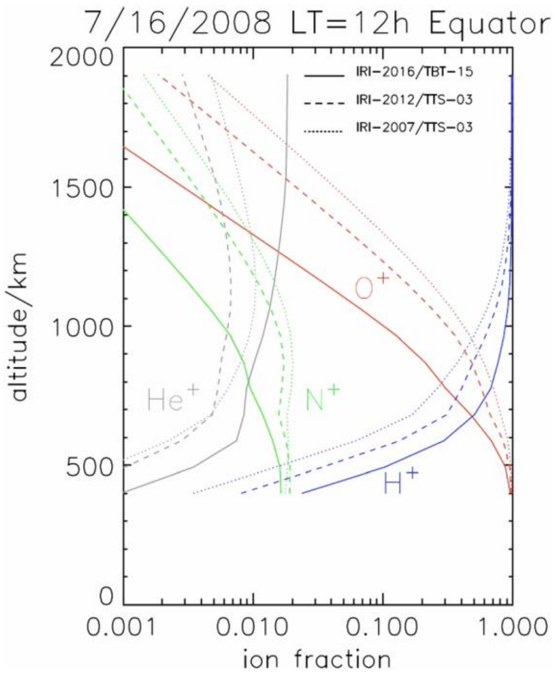


Figure 1: Topside ion composition with the IRI-2007 (dotted curves), IRI-2012 (dashed curves), and the new IRI-2016 models (solid curves) for extreme low solar activity conditions (July 16, 2008). Note the steady decrease in upper transition height from close to 1000 km in IRI-2007 to close to 700 km in IRI-2016.

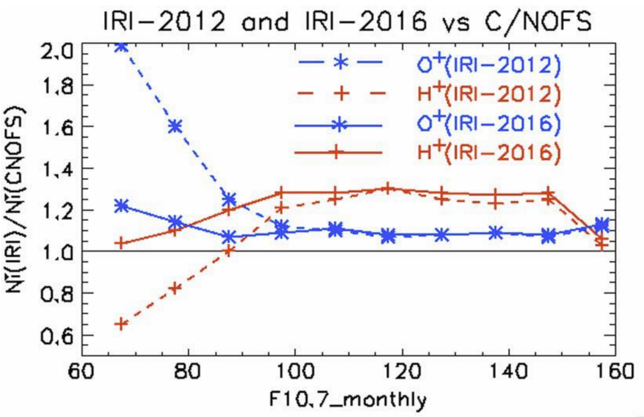
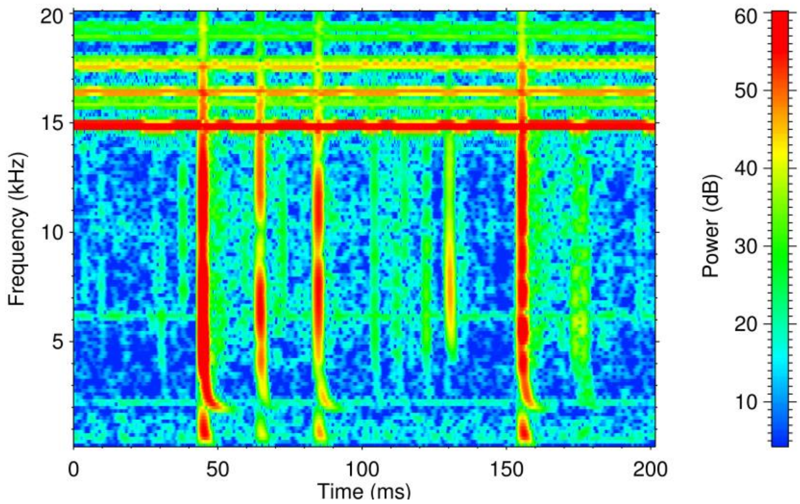


Figure 2: Ratio between IRI predictions and C/NOFS-CINDI measurements of O^+ (blue) and H^+ (red) densities versus the F10.7 monthly solar index for IRI-2012 and the new IRI-2016. Note the large improvement at low solar activities.

Bilitza, D., D. Altadill, V. Truhlik, V. Shubin, I. Galkin, B. Reinisch, and X. Huang (2017), International Reference Ionosphere 2016: From ionospheric climate to real-time weather predictions, Space Weather, 15, 418–429, doi:10.1002/2016SW001593.

Unusual Electromagnetic Signatures of European North Atlantic Winter Thunderstorms (IAP CAS)

All lightning strokes generate electromagnetic pulses (atmospherics) which can travel over distances of thousands of kilometers. Night-side atmospherics show typical frequency dispersion signatures caused by sub-ionospheric propagation. Their analysis can be used to determine the distance to the source lightning, and therefore it represents a safe tool for investigation of distant thunderstorms, as well as for indirect observations of the lower ionosphere. However, such analysis has never been done on the dayside. Here we present the first results which show unusual daytime atmospherics with dispersion signatures originating from strong thunderstorms which occurred during winter months 2015 in the North Atlantic region. Using newly developed analysis techniques for 3-component electromagnetic measurements we are able to determine the source azimuth and to attribute these rare atmospherics to both positive and negative lightning strokes in northern Europe. We consistently find unusually large heights of the reflective ionospheric layer which are probably linked to low fluxes of solar X rays and which make the dayside subionospheric propagation possible. Although the atmospherics are linearly polarized, their dispersed parts exhibit left handed polarization, consistent with the anticipated continuous escape of the right-hand polarized power to the outer space in the form of whistlers.



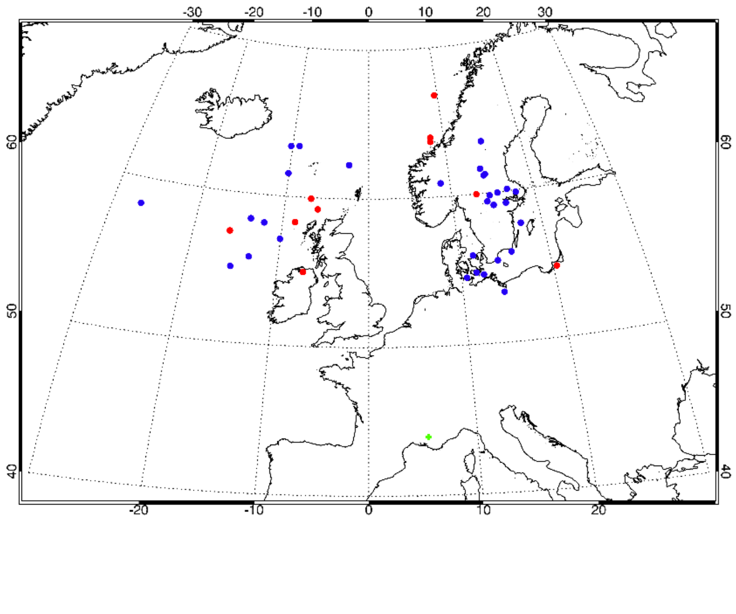


Figure: Top: Frequency-time spectrogram of the N-S magnetic-field shows unusual daytime tweek (9 Jan 2015 at 11:31:41.6). Bottom: Locations of source lightning strokes. Red and blue dots represent positive and negative lightning strokes, respectively; a green cross shows the location of our VLF receiving station.

Santolik,O., and I. Kolmasova, Unusual Electromagnetic Signatures of European North Atlantic Winter Thunderstorms, Scientific Reports 7, 13948, doi:10.1038/s41598-017-13849-4, 2017.

<u>First Observation of Lion Roar Emission in Saturn's Magnetosheath (IAP CAS)</u>

We present an observation of intense emissions in Saturn's magnetosheath as detected by the Cassini spacecraft. The emissions are observed in the dawn sector (magnetic local time ∼ 06:45) of the magnetosheath over a time period of 11 h before the spacecraft crossed the bow shock and entered the unshocked solar wind. They are found to be narrow-banded with a peak frequency of about 0.16 fce, where fce is the local electron gyrofrequency. Using plane wave propagation analysis, we show that the waves are right hand circularly polarized in the spacecraft frame and propagate at small wave normal angles (<10∘) with respect to the ambient magnetic field. Electromagnetic waves with the same properties known as "lion roars" have been reported by numerous missions in the terrestrial magnetosheath. Here we show the first evidence such emission outside the terrestrial environment. Our observations suggest that lion roars are a solar-system-wide phenomenon and capable of existing in a broad range of parameter space. This also includes one order of magnitude difference in frequencies. We anticipate our result to provide new insight into such emissions in a new parameter regime characterized by a higher plasma beta (owing to the substantially higher Mach number bow shock) compared to Earth.

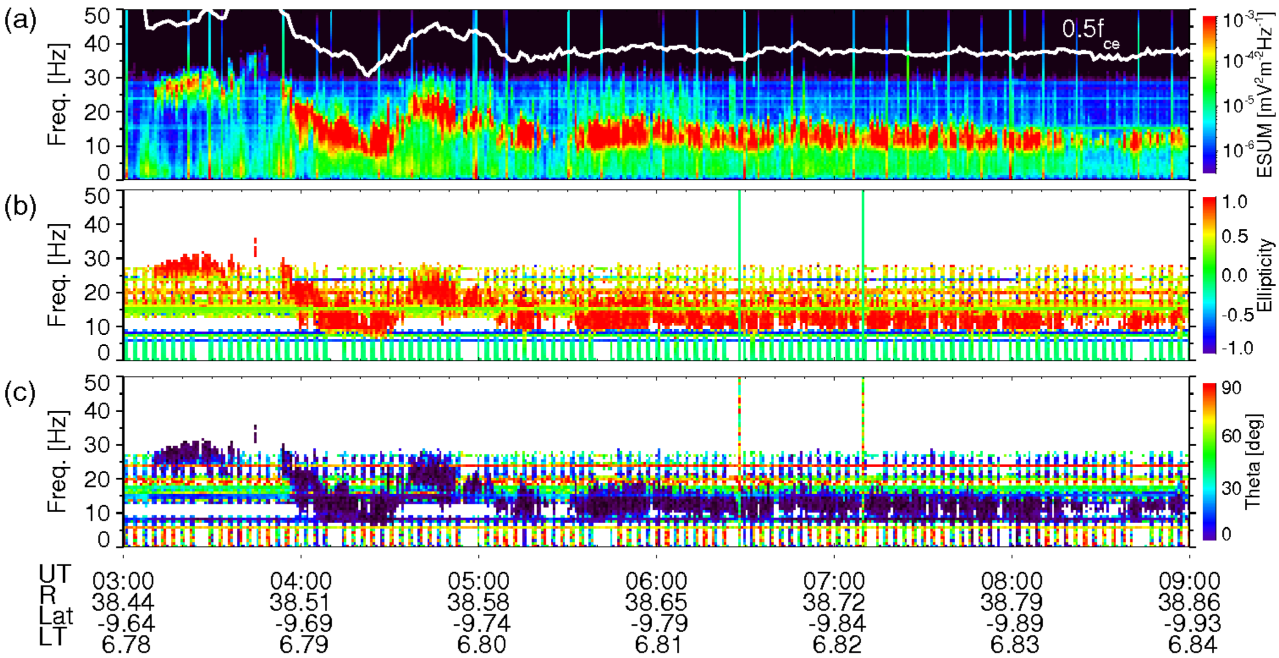


Figure: Cassini RPWS/WFR lower band data measured on 3 July 2005. (a) Sum of the power spectral densities of two components of the electric field. The white line shows fce, calculated from 1 min fluxgate measurements. (b) Ellipticity of the wave polarization combined with the sense of polarization, +1for right-hand and −1 for the left-hand circularly polarized waves. (c) Polar angle of a wave vector, 0∘ for waves propagating parallel to the ambient magnetic field and 90∘ for transverse wave propagation.

Píša, D., A. H. Sulaiman, O. Santolík, G. B. Hospodarsky, W. S. Kurth, D. A. Gurnett, First observation of lion roar emission in Saturn's magnetosheath, Geophys. Res. Let., 45, https://doi.org/10.1002/2017GL075919, 2017.

Observation of ionospherically reflected quasiperiodic emissions by the DEMETER spacecraft (IAP CAS)

Quasiperiodic (QP) electromagnetic emissions are whistler mode waves at typical frequencies of a few kHz characterized by a periodic time modulation of their intensity. The DEMETER spacecraft observed events where the QP emissions exhibit a sudden change in the wave vector and Poynting vector directions. The change happens in a short interval of latitudes. We explain this behaviour by ionospheric reflection and present a ray-tracing simulation which matches resulting wave vector directions. We also attempt to locate the source region of these emissions and conclude that they are most probably generated at the inner boundary of the plasmapause which also acts as a guide during the propagation of the QP emissions.

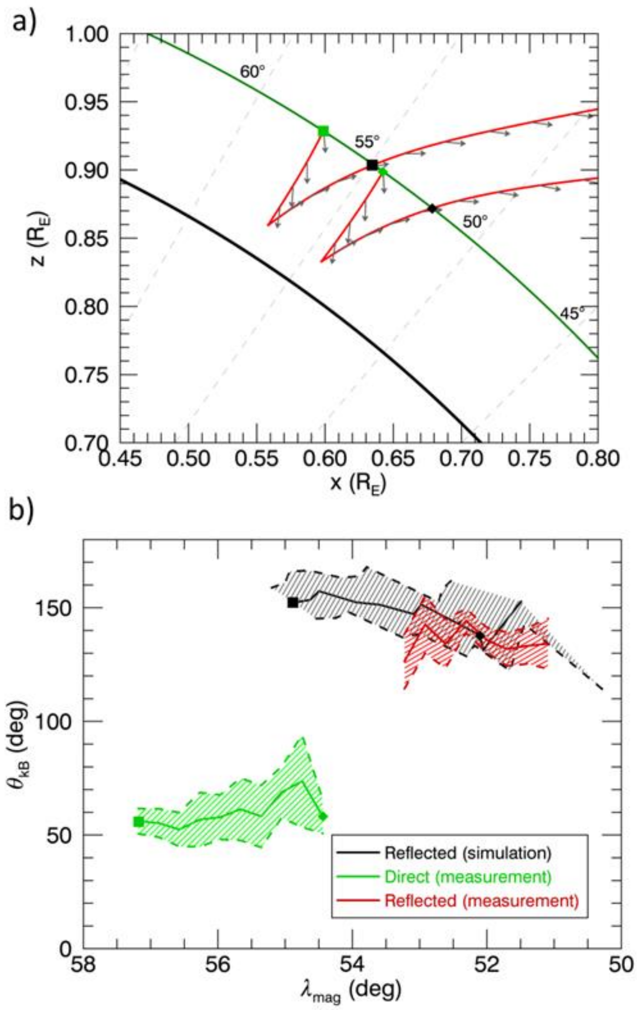


Figure: (a) Detail of ionospheric reflection of simulated ray trajectories of whistler mode QP emissions. The thick black curve is the Earth's surface, and the green curve stands for the orbital altitude of the DEMETER satellite. The grey arrows represent the wave vector directions along the path with equidistant group time intervals of 0.01 s. (b) Dependence of polar angle on geomagnetic latitude for observed waves, together with simulated rays crossing the position of DEMETER. Green line connects the initial measured values of direct waves, red line connects the final measured values for reflected waves. Dashed, green and red lines and filled areas represent the standard deviation. Black line shows the result of simulation of reflected rays. The square and diamond symbols refer to Figure 2a, representing direct (green) and reflected (black) rays. The ~15 s gap between red and green areas represents the time interval where mixing of direct and reflected waves is most prominent and therefore cannot be used for comparison.

Hanzelka, M., O. Santolík, M. Hajoš, F. Němec, and M. Parrot, Observation of ionospherically reflected quasiperiodic emissions by the DEMETER spacecraft, Geophys. Res. Lett., 44, 8721–8729, doi:10.1002/2017GL074883, 2017.

<u>Infrasound waves generated by seismic waves and by large convective systems</u> (IAP CAS)

Infrasound waves observed in the ionosphere by continuous Doppler sounder were analyzed. Namely, the infrasound waves generated by seismic waves and by large convective systems as typhoons were discussed and compared. Nonlinear simulations were also performed to explain the observed features of co-seismic infrasound. Modal resonances were discussed in the second case.

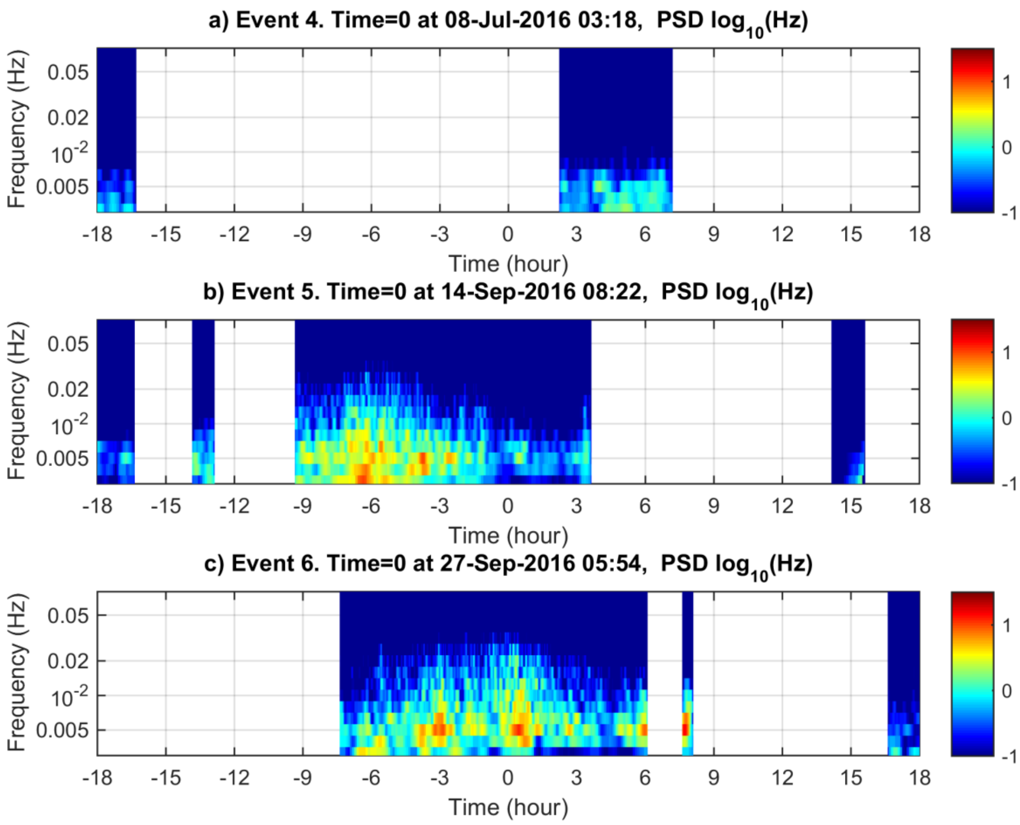


Figure: Dynamic spectra of infrasound waves observed over Taiwan for three different typhoons. Zero times correspond to the closest approach of the typhoon eyes to the Doppler sounder.

Chum, J., J.-Y. Liu, K. Podolská, T. Šindelářová, Infrasound in the ionosphere from earthquakes and typhoons, J. Atmos. Sol.-Terr. Phys., doi:/10.1016/j.jastp.2017.07.022, 2017.

Propagation of gravity waves over Taiwan (IAP CAS)

Propagation of gravity waves over Taiwan by multipoint continuous Doppler sounder, developed at the Institute of Atmospheric Physics CAS, was studied. The observed horizontal propagation velocities were usually in the range 140 to 280 m/s. It was shown that the propagation direction, especially the meridian component, depends on the season (see Figure). Southwestward propagation was extremely rare.

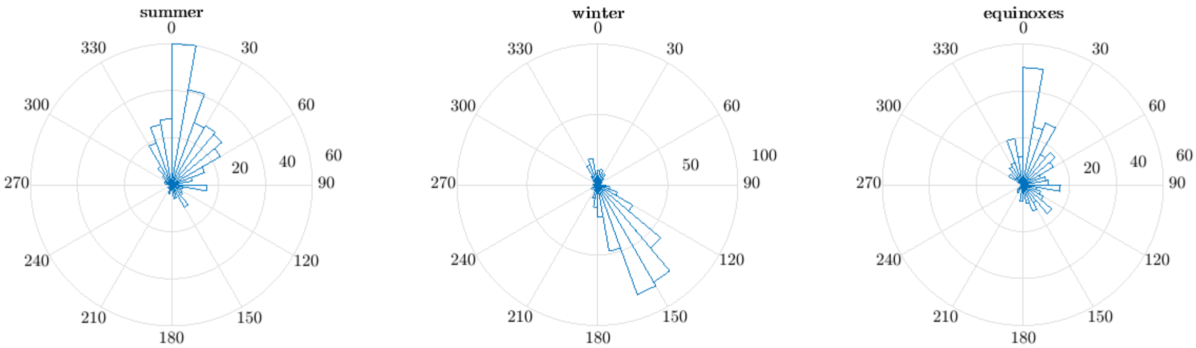


Figure: Number of observed azimuths of propagation during different seasons.

Fišer, J., J. Chum, and J.-Y. Liu, Medium-scale traveling ionospheric disturbances over Taiwan observed with HF Doppler sounding, Earth, Planets and Space, 69:131, doi: 10.1186/s40623-017-0719-y, 2017.

Anomalous effect of geomagnetic storms (IAP CAS)

Geomagnetic storms are the most pronounced phenomenon of space weather. During storm of 15 August 2015, an unexpected phenomenon was observed at higher latitudes of the Southern Hemisphere. This phenomenon was a localized TEC enhancement (LTE) in the form of two separated plumes, which peaked southward of South Africa. The plumes were first observed at 5 UT near the southwestern coast of Australia. The southern plume was associated with local time slightly after noontime (1-2 hours after local noon). The plumes moved with the Sun. They peaked near 13 UT southward of South Africa. The southern plume kept constant geomagnetic latitude (63-64°S); it persisted for about 10 hours, whereas the northern plume persisted by about two hours more. Both plumes disappeared over the South Atlantic Ocean. No similar LTE event was observed during the prolonged solar activity minimum period of 2006-2009. In 2012-2016 we detected altogether 26 LTEs and all of them were associated with the southward excursion of Bz. The negative Bz excursion is necessary but not sufficient condition for the LTE occurrence as during some geomagnetic storms associated with negative Bz excursions the LTE events did not appear.

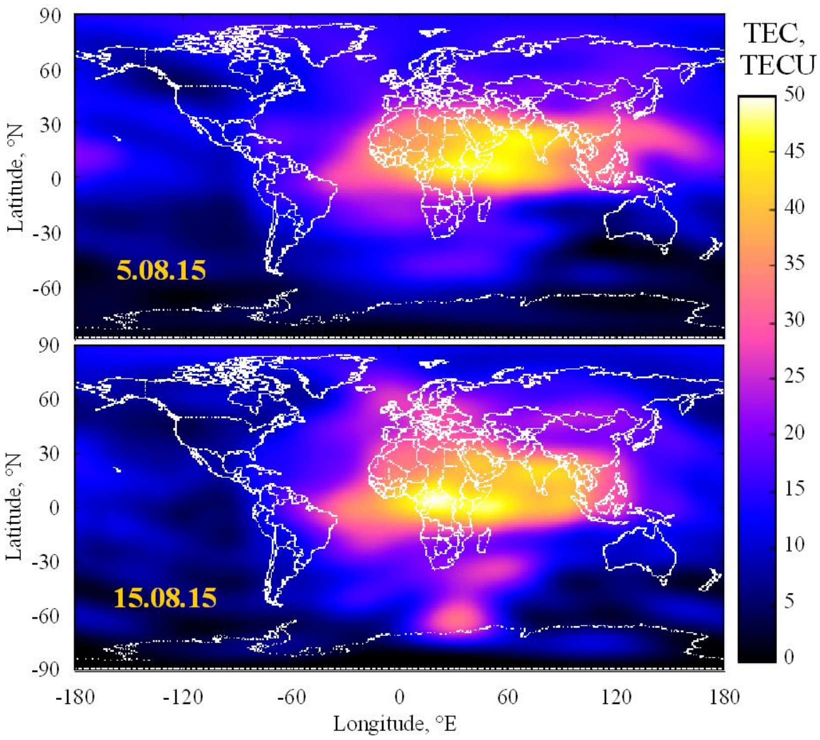


Figure: Global total electron density (TEC) distribution at 12 UT for quiet day of 5 August 2015 (top panel) and the LTE event of 15 August 2015 (bottom panel).

I. Edemskiy, J. Lastovicka, D. Buresova, J. B. Habarulema, Ivan Nepomnyashchikh, Unexpected Southern Hemisphere ionospheric response to geomagnetic storm of 15 August 2015, Ann. Geophysicae, 31, 71-79, https://doi.org/10.5194/angeo-36-71-2018, 2018.

Astrophysical black hole investigations (AI CAS)

Astrophysical black holes exist with a wide range of masses, from a few tens to billion times the mass of the Sun. If "fed" by surrounding gas, they may become amongst the most efficient X-ray emitters in the Universe. Gas can be accreted from a nearby star (as in stellar-mass "X-ray Binaries", XRB), or from material in the nucleus of external galaxies (as in the most massive "Active Galactic Nuclei", AGN). In their recent work Svoboda et al. (2017) used the whole archive of X-ray and optical/UV sources detected by XMM-Newton in its first 15 years of operations to address one of the fundamental problems in modern astrophysics: does accretion onto super-massive black hole work in a similar way as the stellar-mass black holes in X-ray binaries, and do XRB and AGN follow similar evolutionary paths? ? citace ? nejake vysledky

Model of Mercury's environment (AI CAS)

The team of AI CAS prepares a global numerical hybrid model of Mercury's environment for the BepiColombo mission of ESA. The previous version of the model has been used by NASA for the MESSENGER mission to Mercury.

Time-variable gravity field planned as a new product of the Swarm mission (AI CAS)

ESA launched the three Swarm satellites in November 2013, the main goal of the mission is to study the Earth magnetic field. The nominal length of Swarm was planned to be 4 years. The mission's successful global Earth mapping has recently been recognized by ESA officials and Swarm was extended by another 4 years until the end of 2021. Besides the magnetic and electric field instruments, each Swarm satellite carries a high quality GPS receiver, whose observations were demonstrated to be able to provide the temporal variations of the Earth gravity field (e.g. Bezděk et al., 2016). Although the time-variable gravity signal from GPS data is somewhat noisier compared to that obtained from specialized gravity mission GRACE, the availability of Swarm gravity fields is topical now, as GRACE has recently ceased to work and its successor GRACE-Follow-On is not yet launched (planned for launch early in 2018). Thus, Swarm gravity fields will serve as a gap filler for the time-varying gravity field in the meantime. ESA has started a preparatory work for the monthly gravity fields to become a new product of the Swarm mission within its DISC initiative (http://space.dtu.dk/swarm_disc_itts).

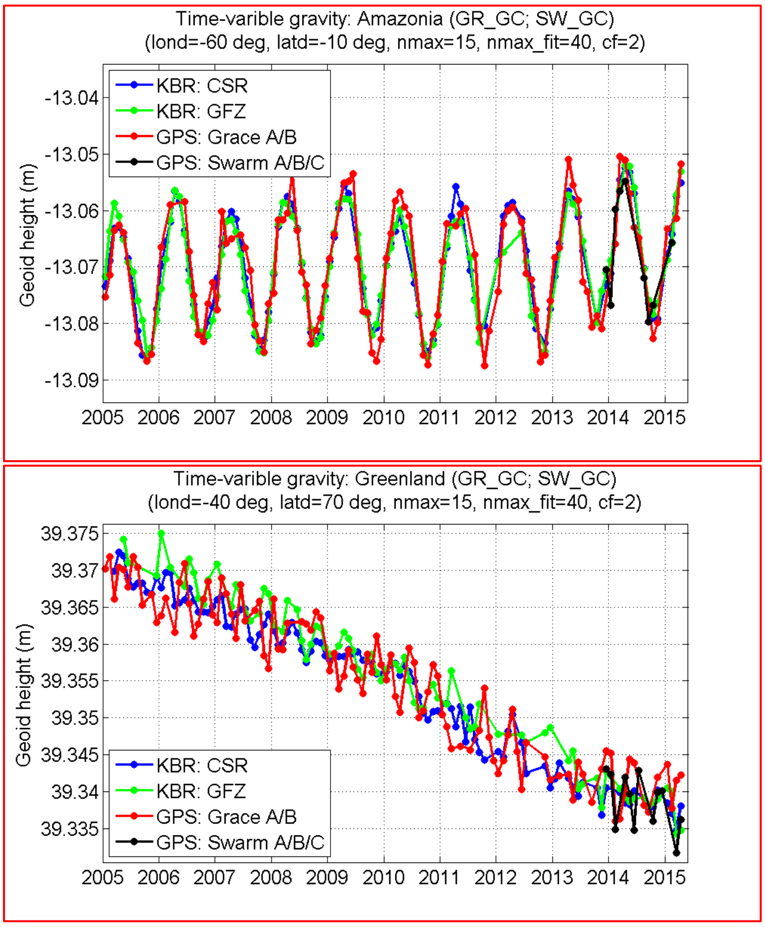


Figure: Time-series of monthly gravity field solutions in regions with strong seasonality (Amazon basin, upper panel) or trends (Greenland, lower panel).

Bezděk A, Sebera J, Encarnação J, Klokočník J., Time-variable gravity fields derived from GPS tracking of Swarm. Geophys. J. Int. 205, 1665–1669, 2016.

<u>Electromagnetic wave events from DEMETER</u> (FMP CU)

Specific electromagnetic wave events have been observed by the low-altitude DEMETER spacecraft, which are formed by intense emissions at well-defined discrete, harmonically spaced frequencies. In a detailed systematic analysis we show that the events are linked to the signals from VLF transmitters in Europe. Our results demonstrate that powerful VLF transmitters can significantly influence the wave activity in a given magnetic meridian, generating new emissions and resulting in energetic electron precipitation over a wide energy range.

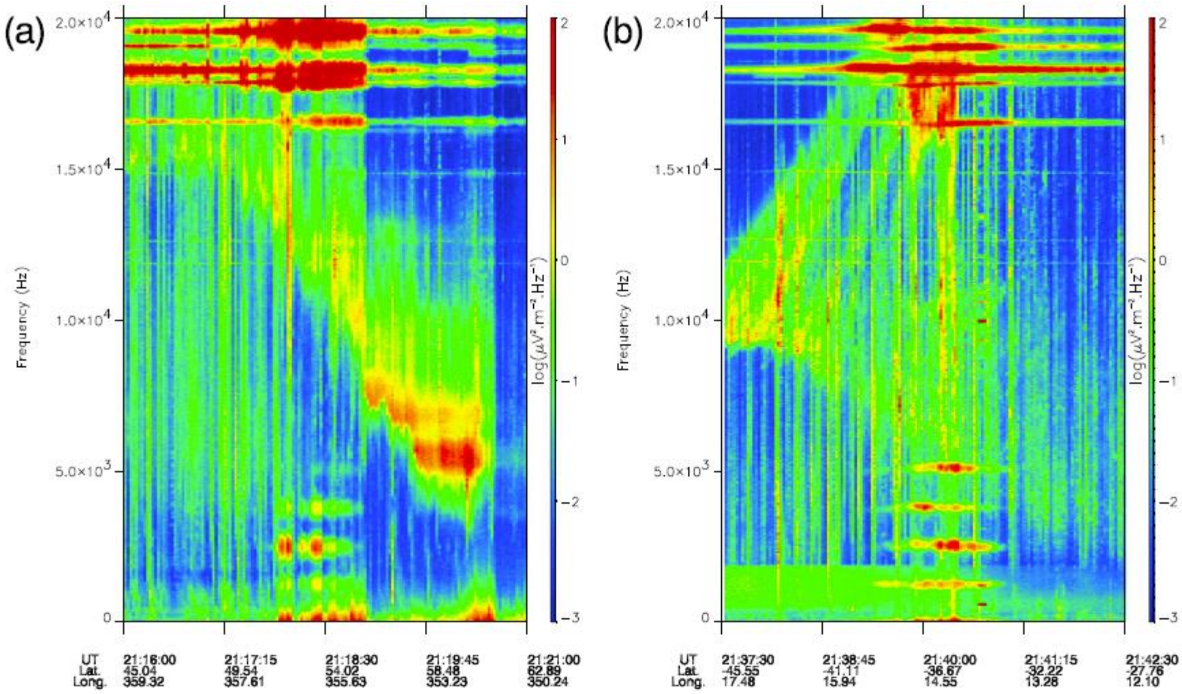


Figure: Frequency-time spectrograms of power spectral density of electric field fluctuations corresponding to an event observed in the Northern and Southern Hemispheres.

Němec, F., K. Čížek, M. Parrot, O. Santolík, and J. Záhlava, Line radiation events induced by very low frequency transmitters observed by the DEMETER spacecraft, J. Geophys. Res. Space Physics, 122, 7226–7239, doi:10.1002/2017JA024007, 2017.

<u>Protons and alpha particles</u> (FMP CU)

Relative properties of solar wind protons and α-particles are often used as indicators of a source region on the solar surface, and analysis of their evolution along the solar wind path tests our understanding of physics of multicomponent magnetized plasma. A comparison of about 20 years of Wind observations at 1 au with Helios measurements closer to the Sun (0.3–0.7 au) was performed. It shows a different evolution of the alpha-proton differential velocity during a regular solar wind expansion (increasing) and for observations inside ICMEs (small constant) – sources, mechanisms, and consequences are discussed in the paper.

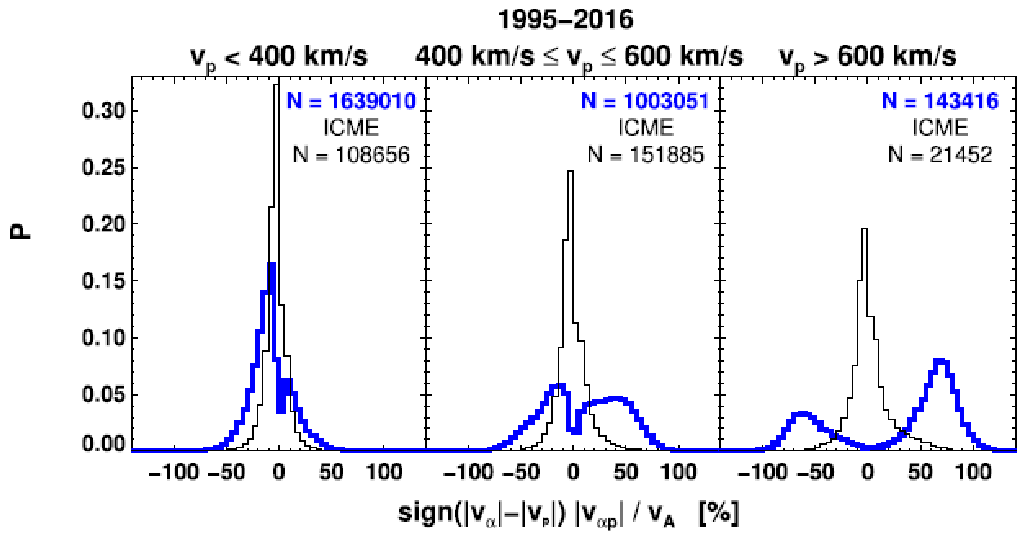


Figure: Probability distributions of the alpha-proton differential speed, v_ap computed for the reduced data set (blue), and their comparison with the distributions during ICME events (black).

T. Ďurovcová , J. Šafránková , Z. Němeček , and J. D. Richardson, Evolution of Proton and Alpha Particle Velocities through the Solar Cycle, Astrophysical Journal, 850-164 (9pp), 2017 December 1, doi:10.3847/1538-4357/aa9618, 2017.

Magnetic reconnection in solar wind (FMP CU)

A paper has been published presenting for the first time observations of unusual reconnection events in the solar wind where, in all solar wind types, we identify magnetic reconnection exhausts accompanied by one or two side jets. This complex structure is created around a single current sheet and the jet(s) oriented in the same direction as the main exhaust is (are) spatially separated from it. A source of these side jets is probably multiple or patchy reconnection at or close to the heliospheric current sheet.

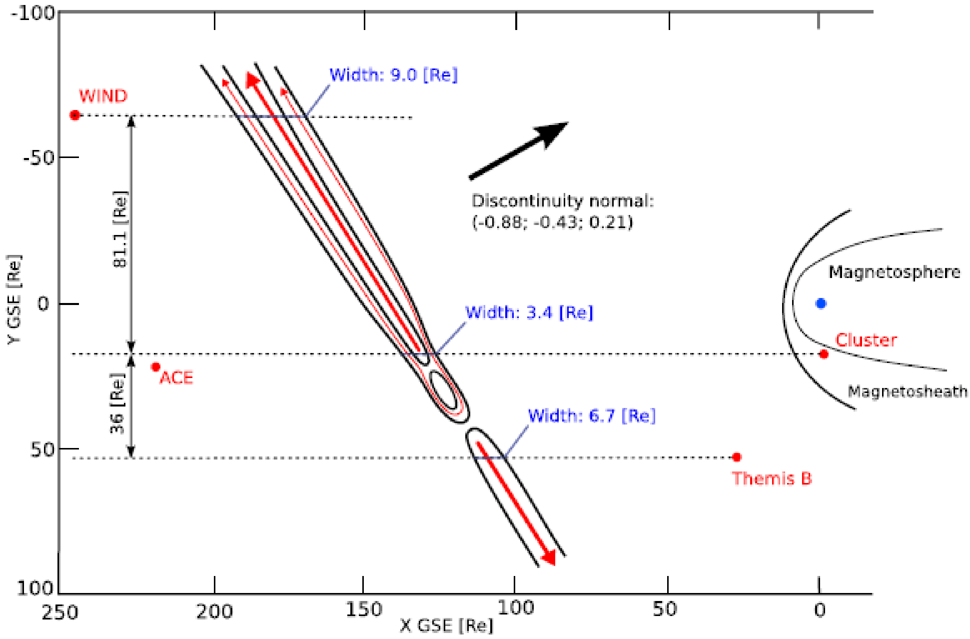


Figure: Sketch of observed magnetic reconnection together with spacecraft positions and projections of spacecraft distances. The sketch shows a proposed magnetic field line configuration (black solid lines) and directions of plasma jets (red lines). The horizontal lines denote the place of an encounter with a particular spacecraft. In the figure, the widths of exhausts as observed by different spacecraft are marked. They were computed from the transition time, solar wind velocity, and using the normal direction of discontinuity.

J. Enžl , J. Šafránková , Z. Němeček , and L. Přech, Spiky Structures around Reconnection Exhausts in the Solar Wind, Astrophysical Journal, 851:86 (8pp), 2017 December 20, doi:10.3847/1538-4357/aa98e0, 2017.

IP shocks (FMP CU)

Using high-time (31 ms) resolution plasma data provided by the Spektr-R spacecraft and 92 s Wind plasma and magnetic data, the decay of kinetic and magnetic fluctuations downstream of IP shocks data has been investigated. We observed the power law behavior of the energy decay profiles and we estimated the power-law exponents of both kinetic and magnetic energy decay rates. A passage of the IP shock increases the power of fluctuations by a factor of 10. This is true for both kinetic and magnetic components and their ratios are conserved in a statistical sense. The enhanced level of fluctuations is roughly constant for ~10 t_nl. Our case study suggests that a level of kinetic fluctuations decreases in the course of this time. The power-law decay starts at t_nl = t_d and its rate is n ~ -1.2 for both fractions of the turbulent energy that are similar to that theoretically derived and observed in MHD simulations. The upstream level of fluctuations is reached in ~80 t_nl, which is an average of about 12 hr of the spacecraft time.

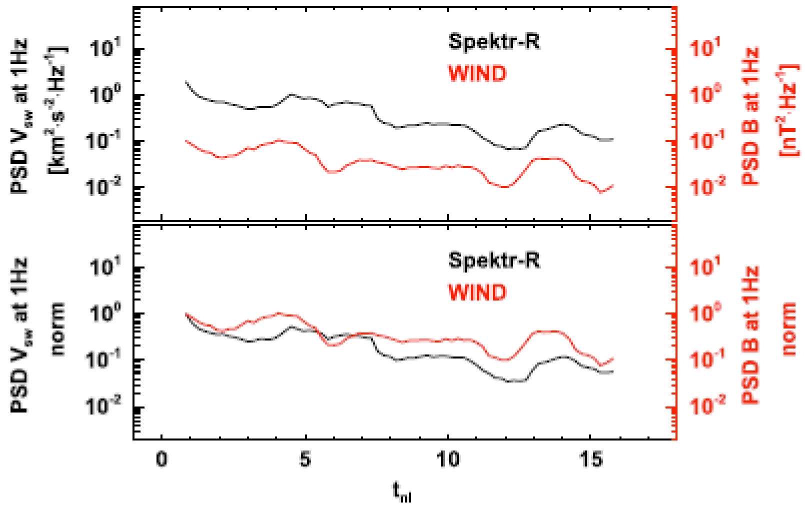


Figure: Evolution of the estimated PSDs of Vsw (black) and B (red) at 1Hz as a function of the nonlinear time. In the bottom panel, the same profiles normalized to the values immediately downstream of the IP shock.

A. Pitňa, J. Šafránková, Z. Němeček, and L. Franci (2017), Decay of Solar Wind Turbulence behind Interplanetary Shocks, Astrophysical Journal, 844:51 (10pp), 2017 July 20, doi:10.3847/1538-4357/aa7bef

Presentation of Czech space activities (AI CAS)

The AI CAS prepared a large-scale poster presenting the Czech space activities in the scientific missions of ESA that was exhibited during the European Week of Astronomy and Space Sciences (EWASS 2017) held in Prague in June. A public exhibition about the Czech involvement in ESA space projects was installed at the CAS main building from May to July 2017.