Czech contribution to ESA scientific missions

projects Interkosmos, Magion, up to modern ESA projects). The space research includes multi-discipline topics, from studying the Earth, its atmosphere and magnetosphere,

Space activities have a long tradition in the Czech Republic (from holes in distant quasars. Being a recent member state of ESA (since 2008), the Czech academic and industrial institutes have become involved in several ESA projects and intend to enhance their participation in future European space missions. The Czech the Sun and the Solar System up to extragalactic physics Academy of Sciences plays an important role in these cosmic of extreme conditions around super-massive black projects and identifies them as one of its strategic topics.

SOLAR ORBITER

Solar Orbiter is an ESA mission dedicated to study the Sun, its heliosphere and also properties of the solar wind. Its launch is planned for 2019 and the observatory will contain 11 scientific instruments. The Czech Republic (CR) has participated in the hardware development of four of them, STIX, METIS, RPW, and SWA.

STIX is an X-ray spectrometer designed to study the solar flares and signs of the Sun's magnetic activity. CR (Asl*) provides the power supply and on-board software.

RPW is dedicated to measuring electromagnetic waves in solar wind plasmas. The Czech teams delivered a power supply (AsI), and a digital plasma wave analyzer capable of on-board detection of rare wave events and dust particle impacts (IAP).

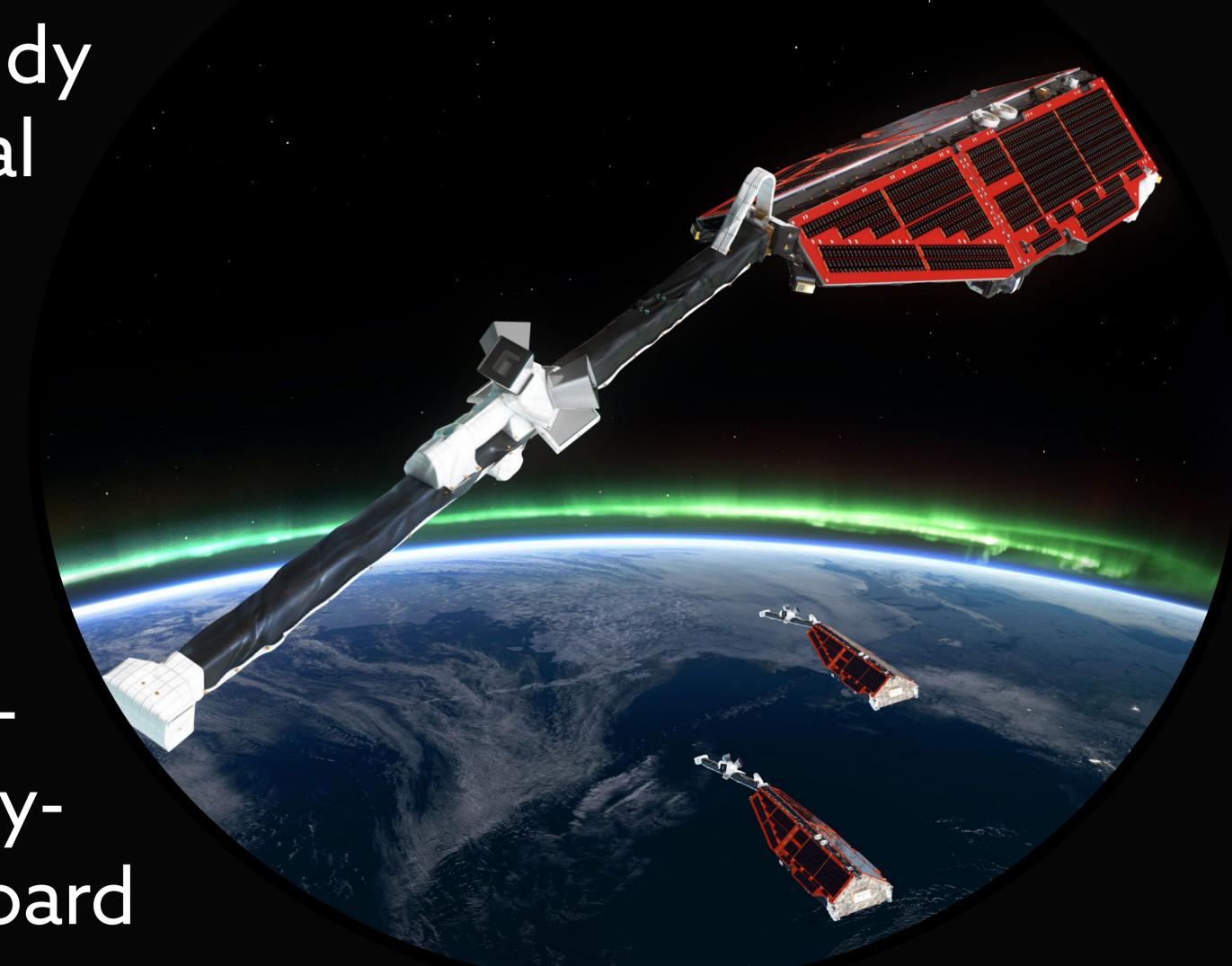
METIS is a coronograph on the Solar Orbiter mission. It will study the solar corona in the optical to UV spectral range. The optical mirrors (right) have been produced and tested in CR (AsI, IPP, Toptec).

SWA will measure properties of ions and electrons of the solar wind. The instrument Proton Alpha Sensor has been developed in an international collaboration with physicists from

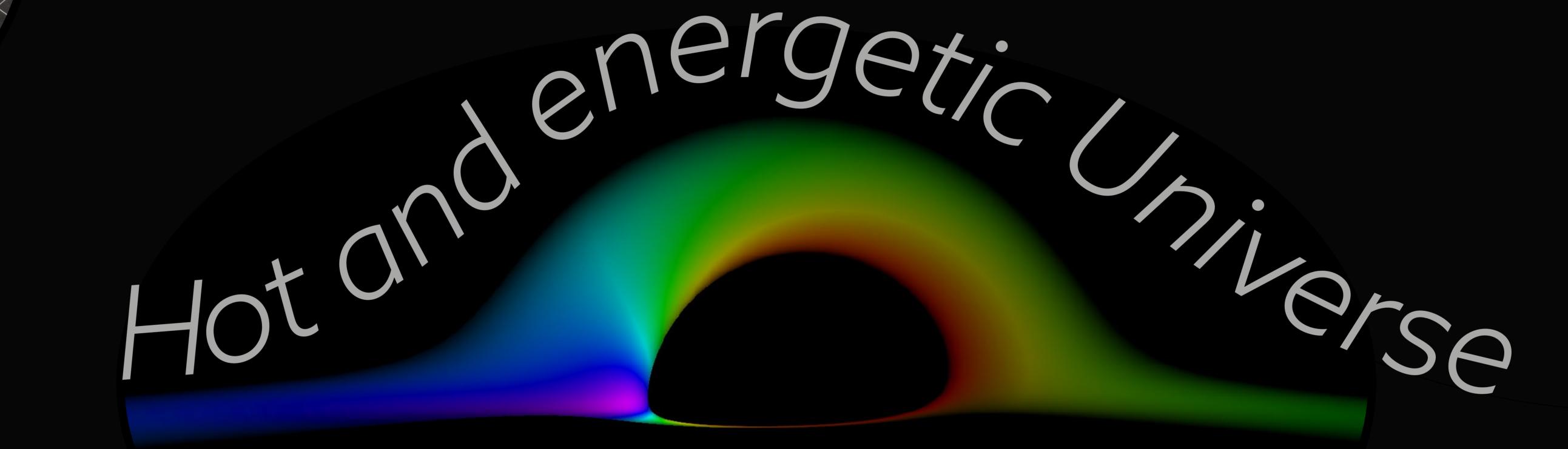


GOCE, Swarm

"Earth missions" are devoted to study Earth's gravity field, nongravitational forces and for geoscientific applications. Czech scientists developed novel geodetic computational methodologies and an original inversion method of converting GPS orbital data into gravity field measurements. They also participate in analysis and calibration of accelerometers aboard Swarm satellite.

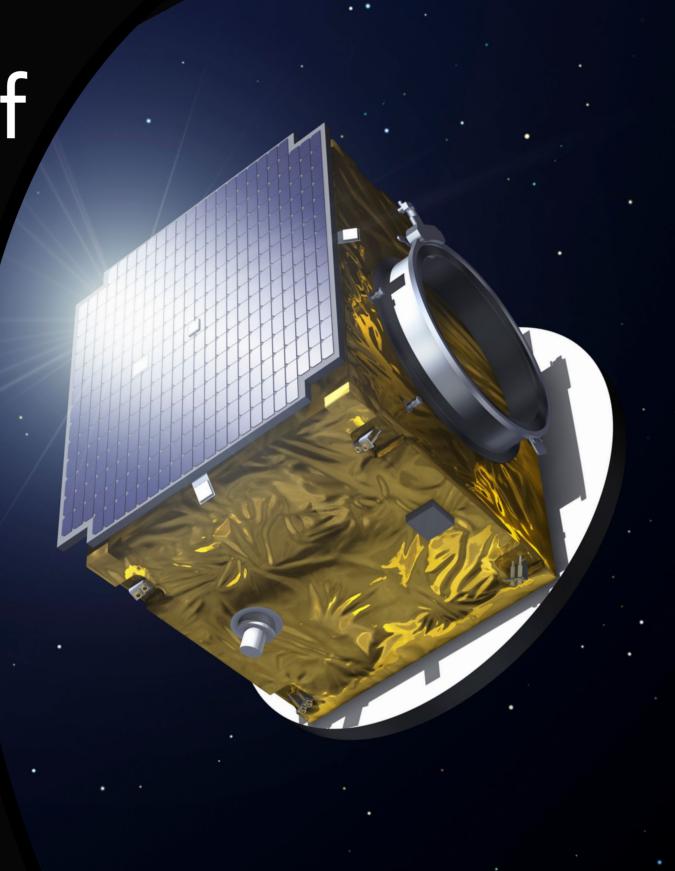


Turbulence Heating Observer spacecraft is one of the candidate proposals studied for implementation as the next ESA medium class mission. It is devoted to detailed measurements of turbulent energy dissipation and particle energisation in plasmas of the solar wind and Earth's magnetosphere. Czech scientists are responsible for two instruments in the role of principal investigators: FWP (Fields and Waves Processor) lead by IAP and FAR (Faraday Cup) developed by CU.



PROBA 3

Proba 3, an ESA technology mission, will consist of a pair of satellites flying in formation, in which one satellite will create an artificial solar eclipse for the other satellite with the coronograph to study the solar corona. The optical lenses and the closing door mechanism will be delivered by CR (AsI, IPP, Toptec).

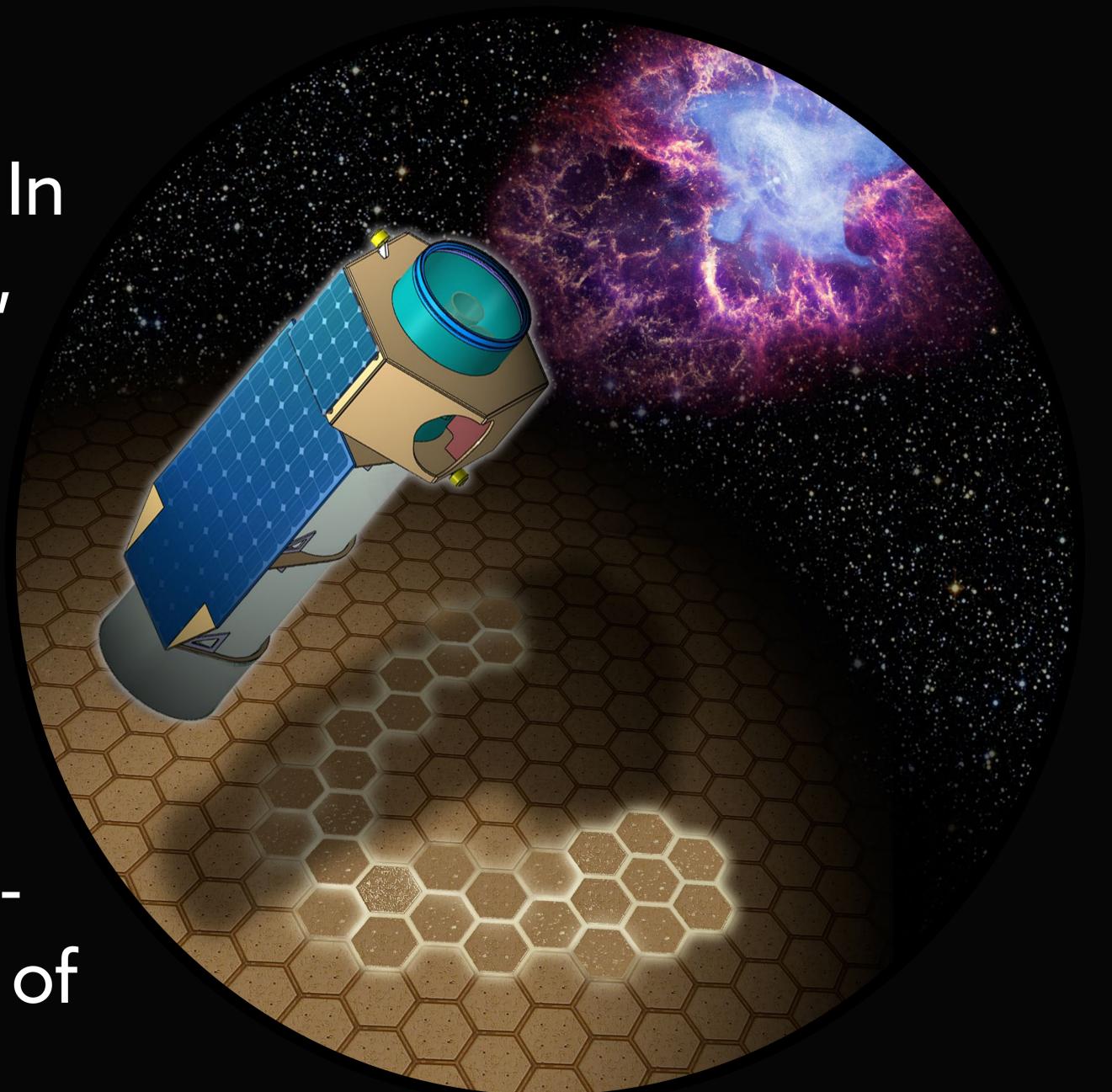


ATHENA

Advanced Telescope for High-Energy Astrophysics is a large (L2) ESA mission devoted to study the hot and energetic Universe. This X-ray observatory will study the large-scale structure of matter and the origin of super-massive black holes in the centres of galaxies. Czech scientists are involved in scientific simulations to show the capabilities of the planned instruments. A high-capability magnetic diverter should be part of the Athena instrumentation payload to deflect charged particles from their trajectories inside sensitive detectors. Precise configuration and design of this component is to be investigated in CR.



The X-ray polarimetry is a window to the Universe which has yet to be opened. In particular, it has potential to discover the state of matter inside neutron stars, what are the properties of space-time under extreme gravity and how light behaves in the presence of ultra-strong magnetic fields. XIPE (X-ray Imaging and Polarimetry Explorer) is a proposed medium-class mission, in which Czech scientists perform data simulations and build new astrophysical models of strong gravity effects on polarised radiation. eXTP (enhanced X-ray Timing and Polarimetry) is an extended Chinese mission proposal to combine polarisation, spectroscopy and timing to study black holes and neutron stars. CR will take responsibility for the mechanical construction of the detector and collimator frames of



the LAD detectors (Large Area Detector).

CR has been involved in several more ESA projects. The Czech contribution consists mainly in the scientific research - data analysis, developing software for the data reduction and visualisation, and proposing new experiments. The scientific research related with space projects does not include only astronomical topics, but also cosmic geodesy, nuclear physics (NPI), geology etc.

JUICE

Jupiter Icy Moons Explorer is a large (L1) ESA mission dedicated to investigation of Jupiter and three Jovian icy moons: Ganymedes, Europa and Callisto. The main goals of the mission are characterization of the conditions that may have led to the emergence of habitable environments among the moons and investigation of the magnetodisc of Jupiter and Ganymedes. The expected launch date is 2022 with the arrival at Jupiter in 2030. CR is participating on a design proposal of the power supply (AsI), and low-frequency analyzer (IAP) as a part of the instrument RPWI to study the magnetosphere of the Jupiter and its icy moons.

ExoMars 2020

ESA mission in collaboration with the Russian space agency Roskosmos which will search for indications of life on Mars. CR (IAP) is developing a wave analyzer module, which will detect electromagnetic signals possibly generated by lightning discharges originating in Martian duststorms and observe electromagnetic radiation propagating from the interplanetary space down to the surface of the planet.

