# High–Energy Astrophysics

The department of High–Energy Astrophysics under the lead of Prof. Andrea Santangelo explores the Universe in a wide range of energies from soft X–rays to TeV–/Gammarays and beyond to Ultra High Energy Cosmic Rays

X–ray Observatories

XMM–Newton / INTEGRAL / eROSITA / ATHENA+ / LOFT

Since more than 30 years our work-group at the IAAT contributes to the planning, simulation and development of X–ray cameras for spaceborne satellite observatories.

In cooperation with the Max–Planck–Institut für extraterrestrische Physik (MPE) Garching and international partners, we participate in the development of onboard electronics, (hardware and software) for the operation of astrophysical experiments.
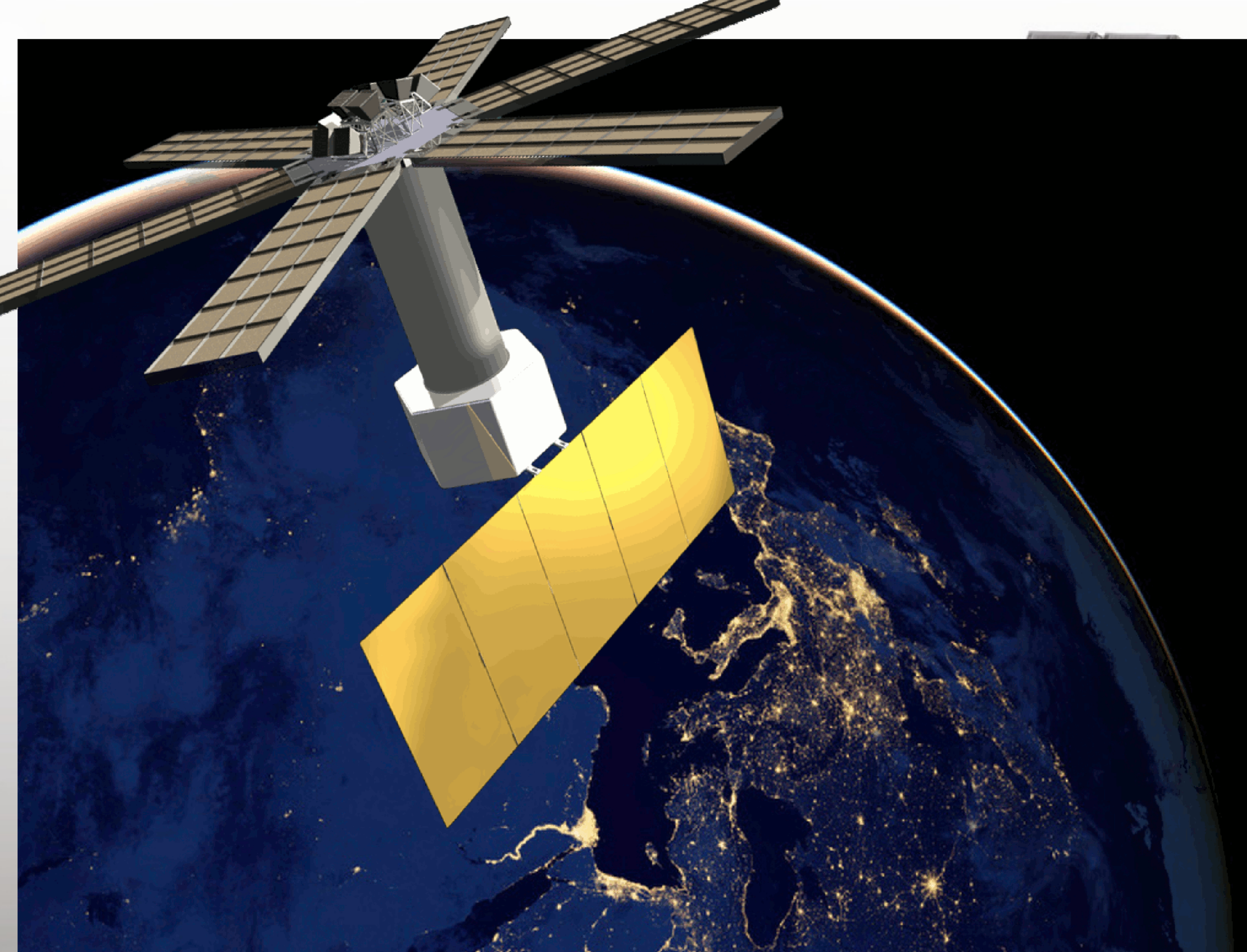
Artists view of the LOFT satellite

The JEM–EUSO mission on the International Space Station (ISS) will contribute to the understanding of the nature of Cosmic Rays and the field of neutrino astronomy. Our institute develops vital parts of the event–trigger electronics of JEM–EUSO. We also conduct simulations in order to predict and optimize the detector performance.

JEM–EUSO onboard the ISS
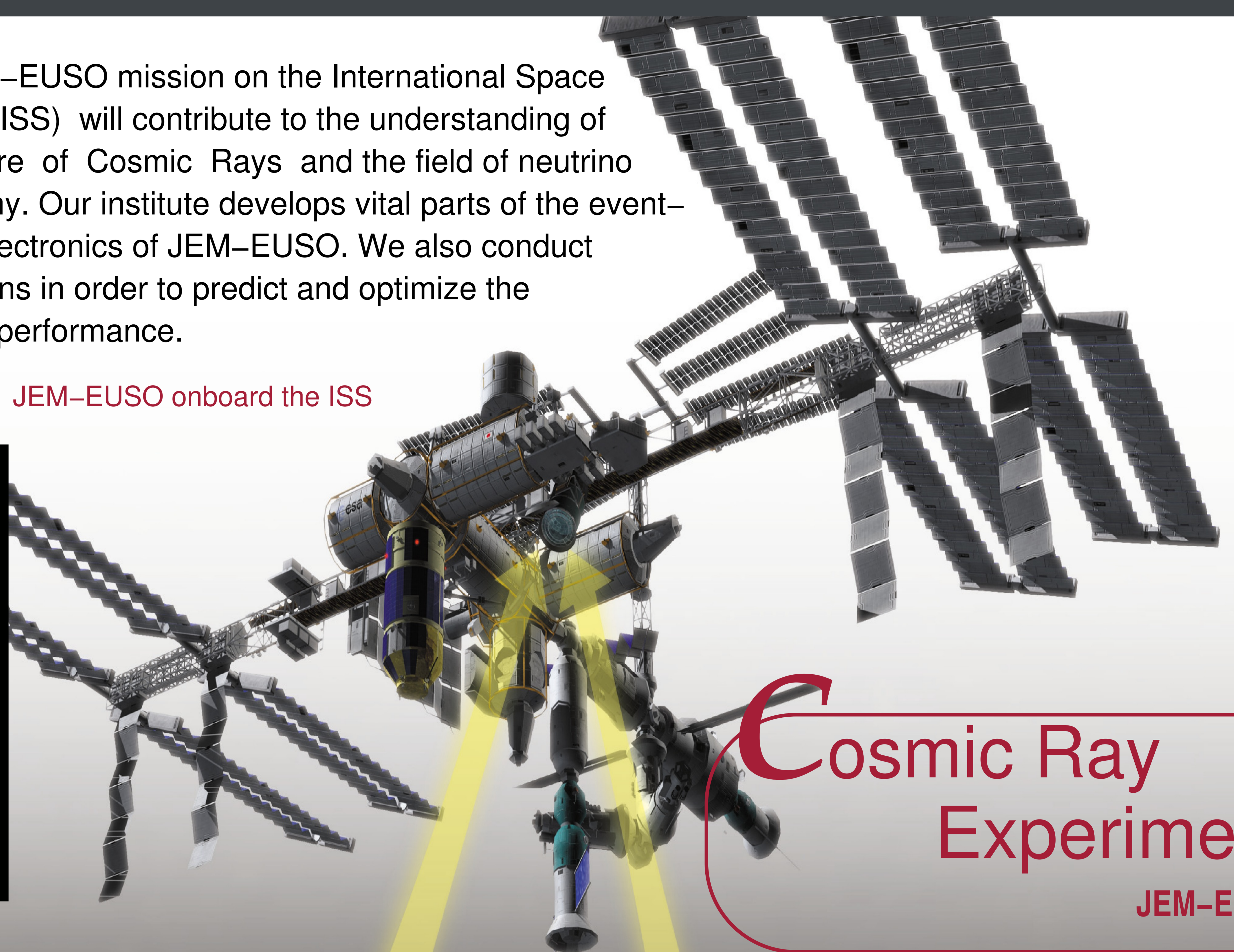
*C*osmic Ray Experiments

JEM–EUSO

*M*onte Carlo – Simulations

In order to optimize the detector performance of future satellite missions, we simulate in a variety of different Monte Carlo–Codes the radiation background of satellites.

The simulations permit us to estimate the performance of the experiment and also enable a prediction of the lifetime, the amount of radiation damage and the background level of the detector.
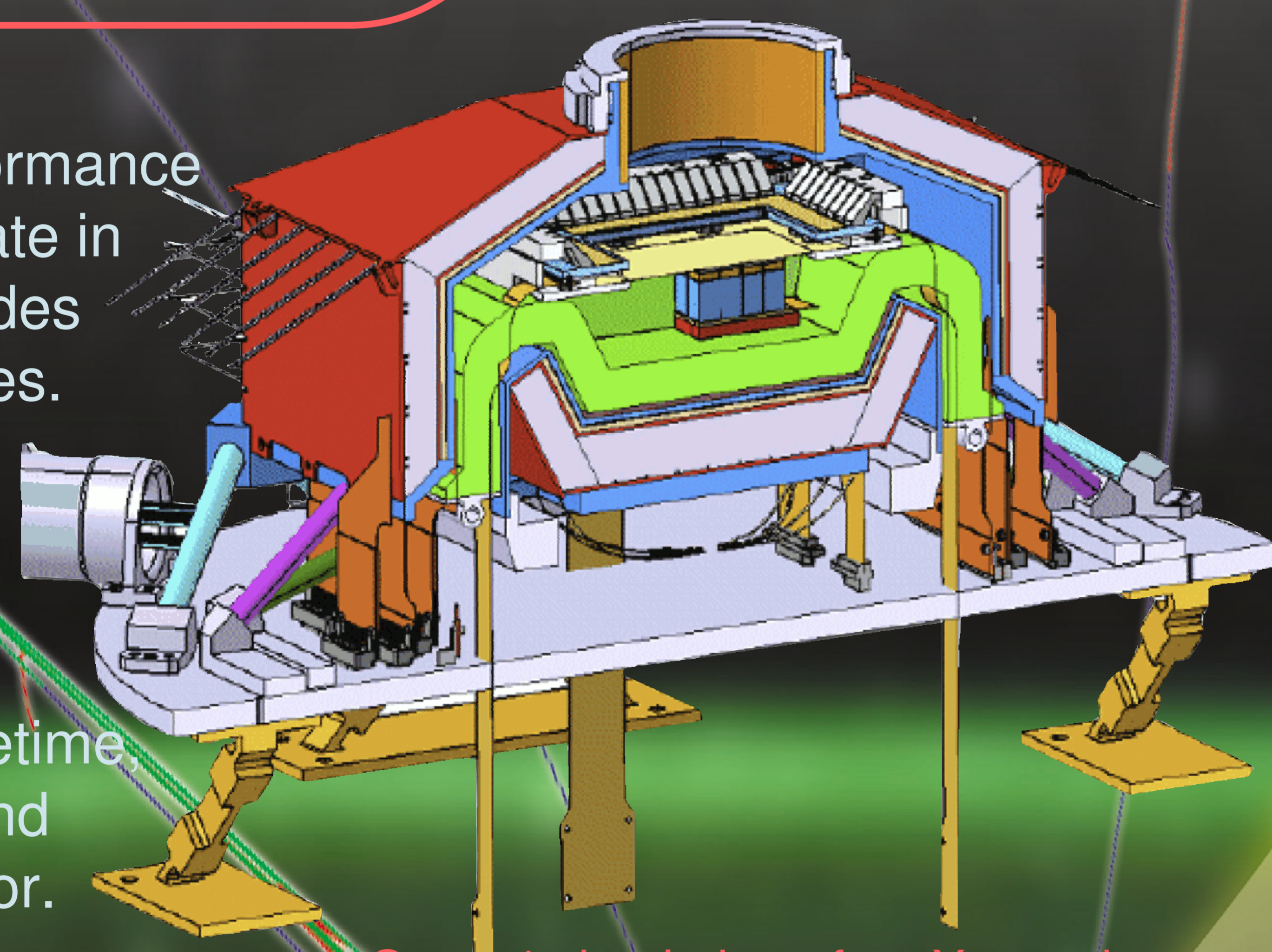
Geant4 simulation of an X–ray detector

*T*eV Astronomy

HESS / HESS2 / CTA

–> see also dedicated HESS posters

We are a member of the HESS–collaboration, lead by the Max–Planck Institut für Kernphysik Heidelberg, that operates a system of five Cherenkov–telescopes in Namibia. For the follow–up project, CTA, we participate in the development of electronics and software for the mirror allignment system and for the operation of the photomultiplier cameras. Cherenkov–telescopes observe so called air–showers in the Earth's atmosphere, which are either caused by gamma–rays or by highly energetic cosmic particles.

HESS II telescope in Namibia
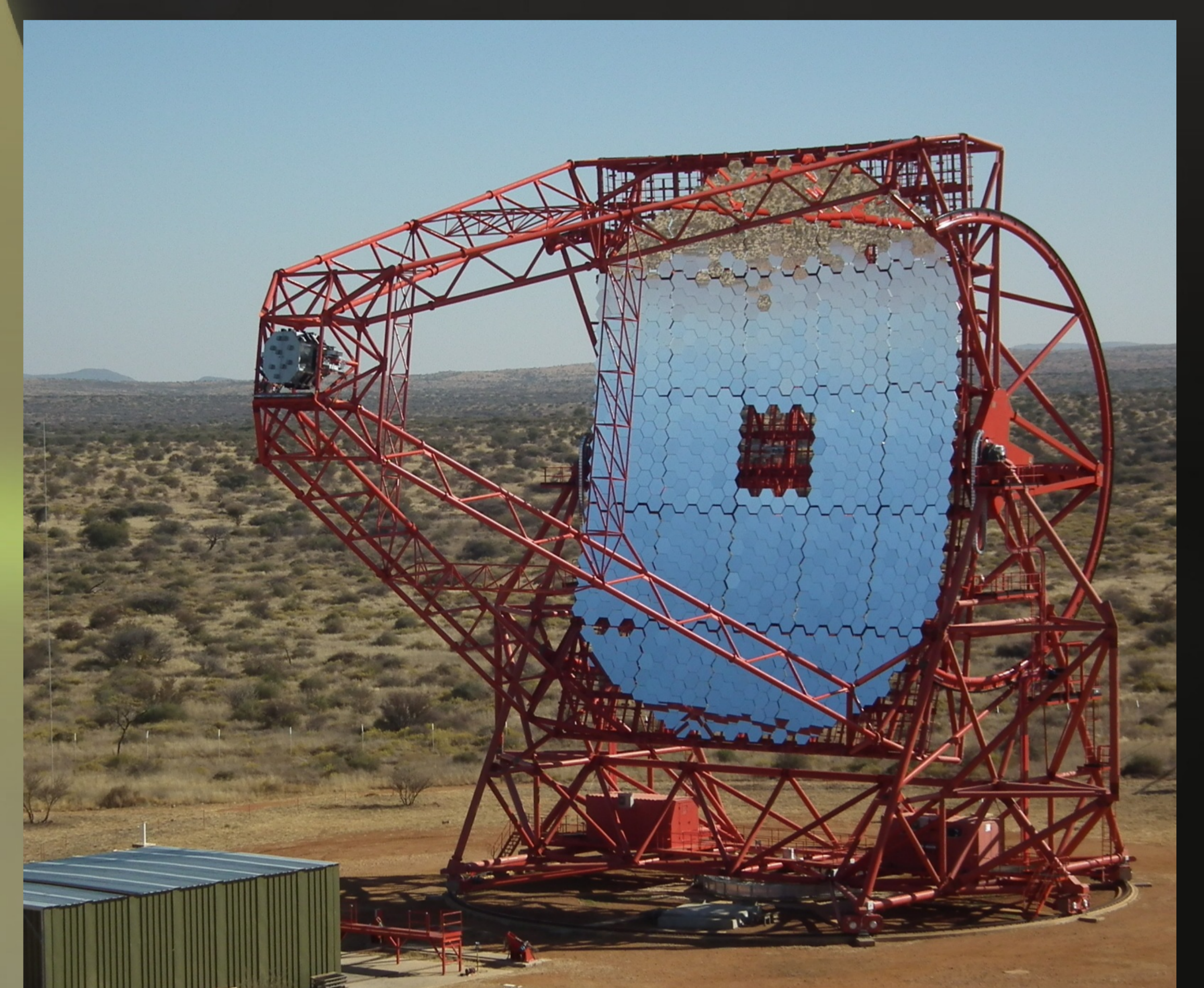
*C*amera Development

ATHENA+ / LOFT / CTA / SVOM / eROSITA

In laboratory setups we investigate and verify the proper function and the performance of X–ray detectors (CCDs, DePFET or PMT) for future missions. In the context of Bachelor– and Master–theses, the results of the Monte Carlo studies are compared with laboratory measurements. They serve as feedback for further improvements in the simulation models. Laboratory setups also allow us to test the electronics components we develop.
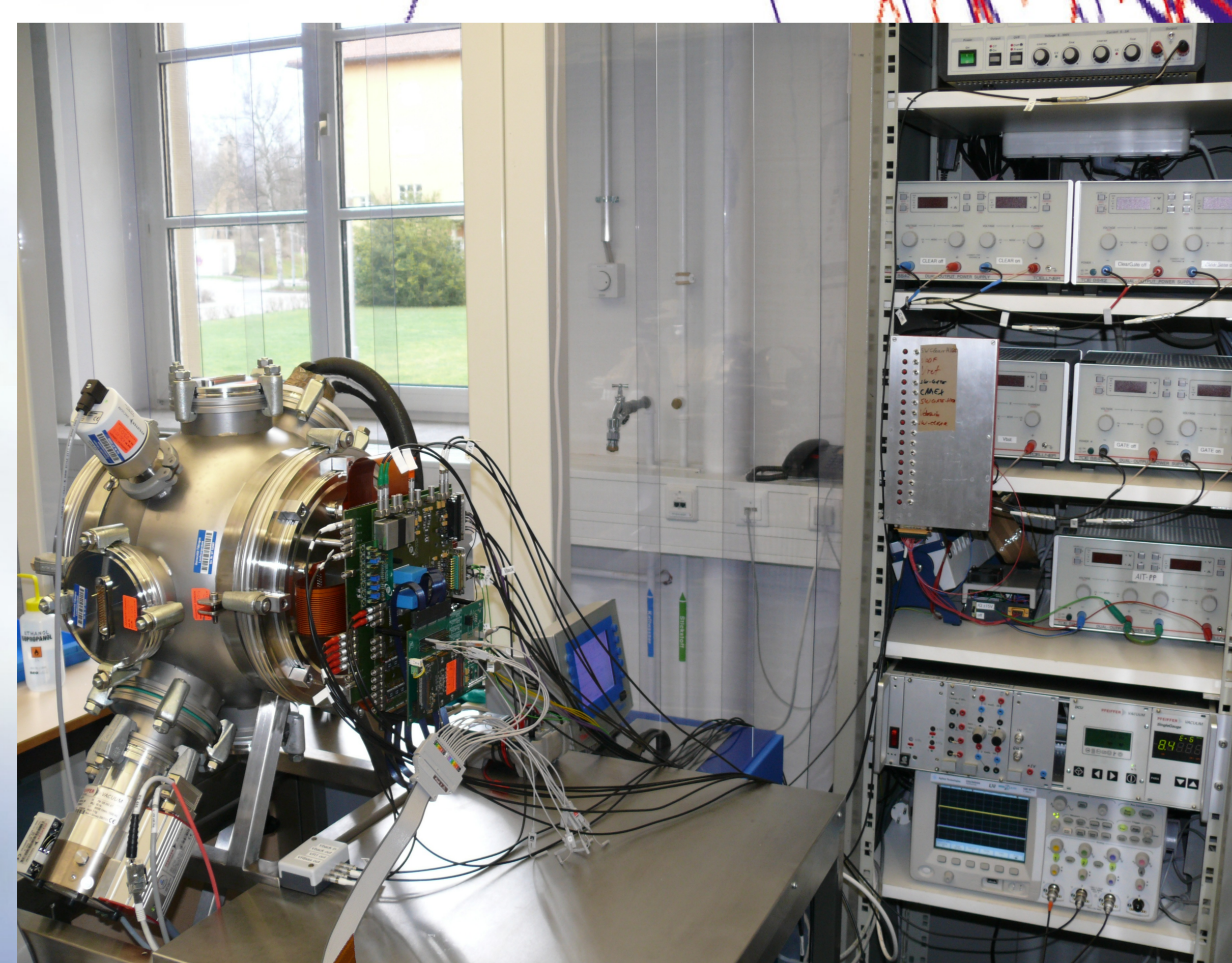
X–ray laboratory setup

XMM CCD and PCB

*E*lectronics- and Chipdesign

FPGA development software

The electronics development in our institute comprises the design of multi–layer PCBs as well as the design and simulation of microchips, so called FPGAs. FPGAs are custom made integrated circuits, that allow a highly parallel data processing for camera systems. The development is mainly performed with the standardized hardware description language VHDL. This allows the complete development chain from design over simulation to synthesis to be completely performed in software without the need for expensive prototyping hardware.

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