

7 DEPARTMENT OF COSMIC RAY PHYSICS

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Overview

The Department of Cosmic Ray Physics in Łódź is involved in basic research in the high energy Cosmic Ray field. Cosmic Rays are energetic particles from outside the Solar System. The energy spectrum (power law energy dependence) suggests a non-thermal origin of these particles. Most of the studies of Cosmic Rays address fundamental problems:

- The nature of the physical and astrophysical processes responsible for the high energies of the particles (up to about 10^{20} eV/particle),
- An estimation of the astrophysical conditions at the acceleration sites and/or search for sources of Cosmic Rays,
- properties of high energy particle interactions at very high energies (nuclear interactions at energies exceeding energy available in the laboratories).

Some Cosmic Ray studies might have practical (commercial) implications, e.g.

- “cosmic weather” forecast - predictions of geomagnetic disturbances related to Solar activity changes (due to large Solar Flares / events of Coronal Mass Ejection); these are important for large electricity networks, gas pipes, radio-wave connections, space missions and satellite experiments.

Presentation of Cosmic Ray registration to high school students becomes a popular way to introduce particle physics detectors and elementary particle detection techniques to young people.

Energetic Cosmic Ray particles produce cascades of particles in the atmosphere, called Extensive Air Showers (EAS). Registering EAS and their properties is the main way of experimental studies of very high energy Cosmic Rays. In the Łódź Department we run the Extensive Air Shower array where EAS are being registered. We concentrate on the studies of detection of neutrons correlated with EAS and interpretation of this phenomenon.

In 2004, we started realisation of the Roland Maze Project, the network of EAS detectors placed on roofs of high schools in Łódź. We received funds from the City of Łódź budget to make a pilot project and equip 10 high schools, each with four 1m^2 detectors and GPS. The network is connected off-line using internet infrastructure and precise time registration. This allows us to correlate detection of the same EAS in a few schools. Students of high schools in Łódź are involved in construction of the array.

In an underground (15 meters) laboratory we continuously register muon (5 GeV energy threshold) flux with the multidirectional telescope. We have observed several disturbances (Forbush Decreases related to Solar activity) in muon counting rates.

International collaborations are important: the Department is a member of KASCADE-Grande Collaboration – the large classical experiment for very high energy EAS, extended to EAS radio emission detection as part of LOPES Collaboration. We collaborate in EAS data interpretation, detection techniques and basic Cosmic Ray studies with Collège de France, Institute for Nuclear Research of the Russian Academy of Sciences, JINR Dubna, and the Cosmophysical Institute in Yakutsk (Russia).

In the area of high energy particle physics the Department participates in the ZEUS experiment at DESY (Hamburg, Germany), was a member of the CELSIUS/WASA Collaboration (Uppsala, Sweden), now moved to Juelich, Germany as WASA@COSY Collaboration.

