Study of electron component of thunderstorm ground enhancement and intense pulses caused by terrestrial gamma ray flashes

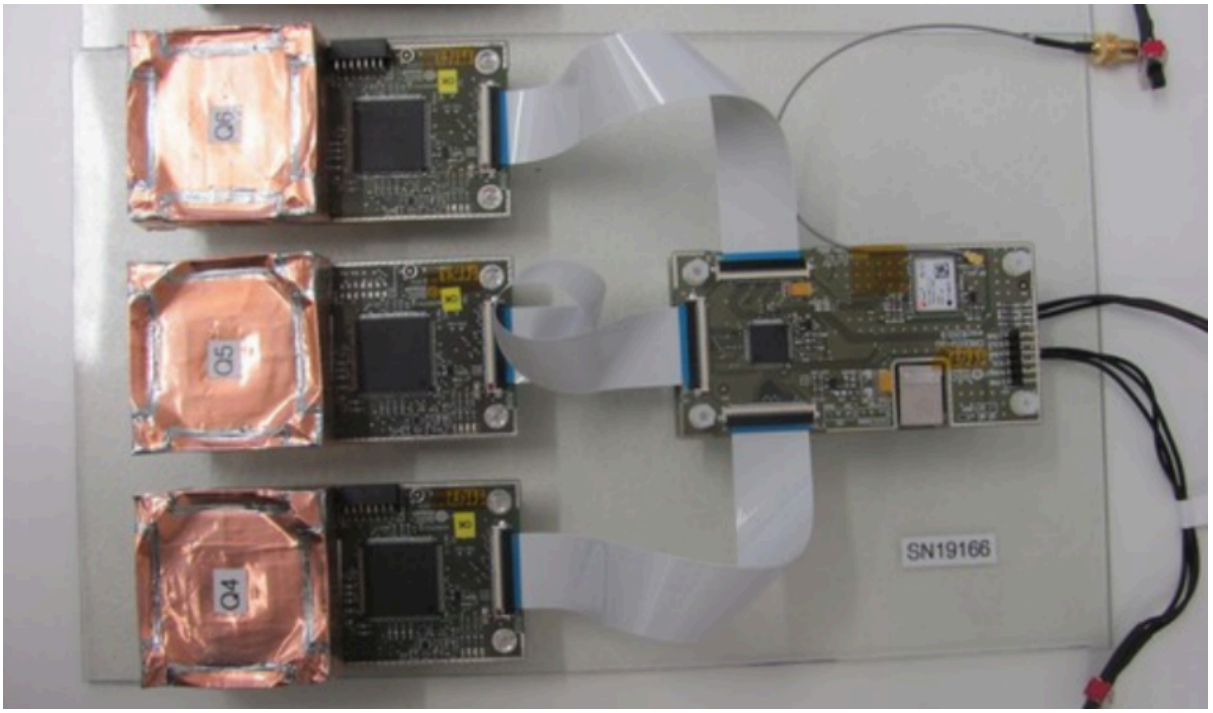
Applicant: Nuclear Physics Institute, Czech Academy of Sciences

Objective and goals:

1. Estimation of the angular distribution of high-energy electrons (> 5 MeV) during the thunderstorm ground level enhancement (TGE).
    a. research of active RREA regions in the thunderstorms - size, time evolution, altitude
2. Spectrometry of low energy electrons (up to 3 MeV) accelerated in TGEs.
    a. additional information for Monte Carlo simulations used for the calculation of RREA parameters such as altitude and intensity
3. Observation of very intense and short pulses of ionizing radiation (less than a microsecond) which could not be detected with scintillators due to time resolution.
    a. could help to prove or disprove the existence of downward terrestrial gamma ray flashes on Aragats

Detectors:

1. Three silicon strip detectors in 4 layers geometry. Each layer is 2x2 cm^2. The strip detector can be used to estimate the angle of electrons passing through the silicon layers. The electrons that are stopped in the detector can be used to resolve the energy spectrum of low-energy components of the accelerated electrons.
    a. used for objectives 1 and 2



2. Minipix Timepix is a one layer silicon pixel detector. Due to its excellent spatial resolution, it can be used in high intensity beams. The active element has 2 cm^2 and the same model has been deployed also at Lomnicky stit for nearly one year (no intensive pulses have been observed so far).

a. used for objective 3

3. Advapix Timepix3 is a similar detector as Minipix Timepix but with superior timing abilities that allow it to partially discriminate between electrons and photons. Due to the improvements in the read-out system it can handle extremely high-fluxes without saturation.
    a. used for objective 3

Requirements:
All three detectors are very compact and small. They will be connected to a mini computer that can be directly connected to the internet. Connection of the detector to the pc will be done via the USB hub which has its own power supply. The expected power consumption is 20 W and data throughput is approximately 30 MB per day.

The entire installation can be fitted in one box which will be provided. Due to the focus on measurements of electrons the lid of the box will be thin. It is also required that the location of the strip detectors is faced to the sky without any heavy shielding material.
The whole setup needs one standard power supply socket, internet connection via ethernet cable and approximately 0.20 m^2 of space.