Expected performance of the High-Energy Particle Detector on-board the second China Seismo-electromagnetic Satellite

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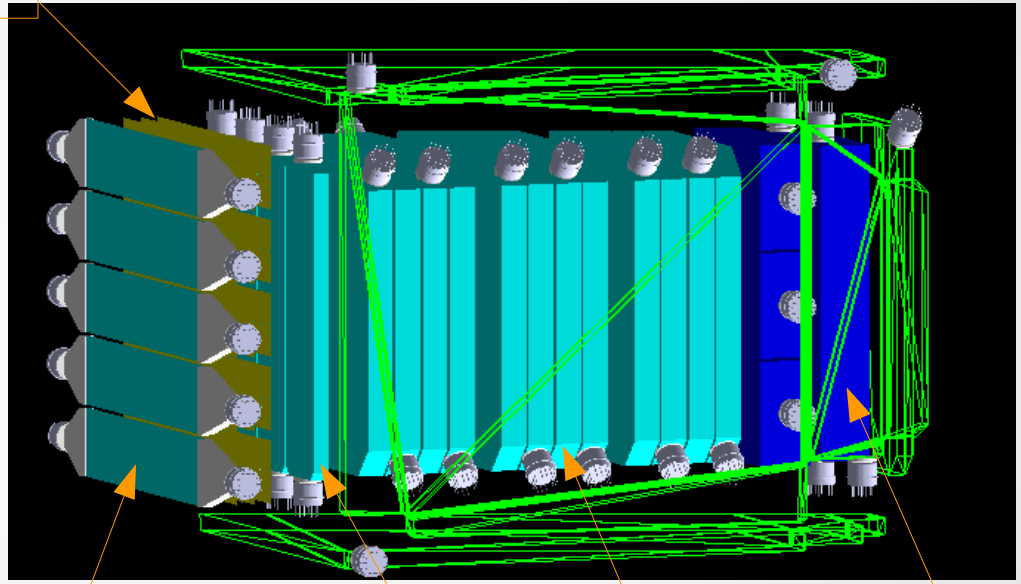
The HEPD-02

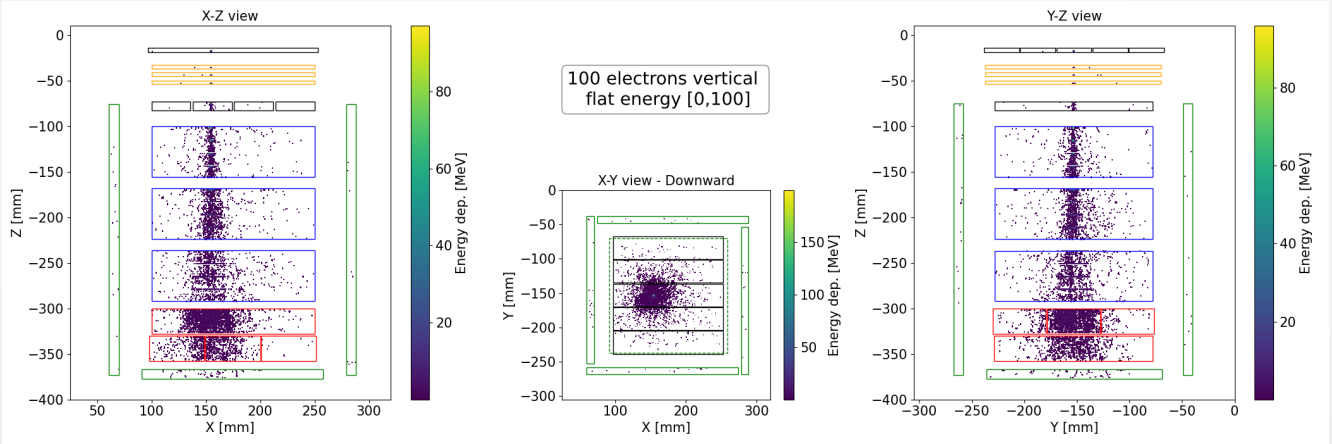
HEPD-02, on board of the China Seismo-Electromagnetic Satellite (CSES-02) is a "*second generation*" particle detector aimed to measure the flux of e-, protons and light ions in near-Earth space and correlate particle bursts to the occurrence of strong seismic events and solar/cosmic phenomena.

The energy range explored is:
3 - 100 MeV for electrons and
30 - 200 MeV for protons.



Simulation

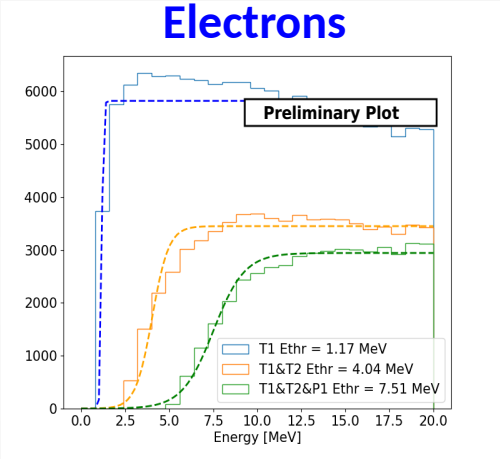
A Monte Carlo simulation of the full detector based on GEANT4 has been developed to study the response of HEPD to electrons, protons and light ions.
→ Also used to train and test Machine Learning algorithms for event reconstruction.

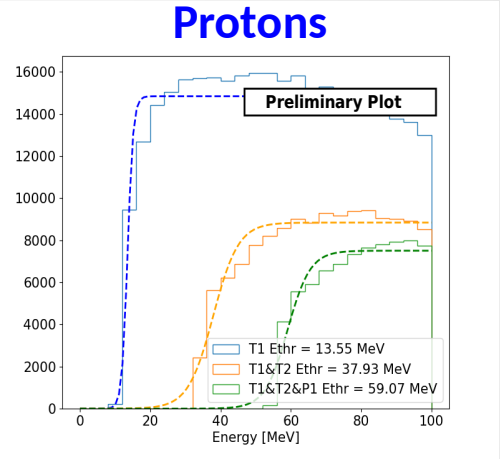


The initial energy is reconstructed form the energy released in each sensitive sub-detector.

HEPD-02 Performance

- Isotropic fluxes of electrons, protons and alpha particles on top of the instrument. (flat initial kinetic energy spectra)
- Three trigger masks were examined: ***T1***, ***T1&T2***, ***T1&T2&P1***
- primary kinetic energy distribution producing a trigger signal





Preliminary results:

→ lower threshold (T1):

- 1.17 MeV for electrons
- 13.55 MeV for protons

HEPD-02 Performance

T1&T2 trigger configuration

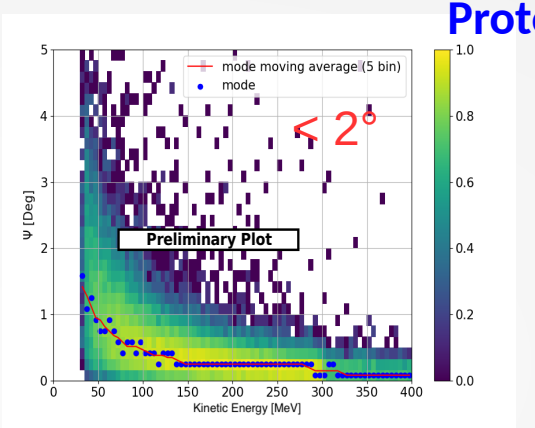
- Angular resolution:

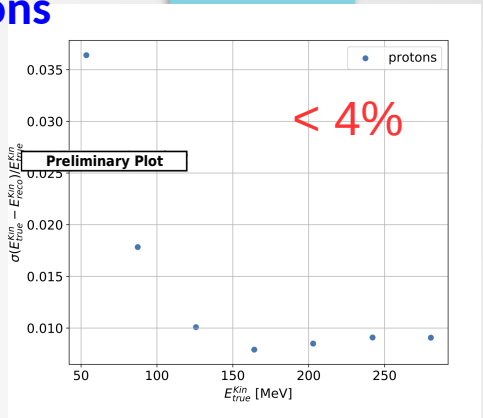
$$\Psi = arccos(vec_{pred}, vec_{true})$$

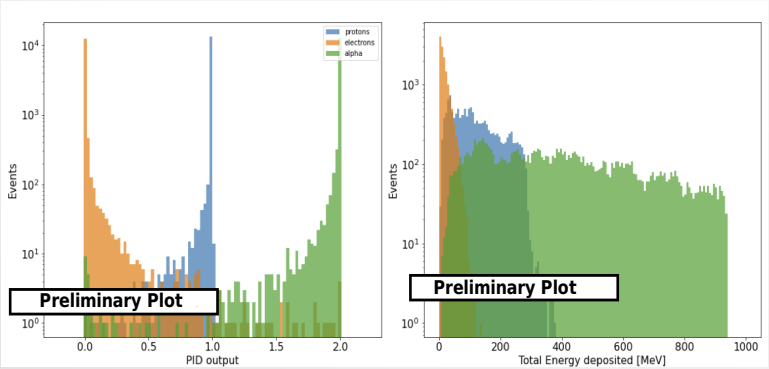
- Energy resolution:

$$\sigma(E_{true} - E_{reco})/E_{reco}$$

Protons







- Particle Identification:
  → electron and proton discrimination (>90%)
  → separate between electrons, protons and alpha particles

Conclusions

- Preliminary results showed HEPD new design is able to reveal electrons and protons with low energies.
- The reconstruction algorithms allow for good particle identification and energy / angular resolution.
- HEPD-02 was found to meet the scientific requirements of the CSES-02 mission.

Thank You!