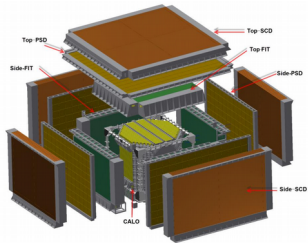


The HERD experiment



The High Energy cosmic-Radiation Detection (HERD):

- It is a space mission that will be installed aboard the Chinese Space Station (CSS) around 2027.
- The main goal is to extend the measurement of cosmic ray spectra up to the knee region.

The instrument:

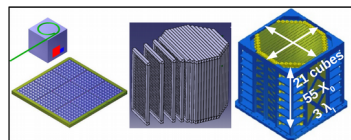
- Silicon Charge Detectors (SCD): multiple charge measurements.
- Plastic Scintillator Detectors (PSD): anti-coincidence detector.
- Fiber Trackers (FIT): reconstructs track of charged particles and photons.
- Transition Radiation Detector (TRD): checks the calibration of the energy scale.
- Calorimeter (CALO): it is similar to the CaloCube design.

Design and expected performances of the large acceptance calorimeter for the HERD space mission.

Lorenzo Pacini et al., for the HERD collaboration

The calorimeter

- It is an homogeneous, isotropic, 3D segmented calorimeter. It consists of ~ 7500 LYSO cubes
- It accepts particles coming from each surface: effective geometrical factor (GF) larger than 1 m²sr.



The “double read-out” system:

- cross-calibration of the energy scale,
- two independent fast triggers.

First read-out system

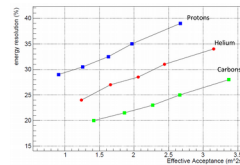
- WaveLength Shifting fibers (WLS).
- Image Intensified scientific CMOS.
- Frame rate: > 800 frames/sec.
- Low read-out noise (< 1.5e).



Calo performance

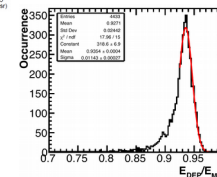
MC simulation based on GEANT4.

Particle	Energy.	Effective acceptance	Energy resolution
Protons	<= 1 PeV	> 1 m2sr	~ 30%
Electrons	<= 10 TeV	~ 2 m2sr	~ 2%



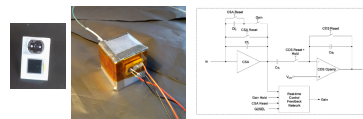
Nuclei @ 10 TeV: energy resolution vs effective GF.

Fraction of energy deposited by 10 TeV electrons: energy resolution ~ 2%



Second read-out system

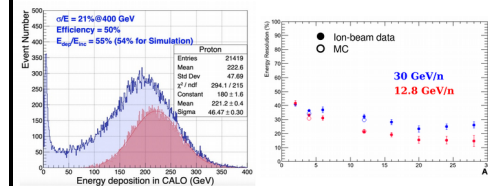
- Photo-diodes with different active areas connected to HIDRA chips.
- The S/N ratio for MIP is >= 4.
- Expected saturation level ~ 250 TeV.



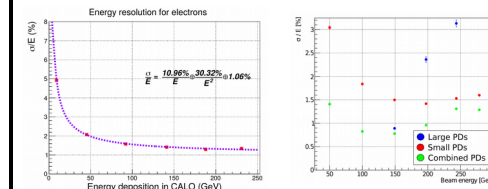
Beam test results

Confirm MC expected performance.

WLS system: protons @ 400 GeV
 PD system: energy resolution of nuclei



Electrons energy resolution with WLS (left) and PD (right) systems.



Summary

The innovative CALO design allows a large effective geometrical factor and a good energy resolution. The double read-out scheme will strongly improve both the calibration and trigger capabilities. A new calorimeter prototype including both WLSs and PDs is under construction.

