The HEPD-02 trigger and PMT readout system for the CSES-Limadou mission

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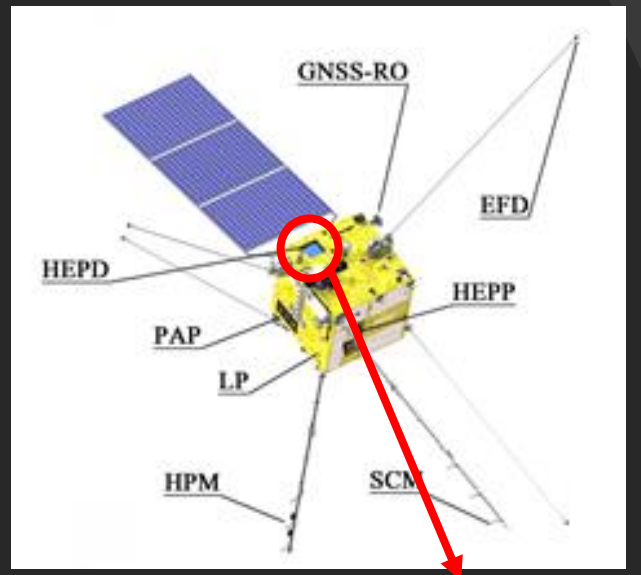
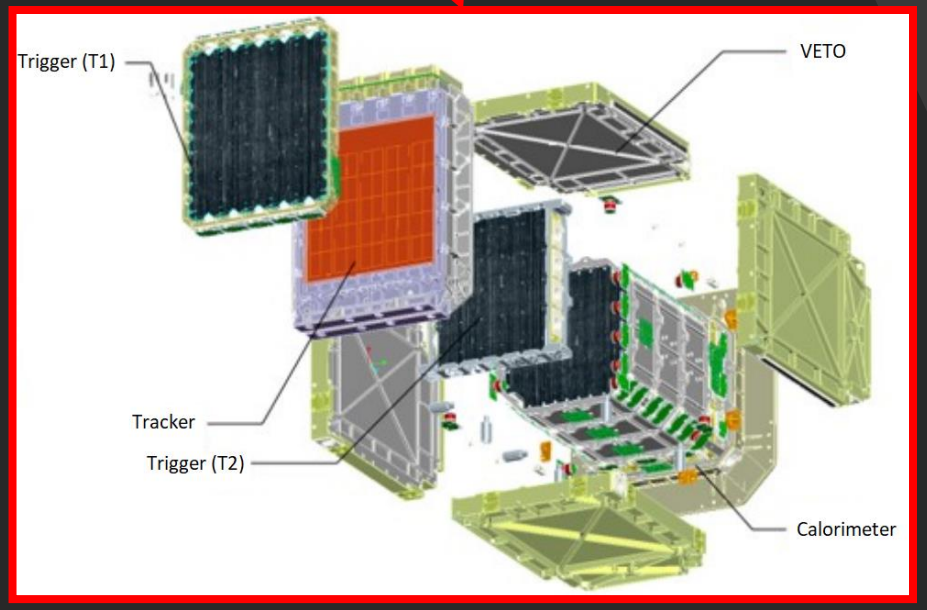
The High-Energy Particle Detector

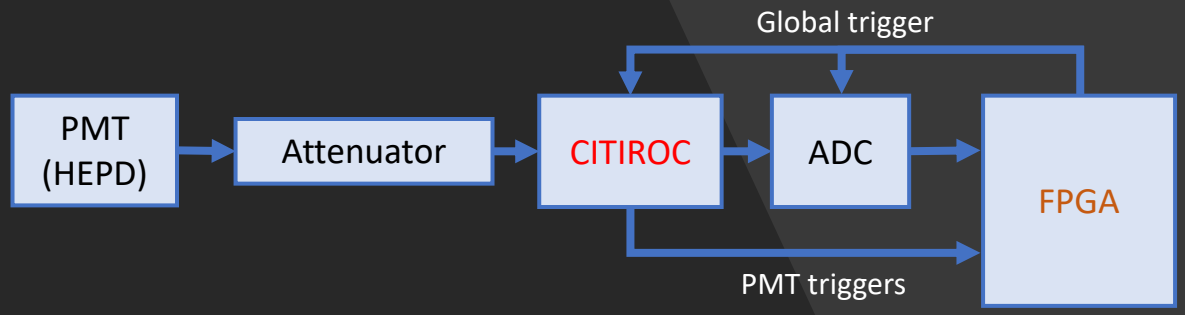
- Details on mission are presented in “The High Energy Particle Detector (HEPD-02) for the second China Seismo-Electromagnetic Satellite (CSES-02)” (C. De Santis)
- The HEPD will detect **electrons** and **protons** in energetic ranges that go from 3 to 100 MeV for electrons and from 30 to 200 MeV for protons
- The second satellite will be provided with an improved version of the HEPD composed by:
  - a **tracker** made of CMOS sensors (ALPIDE sensors), surrounded by two segmented planes of plastic scintillator used for **trigger** signals generation.
  - a **calorimeter** composed by twelve planes of plastic scintillator and two segmented planes of an inorganic scintillator called LYSO
  - a **VETO** system realized by five scintillator planes that surround the entire detector.
- Each scintillator is coupled with two **PMTs**.





The trigger and PMT readout board

- The 64 PMTs of the HEPD are acquired by an electronic board based on **CITIROC read-out integrated circuits by Weeroc**
- Signals from PMT are **attenuated** in order to match the CITIROCs input range
- CITIROCs are designed for the **amplification**, **shaping and sampling** of photomultiplier signals and produce the **trigger** for every PMT.
- Trigger signals produced by CITIROCs are acquired by an **FPGA** that implement various **trigger masks** to match different orbital zones and particles and produces the **global trigger** signal
- The global trigger signal enables CITIROCs outputs and starts the ADC conversion
- The ongoing work consist in the characterization and optimization of the **Engineering Model** of the board in sight of the development of the **Qualification Model**

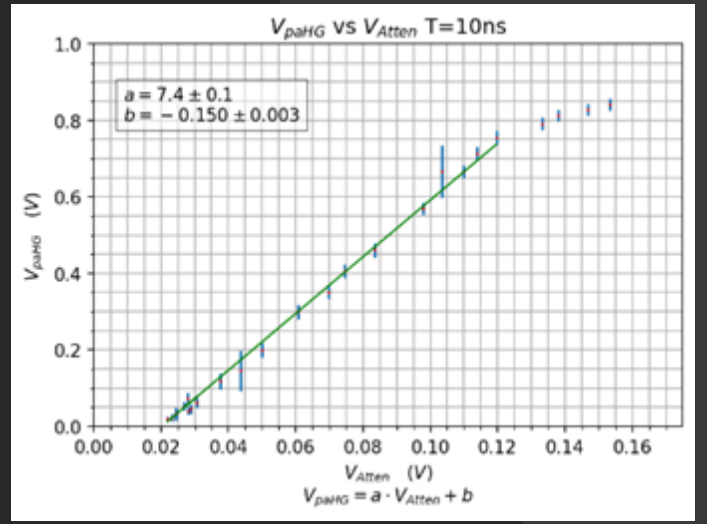


Characterization of the trigger and read-out system

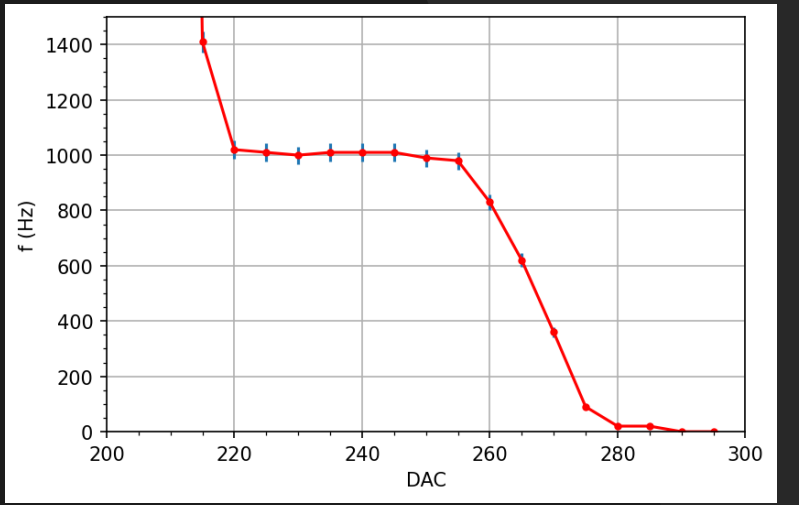
The following activities are in progress:

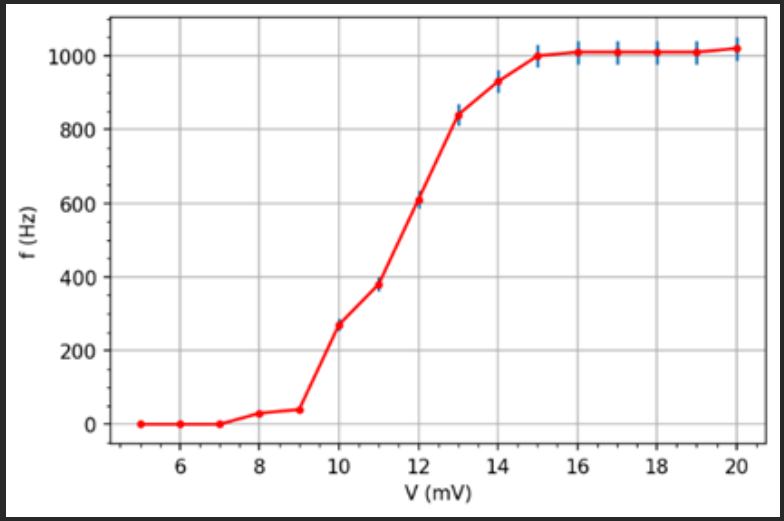
- Threshold measurements (5 p.e. for a PMT with G=6 10^6)
- Optimization of every stage of signal conditioning circuit and characterization of CITIROCs in order to obtain the maximum dynamical range
- Calibration curves for ADC to charge conversion
- Implementation of new functionalities for the firmware

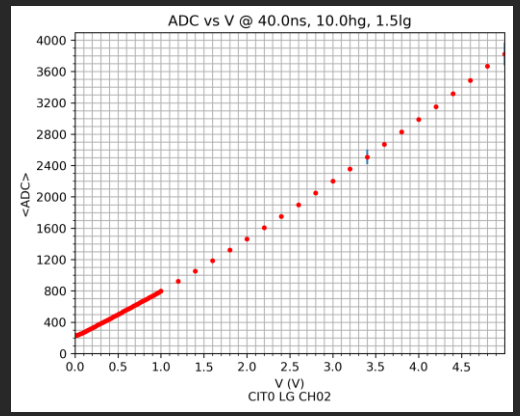
CITIROC characterization



Threshold and minimum signal amplitude







Thank you for your time!