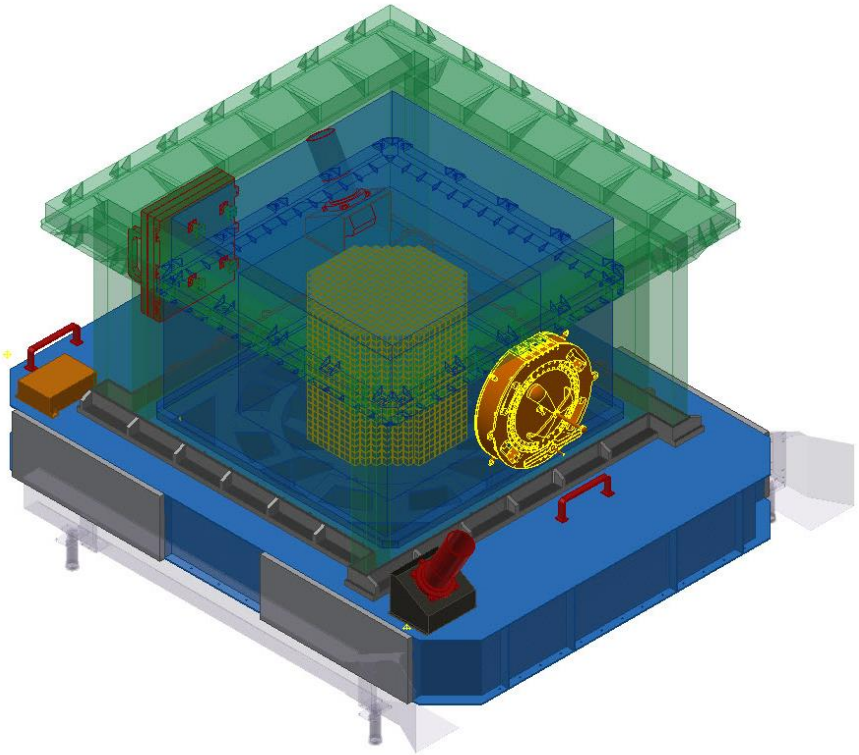
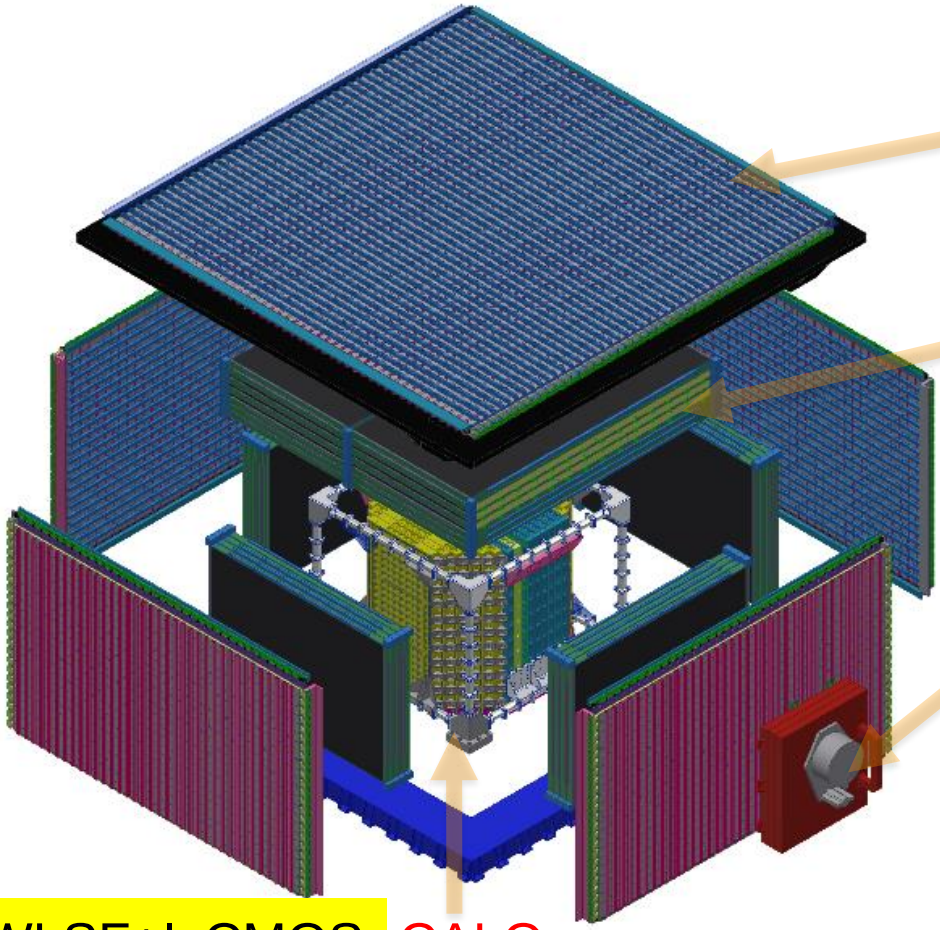
HERD Payload Progress



HERD payload configuration (Baseline + Alternatives)



PSD
γ identification
Z measurement

Long bar
Square tile

Tracker
Z measurement
CR trajectory
γ converting & tracking

Silicon
Fiber+SiPM

TRD
CR calibration

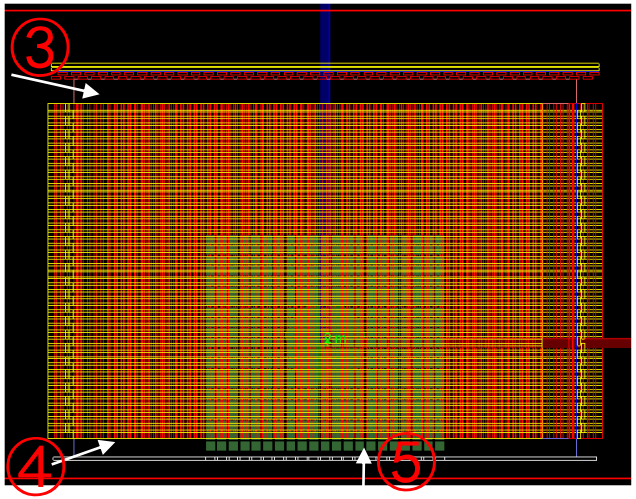
CALO + TRACKER
TIC
Improved proposal

WLSF+IsCMOS
Photo Diode

CALO
Energy measurement
Particle identification

Bottom veto detector

- Input spectra
  - Proton Spectrum (433MeV~1.8TeV) from AMS-02.
  - Upward proton flux from earth measured by AMS-01
    - <1% of downward proton flux
- Leakage from bottom plane ④: ~5.5%
- Trigger contribution ⑤: ~25 Hz

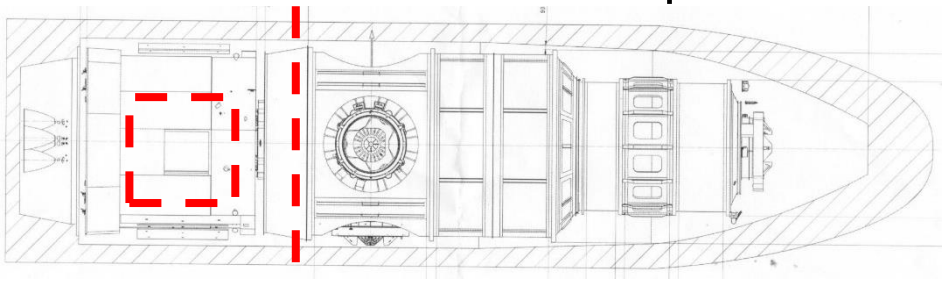


Ring-shaped bottom PSD is added to veto CRs not blocked by EARTH

- Coverage ratio requirement (now 99.95%)
  - Frame rate of IsCMOS (from 500 to 800 fps)
  - Lower energy threshold of gamma ray (now 500 MeV)

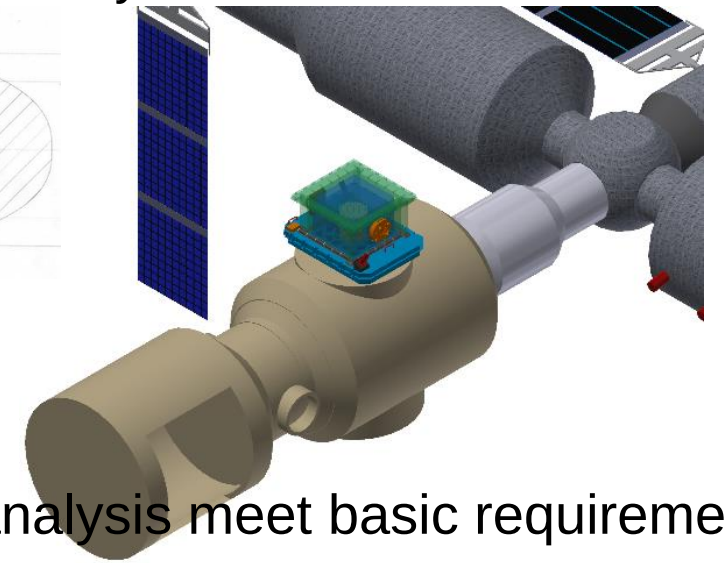
HERD launching scenarios

- Feasibility study (preliminary) on HERD & China-Italy Module is finished.
  - To launch China-Italy Module and HERD together, with HERD hiding inside the Service Module
  - To dock China-Italy Module on CSS
  - To open lateral DOOR of Service Module and move out HERD by using BIG robotic arm
  - To install HERD on top of China-Italy Module



Service Module

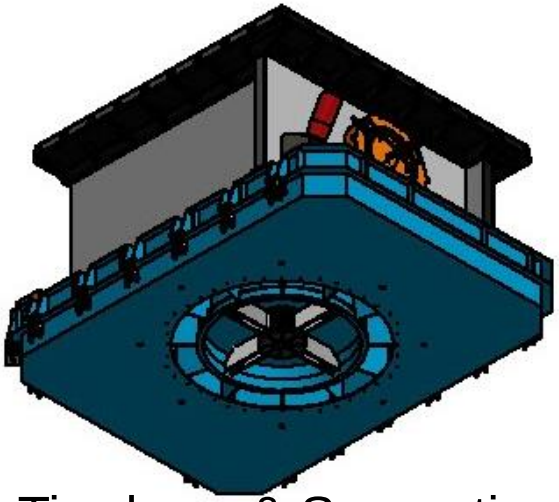
China-Italy Module



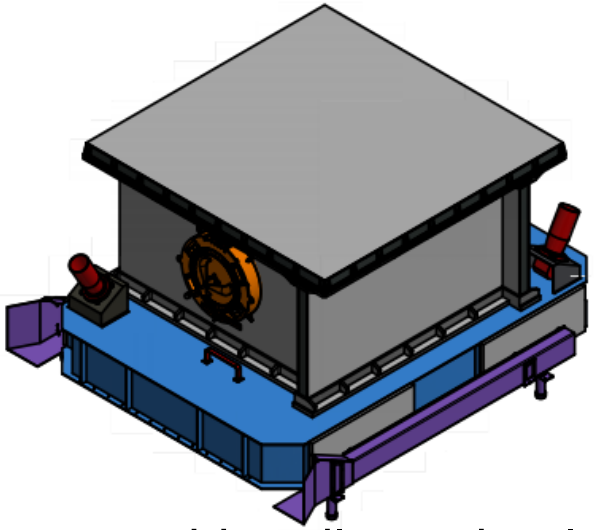
- Results of mechanical & failure analysis meet basic requirements from Service Module.

Interfaces with Service Module

- Tie-down & Separation Mechanism (TSM)
  - To hold HERD during launch and to release HERD after docking
  - To minimize shock input by choosing various priming systems
- Guide Rails & Wheels
  - To support proper alignment during operation of Robotic Arm.
- Harness Separation Mechanism (HSM) – if needed
  - To provide power and data transportation during launch



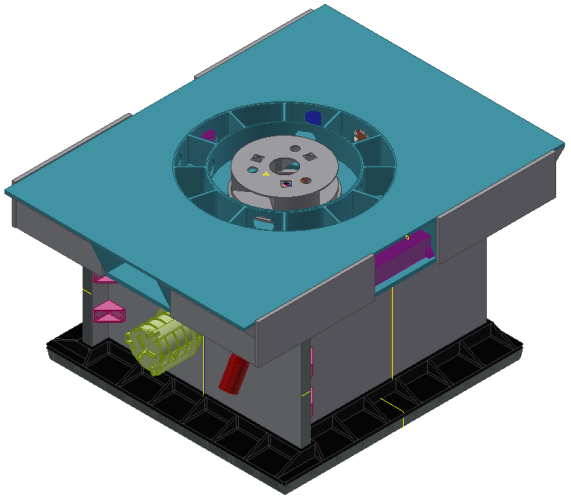
Tie-down & Separation Mechanism



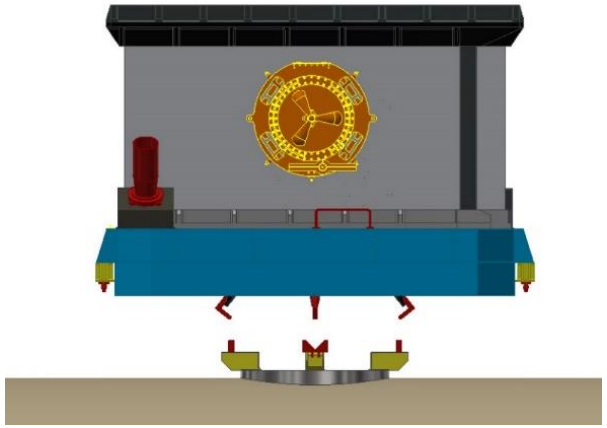
Guide rails & wheels

Interfaces with China-Italy Module - Payload Adapter

- Dimension ≤φ1000mm (TBD) *200 mm
- Localization error (with Robotic Arm)
  - Position +/-40mm, angle +/-1 deg
- Mechanical interface
  - Active part on HERD
  - Passive part on China-Italy Module
  - Shock resistance
- Electrical interface
  - Main Power (100V, 1500W), TC power (28V)
  - 4 FC-AE-1553 fibers
  - 1553B, Analog telemetry, etc.
- Thermal interface
  - Liquid cooling loop with a flux of 300 L/hr and a temperature of 20℃

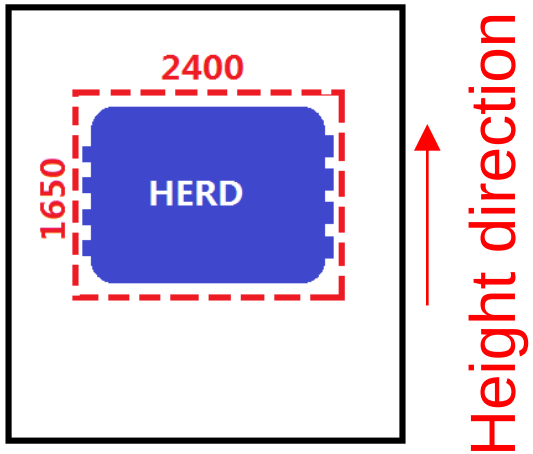


Payload Adapter



Limits in dimension

- HERD and China-Italy Module share space inside the fairing.
- Update of height allocation
  - The China-Italy Module is reduced in diameter and increased in height.
  - The Service Module with HERD inside gets 200 mm more in height.
    - Preliminary constraints on HERD height is increased from 1350 mm to 1550 mm. Overall constraints is 3000*2300*1550 mm^3 (static)
- New constraints from Service Module (CAST) is that dynamic envelope of HERD should be within 3000*2400*1650 mm^3, including
  - Protruded guiding rails & wheels
  - Protruded Tie-down & Separation structure
  - Safety margin for operation of robotic arms

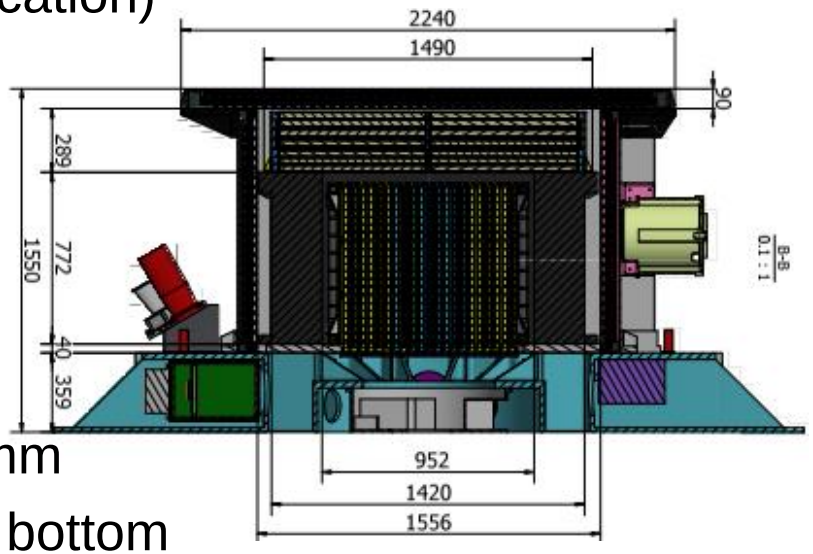


Envelope(L*W*H)	3000*2300*1550 mm^3 (STATIC)
Envelope(L*W*H)	3000*2400*1650 mm^3 (DYNAMIC)

New dynamic limit is much stronger than the static limit

Height dimension breakdown

- Total height is 1550 mm (current allocation)
  - Above CALO
    - MLI, XX mm
    - TOP PSD, 90 mm
    - TOP STK, 289 mm
  - CALO, 812 mm
    - 34mm/crystal*21 layers=714mm
    - Supporting structure on top & bottom
  - Device cabin, 359 mm
    - Payload adapter, 200 mm (with risk)
    - Fiber & cable routing, 159 mm (with risk)



Total height above CALO should be within 380(400) mm

Mass & power constraints

- Overall mass: ≤ 4 T (HERD proposal180425)
  - STK ~650 kg; PSD ~405 kg (HERD proposal180425)
  - Launching capability of LM-5. OK!
  - Transportation capability of BIG robotic arm. OK!
  - Supporting capability of China-Italy Module. (TBD)
- Overall power: ⩾1400 W (inc. thermal control; HERD proposal180425)
  - STK ~300W; PSD ~100W (HERD proposal180425)
  - No solar panels on China-Italy Module
  - No tight constraints from CSS energy system
  - One pair of CSS primary power (100 V) could provide 1500 W.
  - Thermal dissipation of HERD could be a major problem.

Total power of HERD may be increased, but with high risks

Some other scenarios

- Extendable TOP+LATERAL PSD
  - Pros: Increase Z measurement capability of PSD
  - Cons: More PSD detectors needed to fill in gap
- Removable adapter for robotic arm
  - When HERD is installed on China-Italy Module, the adapter for robotic arm is expected to be removed manually.
- Movable TRD
  - When a calibration of TeV CR is finished, the TRD detector panel is laid down.
  - When another calibration is needed, the TRD panel is placed back in position.
- Replaceable key devices/boards
  - i.e. trigger board
- Replaceable micrometeoroid shielding panel/sheet upwind