RADHEPT
RADICALS High Energy Particle Telescope Suite

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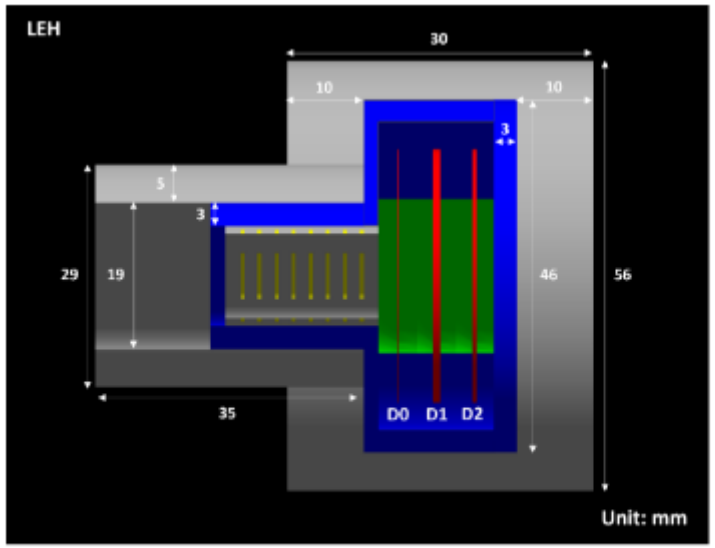
RADHEPT MEASUREMENT GOALS

Three detectors to cover different energy/time domains

- RADHEPT-LE (bidirectional, every 10^{o} rotation, ~0.5 s cadence, $\Delta E/E$ = 30%)
  - Electrons 0.1 – 0.5 MeV (6 channels)
  - Protons 1- 5 MeV (8 channels)
- RADHEPT-HE (bidirectional, every 10^{o} rotation, ~0.5 s cadence, $\Delta E/E$ = 30%)
  - Electrons 0.5 – 4 MeV (8 channels)
  - Protons 5 – 40 MeV (8 channels)
- Microburst Detector (bidirectional, 2π srad view angle each side, 10 ms cadence)
  - 0.1 – 4 MeV electrons in 8 channels at 10 ms cadence ($\Delta E/E$ = 50%)
  - Triggered above a predetermined threshold over current background
  - Sample for10 s and save data

RADHEPT Baseline Design based on dE/dx Silicon Detector Stacks

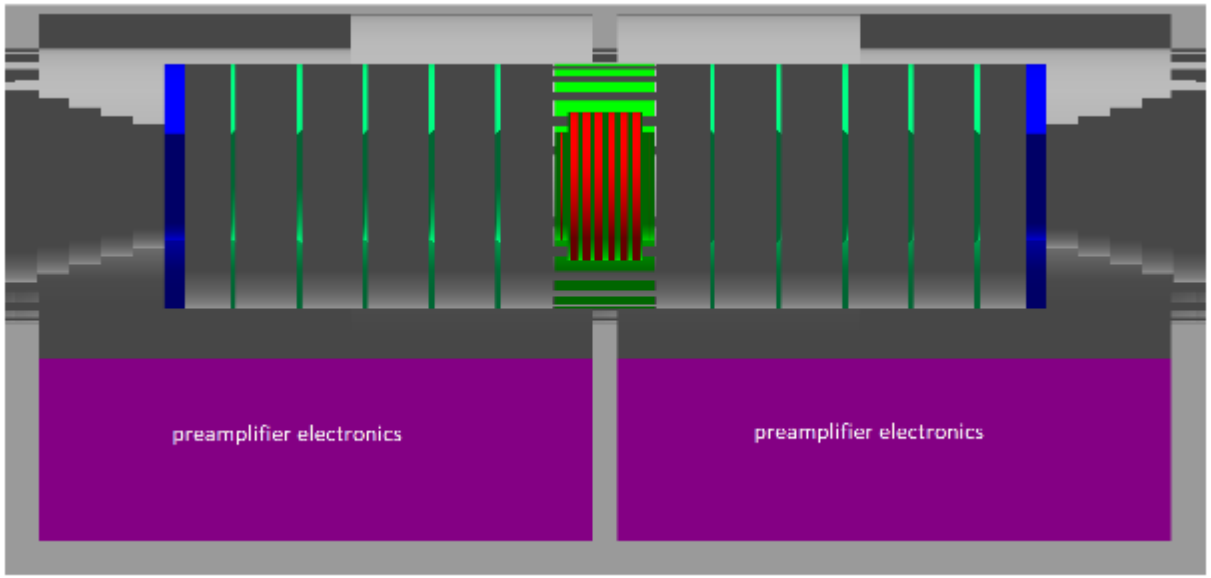
RADHEPT-LE (Low Energy) baseline geometry
smaller GF to measure higher particle flux



Geometry of the low energy head (Blue: Tungsten shielding, Grey: Aluminum shielding, Red: Silicon detectors, Yellow: Tantalum baffles, Green: Detector holders)

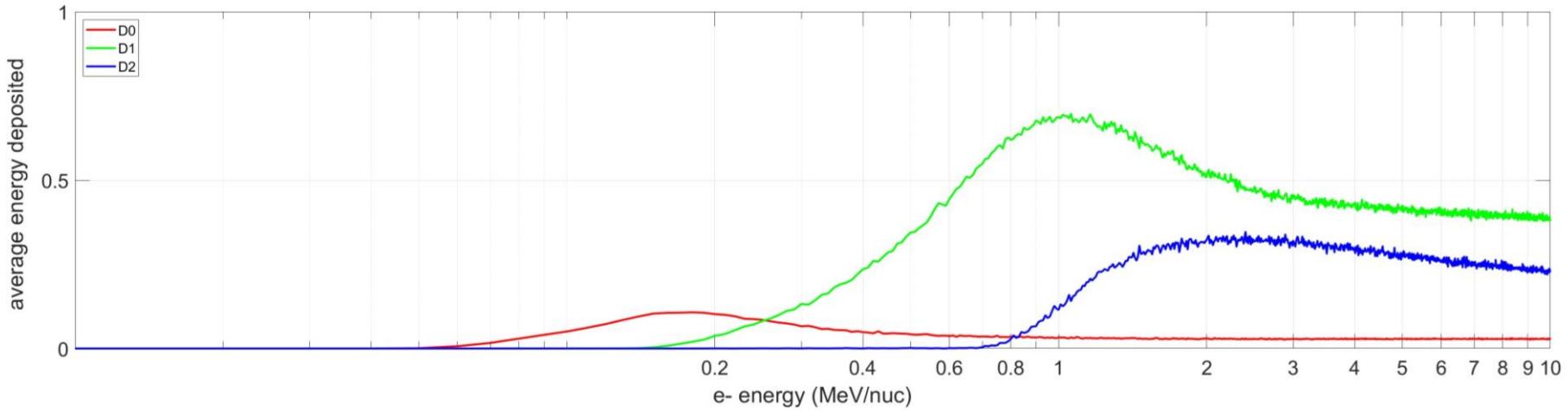
Mass	0.7 kg
Geometric Factor	0.02 $cm^2 sr$
Number of detectors	3

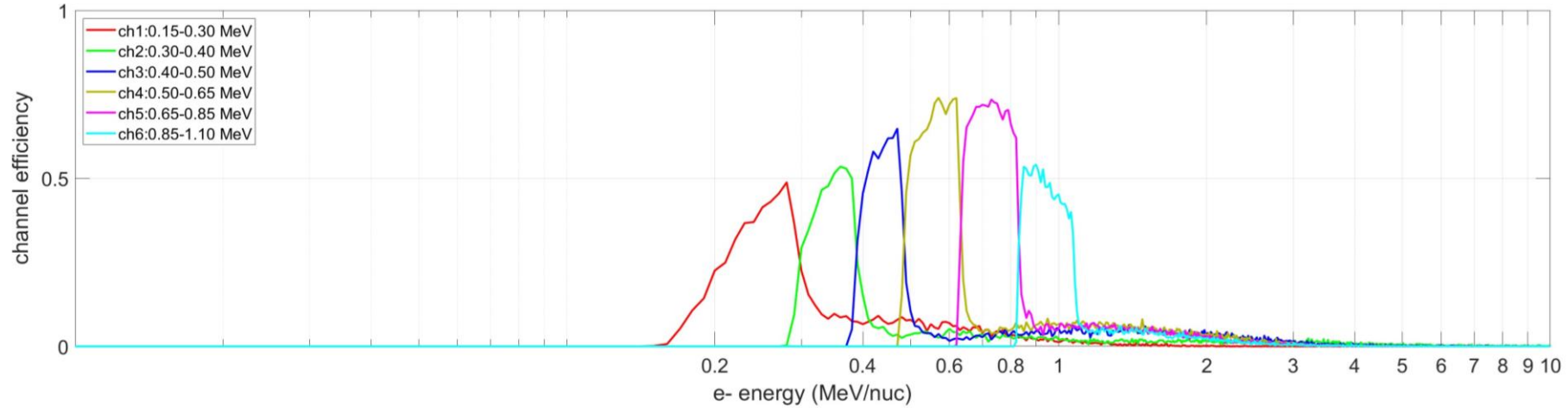
RADHEPT-HE (High Energy) bideirectional geometry



Mass	2 kg
Geometric Factor	0.2 $cm^2 sr$
Number of detectors	8

RADHEPT-LE: Axial Electron Source – Energy Deposition in Detector Elements





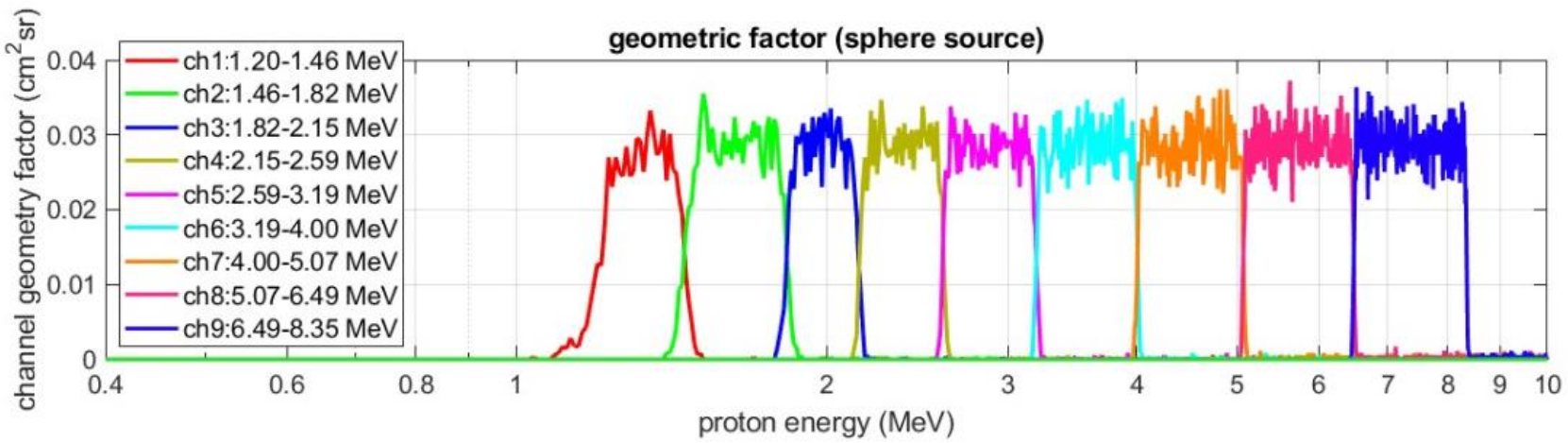
Detected Energies

D0 = 80 μm thick

Original Electron Energy Bins Starting form 200 keV

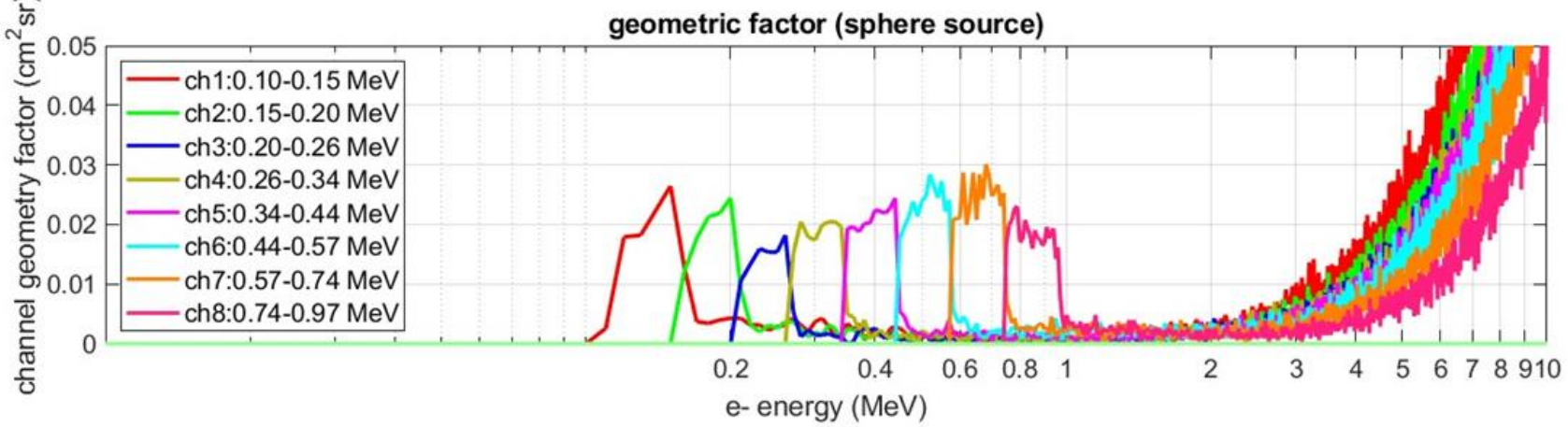
Using D0 to define dE/dx of electrons

RADHEPT-LE: Energy-Dependant Geometric Factor with no Threshold in D0



Protons with energies 1 to 8 MeV are sorted into 16 energy channels.

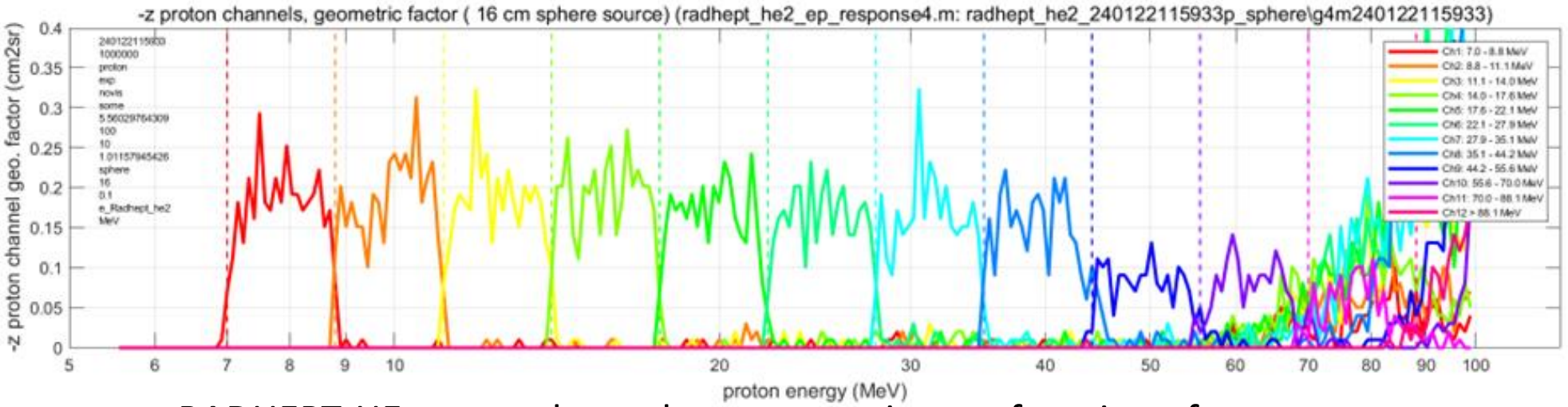
RADHEPT-LE (with tungsten shielding) energy dependant geometric as a function of proton energy.



Electrons with energies 0.08 to 1 MeV are sorted into 6 energy channels. (no dE/dx threshold for D0)

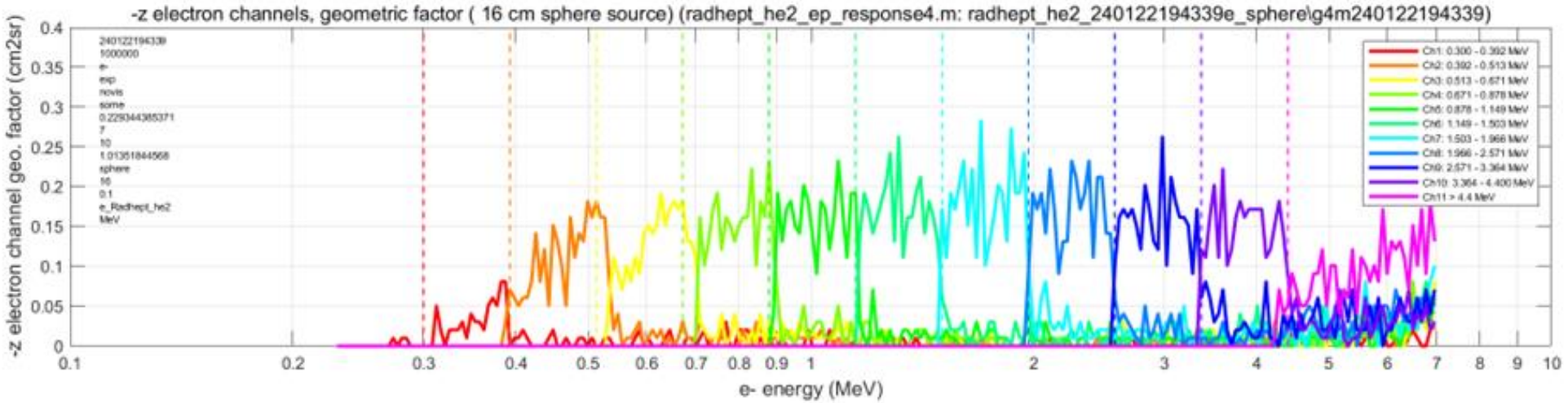
RADHEPT-LE (with tungsten shielding) energy dependant geometric as a function of electron energy.

RADHEPT-HE: Energy-dependant Geometric factor



RADHEPT-HE energy dependant geometric as a function of proton energy.

Protons with energies from 8 to 70 MeV are sorted into 17 energy channels.



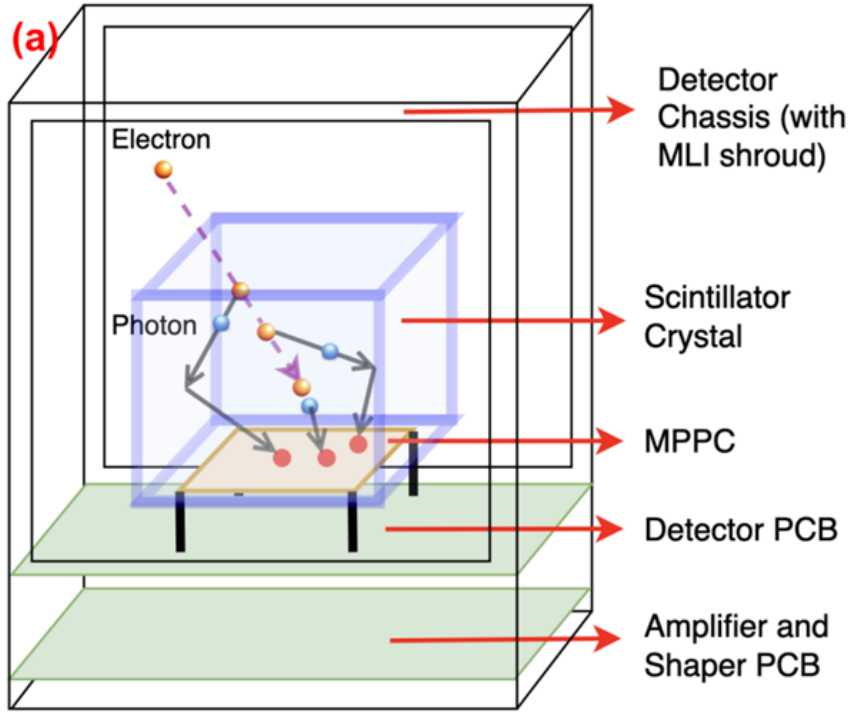
RADHEPT-HE energy dependant geometric as a function of electron energy

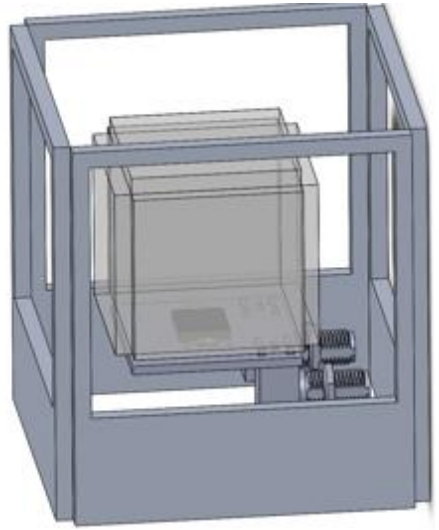
Electrons with energies from 0.3 to 4.4 MeV are sorted into 14 energy channels.

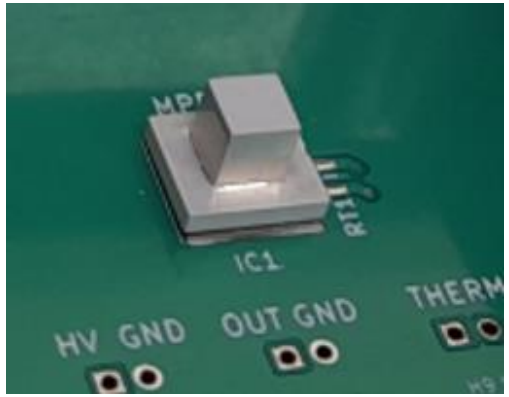
RADHEPT-MB – SPLIT LOW ENERGY AND HIGH ENERGY DETECTORS

Fast Microburst Detector

Electron Energy ~0.1 – 4 MeV, ~ 2 detectors, 7 energy bins,
10 ms resolution, GF ~ 0.5 - 5 cm^2 sr f_{max} ~200 kcps

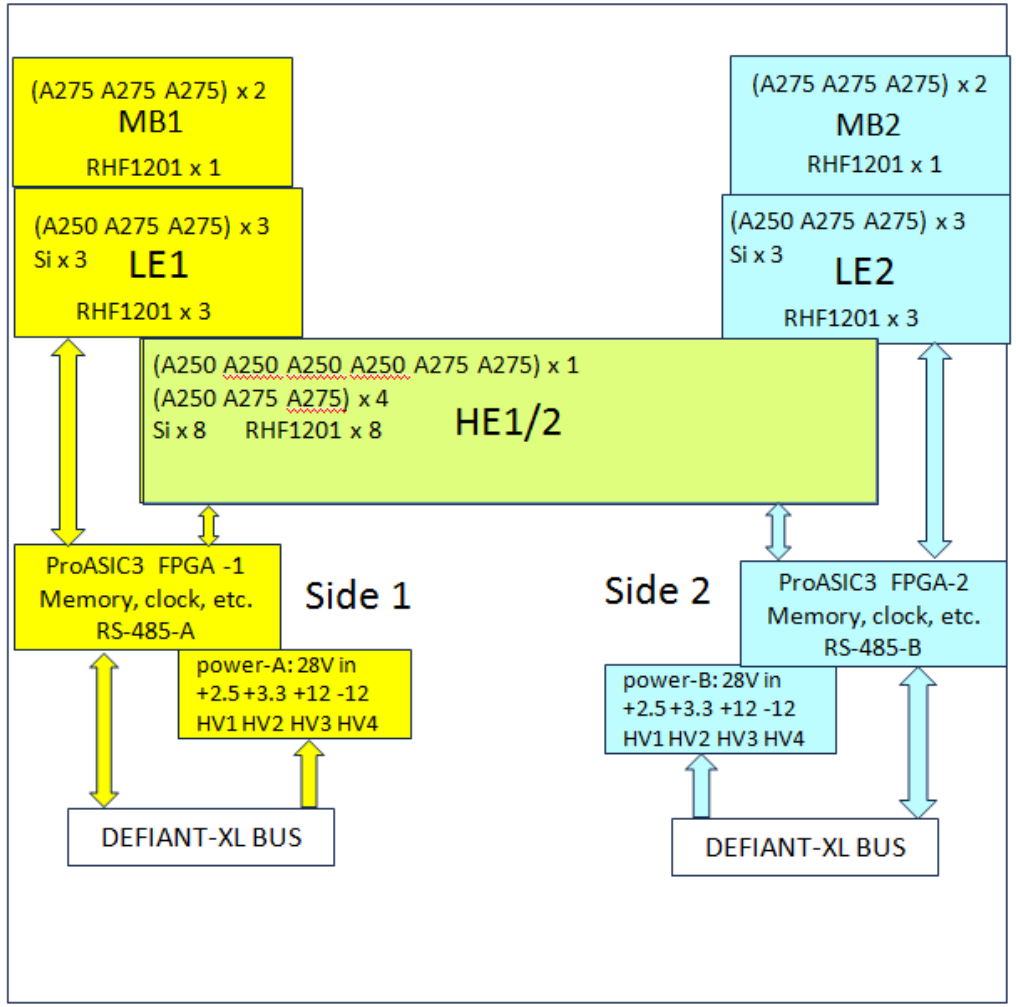






RADHEPT – ELECTRONICS REDUNDANCY

Two separate processors and power supplies for the two directions giving total redundancy

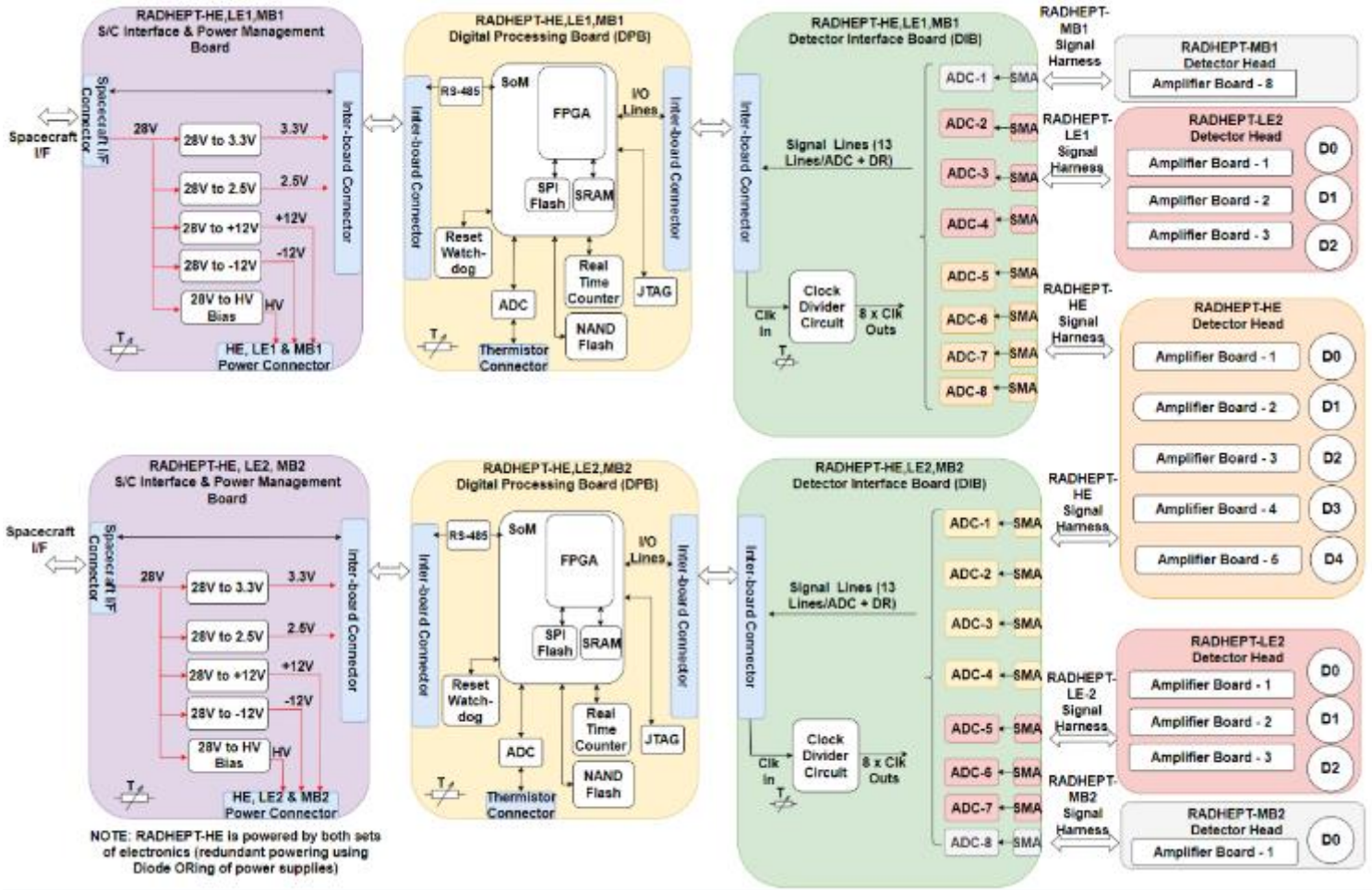


Signal from bidirectional HE detector feeds into both processors

Operational even if one side fails

RADHEPT – SCHEMATIC OF FPGA PROCESSOR

Two separate processors for the two directions giving total redundancy



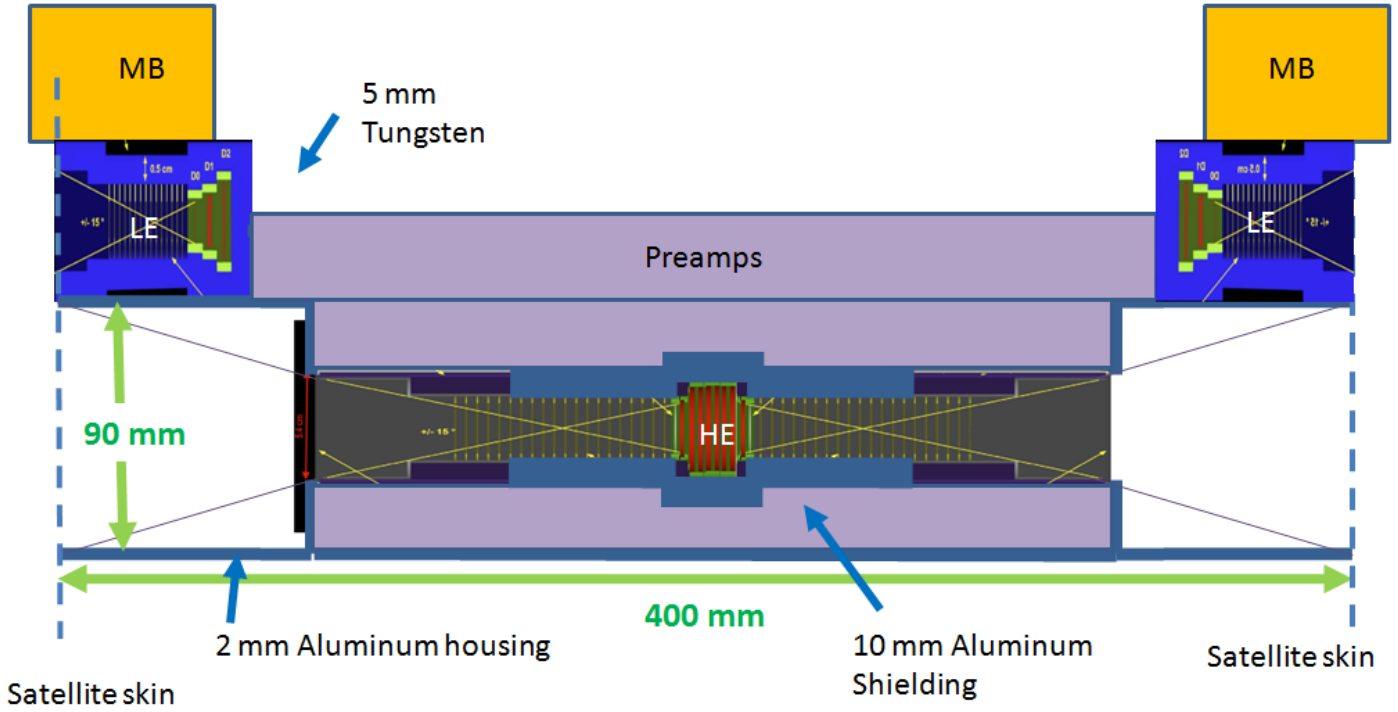
Signal from bidirectional HE detector feeds into both processors

Operational even if one side fails

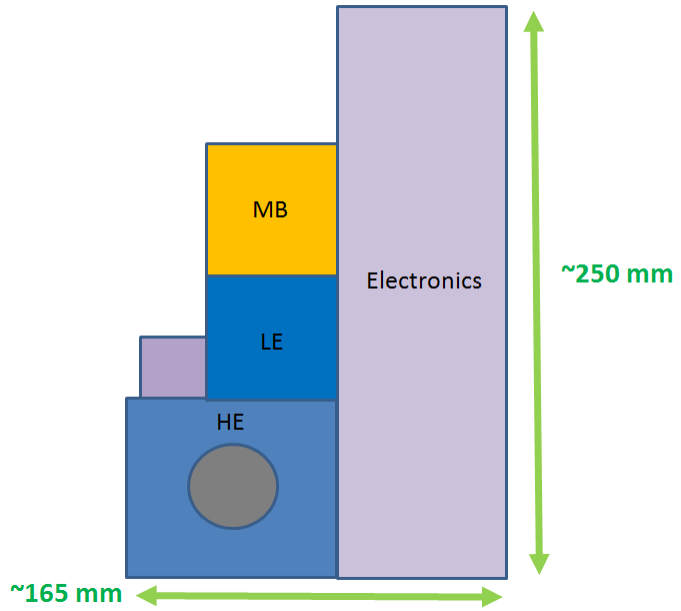
MECHANICAL LAYOUT

Diagnostic Bay on Radicals is 40 by 40 cm

Side View



End View



RADHEPT DATA PRODUCTS

Data Products: (all specifications tentative at present)

- Electron Spectra (bidirectional, every 10^{o} rotation, continuously)
  - LE 0.1 – 0.5 MeV (6 channels)
  - HE 0.5 – 4 MeV (8 channels)
- Proton Energy Spectra (bidirectional, every 10^{o} rotation, continuously)
  - LE 1- 5 MeV (6 channels)
  - HE 5 – 40 MeV (8 channels)
- Microburst Detector (bidirectional, 2π srad view angle each side)
  - 0.1 – 4 MeV in 7 channels at 10 ms cadence when above a predetermined threshold count rate, continuing until below threshold for 10 s.

CONCLUSIONS

- RADHEPT will allow detailed measurements of electrons (0.1 – 4 MeV) and proton (1 – 40 MeV) precipitation versus L-shells
- Angular resolution of 10^{o} by differencing readings taken with 30^{o} view cone
- Omnidirectional Microburst Detection (0.1 – 4 MeV electrons)
- Will quantify electron precipitation into the upper atmosphere
- Will assess relative contribution of microbursts to steady precipitation
- Will give detailed proton data for proton dose over the poles

End