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Current Status of the Low Energy Electron Detector

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From SREM to LEED

- Several radiation monitors in space has parameters that can be optimized
- ESA Standard Radiation Monitor SREM
- M = 2.5 kg
- P = 2 W
- LxWxH ≅ 200 x 100 x 90 mm3
- 15 Energy levels in discriminators
- Proton sensors E_{thr} ≅ 8 MeV
- Electron sensors E_{thr} ≅ 500 keV
- Need for small and robust instrument

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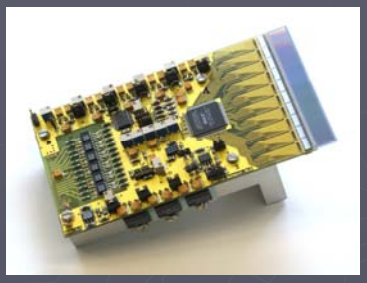
SLS MYTHEN Technology for LEED

- MYTHEN – used at PSI SLS
- Applications at protein crystalography
- Si microstrip, d = 300 μm
- 1280 strips grouped 10x128:
  - L 8 mm x W 50 μm
- Typical operation at 6-9 keV
- Full energy resolution < 140 eV
- Optimized for high counting speed
- Preprocessing using PSI radhard ASIC (LHC CERN spin-off)
- Hardness: > 100 krads (TID 1 Mrad)



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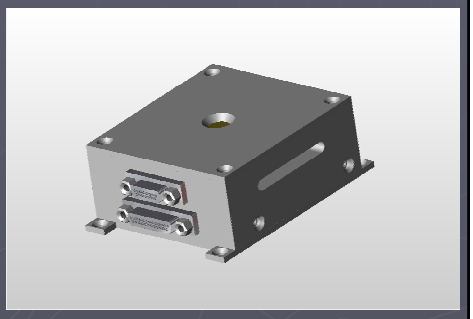
LEED Features

- Energy range: 8 to 250 keV and $\Delta E \cong 3$ keV
- Count rate: fluxes ~ 10^9 /cm^2/s, 1 MHz/strip
- Power consumption: about 200 mW
- Size ~ 5 x 5 x 3 cm^3, mass ~ 200 g
- Si microstrip, d = 300 μm
- 128 strips: L 2 mm x W 250 μm
- CSA, discriminators and counters in ASIC chip
- Wire bonding technique



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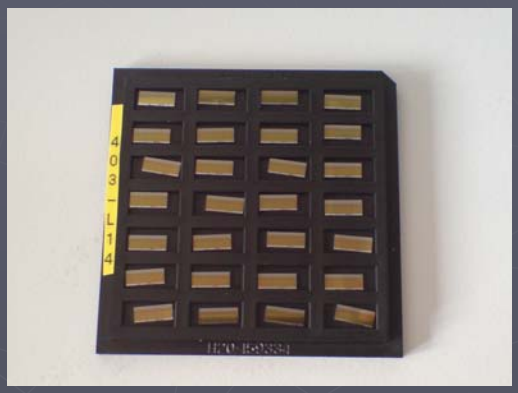
ASIC for Pulse Counting I.

- Asynchronous readout chip for 128 channels
- Low noise
- Each channel 24 bit counter
- Count rate 1 MHz channel
- Channel thresholds set individually
- LVDS logic



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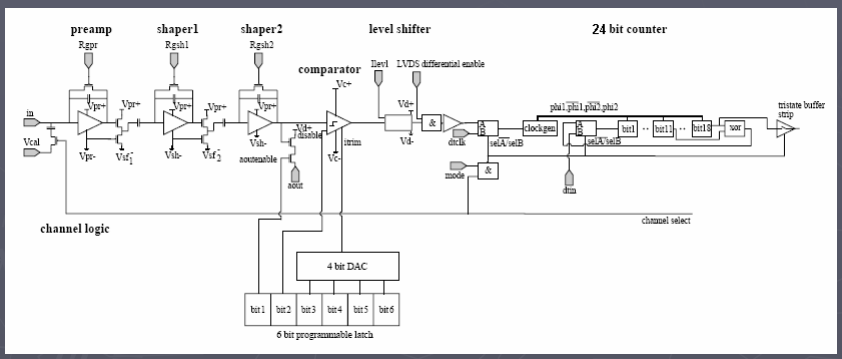
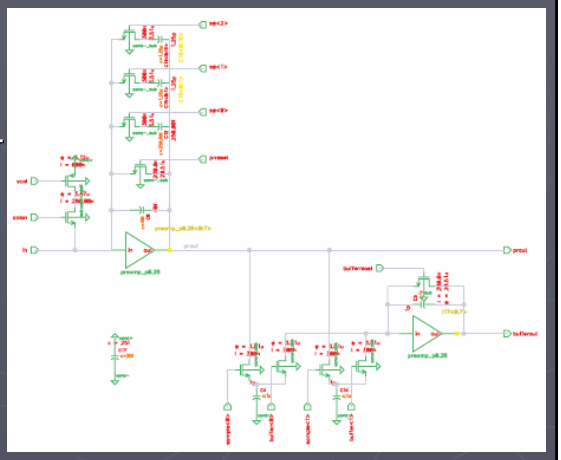
ASIC for Pulse Counting II.

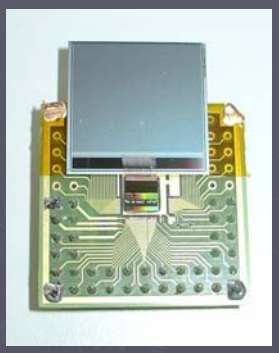


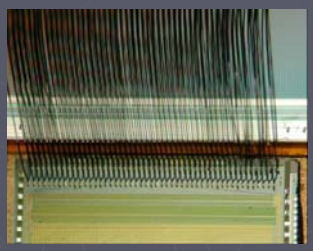
ASIC Current Readout

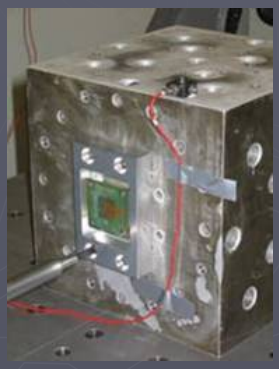
- Used at high flux intensities
- Integrating mode
- Readout time intervals similar as for discrete
- Currently under construction for XFEL at PSI
- On LEED can provide energy discrimination with absorbers
- Other parameters as before



Sensor Bonding and Vibration Test







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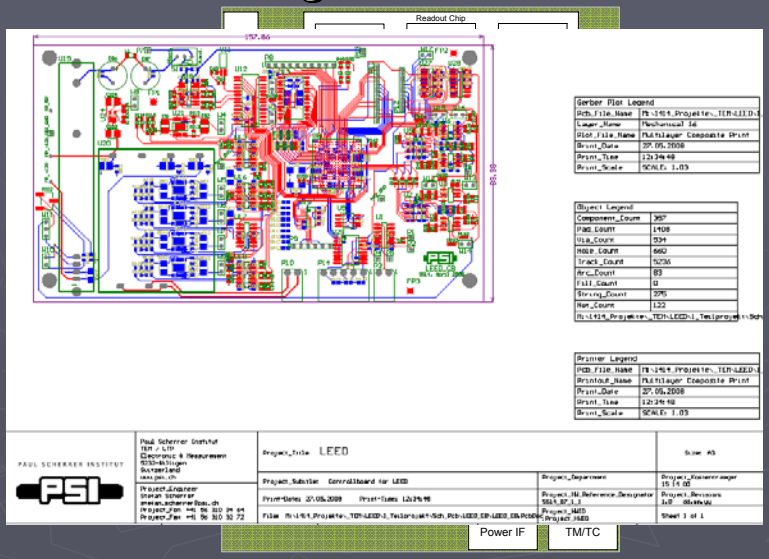
Functional Diagram and PCB Design



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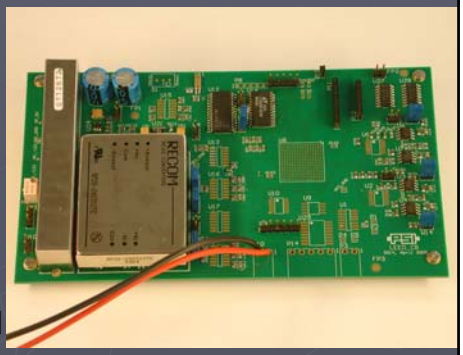
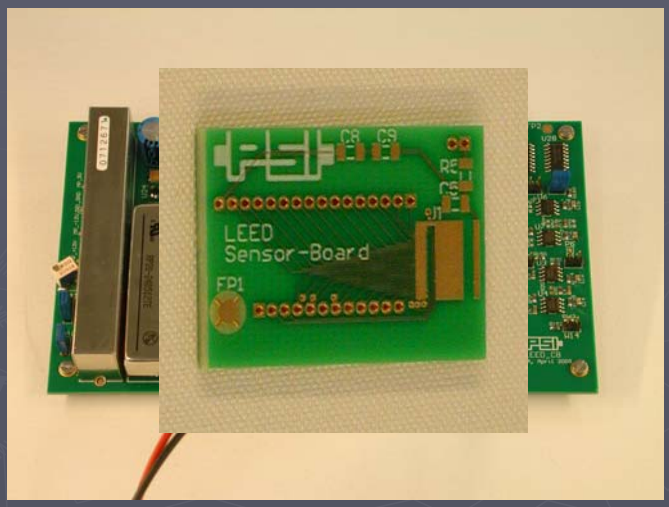
PCB for Demo Model

- Demo model PCB produced
- Board is being assembled
- Goals:
  - study functionality
  - demonstrate electron detection
  - Develop SW, FM, EGSE
- Miniaturization not yet implemented

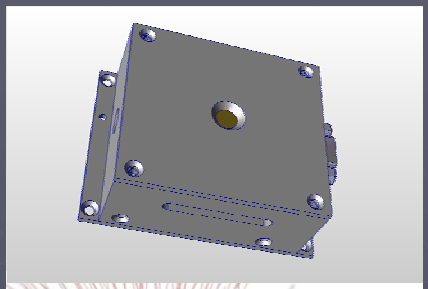


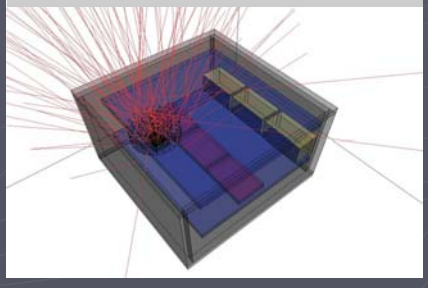
Sensor and ASIC Board



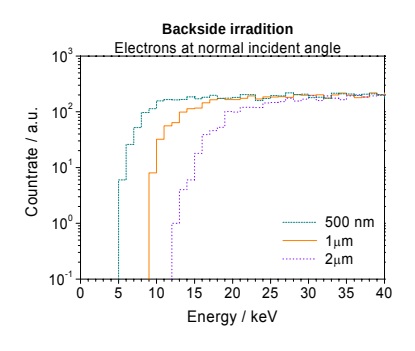
CAD and Monte Carlo Modeling

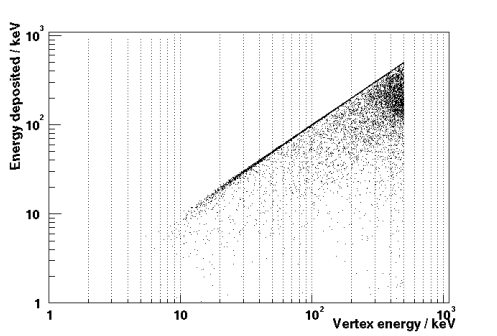
- Preliminary CAD Model constructed
- Parallel GEANT4 version developed
- Full implementation: 5x5x3 cm^3, m≈170 g
- Basic elements included: collimator, sensor, readout chip, PCBs, plugs, housing
- Simulations for different particles, directions, energies



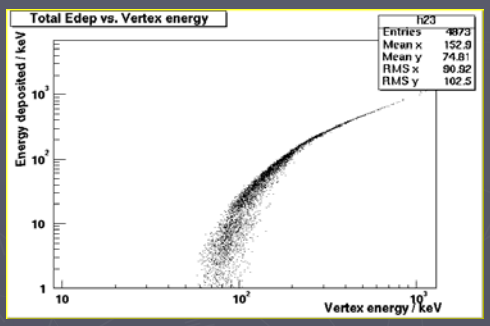


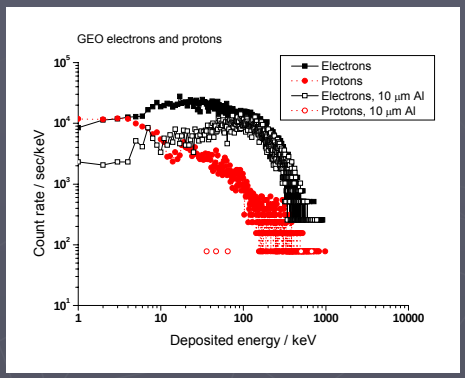
Threshold and Response





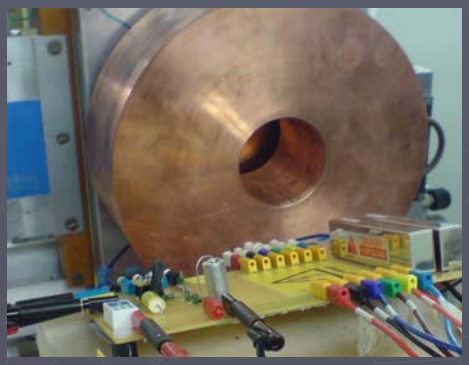
Protons as Background





- Protons rejection techniques implemented if needed
- Contamination strongly depends on S/C orbit
- Various thickness absorbers or E/M deflectors considered

Utilizing PIF protons and SLS X-rays



Current Plans

- Full development of Demo
- Collaboration with University of Bern
- Proposal to Swiss Space Office in summer
- Starting EM with miniaturized, rad hard design
- Flight scenarios:
  - telecommunication Satellites
  - Solar System exploration missions
- New inputs welcomed

Thank You!