

# 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  $\cong$  200 x 100 x 90 mm<sup>3</sup>
- 15 Energy levels in discriminators
- Proton sensors E<sub>thr</sub>  $\cong$  8 MeV
- Electron sensors E<sub>thr</sub>  $\cong$  500 keV
- Need for small and robust instrument



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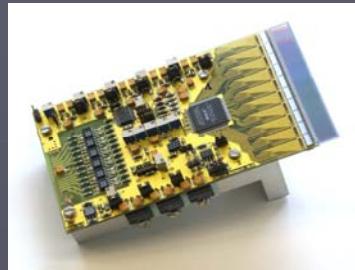
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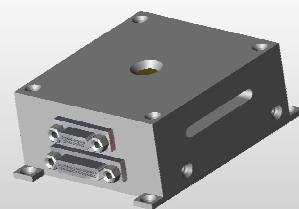
## SLS MYTHEN Technology for LEED

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



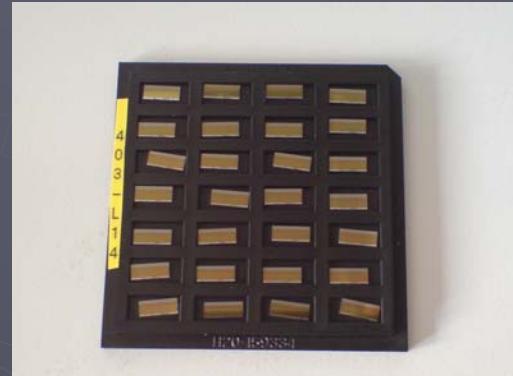
## LEED Features

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

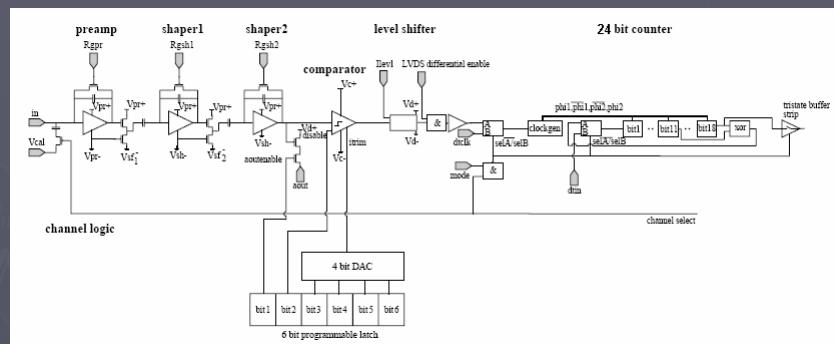


# ASIC for Pulse Counting I.

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

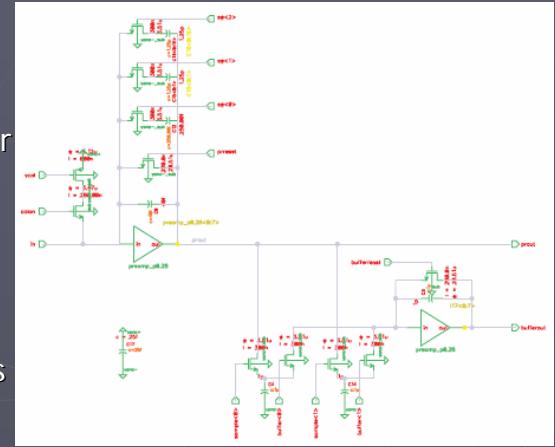


# ASIC for Pulse Counting II.

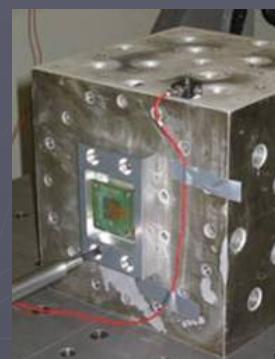
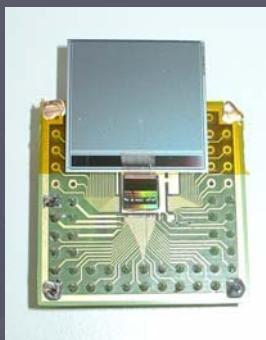


## ASIC Current Readout

- ▶ 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

Gerbier File Legend	
File	File Name: R:\LEO\Projects\TEP-LEEO\1
Layer	Layer Name: Mechanical 1d
Block	Block Name: MultiLayer Composite Print
Text	Text
Print	Print Date: 27.05.2008
Print Scale	Print Scale: 90% Fz: 1.03

Object Legend	
Component	Count: 1207
Pad Count	1108
Via Count	534
Route Count	660
Track Count	5736
Text Count	45
Bill of Material Count	0
String Count	295
Net Count	122

Bomber Legend	
File	File Name: R:\LEO\Projects\TEP-LEEO\1
Print	Print Name: MultiLayer Composite Print
Date	Print Date: 27.05.2008
Time	Print Time: 12:17:16
Scale	Print Scale: 90% Fz: 1.03

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Project_Submitter	Comptechard for LEEO
Project_Dates	20.05.2008 - Print Date: 12:17:16
File	R:\LEO\Projects\TEP-LEEO\1.Tektronix-Tech_Pcb-LEEO_01-LEEO_01.pcb

Project_2	
Project_ID	43
Project_Kennzeichner	PSI
Project_Ref	LEEO
Project_Remarks	Job 2: Status Val
Project_Note	Sheet 1 of 1

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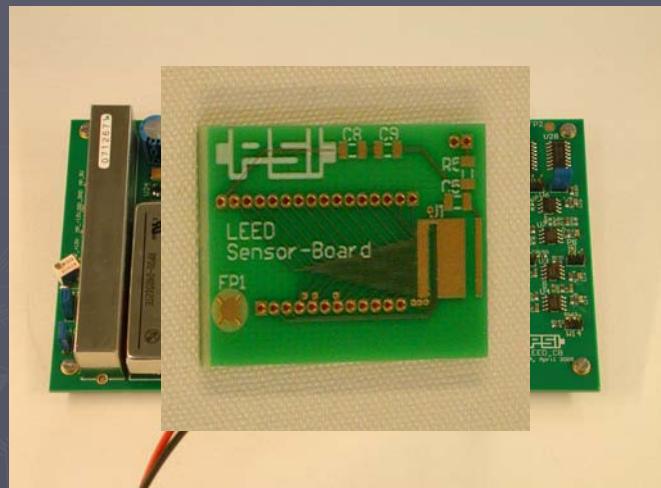
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# PCB for Demo Model

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

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## Sensor and ASIC Board



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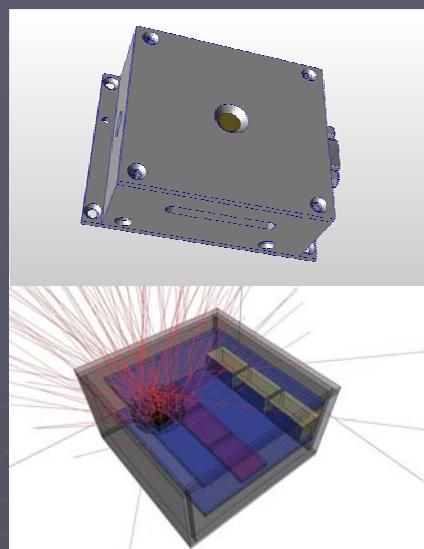
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## CAD and Monte Carlo Modeling

- ▶ Preliminary CAD Model constructed
- ▶ Parallel GEANT4 version developed
- ▶ Full implementation:  
 $5 \times 5 \times 3 \text{ cm}^3$ ,  $m \approx 170 \text{ g}$
- ▶ Basic elements included:  
collimator, sensor,  
readout chip, PCBs,  
plugs, housing
- ▶ Simulations for different  
particles, directions, energies



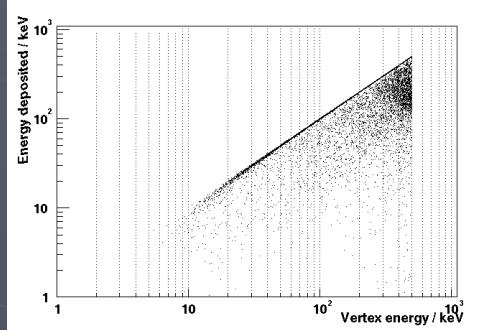
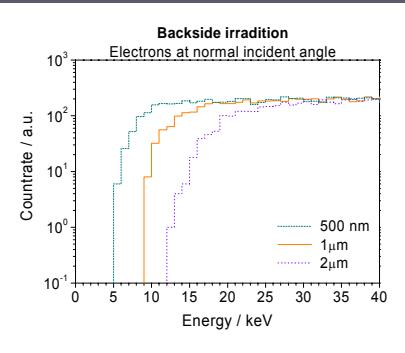
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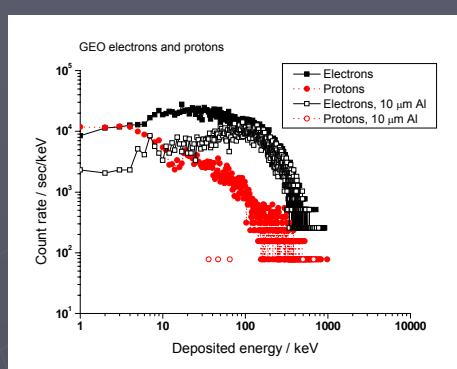
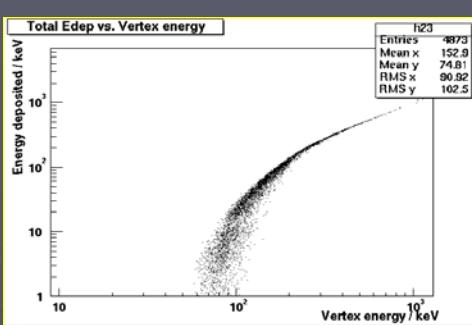
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# Threshold and Response



# 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



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## 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

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# Thank You!

