

# SREM Calibrations at PSI

*Hajdas, W.<sup>1</sup>; Eggel, C.<sup>1</sup>; Mohammadzadeh, A.<sup>2</sup>; Nieminen, P.<sup>2</sup>; Daly, E.<sup>2</sup>*

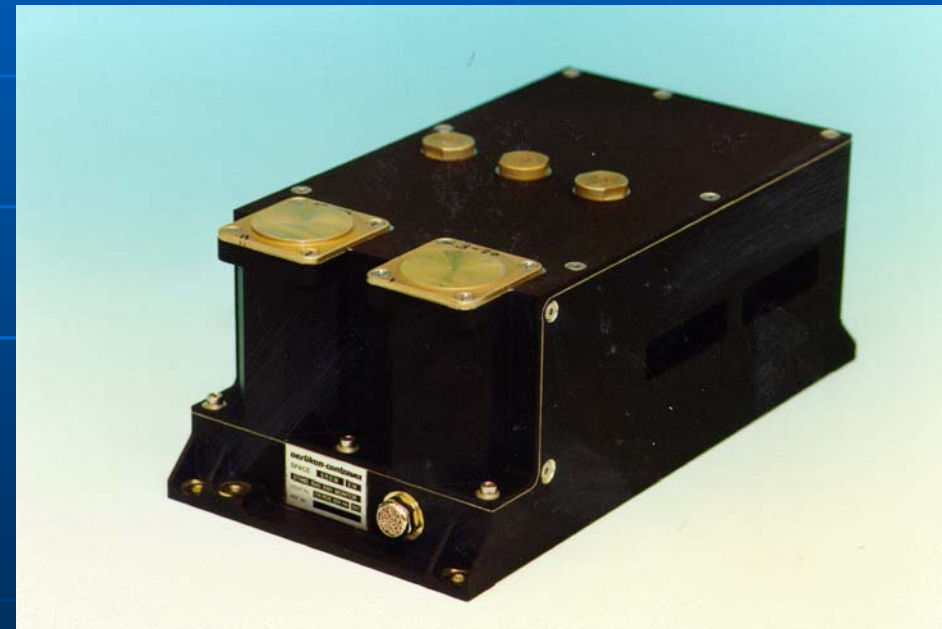
*<sup>1</sup>Paul Scherrer Institut  
<sup>2</sup>ESA-ESTEC*

# OUTLINE

- Procedure
- Calibration site
- On-line results
- Batch comparison
- Application example
- Summary

# SREM Basic Parameters I.

- SREM – Standard Radiation Environment Monitor for ESA
- Manufactured by OERLIKON-CONTRAVES in cooperation with PSI and ESA; 10 units
- Calibration, modeling and part of qualification at PSI
- 4 SREMs flying: STRV1C, PROBA1, INTEGRAL, ROSETTA
- 3 other scheduled for missions: Herschel, Planck, Giove-B
- Missions to be selected for 3 remaining SREM units

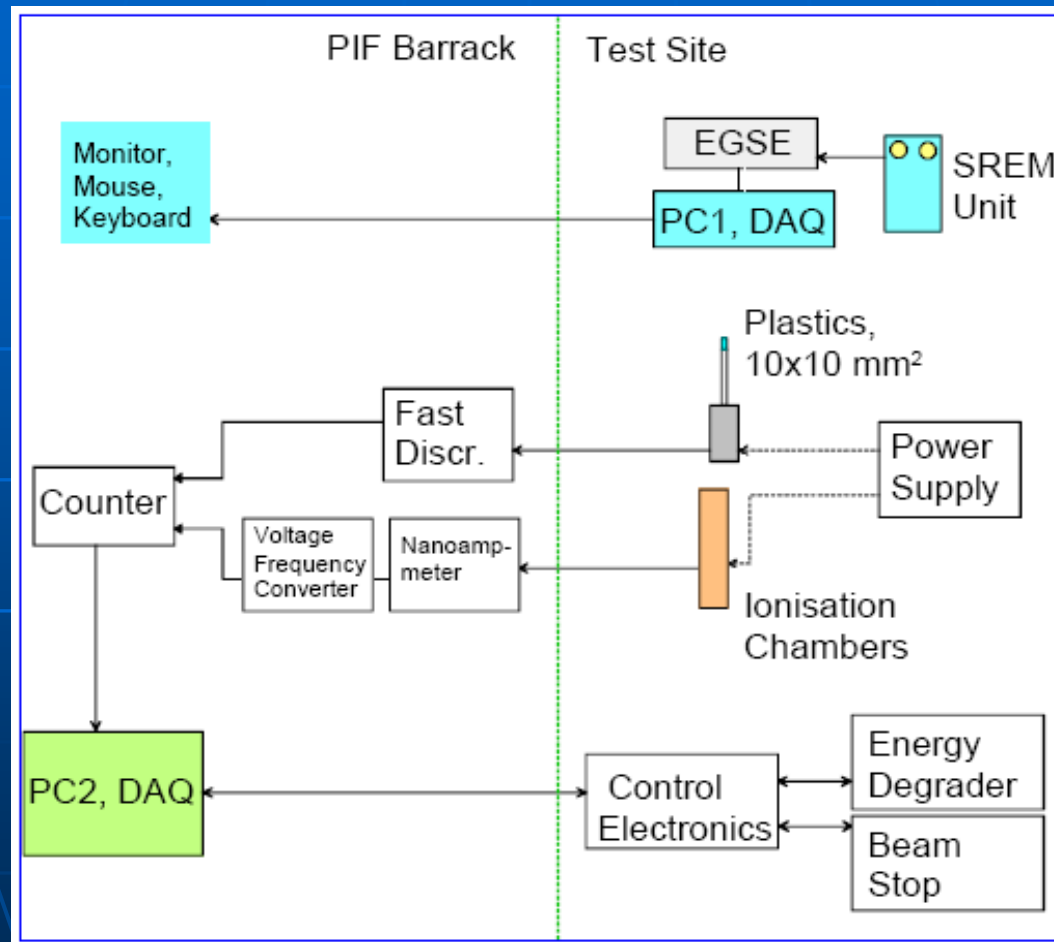


# SREM Basic Parameters II.

1. Particle spectroscopy, total dose and dose rate measurements
2. Mass: 2.5 kg, Dimensions: 96x122x217 mm<sup>3</sup>, Power: < 2W
3. 3 Silicon Detectors
4. Directional sensitivity/telescope
5. Fast discriminators and scalers
6. Count rates > 100 kiloevents/sec
7. Energy range:  
> 8 MeV protons,  
> 0.3 MeV electrons
8. Programmable dose alarm flags



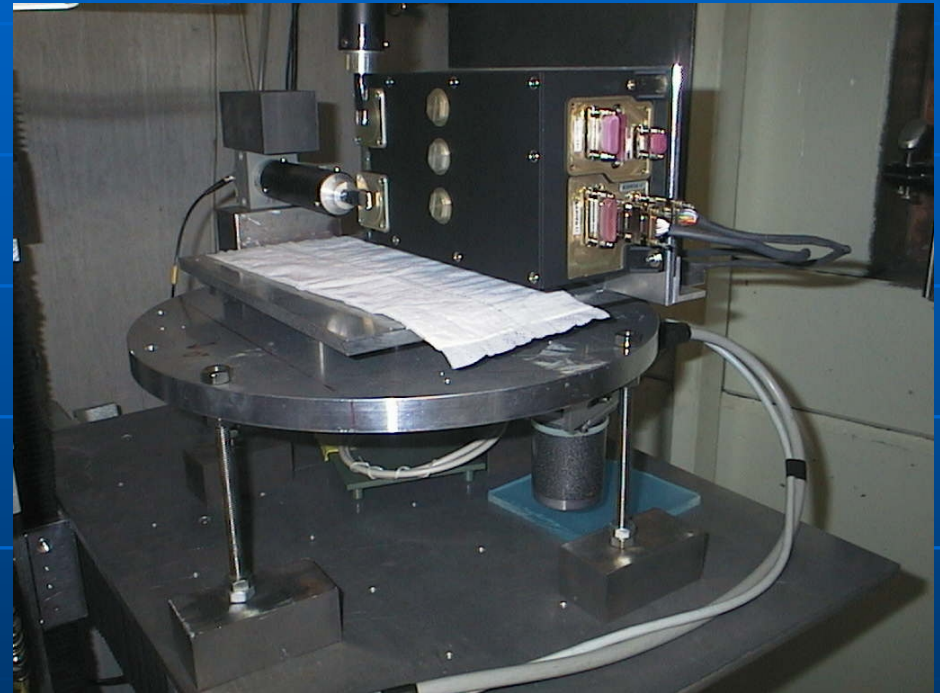
# SREM at Proton Irradiation Facility



Data acquisition and measurement set-up for IREM proton tests.

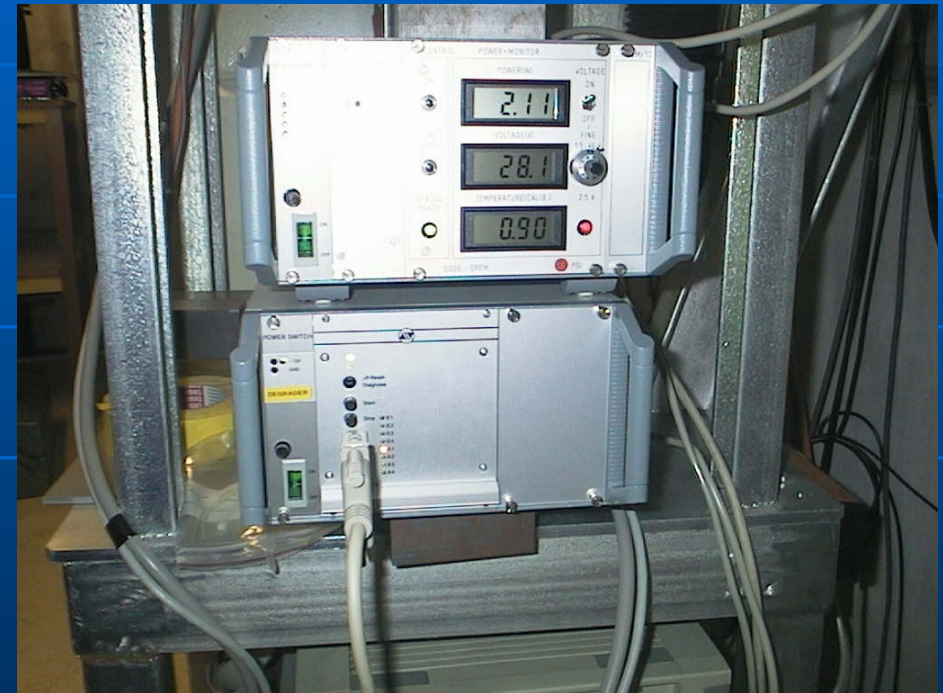
# SREM Arrangement at PIF

- Turn-table for setting of angular position
- Plastic detectors for precise flux monitoring
- Number of proton energies and angles
- Wide range of fluxes
- Automatic operation
- Comprehensive MC modeling of PIF beams

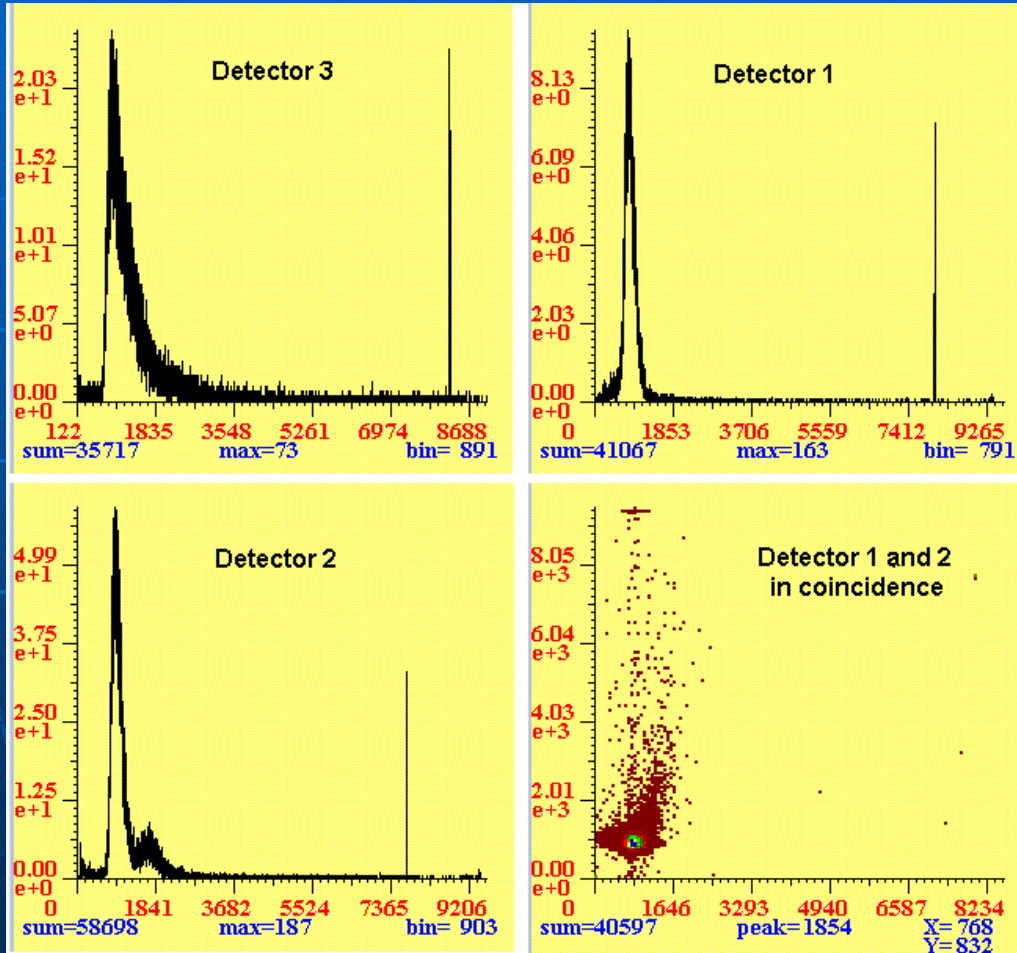


# Ground Support Equipment

- Two EGSE units available for SREM testing at PSI and ESTEC
- All monitor TC procedures implemented
- Monitor status and health monitoring
- Reprogramming of SREM internal SW



# Detailed Checking



## RUN PARAMETERS

Energy : 100 MeV

Angle : 0°

Rate : 700 p/cm<sup>2</sup>/sec

Beam : Uniform 10x10 cm<sup>2</sup>

Pulser: ON

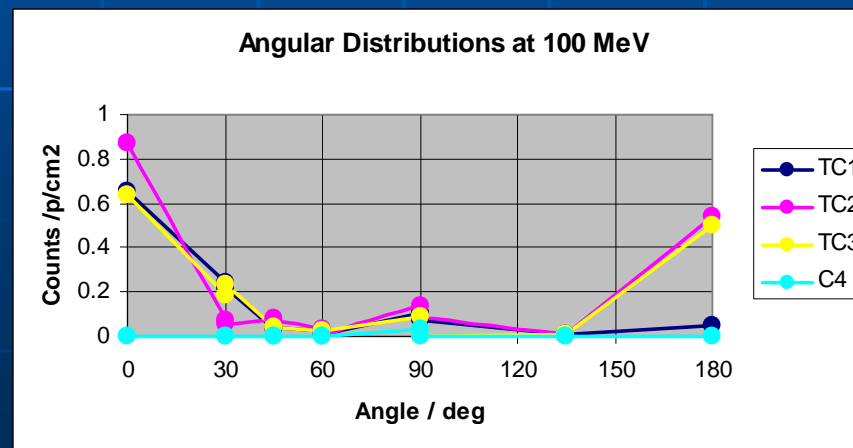
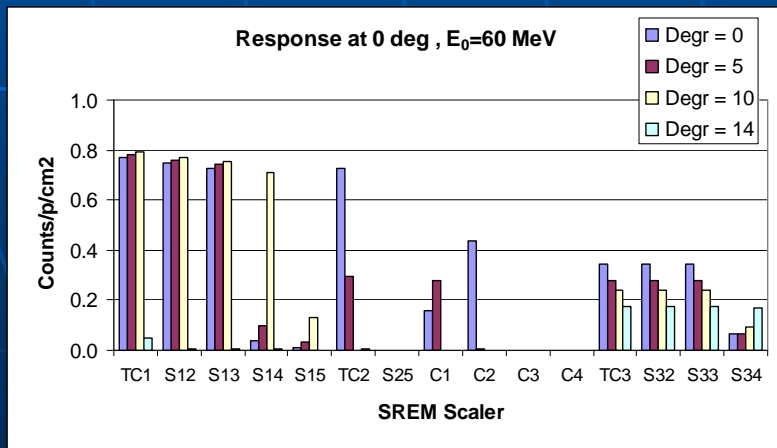
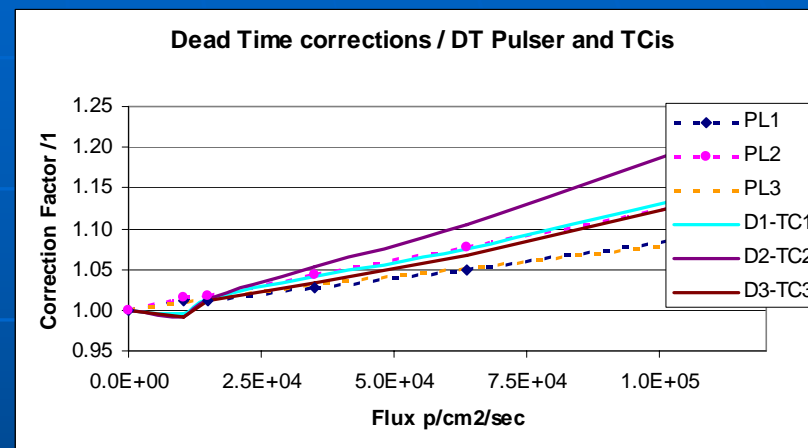
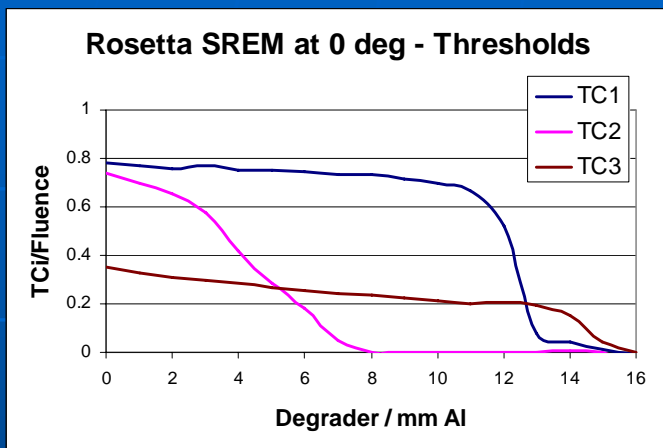
# Calibration Procedure Steps

No	Procedure	Remark
1	PIF Preparation	Beam line, test site, electronics, software
2	SREM SFT, $^{60}\text{Co}$ and Cosmics check	Test readiness proof of SREM & EGSE
3	Test arrangement in the PIF test area	Test site check of SREM, EGSE & PIF
4	Setup for $E_0=60$ MeV proton beam	
5	Energy range measurement	
6	Proton flux normalization measurement	Proton intensity at SREM position
7	SREM Low energy response at $0^\circ$	Using degrader, Energies (0-60 MeV)
8	SREM Thresholds determination	Using degrader, Energies (0-60 MeV)
9	Setup for $E_0=300$ MeV proton beam	
10	Energy range verification	
11	Proton flux normalization measurement	Proton intensity at SREM position
12	SREM Detector area measurement	$E_0= 300$ MeV, flat beam
13	SREM Dead-time determination	$E_0= 300$ MeV, adjustable intensity
14	Full response calibration / set of energies and angles	$E_0=300$ MeV, using degrader; 12 angular positions, 5 energies

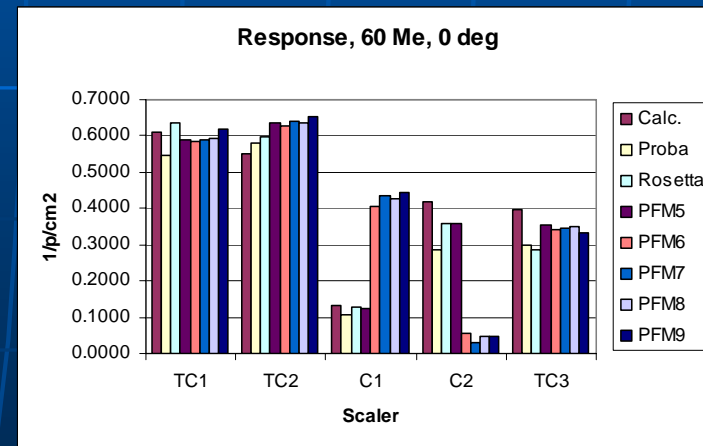
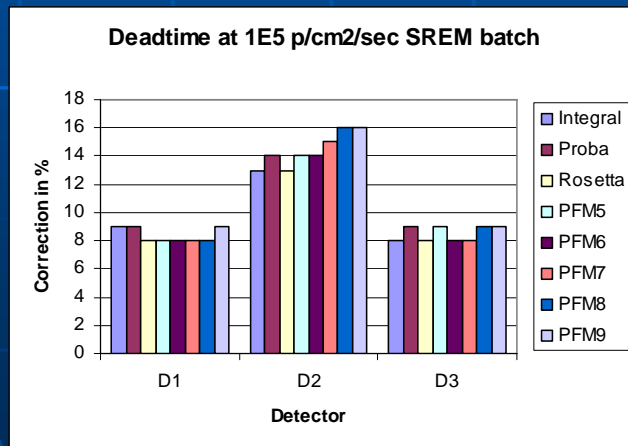
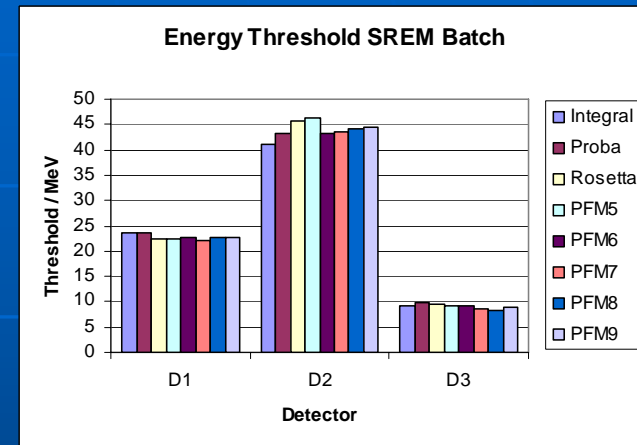
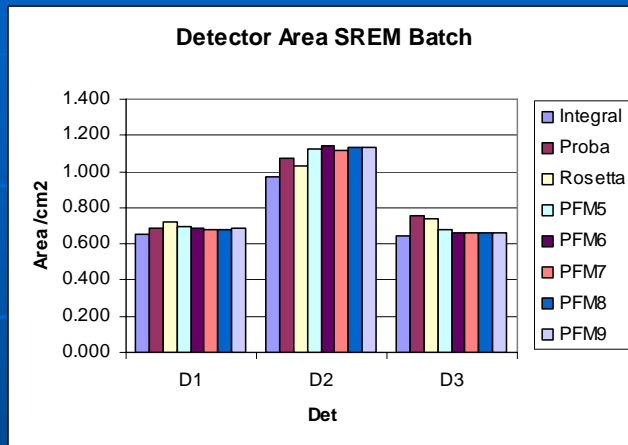
# Procedure Steps at High Energies

Nr	$\Theta$	$\phi$	Energies
[1]	[deg]	[deg]	[MeV]
1	0	0	50.8, 71., 100, 150., 300.
2	30	0	50.8, 71., 100, 150., 300.
3	60	0	50.8, 71., 100, 150., 300.
4	90	0	50.8, 71., 100, 150., 300.
5	45	180	50.8, 71., 100, 150., 300.
6	180	0	50.8, 71., 100, 150., 300.
7	135	180	50.8, 71., 100, 150., 300.
8	135	0	50.8, 71., 100, 150., 300.
9	30	90	50.8, 71., 100, 150., 300.
10	60	90	50.8, 71., 100, 150., 300.
11	45	270	50.8, 71., 100, 150., 300.
12	90	270	50.8, 71., 100, 150., 300.

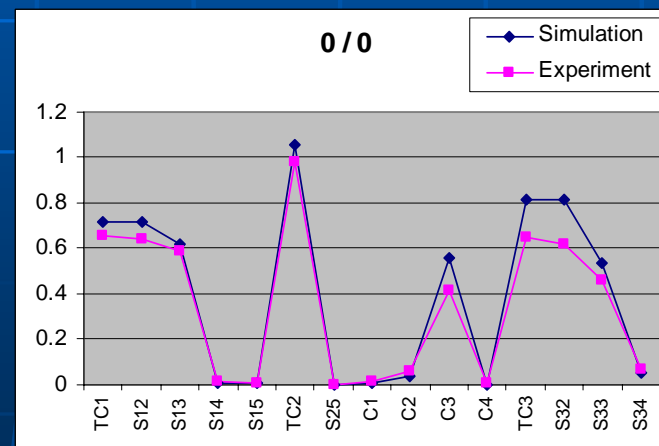
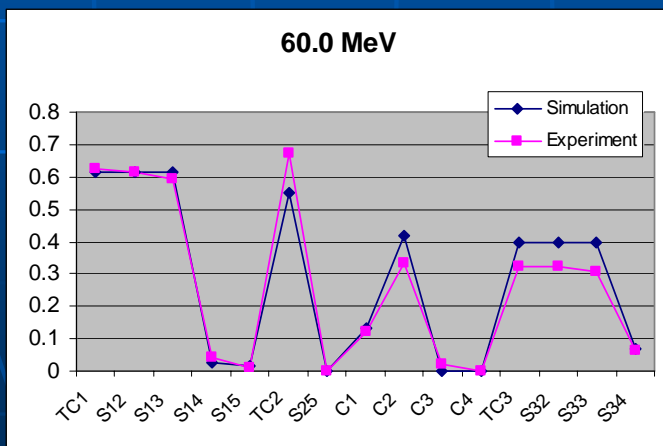
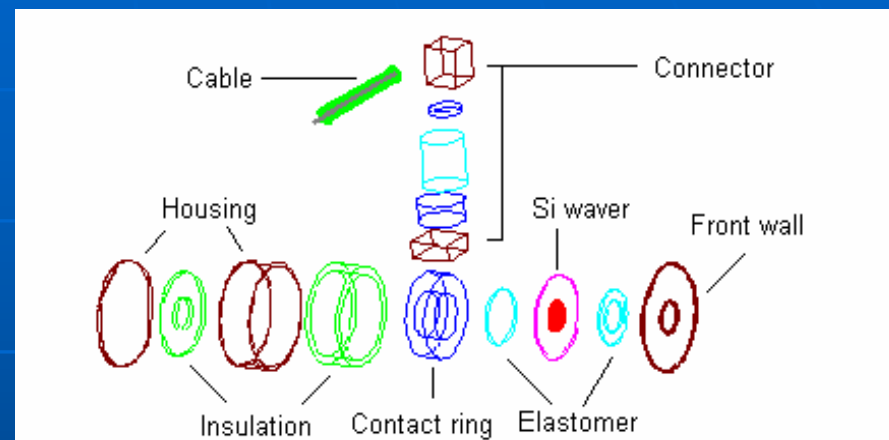
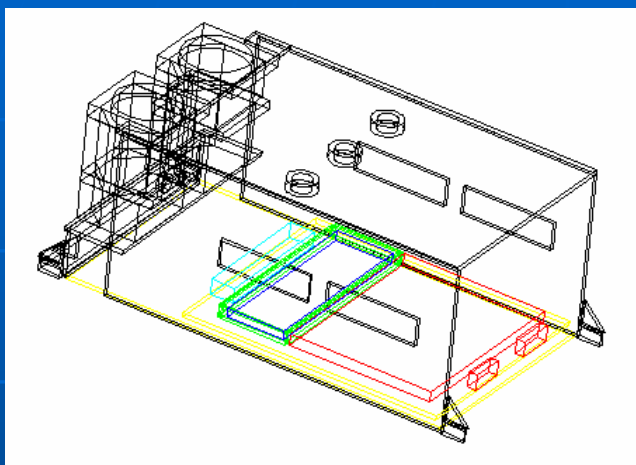
# Main Results



# Batch Comparison



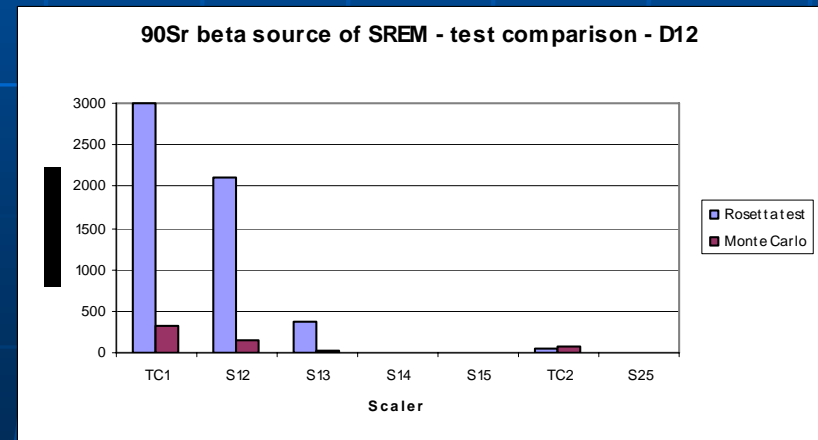
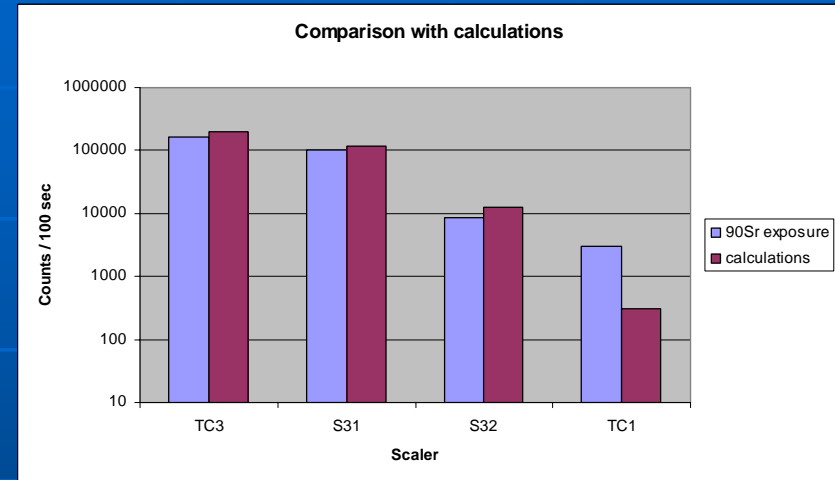
# Comparison with modeling G3



Although in general the agreement OK, one needs to more adjustments, specially in coincidence channels

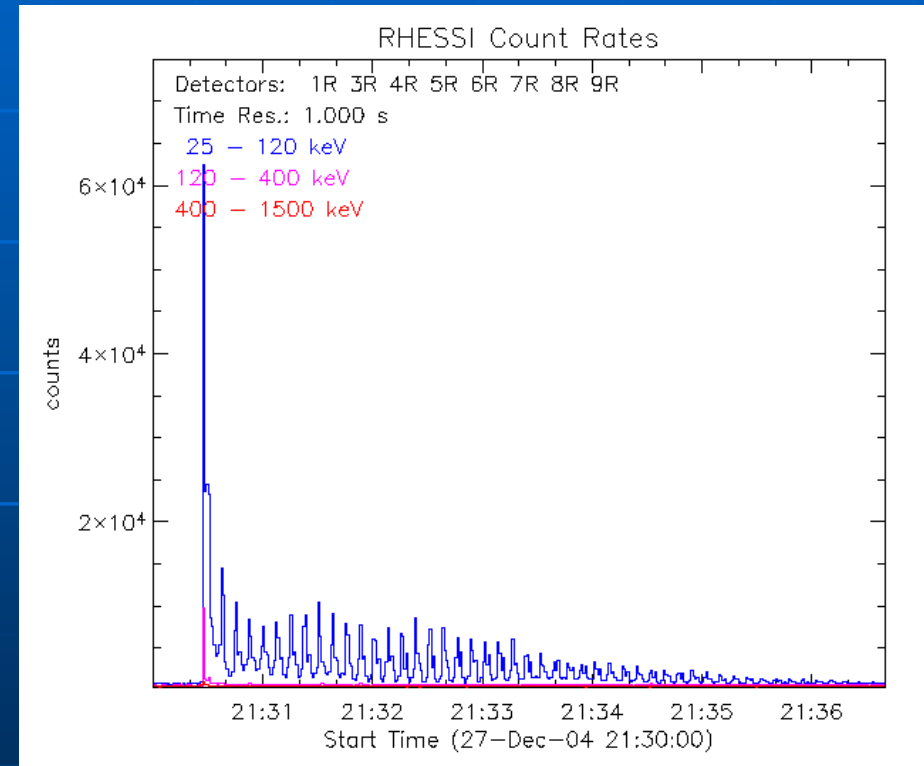
# Electron source test

- Only some scalers can be tested with  $^{90}\text{Sr}$
- All SREMs electron responses similar
- For D3 agreement (15%) already with no free parameters
- Very sensitive to any changes in thickness -D12
- Depends also on opening diameter of collimator



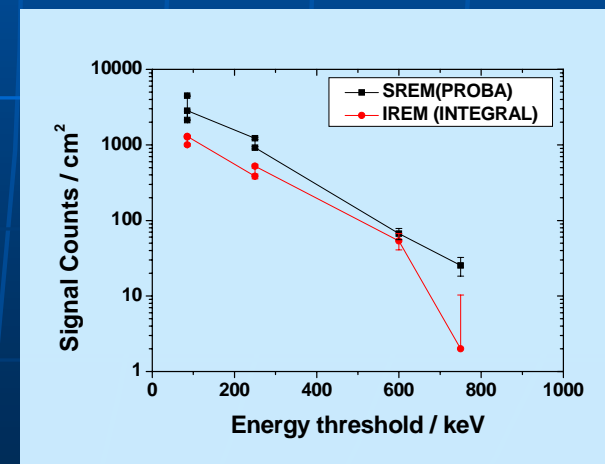
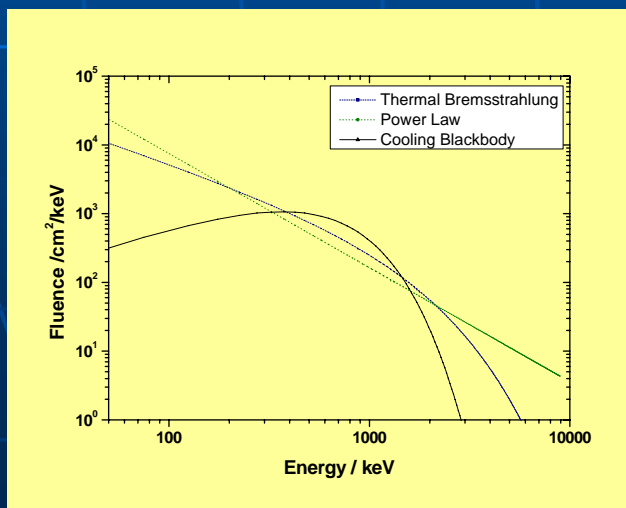
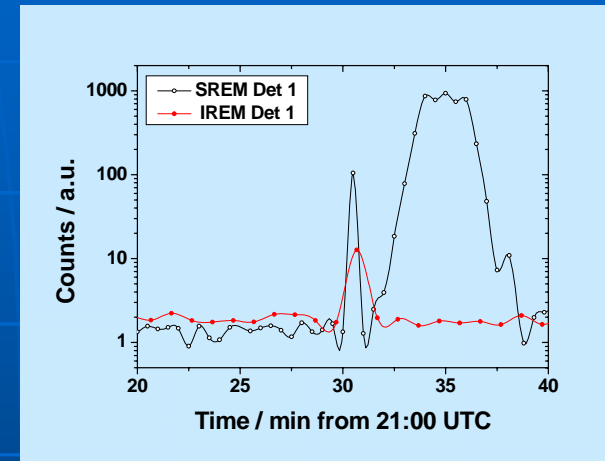
# Case of SGR1806-20 Magnetar

- Main spike of the giant flare from SGR1806-20 (27 Dec 04) released enormous energy
- All  $\gamma$ -, X-ray detectors onboard satellites saturated
- Standard  $\gamma$ -, X-ray detectors, also **RHESSI** could analyze oscillating part only



# SREM observations of SGR1806-20

- Few smaller instruments, incl. two SREMs detected the spike
- Best spectral results for the cooling blackbody shape:
  - $T = 230 \pm 50 \text{ keV}$
  - $E = 0.99 \pm 0.5 \text{ erg/cm}^2$



# Summary

- All SREM units exposed to protons, electrons and  $\gamma$ -rays at PSI
- Calibration determined and verified monitors parameters:
  - active area,
  - threshold,
  - discriminator levels,
  - dead-time corrections,
  - linearity etc.
- SREM characteristics in general confirmed though some corrections and tuning needed
- Response matrix created with MC model based on and adjusted to calibration results
- High quality data from space requires for each monitor individually created response matrix

# Thank You !