

MSL RAD

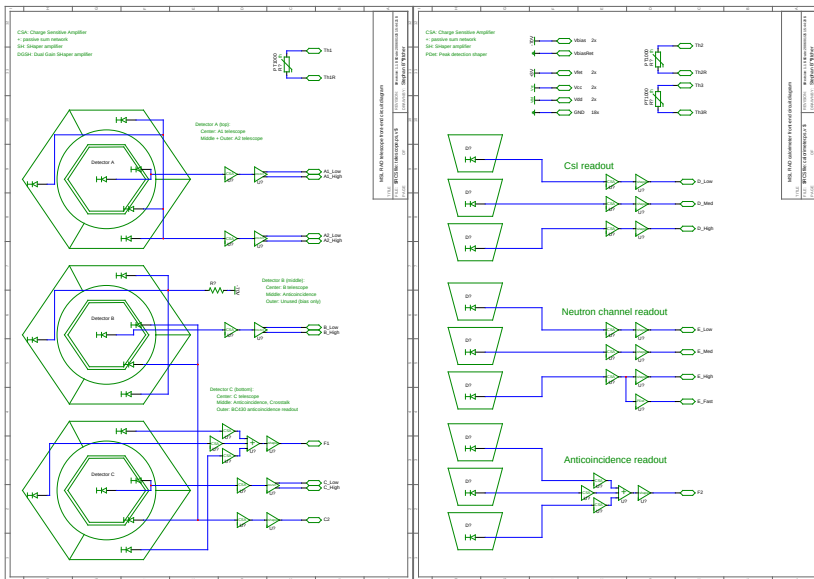
Preliminary Design Review

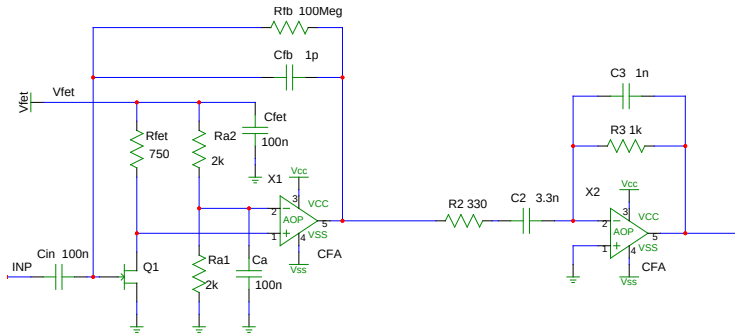
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Christian Albrechts Universität zu Kiel

January 31 – February 1, 2006

- ▶ RSH electronics
- ▶ Geant 4 Simulations
- ▶ Expected Particle Rates

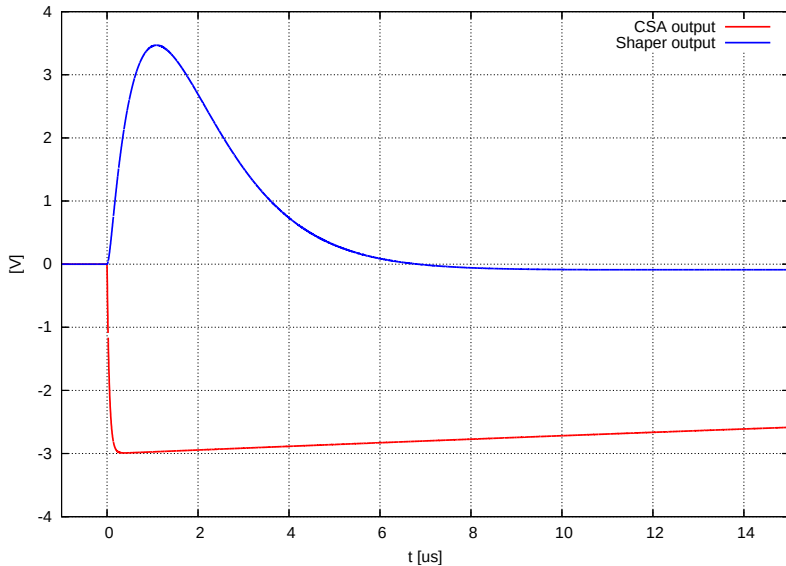


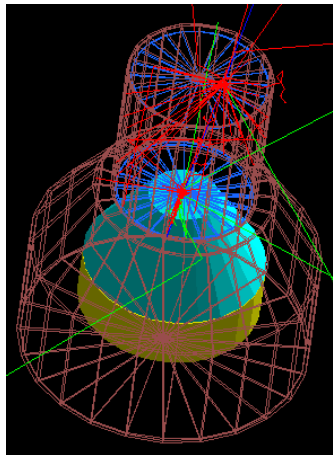


- ▶ 17 charge sensitive amplifiers, 4 mA FET bias, AD8005.
- ▶ 17 shaper amplifiers, AD8005.

Power consumption: 375 mW

RSH electronics: Pulse Shapes



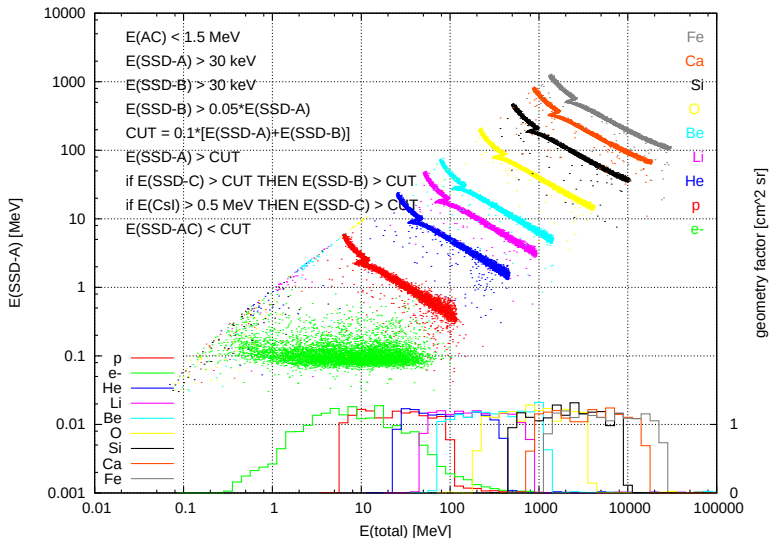


20 GeV iron ion (blue)

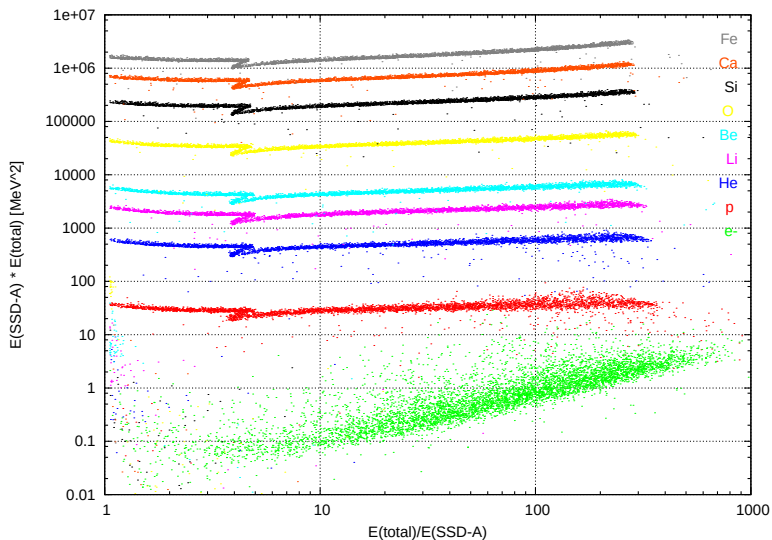
- ▶ Round geometry (not hexagonal).
- ▶ Aluminum housing, 1mm.
- ▶ Teflon spacers between scintillators.
- ▶ No PIN detectors.

- ▶ Stopping Charged Particles.
- ▶ Penetrating Charged Particles.
- ▶ Neutral Particles.
- ▶ Dosimetry.

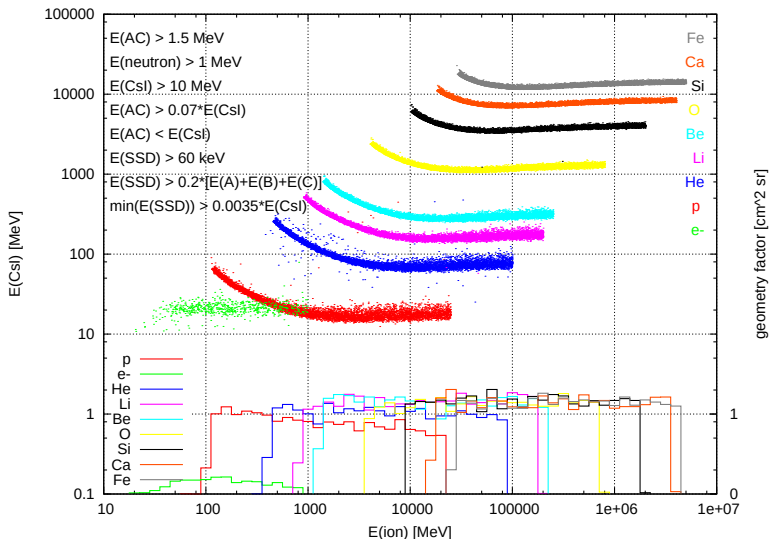
Geant 4: Stopping Charged Particles

 dE/dx (SSD-A) and geometry factor versus total energy deposit

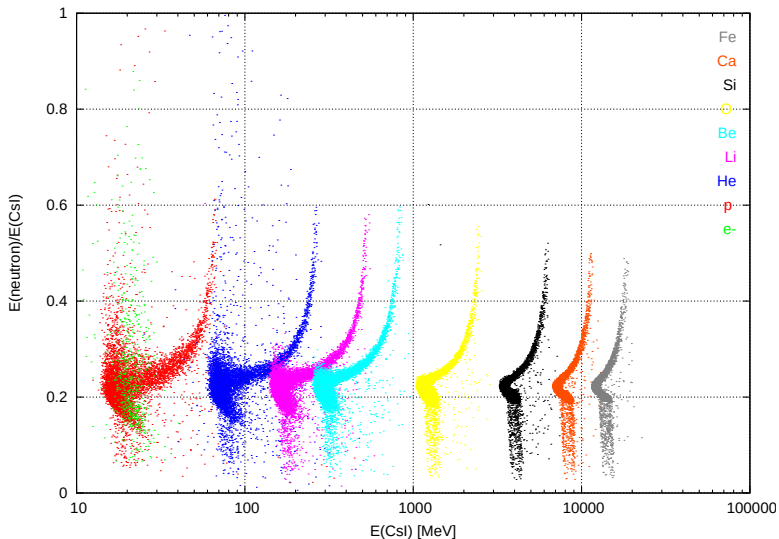
"Böhm Plot"



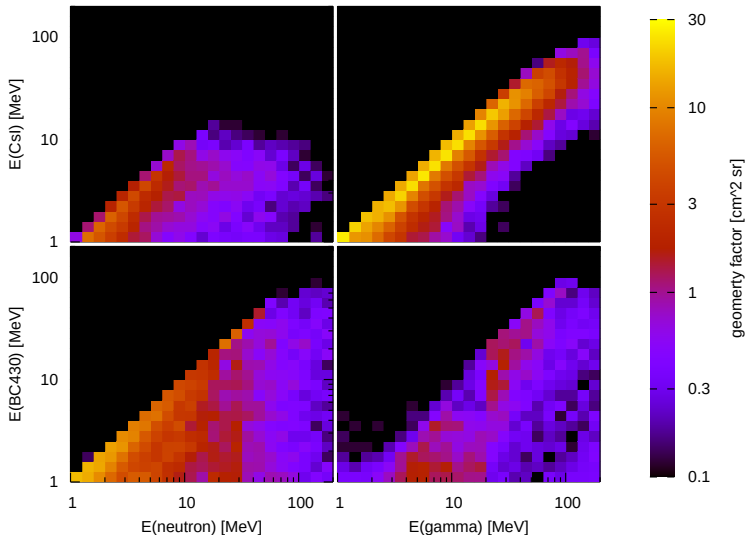
Energy loss and geometry factor of penetrating charged particles



Ratio of energy loss in neutron channel and CsI crystal



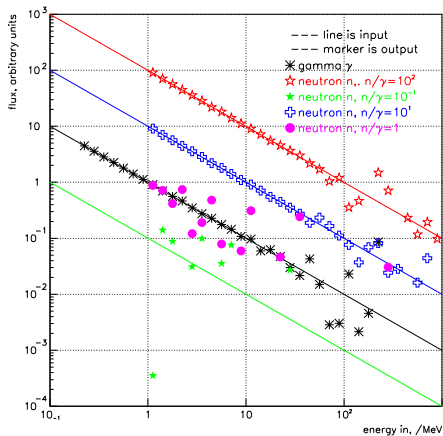
Detected energy vs particle energy matrix



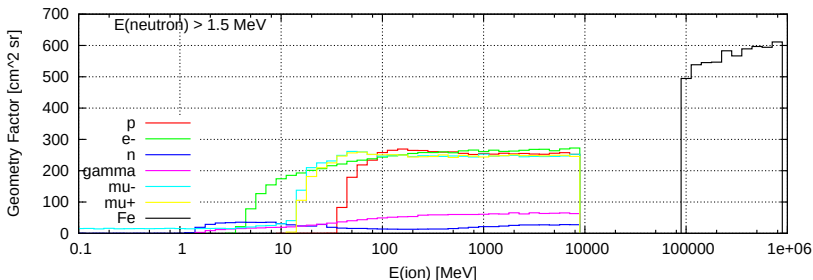
Geant 4: Neutral Particles

$$\begin{pmatrix} \mathbf{A}_{\text{CsI}}^{(n)} & \mathbf{A}_{\text{CsI}}^{(\gamma)} \\ \mathbf{A}_{\text{BC430}}^{(n)} & \mathbf{A}_{\text{BC430}}^{(\gamma)} \end{pmatrix} \begin{pmatrix} f^{(n)} \\ f^{(\gamma)} \end{pmatrix} = \begin{pmatrix} z^{(\text{CsI})} \\ z^{(\text{BC430})} \end{pmatrix}$$

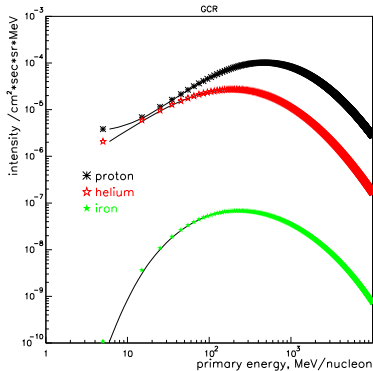
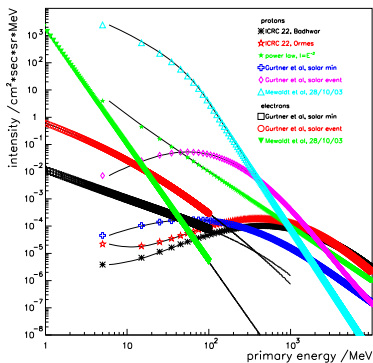
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- ▶ Silicon Total Dose: Add all energy deposits in SSD-A.
- ▶ Silicon LET: dE/dx spectrum with SSD-A & SSD-B coincidence.
- ▶ BC-430 Total Dose: Add all energy deposits in the neutron channel.



Interplanetary Particle Flux

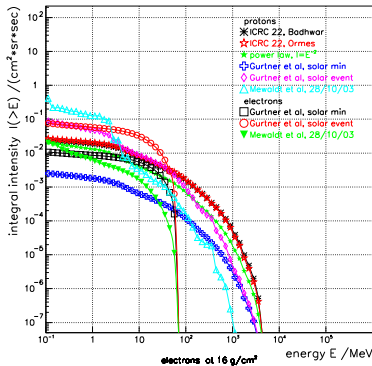
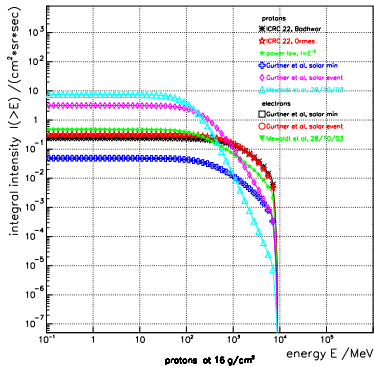


E. Böhm

Protons and Electrons

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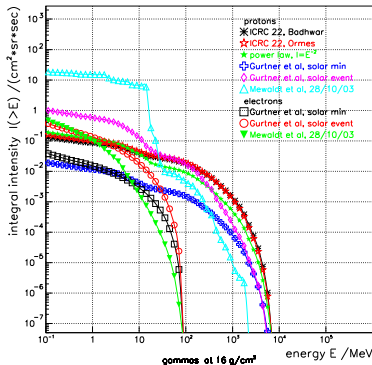
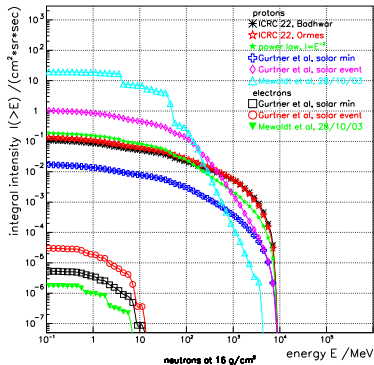


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Neutrons and Gammas

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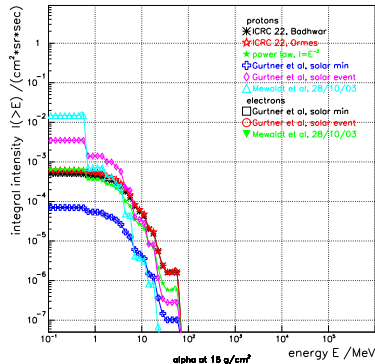
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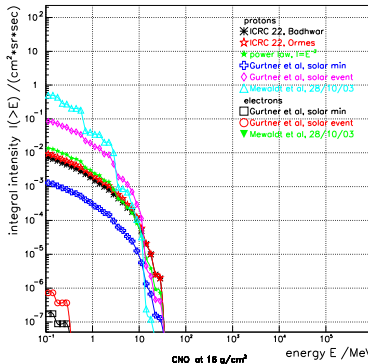
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Alphas and Heavier

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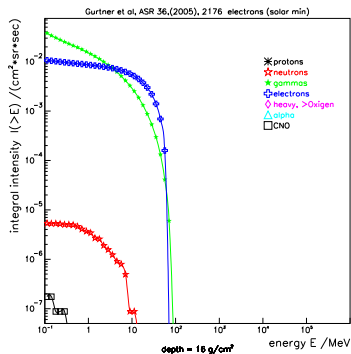
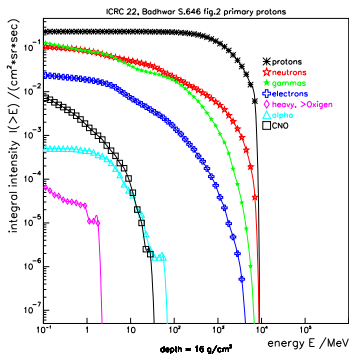


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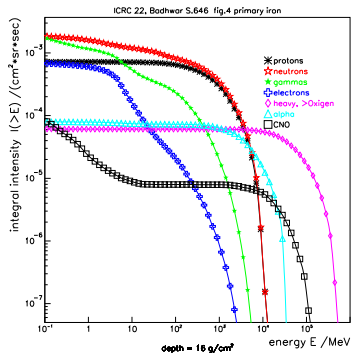
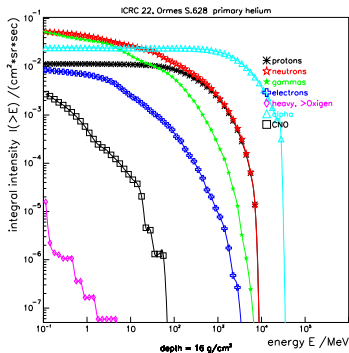


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Primary Protons and Electrons



Primary Helium and Iron



Telescope:

- ▶ Geometry Factor of the Telescope $\approx 1 \text{ cm}^2 \text{ sr}$,
- ▶ particle Fluxes $\approx 10 \text{ cm}^{-2} \text{ sr}^{-1} \text{ s}^{-1}$ *maximum*,
- ▶ $\rightsquigarrow \approx 10 \text{ counts/second}$.

Neutral Particles:

- ▶ Geometry Factor of the Detector $\approx 40 \text{ cm}^2 \text{ sr}$,
- ▶ particle Fluxes $\approx 20 \text{ cm}^{-2} \text{ sr}^{-1} \text{ s}^{-1}$ *maximum*,
- ▶ $\rightsquigarrow \approx 1000 \text{ counts/second}$.

Dosimetry:

- ▶ Geometry Factor of the BC-430 detector $\approx 200 \text{ cm}^2 \text{ sr}$,
- ▶ $\rightsquigarrow \approx 2000 \text{ counts/second}$.