

LUNA: new results on ${}^3\text{He}(\alpha, \gamma){}^7\text{Be}$

Men in pits or wells sometimes
see the stars.... Aristotle

☀ Nuclear Burning
in Stars

☀ $\sigma(E_{\text{star}})$

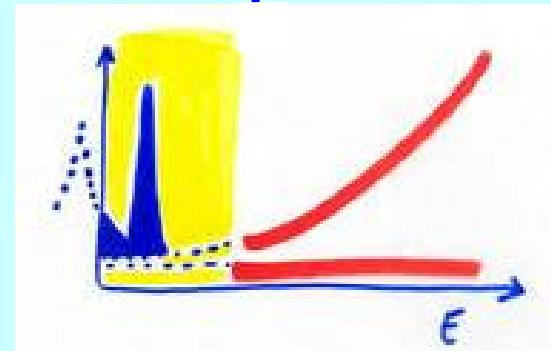
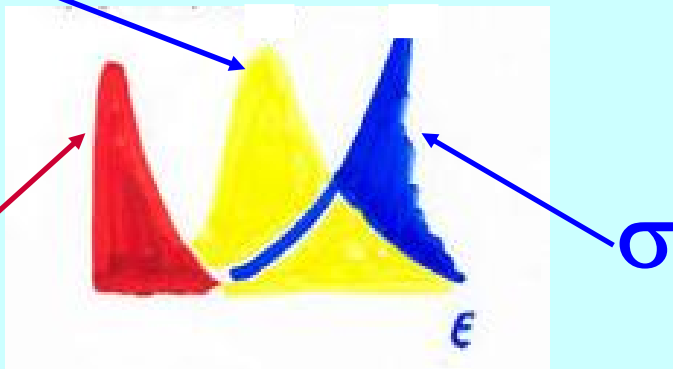
$$\sigma(E) = S(E) e^{-2\pi\eta} E^{-1}$$

$$\text{Reaction Rate}(\text{star}) \div \int \Phi(E) \sigma(E) dE$$

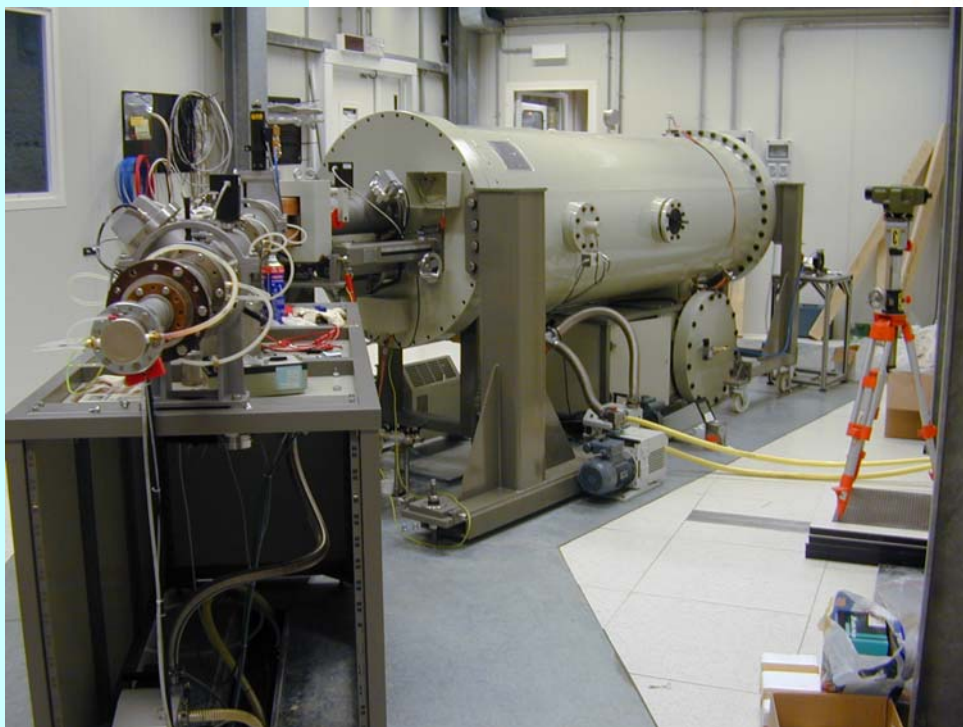
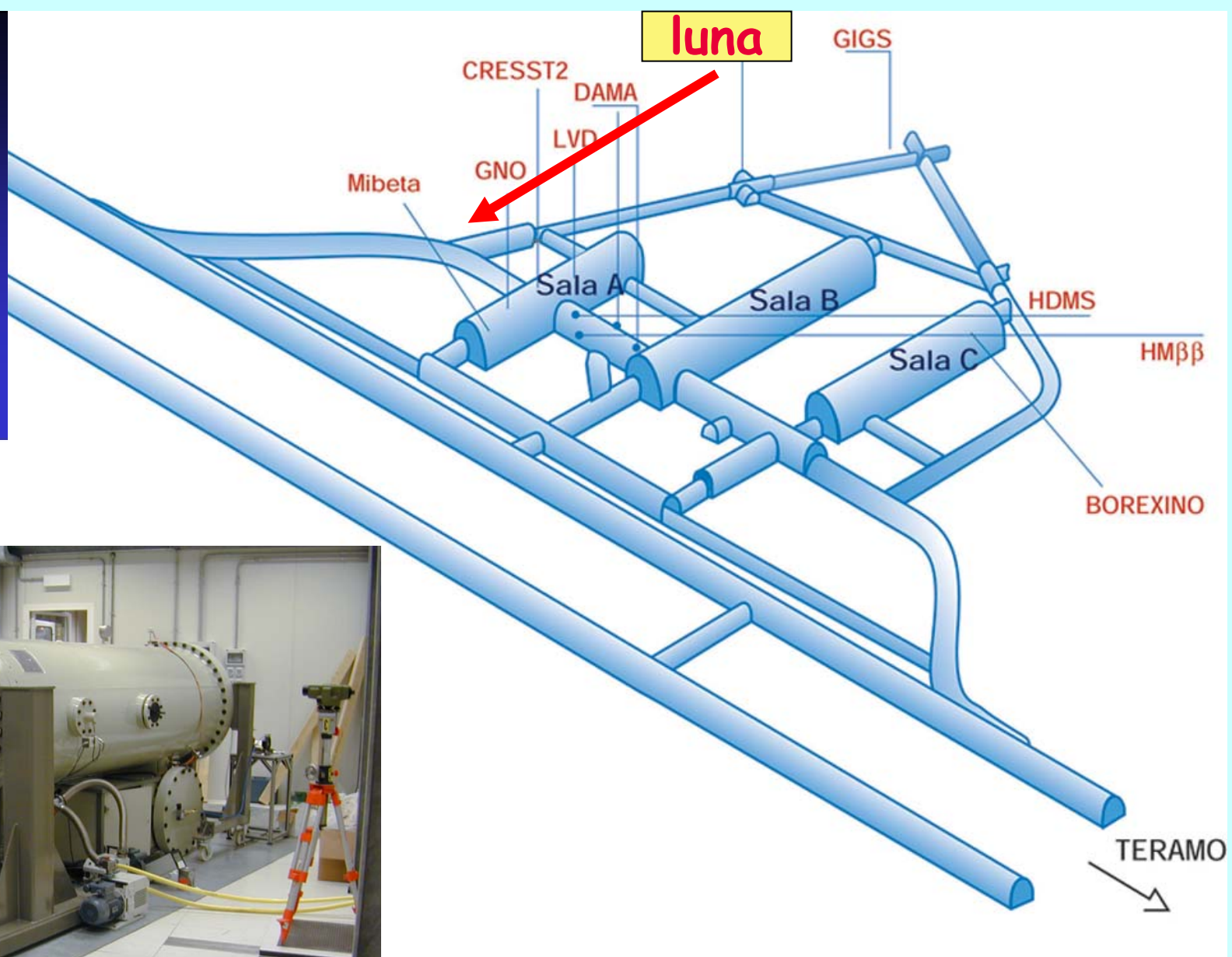
Gamow Peak

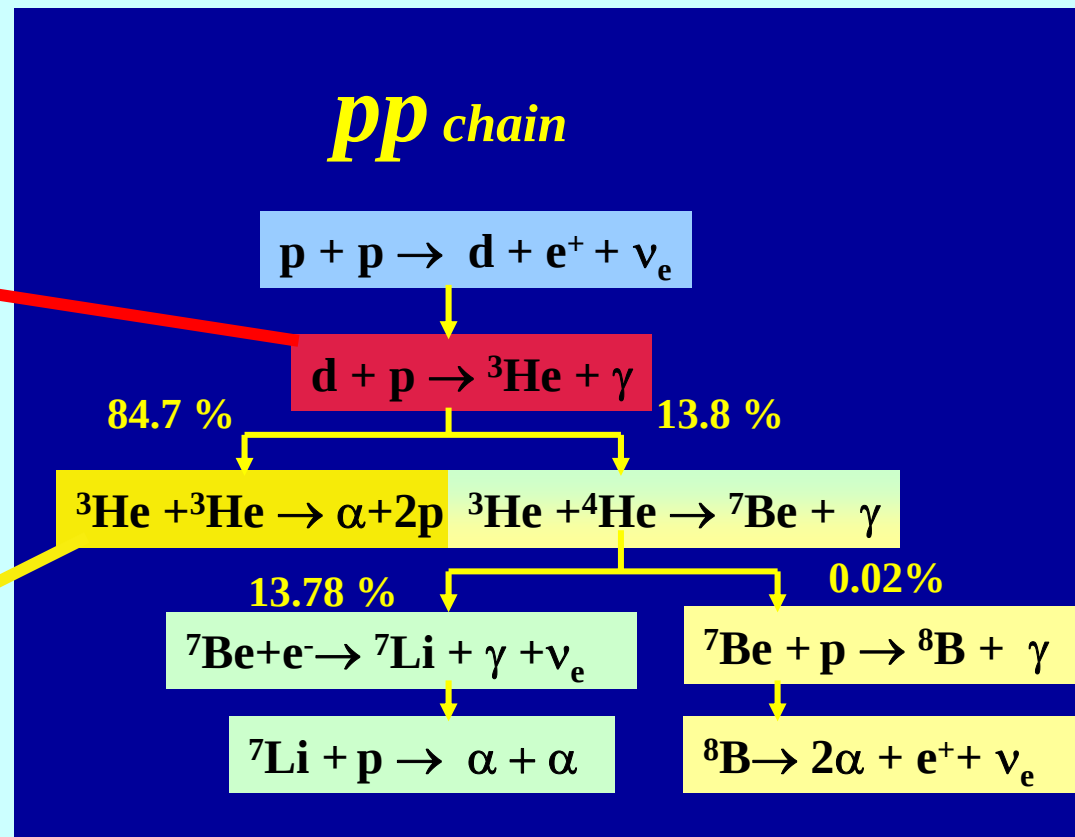
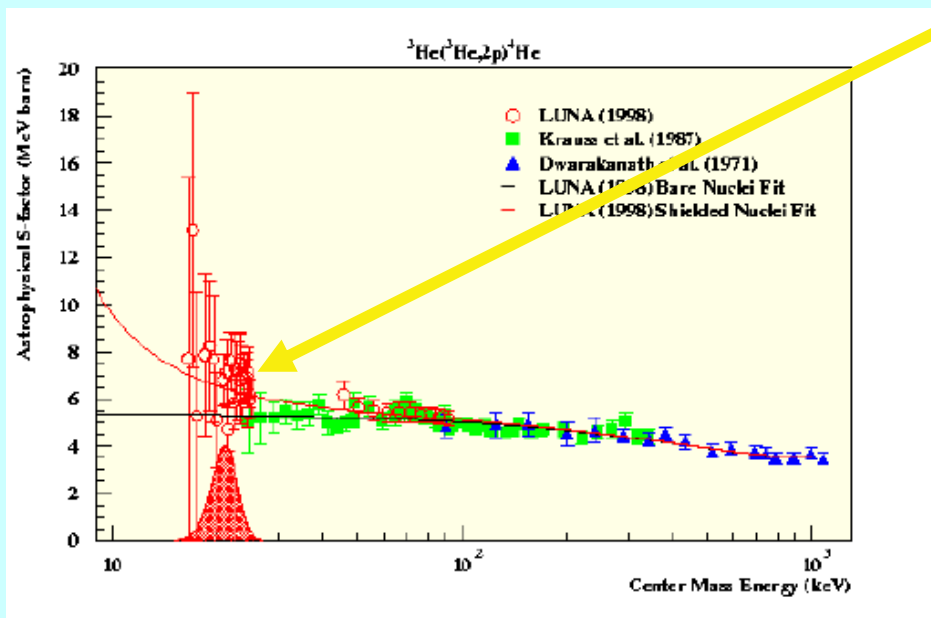
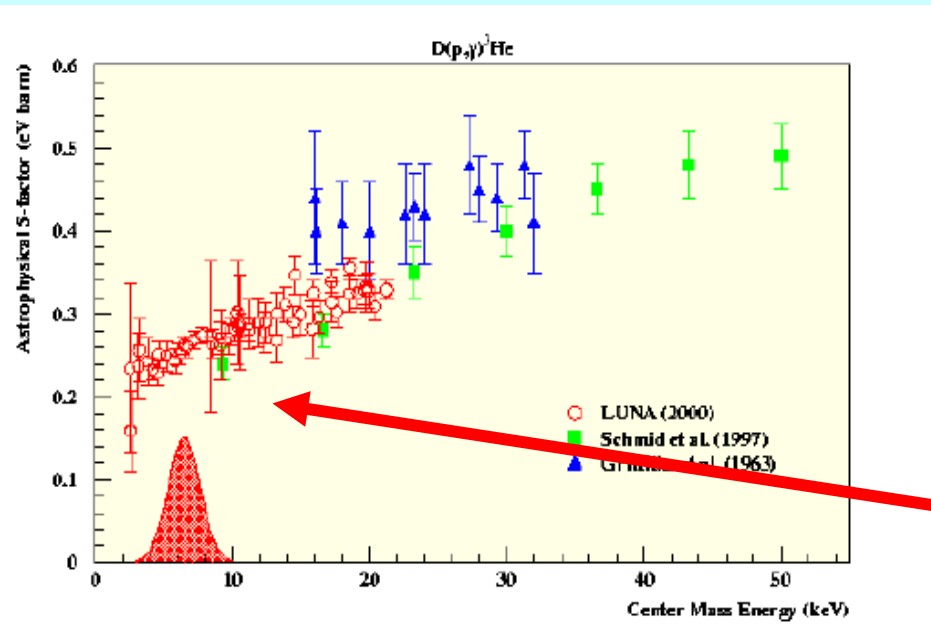
Extrap. | ← Meas. →

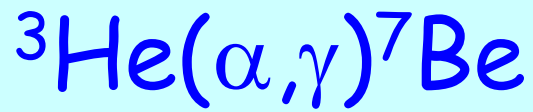
Maxwell
Boltzmann



Carlo Broggini, INFN-Padova



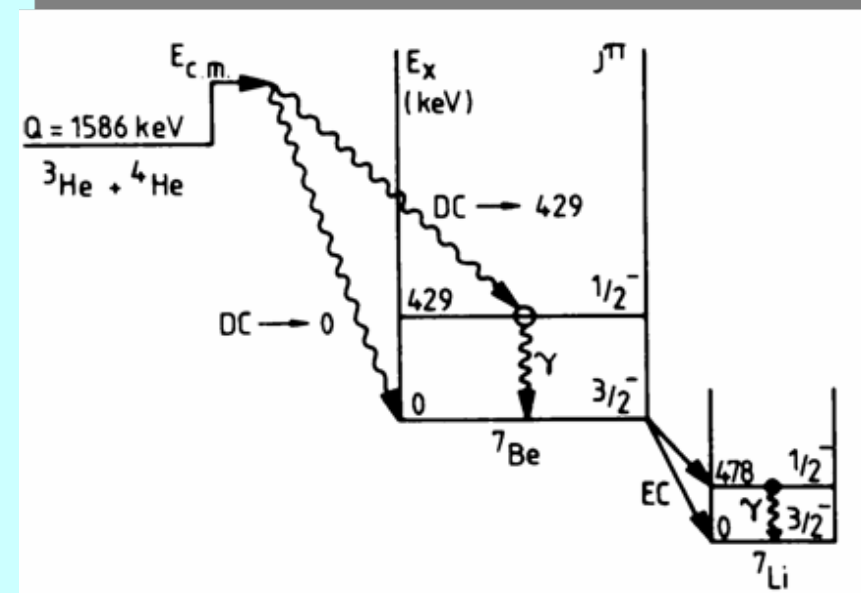




$Q = 1.6 \text{ MeV}$

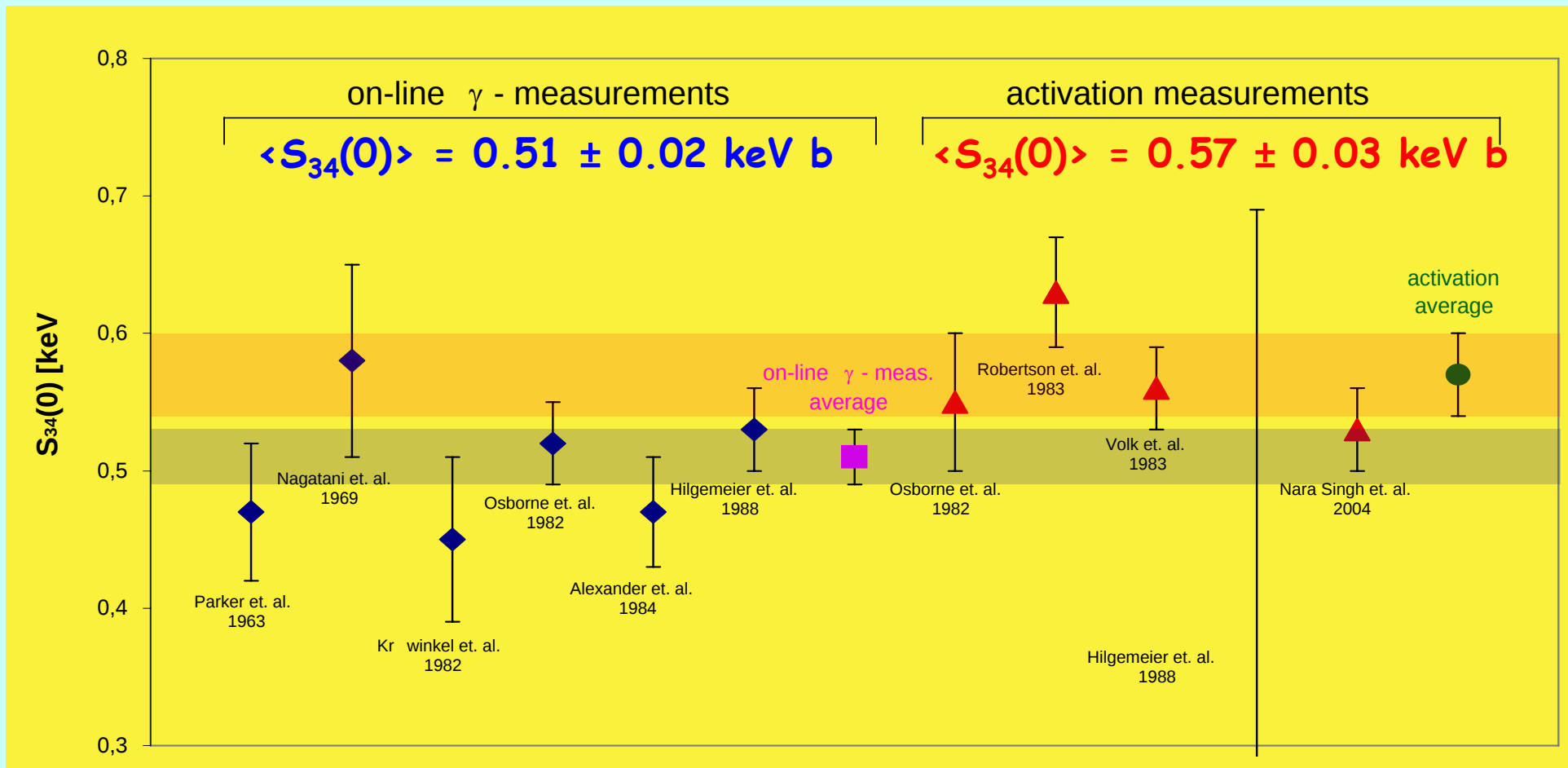
☀ Solar Neutrinos: ${}^7\text{Be}$, ${}^8\text{B}$

☀ BBN ${}^7\text{Li}$



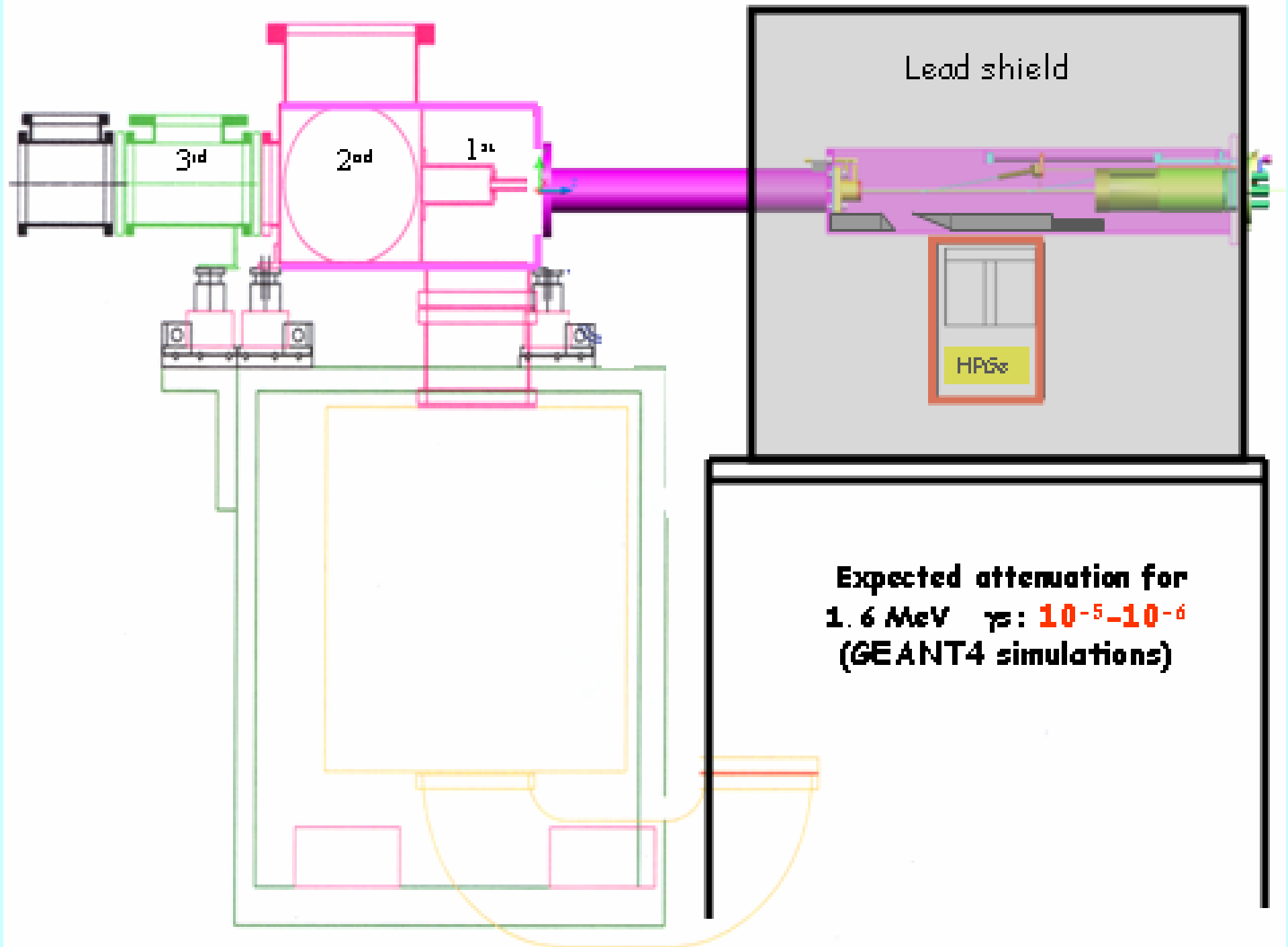
- Cross section from **prompt gamma** down to 90 keV (CM energy) using ${}^4\text{He}$ beam on ${}^3\text{He}$ target
- Activation via off-line **radioactive decay** measurements of the ${}^7\text{Be}$ atoms collected in the beam catcher
- All with a final error $< 5 \%$

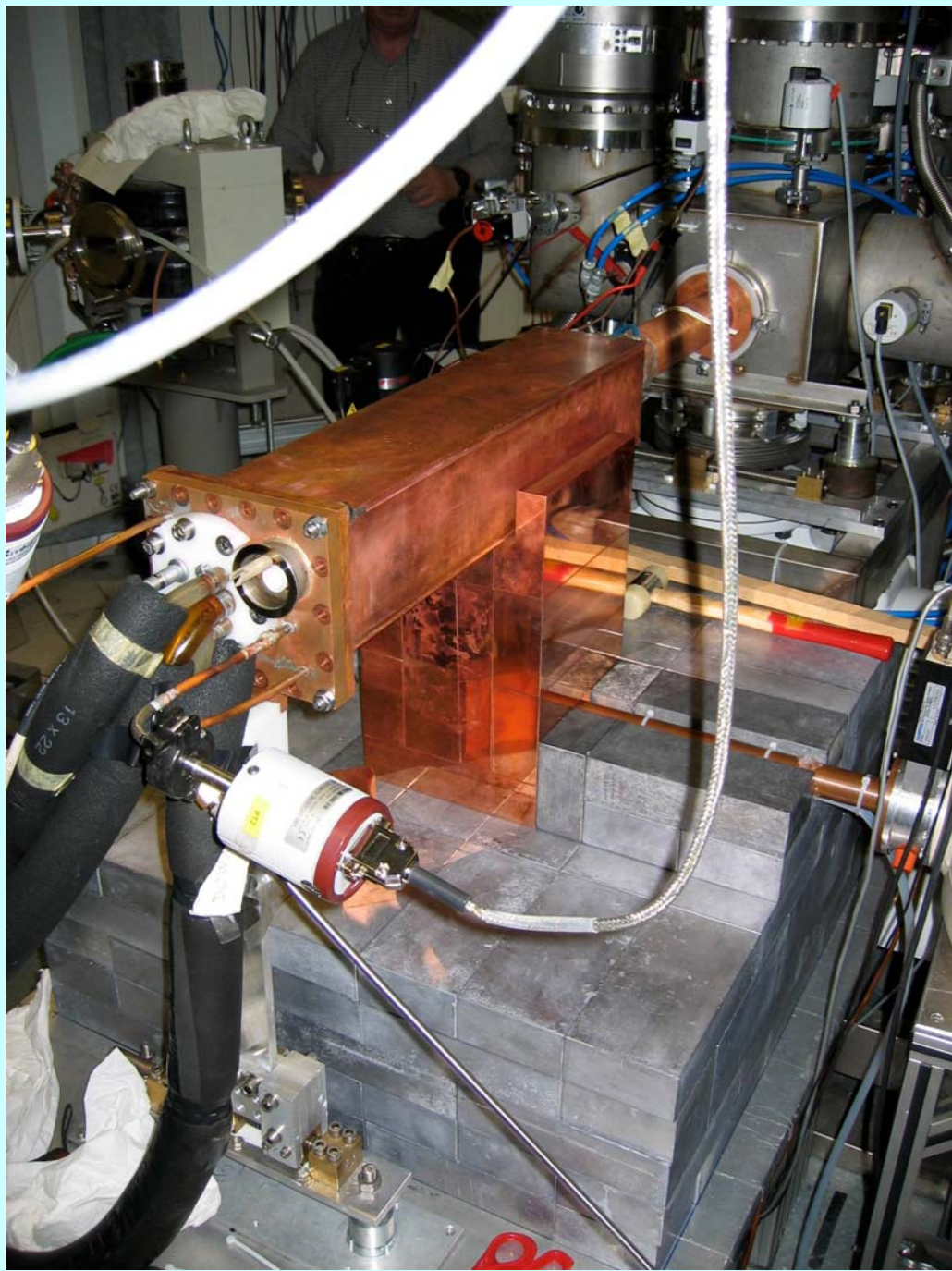
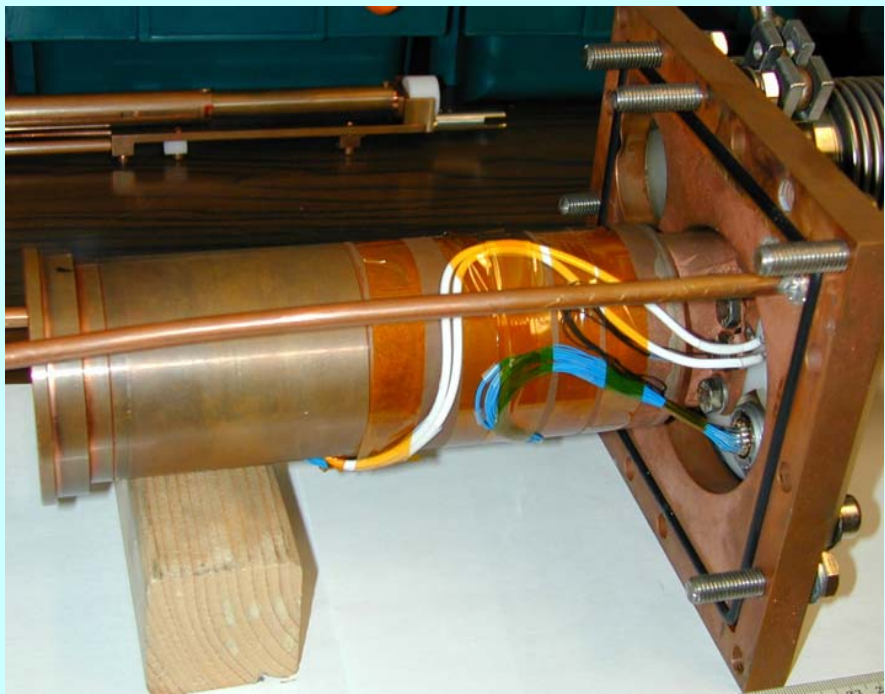
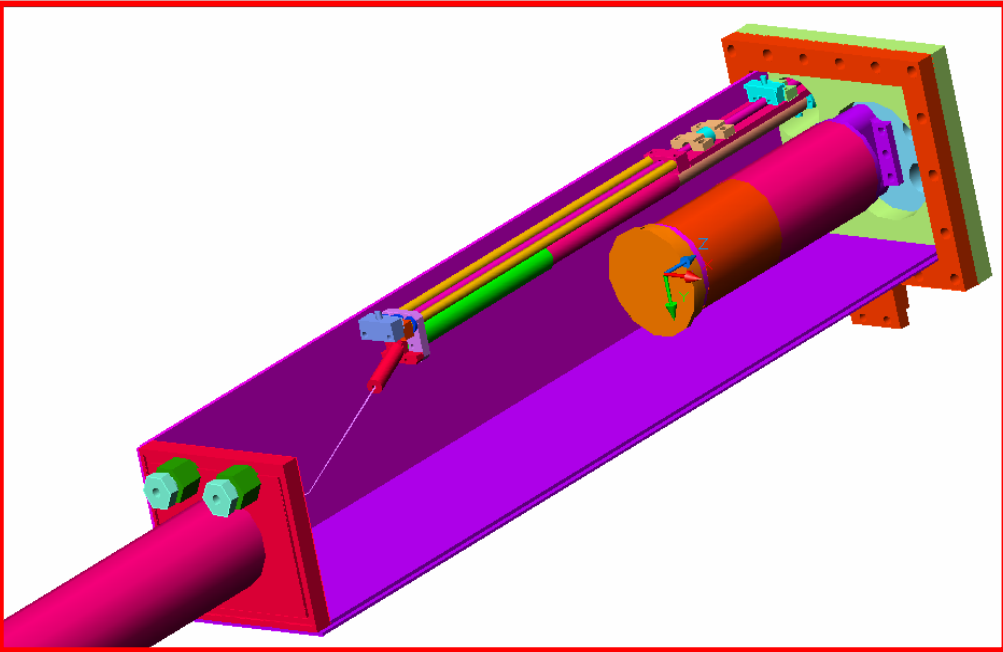
Summary of previous measurements



Recommended $S_{34}(0)$ values: $0.53 \pm 0.05 \text{ keV b}$ (9%) [Adelberger 98]
 $0.54 \pm 0.09 \text{ keV b}$ (16%) [NACRE 99]

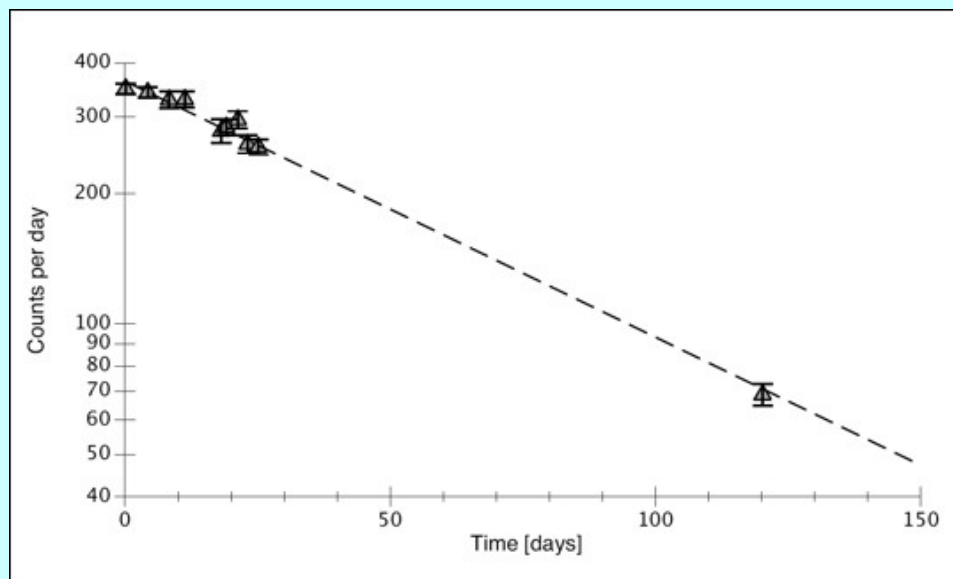
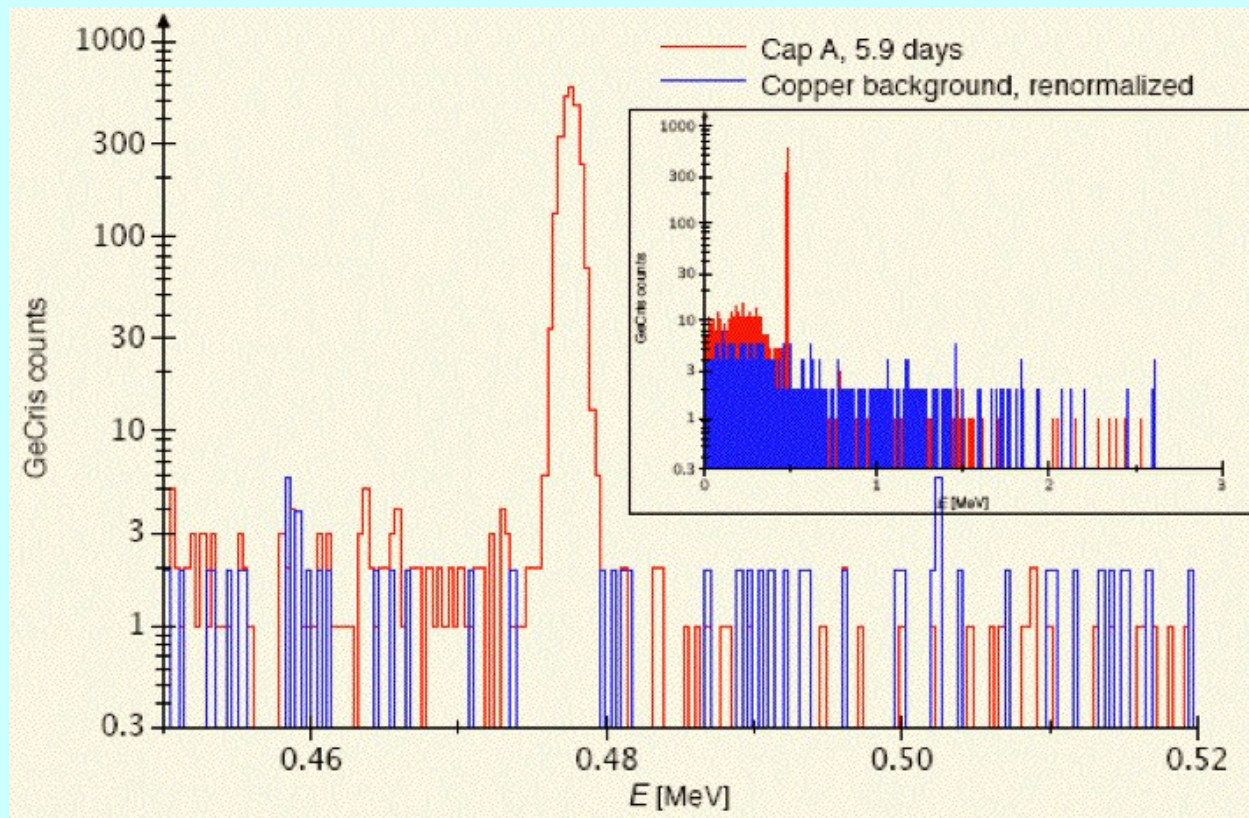
R-matrix analysis: $0.51 \pm 0.04 \text{ keV b}$ (8%) [Descouvemont 2004]



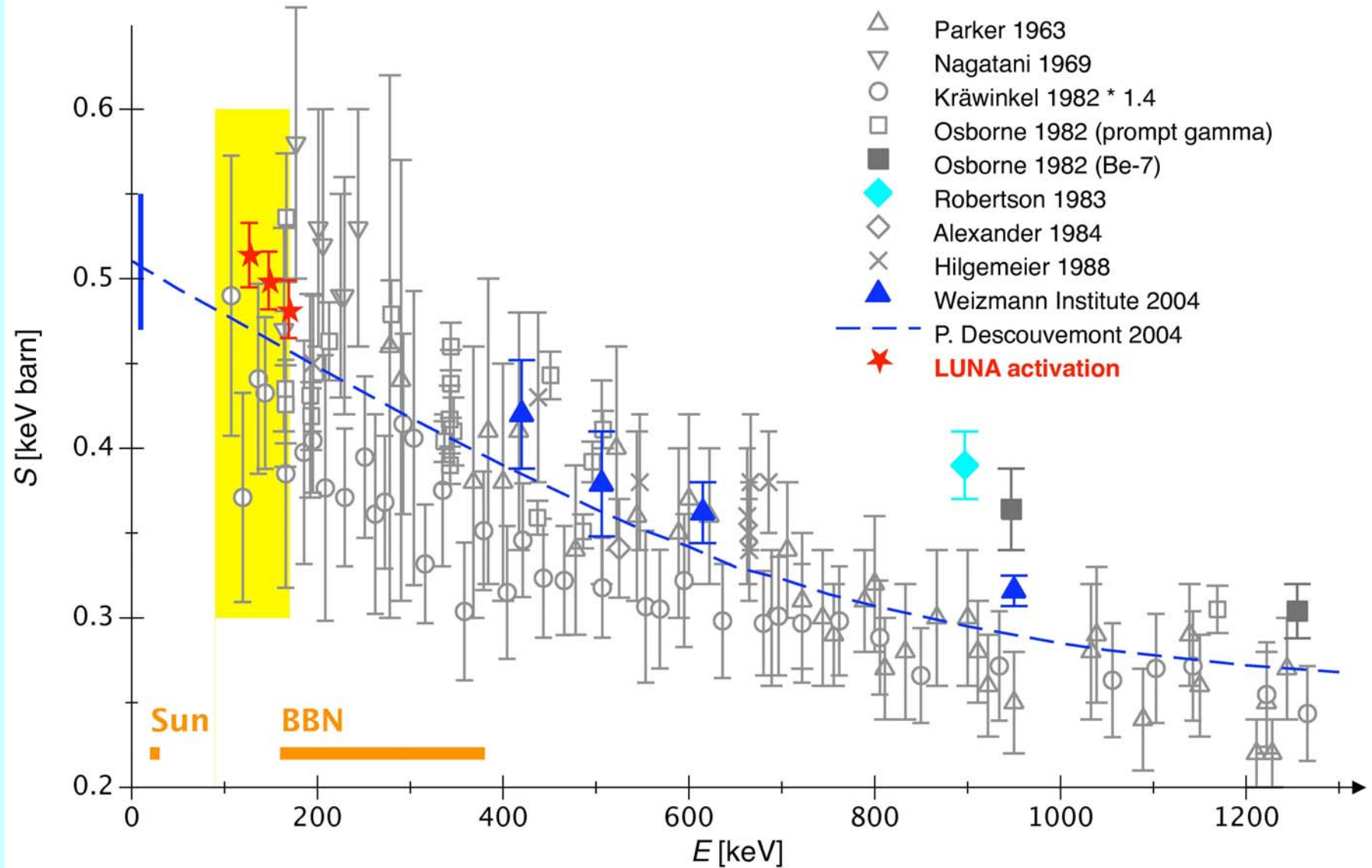


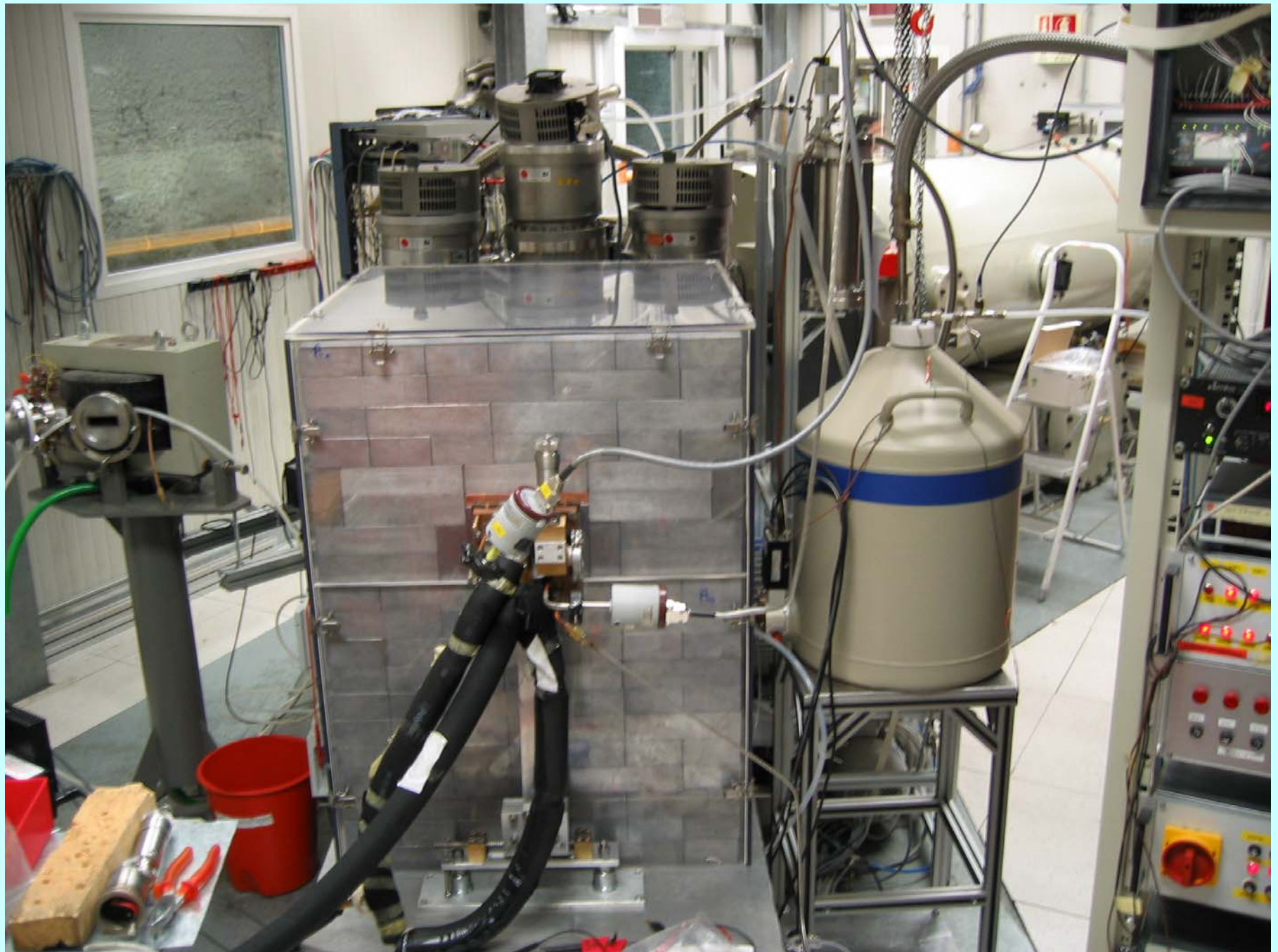
Activation measurement

- o ^4He beam @ 350 keV
- o $\langle I \rangle \sim 230 \mu\text{A}$
- o Recirculated ^3He @ 0.7 mbar

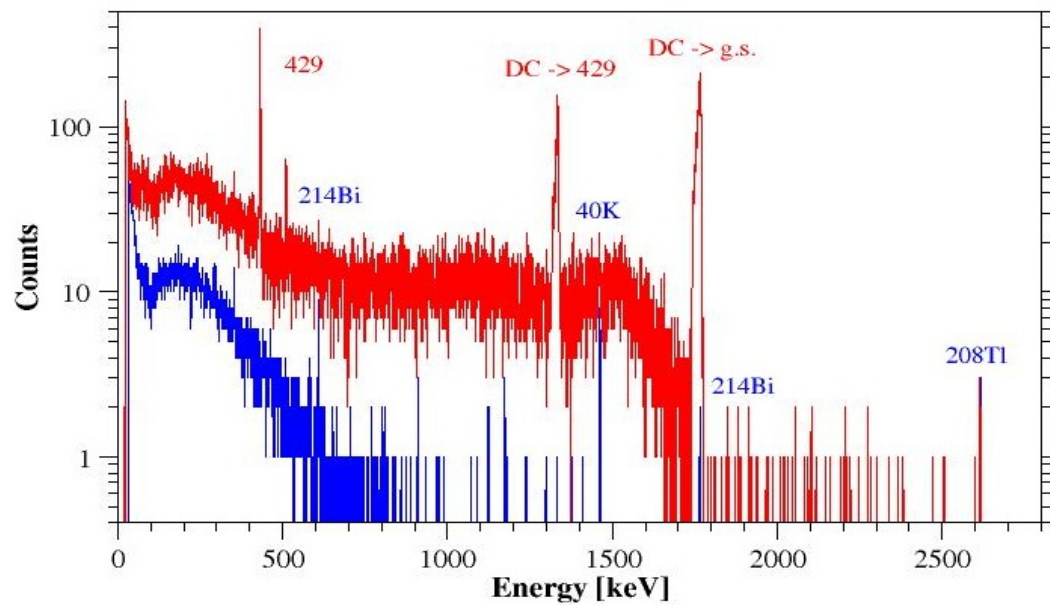


$$T_{1/2} = 52.2 \pm 1.5 \text{ d}$$

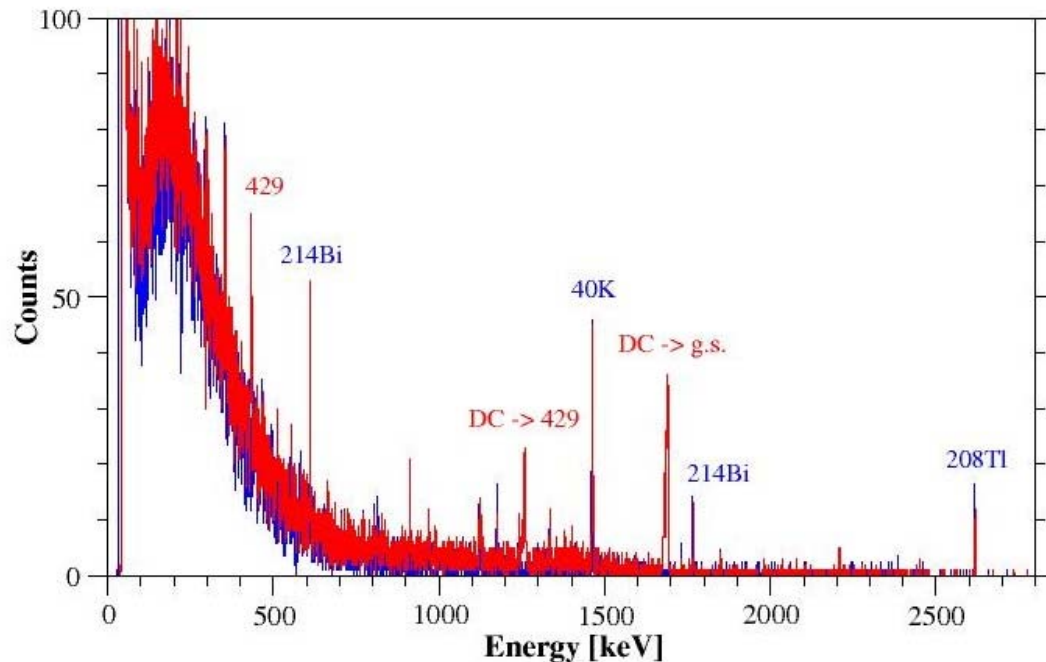




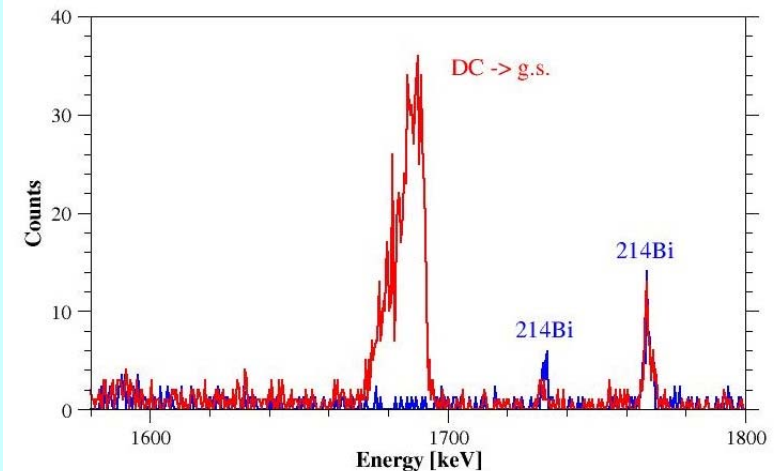
Prompt γ -spectra

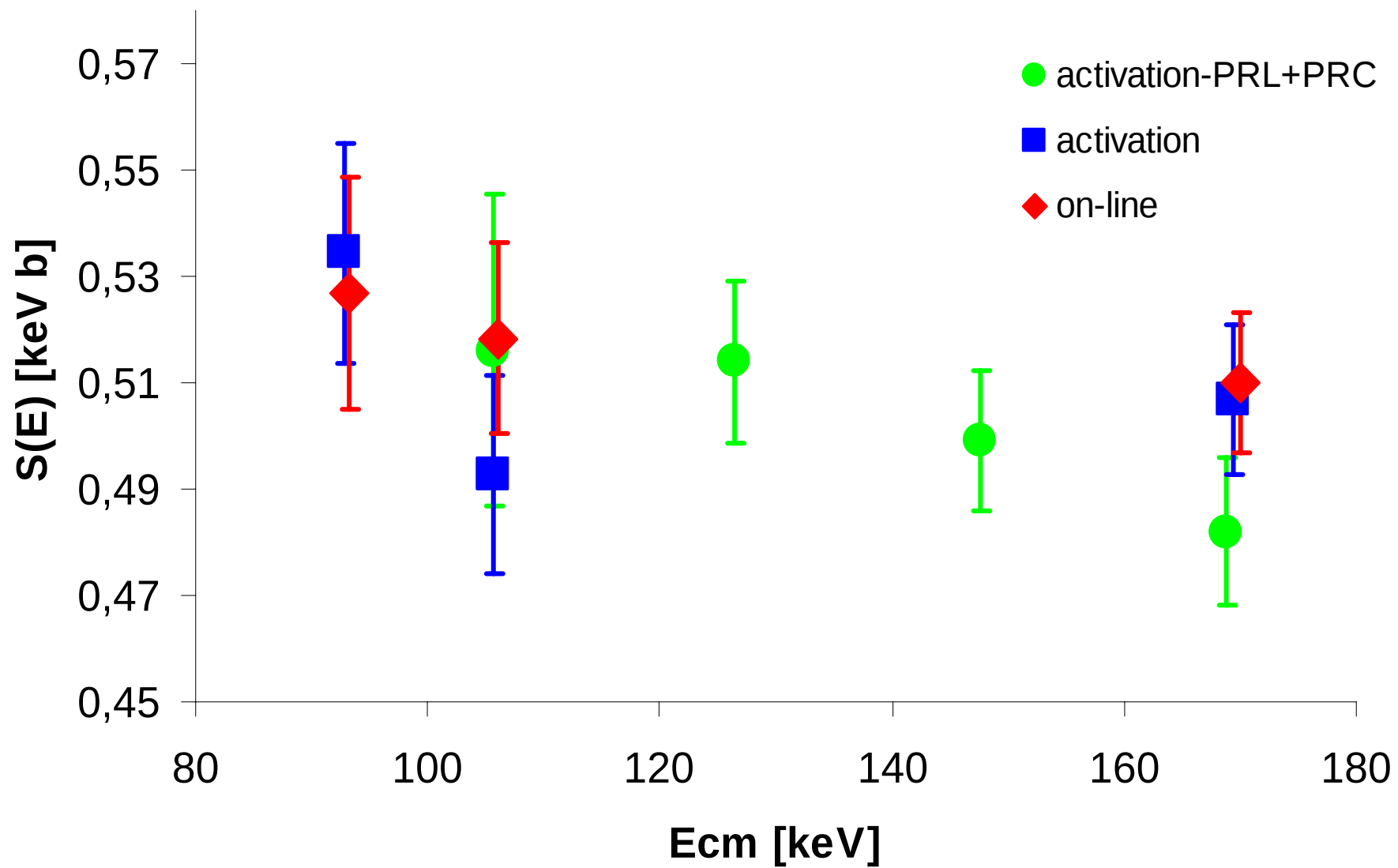


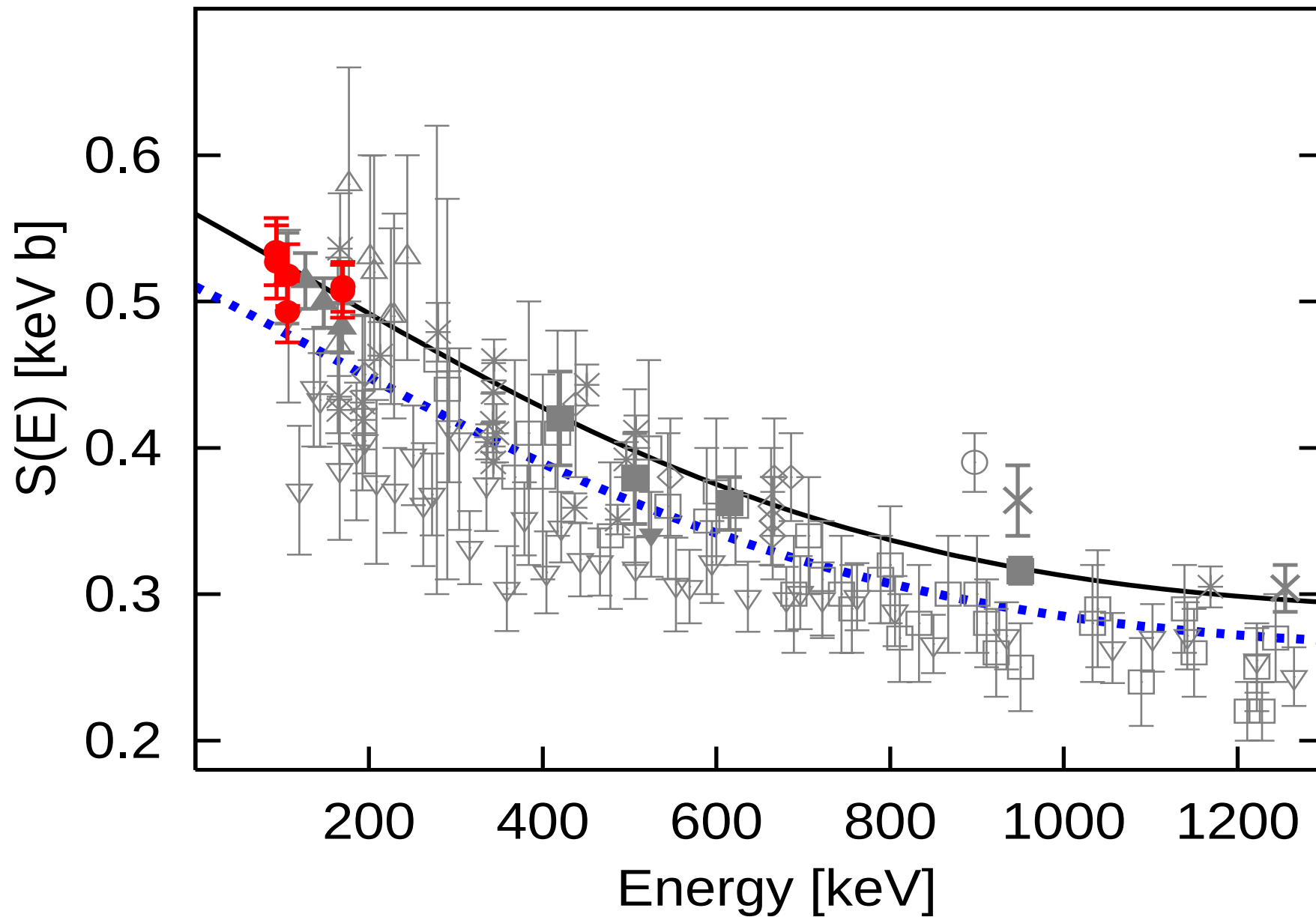
- o ^4He beam @ 400 keV
- o $\langle I \rangle \sim 300 \mu\text{A}$
- o Irradiation time: 4.4d



- o ^4He beam @ 220 keV
- o $\langle I \rangle \sim 240 \mu\text{A}$
- o Irradiation time: 24.4d







☀ σ of ${}^3\text{He}(\alpha, \gamma){}^7\text{Be}$ down to 93 keV
 ${}^7\text{Be} \approx \text{prompt } \gamma$

☀ $\Delta\Phi(v_B)$ reduced from 12% to 10%

$\Delta\Phi(v_{Be})$ reduced from 9.4% to 5.5%
(C. Pena Garay)

LUNA

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