Results of total and partial cross-section measurements of the $^{87}Rb(p,\gamma)^{88}Sr$ reaction

Svenja Wilden, Felix Heim, Martin Müller, Pina Wüstenberg, and Andreas Zilges

Institute for Nuclear Physics, University of Cologne, Germany

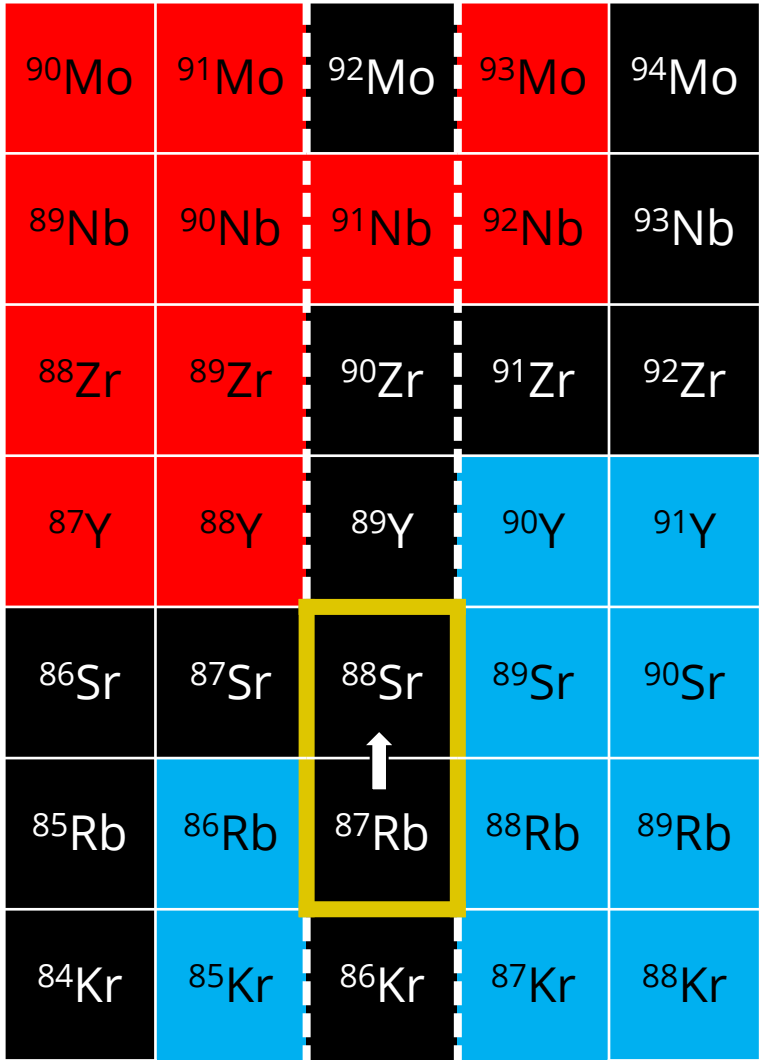
18th Russbach School on Nuclear Astrophysics

12. – 18.03.2023

Supported by the DFG (ZI 510/8-2), ChETEC-INFRA (101009324), Hans-Böckler-Stiftung, and the Bonn Cologne Graduate School of Physics and Astronomy

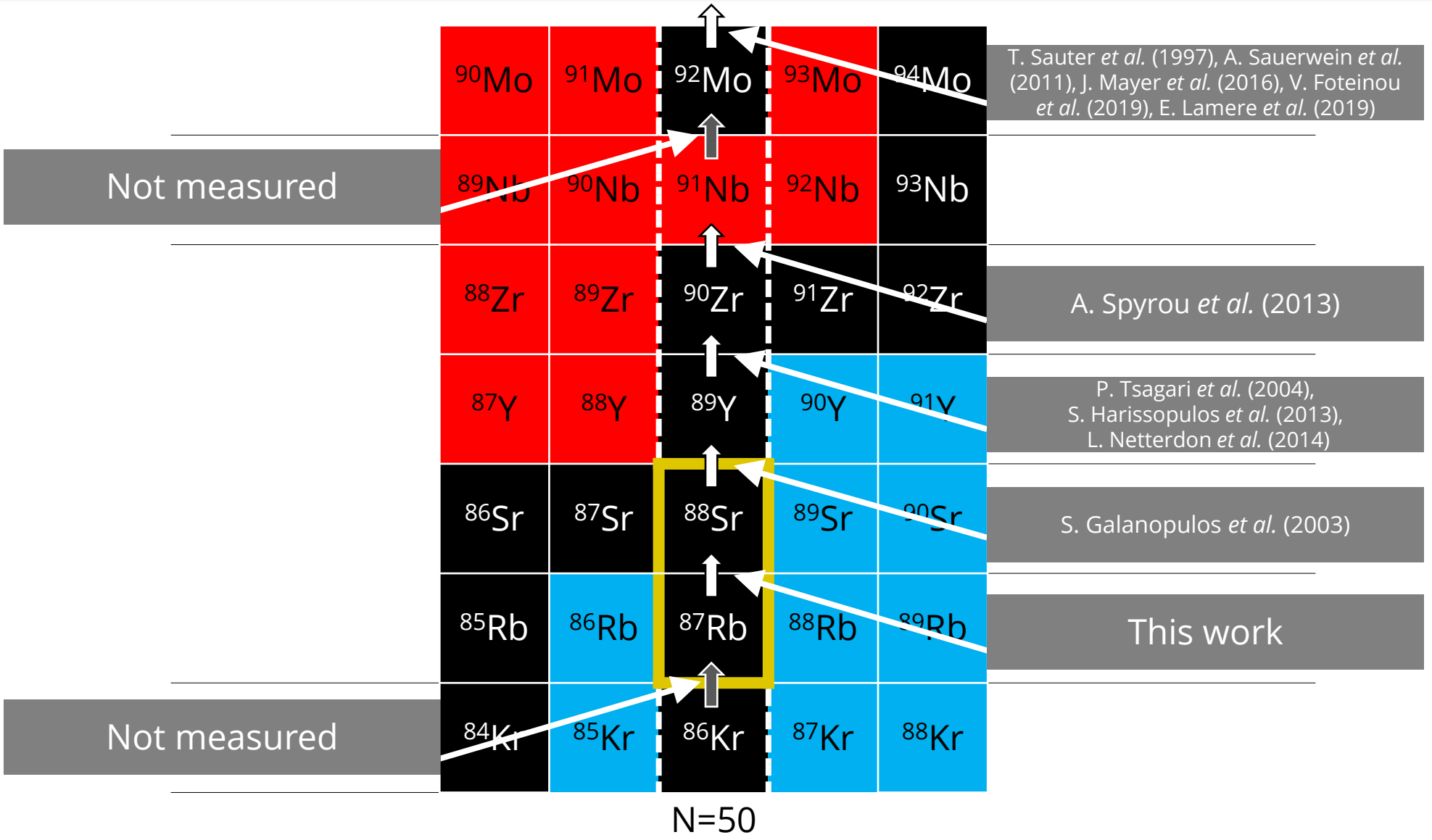
swilden@ikp.uni-koeln.de

Measured (p,γ) reactions at N=50

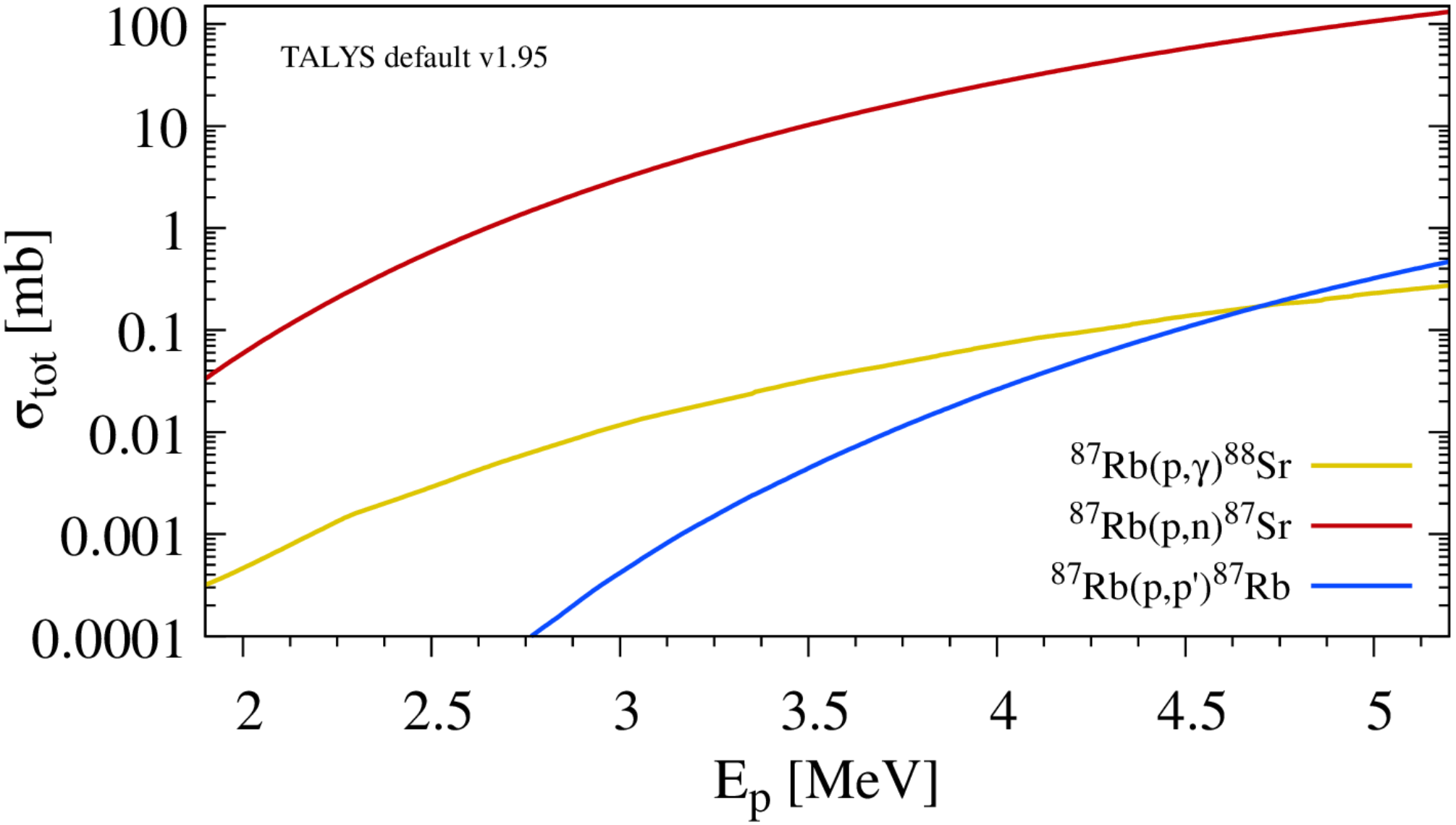


N=50

Measured (p,γ) reactions at N=50

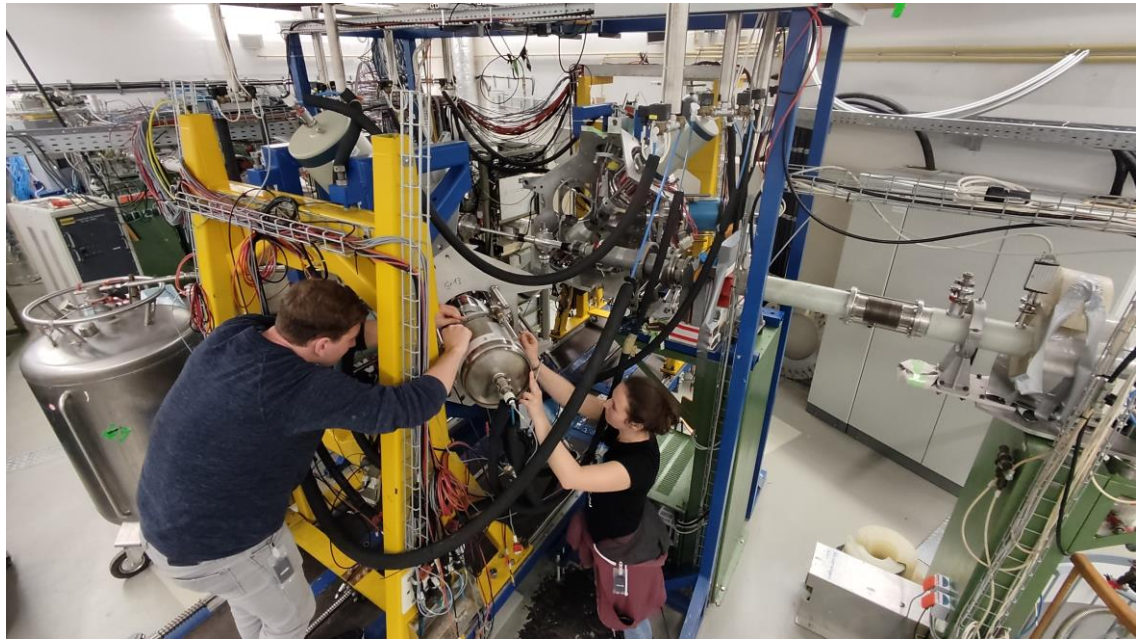


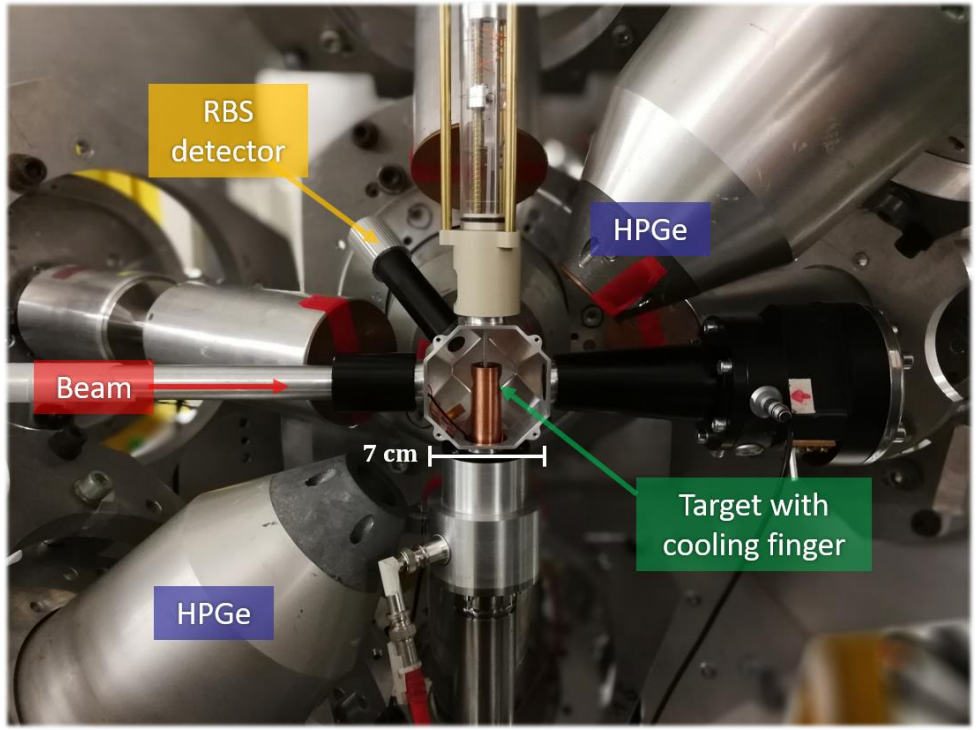
Calculated reaction-channel cross sections



Astrochamber@HORUS

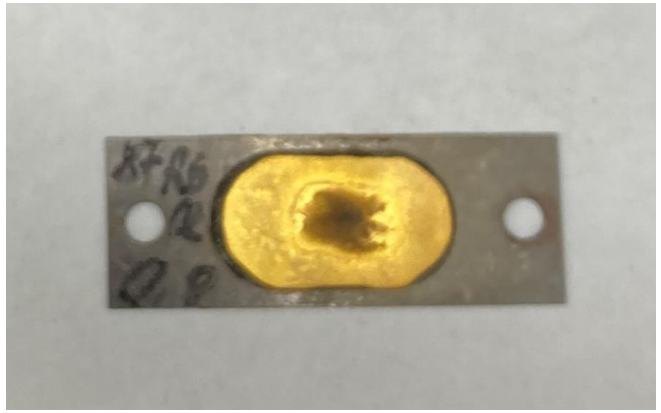
- 10 MV FN-Tandem accelerator providing proton beam
- HORUS consists of 14 HPGe (+RBS)
- Coverage of five different angles with respect to the beam axis
- γγ-coincidence possible





F. Heim *et al*. Nucl. Instr. Meth. A **966**, 163854 (2020)

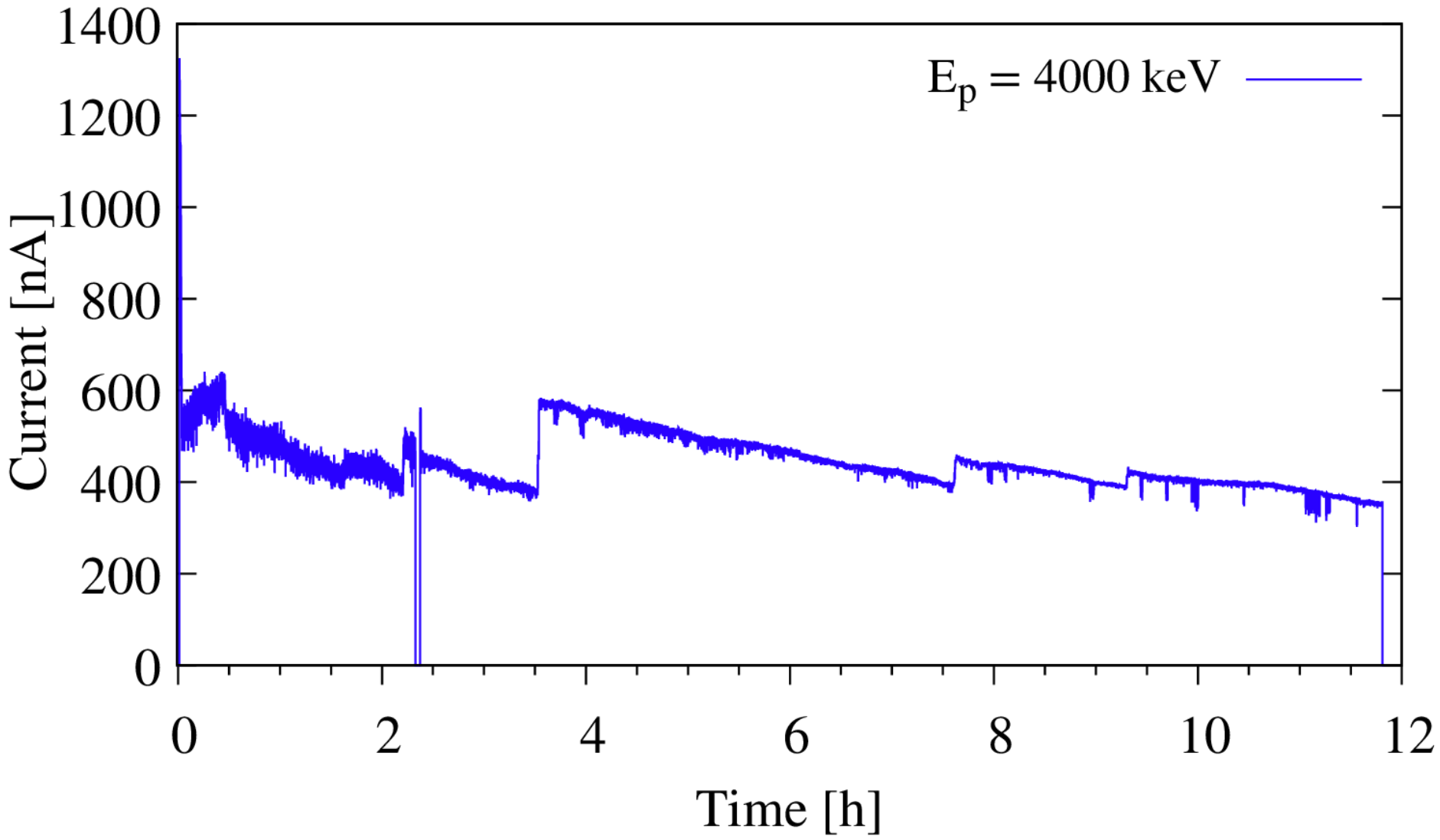
Experimental details



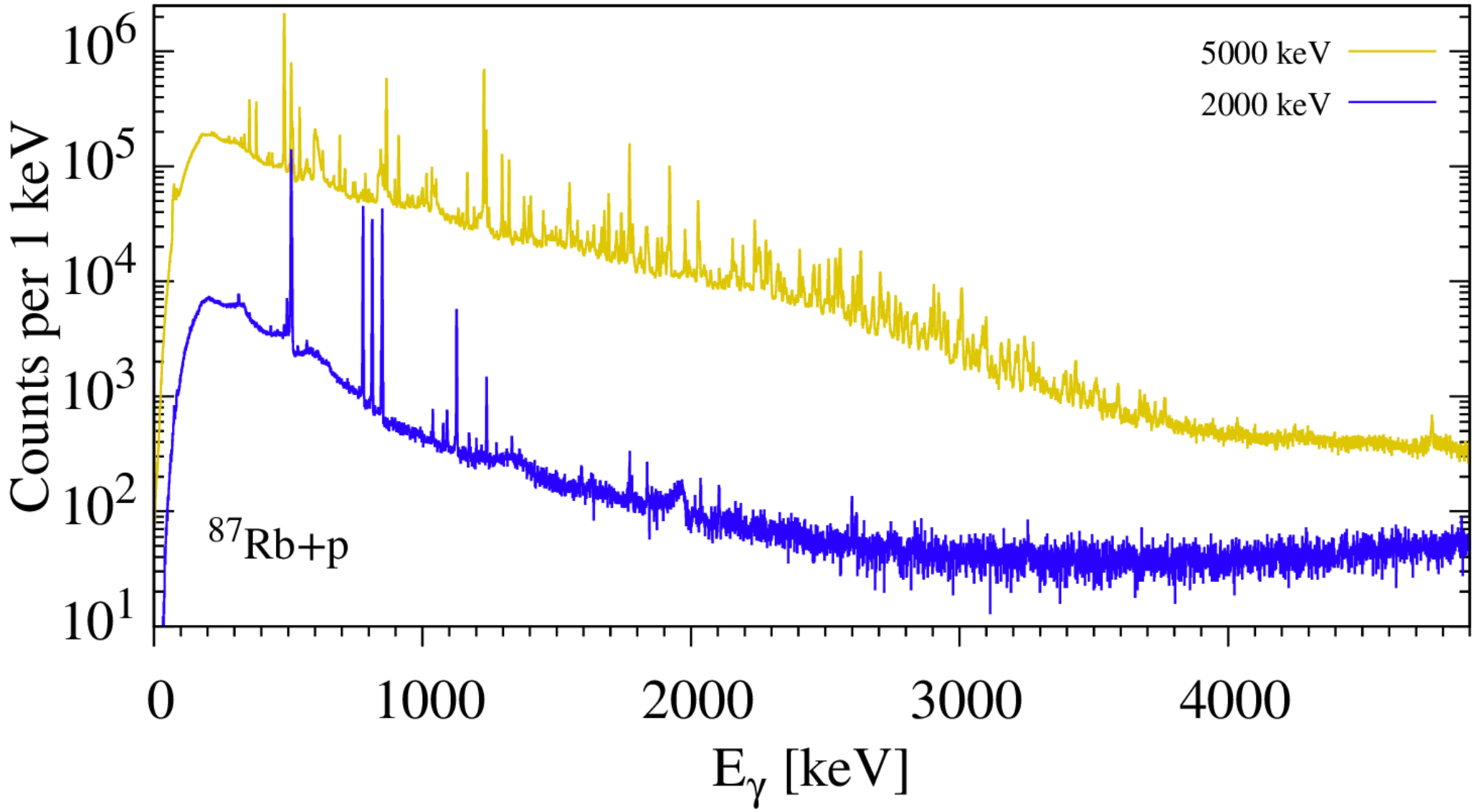
- Rb melting point of T_m = 39°C
- Rb_2CO_3 very hygroscopic
- Areal density $d = 0.52(6)\ \frac{mg}{cm^2}$

Energy [keV]	Current [nA]	Time [h]
2000	620	14.8
2800	610	20.3
3500	430	9.9
4000	360	11.8
4500	170	8.2
5000	140	15.6

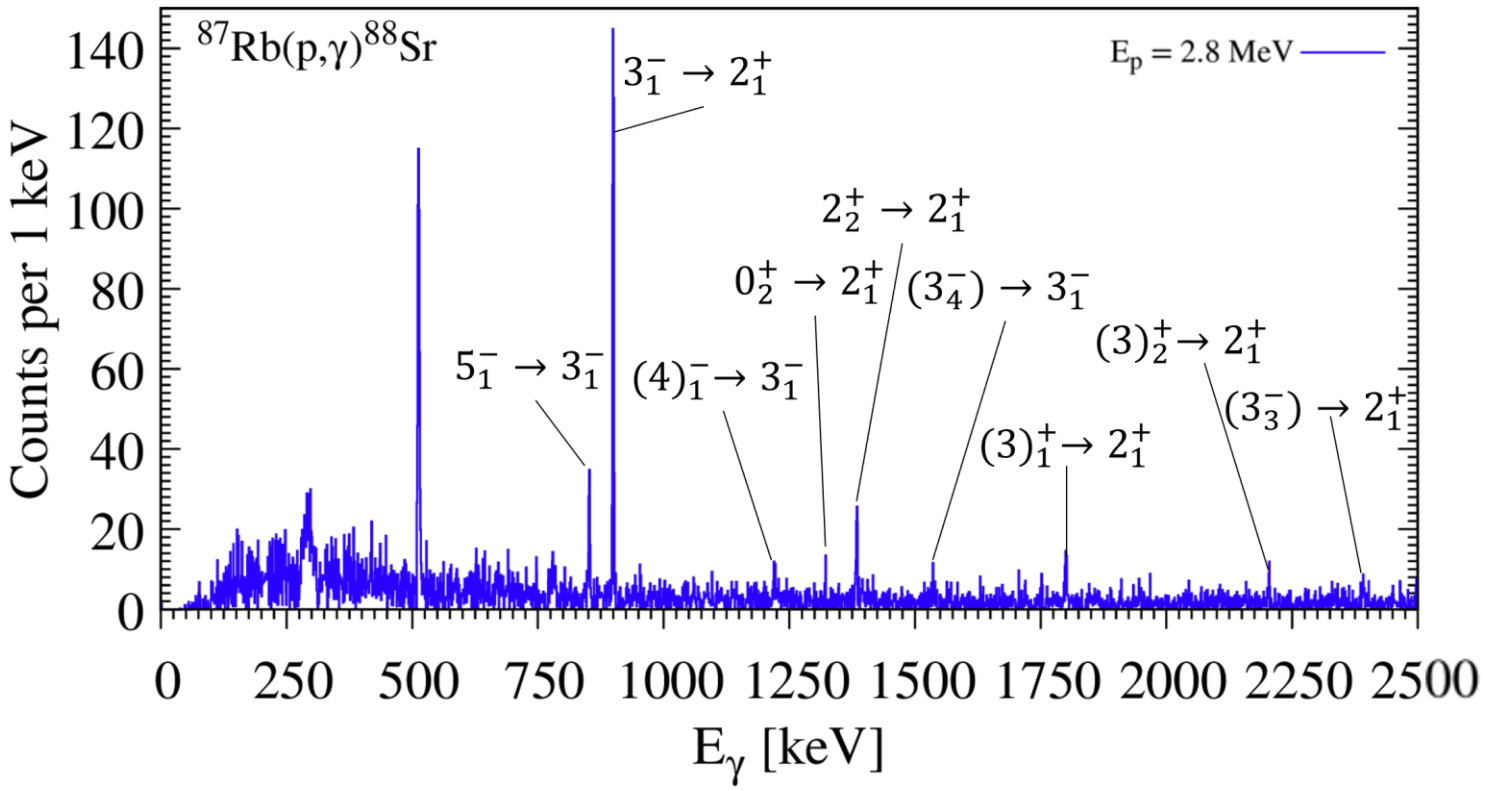
Proton beam current at E_p = 4000 keV

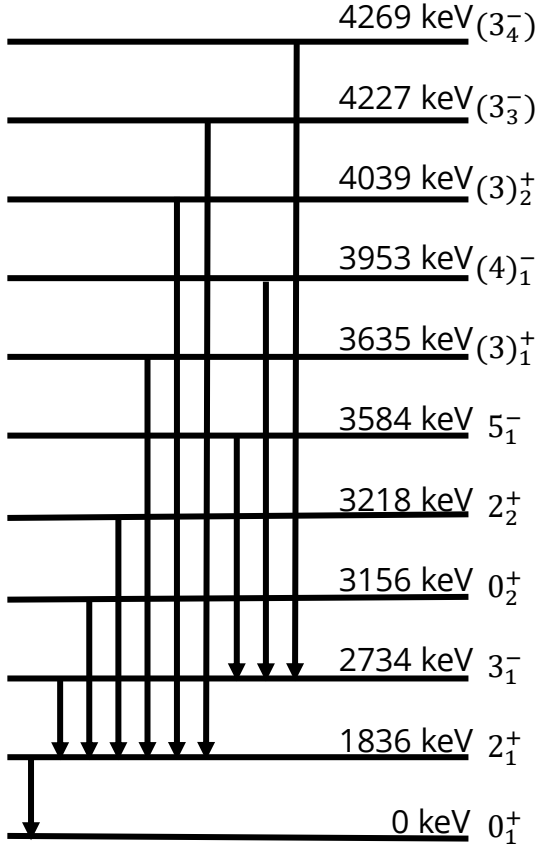


γ-ray energy spectra



Gate on the $2_1^+ \rightarrow 0_1^+$ transition

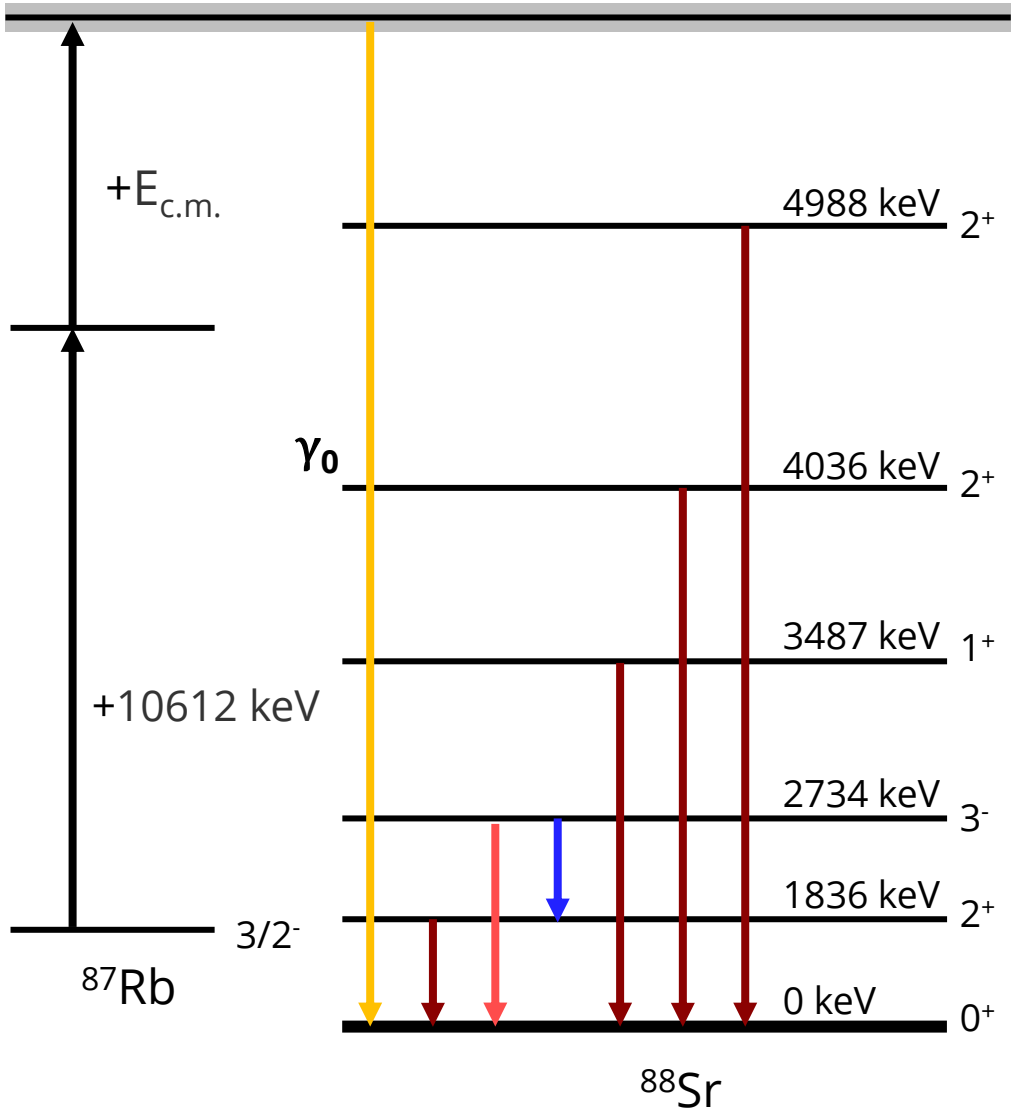




Nucl. Data Sheets 115 (2014) 135.

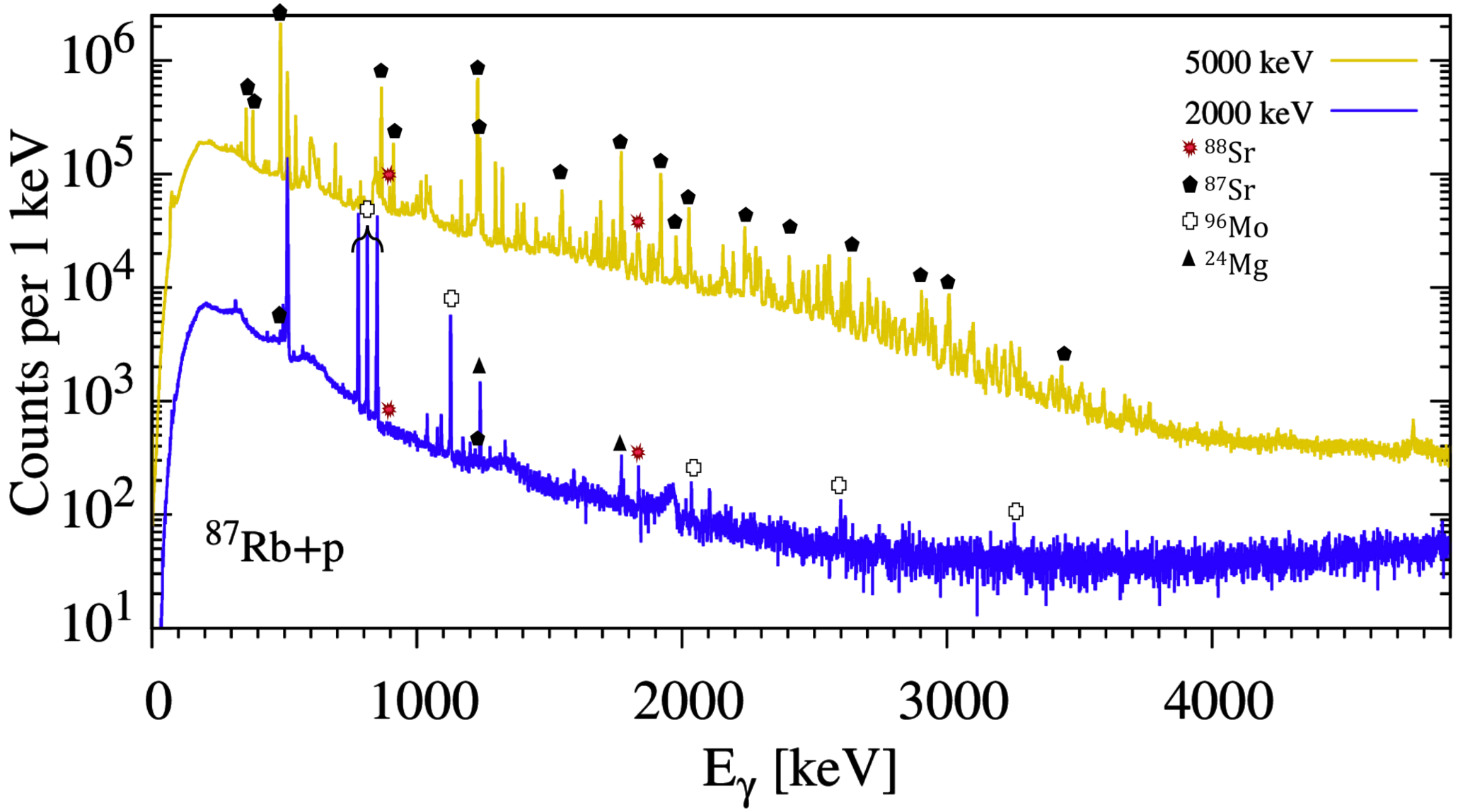
Ground-state transitions

E_x in keV	E_γ in keV
γ_0	γ_0
4988	4988
4036	4036
3487	3487
2734	898
1836	1836

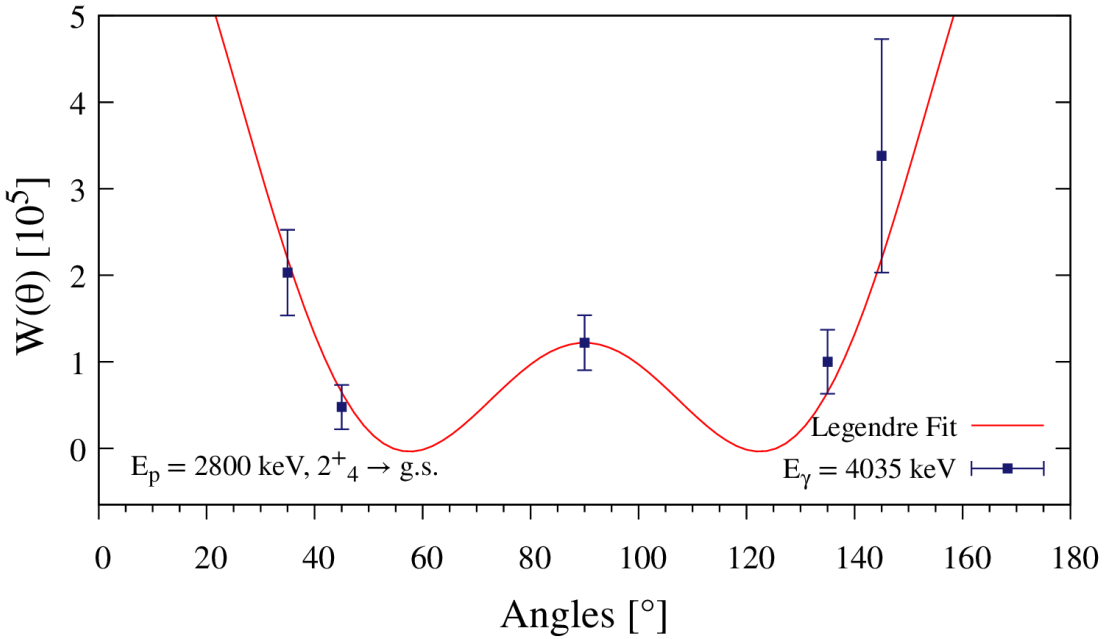


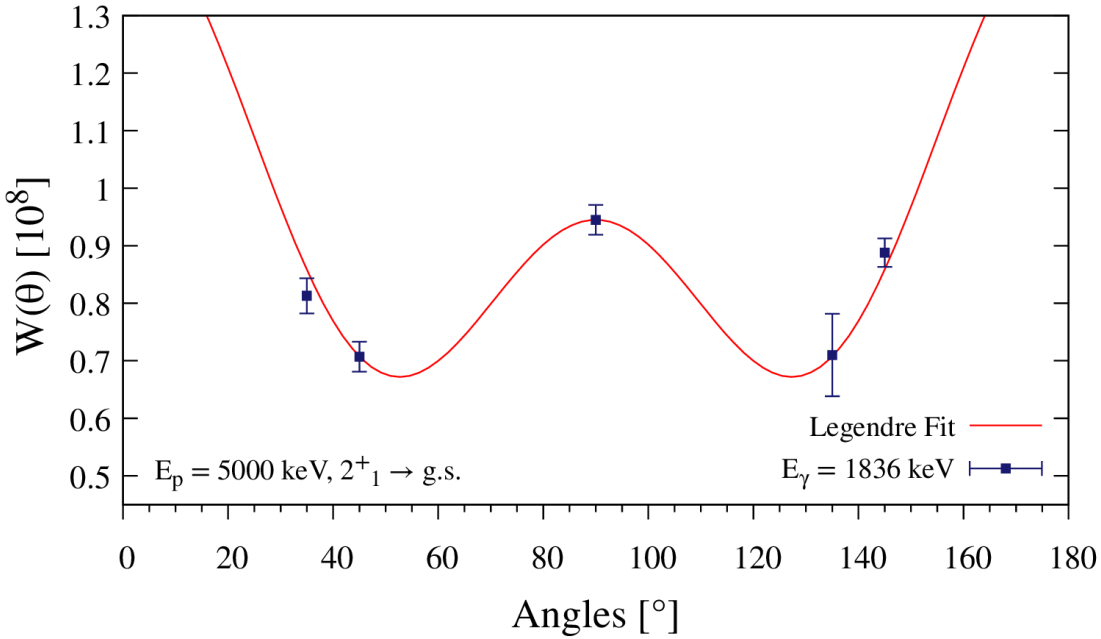
Nucl. Data Sheets 115 (2014) 135.

γ-ray energy spectra



Angular distributions





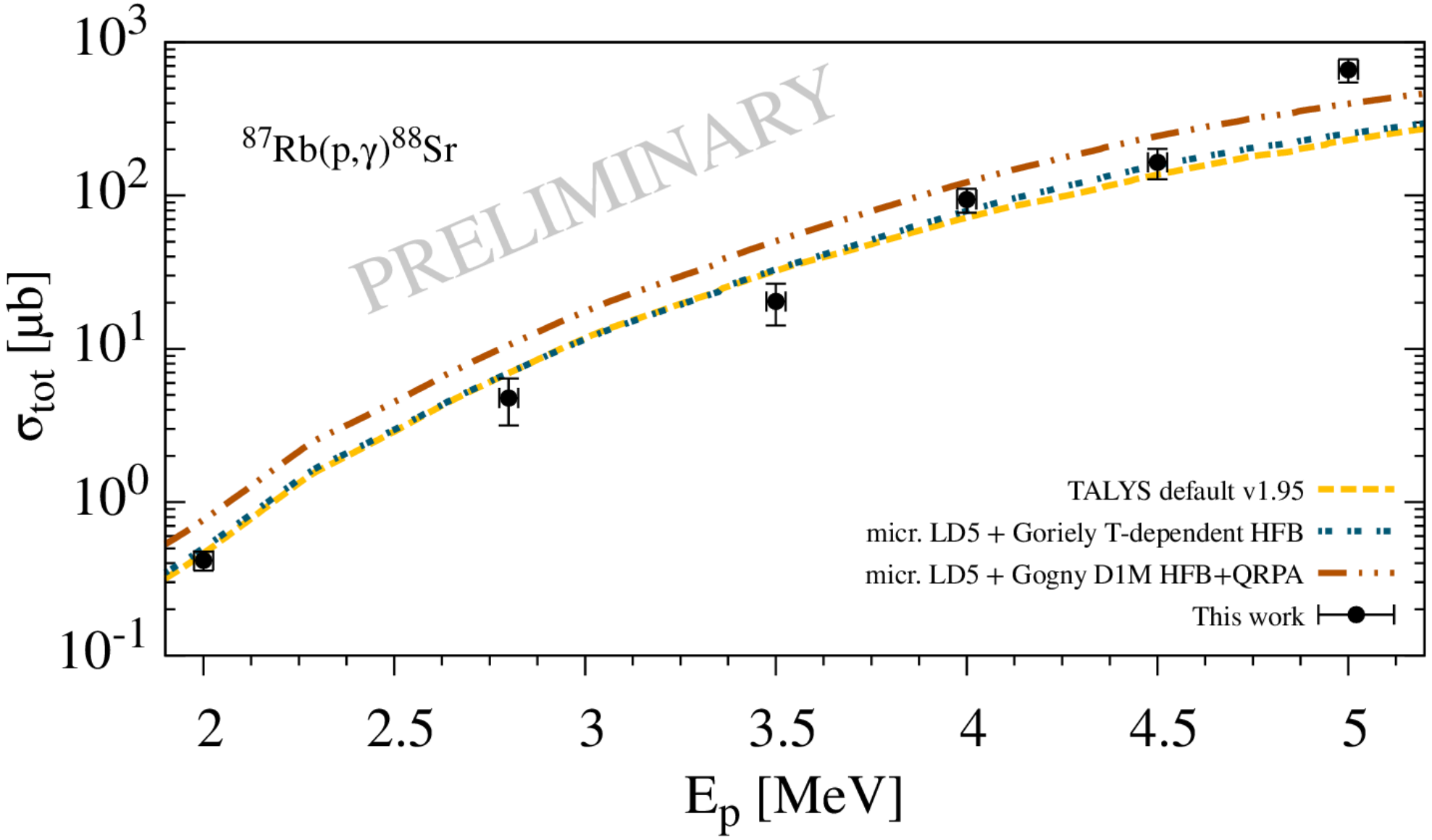
- Experimental yield measured at 5 different angles
- Fitting Legendre polynomials to data

$$W(\theta) = A_0 \cdot (1 + \alpha_2 P_2(\cos\theta) + \alpha_4 P_4(\cos\theta))$$

- Total cross section: $\sigma_{(p,\gamma)} = \frac{\sum_i A_{0,i}}{N_t\, N_p}$

N_t: number of target nuclei
N_p: number of impinging protons

(p,γ) total cross-section measurement



Summary and outlook

- Promising analysis of first $^{87}Rb(p,\gamma)^{88}Sr$ experiment
- Pending
  - Analysis of partial cross-sections
  - $^{87}Rb(p,n)^{87}Sr$
  - N=50 isotonic chain: ^{86}Kr and ^{91}Nb measurement
  - Analysis $^{85}Rb(p,\gamma)^{86}Sr$