

Ramsauer–Townsend effect in solid hydrogen: Final Results

Françoise Mulhauser

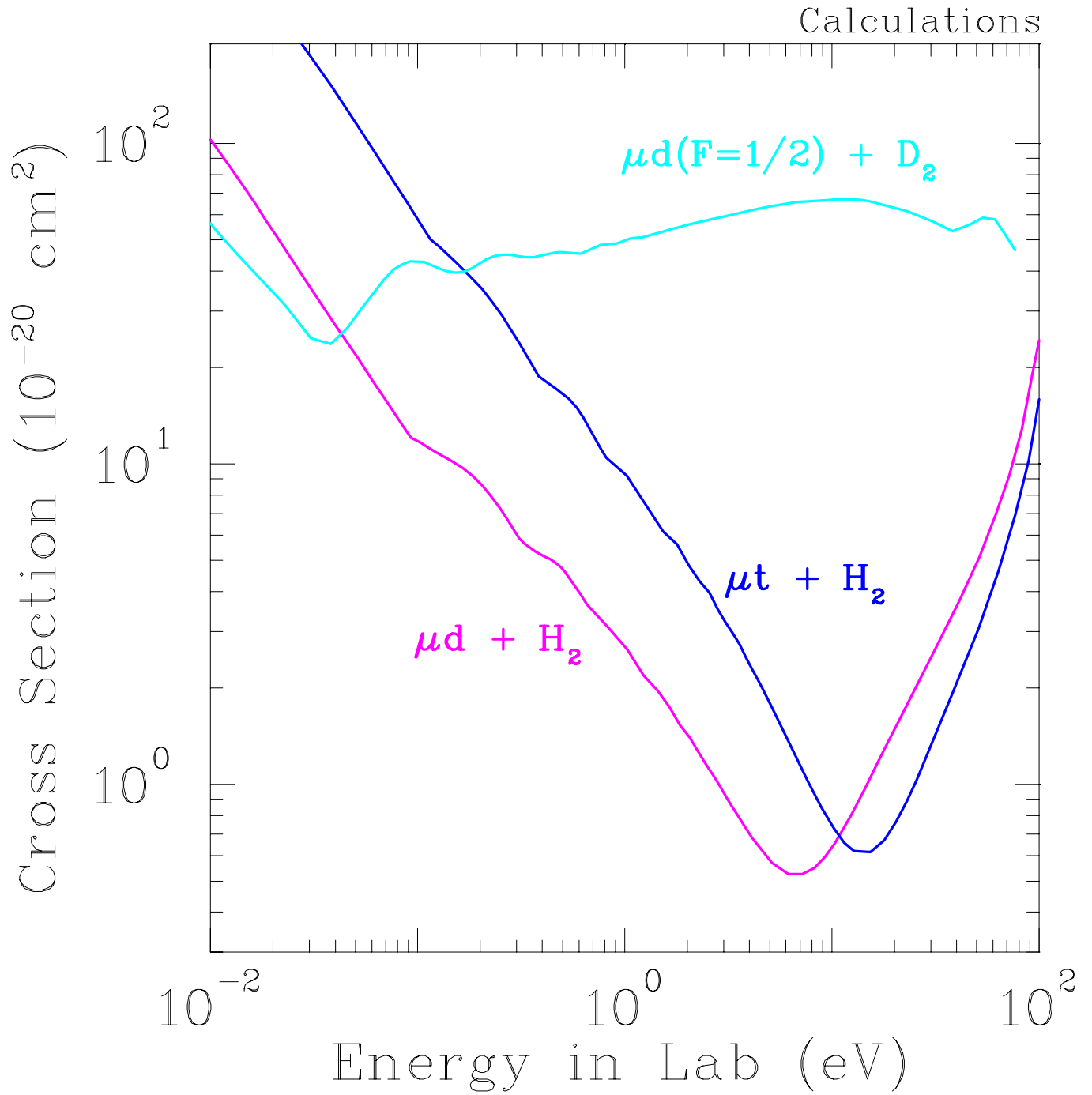
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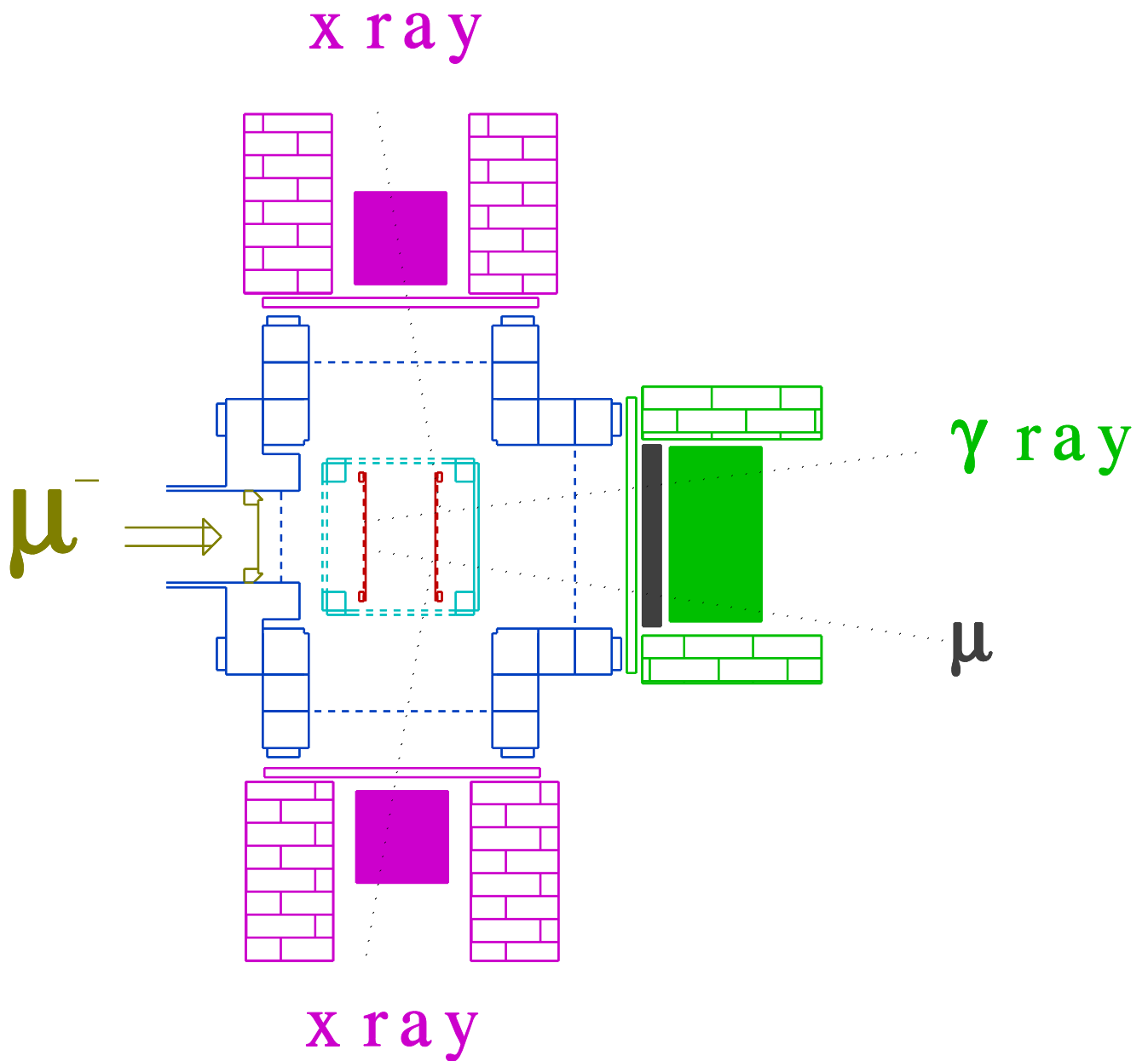
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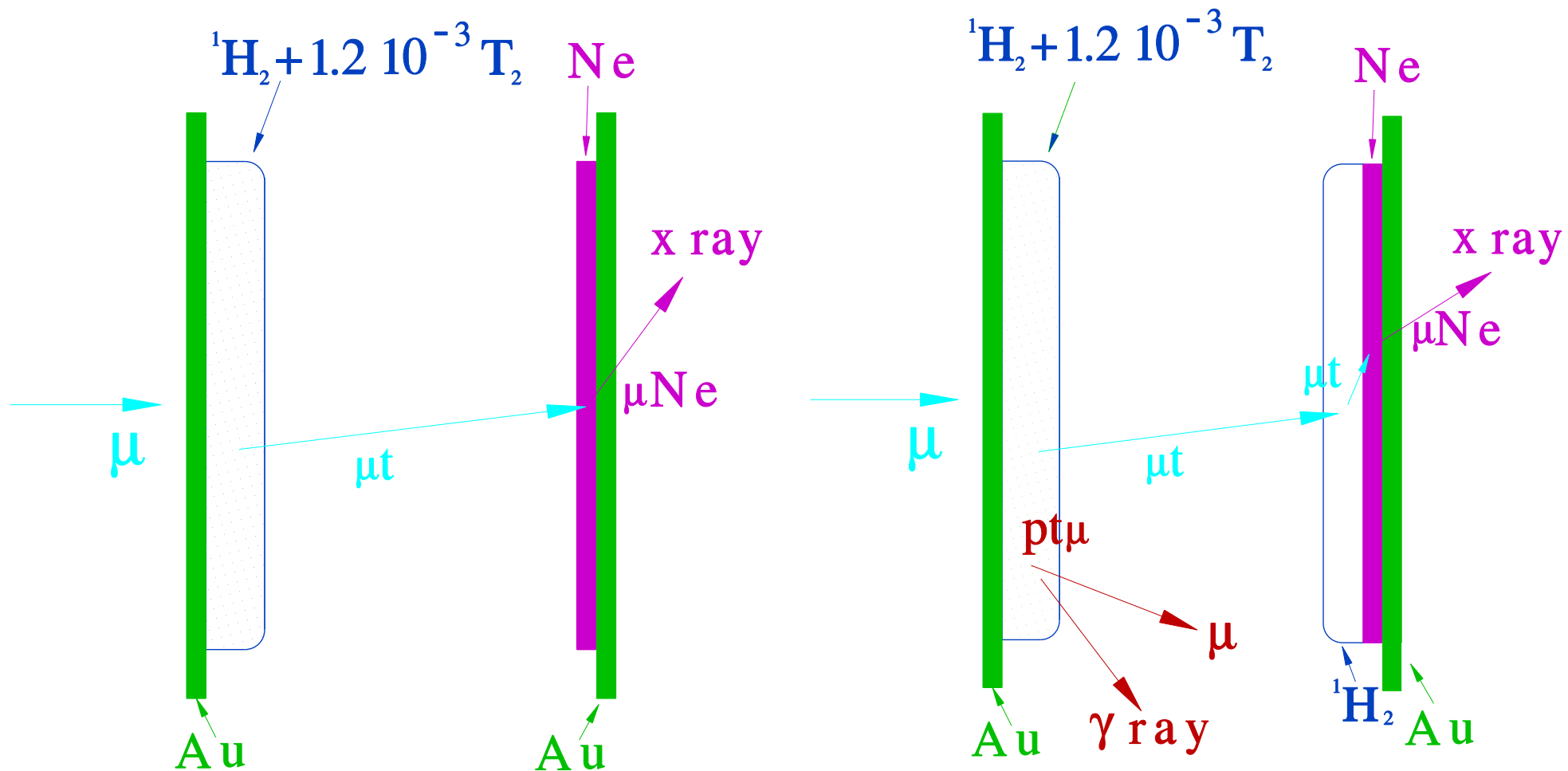
Scattering Cross Sections



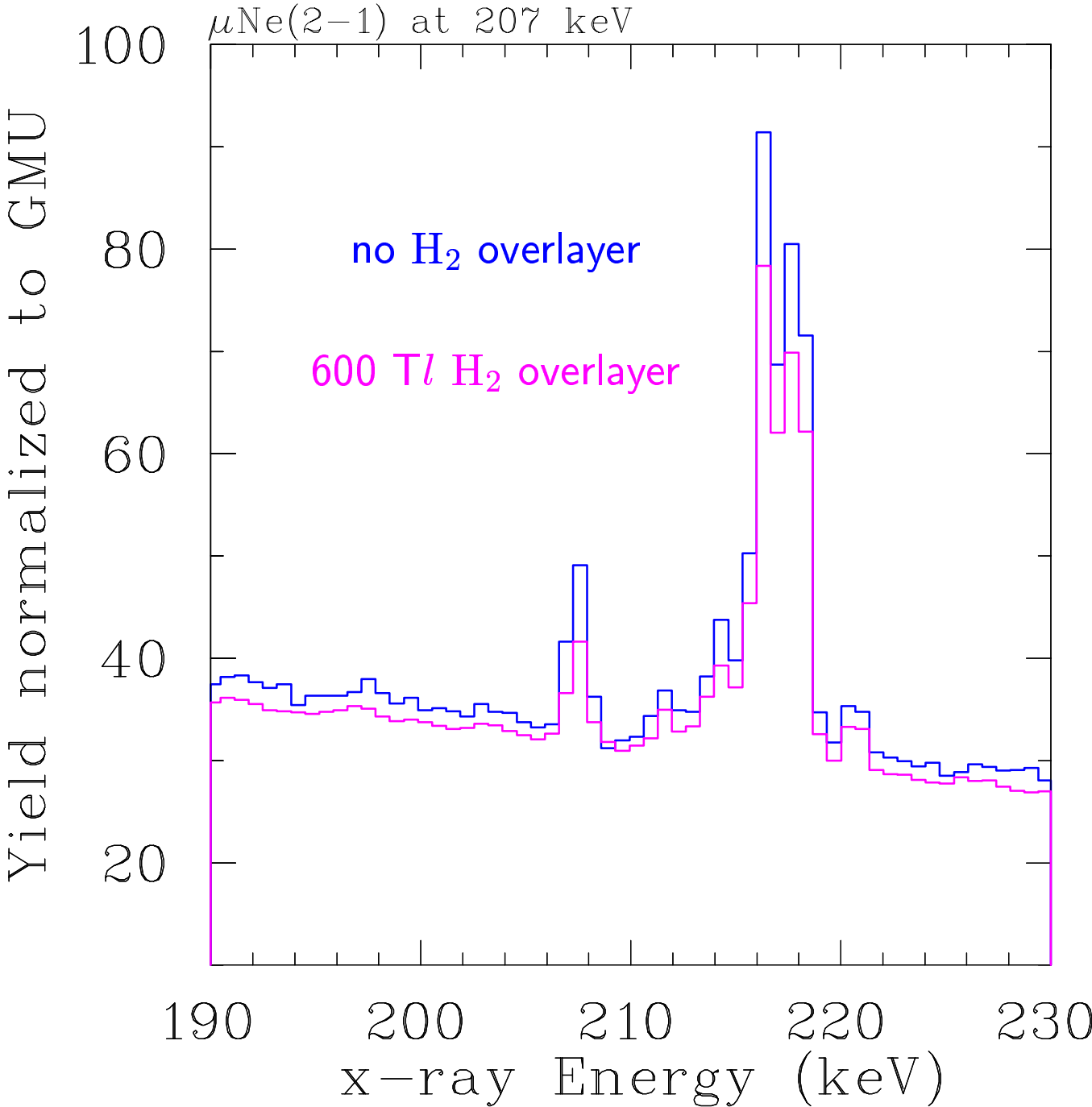
Experimental Setup



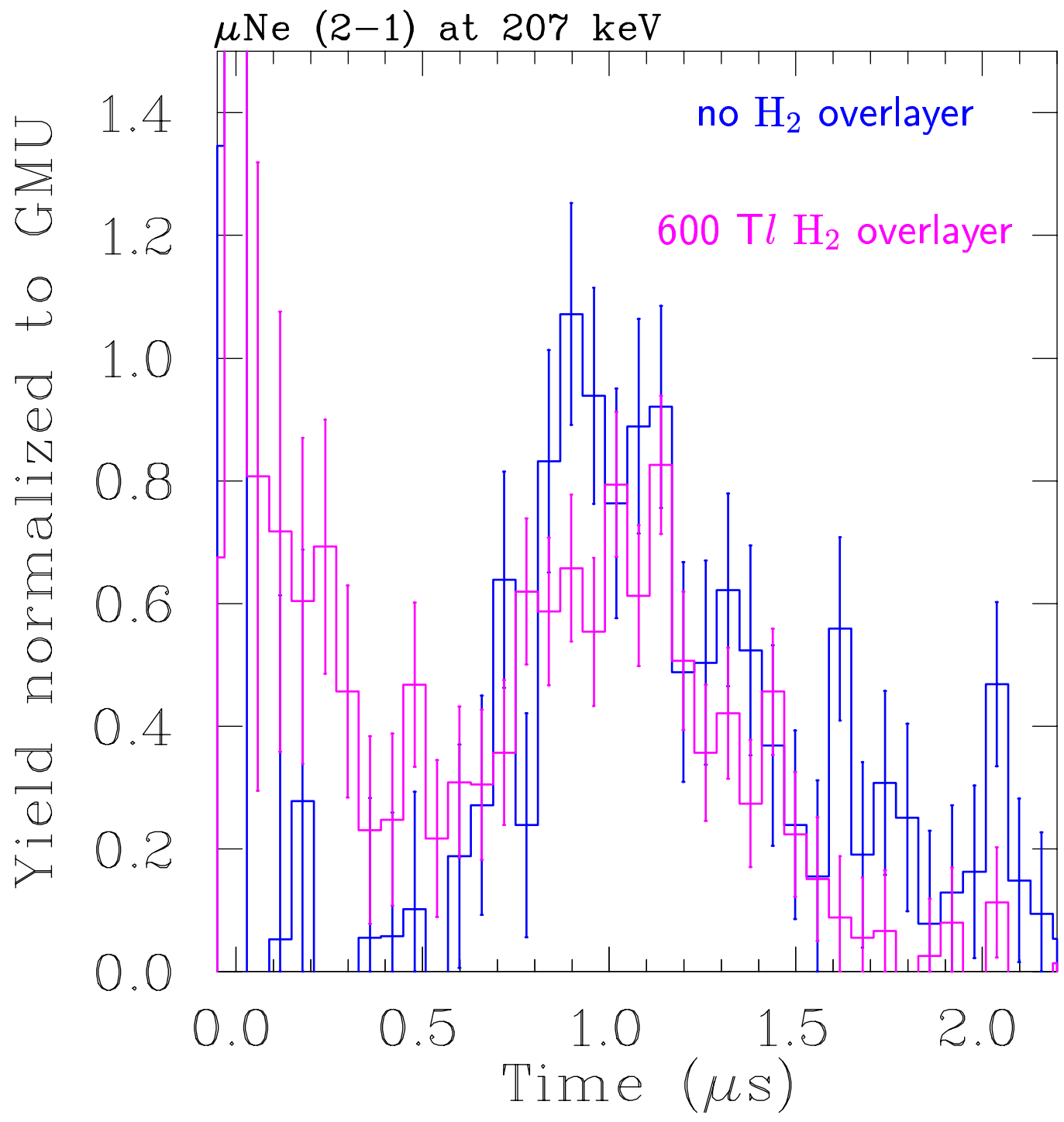
Tritium Experiment



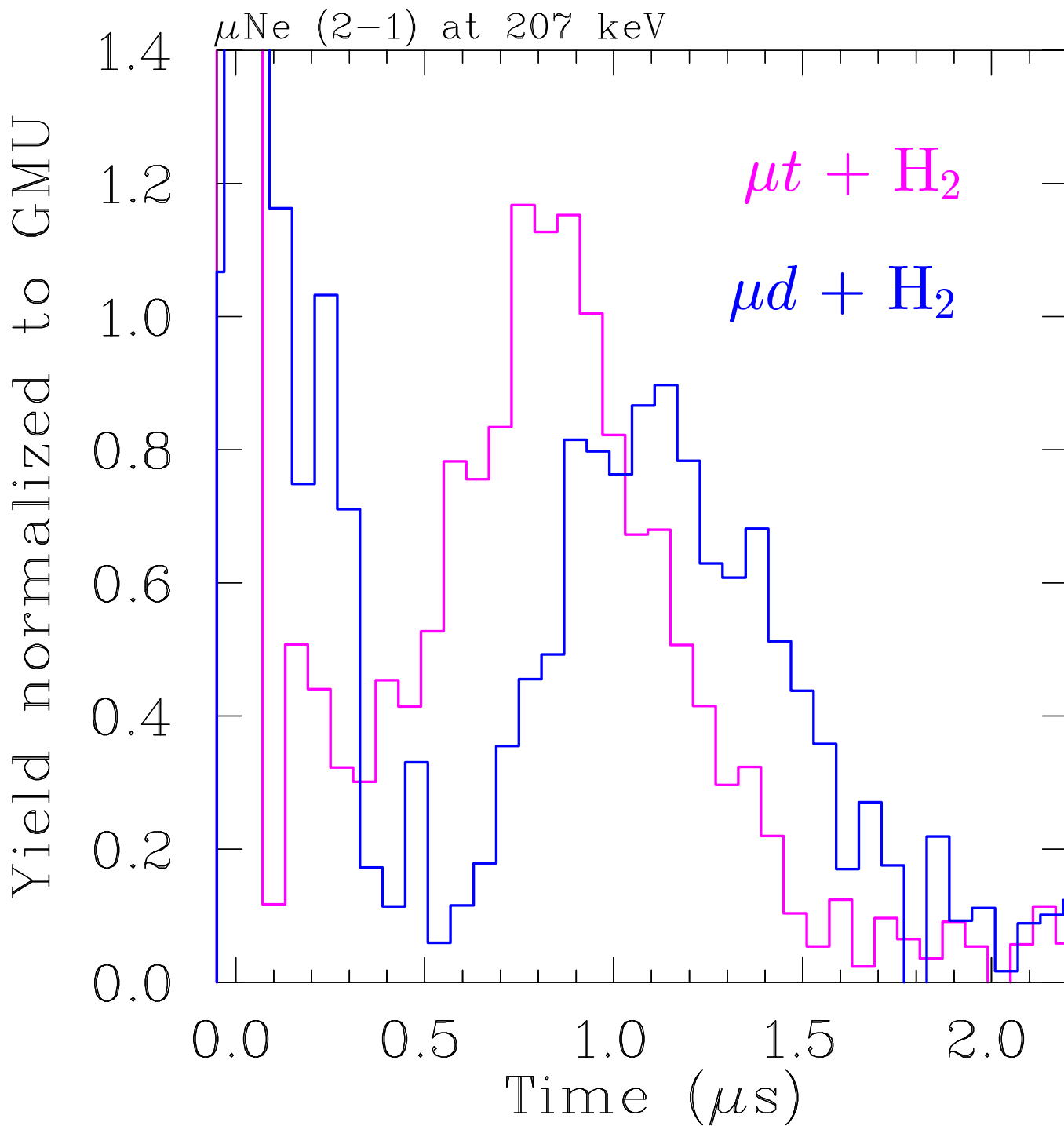
X-ray Energy Spectra for μd



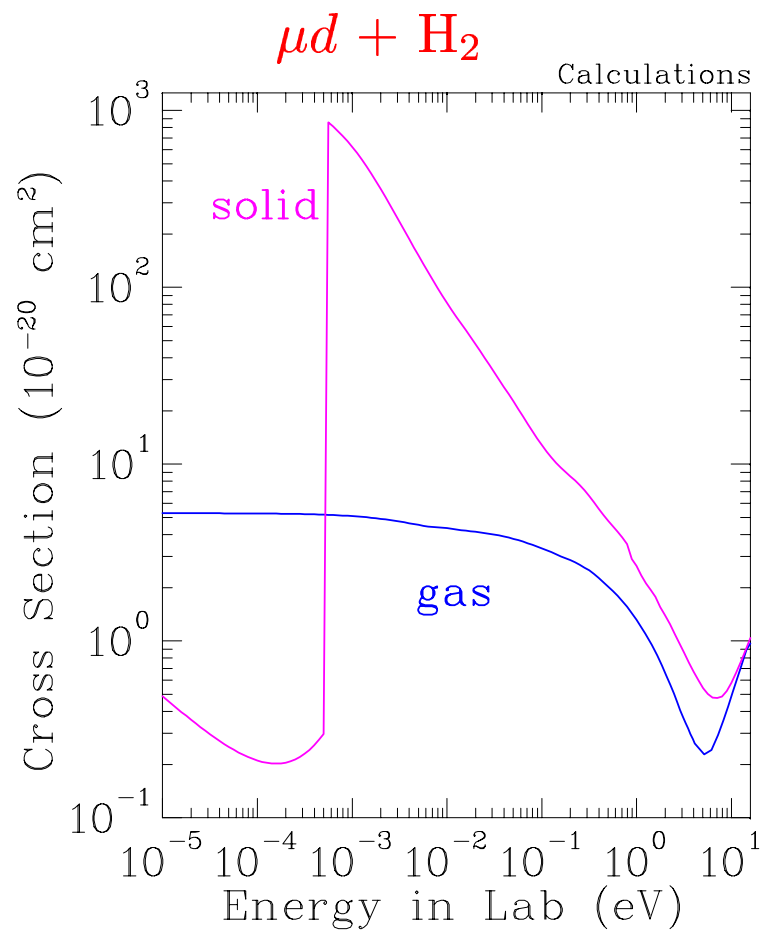
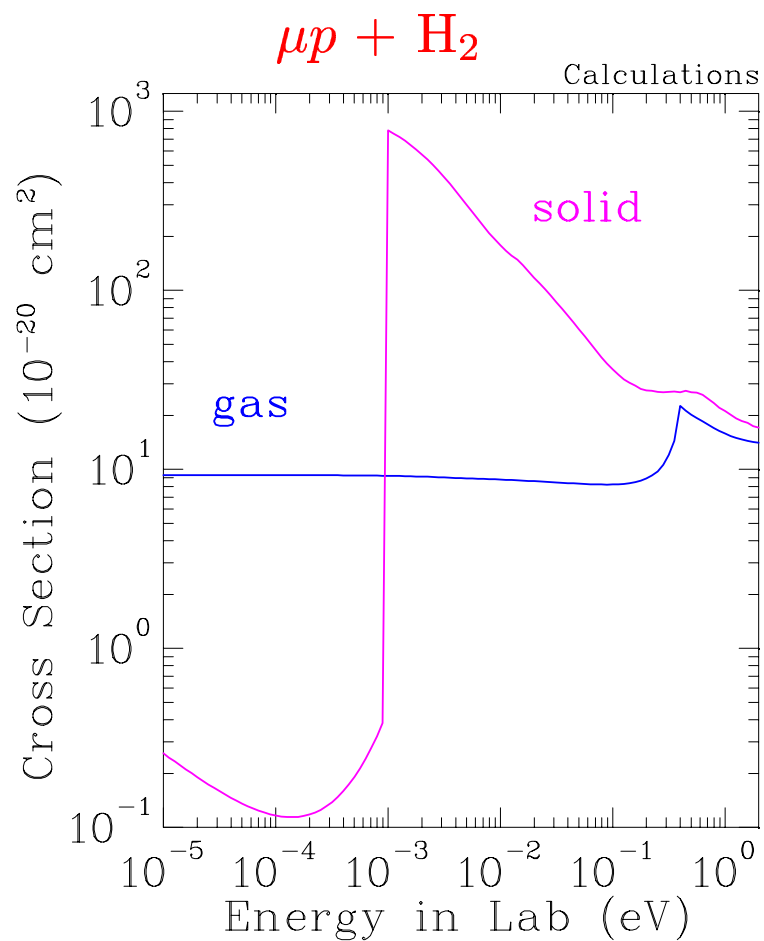
X-ray Time Spectra for μd



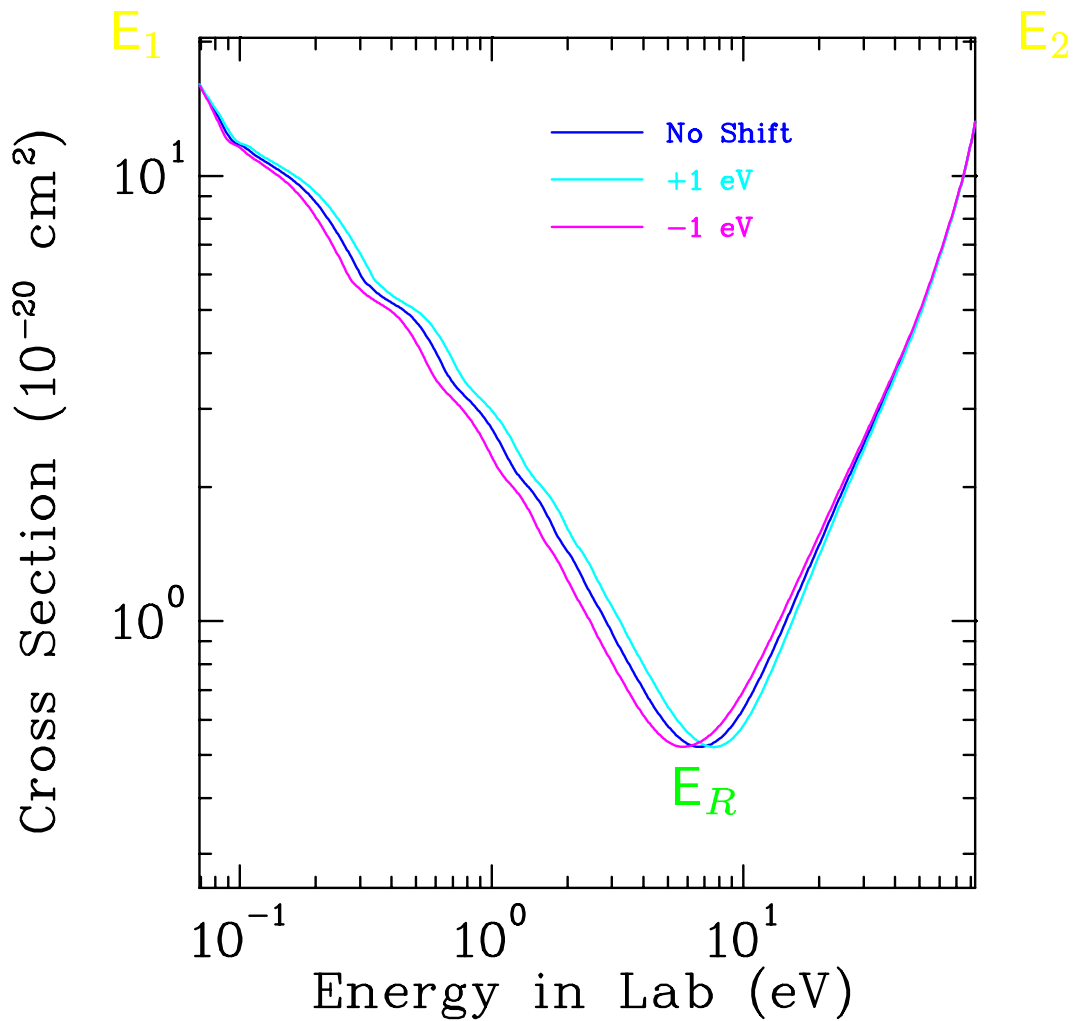
Comparison μt and μd



Gas and Solid Cross Sections



Shift of the Energy Position ΔE_R

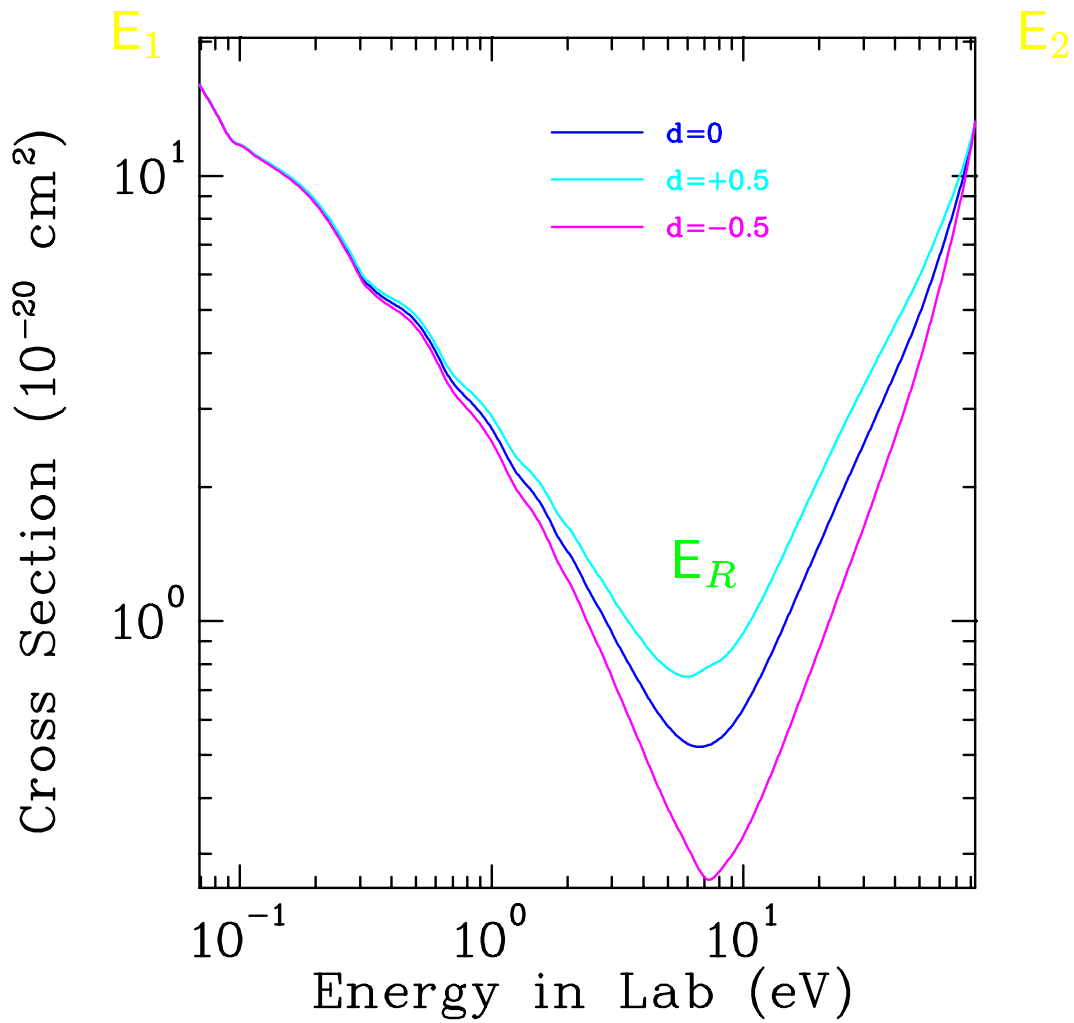


$$\sigma'(E) = \begin{cases} \sigma\left(E + \frac{E - E_1}{E_R - E_1} \cdot \Delta E_R\right) & , E_1 < E \leq E_R \\ \sigma\left(E + \frac{E_2 - E}{E_2 - E_R} \cdot \Delta E_R\right) & , E_2 > E > E_R \\ \sigma(E) & , E \leq E_1 \text{ or } E \geq E_2 \end{cases}$$

$\sigma(E)$ theoretical cross sections



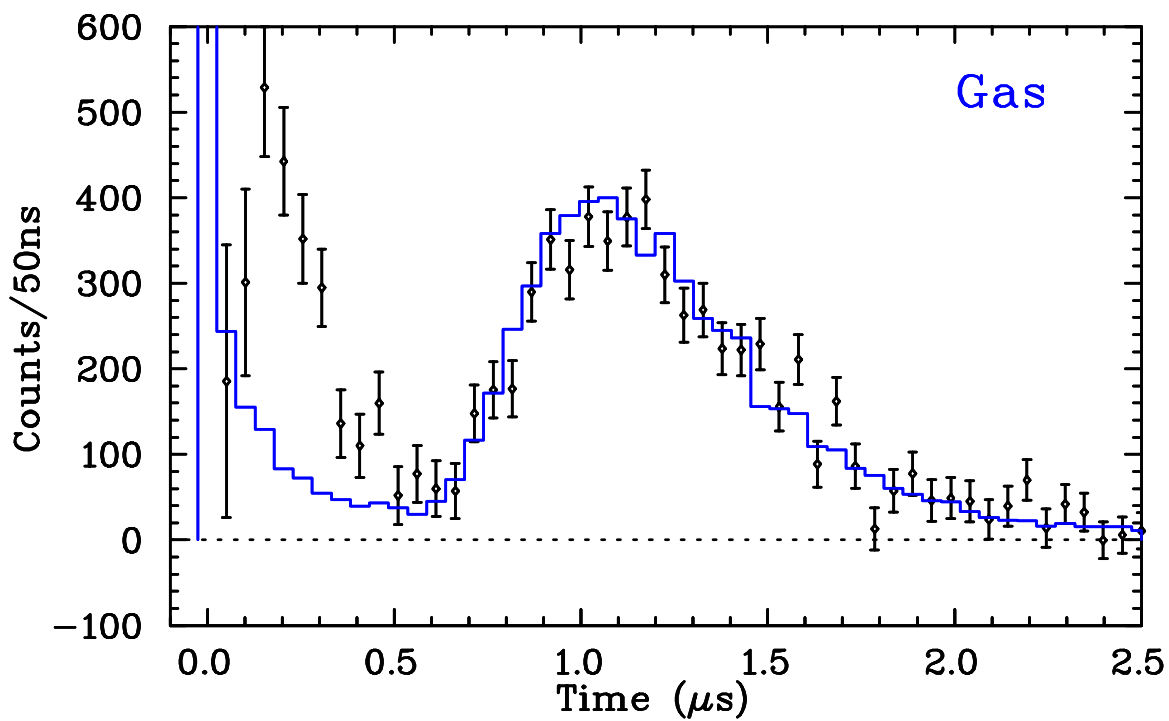
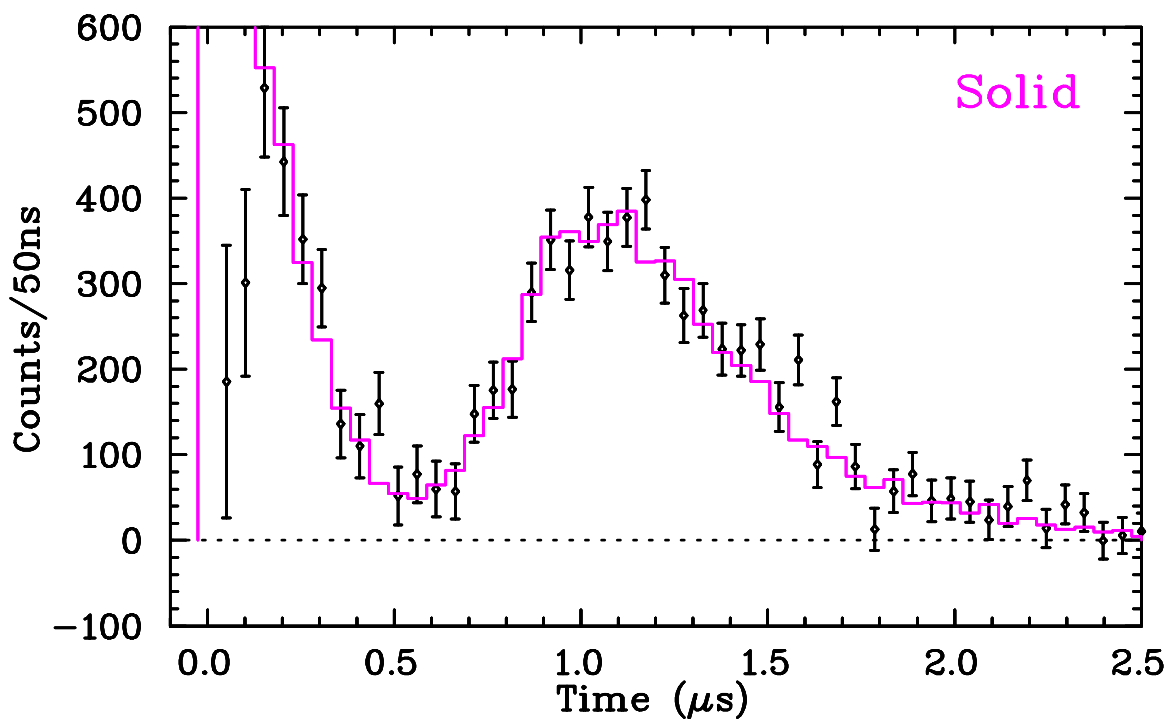
Change of the Depth Factor D



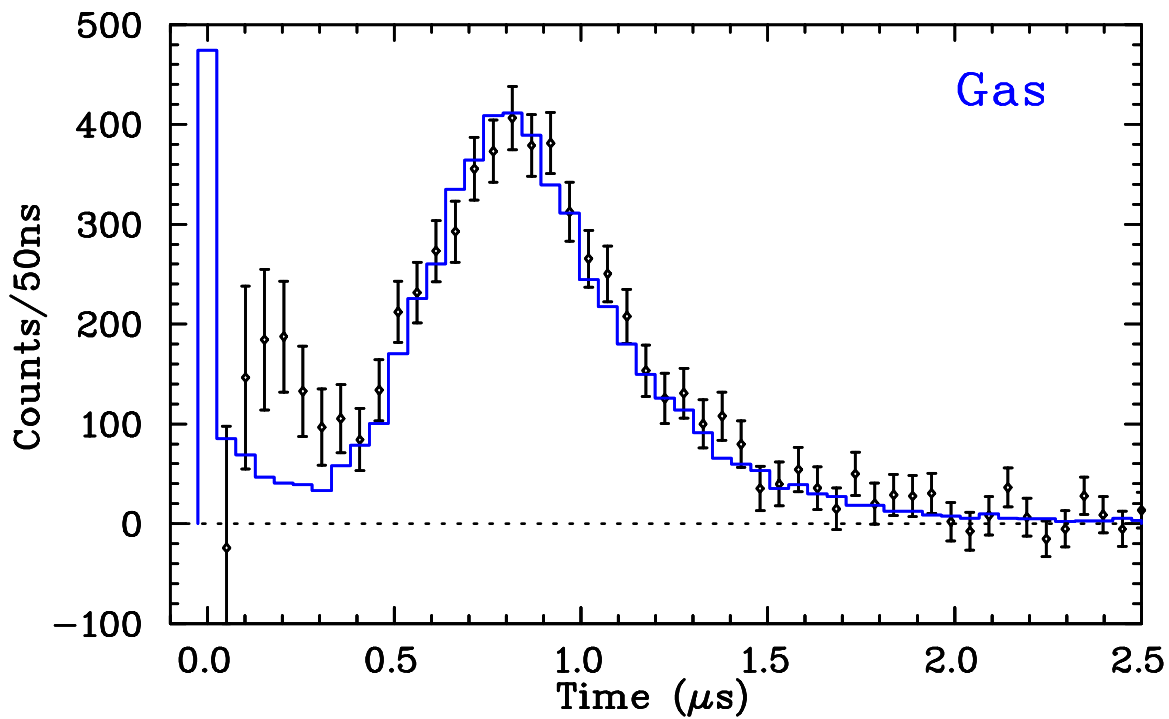
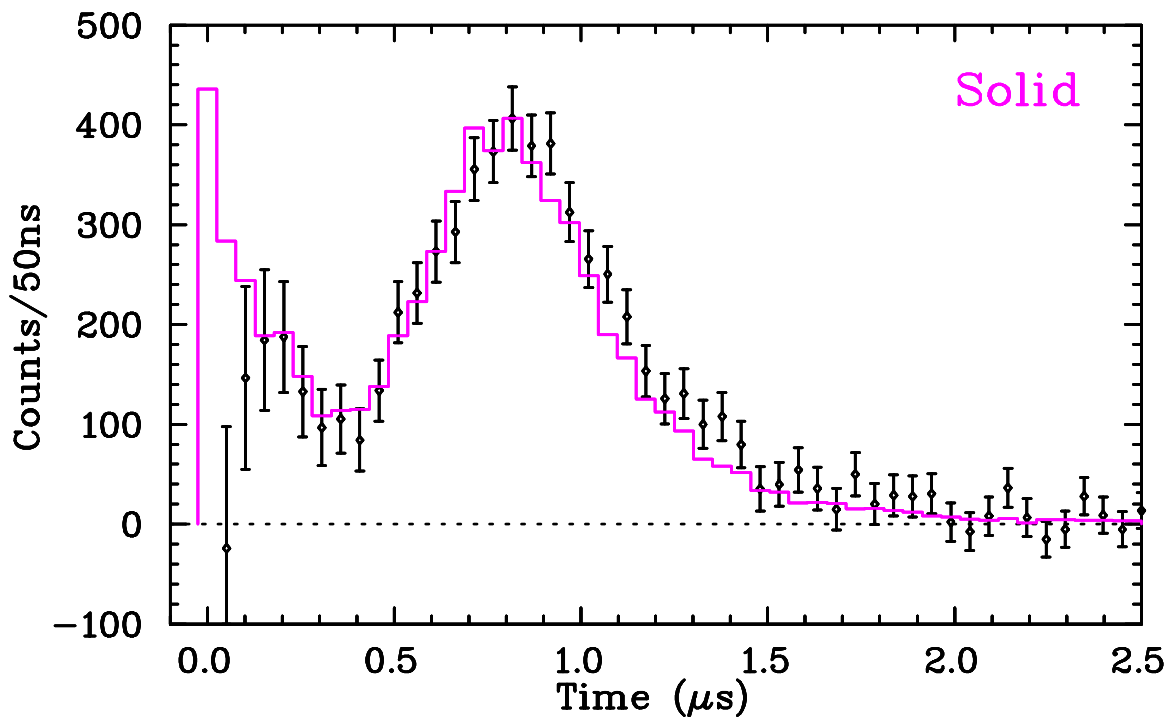
$$\sigma''(E) = \sigma(E) \cdot \begin{cases} \left(1 + \frac{E - E_1}{E_R - E_1} \cdot D\right) & , E_1 < E \leq E_R \\ \left(1 + \frac{E_2 - E}{E_2 - E_R} \cdot D\right) & , E_2 > E > E_R \\ 1 & , E \leq E_1 \text{ or } E \geq E_2 \end{cases}$$

$\sigma(E)$ theoretical cross sections



μd with 300 Torr $\cdot l$ H₂ DS

μt with 350 Torr $\cdot l$ H₂ DS



One parameter Fit μd

Depth factor D at E_R

DS Torr \cdot l (H_2)	0	300	600
D	0.981 (35)	0.923 (90)	0.805 (47)

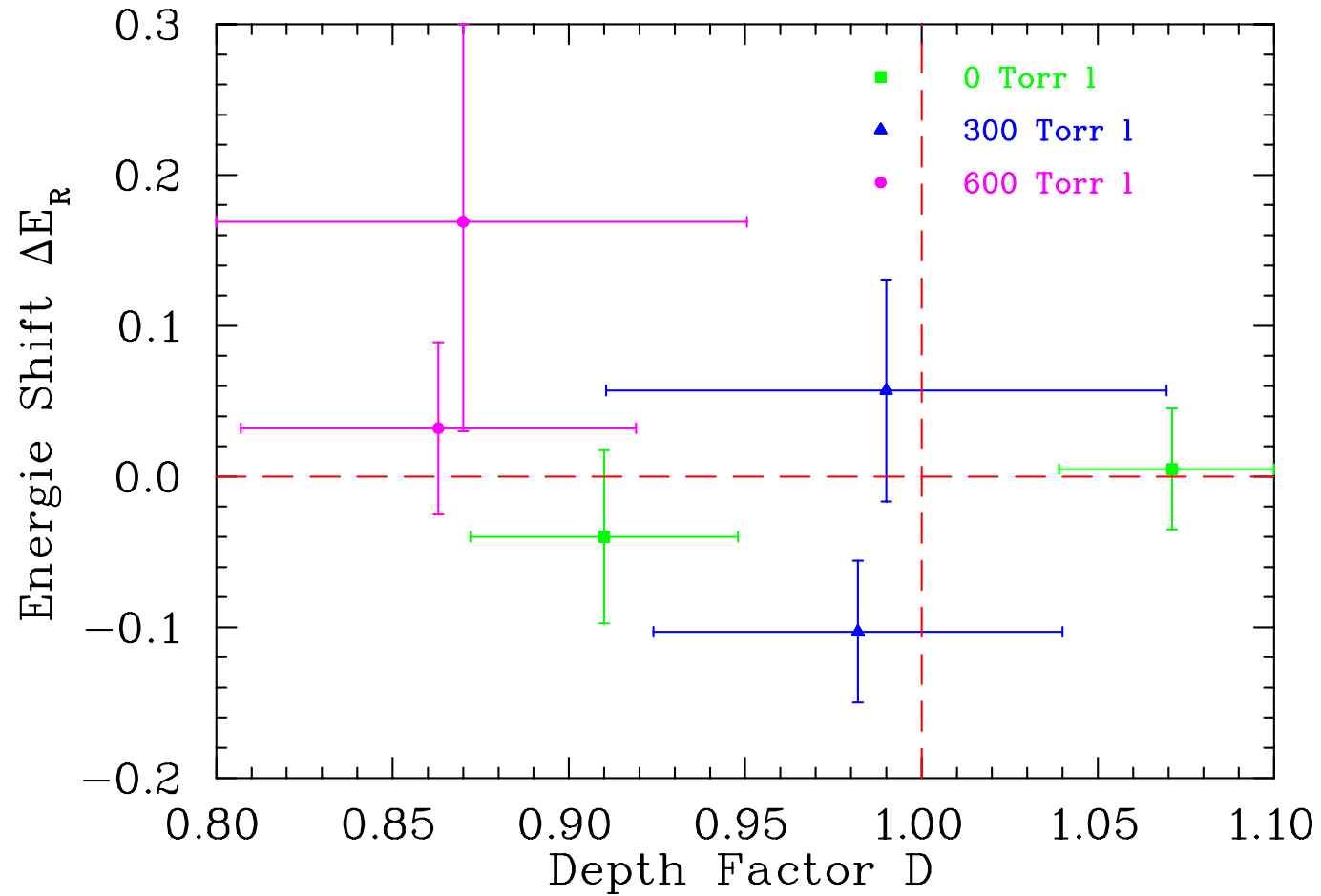
Mean Value: $D = 0.903 \pm 0.044$

Energy shift ΔE_R [eV] in CMS

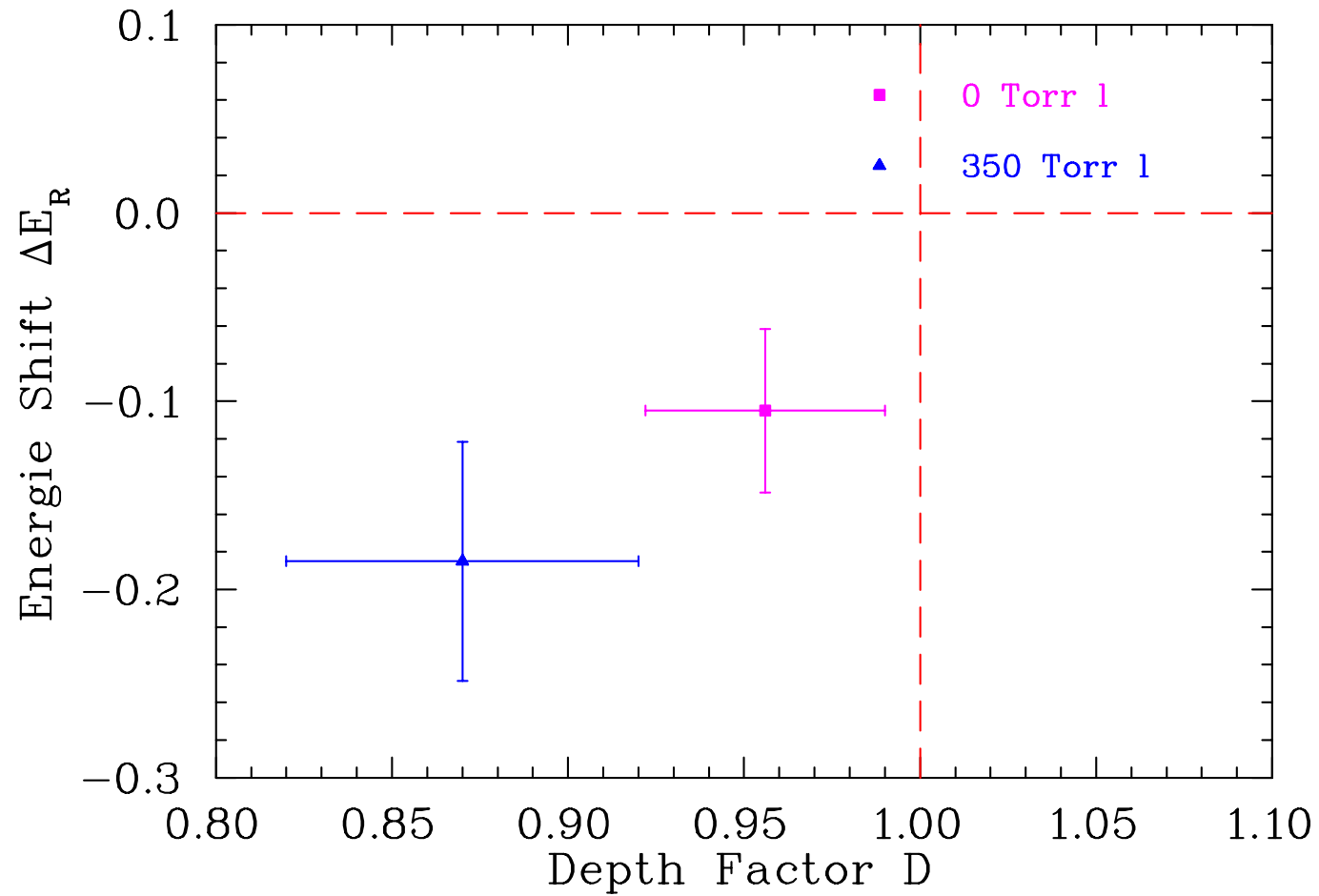
DS Torr \cdot l (H_2)	0	300	600
ΔE_R	0.095 (107)	-0.094 (41)	0.208 (32)

Mean Value: $\Delta E_R = 0.074 \pm 0.063$ eV

Two parameters Fit μd



Two parameters Fit μt



Summary of Results

$\mu d + \text{H}_2$

ΔE_R
[eV]

D

$$-0.01 \pm (0.02)_{\text{stat}} \pm (0.18)_{\text{sys}} \quad 0.98 \pm (0.02)_{\text{stat}} \pm (0.14)_{\text{sys}}$$

$\mu t + \text{H}_2$

ΔE_R
[eV]

D

$$-0.14 \pm (0.04)_{\text{stat}} \pm (0.12)_{\text{sys}} \quad 0.93 \pm (0.02)_{\text{stat}} \pm (0.10)_{\text{sys}}$$

Conclusions

- Measurements showed the Ramsauer–Townsend effect.
- Quantitative results are interesting.
- Statistics is too poor.
- Systematics is important.
- Agreement between Experiment and Theory is good.

Conclusions

- TRIUMF Target System was great.
- TRIUMF Collaboration was successful.
- Beam was not powerful enough.
- Maybe later and somewhere else?

