

Exploring the mass-limits for statistical reaction model calculations with the TALYS code into the region of light nuclei

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YOUNG RESEARCHERS & YOUNG ENGINEERS DAYS - 2024



Motivation:

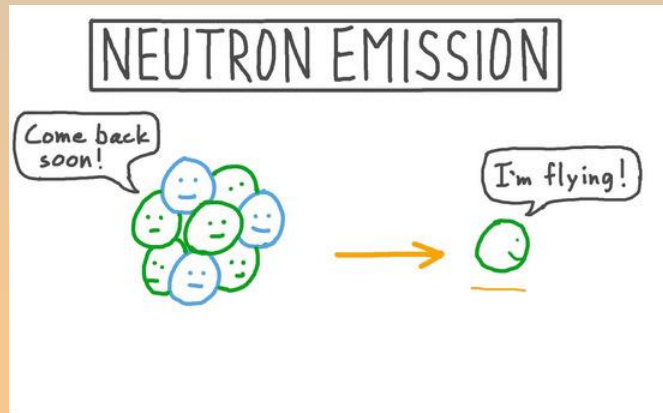
- why light nuclei?
- astrophysical reaction
- reproduce a large fraction of the nuclear chart although with less precision
=> improve accuracy of theoretical models



UHECRs (Ultra-high energy cosmic rays)

(γ ,n) nuclear reaction

Target nucleus (A,Z) + $\gamma \rightarrow$ Product nucleus(A, Z-1) + n



❖ Why TALYS? →

Software which provides nuclear model codes

❖ What is the structure of a TALYS code?

Input.dat

projectile g
element Ca
mass 40
energy range.txt



```
talys <input.dat> output.dat
```



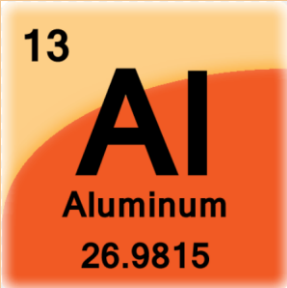
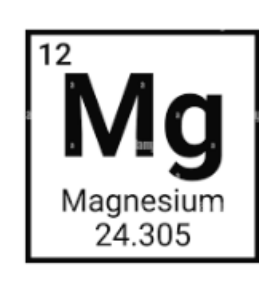
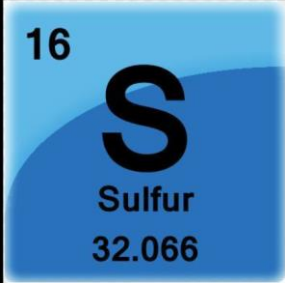
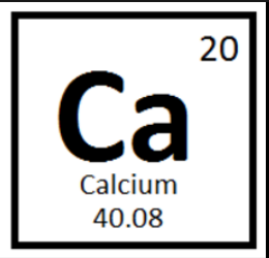
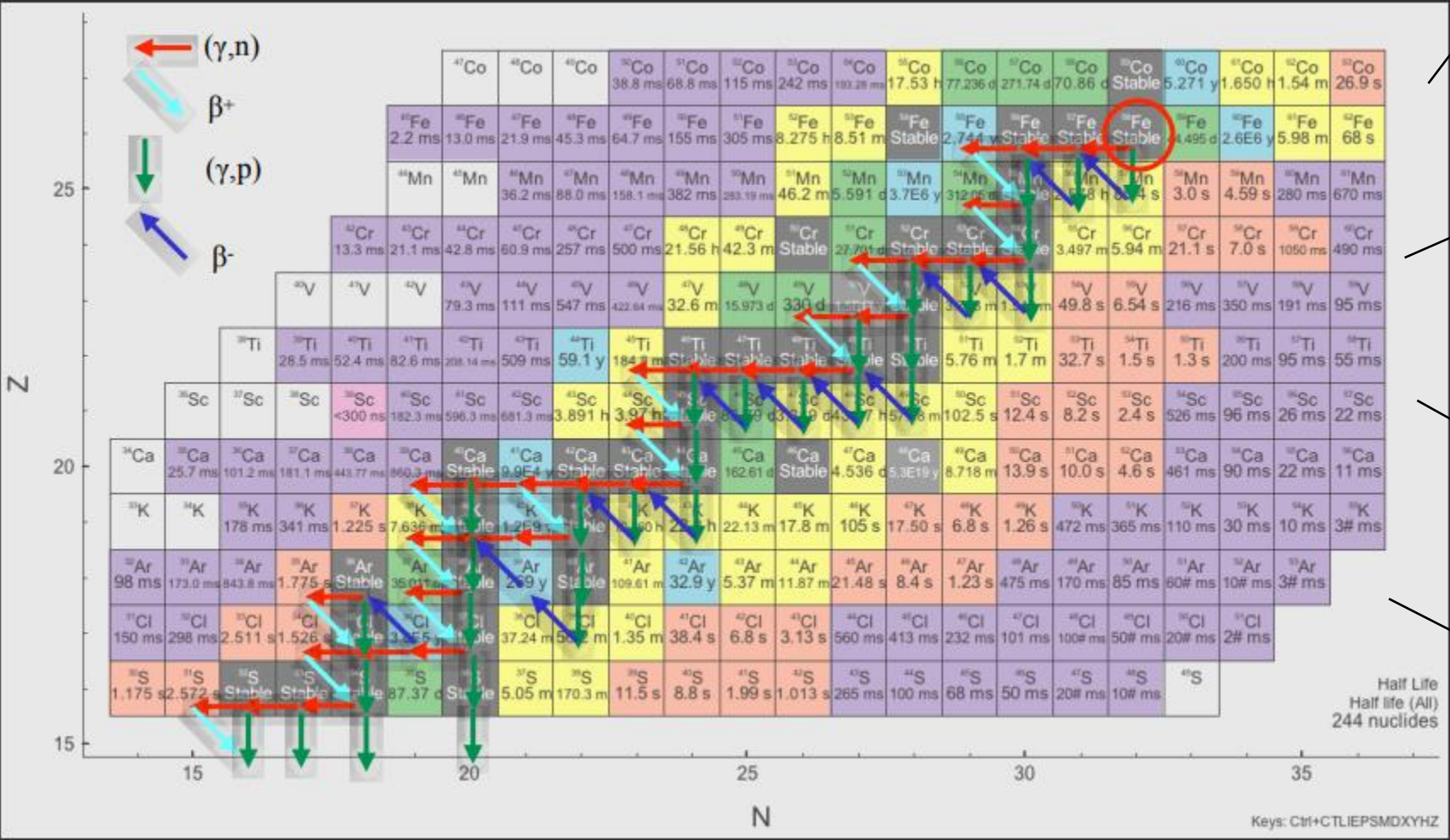
- aprod.tot
- binary.tot
- data.dat
- dprod.tot
- elastic.tot
- gprod.tot
- hprod.tot
- input.dat
- nonelastic.tot
- nprod.tot
- output.dat
- pprod.tot
- reaction.tot
- rp016032.tot
- rp016034.tot
- rp017035.tot
- rp017037.tot
- rp018035.tot
- rp018036.tot
- rp018037.tot
- rp018038.tot
- rp019037.tot
- rp019038.tot
- rp019039.tot
- rp020038.tot
- rp020039.tot
- rp020040.tot
- total.tot
- totalxs.tot
- tprod.tot



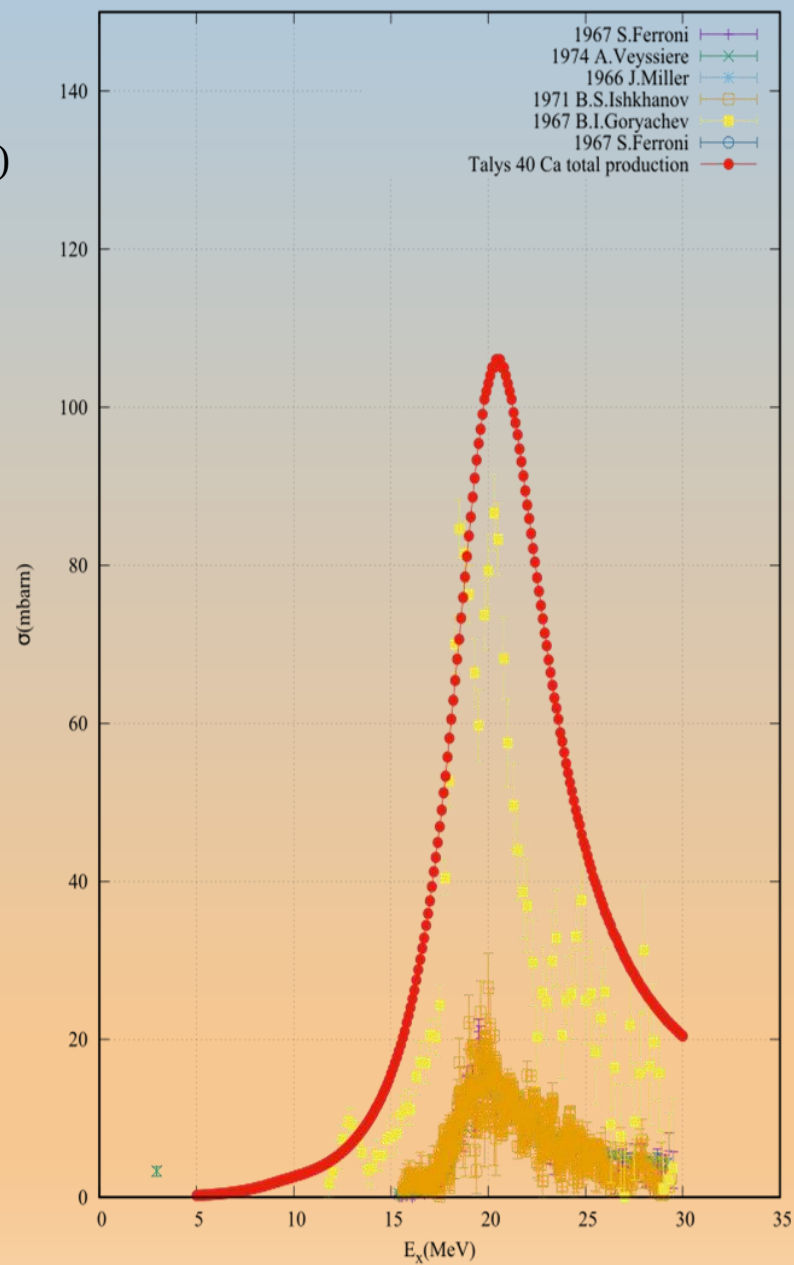
total.tot



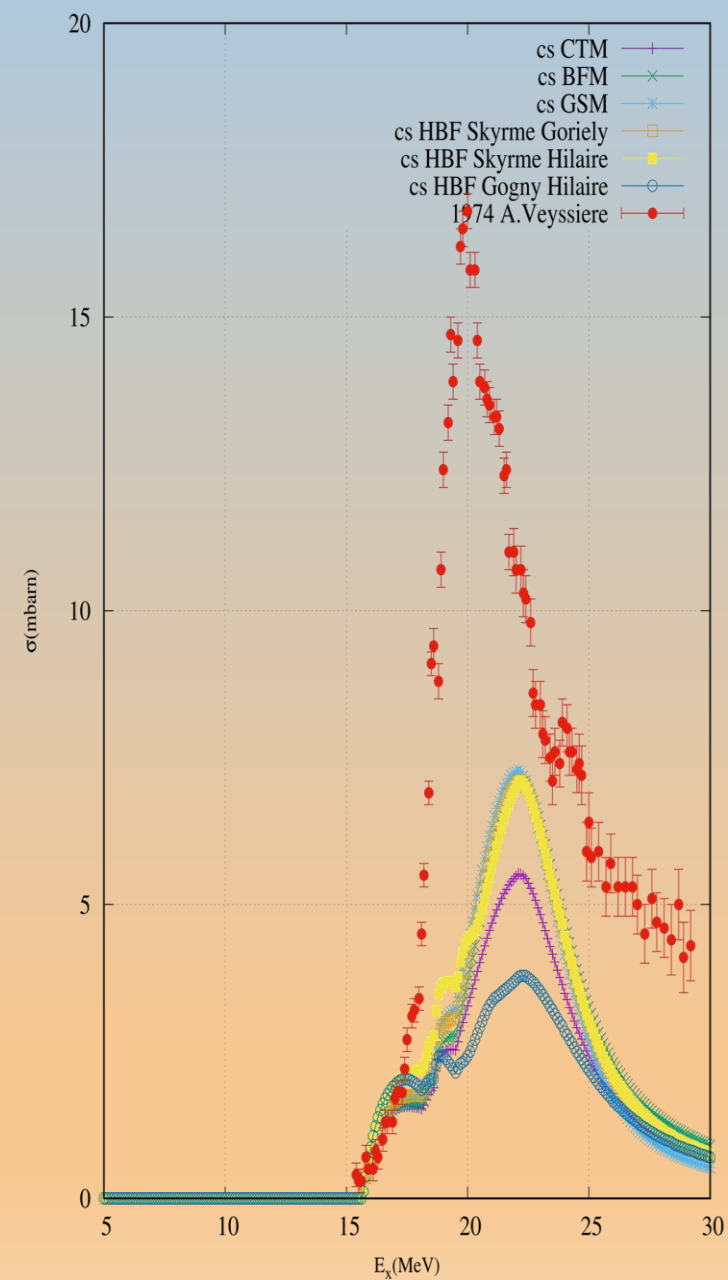
Region of interest



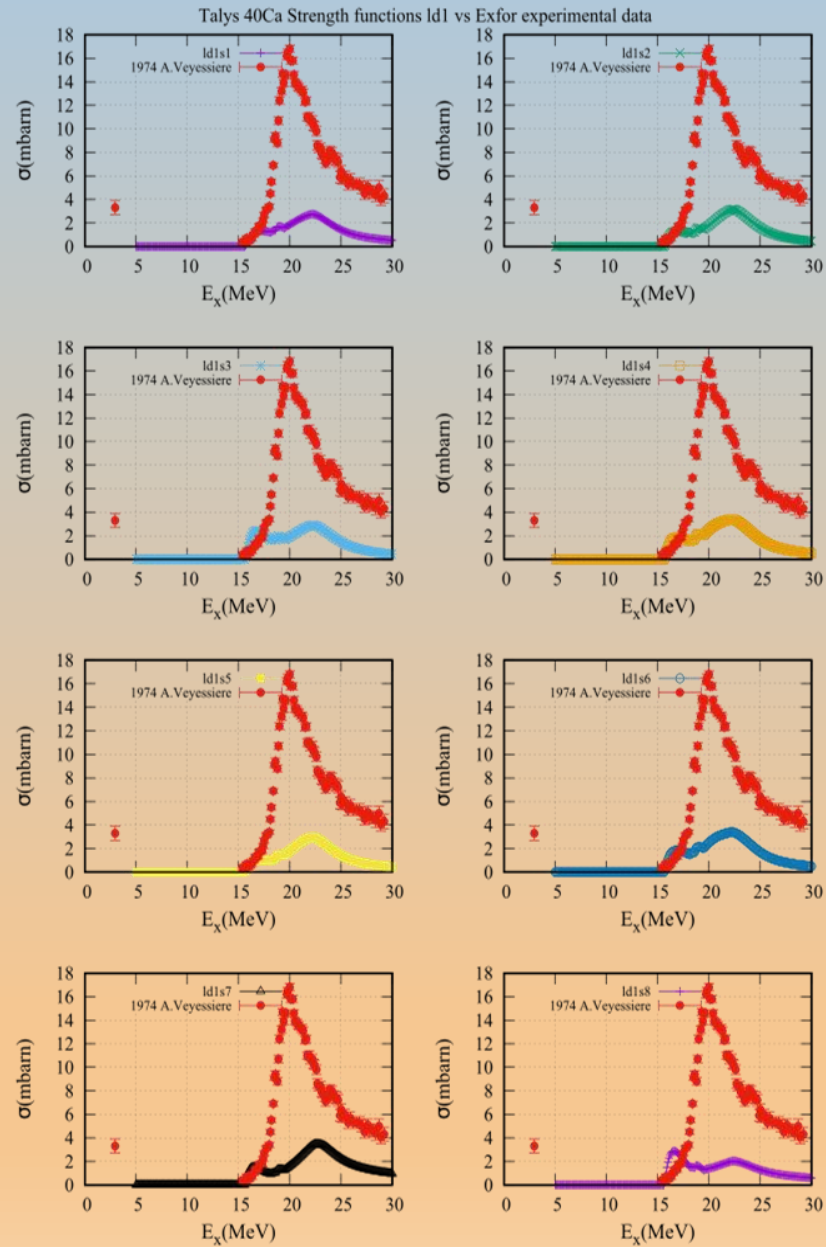
$^{40}\text{Ca}-(\gamma, \text{xn})$



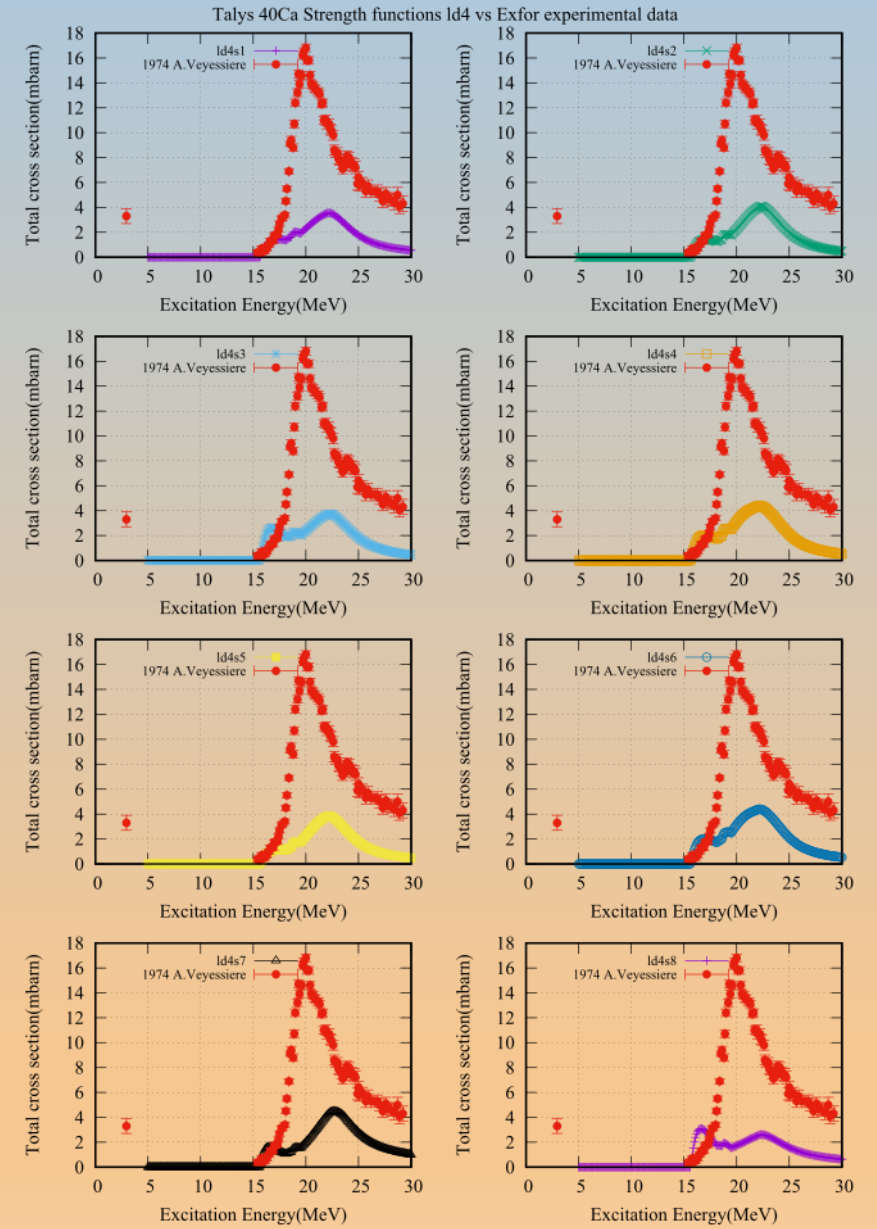
$^{40}\text{Ca}-(\gamma, \text{n})$



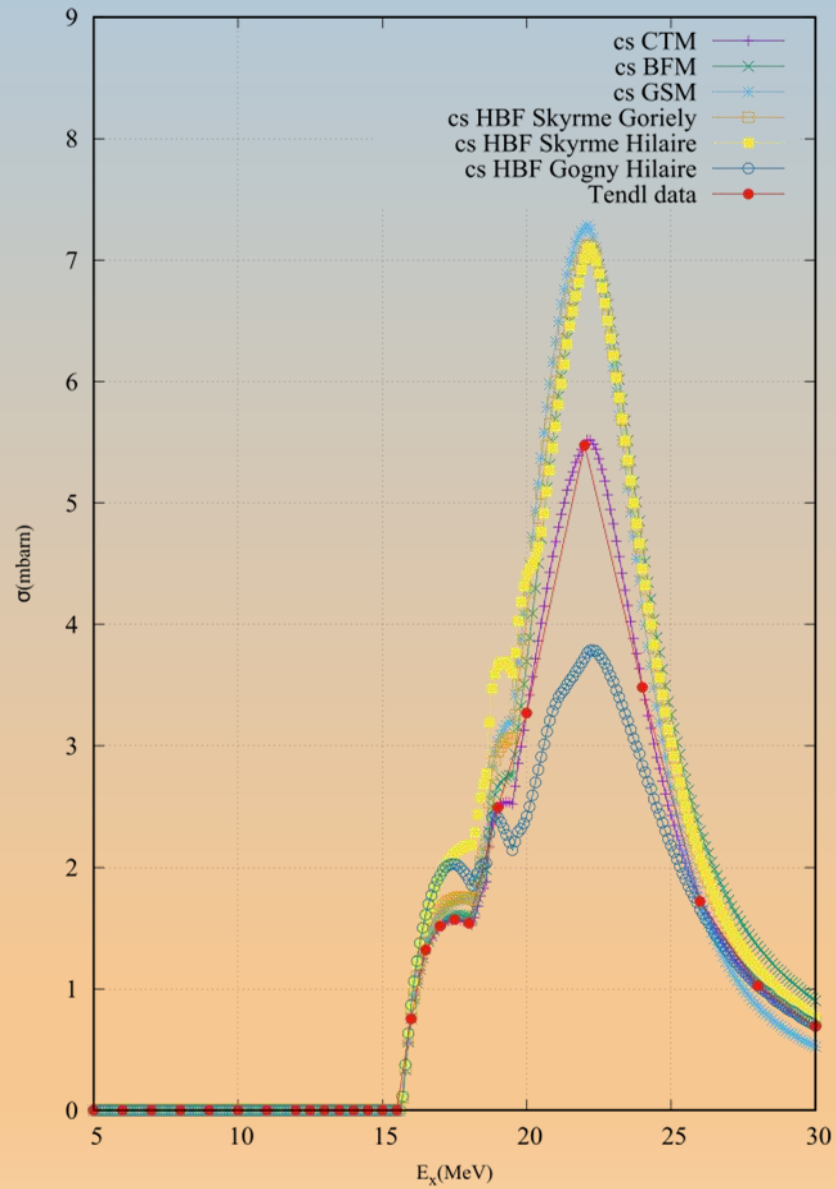
$^{40}\text{Ca}-(\gamma, n)$



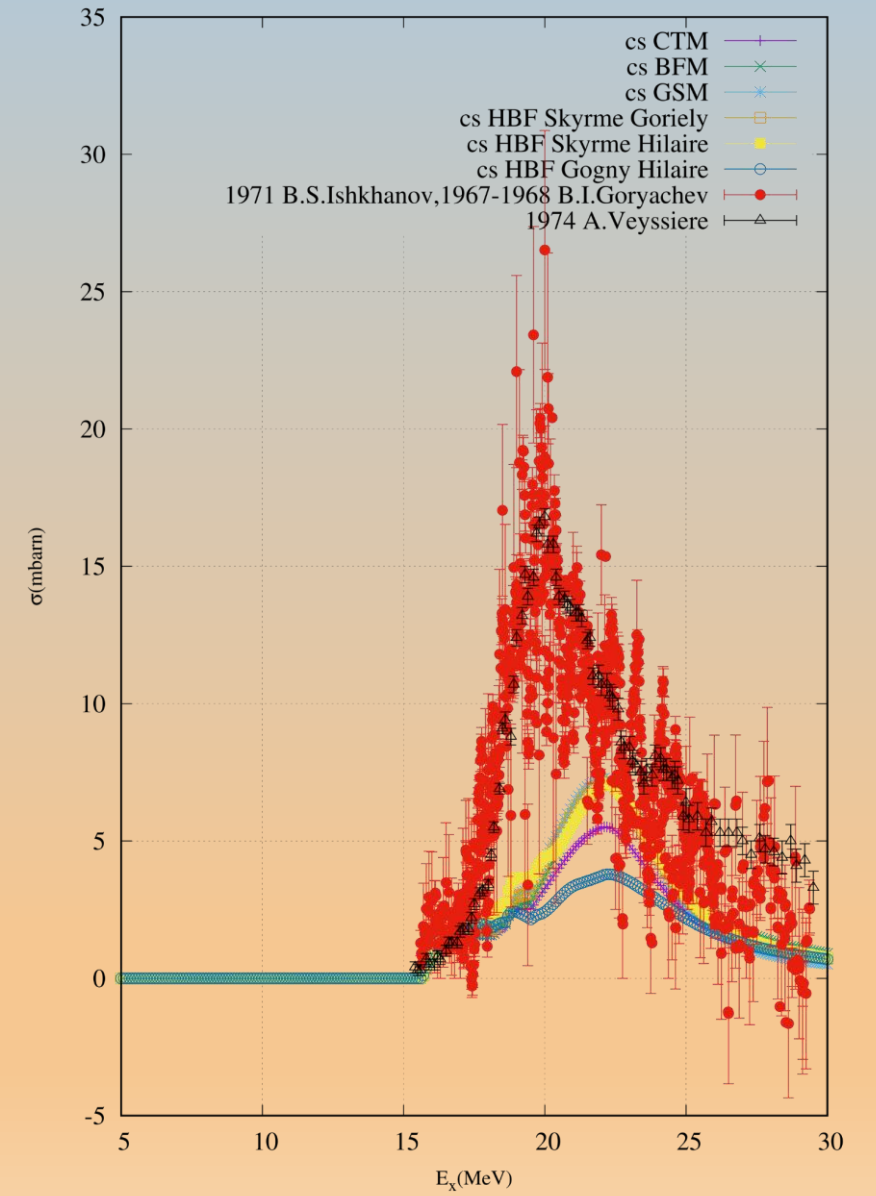
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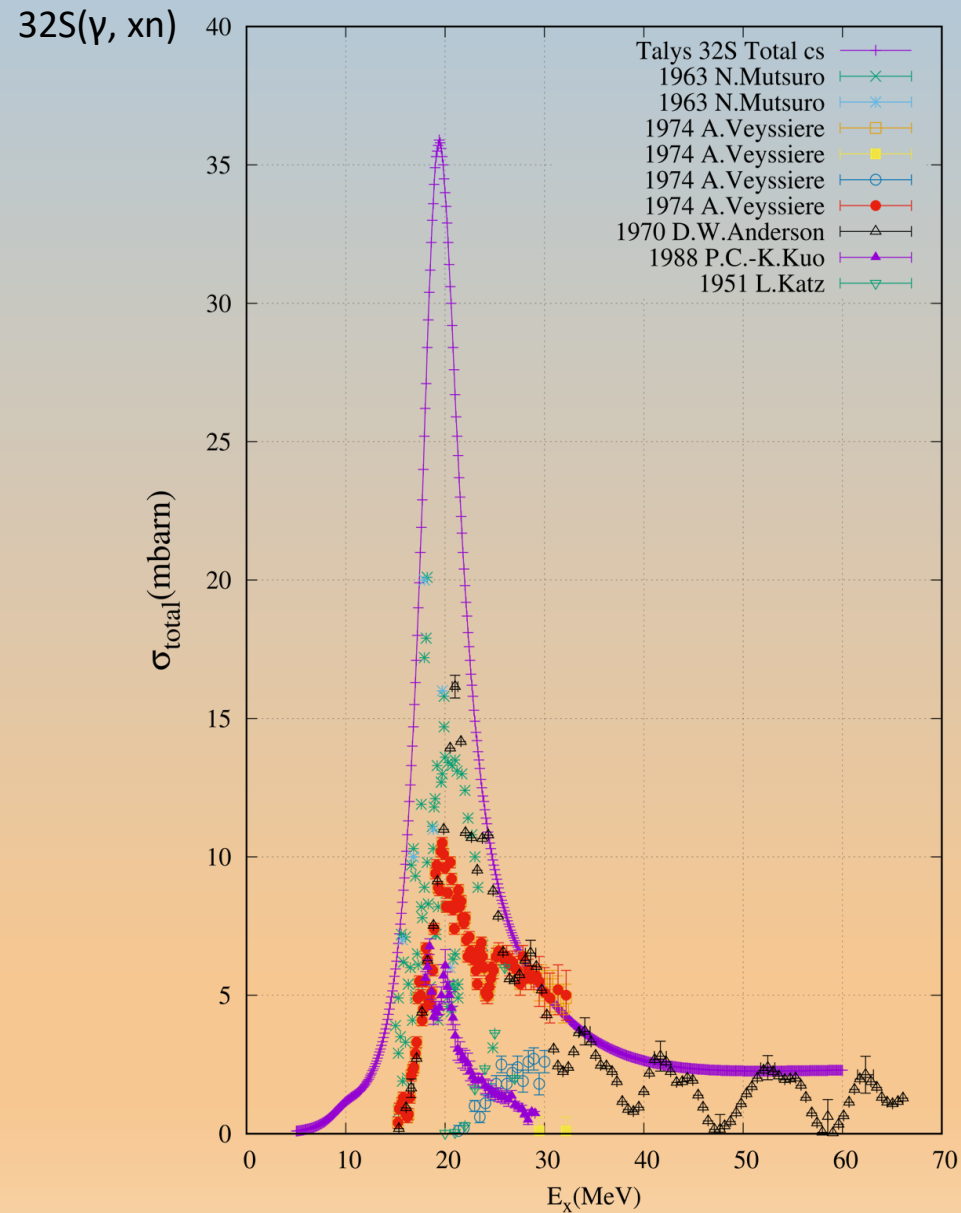


$^{40}\text{Ca}(\gamma, n)$

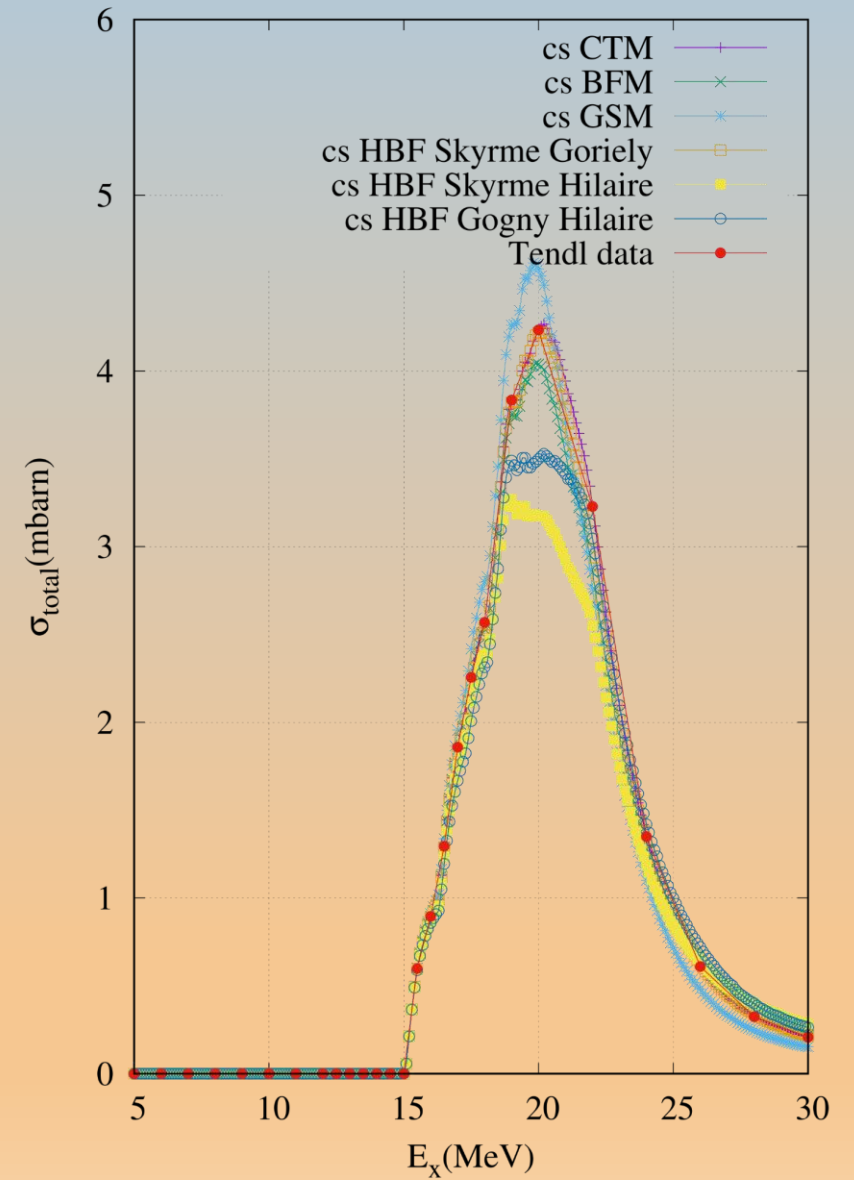


$^{40}\text{Ca}(\gamma, n)$

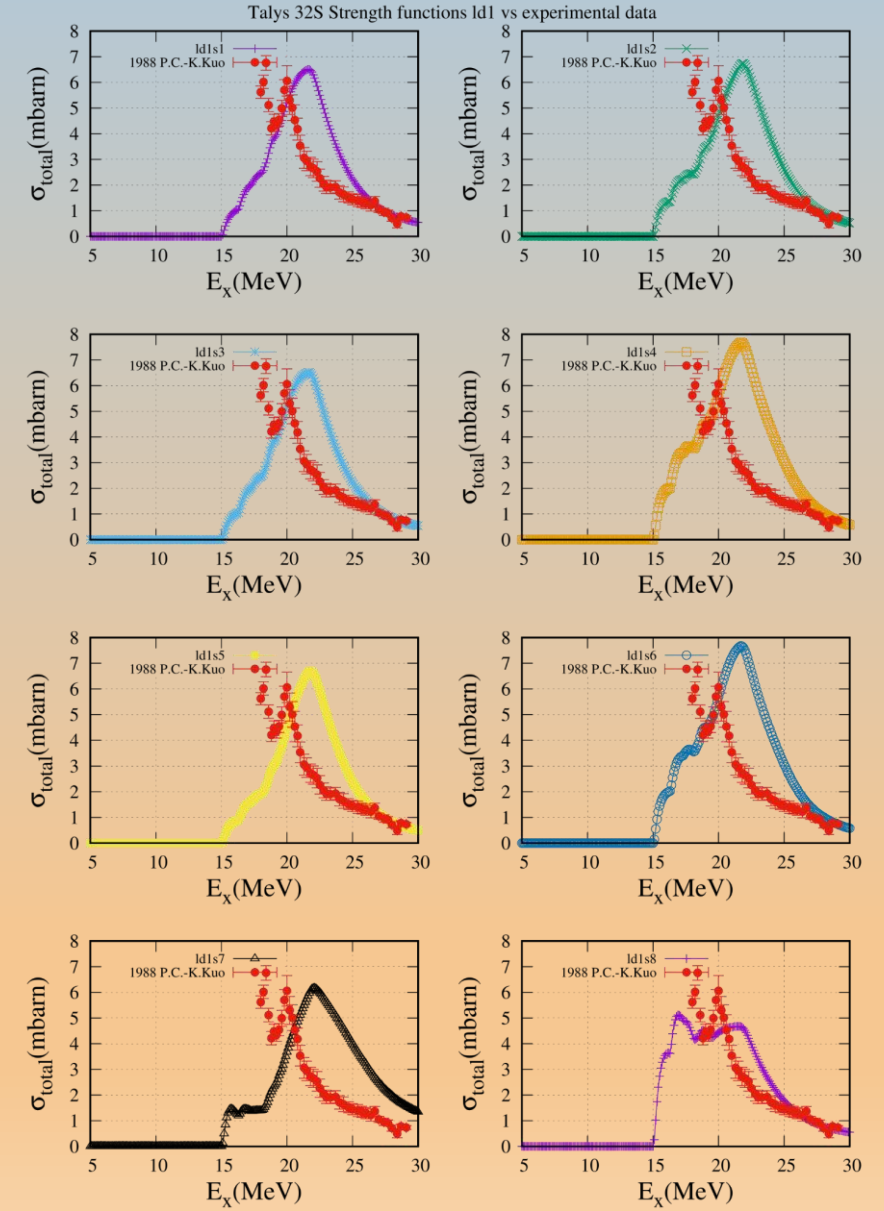
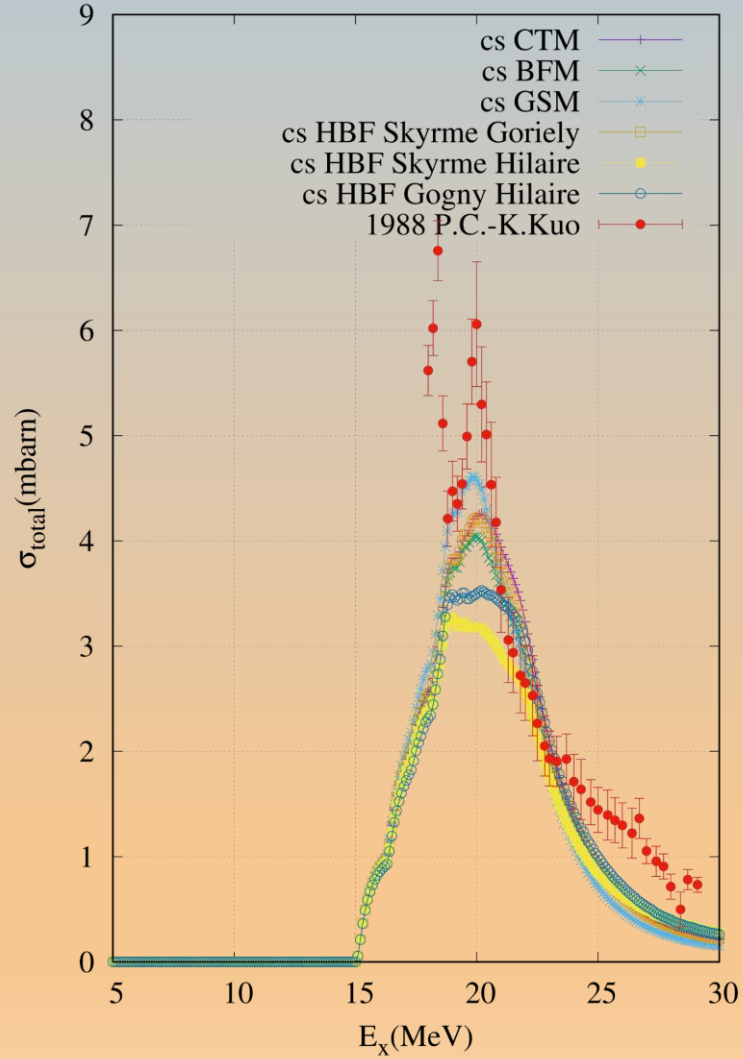




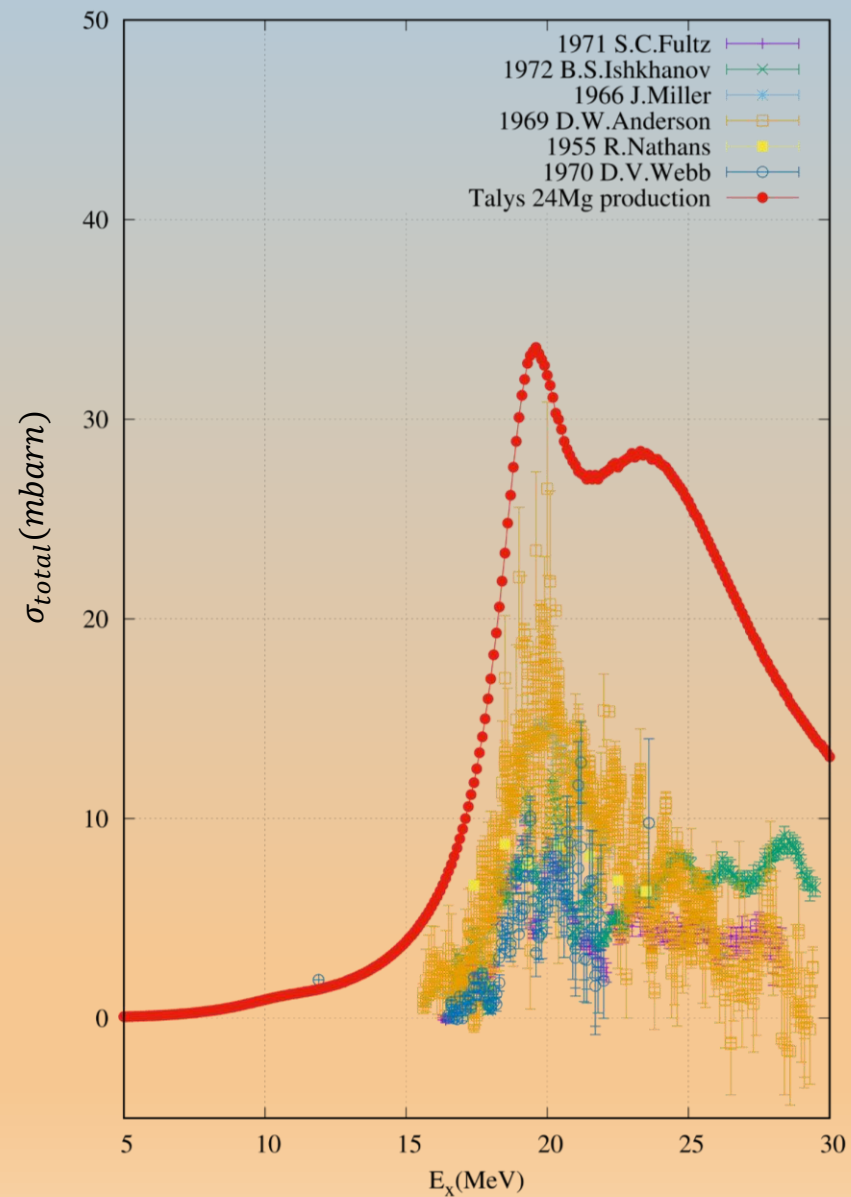
$^{32}\text{S}(\gamma, n)$



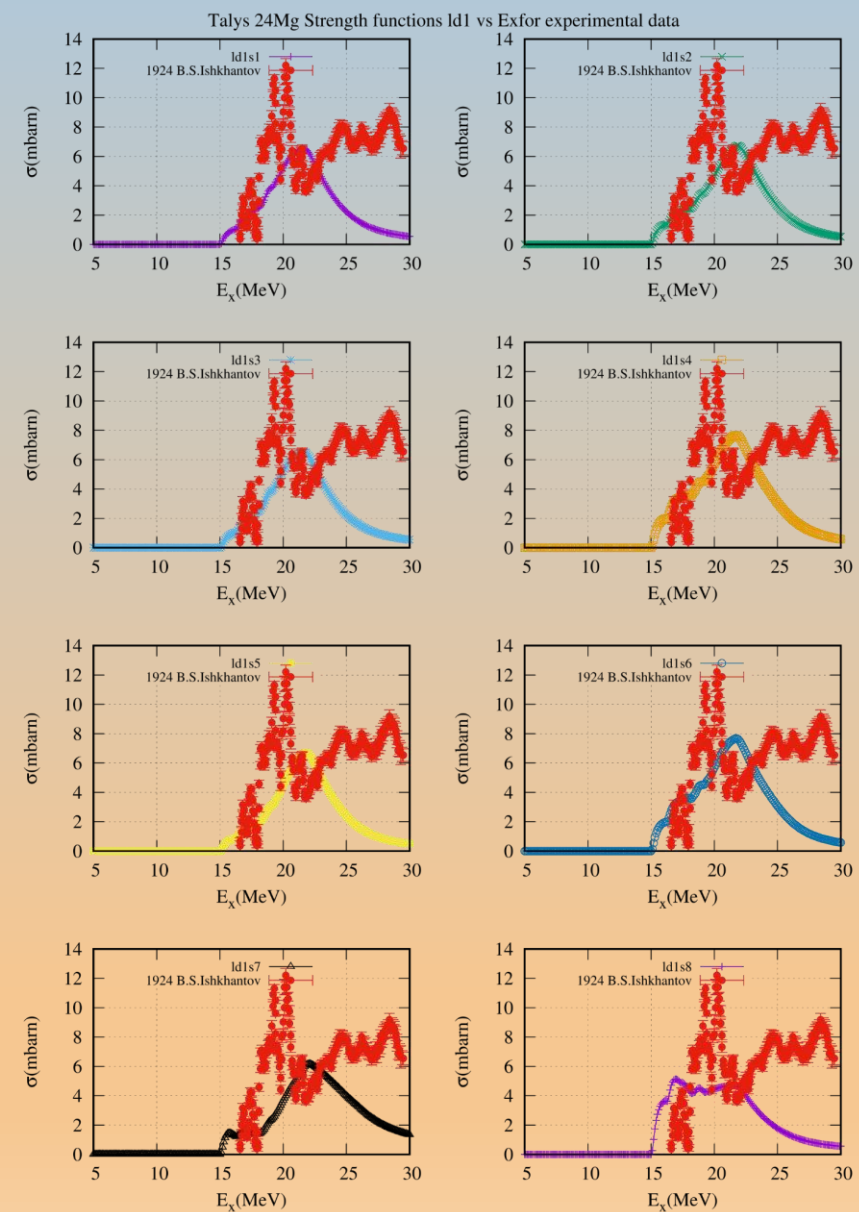
$^{32}\text{S}(\gamma, n)$

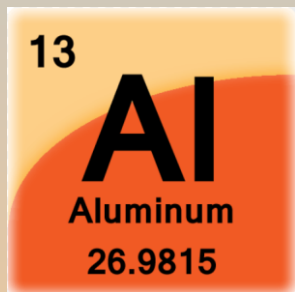


$^{24}\text{Mg}(\gamma, xn)$

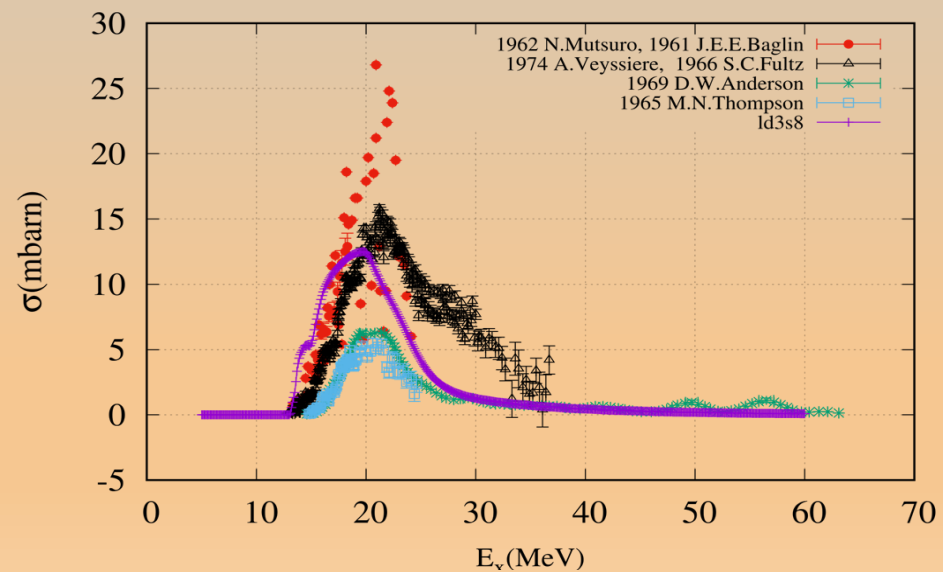
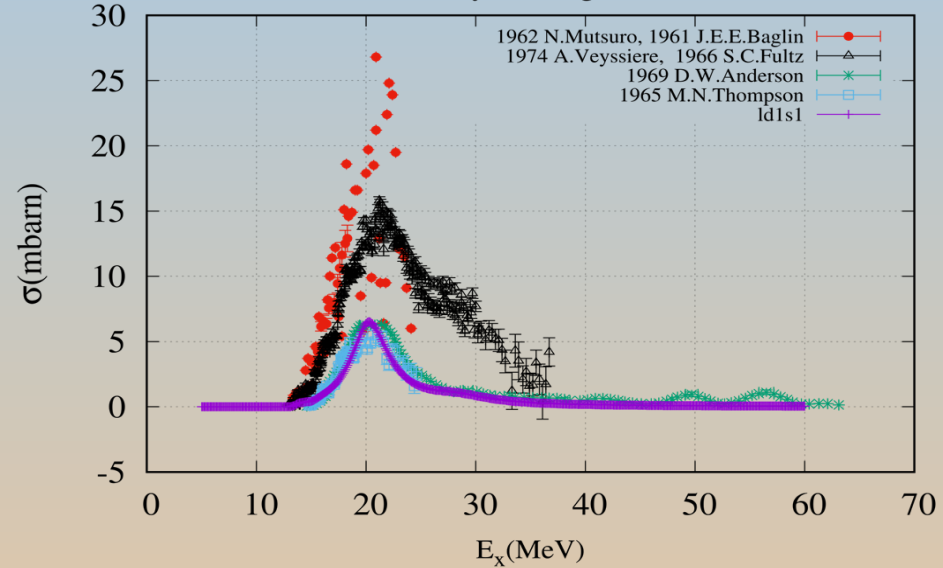


$^{24}\text{Mg}(\gamma, n)$



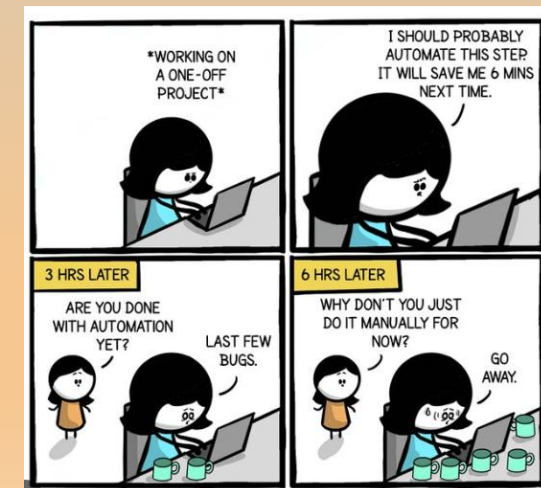


$^{13}\text{Al-}^{27}(\text{G},\text{N})^{13}\text{Al-}^{26}\text{-M}$: Talys strength functions vs Exfor data



Conclusions and future perspectives

- Expanding the calculations in order to understand the impact of different input in Talys
- Expanding the calculations on other light nuclei
- Understand the predictability of the TALYS code in the region relevant to UHECRs
- Automating the process of extracting data from Exfor and Tendl and making histograms with statistical models from Talys
- Identify candidates for (g,n) experiments at ELI-NP



Thank you for your attention!

Благодаря за вниманието!

Merci pour votre attention!

Danke für Ihre Aufmerksamkeit!

Grazie per l'attenzione!