

# $^{14}\text{N}(p,\gamma)^{15}\text{O}$ summary

James deBoer and Tamás Szücs

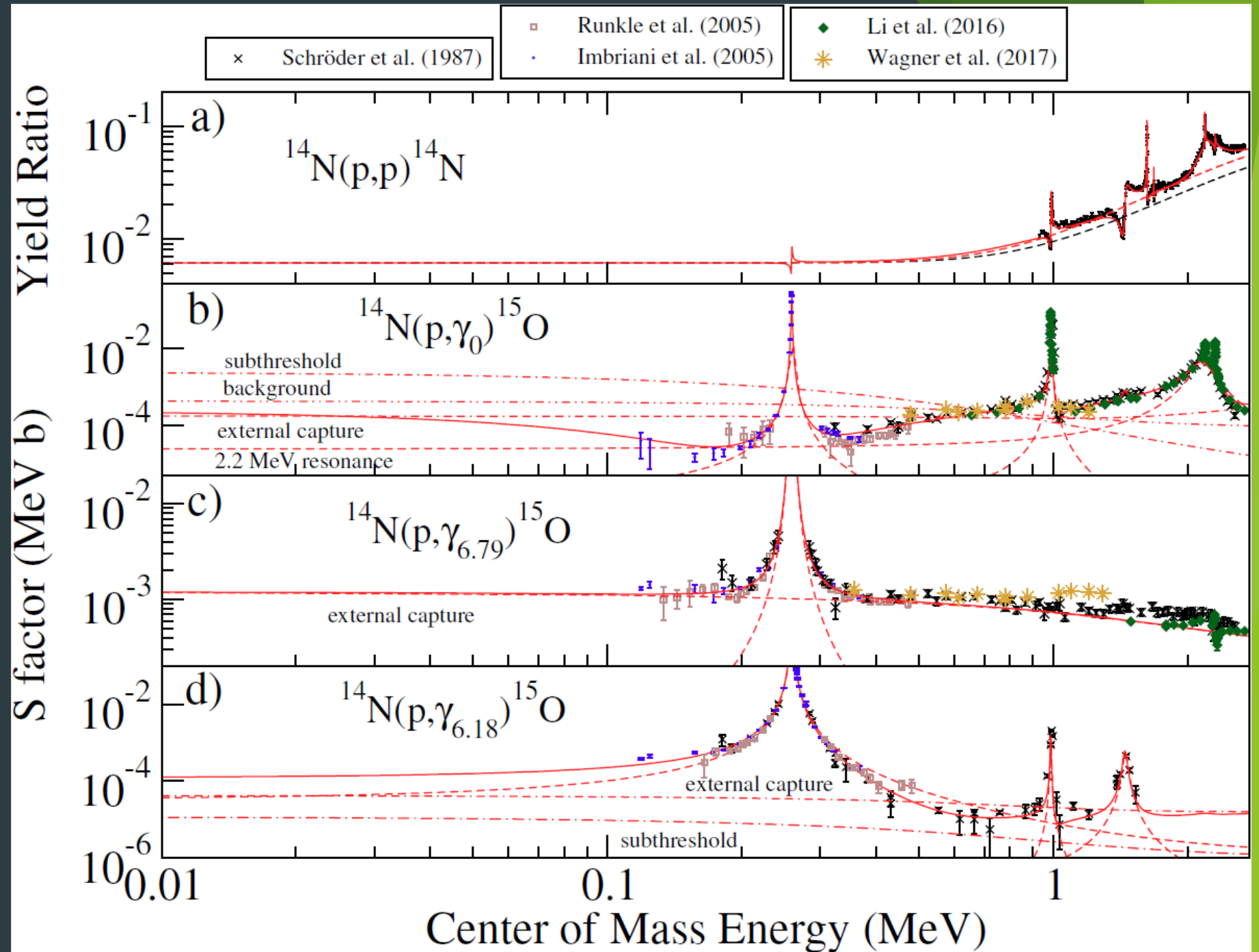
SFIII, July 28, 2022 at UC Berkeley

# Overview

20%

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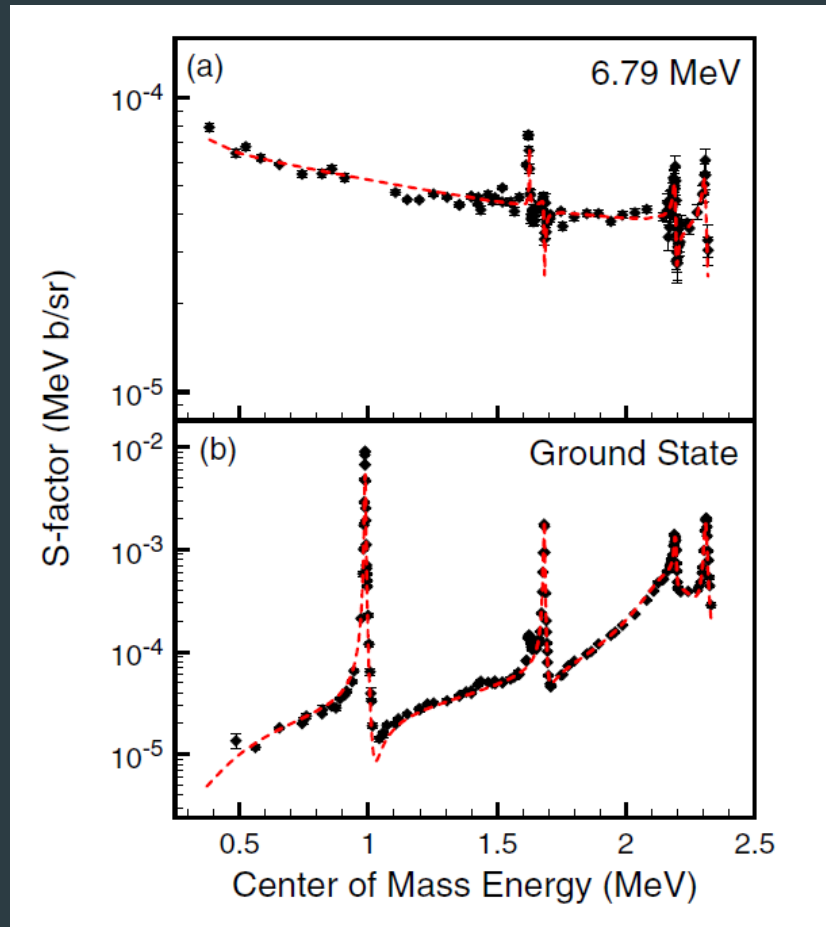


# We had some good discussions!

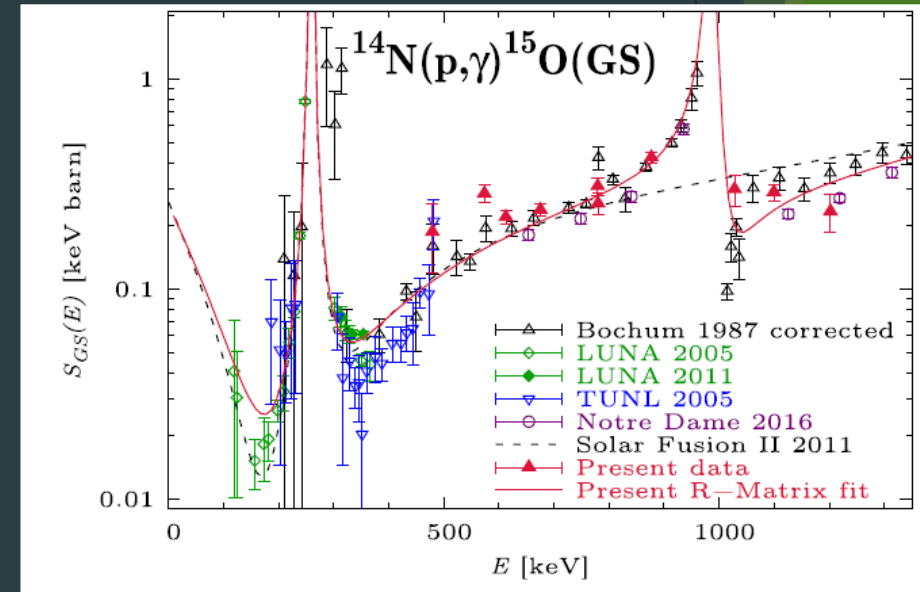
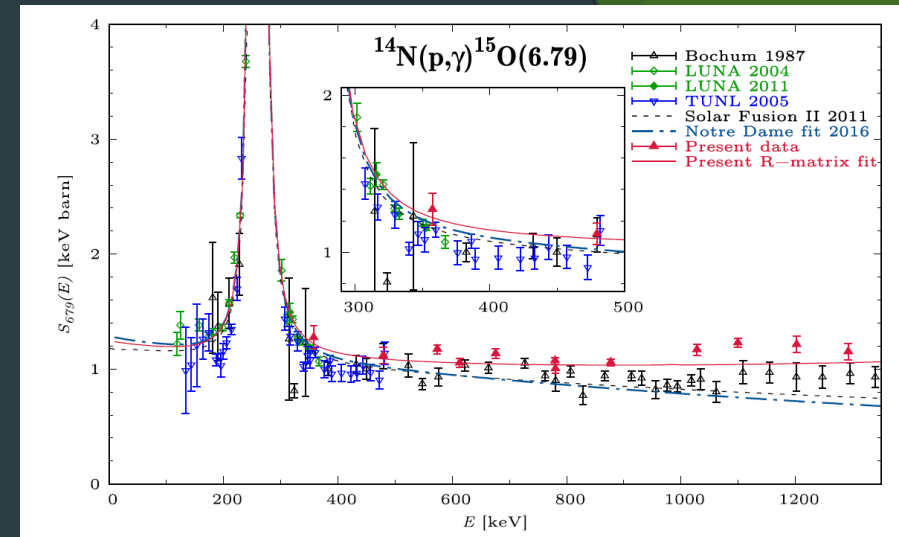
## What did we find?

- ▶ Just two new cross section measurements since SFII and one dedicated effort to reduce the uncertainty in the 278 keV resonance strength
- ▶ Several more R-matrix analyses have been done, which consistently can not fit the low energy ground state transition data
- ▶ Daigle et al. determination of the strength of the 278 keV resonance forgot to correct for the correlation of the nitrogen stopping power that is present in almost all experiments
- ▶ 6.79 MeV transition central value ends up being larger by a little bit and the percent uncertainty ends up being about the same
- ▶ Uncertainty in the ground state extrapolated S-factor has increased substantially from SFII, due to disagreement between R-matrix model and LUNA data

# Two new measurements



Li et al. (2016), Notre Dame



Wagner et al. (2018), HZDR

# Daigle et al. (2016), 278 keV resonance strength

- ▶ The uncertainties from these measurements were combined assuming they were all independent
- ▶ But all these measurements have in common the stopping power of nitrogen!

$$\epsilon_{\text{eff}} = \epsilon_r(\text{N}) + \frac{N_{\text{Ta}}}{N_{\text{N}}} \epsilon_r(\text{Ta}).$$

- ▶ Different materials, but the effective stopping power still always has nitrogen
- ▶ SRIM → **2.8%** uncertainty

Measurement	$\omega\gamma_{259}$ (meV)	Stat.	Sys.	Total
Becker <i>et al.</i> [19]	13.7			1.0
Runkle <i>et al.</i> [2]	12.4	0.4	0.8	0.9
Imbriani <i>et al.</i> [3]	12.9	0.4	0.8	0.9
Bemmerer <i>et al.</i> [5]	12.8	0.3	0.5	0.6
Yield curves	12.60	0.15	0.55	0.6
HPGe fraction fit	12.42	0.29	0.55	0.6
APEX fraction fit	12.76	0.20	0.57	0.6
Recommended <sup>a</sup>	12.6			0.3

**12.9**

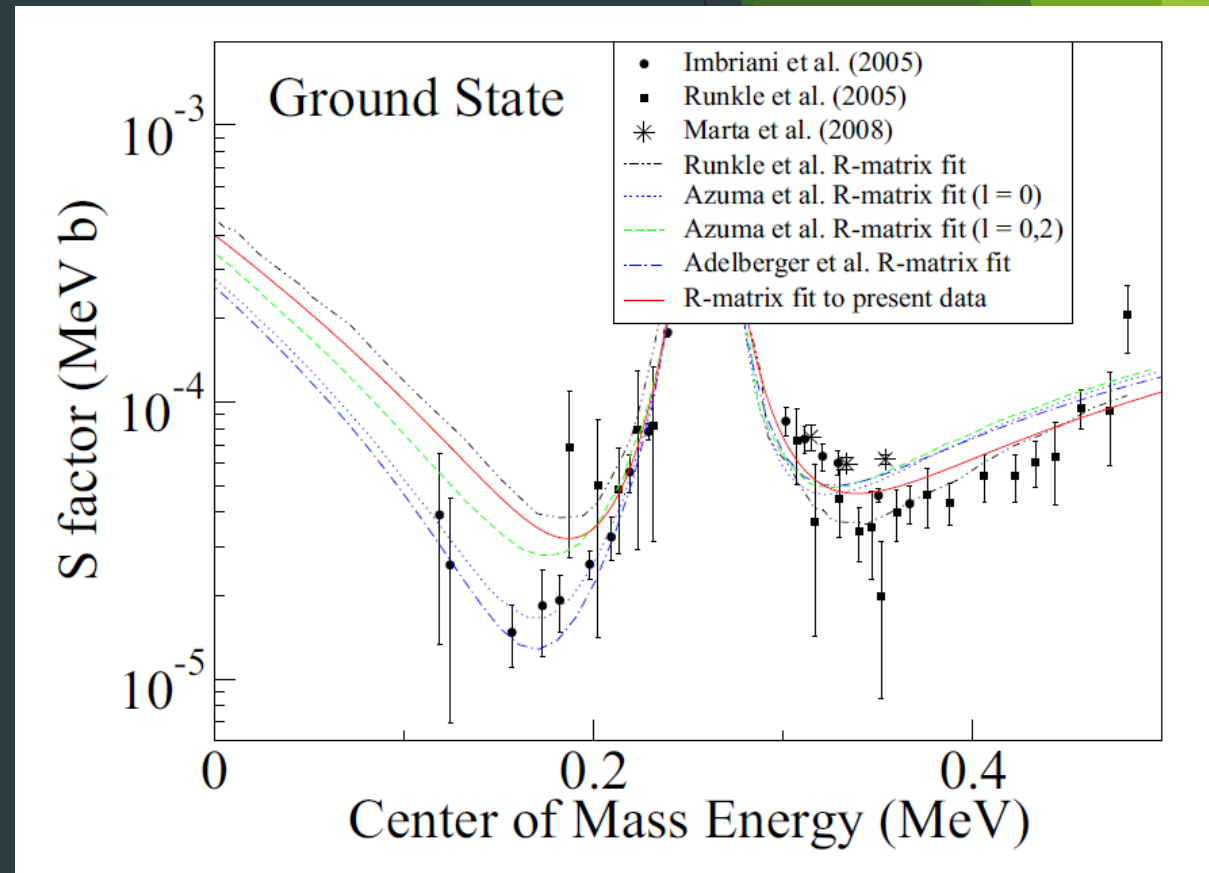
**0.45**

**2.4% → 3.5%**

Runkle et al. (2005)  
 $S(0) = 0.45 \text{ keV b}$

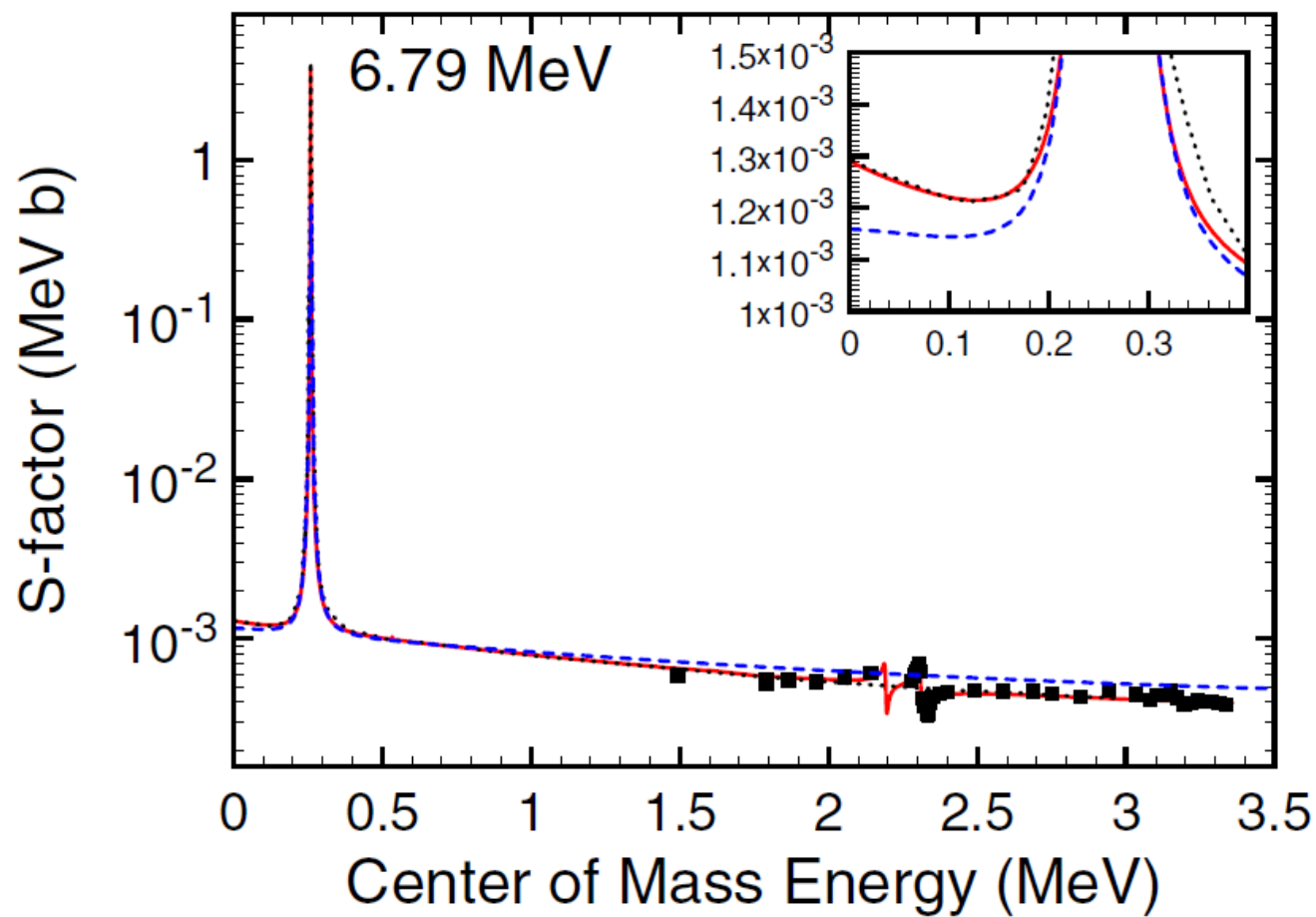
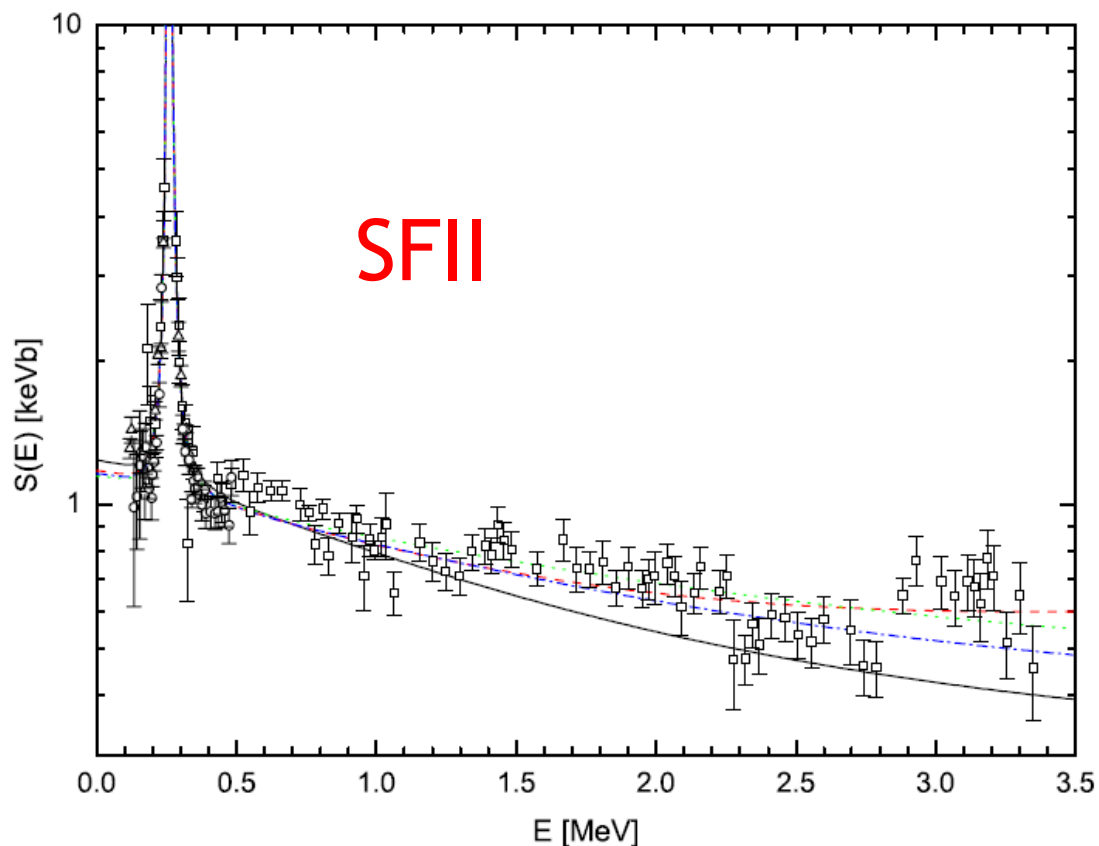
$S(0) = 0.33 \pm 14 \text{ keV b}$

$S(0) = 0.19 \text{ keV b}$   
Wagner et al. (2018)



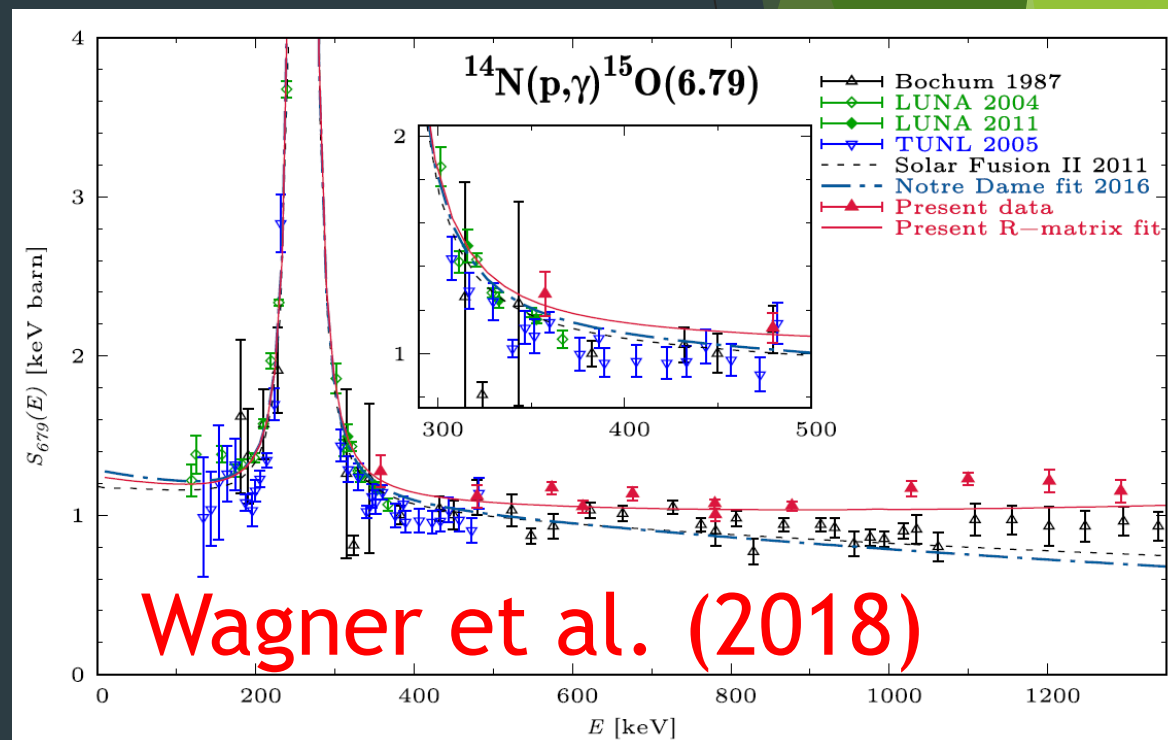
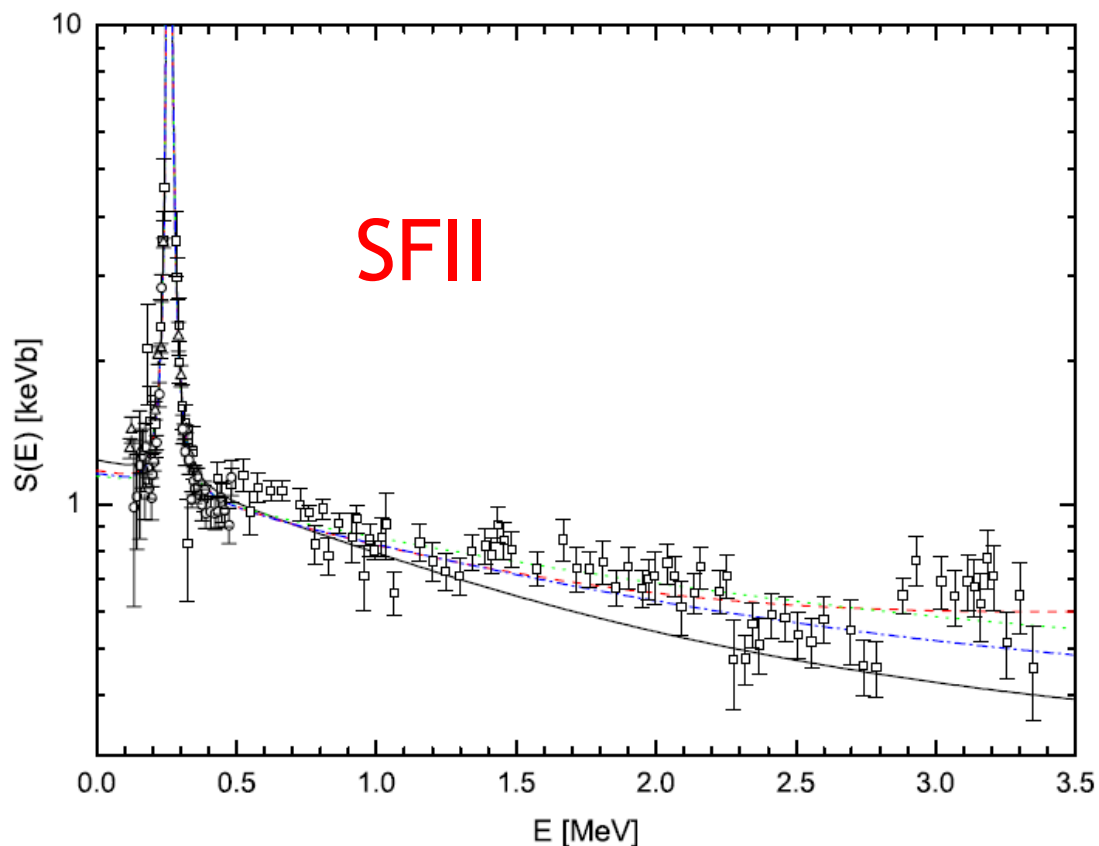
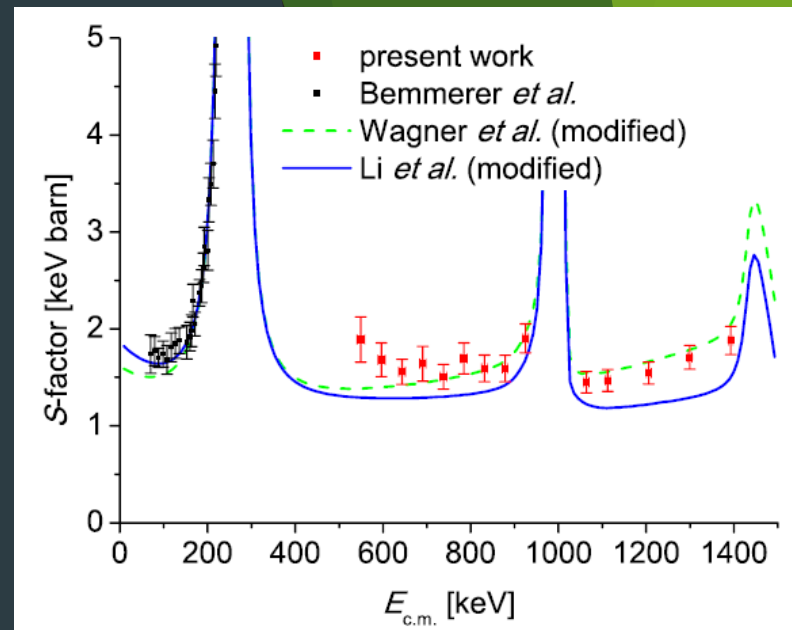
# 6.79 MeV uncertainty

Li et al. (2016)



6.79 MeV uncertainty  
 Still 4% uncertainty

Gyürky et al. (2022)





Transition	$S_{114}(0)$ (keV b)	$\Delta S_{114}(0)$	Reference
tr $\rightarrow$ 0	$0.27 \pm 0.05$	19%	Present
tr $\rightarrow$ 6.79	$1.18 \pm 0.05$	4%	Present
tr $\rightarrow$ 6.17	$0.13 \pm 0.06$	38%	Present
tr $\rightarrow$ 5.18	$0.010 \pm 0.003$	30%	Imbriani <i>et al.</i> (2005)
tr(5.24) $\rightarrow$ 0 <sup>a</sup>	$0.070 \pm 0.021$	30%	Imbriani <i>et al.</i> (2005)
<i>R</i> -matrix sum	$1.66 \pm 0.08^b$	5%	
Additional systematic uncertainty <sup>c</sup>		5%	
Total	$1.66 \pm 0.12$	7%	

SFII

Transition	$S_{114}(0)$ (keV b)	$\Delta S_{114}(0)$	Reference
tr $\rightarrow$ 0	$0.33 \pm 0.14$	42%	Present
tr $\rightarrow$ 6.79	$1.26 \pm 0.05$	4.0%	Present
tr $\rightarrow$ 6.17	$0.13 \pm 0.05$	38%	Adelberger <i>et al.</i> (2011)
tr $\rightarrow$ 5.18	$0.010 \pm 0.003$	30%	Imbriani <i>et al.</i> (2005)
tr(5.24) $\rightarrow$ 0	$0.070 \pm 0.021$	30%	Imbriani <i>et al.</i> (2005)
<i>R</i> -matrix sum	$1.80 \pm 0.16$	8.8%	
Additional systematic uncertainty		3.5%	
Total	$1.80 \pm 0.17$	9.5%	

SFIII