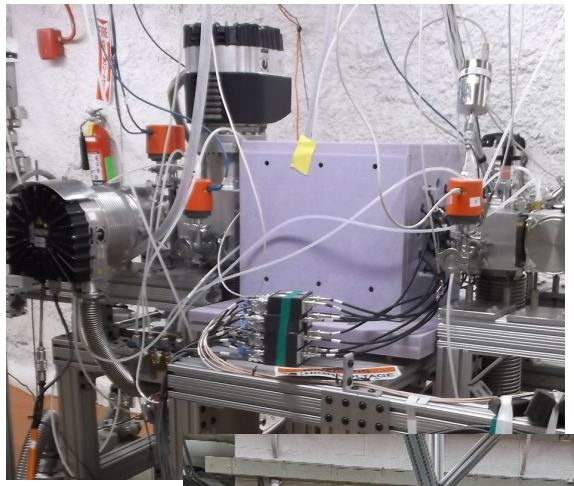
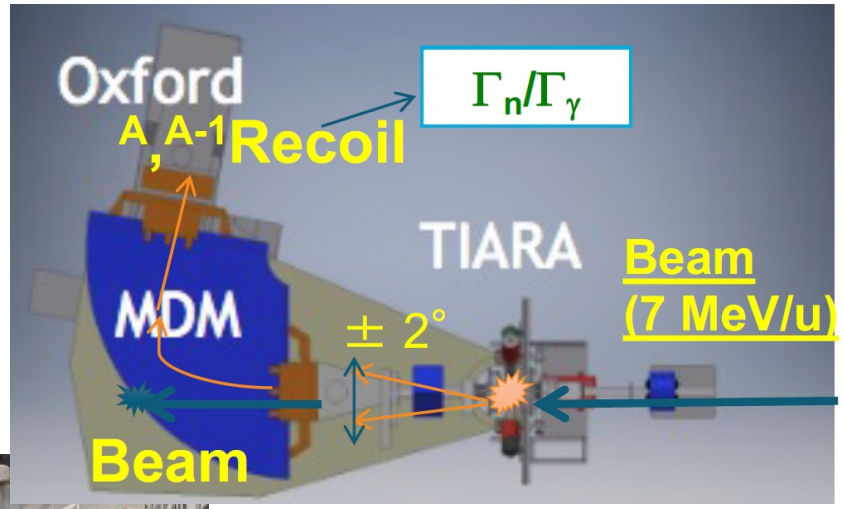
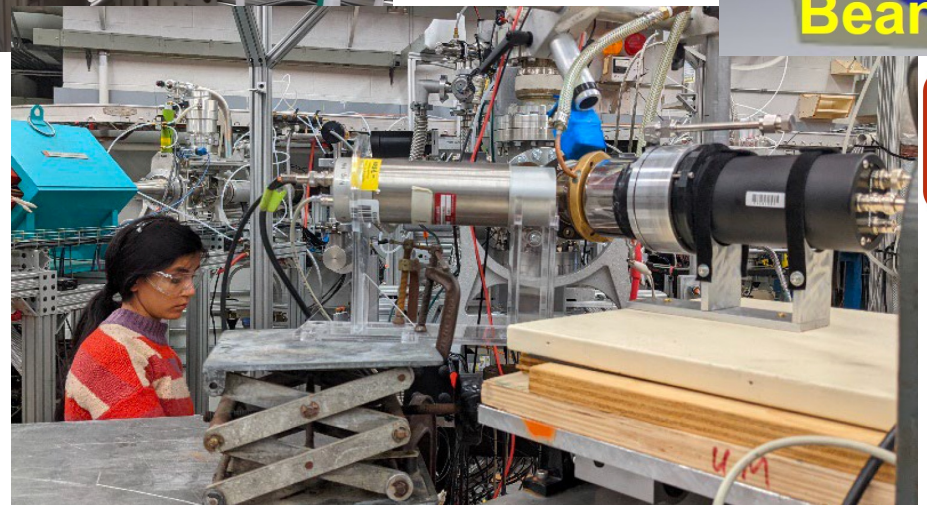
Big Three #3
$^{22}Ne(a,n)^{25}Mg$ - Experiments





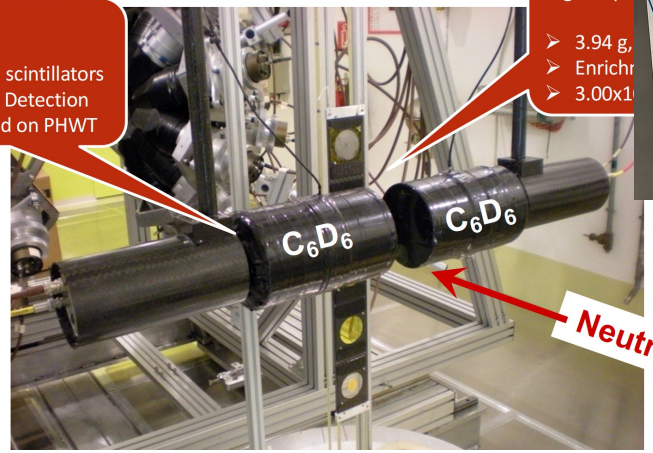


Capture setup:

- 2 C_6D_6 liquid scintillators
- Total Energy Detection System based on PHWT

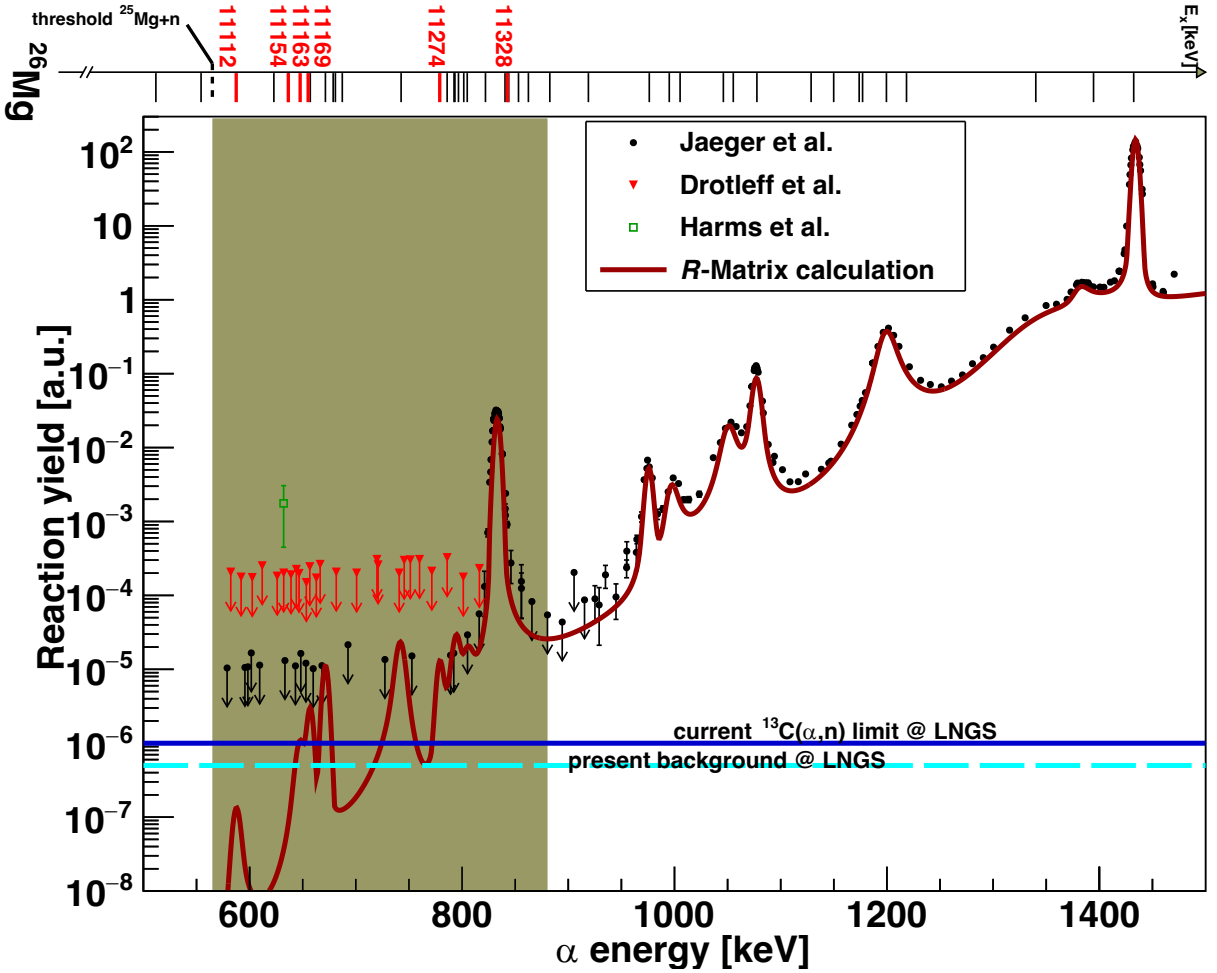
Mg sample

- 3.94 g,
- Enrichr
- 3.00x1



S process meeting in Naples, Feb 24

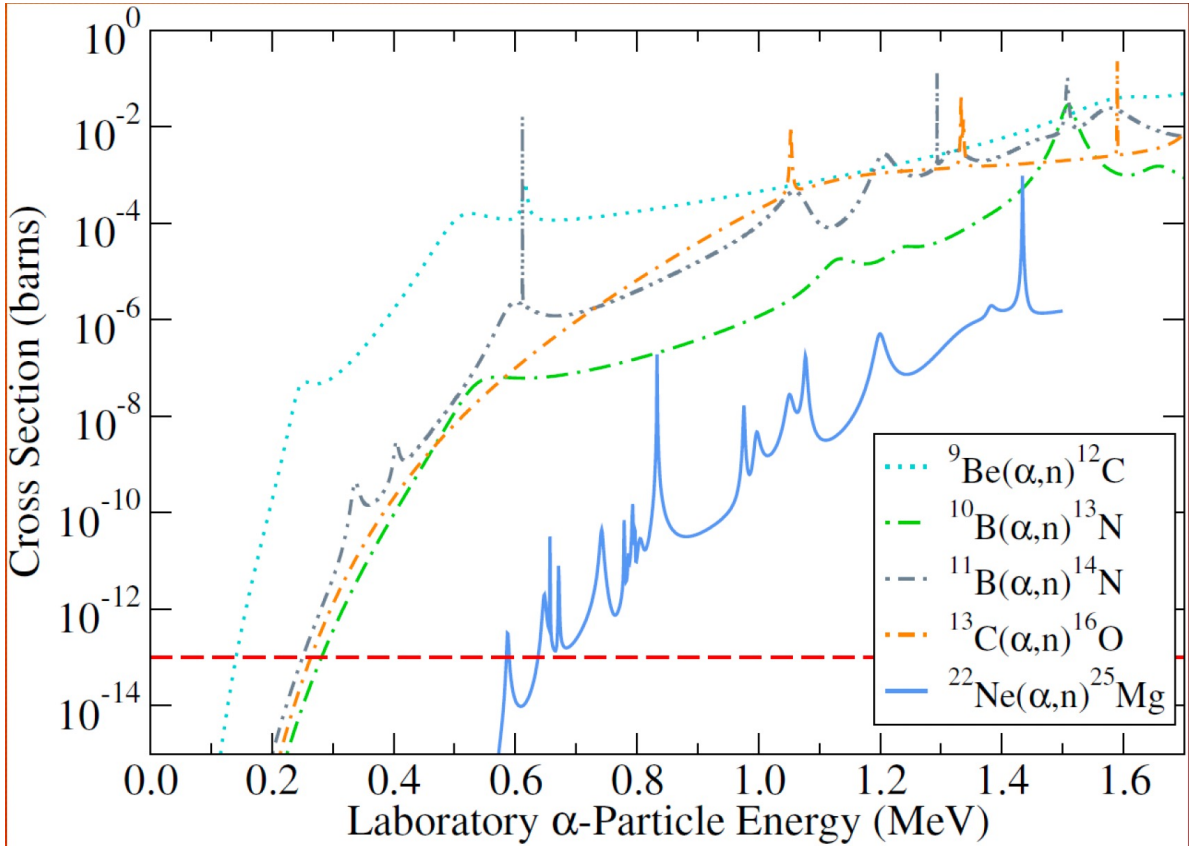
- Conveners: Phil Adsley, Andreas Best
- Experimental talks:
  - Phil Adsley, mostly overview of Chetec paper
  - Chemseddine Ananna, UniNA/LNGS – SHADES (direct, in progress): low E + 832 keV
  - Richard DeBoer, Notre Dame – direct 832 keV, under review
  - Christian Massimi, n_tof/GELINA – ^{25}Mg(n, g/tot)
  - Shuya Ota, TAMU – alpha transfer
  - Frank Strieder, CASPAR, direct 832 keV
- Obviously very strong connection between n and g channels

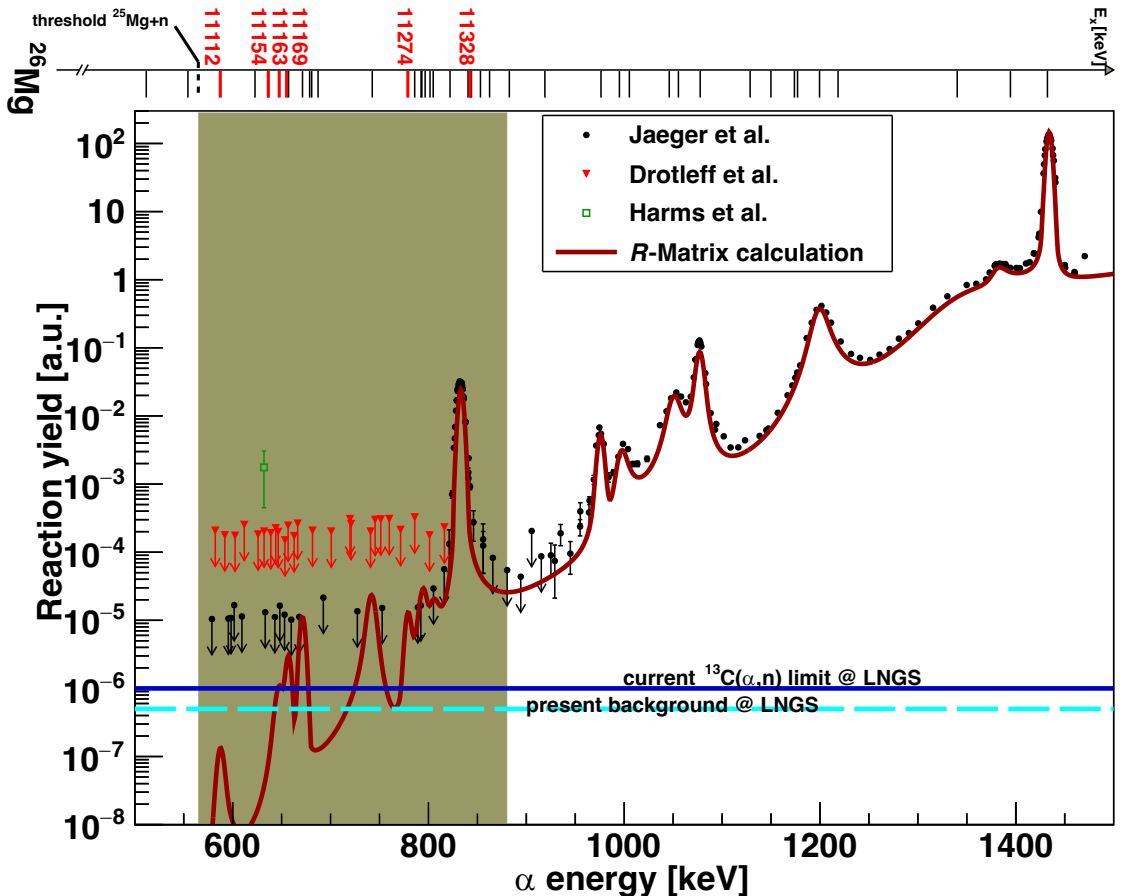


R matrix courtesy R. deBoer/JINA
(hypothetical < 830 keV)

What's the problem?

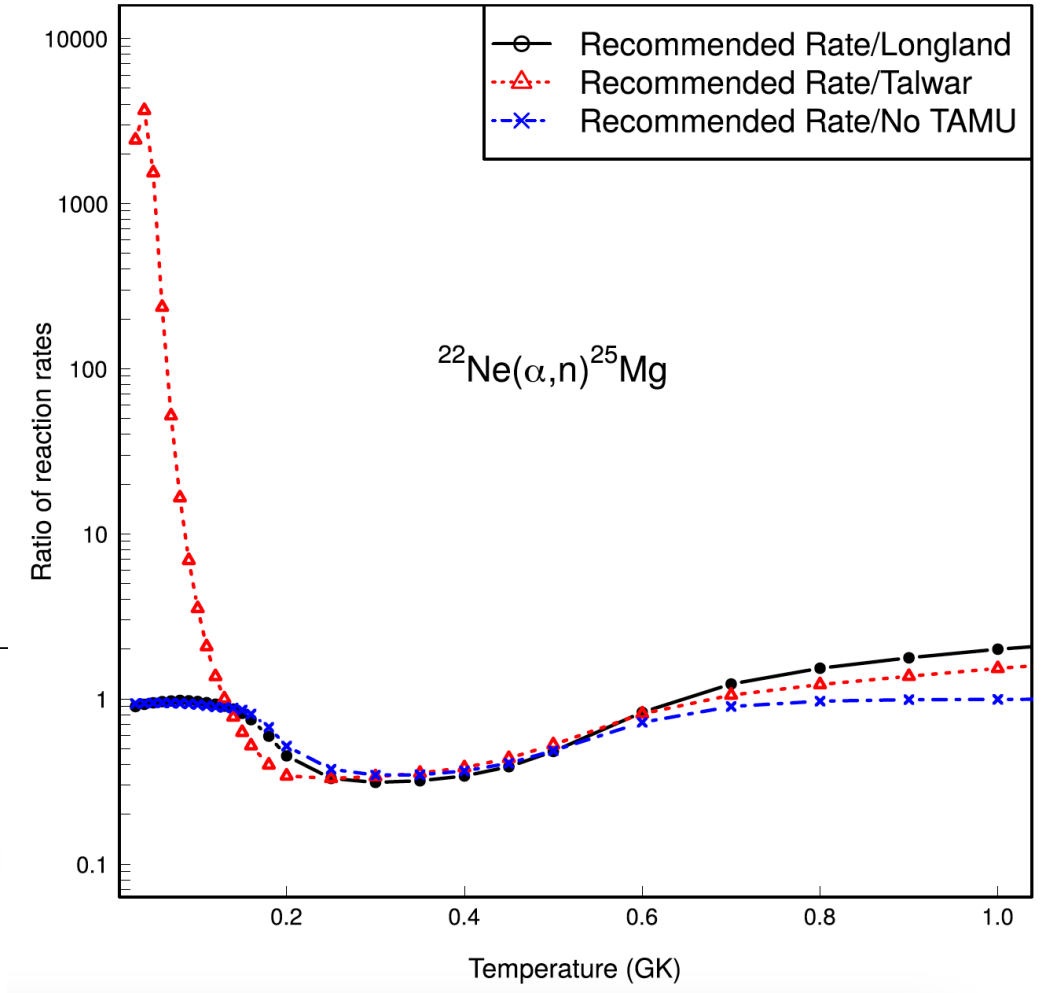
- Z relatively high -> quite low cross section
- External background (on surface) too strong
- Low Z (13C, 10/11B, 9Be etc.) much stronger -> small impurities can bomb the data
- **Are there significantly strong lower-energy resonances**?





Adsley – synthesis of indirect data

- Meant to add new input and update/replace Longland et al evaluation
- Adley, Lotay, Talwar, Ota, Jayatissa
- a, p, (d,p), (^{6}Li, d) -> Energy, Jpi of states
- May states, some discrepancies between measurements, n/g width of 832 resonance?



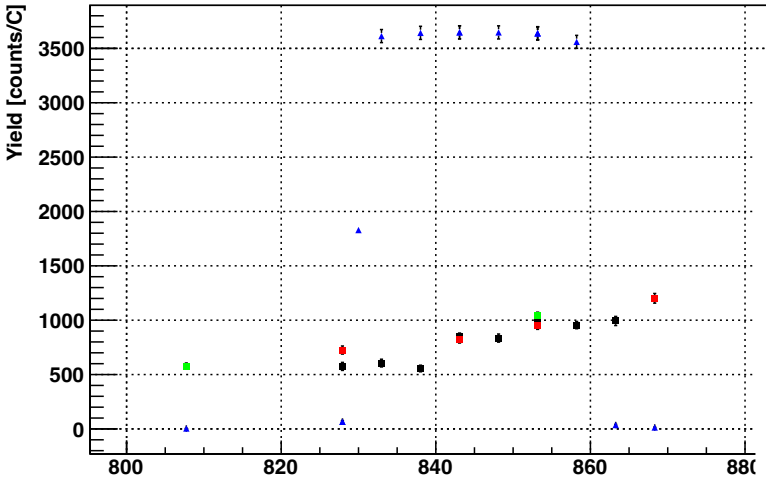
PHYSICAL REVIEW C **103**, 015805 (2021)

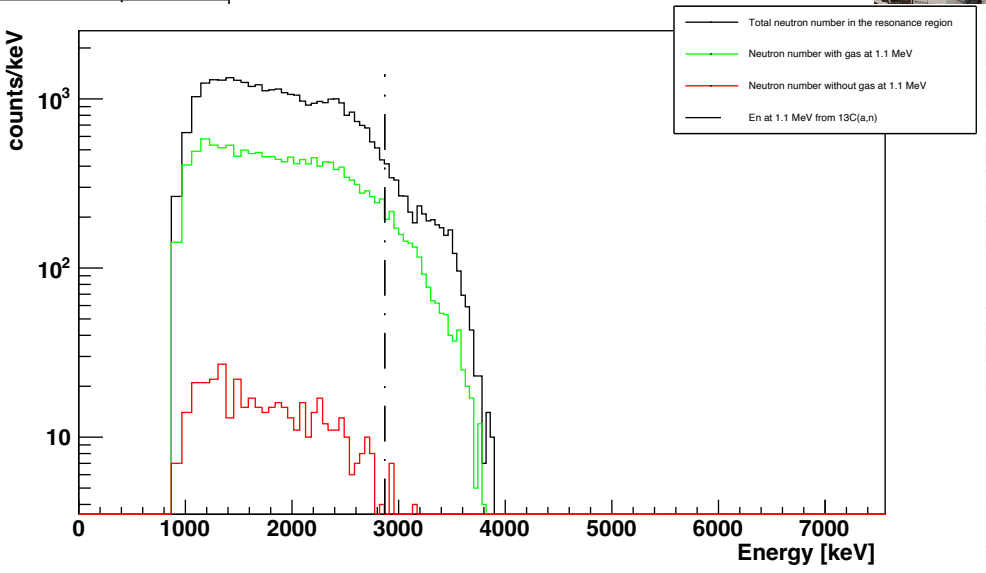
Reevaluation of the ^{22}Ne(α, γ)^{26}Mg and ^{22}Ne(α, n)^{25}Mg reaction rates

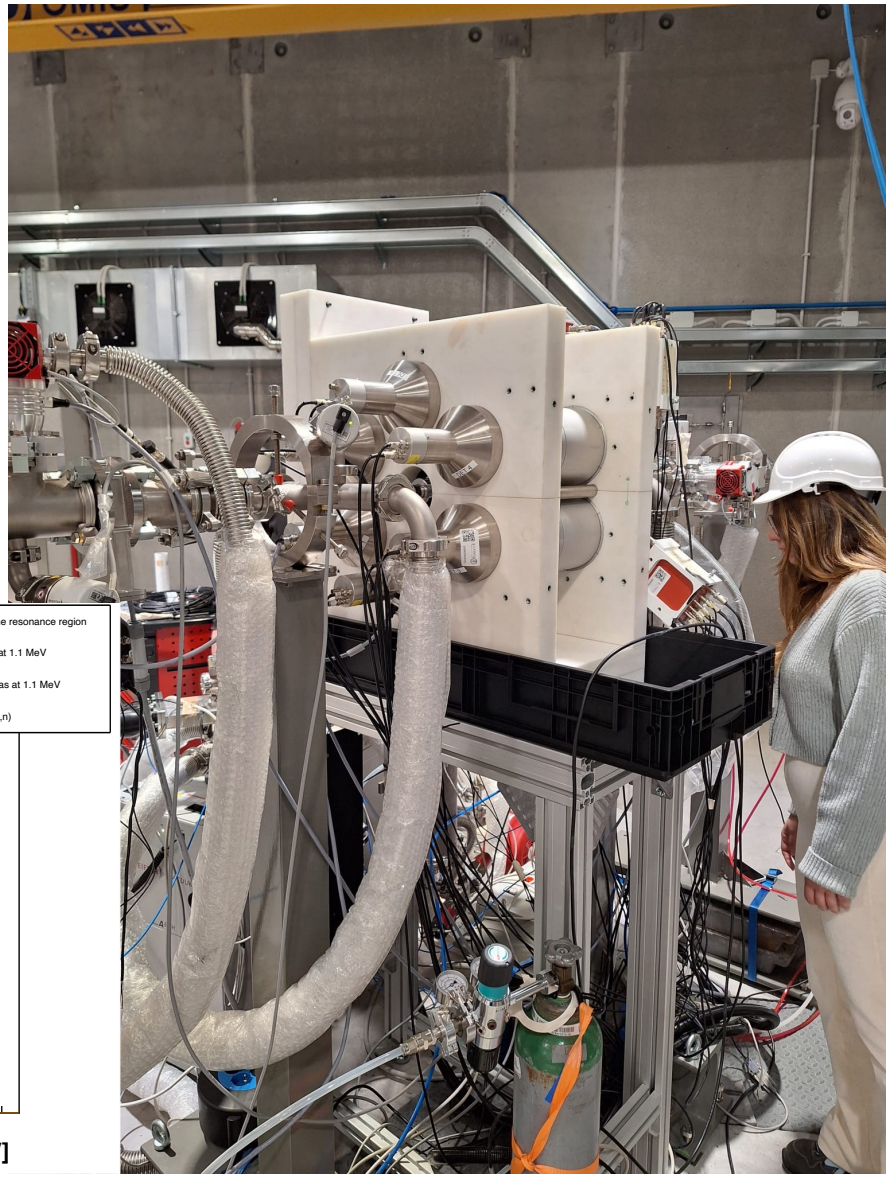
Philip Adsley,[1,2,3,*] Umberto Battino,[4,†] Andreas Best,[5,6] Antonio Caciolli,[7,8] Alessandra Guglielmetti,[9] Gianluca Imbriani,[5,6] Heshani Jayatissa,[10] Marco La Cognata,[11] Livio Lamia,[12,11,13] Eliana Masha,[9] Cristian Massimi,[14,15] Sara Palmerini,[16,17] Ashley Tattersall,[4,†] and Raphael Hirschi[18,19,†]

SHADES – UniNa/LNGS @ LUNA MV

- Direct, deep underground, gas target
- Scintillators + ^{3}He counters
- Sensitivity increase > 2 o.o.m. + energy sensitivity
- First neutron runs w/ natural gas April 24
- Good: saw neutrons. Bad: saw wrong neutrons (BIB)
- Upgrades for next beam time in July





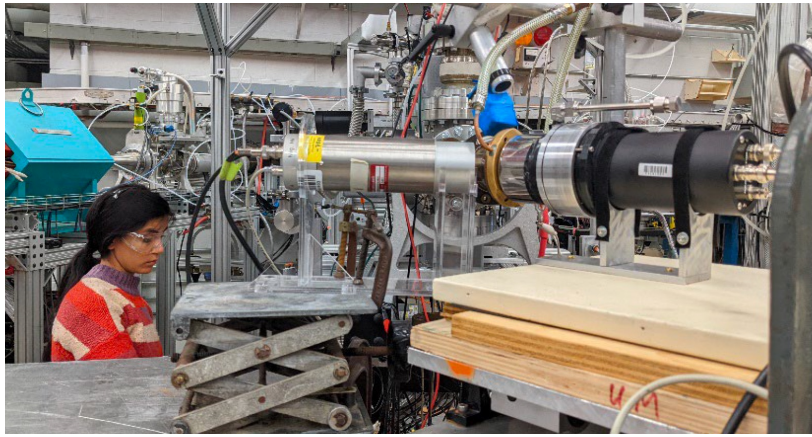


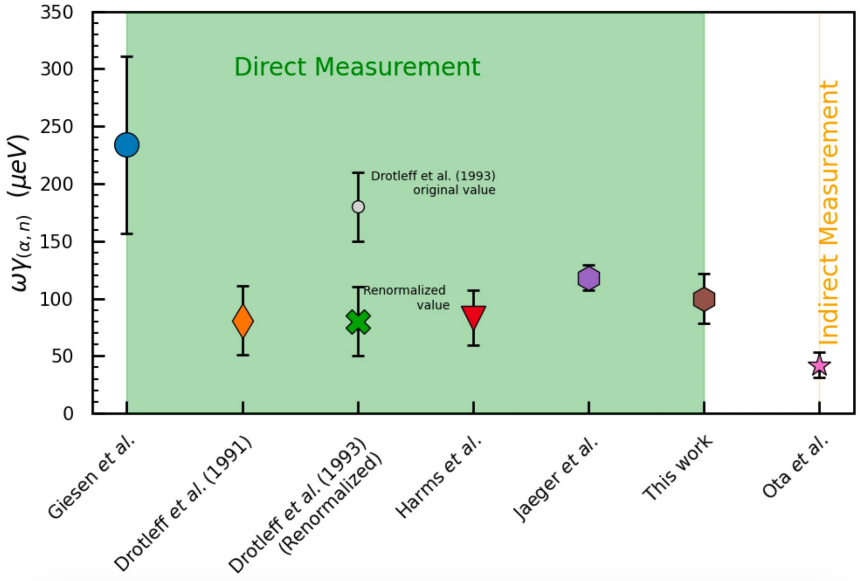
deBoer – Notre Dame 832 keV resonance

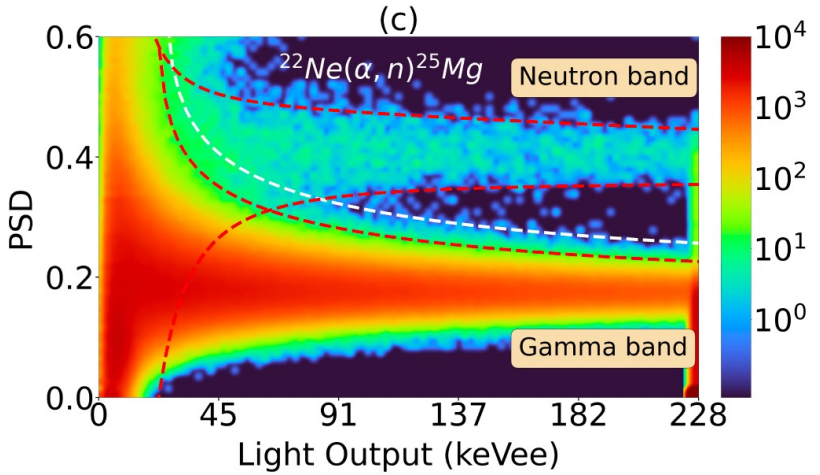
Strength measurement of the $E_\alpha^{lab} = 830$ keV resonance in $^{22}\mathrm{Ne}(\alpha, \mathrm{n})^{25}\mathrm{Mg}$ reaction using a stilbene detector

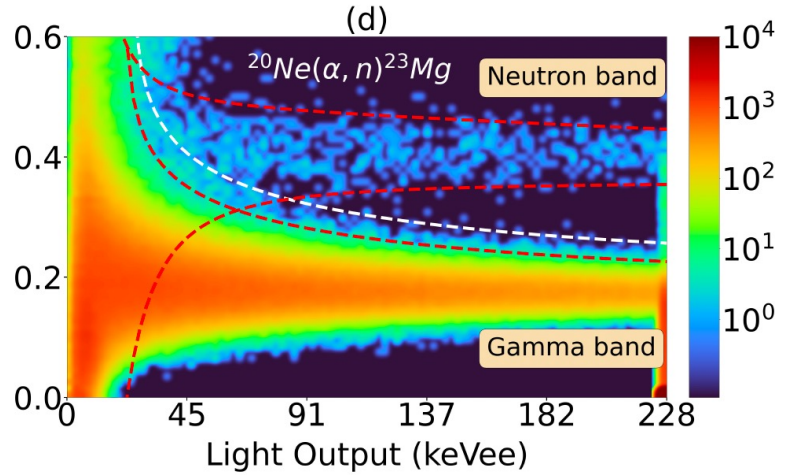
Shahina,[1] R.J. deBoer,[1] J. Görres,[1] R. Fang,[1] M. Febbraro,[2,3] R. Kelmar,[1] M. Matney,[1] K. Manukyan,[1] J.T. Nattress,[2] E. Robles,[1] T.J. Ruland,[2] T.T. King,[2] A. Sanchez,[1] R.S. Sidhu,[4] E. Stech,[1] and M. Wiescher[1]

- Direct, stilbene detector, implanted ^{22}Ne in Ta
- Only on-resonance data
- 22% uncertainty
- Confirms literature average





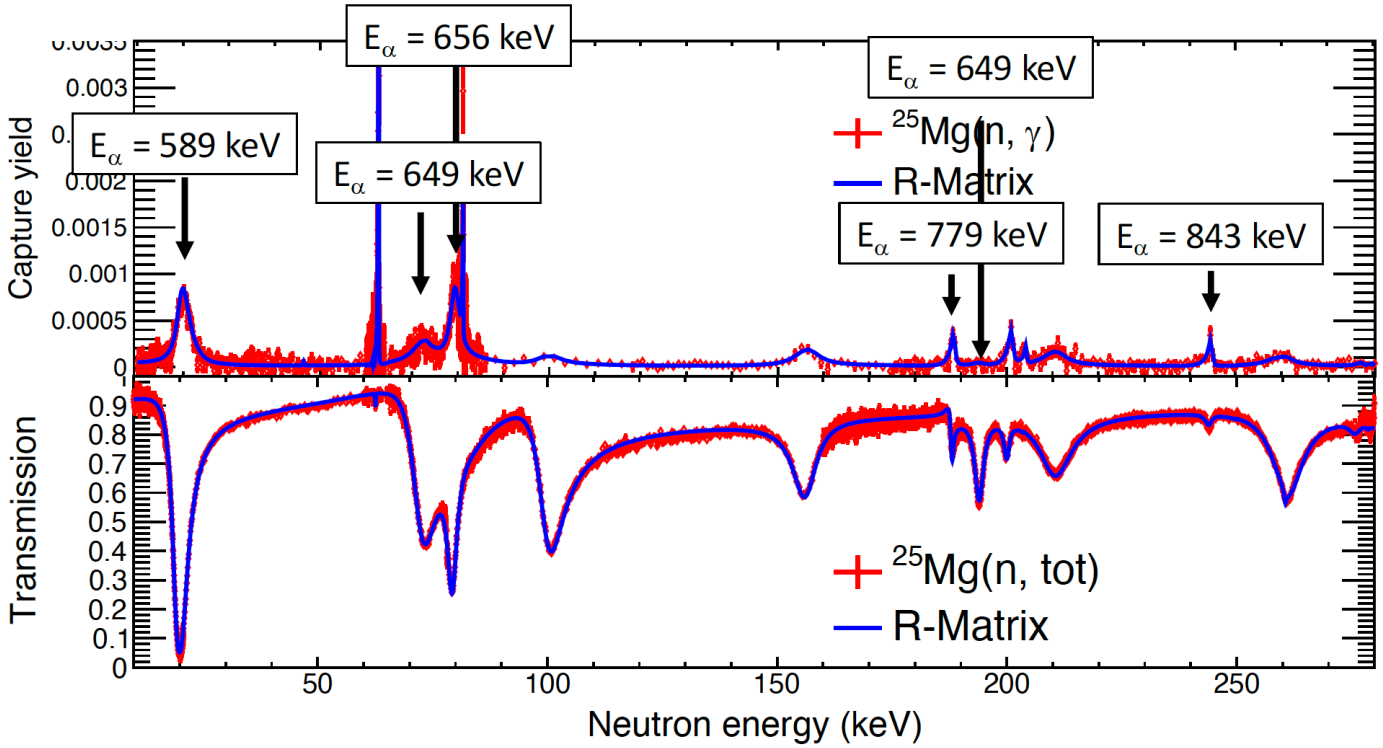


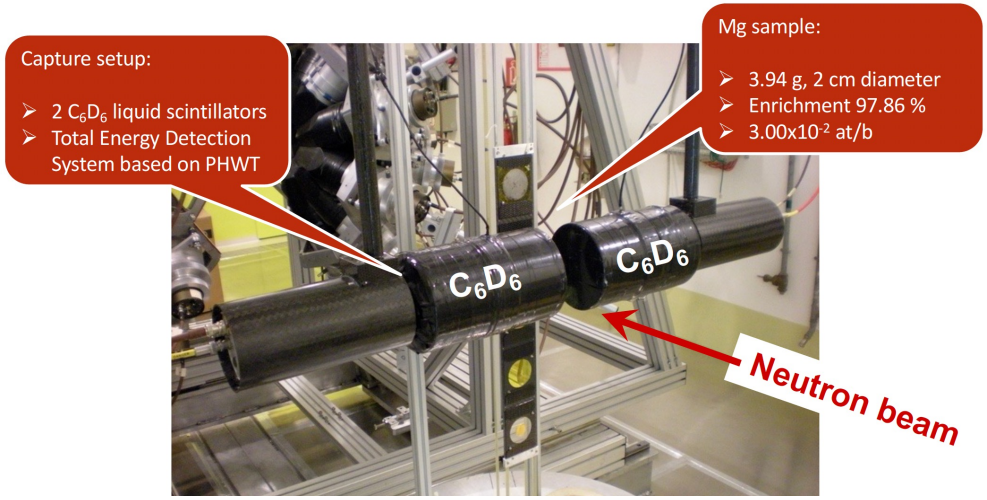


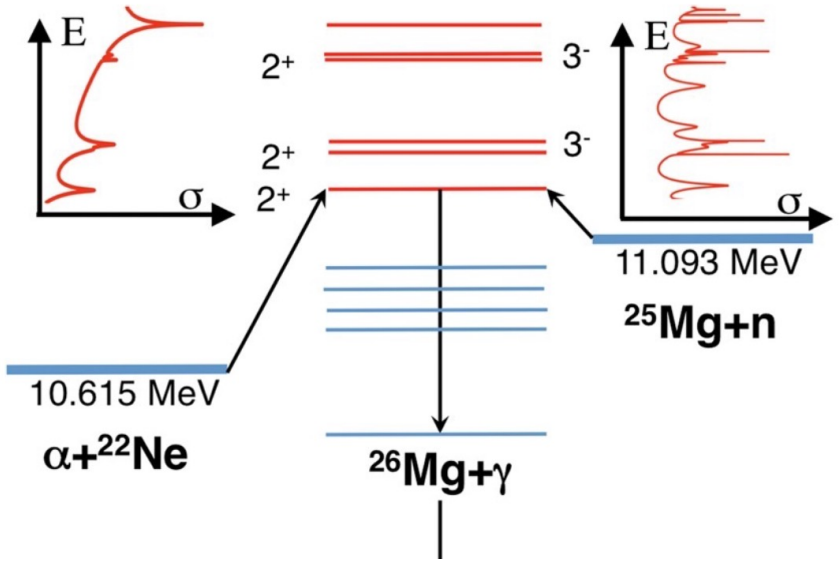
Massimi – (n, g) & (n, tot)

C Massimi *et al.*, Phys. Rev. C **85**, 044615 (2012)
C Massimi *et al.*, Phys. Lett. B **768**, 1 (2017)

- Neutron capture @ n_tof and GELINA
- Very comprehensive dataset and R matrix, extracted widths ,E_x , Jpi
- Identified nat. parity states < 832 keV
- Confusion about 832 res.: width, Energy?

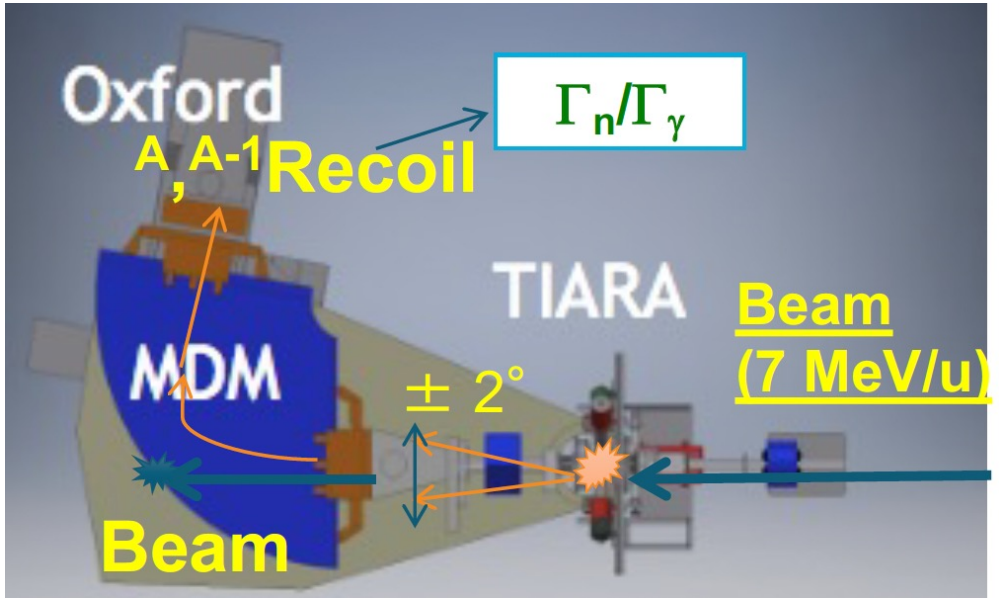


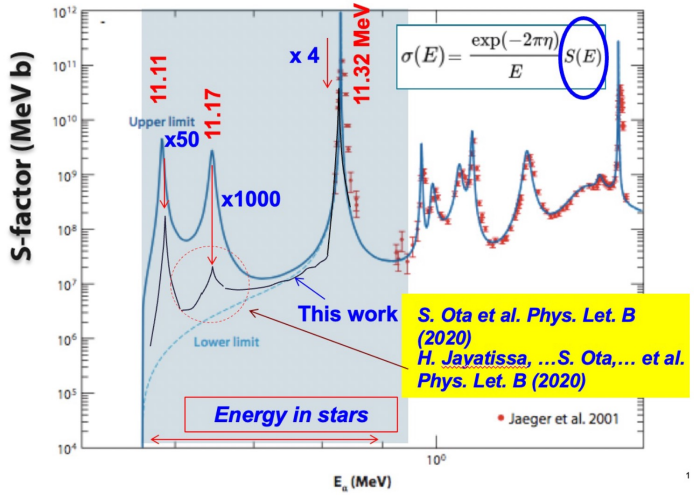




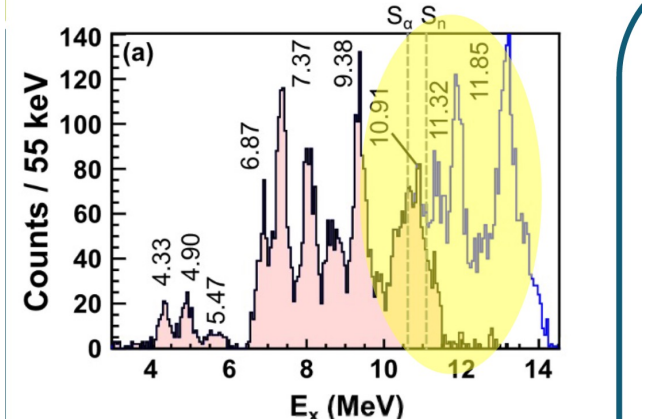
Ota: TAMU alpha transfer

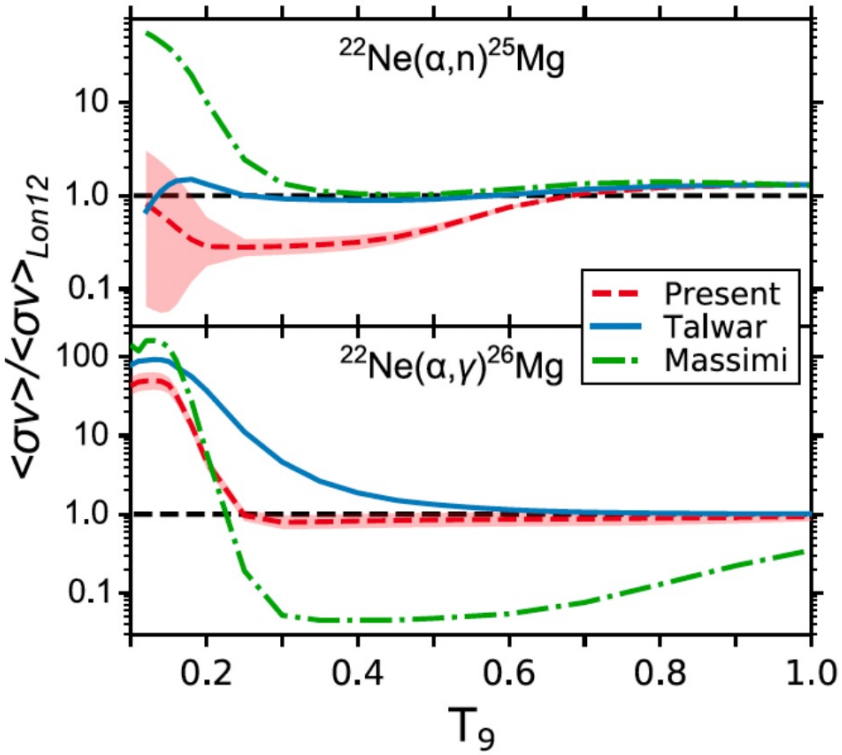
- Ota PRC 2021, Jayatissa PLB 2020, Ota PLB 2020
- ^{22}Ne(^{6}Li, d): detection of recoils + light particles + gammas (few)
- Discrepancies with Talwar et al. and direct 832 keV strength
- *"Ex=11.17 MeV resonance is likely negligible"*
- *"Ex=11.12 MeV resonance is negligible as well"*





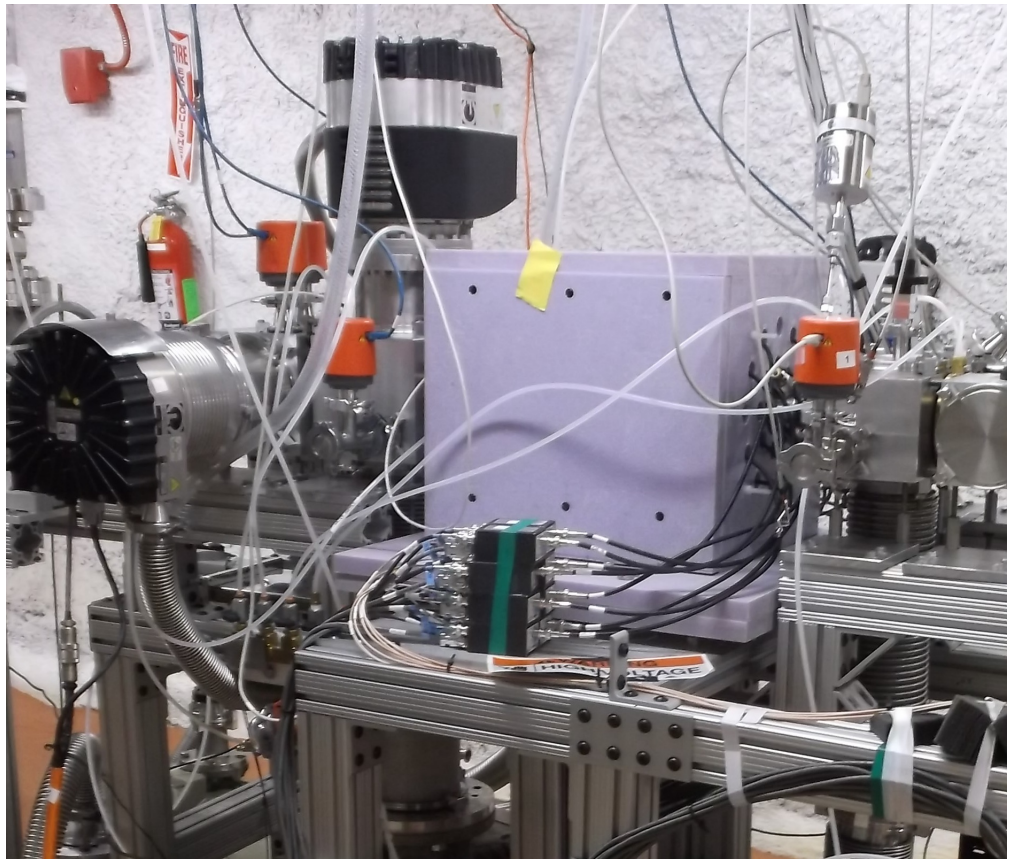
→ **S_α, Γ_n/Γ_γ, and J^π**

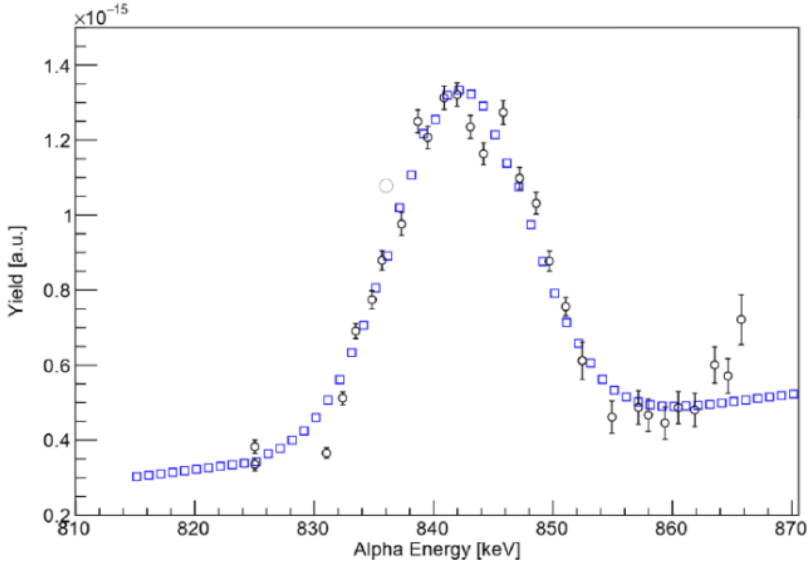


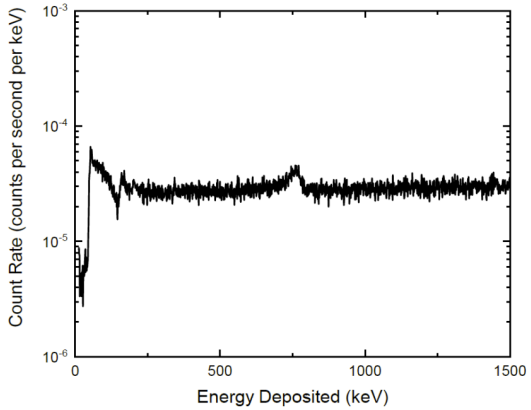


Strieder: 832 keV direct underground @ CASPAR

- Gas target, JN accelerator deep underground @ Homestake
- Moderating detector with ^{3}He counters
- Counters have high intrinsic BG
- Scan of 832 keV resonance
- **Preliminary** wg = 180 ueV (multiple sigma above recent others)







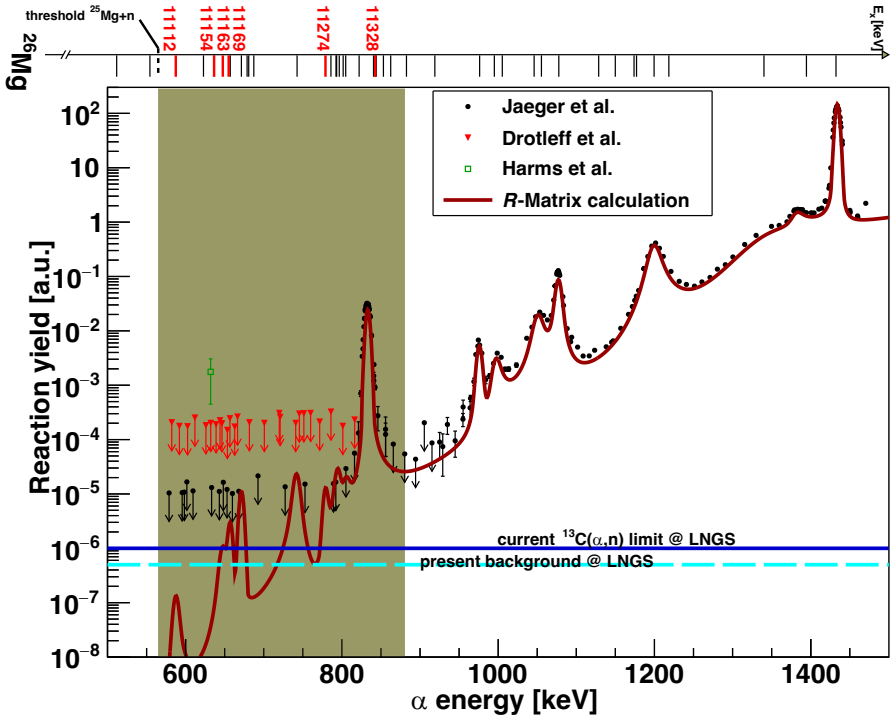
Underground measurement of low energy resonances for the ^{22}Ne$(\alpha,\mathrm{n})^{25}$Mg reaction

T. Kadlecek,[1] M. Couder,[2,3] M. Dannhardt,[1,4] R. Kelmar,[2,3] O. Olivas-Gomez,[2,3] D. Robertson,[2,3] F. Strieder,[1] and M. Wiescher[2,3]

[1] *Department of Physics, South Dakota School of Mines and Technology, Rapid City, South Dakota 57701 USA*
[2] *Department of Physics and Astronomy, University of Notre Dame, Notre Dame, Indiana 46556, USA*

PRC – in preparation

Summary and outlook



- Large number of studies, some consistencies, some inconsistencies
- 832 keV resonance still deemed to be most important, but open questions on identification, exact strength, n/g widths
- Upcoming indirect measurements
  - Adsley, Best, Laird ^{22}Ne(^{7}Li, t) @ TRIUMF (EMMA, TIGRESS)
  - Hammache ^{22}Ne(^{7}Li, t) proposal at Ganil?
- Waiting for publication of CASPAR result
- SHADES direct low energy ongoing, give us a bit more time ☺