The Joint Institute for Nuclear Astrophysics

$^{24}Mg(\alpha,\gamma)^{28}Si$ Resonance Parameters at Low Alpha Energies

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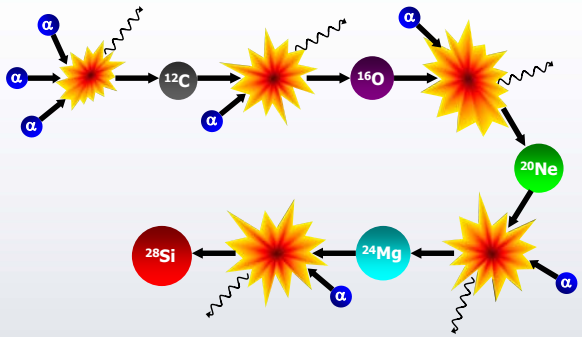
Motivation: Carbon Burning

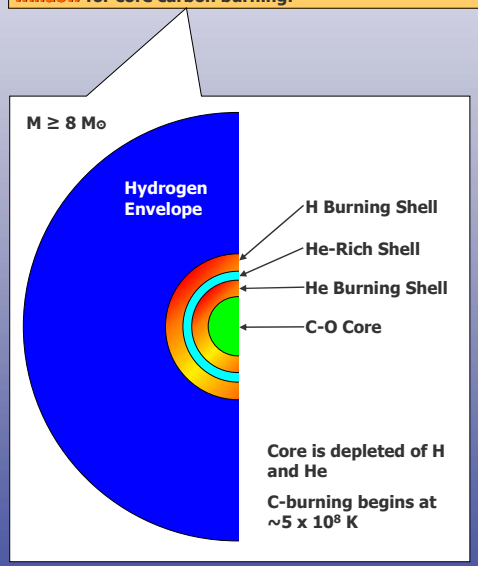
^{28}Si is built from alpha particles during later stages of stellar burning in massive stars



We measured the final step of this process:

$^{24}Mg(\alpha,\gamma)^{28}Si$

Previously, this reaction has been studied at alpha energies down to 1.3MeV. We extended this range down to 1.0MeV, into the Gamow window for core carbon burning.



Experimental Techniques

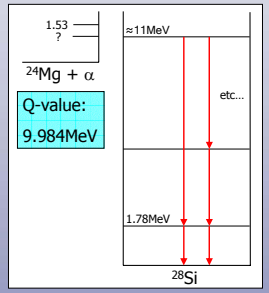
➢We needed high alpha beam currents, durable targets with as much ^{24}Mg as possible, and a very efficient detection system!

Beam: Using the 4MV KN accelerator at Notre Dame, we ran for 4 weeks with beam currents up to 150μA.

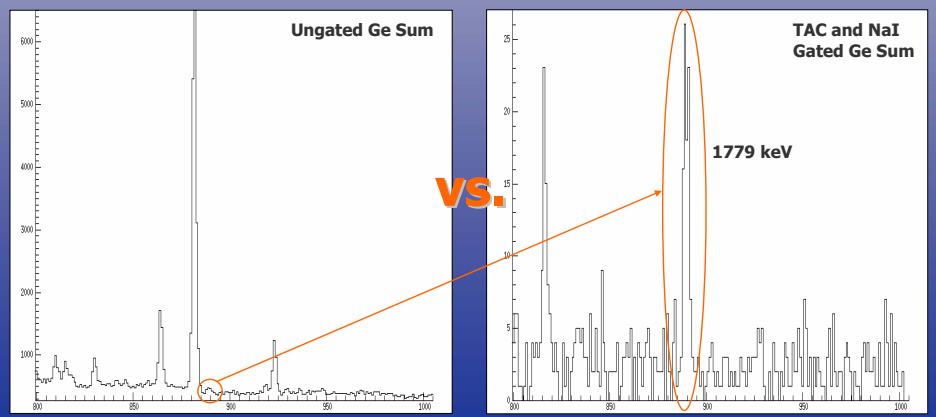
Targets: We used natural magnesium evaporated on copper backings. Targets were stable up to 7 coulombs of accumulated charge.

Four 8 x 6 inch NaI detectors were coupled with a clover HPGe detector. The target and clover were placed at a 45° angle.

With this detector setup, we can exploit the level structure of ^{28}Si to form a coincidence requirement of a high energy gamma in the NaI's + 1779keV in the clover.

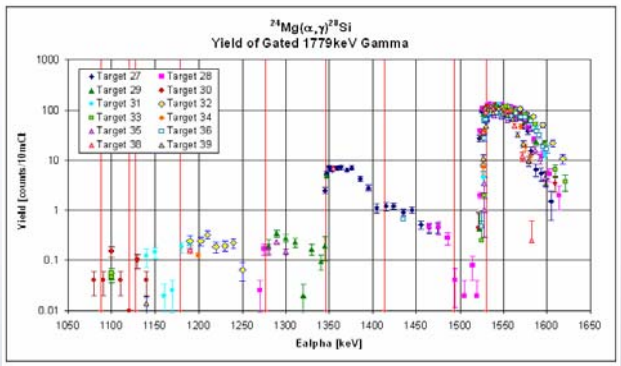


Using the coincidence requirement, background gammas are reduced by 3 orders of magnitude, and weak features are clearly visible!



Results

Excitation function



Using the thick-target yield, we calculated the resonance strength $\omega\gamma$:

E_α (keV)	Current Value (meV)	Previous Experiments (meV)
1530	104 ± 21	110 ± 20 (Maas 78)
1413	0.16 ± 0.03	
1350	2.1 ± 0.5	1.9 ± 0.6 (Lyons 69)
1277	0.034 ± 0.009	
1178	0.34 ± 0.12	
1087	0.013 ± 0.005	
≤1065	≤ 0.004	

Still to do...

Finally, we will use the newly determined resonance parameters to calculate the reaction rate, which will be used to improve stellar modeling codes!

References

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