Particle-decay branching ratios via intermediate-energy transfer reactions

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KVI, Groningen and

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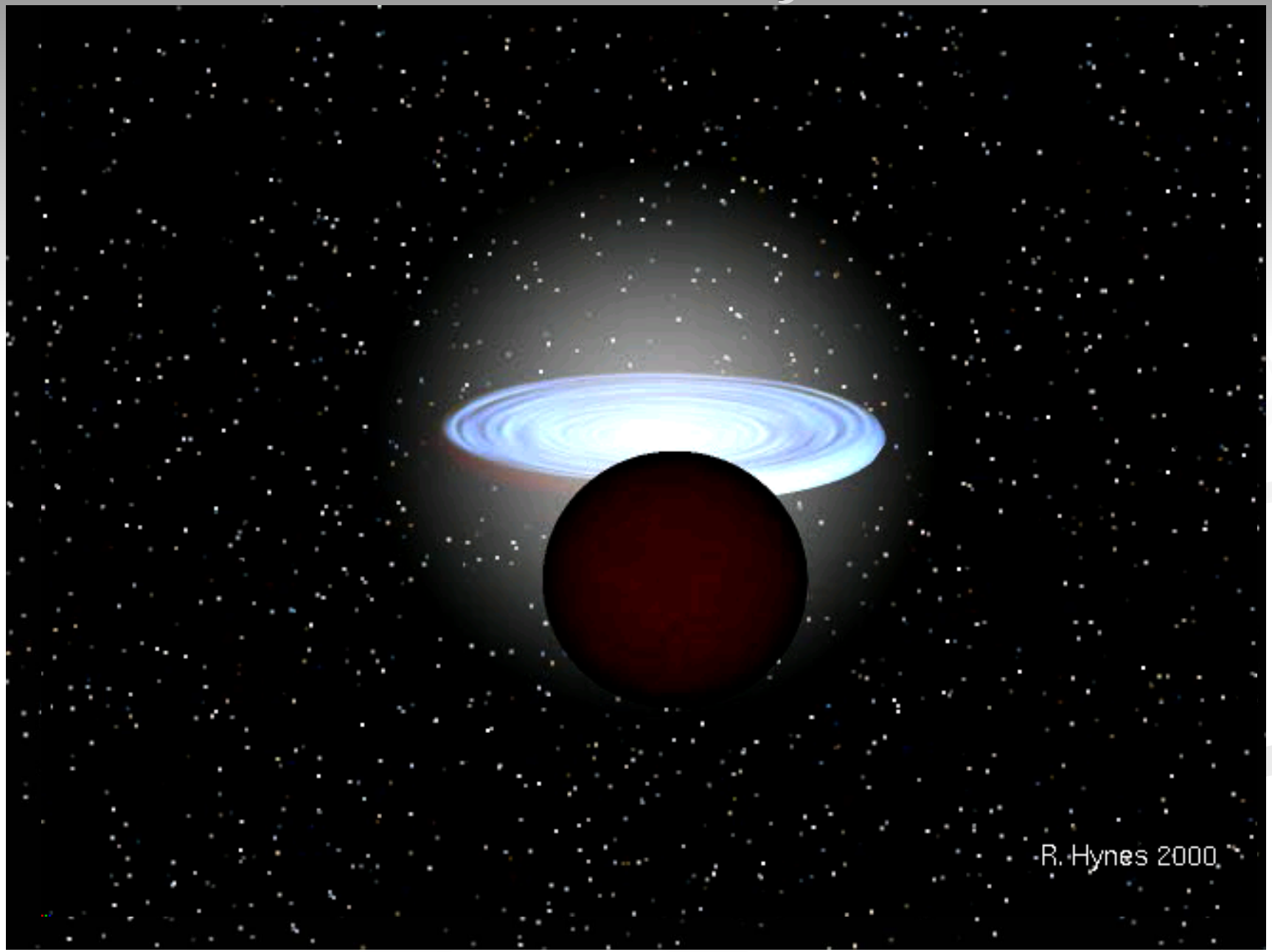
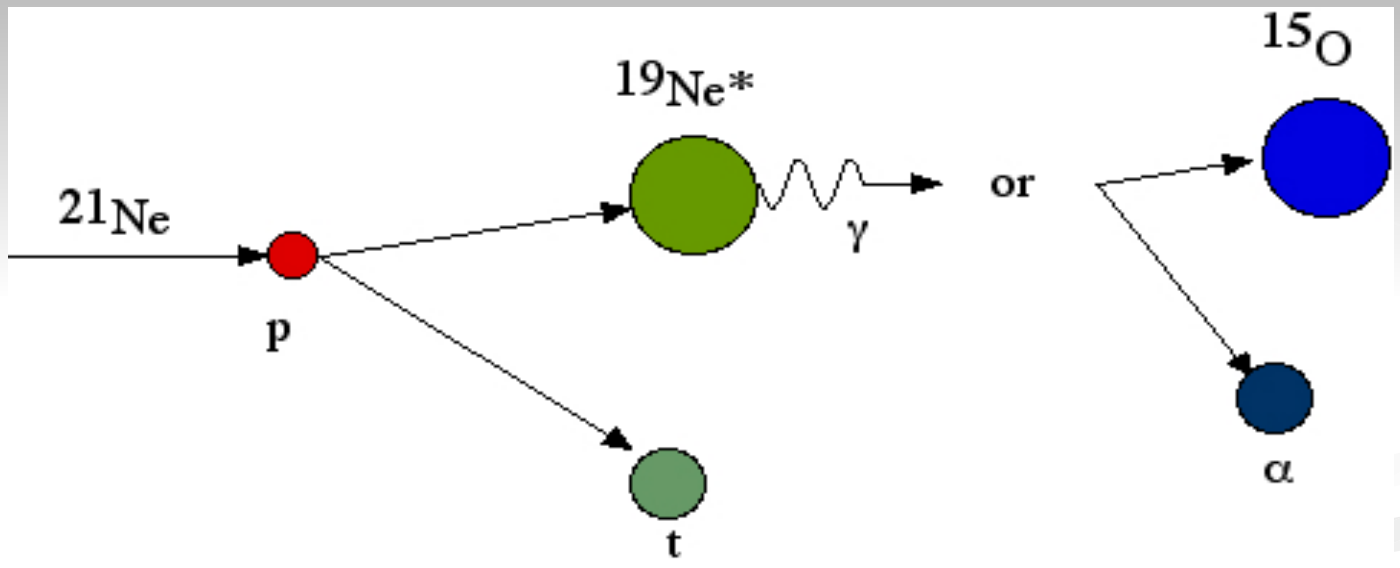
Novae and x-ray bursts

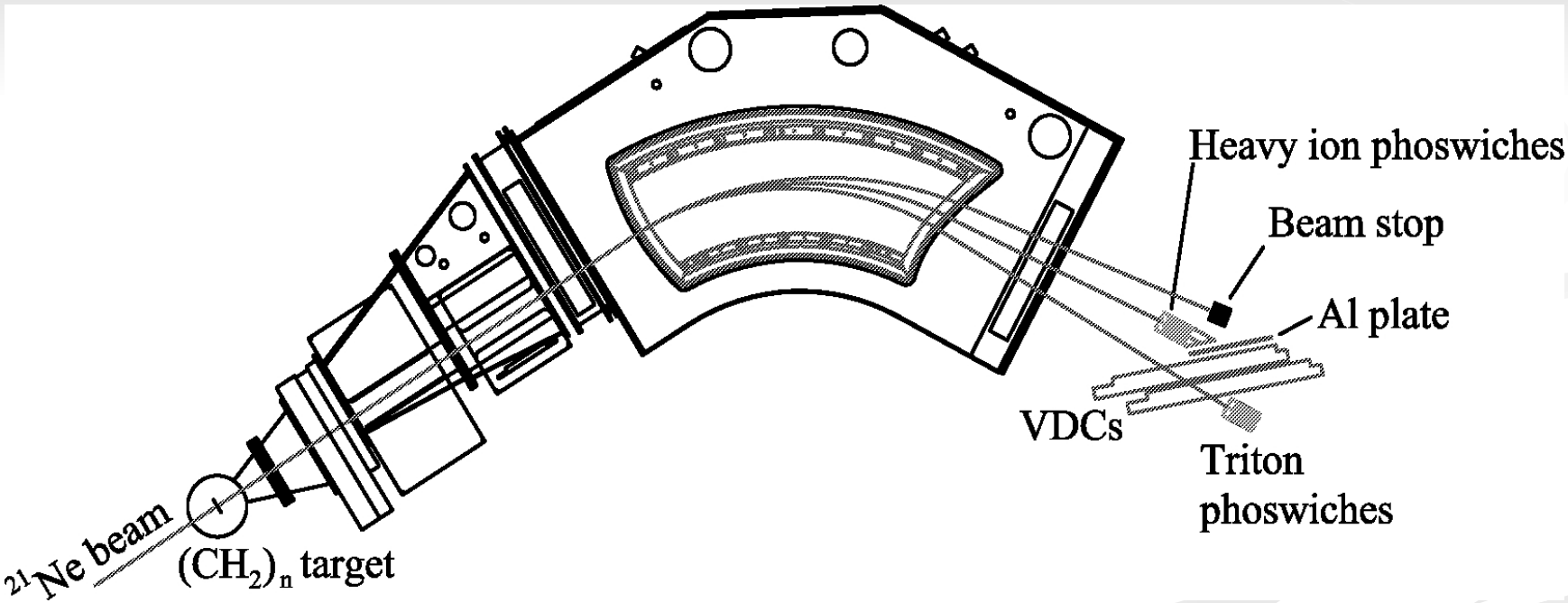


Experimental Technique

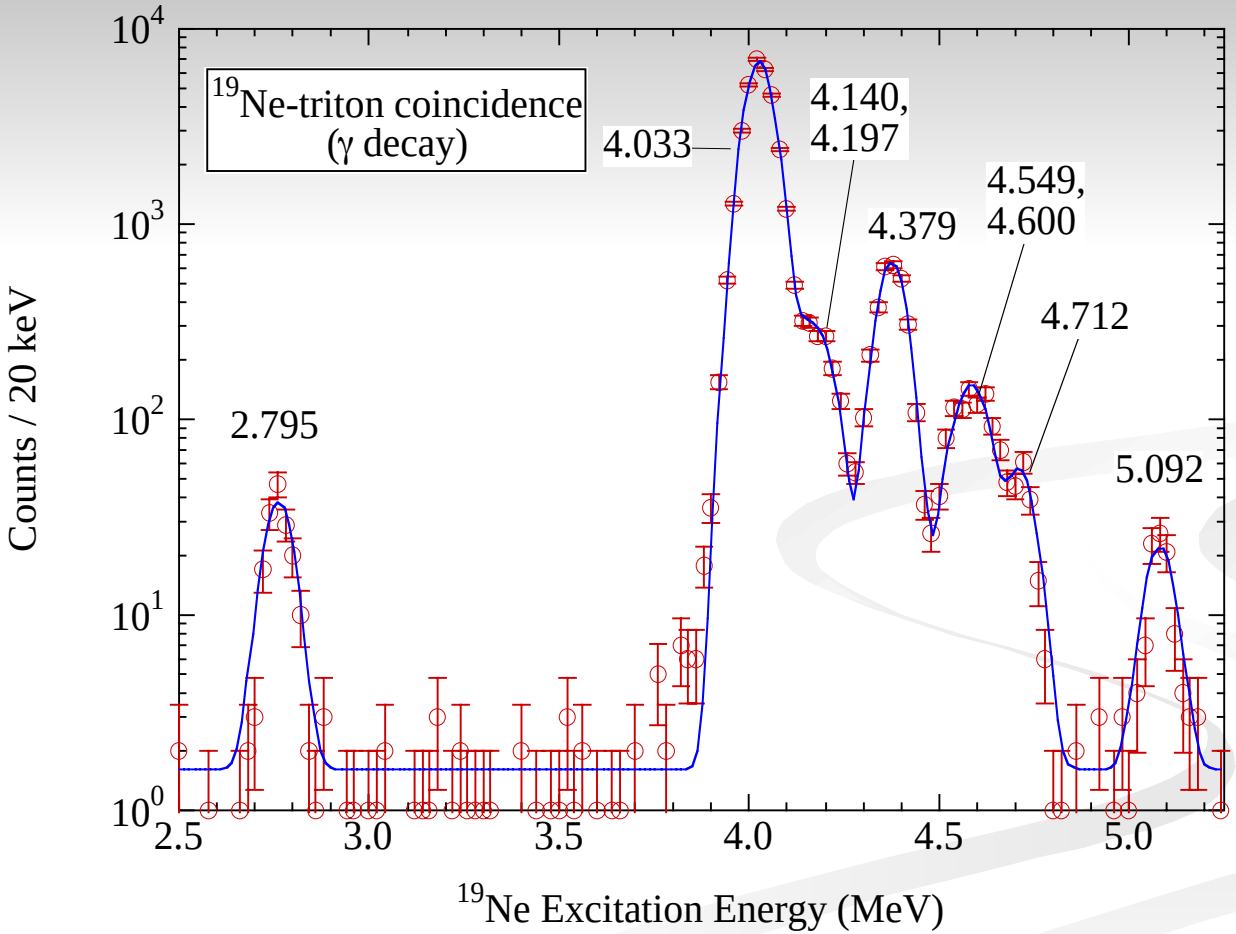


- Populate resonances via surrogate reaction, study decays
- Studied $^{15}O(\alpha,\gamma)^{19}Ne$ using $p(^{21}Ne,t)^{19}Ne$ reaction
- Excited states decay by α or γ emission
- Coincident detection of *t* ejectile and either ^{19}Ne recoil or ^{15}O decay product yields α-decay branching ratio

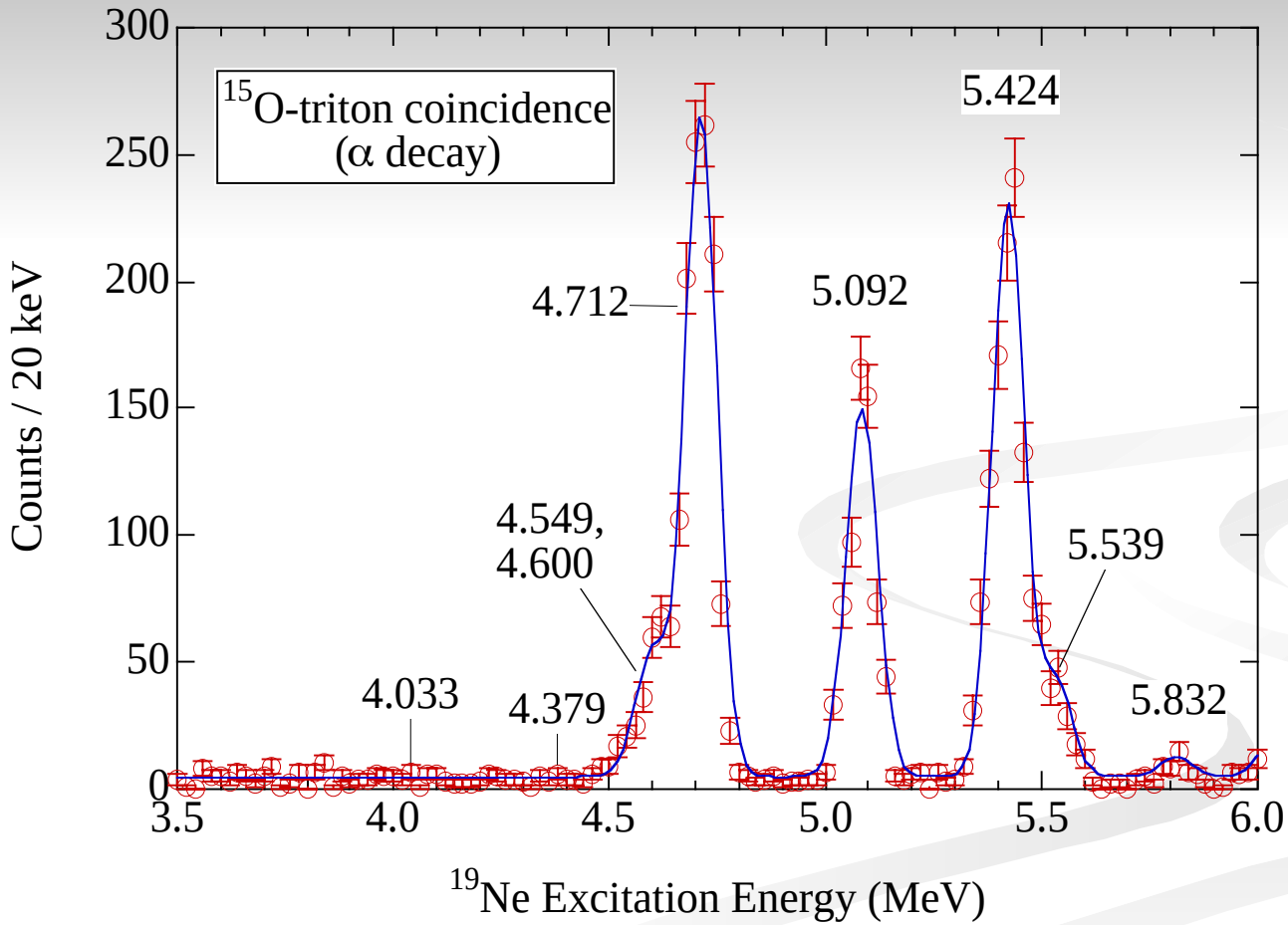
Experimental Setup at KVI's Big-Bite Spectrometer



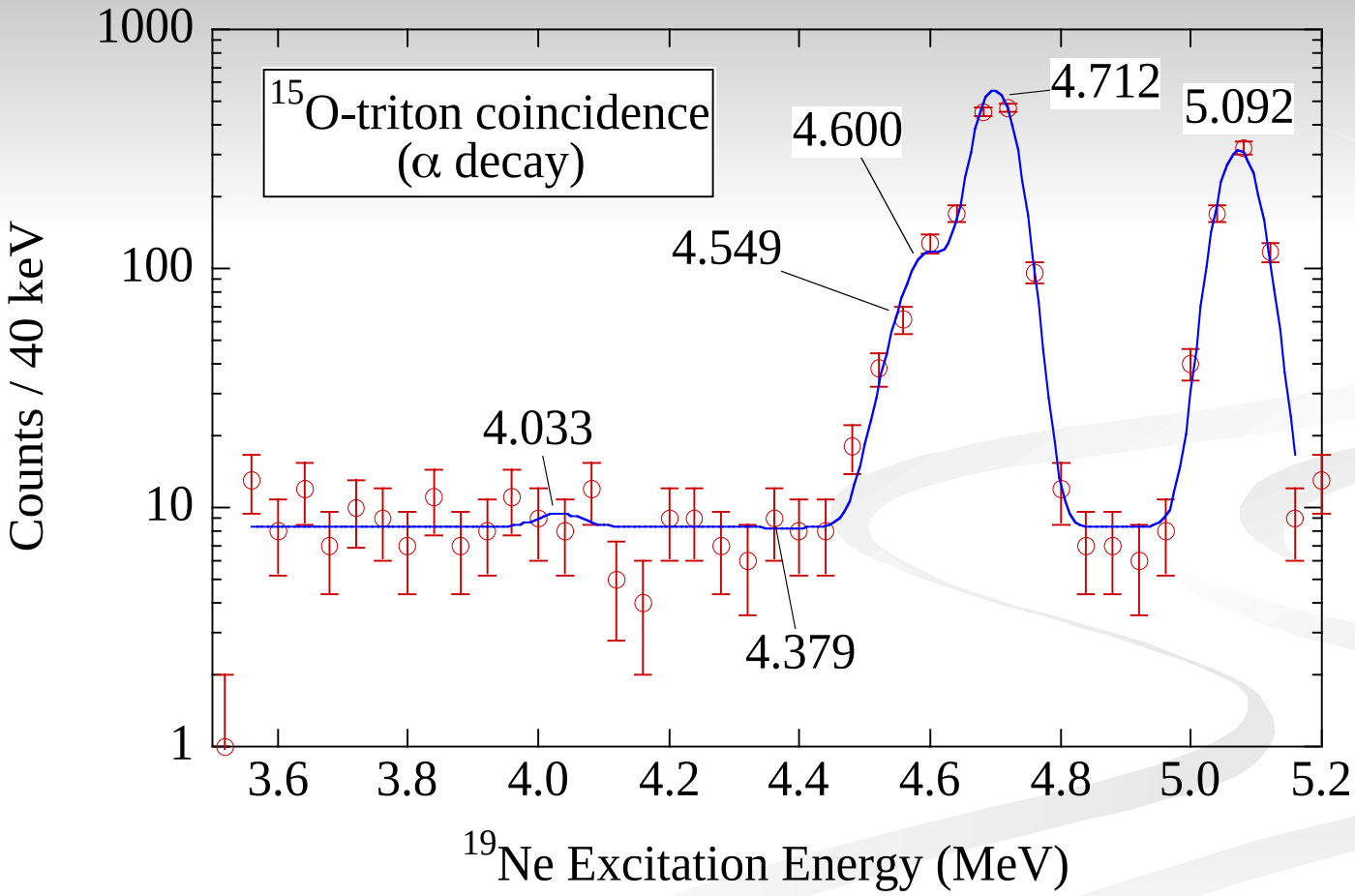
Gamma Decay


^{19}Ne-triton coincidence
(γ decay)
2.795
4.033
4.140,
4.197
4.379
4.549,
4.600
4.712
5.092
Counts / 20 keV
10^4
10^3
10^2
10^1
10^0
2.5
3.0
3.5
4.0
4.5
5.0
^{19}Ne Excitation Energy (MeV)

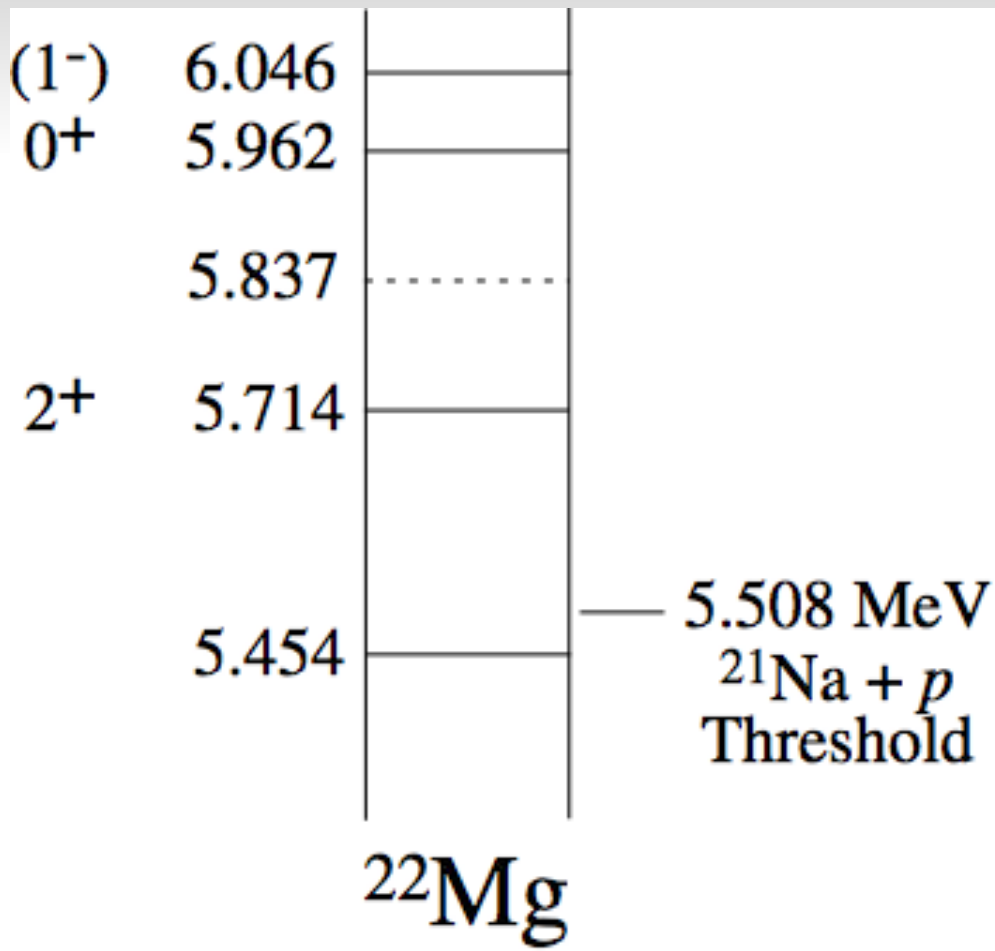
Alpha Decay


^{15}O-triton coincidence
(α decay)
5.424
4.712
5.092
4.549,
4.600
5.539
4.033
4.379
5.832
Counts / 20 keV
300
250
200
150
100
50
0
3.5
4.0
4.5
5.0
5.5
6.0
^{19}Ne Excitation Energy (MeV)

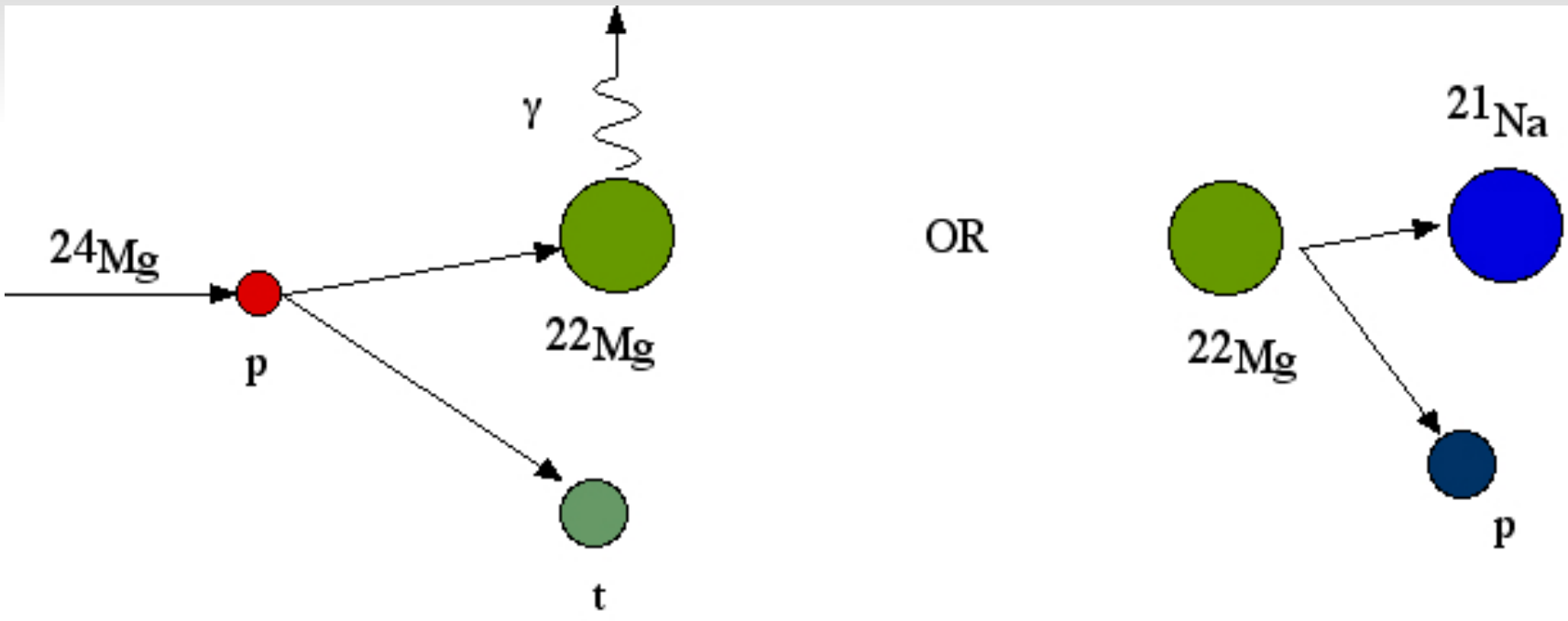
Alpha Decays: Astrophysical Regime



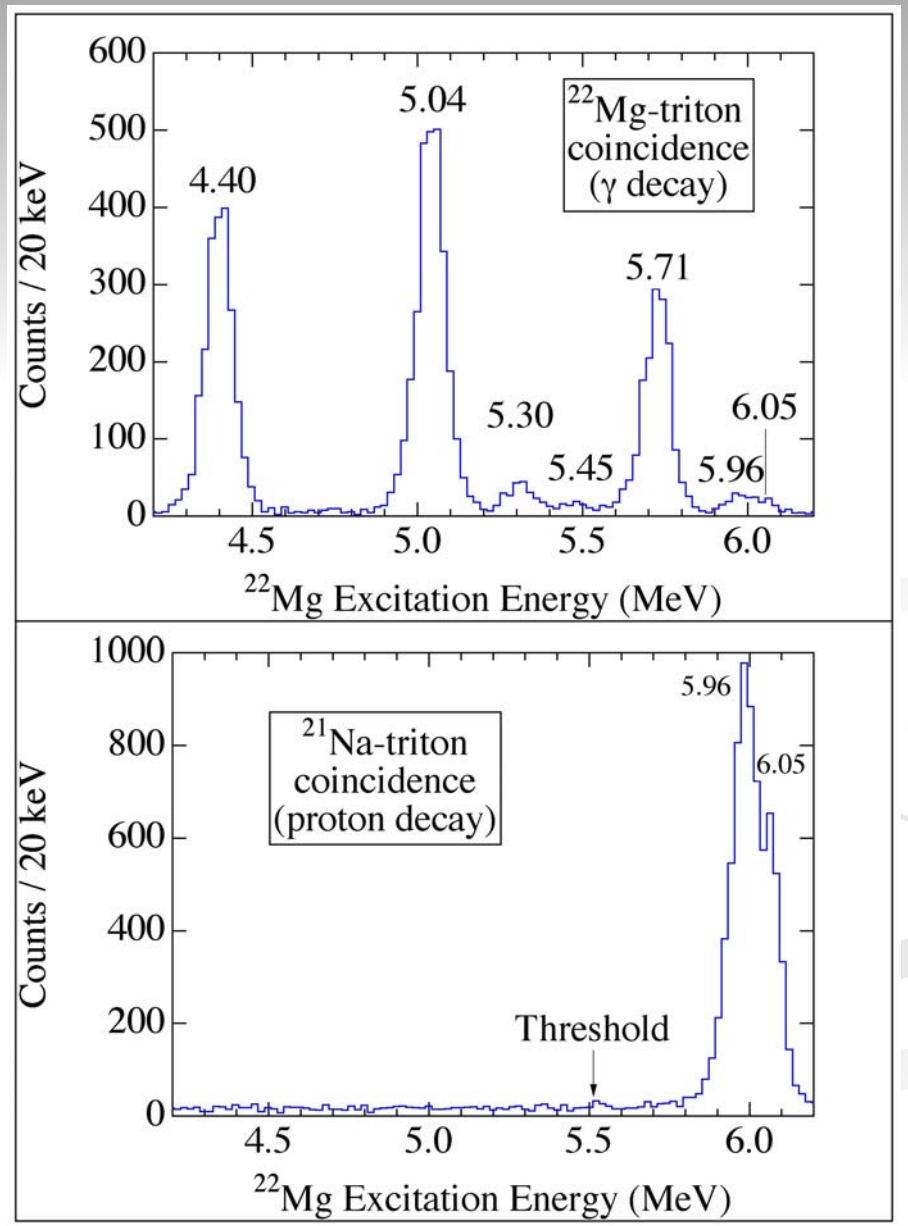
^{22}Mg level scheme at energies relevant to ^{21}Na(p,γ)^{22}Mg



Technique: proton-decay branching ratio measurement

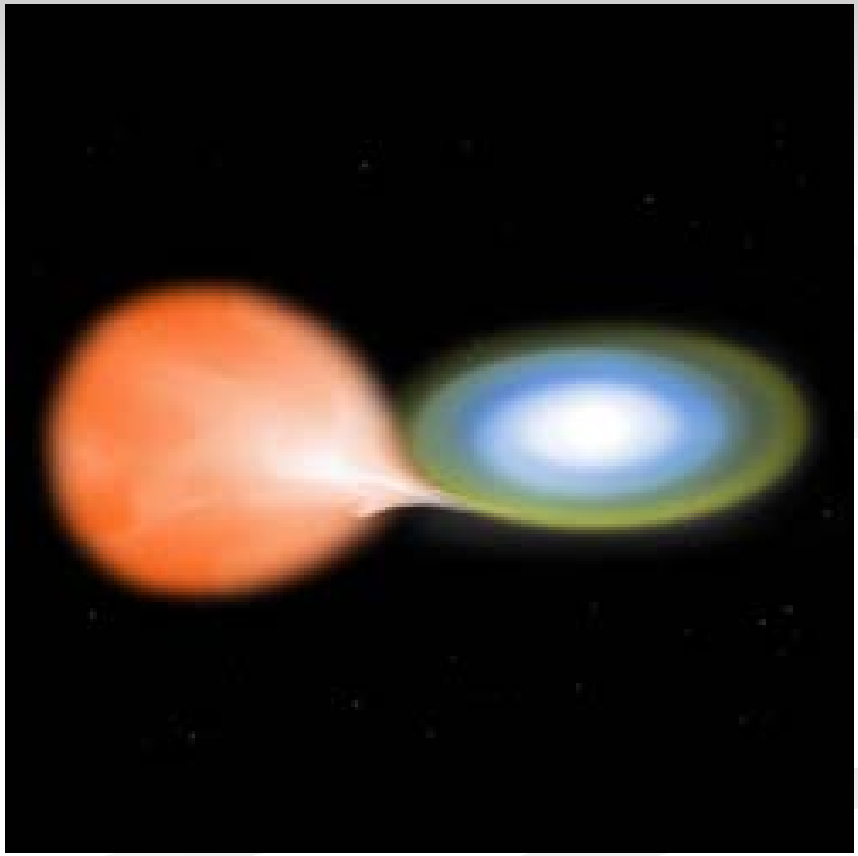


Branching ratio data



Summary

- Measured α-decay branching ratios of states in ^{19}Ne and proton-decay branching ratios of states in ^{22}Mg
- Indirect technique requires independent lifetime measurements of particle-unbound states
- Allows determination of resonant reaction rates in small fraction of time required for direct measurements



Collaborators

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