Cryogenic hydrogen gas target for a measurement of neutron inelastic scattering in ^{12}C

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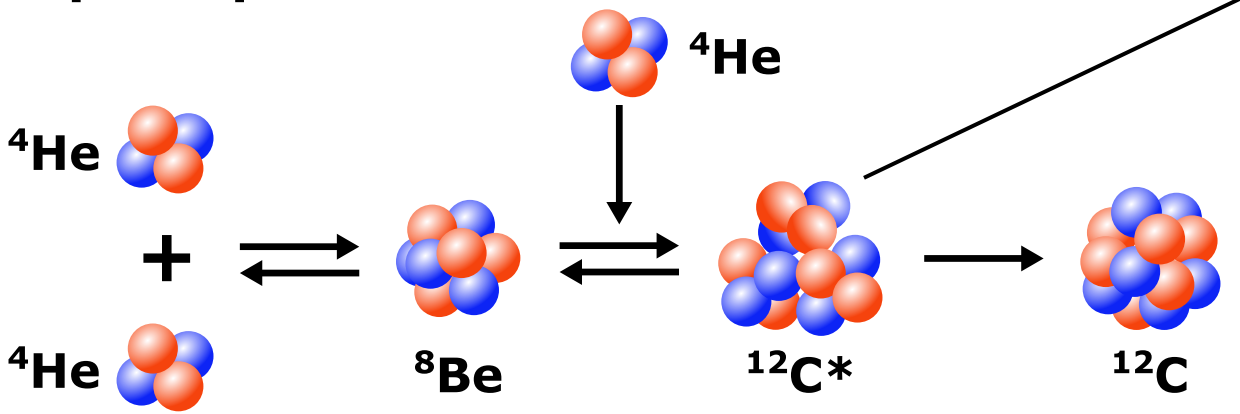
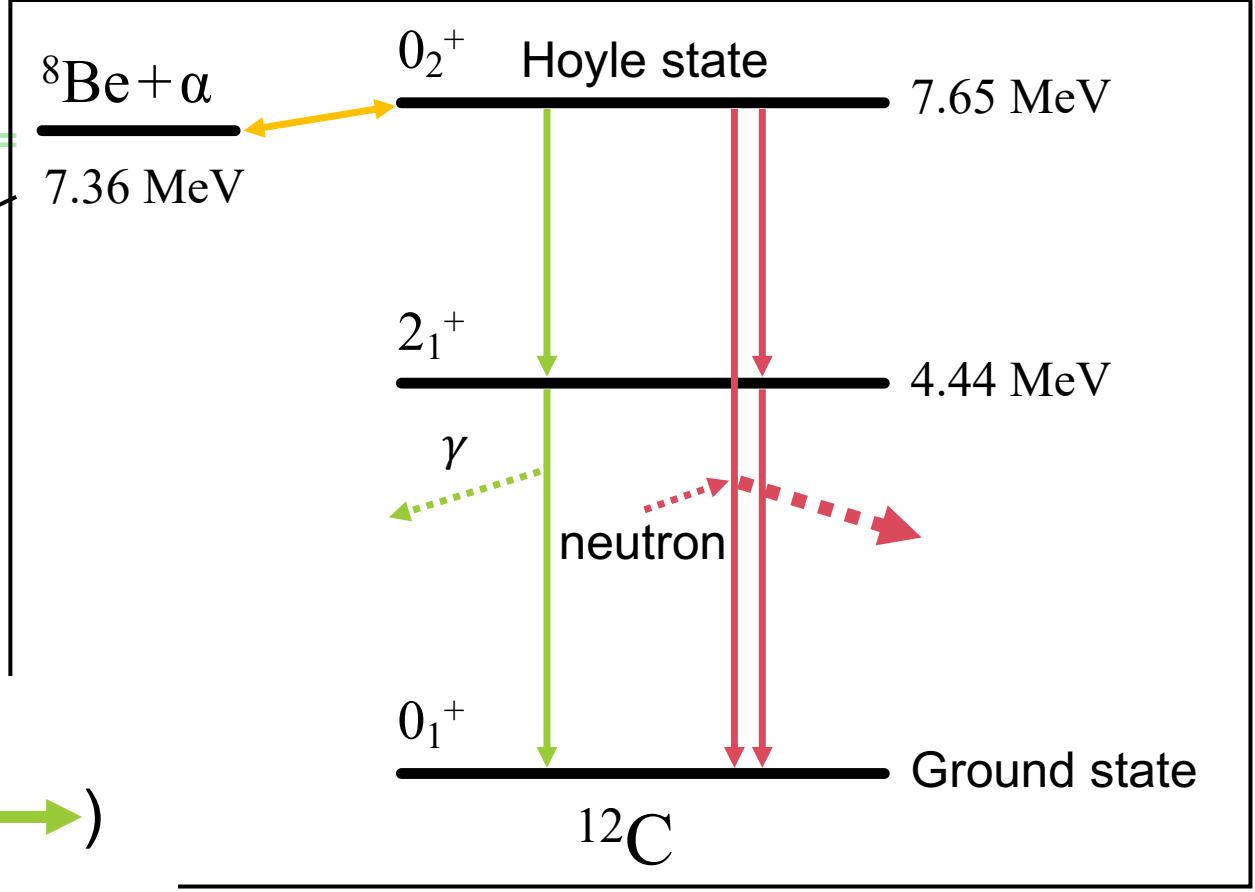
Background

Triple alpha reaction





- key reaction in nucleosynthesis
- ^{12}C is produced (mainly **gamma decay** →)

In a hot and dense environment

neutrons receive excitation energy (**inelastic scattering** →)

→ 3α reaction rate could be **enhanced** greatly at stellar temperature

Our plan:

measure cross section of $n + {}^{12}C \rightarrow n' + {}^{12}C^*$ → enhancement factor

10 MeV monoenergetic neutron source

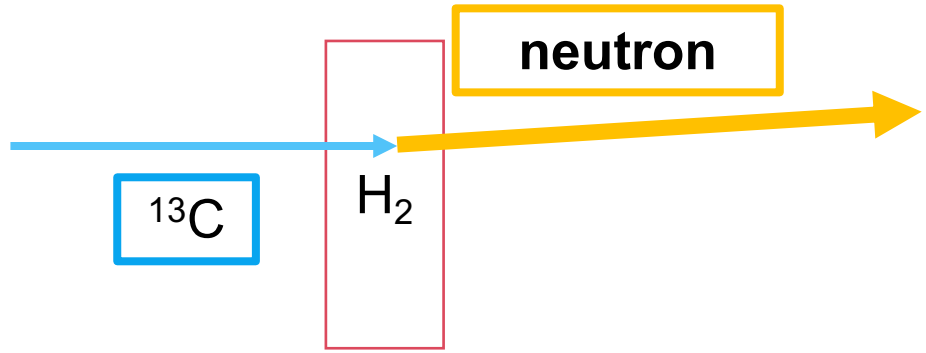
For measurement in threshold energy region;
need **monoenergetic** & **~10 MeV** neutron source

but 8-14 MeV is **gap region** of monoenergetic neutron source

Developed neutron source

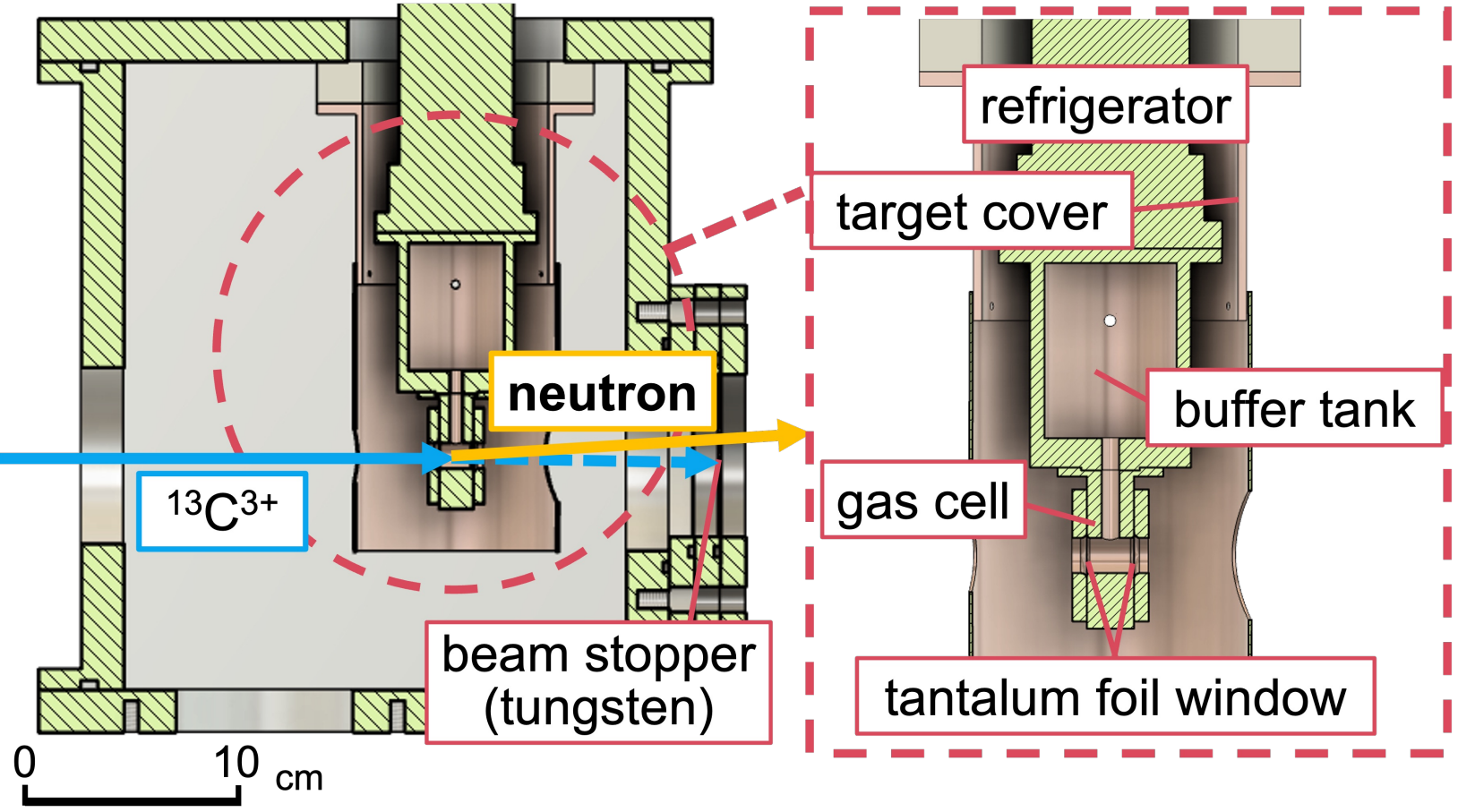
Reaction : $^{1}H(^{13}C, n)^{13}N$

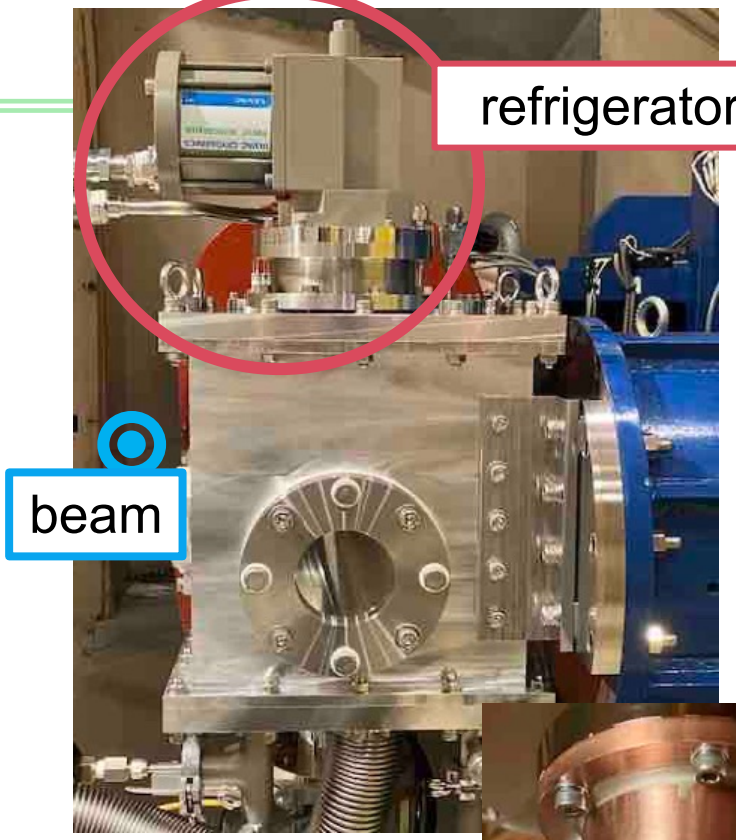
so far: room temperature hydrogen gas target



To obtain **high intensity** & **high SN ratio** neutron beam
developed new **cryogenic hydrogen gas target**

Cryogenic hydrogen gas target





- $^{13}C^{3+}$ beam current is 1 pμA → heat load ; ~ 20 W

Heat load test (with nichrome heater)
confirmed gas temperature is below 77 K @ about 20 W

Performance test with beam

^{13}C beam from AVF cyclotron at CYRIC

Neutron detection with **Liquid scintillators**

- Pulse shape discrimination → n-γ discrimination
- Time of Flight → neutron energy