The ratio is regulated by two reactions:

\[
3\alpha \rightarrow ^{12}C \\
^{12}C(\alpha, \gamma)^{16}O
\]

The cross section of \(^{12}\text{C}(\alpha,\gamma)^{16}\text{O}\) at the stellar relevant Gamow peak is too small to measure in present day experiments.

The cross sections of \(\alpha\)-capture reaction and time-reversal photodisintegration are related by the principle of detailed balance:

\[
\sigma_{\alpha,\gamma} = \frac{2J_{\alpha} + 1}{(2J_{\alpha} + 1)(2J_{\gamma} + 1)} \frac{E_{\gamma}^2}{\mu_{\alpha,\gamma}^2}
\]

The high intensity monochromatic \(\gamma\)-ray beams required for photodisintegration are available at facilities:

- ELI-NP, Romania (under construction)
- HiSyS, USA
- NewSUBARU, Japan

**Goals:**

- study \((\alpha,\gamma)\) and \((p,\gamma)\) reactions of astrophysical interest,
- measure energies and angular distributions of photodisintegration reactions products,
- measure the cross sections of \(^{16}\text{O}(\alpha,\gamma)^{12}\text{C}\) reaction down to 1 MeV,
- reduce the uncertainty of \(^{12}\text{C}(\alpha,\gamma)^{16}\text{O}\) S-factors at Gamow peak to 10%.

**Time projection chamber:**

- low pressure (~100 mbar) gas mixture acts as both ionisation medium and target,
- detector volume: \(33 \times 20 \text{ cm}^2\) (planar readout) \(\times 20 \text{ cm}\) (drift length),
- three 50-\(\mu\)m thick Gas Electron Multiplier (GEM) foils for charge amplification,
- General Electronics for TPC (GET) for signal amplification & digitization,
- self or external triggering.

**Outlook:**

- approved experiments at IFJ-PAN, Poland and HiSyS, USA,
- DAY-1 experiment at ELI-NP, Romania.