

# Remeasuring of the $\gamma$ -decay branching ratio of the Hoyle State

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The triple-alpha process is one of the most fundamental processes in stellar nucleosynthesis, and in particular, the stellar production of carbon. This process entails the fusion of three helium nuclei to form an intermediate state in  $^{12}\text{C}$ . This intermediate state can decay back into its three constituent alpha particles or radiatively decay to form stable  $^{12}\text{C}$ . At temperatures between 0.1 - 2 GK, the triple-alpha reaction is almost exclusively mediated by the Hoyle state in  $^{12}\text{C}$ . Understanding the properties of the Hoyle state is therefore important for the modeling of the subsequent stellar evolution.

The creation of stable carbon through this process happens mainly through two available decay branches, leaving the  $^{12}\text{C}$  in its ground state. The radiative decay of the Hoyle state to form stable  $^{12}\text{C}$  proceeds mainly through gamma decay and pair production. The radiative width of the gamma-branch has been measured several times between the period 1961 to 1976 [1-7]. Most of the measurements performed up until 1976 have yielded results which are in decent agreement with one another. However, a recent measurement performed in 2019 by Kibédi *et al.* [8] resulted in a significantly larger radiative branching ratio ( $\Gamma_{\text{rad}}/\Gamma$ ) compared to all previous measurements.

Given the astrophysical significance of the Hoyle state, resolving this conflict is crucial. Therefore, new measurements have been performed to reinvestigate the gamma-decay branching ratio of the Hoyle state. The experiments have been performed at the Oslo Cyclotron Laboratory through the  $^{12}\text{C}(p, p'\gamma\gamma)$ -reaction. In these experiments, the SiRi particle telescope [9] was employed to detect proton ejectiles and the OSCAR LaBr3 array was used to detect the coincident gamma-ray decays. Preliminary results from this measurement will be presented, together with the analysis method and experimental details.

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