Carbon burning in stars: An experimental study of the ^{12}C+^{12}C reactions towards astrophysical energies

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^{12}C+^{12}C reactions are among the most important processes in the evolution and nucleosynthesis of massive stars. The measurement of these reactions at astrophysical energies is very challenging due to their extremely small cross sections, heavy resonant structure and the presence of natural hydrogen and deuterium contaminants in the carbon targets. To date, no measurement of the ^{12}C+^{12}C reactions has been possible at energies below E_{cm} = 2.14 MeV. In addition, measurements at $E_{cm} < 3.0$ MeV present large uncertainties due to the target H contamination. In this work, the measurement of the ^{12}C+^{12}C reactions at E_{cm} = 2.52-4.30 MeV was performed using the CIRCE accelerator in Caserta, Italy. We used the ΔE-Erest particle identification technique to unequivocally identify protons and α particles. The ^{12}C+^{12}C reactions cross sections and $\tilde{S}$-factors were extracted from the thick target yield. The experimental results as well as their impact on the determination of the stellar rate of ^{12}C+^{12}C fusion reactions are discussed.