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Studying the ^{12}C+^{12}C fusion reaction at astrophysical energies using HOPG target

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Carbon fusion reaction is one of the primary reactions in massive stars. It also serves as the ignition reaction for Type Ia supernova explosions and X-ray superburst. Accurate carbon-carbon fusion reaction rate can reduce uncertainties in massive stars and the ignition condition in Type Ia supernova. It also can resolve the ignition problem in superburst.
However, the carbon-carbon fusion reaction in stars occurs at energies below 3MeV at center-of -mass frame, it's far below the Coulomb barrier at 5.8MeV resulting in an extremely low fusion cross-section. This a big challenge to measure directly in experiments.Meanwhile, the extremely low cross-section also causes the influence by the background .And the complex exit channels is another dfficulty to determine the cross-section.
Given these difficulties ,Qur experiment was performed at the LEAF(Low Energy high-intensity high-charge-state ion Accelerate Facility)of the Institute of Modern Physics,Lanzhou.Leaf provided a 12C2+ beam intensity of up to 174euA on target .is the most intense 12C beam for 12C+12C reaction studies.
We have developed a ΔE-E detector telescope system composed of a Time Projection Chanmber(TPC)and Si array,which enables effective background substraction and particle identification. By adjusting the voltage applied on TPC and the working gas, detection of both alpha particles and protons can be conducted within the same experimental setup.
We have measured the 12C(12C,α)20Ne reaction at Ecm = 2.22MeV using HOPG target.The total accymulated charge was 3.26×106 μC.Left picture is original spetrum and the right is after tracking using our detection system.From the energy spectrum, it can be observed that HOPG is indeed a target with extremely low background, making it highly suitable for carbon-carbon fusion experiment measurements.
However, during the experimental measurements, we encountered problems with HOPG.We find the yield of αand proton are reduced significantly under intense beam bombardment due to radiation damage of the HOPG.
We can correct for the yield loss due to the radiation damage with HOPG.

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