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Experimental studies of high-temperature hydrogen burning using low-energy radioactive beams

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Nuclear reactions of unstable nuclei play a key role in explosive burning in the universe. We have been conducting experiments with low-energy radioactive beams to learn the critical nuclear reactions under explosive condition, especially the early stage of the rp- process. We will report recent results using the CRIB separator at CNS, University of Tokyo. Low-energy radioactive beams at about 5 MeV/nucleon or below are produced by the low-energy in-flight method from high-intensity heavy-ion primary beams. The CRIB line, consisting of a magnetic separator and a Wien filter, can effectively purify the secondary beams. A series of experiments was performed to study proton elastic resonance scattering (A+p) with unstable nucleus A. The information of the A+p resonances (E_x, J^π and Γ) in nucleus B may help understand resonance contributions to hydrogen-burning A (p,γ)B reactions under high temperature conditions. We will show the resonance data of ^{11}C+p/^{12}N+p (relevant to the hot pp-chain), ^{13}N+p (hot CNO), ^{23}Mg+p (break out from the NeNa cycle), and some others. Other experimental projects for measurements of stellar reactions are in progress. For example, the direct measurement of ^{14}O(α,p)^{17}F at the first stage of the high-temperature rp-process was performed for the first time using a high-intensity ^{14}O beam and a thick cold He target. The current status of the projects and future outlook will be discussed.