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Study of the contribution of the 7Be(d, p) reaction to the 7Li problem in the Big-Bang Nucleosynthesis

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Our research goal is to measure the cross-section of the 7Be(d, p) reaction in search of a solution/key to the cosmological 7Li problem (CLP). The CLP is the overestimation of primordial 7Li abundance in the standard Big Bang nucleosynthesis (BBN) model compared to observed abundances, a major unresolved problem in modern astrophysics. A recent theoretical BBN model emphasized that the primordial 7Li abundance is about three times larger than the recent precise observation [1], [2]. 7Li nuclei were produced predominantly by the electron capture decay of 7Be after the termination of nucleosynthesis in the standard BBN model. We focus on the 7Be(d, p) reaction since it is considered one of the contributors to 7Be destruction in the BBN [3]. Our experiment means that we reproduce the nuclear reactions that occurred in BBN are reproduced in the modern world. We developed a method to produce 7Be (half-life = 53.22 days) target to measure the reaction cross-section in normal kinematics. The experiment was performed at the Tandem Electrostatic Accelerator Kobe University [4]. A 2.36 MeV proton beam irradiated a natural-Li target to transmute 7Li particles to 7Be particles via the 7Li(p, n)7Be reaction [5]. We produced 3.03×10^13 7Be particles in the target after two days of proton irradiation. After the target production, the beam ion was changed to deuterons, and the 7Be(d, p) reaction was measured at energies 0.6, 0.86, 1.0, and 1.6 MeV. Layered silicon telescopes measured the outgoing protons at 30 and 45 degrees. In this talk, we will talk about the experimental setup and preliminary results of this study, including the 7Be(d, p) cross-section and its impact on the solution of the CLP.

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Primary author: INOUE, Azusa

Presenter: INOUE, Azusa

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