

Study of the contribution of the ${}^7\text{Be}(d, p)$ reaction to the ${}^7\text{Li}$ problem in the Big-Bang Nucleosynthesis

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Our research goal is to measure the cross-section of the ${}^7\text{Be}(d, p)$ reaction in search of a solution/key to the cosmological ${}^7\text{Li}$ problem (CLP). The CLP is the overestimation of primordial ${}^7\text{Li}$ 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 ${}^7\text{Li}$ abundance is about three times larger than the recent precise observation [1], [2]. ${}^7\text{Li}$ nuclei were produced predominantly by the electron capture decay of ${}^7\text{Be}$ after the termination of nucleosynthesis in the standard BBN model. We focus on the ${}^7\text{Be}(d, p)$ reaction since it is considered one of the contributors to ${}^7\text{Be}$ 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 ${}^7\text{Be}$ (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 ${}^7\text{Li}$ particles to ${}^7\text{Be}$ particles via the ${}^7\text{Li}(p, n){}^7\text{Be}$ reaction [5]. We produced 3.03×10^{13} ${}^7\text{Be}$ particles in the target after two days of proton irradiation. After the target production, the beam ion was changed to deuterons, and the ${}^7\text{Be}(d, p)$ 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 ${}^7\text{Be}(d, p)$ cross-section and its impact on the solution of the CLP.

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