Cross-Section Measurement of $^{14}N(n, p)^{14}C$ Reaction

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Accurate cross sections and differential cross sections of the $^{14}N(n, p)^{14}C$ reaction are of significant importance for research in Boron Neutron Capture Therapy as well as astrophysical element synthesis. From the last century to the present, several measurements have been conducted, and cross sections have been obtained. However, on one hand, present experimental measurements show considerable discrepancies in the keV neutron energy region; on the other hand, there is a severe lack of differential cross sections for the $^{14}N(n, p)^{14}C$ reaction across the entire energy spectrum, with a shortage of measurement results. Based on the Back-n white neutron beamline at China Spallation Neutron Source, this research utilized wide-spectrum neutrons and employed charged particle detectors for experimental measurements. Through simulation and multiple beam test experiments, the experimental conditions and methods were explored, and a successful 400-hour beam time experiment was conducted. For the first time internationally, the differential cross sections of the $^{14}N(n, p)^{14}C$ reaction in the 0.1–6MeV neutron energy range was measured, and differential cross sections as low as 0.1mb in the 0.1–0.45MeV neutron energy range were provided, which are expected to clarify the discrepancies in previous measurements and different evaluation databases in this energy region.