# Study of Nucleon Induced Reactions on Lithium-6,7 with Continuum Discretized Coupled Channels Method

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（連続状態離散化チャネル結合法を用いたリチウム 6, 7 に対する核子入射反応の研究）

区　　分：甲

# 論 文 内 容 の 要 旨

The study of lithium related reactions has recently attracted great interest because of their applications in many fields, such as in nuclear astrophysics and fusion applications. Lithium is an important element relevant to not only a tritium breeding material in deuterium-tritium (D-T) fusion reactors but also a candidate for target material in the intense neutron source of the International Fusion Materials Irradiation Facility (IFMIF). The accurate nuclear data of nucleon induced reactions on $^{6,7}$Li at incident energies up to 150 MeV are currently required for the design of such kinds of fusion related facilities, especially the nuclear data on double differential cross sections (DDXs) of neutron and triton emission from neutron induced reactions. Since $^{6}$Li and $^{7}$Li can easily break up, namely, $^{6}\mathrm{Li} \rightarrow d + \alpha$ and $^{7}\mathrm{Li} \rightarrow t + \alpha$, the understanding of the $^{6,7}$Li breakup processes is essential to the analysis of these nuclear reactions. However, the $^{6,7}$Li breakup processes cannot be described well by means of traditional theoretical models. Therefore, the study of nucleon induced reactions on $^{6,7}$Li is not only of application value but also of theoretical significance. The purpose of this work is to analyze both neutron and proton induced reactions on $^{6,7}$Li over a wide incident energy range up to 150 MeV considering the breakup effect by means of continuum discretized coupled channels method (CDCC), and provide the quantitative description of the nucleon scattering DDXs and the triton production DDXs from the breakup process of $^{7}$Li.

In Chapter 1, the motivation and background of this work are introduced. A brief review of the evaluation data and theoretical study on nucleon induced reactions on $^{6,7}$Li is presented. The purpose of this work is described.

In Chapter 2, the formulation of CDCC with diagonal and coupling potentials obtained by folding the complex Jeukenne-Lejeune-Mahaux (JLM) effective nucleon-nucleon (N-N) interaction over the transition densities is described. The calculation formulas of nucleon scattering DDXs and triton production DDXs from the breakup process of $^{7}$Li are also given.

The neutron total, proton reaction cross sections and nucleon elastic and inelastic scattering angular distributions for nucleon induced reactions on $^{6,7}$Li at incident energies up to 150 MeV are analyzed using CDCC in Chapter 3. The Energy dependence of the normalization factors, $\lambda_v$ and $\lambda_w$, of the JLM interaction is determined explicitly from measured neutron total and proton reaction cross sections. As a result, the CDCC calculation reproduces successfully well the experimental angular distributions of nucleon elastic and inelastic scattering from $^{6,7}$Li. The importance of $^{6,7}$Li breakup effects in the nucleon scattering from $^{6,7}$Li is also examined and confirmed.

In Chapter 4, the nucleon scattering DDXs and the triton production DDXs from the breakup channels of *n,p* + $^{7}$Li reactions are calculated and discussed. For the nucleon production DDXs, the calculated results can reproduce the experimental data well for higher emission energies, while they underestimate the experimental data for lower emission energies. The reason for the discrepancy is that some other reaction channels except the breakup channels also have contribution to this energy region. The triton production DDXs from breakup process are analyzed by CDCC and those from $p(n) + {}^{7}\text{Li} \rightarrow t + {}^{5}\text{Li}({}^{5}\text{He})$ channels are given by final-state interaction (FSI) model. The calculations can reproduce reasonably well the experimental data, while there are some peak structures for medium emission angles at maximum emission energy region. The contribution from S and D internal states of $^{7}$Li is discussed and regarded as the main reason for these peaks.

Finally, Chapter 5 is a summary and conclusion, and the perspectives of the future work are described.