量子物理学・ナノサイエンス第 36 回特別セミナー

The role of the deuteron D-state on (d,p) transfer reactions in the presence of nucleon non-locality

講師　：　Professor Jeffrey Tostevin

Physics Department, University of Surrey, UK

日程　：　1 月 30 日（月）15:30–16:30

場所　：　本館 1 階　H119B 講義室

概　要

Theoretical models of the (d,p) transfer reaction are being exploited for both nuclear astrophysics and spectroscopic studies in nuclear physics. Usually, these direct reaction models use *local* optical model potentials to describe the nucleon-target and deuteron-target interactions. Within this usual framework, the importance of the deuteron D-state upon low-energy (few MeV per nucleon) reactions is normally associated with spin observables and tensor polarization effects - with very minimal influence on differential cross sections. In contrast, recent work that includes the inherent non-locality of the nucleon optical model potentials [1] in the Johnson-Tandy adiabatic [2] three-body model description of the (d,p) transition amplitude, which accounts for deuteron break-up effects, shows sensitivity of the reaction to the large n-p relative momentum content of the deuteron ground-state wave function. The importance of the deuteron D-state component at high n-p relative momenta leads to significant sensitivity of calculated (d,p) cross sections and deduced spectroscopic factors to the choice of deuteron wave function [3]. I will present details of the Johnson-Tandy three-body model of the (d,p) transfer reaction when generalized to include the deuteron D-state and in the presence of *nonlocal* nucleon-target interactions. Exact calculations within this model will be compared to approximate (leading-order) solutions [1]. The latter approximate solutions can be interpreted in terms of local optical potentials, but evaluated at a shifted value of the energy in the nucleon-target system. This energy shift is shown to increase when including realistic wave functions - with a D-state. I will show the calculated dependence of the D-state effects on the separation energy and orbital angular momentum of the transferred nucleon. The effect on spectroscopic information extracted is also shown for a particular recent case of astrophysical significance [4].

[1] *Nonlocality in deuteron stripping reactions*, N.K. Timofeyuk and R.C. Johnson, Phys. Rev. Lett. **110**, 112501 (2013).

[2] *An approximate three-body theory of deuteron stripping*, R.C. Johnson and P.C. Tandy, Nucl. Phys. **A235**, 56 (1974).

[3] *Sensitivity of (d,p) reactions to high n-p momenta and the consequences for nuclear spectroscopy studies*, G.W. Bailey, N.K. Timofeyuk, J.A. Tostevin, Phys. Rev. Lett. **117**, 162502 (2016).

[4] *Inverse kinematic study of the ^{26g}Al(d,p)^{27}Al reaction and implications for destruction of ^{26}Al in Wolf-Rayet and asymptotic giant branch stars*, V. Margerin, *et al*., Phys. Rev. Lett. **115**, 062701 (2015).

連絡教員　物理学系　中村　隆司（内線 2652）

ナノサイエンス・量子物理学国際研究センター 主催

東京工業大学理学院・物理学系、「ナノサイエンスを拓く量子物理学拠点」共催

2017 年 1 月