Studies of the Single Particle Structure of Exotic Nuclei using Transfer Reactions

B. Fernandez-Dominguez[1], L. Caballero[2], W. N. Catford[3], R. Chapman[4], M. Chartier[1], W. Gelletly[3], M. Labiche[4], R. C. Lemmon[5], M. Freer[6], F. Rejmund[7], M. Rejmund[7], B. Rubio[2], H. Savajols[7], C. Timis[3], N. A. Orr[8]
for the TIARA Collaboration

[1]*Department of Physics, University of Liverpool, Liverpool L69 7ZE, UK*
[2]*IFIC, CSIC-Universidad de Valencia, E-46071 Valencia, Spain*
[3]*Department of Physics, University of Surrey, Surrey GU2 7XH, UK*
[4]*University of Paisley, Paisley, Scotland PAI 2BE, UK*
[5]*CCLRC Daresbury Laboratory, Daresbury, Warrington WA4 4AD,UK*
[6]*University of Birmingham, Birmingham B15 2TT, UK*
[7]*GANIL, BP 55027, 14076 Caen Cedex 5, France*
[8]*LPC, IN2P3-CNRS, ISMRA and Universite de Caen, F-14050, Caen, France*

An area of fundamental interest in modern nuclear physics is the evolution of the single particle structure with isospin. Detailed studies are now becoming possible largely as a result of the recent development of beams of exotic nuclei with energies that allow the use of techniques based on direct reactions. Transfer reactions that add or remove single nucleons from the valence orbitals have traditionally been a powerful tool in exploring such questions and were highly influential in demonstrating the single particle picture of stable nuclei. Studying exotic nuclei using transfer reactions is technically very challenging primarily for two reasons: firstly, the reactions are in inverse kinematics and secondly, the beams of exotic nuclei are very weak. This necessitates the use of detection systems that are highly segmented, have high efficiency and allow the complete kinematics of the reaction to be measured.

We have recently installed the TIARA/VAMOS/EXOGAM detection systems at the GANIL/SPIRAL facility to perform such experiments [1,2]. This setup is pioneering the use of transfer reactions to study exotic nuclei. In a first campaign, the changing single particle structure in the region around the N=16 shell closure has been investigated using the ^{24}Ne beam from SPIRAL [3]. We will describe the experimental set-up and the analysis, concentrating in particular on the use of the large acceptance magnetic spectrometer VAMOS [4] that has been used to detect the heavy fragment after the reaction. Preliminary results from this campaign will be presented, together with some examples from the experiments used to commission the apparatus.

[1] W.N. Catford *et al.*, in Tours Symposium V, edited by M. Arnould et al., AIP Conference Proceedings 704, (Melville, New York 2004) 185.
[2] W.N. Catford *et al.*, in CAARI 2002, edited by J.L. Duggan and I.L Morgan, AIP Conference Proceedings 680, (Melville, New York 2003) 329.
[3] W.N. Catford *et al.*, Eur. Phys. J. A (in press).
[4] H. Savajols *et al.*, Nucl. Phys. A 654 (1999) 1027c.