NP PAIRING CORRELATIONS IN SINGLE-L AND SINGLE-J MODELS*

A. O. Macchiavelli, P.Fallon, R.M.Clark, M.Cromaz, M.A.Deleplanque, R.M.Diamond, I.Y.Lee, F.S.Stephens, and D.Ward
Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA94720.

Advances in experimental techniques and new possibilities provided by radioactive beams are driving a renaissance of nuclear structure studies, in particular along the N=Z line. These nuclei constitute unique systems to study isoscalar (T=0) and isovector (T=1) pairing correlations. On the basis of charge independence we expect to observe all three components of the standard T=1 pairing, T_z=0 (*np*) and $|T_z|$=1 (*nn* and *pp*), on an equal footing. In addition, there is the possibility to study the formation of a condensate of T=0 *np* pairs, as well as the co-existence of pairs of isoscalar and isovector type. Although the bare nuclear force is stronger in the T=0 channel there is controversy regarding the effectiveness of T=0 correlations in producing a condensate in the many-body medium. Using binding energy differences as a fingerprint of pairing correlations we found [1] that the residual pairing interaction mixing *np* pairs is dominated by the T=1 component. Similar conclusions were drawn from our study of pair vibration spectra around ^{56}Ni [2]. At present we are carrying out a program, in collaboration with ANL, to directly measure the T=0 and T=1 pairing strength using the (^{3}He,p) transfer reaction on radioactive beams in inverse kinematics.

In conjunction with the experimental analysis we have carried out a number of model studies to investigate expected signatures of T=0 pairing. Although simple in nature, schematic single-l shell model calculations [3,4] capture the main ingredient of the mechanism responsible for the appearance of a superconducting phase, namely the large spatial overlap of the nucleons' wave function in an L=0 state. However, because of the spin-orbit splitting, a more realistic case is a single-j shell that incorporates the more appropriate jj coupling scheme. We used the shell model code OXBASH [5] with an effective two-body force of the form $V=xV_{J=0}^{T=1} + (1-x)V_{J=1}^{T=0}$ to model the mixture of the two types of competing interactions via the parameter x.

In this work we will briefly review the status of our np pairing studies and present the results obtained with the models discussed above, in particular as they apply to the interpretation of the experimental data on binding energy differences for nuclei along the N=Z line. Based on qualitative pair blocking arguments and this model study, the basic features of the data can be understood in terms of a residual pairing interaction of the isovector type.

An intriguing phenomenon was observed in the single-j approximation when the isoscalar component is dominant. In this case the ground state of the many-particle system prefers the aligned configuration of the basic deuteron-like pairs of spin J=1. We trace back this effect to the spin-orbit splitting, which can also be responsible for the weakening of the isoscalar pairing.

*Work supported by the U.S. Department of Energy under grant DE-AC03-76SF00098.

[1] A.O.Macchiavelli, et al., Phys. Rev. **C61** 041303(R) (2000).
Similar conclusions were reported by P.Vogel, Nucl. Phys. **A662**, 148 (2000).
[2] A.O.Macchiavelli, et al., Phys. Lett. **B480**, 1 (2000).
[3] S. Pang, Nucl. Phys. **A128**, 497 (1969).
[4] J. Evans et al. **A367**, 77 (1981).
[5] B.A.Brown, A. Etchegoyen, W.D.M.Rae, MSU-NSCL Report **524** (1988).