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Multiple multi-j pairing $SO(5)$ and seniority $Sp(2\Omega)$ algebras with isospin in nuclei

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Abstract

With m nucleons occupying say r number of shell model orbits j orbits $(j_1, j_2, \ldots, j_r)$, the isovector pair creation operator A^1_μ (creates a two particle state with $J = 0$ and $T = 1$) is no longer unique. The pair creation operator can be chosen to be a sum of single-j pair creation operators giving $A^1_\mu(\beta) = \sum_j \beta_j A^1_\mu(j)$ with the phases $\beta_j = \pm 1$. Then, there will be a pairing $SO(5)$ algebra for each $\{\beta\} = \{\beta_{j_1}, \beta_{j_2}, \ldots, \beta_{j_r}\}$ set. Without loss of generality, choosing $\beta_{j_1} = +1$, it is easy to see that there will be 2^{r-1} isovector pairing $SO(5)$ algebras generated by the 10 operators $\{A^1_\mu(\beta), [A^1_\mu(\beta)]^\dagger, T^1_\mu, \hat{n}\}$ where T^1_μ are isospin generators and $\hat{n}$ is number operator. Thus, with two j orbits there will be two $SO(5)$ algebras, with three there will be 4 $SO(5)$ algebras and so on. More importantly, corresponding to each $SO(5)$ there is a complementary $Sp(2\Omega)$ algebra $[2\Omega = \sum_j (2j+1)]$ that gives seniority and reduced isospin quantum numbers. These are all established using generators, quadratic Casimir invariants and the irreducible representations of the various algebras involved. These results and some of the applications of multiple $SO(5)/Sp(2\Omega)$ algebras will be presented in this talk.