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Investigation of the proton-neutron T=0 condensate through GT decay to the quasi-deuteron 1+ state in odd-odd N=Z Nuclei

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It is well known that in the atomic nucleus, alike nucleons (neutrons or protons) in time reverse orbits, couple in pairs giving rise to nuclear superfluidity, with very significant impact in the structure as well as in the collective properties of the nucleus. In addition, nuclei consist of a combination of two fermionic fluids (neutrons and protons) and as a consequence of the isospin (T) degree of freedom, four types of pairs, the triplet with T=1, J=0 and the singlet T=0 J>0, are expected. It has been shown that T=0 pairs will be only relevant in the vicinity of N=Z nuclei[1,2]
In medium mass N=Z nuclei, the existence of T=0 pairing has been studied searching for the absence of Coriolis Anti-Pairing effects at high angular momentum in rotational bands[1,2,3]. It has been suggested as well that the structure of heavy N=Z nuclei as the 92Pd can be due to proton-neutron isoscalar pairing correlations [4]. Nevertheless no clear-cut signature has been found, in particular on the existence possibility of a T=0 pairing condensate. It has been suggested that enhanced Gamow-Teller (GT) β-decay rates between the ground state of an even-even N+2=Z nucleus and the lowest I=1 state of its odd-odd N=Z daughter nucleus can be the fingerprint of T=0 pairing. The role played in β-decay by proton-neutron coherent pairs (bosons) have been extensively discussed by F.Iachello [5,6] in the framework of the proton-neutron boson scheme (IBM-4).
While in light nuclei strong GT transitions to low lying states result from the presence of approximate SU(4) symmetry, the existence of strong spin-orbit splitting, in heavier nuclei, suppresses the symmetry. The GT strength can then be fragmented over many final states resulting in a reduced B(GT) for the low lying ones [7,8,9,10].
Recently, the Gamow-teller β-decay of the 62Ge T=1 0+ g.s. into excited states of the odd-odd N=Z 62Ga have been studied for the first time at the GSI laboratory with the Fragment Separator (FRS) and the RISING Ge-array coupled to an active implantation setup. The aim was to seek for an enhancement of the B(GT) as fingerprint of the proton-neutron T=0 condensate in the odd-odd N=Z nuclei. Contrary to expected, a diminish B(GT)=0.07±17 gA2/4π has been observed for the transition to the first 1+ state lying at 571 keV excitation energy. A lifetime of τ=119.6 ±20 ms has been measured for the 62Ge ground state.
The reason for choosing the 62Ge T=1 0+ g.s decay was mainly the secondary beam intensities available at FRS during the Rising Stopped beam campaign. Nevertheless, there are strong indications that only in heavy masses A~80 it would be possible to find a real T=0 p-n pairing condensate.
In the present LoI we propose the study of the Gamow-Teller decay of the 78Zr or 82Mo, Tz=-1 nuclei, T=1 0+ g.s to the odd-odd N=Z 78Y or 82Nb. While probably the 82Mo is a better choice, the secondary beam intensities might prove the experiment unfeasible.
The 78Zr nuclei will be produced by fragmentation of a 124Xe primary beam at 345 MeV.A in a 1000 μm Be target. The yield with BigRIPS, assuming a primary beam with 10 pnA , will be of the order of 9.0 10-2 leading to the implantation of 7000 78Zr atoms per day. To achieve the sensibility obtained in the 62Ge case 4 days of beam time will be required.
The 82Mo nuclei can be as well produced by fragmentation of a 124Xe primary beam at 345 MeV.A in a 1000 μm Be target. The yield with BigRIPS, assuming a primary beam with 10 pnA , will be of the order of 2.0 10-2 leading to the implantation of 1500 78Zr atoms per day. To achieve the sensibility obtained in the 62Ge case 10 days of beam time will be required. A minimum of 7 days has to be allocated for the 82Mo case
The active stopper, for the beta-decay studies, is required.

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