Contribution ID: **125** Type: **Poster**

Double Beta Decay within the Relativistic QRPA

In nature there are about 50 nuclear systems where the single beta-decay is energetically forbidden, and double beta-decay turns out to be only possible mode of disintegration. It is the nuclear pairing force which causes such an "anomaly", by making the mass of the odd-odd isobar, (N-1,Z+1), to be greater than the masses of its even-even neighbors, (N,Z) and (N-2,Z-2). The modes by which the double beta decay can take place are connected with the neutrino and antineutrino distinction. The Quasi-Particle Random Phase Approximation (QRPA) has turned out be the most simple model for calculating the nuclear wave function involved in the single and double beta-decay transitions. In this work we perform a self-consistent relativistic QRPA (RQRPA) calculation of double beta-decay based on relativistic BCS (RBCS) mean field theory results for odd-odd intermediate nuclei ^{48}Sc, ^{76}As, ^{82}Br, ^{100}Tc, ^{128}I, and ^{130}I. We use the parameter set NL3 for interactions between protons, neutrons, σ, ω, ρ mesons and fotons. The RQRPA equations are solved for the residual pion and rho interaction by employing the same parameters used in the RBCS, and experimental values for the pion and nucleons. The RQRPA results for the double beta-decay matrix elements are similar to those obtained within the QRPA and the shell model. Motivated by the results obtained here, we intend to calculate the neutrinoless decay in order to estimate the neutrino mass.

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Session Classification: Poster Session