Improved Relativistic QRPA calculations of the γ-ray strength

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Microscopic treatment of nuclear excitations capable to describe observed gamma-ray strength distribution of nuclear reactions as well as resonance widths in neutron rich nuclei, requires approaches which account for the exact coupling to the positive energy continuum as well as proper treatment of the nuclear deformation. Although both improvements are particularly complicated, their importance in extreme nuclei is unambiguous. For that purpose, we have formulated the Quasiparticle Continuum Random Phase Approximation (QCRPA) and the Quasiparticle Deformed RPA (QDRPA) respectively.

The first method is based on the Relativistic Mean Field theory plus BCS, where point coupling phenomenological parameters are used. It has been found that when the coupling to the continuum is treated properly, it does extremely well in reproducing the E1 spectrum with one order of magnitude less numerical effort. The second method, uses the Relativistic Hartree Bogoliubov with density-dependent forces for the static spectrum and can be applied to deformed nuclei.

Both developments, ie. a proper account of the continuum and of the deformation effects, have been applied separately to the calculation of the E1 strength distribution of stable and exotic neutron rich nuclei. The impact of these effects on the neutron-capture cross sections of astrophysical relevance has been studied.