GDR at finite temperature for isospin mixing measurements

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The electric dipole (E1) response of a nucleus is mainly concentrated in the Giant Dipole Resonance at energies higher than the particle binding energy. The GDR in nuclei at finite temperature and angular momentum was investigated in many experimental and theoretical works and, thus, a solid base exists for the use of this approach. Therefore, the γ decay of the GDR can be used as a probe to study complex aspects of nuclear structure as for example the restoration/breaking of the isospin symmetry.
In a nuclear system, Coulomb interaction breaks the isospin symmetry but excitation energy is expected to restore partially or totally this symmetry in a dynamical way. In fact, the Compound Nucleus may decay (because of the very short lifetime for particle emission) before mixing occurs.

At the INFN laboratories of Legnaro a series of experiments were performed, using a combined system of $LaBr_3$:Ce and HPGe detectors (HECTOR+, AGATA and GALILEO), focused to the measurement of isospin mixing in mid mass nuclei. In particular, the isospin mixing in N=Z ^{80}Zr and ^{60}Zn isotopes were measured. The used experimental method is based on the analysis of the GDR gamma-ray emission in a fusion-evaporatio reaction where the Compound nucleus is built in a isospin $I \neq 0$ and I=0 channels. The former is used to tune the statistical model and the GDR parameters while the second is used to measure the isospin mixing violation. This because, in self conjugated nuclei (N=Z isotopes), isospin symmetry forbids a $\Delta I=0$ transition and, consequently, hinders the first step E1 γ decay of the GDR. The isospin mixing value, directly measured at finite temperature, can then be estrapolated to zero temperature. This information for A=80 is not accessible in other ways.