Dipole Excitations and Parity Assignments in ^{48}Ca

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Dipole and quadrupole excitations in the doubly magic nucleus ^{48}Ca have been investigated up to the neutron treshold at about 10 MeV by performing Nuclear Resonance Fluorescence (NRF) experiments at the S-DALINAC in Darmstadt, Germany [1,2]. Real-photon scattering provides a high selectivity to low multipolarities and, therefore, is an established method to study dipole excitations in atomic nuclei. Photons interact with the whole nucleus through electromagnetic interaction. On the contrary, ions can be a complementary probe that interacts with the nucleus also through strong interaction. Inelastic scattering experiments with particles like e.g. α particles can clarify the structure of complex excitation modes, like the electric pygmy dipole resonance (PDR). The PDR is a concentration of low-lying E1 strength below and around the particle threshold. Recent experimental data shows a splitting of the PDR by comparing the results of NRF and $(\alpha, \alpha'\gamma)$ experiments [3].
To gain a deeper understanding of the underlying structure of low-lying dipole excitations in medium mass nuclei, an $(\alpha, \alpha'\gamma)$ experiment on ^{48}Ca has been performed using an α-beam energy of 136 MeV at the Big-Bite Spectrometer at the Kernfysisch Versneller Instituut (KVI) in Groningen, the Netherlands. The challenging experimental technique of α-γ-coincidences using a HPGe-detector array yields the required energy resolution and selectivity to dipole transitions that is necessary to investigate the PDR [4].
Recently, in addition a direct parity measurement [5] in ^{48}Ca has been performed by means of the $(\vec{\gamma}, \gamma')$ reaction. The polarized and nearly mono-energetic photons were produced at the High Intensity Gamma-Ray Source (HI$\vec{\gamma}$S) facility at the Duke University in Durham, USA [6]. First results assign negative parity to all observed dipole excitations.

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