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Investigation of the low-lying dipole response in real-photon scattering experiments

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Real-photon scattering experiments, also called Nuclear Resonance Fluorescence (NRF) experiments, are a well-established tool for investigating the low-lying dipole response in atomic nuclei due to the low-momentum transfer of photons [1,2]. By studying the angular distributions of the emitted photons during the decay of the previously excited nucleus, spin and parity quantum numbers can be assigned. Furthermore, total photoabsorption cross sections can be extracted in a model-independent way.
Systematic studies of the photoabsorption cross section can be utilized to investigate the properties of dipole excitation modes. For instance, in many nuclei an accumulation of electric dipole strength below and around the neutron separation threshold has been observed which is commonly denoted as Pygmy Dipole Resonance (PDR) [3,4]. Although the PDR strength is very small compared to the strength of the IsoVector Giant Dipole Resonance (IVGDR) [5], it might have some impact on the reaction rates in the rapid neutron-capture process (r process) [6,7]. During the last two decades, experimental and theoretical effort was put into the investigation of the PDR. Nevertheless, there are still some open questions concerning this excitation mode. Therefore, systematic investigations in different isotopic and isotonic chains have been performed, e.g., in the nickel isotopic chain.
The low-lying dipole response in ^{58,60,62}Ni has already been investigated in NRF experiments [8-10]. Furthermore, relativistic Coulomb excitation experiments in inverse kinematics on the unstable isotopes ^{68,70}Ni have been performed to extract the dipole strength [11-13]. Hence, ^{64}Ni is the missing link for completing the systematics in the even-even Z = 28 nuclei.
In this contribution, the NRF technique will be explained by showing the analysis of two complementary NRF experiments on ^{64}Ni using a continuous bremsstrahlung and a quasi-monoenergetic photon beam. Additionally, recent NRF results of different nuclei will be presented.
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Primary author: MÜSCHER, Miriam (University of Cologne)

Co-authors: Dr ISAAK, Johann (TU Darmstadt, Germany); Mr KLUWIG, Florian (University of Cologne, Germany); SAVRAN, Deniz (GSI); SCHWENGNER, Ronald (Helmholtz-Zentrum Dresden-Rossendorf); Prof. ZILGES, Andreas (University of Cologne)

Presenter: MÜSCHER, Miriam (University of Cologne)