Nuclear Structure of Exotic Nuclei by Direct Reactions: Investigations with Stored Radioactive Beams and with Active Targets

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The investigation of direct reactions with radioactive beams in inverse kinematics has already been proven to be a valuable tool for providing important information on the structure of exotic nuclei. In particular, it turned out that in many cases essential nuclear structure information can be deduced from high-resolution measurements at low momentum transfer. Such experiments can favourably be performed either by using the experimental technique of active targets, or, with even higher luminosities, with the new and innovative method of using stored and cooled radioactive beams interacting with thin internal targets at storage rings within the EXL[1] project.
The experimental techniques developed and applied for both of these methods will be discussed, and an overview on recent results will be presented. In particular, nuclear matter distributions and matter radii obtained from small angle elastic proton scattering at intermediate energies for light neutron-, and proton-rich halo candidates using the active target IKAR will be discussed. Using the EXL technique an – even on a world-wide scale – first reaction experiment with a stored radioactive beam with the aim to investigate the nuclear matter distribution of the doubly magic ^{56}Ni nucleus was recently performed. The results of this experiment and the results of a feasibility study on ^{58}Ni($\alpha,\alpha`$) inelastic scattering, where it was demonstrated that the Giant Monopole Resonance in ^{58}Ni can be investigated by the present technique down to cm angles below 1 degree, will be presented.
Finally an overview on the perspectives at the future facility FAIR will be given.

[1] EXL: EXotic nuclei studied in Light-ion induced reactions at storage rings