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Study of proton and neutron excitations along Silicon Isotopes between N=20 and N=28

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The main subject of this study is the experimental investigation of the nuclear structure of exotic neutron-rich nuclei in the vicinity of shell closures in order to constrain the description of the nucleon-nucleon interaction, and in particular its tensor term. Previous studies have shown that a deformation region develops along the N=28 isotonic chain between the doubly magical and spherical ^{48}Ca nucleus (20 protons/28 neutrons) and the ^{42}Si nucleus which is extremely deformed in spite of its semi-magical character (14 protons/28 neutrons). It has been shown that this deformation results from neutron excitations above N=28 and proton excitations above Z=14, both made possible by the reduction of these shell closures under the effect of the tensor component of the nuclear interaction. The goal is now to follow the evolution of the deformation along the Si isotopic chain, between ^{34}Si (N=20) and ^{42}Si (N=28) by measuring for the first time and in a simultaneous way through experiments at GANIL (Grand Accelerator National d'Ions Lourds):

- The contribution of neutrons to the excitation of the 2^+ state of $^{34-36-38}$Si nuclei by inelastic proton scattering.
- The contribution of protons and neutrons to the excitation of the 2^+ state of $^{34-36-38}$Si nuclei by Coulomb excitation on a gold target.

The experiments has been set up during the 2022 campaign of LISE spectrometer (Line d'Ions Super Epluchés) at GANIL. This spectrometer allowed to produce and select ^{34}Si, ^{36}Si and ^{38}Si nuclei. In order to measure the proton and neutron contributions, the experimental setup was composed of two independent experiments on the same beamline with the same radioactive beam.

The first experiment was perfomed with ACTAR-TPC detector (ACtif TARget-Time Projection Chamber). The purpose of this experiment was to measure the inelastic scattering of ^{A}Si(p,p')^{A}Si* reactions, with $(A = 34, 36, 38)$. The analysis of this part is in progress by one of the thesis students of the ACTAR collaboration.

The second experiment was the CoulEx part (Coulomb Excitation). The goal of this experiment was to measure the effective cross section of coulomb excitations. Several types of detectors composed the CoulEx setup. The work of this thesis is mainly based on the analysis of this experiment.

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