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Coupling gamma-ray detection to an active target in a high magnetic field: the SpecMAT project for direct reaction studies

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SpecMAT (Spectroscopy of exotic nuclei in a Magnetic Active Target) entails the development of a new active target detector, surrounded by an array of scintillators and placed in a high magnetic field.
The setup will operate at HIE-ISOLDE (CERN), where a 4 Tesla solenoid will be installed in a dedicated beamline. The HIE-ISOLDE facility is already providing post-accelerated radioactive ion beams with energies up to 4 AMeV, which will rise to 10 AMeV in forthcoming years.
This unique combination of beams and instrumentation will allow studying nucleon transfer reactions in inverse kinematics, even with very low intensity beams, thereby widening the scope of research to the most exotic nuclei. The main goal of the project is to perform complete nuclear spectroscopy studies in the neutron-rich nuclei around Z = 28 and in the neutron-deficient nuclei around Z = 82, tackling open issues such as the evolution of nuclear shells and magic numbers, as well as answering questions about shape coexistence in those regions.
In addition to the well-known advantages of the active target approach, such as high luminosity and high efficiency, the combined use of scintillators will allow for the detection of coincident gamma-rays, providing complementary spectroscopic information. At the same time, light charged particle trajectories will be reconstructed by measuring their spiral motion inside the magnetic field. This configuration should allow for the measurement of binary reactions with an improved dynamic range with respect to conventional active targets.
The main goals of the SpecMAT project and the present status will be illustrated. The contribution will then focus on the development of the scintillation array and on the status of the GEANT4 simulation of the device and tracking algorithms.
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Primary authors: Prof. RAABE, Riccardo (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica); MARCHI, Tommaso (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica)

Co-authors: RENZI, Francesca (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica); DE WITTE, Hilde (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica); SWARTZ, Jacobus Andreas (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica); OLEKSII, Poleshchuk (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica)

Presenter: MARCHI, Tommaso (KU Leuven Department of Physics and Astronomy Instituut voor Kern- en Stralingsfysica)

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