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Integration of the scattering chamber of the NUMEN experiment

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The NUMEN experiment aims to measure double charge exchange reaction (DCE) cross sections with heavy-ion beams of unprecedented intensity interacting with specific isotopes [1]. DCE proved to be useful for getting information on the nuclear matrix elements of neutrinoless double beta decay, the most promising probe to establish the Majorana or Dirac nature of the neutrino, and to evaluate the effective neutrino mass.
The proposed technique was tested with pilot runs at INFN-LNS, in Catania, with the pre-existing magnetic spectrometer MAGNEX and ion beams.
However, to get statistical significance from such challengingly DCE low cross sections, higher intensity ion beams are required.
The super conducting cyclotron is being fully refurbished featuring ion beams with energy from 15 up to 70 MeV/u and intensity up to 10^{13} pps at the reaction target point [2] and a complete upgrade of the MAGNEX spectrometer [3] including the scattering chamber (SC), where beam collides to target, is ongoing. The integration of this chamber with all the components around represents an important engineering challenge.
Inside the SC the target of the experiment consists of a thin isotope film evaporated on a graphite layer featuring high thermal conductivity. This layer is clamped in a target holder which holds it in position and it is connected to the cold finger of a cryo-cooler. To correctly align the target on the beam, the cryo-cooler will be vertically shifted by a regulation system; this system also allows the positioning of other spot of the target holder on the beam, useful for diagnostic purposes. Since the radiation level expected during experimental run will be non-negligible, an automatic system is designed for the manipulation of the target to manage the target replacement [4].
Downstream to the chamber a slits system will be positioned. It is composed by four different moving plates made in tantalum useful to control acceptance of MAGNEX spectrometer. This system also includes a pepper-pot to calibrate position measurement of the particles emerging from the target. For diagnostic purpose and for the measure of the incident beam charge during the runs a Fadaray Cup will be positioned inside the SC downstream of the target. All these systems are designed to work with remote settings and to cooperate each other with automatic procedures.
The integration of the beam lines with the SC is another challenging constraint to the design because it is required the connection to them with different incidence.
The external shape of the SC is imposed by the presence of gamma detectors to be positioned all around the main body. This necessity leads to the design of a spherical shape made in aluminium (series 5000) to reach maximum efficiency to gamma detection.
Since the design of this integration is completed all the particulars are under manufacturing and the test of some subassemblies is already started to check compliance to the requirements and to define best procedures.
The system will be presented in details with actual first results of the testing.

References:

[1] - F. Cappuzzello et al., The NUMEN project: NUclear Matrix Elements for Neutrinoless double beta decay, *European Physical Journal A* 54 (5) 72 (2018). doi: doi.org/10.1140/epja/i2018-12509-3

[2] - C. Agodi et al., The NUMEN project: Toward New Experiments with High-Intensity Beams, *Universe* 2021 7 (2021) 72. doi: doi.org/10.3390/universe7030072

[3] –F. Cappuzzello et al., The NUMEN Technical Design Report, *International Journal of Modern Physics A* (2021) 36:30. doi: doi.org/10.1142/S0217751X21300180

[4] –D. Sartirana et al. For the NUMEN collaboration, Target Manipulation in Nuclear Physics Experiment

with Ion Beams, *Advances in Service and Industrial Robotics (Springer)*, (2020) 84:535-543. doi: doi.org/10.1007/978-3-030-48989-2_57

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