FAZIA: A VERSATILE DETECTION SYSTEM FOR EOS STUDIES

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For the FAZIA Collaboration

FAZIA is an international collaboration involving research institutions mainly from France, Italy and Poland. It aims at performing studies on Nuclear Collisions around the Fermi energies, with particular emphasis on the aspects connected to the nuclear Equation of State (nEoS). The first, preliminary goal of the Collaboration has been to design and build detector prototypes having the most suited characteristics to that aim, namely the highest as possible dynamic range in term of A and Z identification of detected fragments, over the largest energy span. The solution has been identified in an array of three-stage Si-Si-CsI(Tl) telescopes, implemented in order to push to their limits the associated performances, believing that the relevant performances were not yet fully exploited in the existing apparatuses. In this framework, cooperative efforts amongst the various institutions have been dedicated to improve the detector quality (semiconductors and scintillators materials), to understand and improve the methods of pulse shape and DE-E techniques and to design and build the associated digital electronics, necessary to get out of the devices the best performances. That phase ended with the construction of the Demonstrator, a fully operational prototype of the FAZIA array, simply limited, with respect to the final apparatus, in terms of numbers of telescopes.

The Demonstrator of FAZIA is now in operation at LNS-INFN in Catania in a configuration covering the forward polar angles, thus suitable for nEoS studies. It implements and exploits all the advanced and novel features about detectors and electronics, i.e. those identified during the R&D phase.

In the presentation, the features of the apparatus will be shown and are briefly summarized hereafter:

- Selected Silicon material obtained via neutron transmutation doping for best uniformity, mandatory for Pulse Shape analysis
- Silicon detector diced from wafers cut in such a way as to minimize channeling effects, also critical to both Pulse Shape and DE-E techniques
- Design of a low-noise, high dynamic range preamplifier providing both charge and charge differentiated outputs
- Design and implementation of a dedicated fully digital electronics connected as close as possible to the preamplifiers in order to keep at minimum noise and pick-up
- Compactness of the solution for the electronics which operates under vacuum, equipped with FPGA’s programmed in such a way as to remove the necessity of any further electronic modules dedicated to energy, timing and Pulse Shape analysis
- Transmission of the programmable trigger-selected data via a reduced number of fiber-optic cables connecting the electronics inside of the vacuum chamber with the external PC farm collecting and storing the data
- Mechanical implementation of the device necessary to guarantee the operation under vacuum at controlled temperature of the detector and of the associated electronics

A brief discussion will be dedicated to recent Physics results obtained with the prototypes, confirming the availability of unprecedented performances in terms of Z and A discrimination, mandatory for nEoS and isospin oriented studies.