Sailing with Needle beyond the horizon*

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Contemporary studies of nuclear structure concentrate in regions far from the valley of β stability. Experimentally such regions are accessible via, inter alia, fusion-evaporation reactions in which the nuclei of interest are produced by the emission of a few particles from the compound nucleus. The arrays of HPGe detectors used for these studies have to be complemented with ancillary devices, which make possible accurate identification of the reaction products, and thus of the reaction channel. In particular, when approaching very neutron-deficient nuclei the channels with neutron emission lead to the most exotic nuclear structures, which are produced with very small cross-sections. With the purpose of identifying neutron-evaporating reaction channels, large arrays of liquid scintillator detectors like the Neutron Wall [1,2] and the Neutron Shell [3] were constructed in the past and successfully used in many experiments, aiming at the study of more and more neutron deficient nuclei, especially along and close to the $N = Z$ line, up to the region of the doubly magic ^{100}Sn.

Building up on the decades of experience with the above-mentioned arrays, following the extensive R&D phase, a new neutron multiplicity filter NEDA [4] has been constructed. The new array is optimized to have high efficiency, excellent capabilities to distinguish the detected neutrons and gamma rays and to properly determine the multiplicity of neutrons. It should also work at high counting rates. Thanks to these features NEDA is apt to work as an ancillary device to modern γ-ray spectrometers. Indeed, within its first physics campaign in 2018 [5–7] NEDA was connected to AGATA at GANIL [8] presenting excellent performance.

At present, the neutron multiplicity filter NEDA is installed at the Heavy Ion Laboratory, University of Warsaw, in conjunction with the EAGLE γ-ray spectrometer [9]. The new aggregate of the detectors, named NEEDLE, was constructed to investigate the structure of exotic neutron-deficient nuclei. The first experimental campaign of NEEDLE, enriched with the Köln plunger [10], finished in April. As the next step, NEEDLE will be also equipped with the charged particle detector DIAMANT [11], which will further enhance the selectivity of the entire setup. The features of DIAMANT and a wealth of physical phenomena possible to address employing NEEDLE–DIAMANT setup constitute to a separate contribution to the Conference.

In this contribution, the current status of NEEDLE, its performances during the last measurements and the highlights from the first physical campaign will be presented. The possibilities to perform the experiments on this setup will be discussed and advertised.

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