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PISTA, a new detection system for transfer-induced fission in inverse kinematics at VAMOS

More than 80 years after its discovery, a complete description of the fission process remains a challenge. It is a many-body dynamic problem involving both microscopic and macroscopic aspects of nuclear matter. To further understand the fission process, new experimental data on exotic fissioning systems that cannot be probed using direct neutron-induced fission are needed. Moreover, technological breakthroughs such as the development of Gen-IV reactors and various fundamental aspirations motivate the scientific community to better understand this mechanism.

At GANIL, fission studies using the VAMOS++ large acceptance spectrometer combined with 238U beams at energies around the Coulomb barrier allow to populate exotic fissioning systems. Also, fission induced by transfer or fusion reaction in inverse kinematics allows obtaining isotopic identification (in mass and charge) of fission fragments. Furthermore, the detection and identification of the target-like residue provide the characterization of the fissioning systems in terms of mass, atomic number and excitation energy. Such a combination has been shown to be a powerful tool to extract post-evaporation isotopic yields and neutron content (N/Z) that hold the signature of the shell effects at play in the process [1] as well as the fission barrier [2].

Recently, an upgrade of the target-like residue detection systems has been initiated. For this, the new PISTA (Particle Identification Silicon Telescope Array) detector has been developed. PISTA is an array of eight trapezoidal silicon telescope detectors assembled as in a corolla. Each telescope is composed of two single sided silicon detectors, 100 µm and 1000 µm thick, placed 10 cm from the target. The array covers angles between 30° and 60°. Target-like nuclei are identified using (ΔE, E) technique up to Oxygen isotopes, resulting in the characterisation of the fissioning system. The high angular granularity of the detector allows the reconstruction of the reaction kinematics, thus allowing the reconstruction of the Excitation energy of the fissioning system using two-body kinematics. Thanks to this detection system coupled to VAMOS++, isotopic fission yields with high statistics per energy bin of about 1 MeV in excitation energy from 6 up to 20 MeV are expected.

In this presentation, the results of the first experiment using PISTA will be discussed. This experiment used a 238U beam at 6 A MeV impinging on a 100 µg/cm2 thick 12C target. The characteristics and the performances of the PISTA detection system will be presented.

[1] D. Ramos et al. Phys. Rev. C 101, 034609 (2020)

[2] C. Rodríguez-Tajes et al. Phys. Rev. C 89, 024614 (2014)

[3] Rejmund, M., et al. NIM Section A 646 (2011): 184-191.

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