Study of the structure of neutron-rich nuclei in the N~50

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This internship will focus on studying the nuclear structure of exotic neutron-rich nuclei in the N~50 region, specifically near ^{78}Ni. Investigating the properties of these nuclei help reveal the disappearance of well-established magic numbers in stable matter and the emergence of new magic numbers. In this region, it is apparent from both mass and spectroscopic data that the size of the effective N = 50 gap continuously decreases from stability down to Z = 32. This decrease can hardly be attributed to the emergence of shape coexistence.

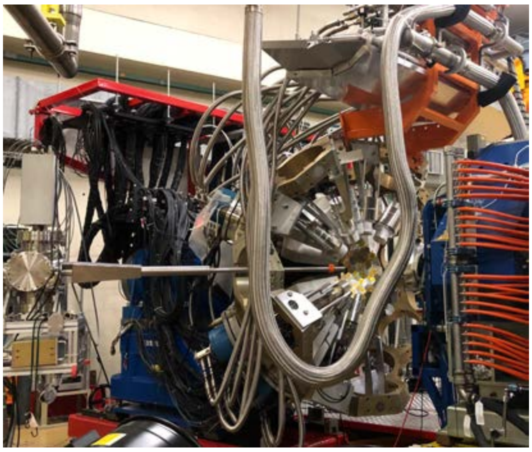

Figure : gamma-rays serve as electromagnetic probes that allow for the precise extraction of nuclear information and enable high-resolution spectroscopy. The AGATA gamma-ray multidetector, based on gamma-ray tracking technology in germanium, stands as the most advanced gamma spectrometer.

A previous experiment was performed at GANIL, where a large data set for neutron-rich nuclei was produced in a fusion-fission reaction with ^{238}U beam impinging on a ^{9}Be target. The several fission fragments were selected unambiguously (A and Z identification) by the VAMOS++ spectrometer. The prompt gamma-rays were detected in coincidence with the fission fragments by the AGATA array composed of 8 triple-clusters (32 crystals). However, due to the small number of crystals in AGATA and, despite the large acceptance of the VAMOS++ spectrometer used as a trigger of the gamma spectra, low statistical data were acquired in particular in gamma-gamma coincidences to well establish the level scheme. Thus, a new experiment will be proposed using AGATA in a configuration approaching 60 crystals surrounding a thick ^{238}U target bombarded by a 26 MeV deuteron beam. In the present case, the identification of the nuclei and assignment of the gamma-rays will be based on double gating on known gamma-ray transitions which were firmly identified in the dataset of the previous GANIL experiment.

The future PhD student will need to model the upcoming experiment using Monte Carlo simulations with GEANT4 and the analysis will be performed within ROOT frameworks. The PhD student will also work in close collaboration with the Strasbourg Theory Group, one of the world leading experts of Large-Scale Shell Model calculations to interpret the experimental results within the framework of nuclear theory. The PhD student will participate and present the results in national and international conferences and contribute to other experiments at national as well as international facilities (e.g. GANIL, INFN...).