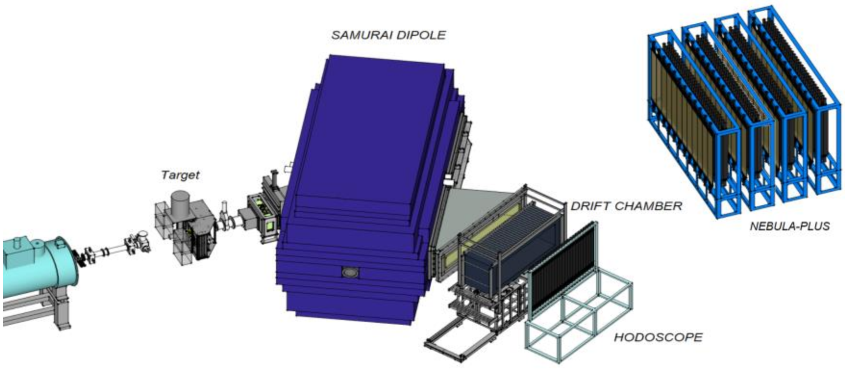
Investigation of the most neutron-rich isotopes of Beryllium and Boron

Nuclear Structure group LPC-Caen: PhD thesis (2022)

The light neutron-rich nuclei, with extreme N to Z ratios, provide a unique testing ground for understanding nuclear structure. In particular, it is in this region that we are able to reach the furthest from the line of beta-stability experimentally, including systems beyond the "neutron dripline" - the point at which the nucleus cannot bind the last neutron(s). The present PhD project aims to explore the limits of the beryllium isotopic chain by searching for ^{17,18}Be – which are unbound to neutron emission and exist as resonances – and exploring their multi-neutron decay (3 and 4 neutrons respectively). The work proposed here will build on recent PhDs within our group which have extended our knowledge of the Be isotopes to ^{16}Be and the B isotopic chain out to ^{20,21}B [1,2].



The experiment will be carried out at the Radioactive Isotope Beam Factory (RIBF) of the RIKEN laboratory in Saitama near Tokyo, Japan and will be undertaken using the SAMURAI setup as shown here schematically. In order to increase the neutron detection capabilities, which are critical in identifying a nucleus which decays in flight by the emission of multi-neutrons, two addition scintillator walls (NEBULA-Plus), constructed by our group within an ANR funded project, will be installed in 2022 to supplement the existing two-wall NEBULA fast neutron array. Additionally, a target vertex detector system (STRASSE – partially financed by a Normandy government grant) including a thick hydrogen target will be incorporated in the setup. In short, the ^{17,18}Be, formed by removing protons from beams of ^{19}C and ^{19}B produced by the RIBF, will be reconstructed from measurements of their decay products – ^{14}Be and 3 or 4 neutrons.

The student will participate in the preparation and running of the experiment and will be responsible for the analysis of the data and the interpretation of the results. The analysis will involve the use of software packages such as Root and GEANT4. Simulations will play a central role in interpreting the results. As such, beyond a clear interest in being involved in fundamental research, a proficiency in computing would be highly desirable as would be a willingness to work within a large international collaboration.

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[1] *B Monteagudo Godoy, PhD Thesis, LPC-Caen (2019) ;* http://hal.in2p3.fr/tel-02420708
[2] *S Leblond et al., Phys. Rev. Lett.* ***121*** *(2018) 26250*