

Study of exotic nuclei



GANIL, Caen, Normandy



S³ Super Separator Spectrometer
Studying the properties of rare and superheavy nuclei

Scientific leader: Hervé Savajols (GANIL) *
Laboratories involved: GANIL (Caen), IJCLab (Orsay), IPHC (Strasbourg), LPCC (Caen)
Nature: research instrument for nuclear physics
Status: project under construction, financed by the IN2P3, CEA, EQUIPEX, CPIER, ANR, GANIL, CPER and FEDER. Component of the national SPIRAL2 infrastructure at GANIL.
Website: <https://www.ganil-spiral2.eu>

Scientific objectives

S3 will take advantage of the heavy ions stable beams of very high intensity from the SPIRAL2 linear accelerator to produce, by collision on targets, nuclei with very low effective cross-sections (these have only a low probability of formation). They are superheavy nuclei at the end of the Mendeleev table, or exotic nuclei far from the stability valley. S3 implements a spectrometer to separate these very rare nuclei from the largely dominant background of classical nuclei, and will make highly innovative measurements that have never before been applied to exotic nuclei.

Resources deployed

- A highly innovative set of triplets of superconducting multipoles coupled to magnetic and electrostatic dipoles ensure the rejection of the incident beam that has not interacted with the production target, excellent transmission of the nuclei of interest and a physical selection in mass that is unique in the world. Two complementary detection systems will be installed at the final focal plane.
- SIRIUS studies nuclei through their radioactive decay. It uses fast electronics to capture and study very rare events that were previously inaccessible.
- LEB will provide new information about the most exotic nuclei: charge radii, electromagnetic moments, nuclear spins and atomic masses.

7 superconducting magnets	12 partner laboratories
1 particle in 10 ¹³ per second: selectivity	€ 21M construction cost
4,2°K operating temperature of superconducting magnets	

- IN2P3 CONTRIBUTIONS**
- Scientific coordination of the project (GANIL)
 - Design and construction of the high-power target system
 - Design of the magnetic elements: magnetic dipoles and triplets of superconducting multipoles
 - Design and construction of the electrostatic dipole
 - Design and construction of the entire SIRIUS detection system in partnership with the CEA/IRFU
 - Design and construction of the LEB detection system in partnership with KU Leuven

Other french laboratories involved

Irfu (CEA Saclay)

2010 ANR EQUIPEX S³

2011 Launch of the construction of the spectrometer

2014 Reception of the SPIRAL2 buildings

2014-2015 Launch of the construction of the experimental devices (SIRIUS, LEB)

2018 Delivery of the first superconducting magnet to GANIL (out of a series of 7)

2025 Start of commissioning for the first experiments

* Since 2010