

# The (NA)2STARS: Neutrinos, Applications and Nuclear Astrophysics with a Segmented Total Absorption with higher Resolution Spectrometer, a combination of calorimetric and spectroscopic tools for beta decay and in-beam measurements

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The international collaboration constituted based on the Total Absorption Gamma-ray Spectroscopy technique (TAGS) in Europe is aiming to build a Total Absorption Spectrometer (TAS) of the next generation. TAGS is a calorimetric technique using large monolithic or segmented scintillators that cover more than 80% of 4p, but with limited energy resolution. It complements high-resolution spectroscopy using Germanium crystals. It is particularly well suited to physics themes requiring the detection of high-energy or multiple gamma photons, as in the case of beta decay of short-lived nuclei, or the measurement of reaction cross sections useful in certain nucleosynthesis processes. Indeed, in the case of beta decay of nuclei with large Q-values, the excitation energy states of the daughter nucleus are located at high energy and de-excited by multiple gamma lines or very energetic gamma-rays. A systematic error known as the Pandemonium effect [1] can affect data due to the low intrinsic or geometric efficiency of devices based on HPGe-type detectors. This effect results in poor determination of beta intensity distributions, and has far-reaching consequences for topics involving good knowledge of these intensity distributions.

The new instrument, called STARS (Segmented Total Absorption with higher Resolution Spectrometer), will ally efficiency with a higher segmentation and energy resolution than the existing spectrometers thanks to the addition of 16 LaBr<sub>3</sub> crystals. The two segmented TAS that exist in Europe that will benefit from this upgrade are DTAS detector (18 NaI crystals [2]) and the Rocinante detector (12 BaF<sub>2</sub> crystals [3]). The scientific advances that will be made possible will concern nuclear structure, nuclear astrophysics, neutrino and reactor physics, topics to which the TAGS technique has proven to bring significant advances [4]. The research objectives span a wide physics program.

The first experiment with the STARS is planned in GANIL in July. It will act at the time as a commissioning of the advanced TAS that will be then be available for new nuclear data measurements.

[1] J. C. Hardy et al., Phys. Lett. 71 B, 307 (1977).

[2] V. Guadilla et al., Nucl. Instr. Meth. A910, 79-89 (2018).

[3] E. Valencia et al., Phys. Rev. C 95, 024320 (2017).

[4] A. Algora, B. Rubio, J.-L. Tain, M. Fallot, W. Gelletly, Eur. Phys. J. A 57, 85 (2021) and references therein.

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