**Questions adressed :**

What the dark sectors of the Universe are made of?

Can the theory of Dark Sectors bring an answer?

Does a fifth of nature, that makes the link between ordinary matter and Dark Sectors, exist?

**Collaboration :**

GANIL : B. Bastin, F. de Oliveira, M. Lewitowicz, D. Ackerman

CSNSM : A. Coc, J. Kiener, C.-O. Bacri, I. Deloncle, C. Hamadache, A. Laviron, J. Bourçois, V. Tatischeff.

IPNO : F. Hammache, N. de Séréville et B. Roussière.

**Summary:**

Our universe is mainly composed of dark energy (DE) and dark matter (DM), at estimated percentages of 69% and 26% respectively, deduced from the cosmic background radiation measurements and in accordance with the prediction of Jim Peebles, who was awarded the 2019 Nobel prize in Physics. **The Standard Model (SM) of particle physics fails to describe hidden sectors of our universe.** To address this issue, several models have been developed and in recent years **particular attention is paid to studies of so-called Dark Sectors (DS), introduced [1][2][3] but poorly tested [4]**. DS can be defined as **hypothetical sets of relatively light particles with interaction orders of magnitude lower than the electromagnetic interactions**. From a theoretical point of view, **DS are composed of one or more particles, that couple to SM through portals, as described in Fig.1.** DS may or not include DM particles. **This leads to the fundamental question of the existence of a fifth force of nature.**

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***Fig. 1:*** *illustration of the Standard Model coupling to dark sectors through given portals. Portals that might be studied though nuclear physics experiments are indicated with a red frame.*

This project is about **New J**udicious **E**xperiments for **D**ark sectors **I**nvestigations (**New JEDI**). The main goal is to **check, through tailor-made nuclear physics (NP) experiments, the** **EXISTENCE or NOT of a new gauge boson** **with a mass of few MeV** that will act as a messenger of this new fifth force. This investigation is further **motivated by the recent claim of the anomaly observed in the e+e- decays of excited states of 8Be interpreted as the signature of a hypothetic dark boson** [5]. If we prove that it is indeed a **real experimental signature of a new boson** and not some **spurious effect related either to an experimental error or a subtle effect of NP in such a complicated system as 8Be**, it would **open up an entire new field in Particle Physics Beyond the Standard Model** (PPBSM). Should such particle exist, it will manifest itself in many reactions with light nuclei. **For that purpose, focus** of this proposal is the study of **simplest nuclear systems, such as 3He, d…**, **to reduce as much as possible nuclear structure uncertainties**. **Some of foreseen reactions may also shed additional light on the dynamics of few nucleon systems, relevant for the precision Big Bang Nucleosynthesis (BBN) studies, and that constitutes the second scientific motivation of this project**.

**The experimental program will start at the** [**ARAMIS-SCALP**](https://www.csnsm.in2p3.fr/scalp) **(France) and** [**NPI**](http://www.ujf.cas.cz/en/research-development/experimental-facilities/) **(Czech Rep.) facilities until the new European Strategy Forum on research Infrastructures** [**GANIL-SPIRAL2**](https://www.ganil-spiral2.eu/en/) **facility (France) is ready to deliver the most intense stable beams in Europe at an energy range from 0.75 to tens MeV (expected 2021). It will cover the full set of beams required for the project.**

**REQUEST to IN2P3:**

- 200k€ (material, travels....).

- one post doc.

[[1] C. Boehm et al., NPB 683 (04) 219](https://arxiv.org/abs/hep-ph/0305261).

[[2]\* M. Pospelov et al. PLB 662 (08) 53](https://doi.org/10.1016/j.physletb.2008.02.052).

[[3] N. Arkani-Hame et al. PRD 79 (09) 015014](https://doi.org/10.1103/PhysRevD.79.015014).

[[4]\* J. Alexander et al. arXiv:1608.08632](https://arxiv.org/abs/1608.08632).

[[5] A.J. Krasznahorkay et al., PRL 116 (16) 042501.](https://doi.org/10.1103/PhysRevLett.116.042501)