



# Luminous Dark Matter searches with XENONnT and DARWIN experiments

Laboratories: SUBATECH & The School of Physics at The University of Melbourne

Start:

at SUBATECH : between 01/10/2022 and 01/12/2022

at The University of Melbourne : between 01/10/2022 and 01/03/2023

Supervision:

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The Xenon Group of the SUBATECH laboratory in France and the School of Physics of the University of Melbourne in Australia are seeking **two highly motivated students** with a master degree in physics and a solid background in particle and/or astroparticle physics to work on a joint project to probe luminous dark matter with liquid xenon time projection chambers.

The existence of Dark Matter is known from gravitational effects, but its nature is still totally unknown, and its characterization is one of the major theoretical and experimental challenges of modern particle and astroparticle physics. Several proposed candidates have been put forward over time: among them, the Luminous Dark Matter. In the recent years, this model gained a lot of attention as it could possibly explain a recent observation by the XENON1t experiment of a yet-unexplained electronic signal.

In this context, **the main objective of this project is the search for Luminous Dark Matter with the dual phase liquid xenon time projection chambers XENONnT and DARWIN.**

Dual phase liquid xenon time projection chambers are among the most promising technologies for the proposed research: the XENON1T experiment has recently achieved the most stringent limits on dark matter searches and demonstrated its exceptional capabilities for additional rare event detections. Xenon detectors are expected to continue leading the field with the DARWIN experiment.

The SUBATECH Xenon Group is strongly involved in dark matter and rare events searches within the international XENON collaboration, which is operating the XENONnT experiment at Laboratori Nazionali del Gran Sasso, in Italy. The group is contributing to the R&D and sensitivity studies of DARWIN to rare events physics channels.

The School of Physics of the University of Melbourne recently joined the DARWIN collaboration. Their members have a strong expertise in theoretical modelling and data interpretation including direct detection dark matter searches and physics beyond the Standard Model. The school hosts the Australia Research Council Centre of Excellence for Dark Matter Particle Physics and is part of a universities consortium that supports the Stawell Underground Physics Laboratory.

One PhD project will be based at the SUBATECH laboratory in Nantes with a minimum 12-month stay at the University of Melbourne. The other PhD project will be based at the University of Melbourne with a minimum 12-month stay at the SUBATECH laboratory in Nantes. The two candidates will be enrolled in the PhD program at the IMT Atlantique Nantes School of the SUBATECH laboratory and in the PhD at the School of Physics at the University of Melbourne

The student primarily based at the SUBATECH laboratory will be a member of the XENON and DARWIN collaborations. He/She is expected to analyze the data coming from the XENONnT experiment and to integrate the simulation and analysis frameworks of the XENONnT with new tools developed explicitly to test the Luminous Dark Matter hypothesis.

The student primarily based at the University of Melbourne will collaborate with the SUBATECH members I. integrating the Luminous Dark Matter model into the DARWIN simulation framework. He/She will be member of the DARWIN collaboration. He/She will study and simulate all the possible sources of backgrounds and develop novel analysis method to increase the sensitivity of the DARWIN experiment to the Luminous Dark Matter hypothesis. Both students will also participate in R&D activities for the DARWIN project.

The PhD candidates will benefit from the combined expertise of the project supervisors, and the embedding into two research environments. Demonstrated experience in the field of particle or astroparticle physics, good computing skills and previous experiences on simulations, data treatment and analysis will be advantageous.

The application forms (to be sent to [diglio@subatech.in2p3.fr](mailto:diglio@subatech.in2p3.fr) and [barberio@unimelb.edu.au](mailto:barberio@unimelb.edu.au)) must include an academic curriculum vitae, a summary of all of the candidates' higher education, a motivation letter, an academic transcript and two letters of recommendation, including one from the master internship (M2 stage, in France) supervisor.