

GDR Deep Underground Physics (DU ϕ)

Who, Why, What, When?

Who?

GDR DU ϕ aims to federate the French community of underground experiments, associated with the physics of rare events.

The goal is to pool our expertise to reinforce relations between theorists and experimentalists, to develop new synergies and collaborations.

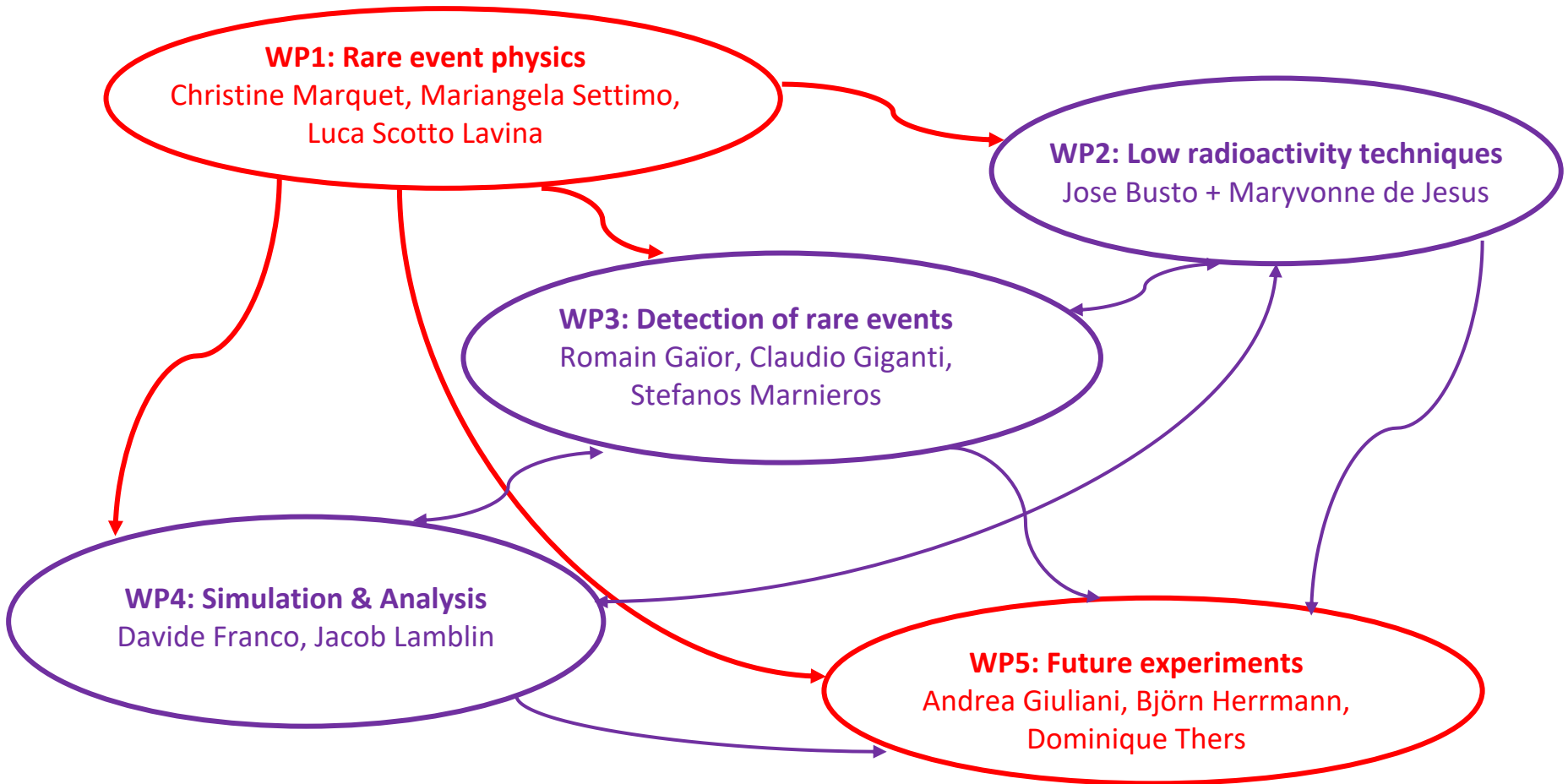
GDR DU ϕ missions:

- facilitate the development and access of new players to European underground platforms (LSM, LNGS, LSC, BUL...),
- provide visibility for the French underground physics community,
- favour the emergence of new collaborations with new projects,
- promote the young generation of researchers working in the field
- Initiate reflections on the needs of future experiments in this area.

The reflection on the underground physics will be done within the GDR DU ϕ , in close link with the GDR/IRN Neutrinos/Terascale/Resanet + the various actors involved in the research field of **“rare-event physics in an ultra-low radioactivity environment”**, with partners from other research organizations in France.

Why?

Through multi-thematic exchanges, the GDR Duφ goal is to define a strategy, both **scientific** and **technological**, for 3rd generation projects in DULs to study BSM physics. In particular the properties of neutrinos (via neutrinoless double beta decay searches) and the identification of dark matter nature (via direct detection experiments), thanks to five work packages (WP):



What?

WP1: Rare event physics

- Goals: establish the status of rare-event BSM physics from both theoretical and experimental sides ($\beta\beta 0\nu$ and direct detection of dark matter (WIMPs and WISPs) + double electron capture, proton decay, study of solar and atmospheric neutrinos in DULs, etc....)
- Elaboration of new synergies between the different experiments and development of new collaborations with theorists, with the contribution of other nuclear and particle physics communities. It also includes experiments not directly related to underground physics but which can provide hints for a better treatment and interpretation of data (accelerator, cosmology, nuclear physics...).
- Discussions within WP1 will provide the material to establish promising new directions for the future of rare event physics in DULs (WP5) and for experimental and technological efforts (WP2, WP3 and WP4).

WP2: Low radioactivity techniques

- An ultra pure environment in terms of radioactivity is a key point in an experiment dedicated to search for rare and low-energy events $\Rightarrow$ essential role for WP2, beyond the scientific aspects.
- Goals: develop a synergy with other disciplines, establish a balance sheet of the best purification techniques, to understand the contamination processes or, in the case of radon, the transport and capture.
- At the heart of WP2 is the creation and/or participation in a website where all the information associated with radiopurity experiments would be accessible, not only to other WPs but also to the national and international community.

What?

WP3: Detection of rare events

- The major interest of WP3 concerns the experimental techniques used for the detection of rare events, within the framework of experiments with low background noise.
- Goals: share instrumental expertise, essential for the pursuit of low backgrounds. Exchanges between experimentalists and theorists would also be valuable to guide the best operation of the current experiment and the design of the future ones, in terms of signals detected as of detector calibration.

WP4: Simulation & Analysis

- The installation in a DUL and the radioactivity mitigation of the detector materials ensures the low background environment mandatory for the study of extremely rare phenomena. But it is essential to predict the residual background noise after selection cuts, to validate the predictions on the data and to extract the signals or limits with robust techniques.
- Goals: establish a review of these techniques for both simulation and data analysis, to compare them, to promote the exchange of knowledge and to identify synergies between the experiments. Due to the growing complexity of detectors, the development of techniques based on artificial intelligence (machine learning) will also be considered.

What?

WP5: Future experiments

- Physics experiments dedicated to the observation and understanding of rare events are by nature confronted with the experimental challenge. WP5 will propose a scientific and technological watch of the detectors and DULs used or under development for this research, in order to compare the evolution of experiments and to highlight the complementarity of the different approaches thanks to the great diversity of the proposed detectors.
- This review of experimental and technical development must align with theoretical and phenomenological developments in BSM physics. Exchanges with theorists will help to understand which BSM theories, or which part of their respective parameter space, is covered by current underground experiments, and which experimental progress, including those of underground laboratories, will be necessary to access promising new physics not yet discovered.
- All these issues will be addressed during regular GDR DU ϕ meetings, so that the community can contribute through invited talks and round tables. It will include specific discussions on underground labs and DULs worldwide and their complementarity for underground physics and/or underground sciences.

What?

Scientific Management Committee:

- A director
- An executive board (“le bureau”) with the 13 conveners of the 5 WP = underground physics experts
- 6 additional members from specific thematic to extend the GDR scope (to both ensure an institutional representativeness and open to scientific topics not represented in the executive board).
 - theorists – double beta, dark matter, BSM physics (Sacha Davidson, Frédéric Nowacki)
 - experimentalists – “underground or not” neutrinos and DM physics (Yves Lemièrè, Pascal Paganini, Vincent Poireau)
 - underground science (Vincent Breton)

Operating mode:

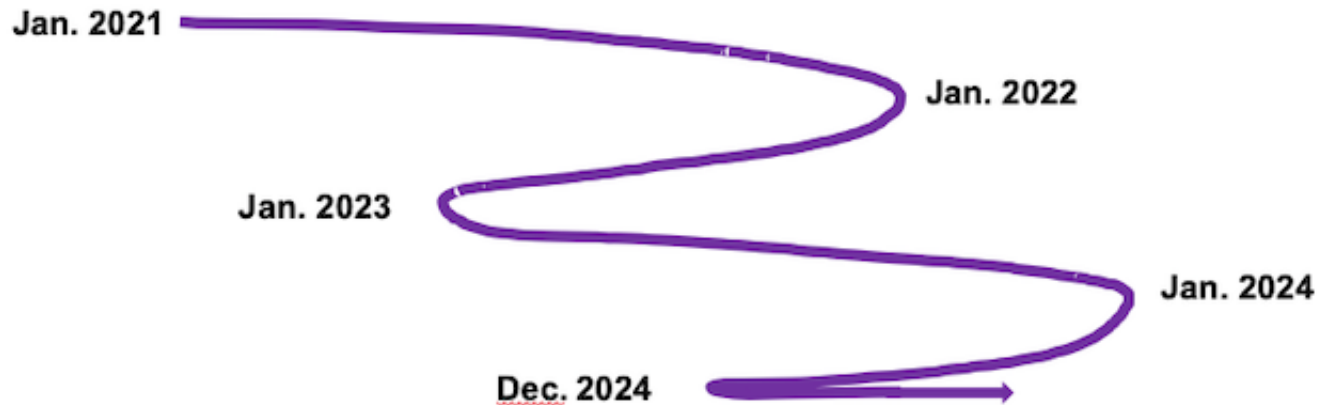
The format of the meetings will be:

- plenary session with talks associated to the 5 WPs;
- session dedicated to one WP or multi-WPs (but not all);
- sessions having common place and date with other GDR or IRN if possible (Neutrinos, Resanet, Terascale, . . .).

When?

Review for agreement by Section 01 on 2020-11-05

If approved, term Jan.2021-Dec.2024



Hope you will join GDR DU ϕ and continue to participate actively to dedicated scientific GDR/IRN (Neutrinos, Terascale, Resanet,...): links are needed...

Soon a website... and a logo!

