Deep Underground Physics

Rare event physics
Activity report

WG1

Our ambitious mission :

- Show the **state of the art** of the physics of rare events
- Cover for both **experimental** and **theoretical** aspects
- Provide hints for the exploration of next generation experiments (link with **WG5**)
- Provide a guideline for experimental and technological efforts, like constraints for low cosmo- and radio-purity techniques (**WG2**), for detection methods (**WG3**) and analysis tools (**WG4**)
- **Being inclusive** to any other scientific fields that would profit of deep underground sites

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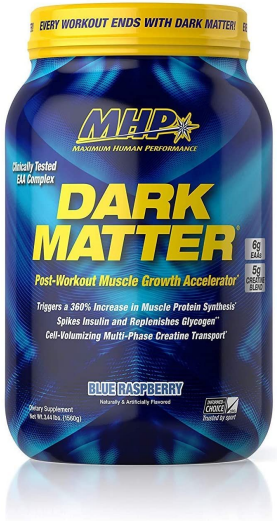
October 10, 2024 - IP2I

Deep Underground Physics

Two major axes

1. Dark Matter

WG1



We will keep a particular eye on direct search of dark matter :

- Scoping the whole zoology of models (WIMP, WISP, axions, …), nucleo- or lepto-philic
- Exploring a wide (and experimentally accessible) range of masses/energies (>GeV, sub-GeV, down to μeV)
- Looking for any trace of daily and seasonal modulation
- Using a plethora of targets and combinations of energy losses
- Complementarity with colliders (new particles) and indirect evidences (annihilation)

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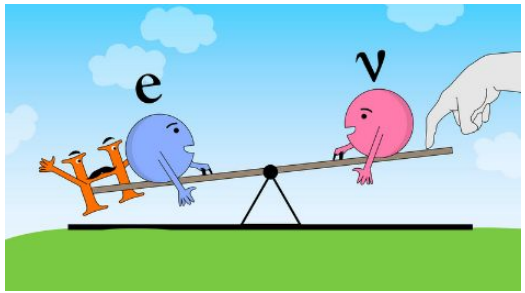
Two major axes

2. Neutrinoless double beta decay

WG1



We will keep an eye on the search for the intimate nature of neutrinos :

- Nature of neutrino (Majorana/Dirac)
- Fixing the neutrino mass scale and possible mass scenarii
- Proof of a lepton number violation
- Neutrino hierarchy
- Impact on baryon asymmetry of the Universe via Leptogenesis

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… and more

WG1

Many other challenges and synergies, some of them scoping physics beyond Standard Model :

- Double electron capture
- Proton stability
- Solar neutrino flow
- Coherent elastic neutrino-nucleon scattering
- Contribution to detection and study of supernovae properties
- Geo-neutrinos
- Sterile neutrinos

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Links
with other communities

WG1

Our mission naturally includes the connection with other communities :

- GDR Neutrinos (http://gdrneutrino.in2p3.fr/) for 0νββ and any other low background physics
- GDR RESANET (http://resanet.in2p3.fr/) for nuclear physics processes
- GDR Terascale ((http://terascale.in2p3.fr/) for particle physics beyond Standard Model
- Accelerator physics
- Cosmology
- Anything else related to underground physics (geology, biology, chemistry, …)
- Finally, involving other institutes and countries

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Deliverables

WG1

Practically speaking, we aimed to :

- Encourage people, especially young ones, to **present** freshly new theoretical and experimental results ⇨ Done, see next slide
- Coordinate the efforts for the preparation of a **biennial summary document** (ideally early 2023 and 2025) with the state of the art of the field (form to be defined: short communication, activity report, …) ⇨ Done only once, and with other WGs
- Develop and maintain a **web page** (in GDR web site or linked to it) with a collection of the existing experimental results (as a form of publications, oral talks and summary plots) ⇨ Done, through multiple initiatives
- **Promote** round tables, seminars, outreach events ⇨ Done

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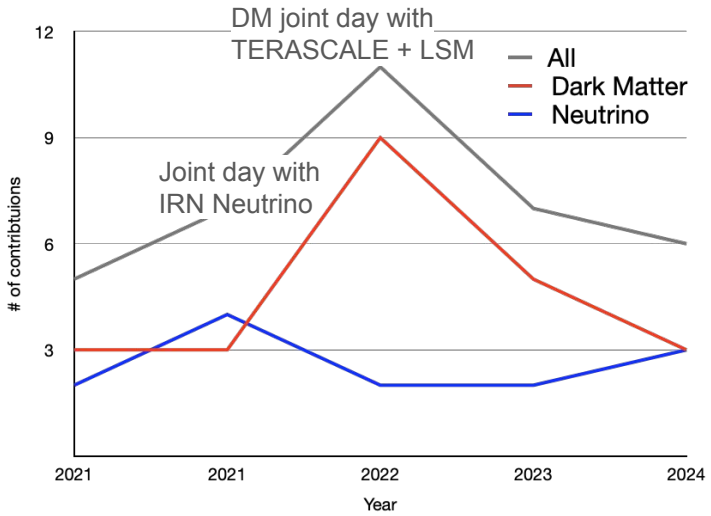
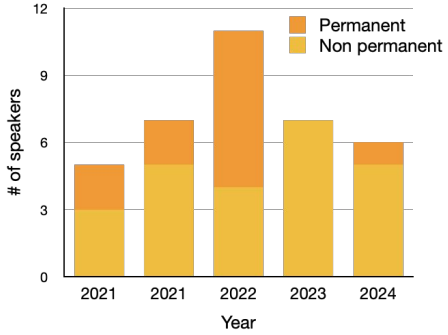
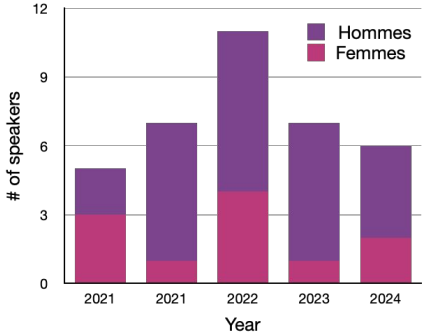
Presented results

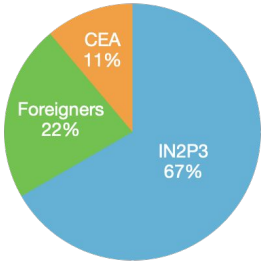
WG1

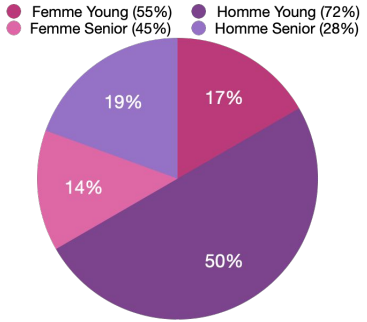


- 6/36 talks (2021, 2022) on theory, nuclear physics, LHC, indirect search









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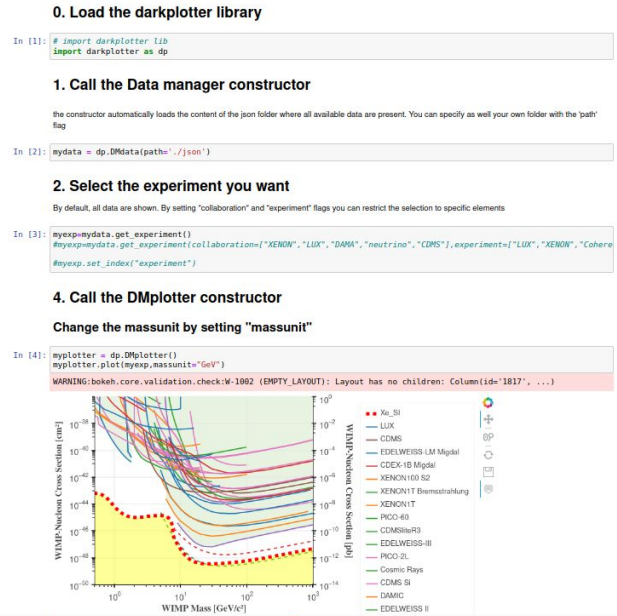
DMPlotter

WG1

The Dark Matter Plotter is:

- an Open Science Initiative (shared data and code)
- a Collaborative Online Tool
- meant for everyone: scientifics and general public
- a bibliographic source (each piece of data contains a full reference)
- downloadable (git) to use locally and runnable online (via Binder)
- under continuous improvement (needs your feedback!)

Code maintainer : Olivier Dadoun (LPNHE)
https://github.com/odadoun/DarkPlotter



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Conclusion and outlook

WG1

Quite a lot of activities during those years, with great outcomes :

- Deliverables aimed at the beginning of the GDR mostly done
- Great opportunity to better know the (inter)national community
- Improved networking with other GDR/IRN

Outlook :

- Reshaping the WG
  - Breaking theory+phenomenology vs experiment ?
  - Including relevant news from other communities (astrophysics, cosmology, HEP, ...)
  - Merging present and future (WG1+WG5) ?

New ideas (out of the scope of WG1, a new WG?)

- **On outreach** :
  - Participate / organize tematic days (DM / neutrinos / UG)
  - Prepare outreach material (posters, videos, comics, stikers, flyers,...), targeting young public
  - Organize challenges on “my thesis/my research in a single slide”
  - Science and art
- **On society** :
  - Work on sustainability and inclusivity in our community

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