iDMEu kick-off breakout session: Uncovered/future topics
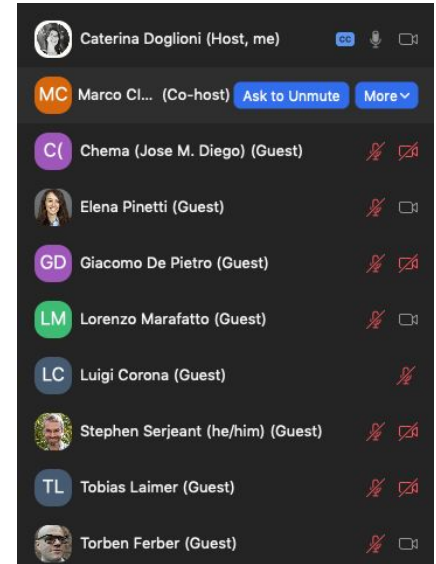
Moderators:

Caterina Doglioni
Torben Ferber

Participants:

Caterina Doglioni (Host, me)
Marco Cl... (Co-host) Ask to Unmute More
Chema (Jose M. Diego) (Guest)
Elena Pinetti (Guest)
Giacomo De Pietro (Guest)
Lorenzo Marafatto (Guest)
Luigi Corona (Guest)
Stephen Serjeant (he/him) (Guest)
Tobias Laimer (Guest)
Torben Ferber (Guest)

Bradley Kavanagh
Oliver Buchmueller

Introduction and aims of this breakout session

There certainly are topics that we haven't covered in this kick-off meeting → we can use them to shape up further discussions.

How the session took place:

1. 5' of "Brainstorming" about new topics
   a. raise your Zoom-hand / post in the chat
2. Briefly discuss any of the following points for [*new topic*]
   a. Current challenges to make progress (including cross-talk between communities)
   b. Status of data/software/tools sharing
   c. Future needs
   d. **How can iDMEu help?**

Step 1: brainstorming on list of topics we haven't covered

- [O. Buchmueller, via e-mail] Quantum sensors for ultra-light DM
- [T. Ferber, via e-mail] DM searches at e+e- colliders / B-factories
- [B. Kavanagh] DM capture in astrophysical objects (neutron stars, white dwarfs…)
- [Stephen Serjeant] Open data releases usually don't explain nuances and instrumental/astronomical systematics (e.g. Fermi). Needs lots of metadata or (better) expertise on tap. How do we make open data *useful*? See also:
- [Lorenzo Marafatto/Elena Pinetti] need for a "Dark Matter Virtual Forum" to share expertise, ask questions, search for collaboration and more.
- [N/A] Tabletop experiments for Dark Matter

# Quantum sensors for ultra-light DM

O. Buchmueller, example of AION
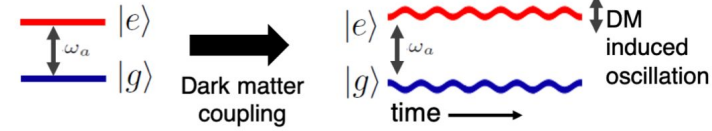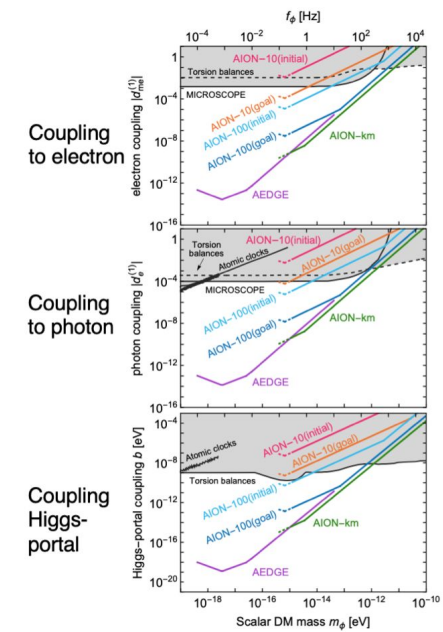
The AION staged programme will have unprecedented sensitivity to DM with scalar couplings to matter, which cause time variation of fundamental constants such as the electron mass.
Based on: Arvanitaki et al., PRD **97**, 075020 (2018).

Linear scalar DM interactions
Quadratic scalar DM interactions

With different configurations of the Atom Interferometer it will be also possible to search for Axions (pseudo-scalar) and Vector DM candidates!
[studies are ongoing]
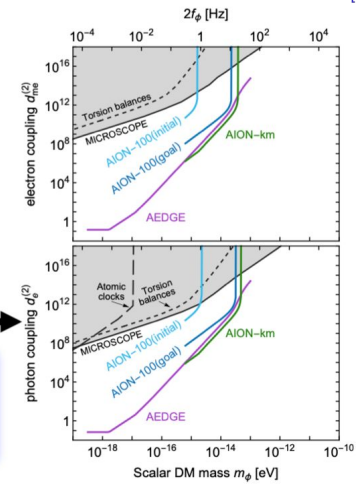
- Very active community (ECFA European Detector Roadmap / Physics Beyond Colliders target)
- Technology connections with Gravitational Waves detectors → JENAA EOI on GW
- iDMEu webpage/meetings should include this kind of experiments and related events

Dark Matter at the e⁺e⁻ intensity frontier: Belle II, BaBar, BESIII, …

Direct production

Meson decays
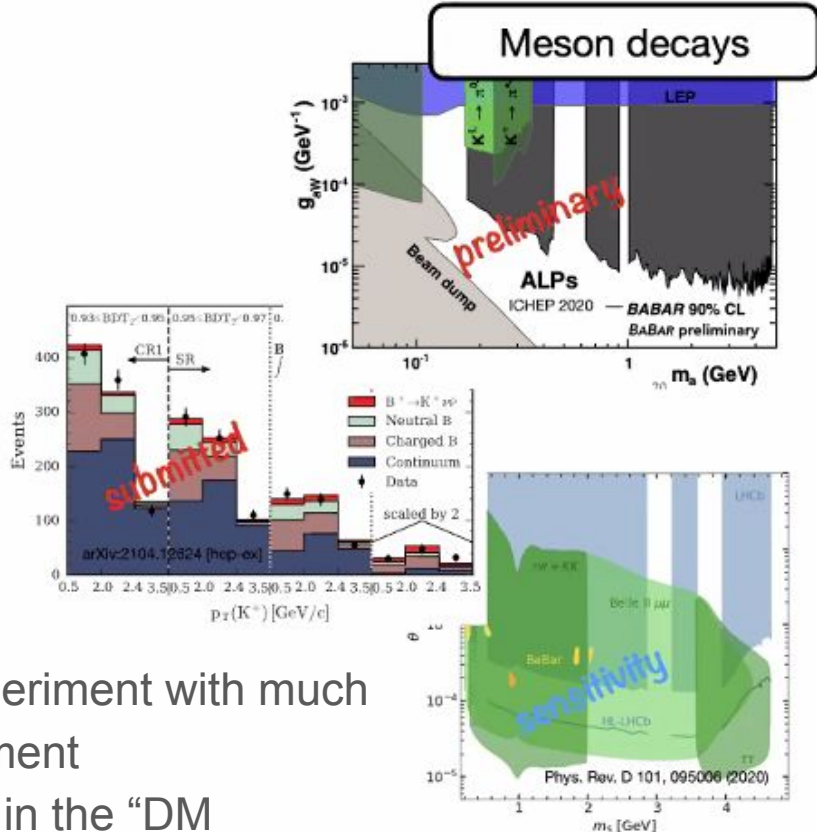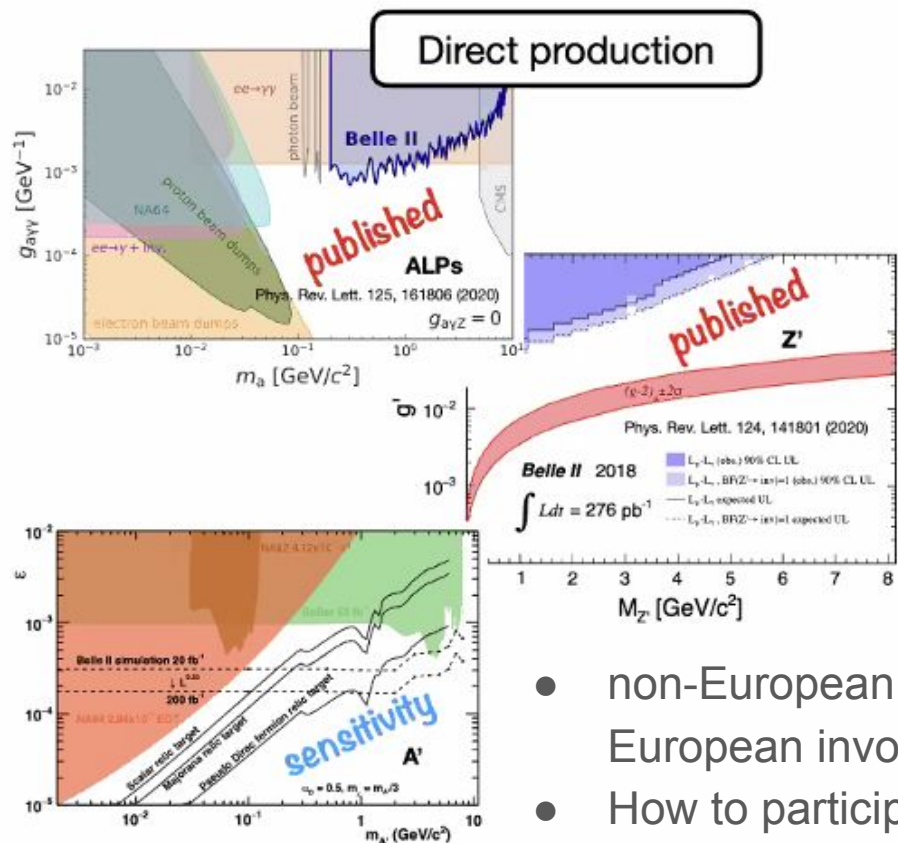
- non-European experiment with much European involvement
- How to participate in the "DM conversation"? → next iDMEU meeting

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DM Capture in astrophysical objects

DM may scatter and be captured in Neutron Stars, White Dwarves, exoplanets etc. → leads to heating which may be observable

$1750\,\mathrm{K}\,f^{1/4}$
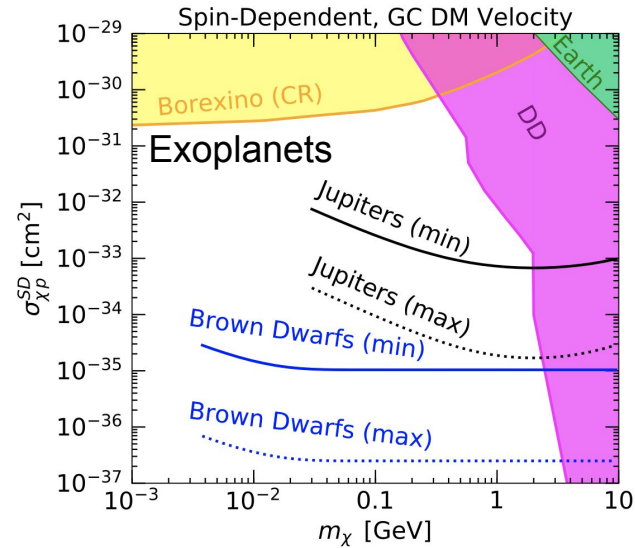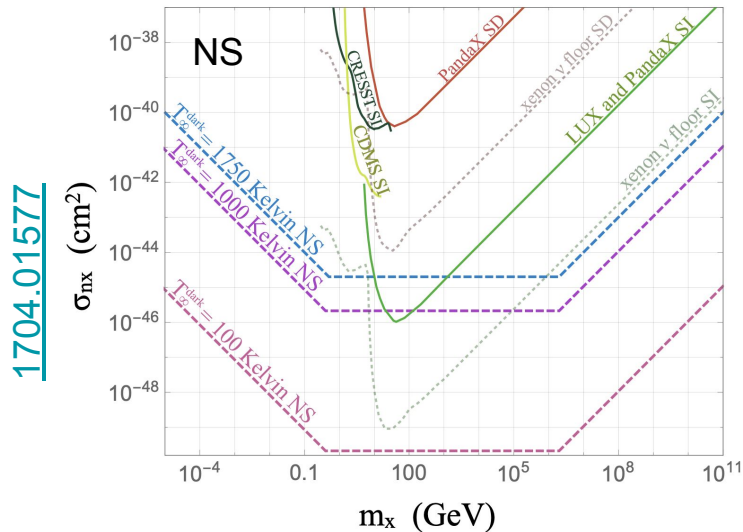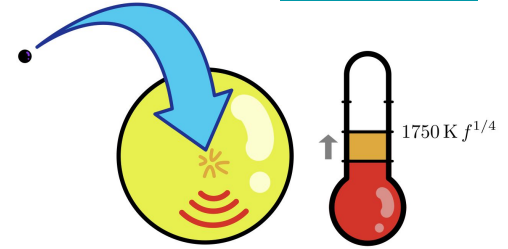
Probes a complementary parameter space to direct detection → work needed to quantify uncertainties & develop the same language / common models → discussions in Physics Beyond Collider + DM Working Group?

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Data sharing questions

*"**Making data FAIR is relatively straightforward, but making FAIR data useful is difficult**"*
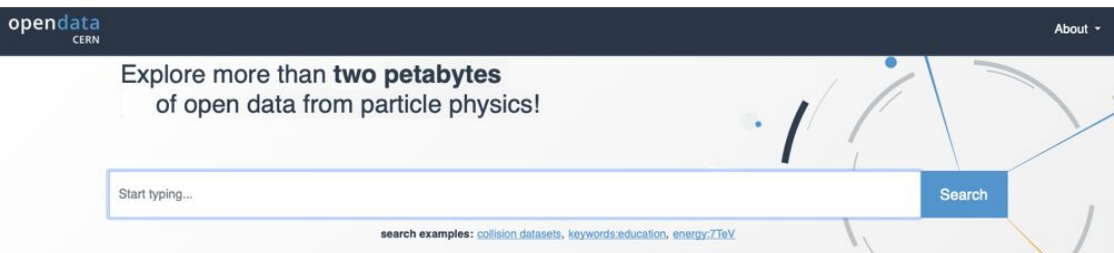
from a conversation with Stephen Serjeant, Hugh Dickinson

- Collaborations may agree to share data, but how to make it useful for everyone?
  - systematics/nuances with the data (do we understand all effects, e.g. detectors or astro backgrounds).

- iDMEu could start discussions to help communities develop a consistent set of metadata and documentation so that data is useful
- Important point (also for JENAA): this work needs to be rewarded

A DM virtual forum

- Identified the need for a "Dark Matter Virtual Forum" to share expertise, ask questions, search for collaborations and more.
  - iDMEu proponents thought of adding such functionalities to the website
  - Option that can be discussed:
    - List of ongoing projects that people want to make public and find collaborators for (e.g. darkmachines.org)
    - Virtual forum with threads & popularity functionalities (e.g. Discourse, phpBB)
- Points to consider
  - Avoid duplication of work → liaise with EuCAPT/others as they also want to have an "expert webpage"
  - In case of forum: moderation + who is allowed to post
    - Needs to be "safe" (including code of conduct)
    - Needs to be inclusive (avoid one person dominating all conversations)
  - Maintenance
    - Who keeps lists up to date?

Backup: speakers instructions

What would we like your talk to cover?: We would like the 'community overview talks' to be sufficiently broad and representative, focussing more on the future than on the past, and more on the challenges than on the achievements. Concretely, that means:

i) A brief overview of the status of research in your 'community', aimed at a general audience and recalling the basic concepts. This should take indicatively a third of the time allocated to the talk.

ii) A focus on the current challenges within your community and in terms of cross-talk with others: What are the problems arising in the comparisons of results within your community (assumptions, statistics…)? What are the problems faced in the comparisons of results outside of your community (implicit assumptions, theory limitations, ...)? Are data/results/software tools... shared within/outside of the community?...

iii) A focus on current and future needs: What inputs from other communities are or could be useful for yours? What can your community offer? What do you expect from an event like this kick-off meeting and from future iDMEu meetings?…

Backup: A DM Virtual Forum wishlist

Sharing ideas / problems / expertise somewhere public, e.g.

- I need technical help on this topic / tool
- Various fields can collaborate and share expertise

Practical questions:

- Buy-in: why should I join another one (chat) on top of everything I already have?
    - A: because it's better than others → find the right tool for the job
- Implementation
    - Needs to be "safe"
    - Easy to use and quick
    - Need to be usable in many countries
    - Internet forum-like thing
    - Idea of likes / promotion of good topics that come to the top of the list
    - We would need to have a "private/announcement" channel where things are posted by expert
    - Discourse may cover all bases above?
    - Search needs to be good as well
    - Discussion topics with authors of the paper
- Moderation
    - "Social problem" of not having someone dominate the conversation
    - We need someone senior?
    - Young and senior moderator (such as retired professors)
- Maintenance

iDMEu breakout sessions (choose from the same Zoom room)

1. Feebly Interacting Massive Particles: cosmology and experimental signals
   Moderator: F. D'Eramo
2. Instrumentation challenges in DM experiments
   Moderator: B. Majorovits
3. Dark matter direct detection data sharing
   Moderator: F. Reindl
4. [TBC]
   Moderator: X Y
5. Topics we haven't covered in this kick-off/for future iDMEu meetings
   Moderator: C. Doglioni

Outcome: 5' summaries of the discussion to be shown and discussed in the closing session (17-18 CEST, tomorrow)