iDMEu town hall @ TAUP - 01/09/2023

Introductory talks

Federica Petricca - iDMEu goals

Main goal: building a permanent platform to discuss DM among different communities via:
- Website
- Town-hall meetings (like this one)

Additional goal: help build a coherent story on DM for different audiences

Andreas Haungs - JENA

JENA = Joint Activities of ECFA, NuPECC and APPEC

JENA**S** = Seminar with members of all different community

Expressions of interest on different topics beyond iDMEu: GW, ML optimisation, Neutron EDM…all recognised as overarching community initiatives.

Recent activities:

- JENA Computing Workshop in Bologna, June 2023 → working groups
    - In the next few days/weeks information will be sent around on how to join the working groups
    - Midterm evaluation of APPEC roadmap (2021-2023), as a dynamic roadmap, identification of new topics and priorities.

iDMEu website talks - part 1

Marco Cirelli - website / virtual platform

Preliminary website (beta version) at: http://nectarclient.co.uk/idmeu/

Curators: undergraduate students who do a project (generally review + a hands-on part) and postdocs devoting part of their time to maintaining website

Functionalities:
- Groups and communities
- Searchable tables containing information about experiments and numerical simulations
    - Suggestions on tables:
        - Make it possible to jump within the table, as tables are very long

        - A visual calendar where the start and end dates of each experiments (especially the future ones) would be great to have a global view of what's coming and when.
    - Q: What are the “main publications”? Most recent publication is useful because it’s not necessarily easy to find, make sure that you cover all different papers.
        - For ID, TDR (no results)
            - Reason for not having them: there are too many, and there are many papers by theorists…could be automated, needs some volunteers to help out.
        - For DD, results of a given run / new data releases. Only publications by the collaboration, no reanalyses.
    - Q: what is the backend of the paper? How do you make sure this is the latest paper?
        - We don’t, we have students putting in information from the tables.
        - Important disclaimer: not yet reviewed/validated by experiments, the collaborations can say “you are missing this piece of information”, for now we only have disclaimers.
    - Q: isn’t the website also a repository for data from various experiments?
        - Not in scope at the moment, because other repositories exist. DM hub? We don’t want to duplicate efforts, there are already such repositories (e.g. a CR database, DM Direct).
        - Can add a specific link of data catalogues.
    - Comment: in reading papers from the experiment, there are many common devices (e.g. photomultipliers, sensors…). Can we have a section about main technologies of the experiments, and explain how they work?
        - This could be interesting, see forum as well.
- Resources:
    - Outreach resources for different audiences
    - Lectures
    - DM primer (what to read when you start)

Scientific talks

Giorgio Arcadi - overview of DM theory

Very large DM landscape (couplings/mass)

What does a DM physicist/phenomenologist wish for?
- Viable interface between theory and experimental outcome
- Combine experimental information with DM production
- Use new experiments

“Usual” complementarity: ID, DD and colliders, some discussion points.

Topic 1: examples of interplay, with complications.

- Higgs portal: ‘vector DM’ collider results ported to DD plane leads to different lines.
- Simplified vs realistic models can give different results, widely different in case simplified models are not theoretically consistent (e.g. divergences)
    - Realistic models may have degrees of freedom that alter the message of the plot, much stronger or much weaker. Compromise solution: add lines for realistic models.

Topic 2: Impact of relic density on experimental constraints

- Considering a popular scenario of freeze-out for invisible width of Higgs, what are the allowed points within the collider result (which does not impose a relic constraint)? Distribution of points does not follow the collider results.
    - However, freeze-out/thermal is not the only way: new work also including freeze-in.

Q&A

Q (Georgia Karagiorgi (?)): As a direct DM experimentalist, it looks like there are ideas of models that come up and then they aren’t mentioned again - cycles of popularities, how do we follow up?
A: DD is very good at constraining many models, difficult to have single models that are fully constrained or fully open, maybe one could make a list.
Comment (Marco Cirelli): at the moment, most popular: sub-GeV for electron scattering, axions.

Q: Clarify the DD/collider invisible Higgs plots and the assumptions.
A: the way the plot is made is assuming that all DM is contributing to the Higgs invisible width, so you can set a constraint on DM based on the constraint on invisible Higgs decay. Follow up offline.

Ian Shipsey - ECFA Detector Roadmap

How the ECFA detector roadmap can help answer a number of mysteries of our universe through discoveries? Data-driven era when we need instruments for answers.

- Identify main technology areas needed for instruments in the next decade in ECFA
- Roadmap document: Task Forces for technology area + training: propose a time-ordered detector R&D programme that wouldn’t otherwise be achievable

Long-term planning starting with 2019 European Strategy Update, now creating Detector R&D (DRD) collaborations where people commit to working on a given topic, similar to general conditions for execution of CERN experiments.

DRD areas relevant to DM:

- Gaseous detectors
- Photon detectors
- Liquid detectors → see next talk

- Quantum detector

Organization & resources for a DRD collaboration: see slide, important points and timescales there.

Quantum and emerging technologies = rapidly emerging areas of technology development to study fundamental physics and many DM models. → covered in DRD5.

Q: how to get involved at this stage?
A: DRDs tried to contact the communities, so to get in touch find the webpage for each of the DRDs and contact the organisers (a new slide will be added). Next talk will have specific examples.

Anyssa Navrer-Agasson - ECFA R&D: liquid detectors

Liquid detectors as use case, what has been going on in this area.

Physics: neutrinos, dark matter, neutrinoless double-beta decays…
Technologies: liquid scintillator, noble liquid, water cherenkov…

Different physics goals, common challenges:
- Lower energy thresholds, improvement of energy resolution, reduction of backgrounds
- Common to all: scalability

Liquid detector R&D: four different groups with subgroups, example, Charge readout is the group with pixel charge & light as one of the subgroups

Liquid detectors for DM: Argon/Neon/Xenon, examples of how they are used and what they access (parallel between DM noble liquid TPCs for direct DM detection and neutrino LAr TPCs for indirect dark sector access), and what the main issues are especially in scalability.

Many R&D areas for liquid detector with synergies between science topics, will create a network of R&D facilities and shared resources. Links to participate are on the slides.

→ can iDMEu have the link to help advertise?
A: links should be on the website - people can follow them and get to a place where there is information about status. Initially there was one place to find everything, but then with time things got a bit disjoint and not everything in the same place.

Early page, with everything:
https://indico.cern.ch/event/957057/page/27294-implementation-of-the-ecfa-detector-rd-roadmap but the links are not the most up to date there → ECFA detector leadership will make one page only, and that is the page to link. There is one slide by

[idea for website: add a “roadmaps for DM” page including APPEC, European Strategy document, DRD. Help with this.]
Q: what happens in the Selenium case?

A: this has to do with e/hole pair creation, but would have to look it up
Q: enhanced photosensitivity for liquid chambers, where does it help? Discrimination, or charge signals?
A: Both, can help also in improving energy resolutions

Deborah Pinna - Snowmass complementarity

Snowmass: similar process to European Strategy Update but broader in scope (all of particle physics, including astrophysics, neutrino and intensity frontier), giving input to prioritisation in the next decade.

Complementarity effort: see report https://arxiv.org/abs/2210.01770 and short version https://arxiv.org/abs/2211.07027, containing:

- Roadmaps (= more of a wishlist) for different types of DM experiments to discover DM in the next decade.
- Discovery scenarios where experiments are complementary

Q: how do you identify priorities when you have budget restrictions?
A: US-based answers - there are some priorities that were highlighted and scenarios of what could be cut. But in any case we need experiments that are complementary to each other.
Comment (CD): going in with a united front and highlighting good things of other experiments in addition to good things of one's own experiment will lead to better funding results than only highlighting one experiment at a time.
Q: What if *I don't have enough money for everything, what do we do?* We can face this problem, and it's difficult - prioritising means you choose. From the theory reviewer point of view then it's hard…
A: there are experiments that do more than what they were designed for (e.g. LHCb and dark sectors, CMS triggering for GeV-level…), so think about this before descoping experiments?
Comment (CD): this can include the discussion of "popularity contest" for themes
A: we have an infinite parameter space, we want to do everything in every way. So how do we show that we aren't asking for everything?
Comment (CD): prioritisation can be helped by theory community: what theory is robust && promising and we should look there? And how do we do the most things possible with one experiment?
Deborah: let's look at broader picture, general experiments.
Federica: it's true that we don't have funding for everything, but we need to go in with a collaborative mindset rather than with an exclusively competitive.

iDMEu website talks - part 2

Caterina Doglioni - iDMEu forum

Interactive session on why/if an online forum would be useful, see slides.

Results of the polls:

Why would(n't) you use a DM internet forum?

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Would be nice to openly discuss hot topics timely for people who do not use twitter.

To ask questions

would need to make sure it is established, otherwise waste of time... --> where ist the threshold for "established", how to measure this? How do people know this?

I would but not sure how sustainable it will be since forums seem to be losing popularity in the Internet and young people may not engage

I could use it, just now I don’t know.

To find answers to questions I might have 😊

DM stackoverflow 😊

To ask questions

What forum topics would you suggest and what comments would you have on the existing topics?

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like "Arxiv of the day", which will be completely deleted after a week/month?

create platform for students and postdocs to discuss their experience on daily work of the experiments as help for choosing next job

Seeking explanation from experts