

Welcome to CF1 kickoff meeting - 107 participants at peak that Hugh noticed
Conveners are Hugh Lippincott, Jodi Cooley, Tongyan Lin, Tracy Slatyer
We are recording this meeting

Agenda for today:

First 5-10 minutes - scope of work, intro

Next 40 minutes - framework for future science discussions - Tracy, Tongyan

Hugh will sum up

Introduction:

Snowmass website: <http://snowmass21.org>

Snowmass is the overarching organization, within that there are various frontiers, in Cosmic Frontier there are seven topical working groups, we are CF1

Please fill out google form (see slides for links) - we will take information from this form to organize online discussions and meetings going forward, on a variety of topics. We also ask if people plan to submit a letter of intent/interest.

All these slides will be posted after the meeting (on indico).

Join email list, Slack.

There are Snowmass virtual town hall presentations accessible on indico - also an indico master site.

Timeline:

-ASAP: fill out Google form so we can organize future meetings

-August 31: letter-of-interest deadline

-On website, template you can use for letters of interest

<https://snowmass21.org/cosmic/start#submissions>

Template allows you to indicate multiple topical working groups relative to your letter

We encourage submission of cross-topical LOIs to multiple groups

Letters of interest:

-2 pages, not including bibliography / author list

-Due August 31

-Inputs to planning meeting

Definition of CF1:

-DM signals appear in experiments as individual quanta, including direct detection and indirect detection

-Approximate boundary between “particle-like” and “wave-like” dark matter corresponds to DM mass scales of ~ 1 eV

-CF3 contains broader range of astrophysical/cosmological probes, but CF1 is the go-to place for classic indirect detection for decay/annihilation signals

Synergies with many other areas of Snowmass, we will try to facilitate discussions with members of other topical groups (see slides for list of synergistic groups). Within Cosmic Frontier, we overlap primarily with CF2 and CF3

Question (Katie M): Do people go into multiple groups? Yes you can. If you have ideas for CF1 and for CF3, please submit to both or contribute to both.

Question (Tali): Multiple submissions? Answer: No formal top level advice allowing people. CF has developed a template that can have multiple check boxes. Our current informal answer is to submit to both/all just to make sure it doesn't fall through cracks and conveners will sort it out.

This answer was changed below - there is a way to submit the same LOI to multiple frontiers in the submission form. Not clear if that is true for multiple subtopics with frontiers.

Question (Rick G): Are we working with funding agencies? A: At this point, we are not aware of official channels. We are waiting for BRN for example, but there's no official channel at our level. Tracy: In principle, SNOWMASS is not prioritization - our instructions are discussion of what the physics community wants/thinks are the interesting questions, to be followed by P5 style. Jodi: We are under the impression that we want to be more inclusive at this point. Rick: Required resources for different projects are of course different, and while of course this is inclusive, we need to know lay of land with agencies. Tracy: Good point, we'll discuss with CF conveners

Question (Dan M): Are there official liaisons with all of our cross/overlapping topics? Jodi: Not for every one. Official liaisons to UG physics (Jodi and Hugh) and IF (Hugh). Asked some computational people to work on the Computation side. Caterina Doglioni is liaison with Energy Frontier, Tali is liaison to Neutrino Frontier. Within CF, we have our own discussions.

NF05 is another overlap with double beta decay and magnetic moment.

Direct detection discussion:

Slides show what we have so far, but this is preliminary, just intended as a prompt for discussion

Direct detection landscape is enormous and we need to think about how to organize it

One slicing: models vs signatures - see slides.

Can be roughly organized by dark matter mass. We can consider classic weak-scale DM scattering on visible matter, also consider possible portals to the Standard Model in the context

of sub-GeV direct detection - Higgs-portal-mediated, dark-photon-mediated, scalar-mediated - that could lead to scattering off electrons or nucleons. At lower masses there are absorption signals, not just scattering signals; can merge into overlap with CF2.

Signals: spin-dependent and spin-independent nuclear recoils at GeV+ DM masses, spin-independent and spin-dependent nuclear recoils from sub-GeV DM, electron recoils, collective excitations (plasmons, photons, etc)

One dimension that is compressed: how the dark matter abundance is obtained
For scattering signals, can potentially relate to relic density via SIMPs, ELDER, freeze-out, freeze-in, etc

More complicated signatures: inelastic scattering, very large cross sections, accelerated or upscattered dark matter

Hugh: the way we're thinking about it is that we'll be hosting follow-up meetings on some subset of these topics, e.g. we might have a specific meeting on spin-dependent nuclear recoils, we want to make sure up front if we're missing some category

Dan McKinsey: dark blobs, dark nuggets, 100 TeV+ - may be meaningfully different from "10 GeV and higher" regime

Asher: signals other than scattering/absorption - multi-particle interactions, direct deflection (may fit better into another working group, will discuss)

decays, annihilations

Yu-Dai: upscattering in detector, followed by decay

Tongyan: those extra signatures are possible in many models, hard to classify with specific models, but we should think about how to add that signature in

Volodomyr Takhistov: Other couplings beyond spin-independent/spin-dependent

Cecilia Levy via private chat: Snowball chamber - maybe "bubble-chamber-like" category - keV-sub keV threshold SI

Q: is there a place we can share all the papers for relevant topics? Could be helpful for smaller meetings for relevant topics?

Tongyan: once we start organizing these meetings, that will be useful

Jodi: will store minutes for meetings

You can put useful information in the Slack channel too, putting interesting papers there may be helpful

Glennys: "I think Eve's suggestion is to create a bibliography or reading list for each box. That sounds useful to me." "But in the boxes here, a link to relevant refs for each box (so one could quickly/easily see a comprehensive list)"

Jodi: ideally white papers should discuss what we want to do in the future, not asking people to submit already-finished work as white papers. Collecting a bunch of existing papers into folders is not a substitute for white papers.

Tongyan: we could have a table that links to both existing relevant literature and to letters-of-interest/white papers in that area

Rouven: for LOIs, one LOI per concept, or all lumped together? Hugh: LOIs have generated a lot of confusion and the guidance keeps changing, if you're worried about something getting missed submit to multiple places, if you have closely-connected concepts can put them in the same LOI, if you have significantly different concepts put them in separate LOIs

Indirect Detection (Tracy)

Another matrix of classifications - first pass as prompt for discussion. What are we missing by thinking about it this way. Large parameter space, many possible signatures/energy scales, neutrinos to cosmic rays to photons. Gravitational signatures are mostly in CF3, but if you have questions about a boundary case, please raise it. One way to characterize is what is signature - what is energy range/particle- that's the y-axis, with some known experiments in brackets. If you are not included, let us know. Other axis is similar to DD - what kinds of models are we probing. Red line divides type of model, with left organized by mass, and right organized by particular class of models that might be of particular interest for some reason (overlap with other searches, or other characteristics).

Starting point for discussion - Goes through categories on the slides, starting with mass ordering (top axis, left). I won't put that in notes, as I think the table describes it.

At lower energies of scales that are more in line with CF2 (~eV), we also have radio signals, but heavier particles can also give these signals, so mass/signal alignment is broken a bit.

Goes through top axis right of model types, same comment on notes.

Start discussion - is this a useful classification? Other axes? What have we missed?

Chat question from Joe Bramante: Does dark matter's effect on stars and other astrophysical objects go into CF2? Some of these are detected in radio, optical, x-ray, so is that where they fit in?

Tracy: When we polled opinions on this, not a clear consensus. IF your model is DM does something that changes how stars work, that probably goes first to CF3, but also possibly to CF1 or CF2 depending on mass scale. For example, kinetic heating of stars by DM, could overlap with us as well. To be safe, submit to us as well, but in general, star dynamics go to CF3 (they have kickoff meeting next week). If they can go on a classic DD or ID search plot, send to us.

Yu-Dai: How about dark stuff that is not ambient dark matter? Supernova constraints.

Kerstin Perez: what about solar axions?

Let's ask CF2/CF3 conveners about solar axion helioscope searches - likely to be CF2, but should double check.

Where does XENON1T search go? White paper can include everything, but technically, the working groups are divided such that the axions should go to CF2. Working groups are on science, not experiment, so experiment goes to multiple groups.

At this stage, it is more important that we don't drop anything than to avoid repetition.

Katie Mack: Warm dark matter radio searches (21 cm) - probably into CF3 overlap. Core of CF1 astrophysics - we are looking for particle-like signatures - either direct particles or their effects in some relatively direct way. But effect of dark matter on clustering, etc, that's more CF3.

PBHs: also radio & bbn. WDM: also radio.

Yu-Dai- I think stellar energy loss and direct detection signature are different in terms of observations/detections, but they can come from the same dark stuff (axion, dark photon, etc)

Mostly classifying on physics you can go after. CF1/CF2 is on physics you can go after, CF3 is signature, which is why there is a blurry boundary. Stellar energy loss constraint could be sent to us, but also contact CF3.

Glennys: Could you and earlier direct detection conveners comment more on relation between theory relevant to CF1 and theory frontier, and the LOIs and White Papers?

Tracy: CF is focused on experimental signatures of various physics. But there is theory that is highly relevant - e.g. my theory predicts a signature. We haven't yet chatted much with Theory conveners on how things should be split up. On to do list. Better to have more LOIs than fewer. For LOIs and white papers - intention of LOI is a statement of interest. I am tentatively planning to write a white paper on this. Does not need to be a one to one relationship. Summary reports will be taking figures and text from white papers, and things could get combined at that stage. Point of LOIs is to tell conveners "what is coming and what we should know about" so we can get organized: white papers are permanent record of the Snowmass process that are pulled into summary reports.

We can now submit LOIs to multiple frontiers. This is a database with keywords - so people can search on them.

From Glennys R Farrar to Everyone: (10:53 AM)

Regarding being able to submit LOIs to multiple frontiers, it is supposedly setup that way (a change from the very beginning) so please contact Snowmass Steering Committee if its not working. Here's from Bob Bernstein and Sergei Chekanov who set it up At

<https://www.snowmass21.org/docs/upload.php> we say you can choose multiple frontiers (and

then the Frontiers get coded into the name) and you can also pick a topical group within each Frontier. 2nd pic are EF examples where the first one is EF-RF-TF-IF-CompF.

Summary.

Kim: Is there a way for discussions to be moderated so we don't end up having to sit through lots of short talks of people's pet idea. Can we request people to work together in advance to work through synergies?

Jodi: Answering slightly off topic - how to get younger people involved if say the mentor is not directly involved. We are aware of this - interest form is to try to bring people together to have thematic topical meetings.

Tracy: What topics are you willing to talk about or discuss is a question in the interest survey

Kim: Worries about listening to 15 theory talks in an hour - bigger structure

Jodi: will try to use pre-meetings to coordinate, please fill in topic interest survey.

Having panel discussion instead of 15 straight presentations might be better. Also more focused discussions are good.

Tongyan - DD and ID slides show how we're starting to organize, and might lead to structure for meetings, so feedback on that is useful.