CF1: Particle-Like Dark Matter Snowmass Restart

Conveners: Jodi Cooley, Hugh Lippincott, Tracy Slatyer, Tien-Tien Yu*

September 24, 2021

*New convener beginning this week, replacing Tongyan Lin

“Big Questions” white papers

~150 LOIs submitted to CF1 (including cross lists) - huge amount of community interest and ideas, the most of any topical group!

In the months before the pause, we realized we needed to corral the science in the many LOIs into <10 “Big Question” white papers. Based on the LOIs and the discussion at CPM, we identified a few broad science themes.

The CF1 summary white paper will be prepared by conveners based **primarily** on these “Big Questions” white papers. We had recruited coordinators for these white papers just before the pause

The next few slides are our *working proposals for the white paper topics*.

“Big Questions”: Direct Detection

1. **Direct detection to the neutrino floor (above the proton mass?) - Coordinators: Prisca Cushman, Rick Gaitskell, Cristiano Galbiati, Ben Loer**
    a. multi-scale portfolio that includes a broad energy range and experiment cost. (Xe, Ar, CCDs, Phase change, Solid State Detectors, ...)
    b. Mainly focus on ~>1 GeV nuclear recoils
    c. reasonable to achieve on a G3 timescale (~10 yr including construction and operations), but acknowledging that not everything here is necessarily “G3”

2. **The landscape of low threshold detection in the next decade - Coordinators: Graham Giovanetti, Noah Kurinsky, Dan McKinsey, TBD**
    a. Re-statement of parts of BRN/Cosmic Visions for low threshold detectors?
    b. Theory to motivate then a description of the new wave of experimental ideas.
    c. How to handle experiments at different phases (e.g. SENSEI/DAMIC and CDMS vs. LHe vs. other novel ideas that are even more in R&D stage)?

3. Calibration/backgrounds for direct detection - Coordinators: Dan Baxter, Ray Bunker, Sally Shaw, Shawn Westerdale
    a. What improvements do we need to make in understanding detector calibration and backgrounds to support/enable the direct detection program over the next decade?
    b. Discuss common needs/issues across experiments
    c. Endorsement of low energy NR sources wherever they are
    d. Discussion of noise sources (electron emission, IR backgrounds, etc).

4. Theory/simulation/analysis/statistics needs for direct detection - Coordinators: Yoni Kahn, Maria Elena Monzani, Kim Palladino
    a. What theoretical developments do we need to support/enable the direct detection program over the next decade?
    b. Could cover effective theory techniques, common statistical frameworks, better simulations, new theory for primary and secondary interactions & collective excitations, etc.
    c. Support theory and interdisciplinary research (materials theory, condensed matter, AMO)

“Big Questions”: Indirect Detection

5. The landscape of cosmic-ray and high-energy photon probes of particle dark matter - Coordinators: Tsuguo Aramaki, Stefano Profumo, Philip von Doetinchem

a. Broad-scope indirect detection paper covering electromagnetically interacting messengers (not neutrinos or gravitational waves), including X-rays/gamma rays and charged (anti)particles
b. A possible milestone (not endpoint!): targeting full mass range for thermal(ish) dark matter, bounded below by warm dark matter limits and above by unitarity. Discussion of cosmology that allows evasion of unitarity bound.
c. Could include a brief discussion of PBHs
d. Discuss synergies with multiwavelength/messenger astrophysics and measurements of DM density/distribution

6. Puzzling excesses and how we can resolve their origin/existence - Coordinators: Rebecca Leane, Liang Yang, TBD

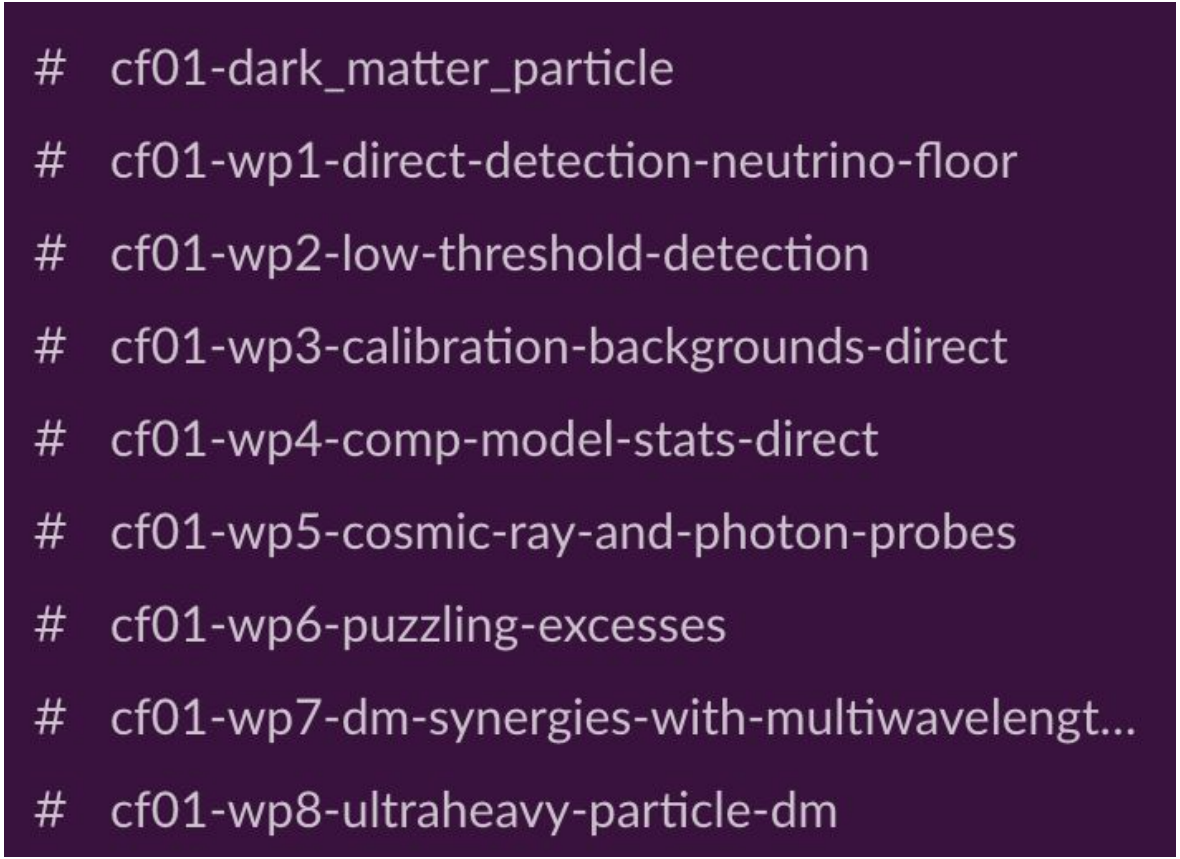
a. Would likely include discussion of GCE, 3.5 keV line, antiprotons, others?
b. Maybe include DAMA cross-check experiments in direct detection / modulation analyses
c. What are the necessary steps (achievable within the next 10 years) to get a clear answer one way or the other?

7. Synergies between DM searches and multiwavelength/multimessenger astrophysics / understanding astrophysical backgrounds - Coordinators: Shunsaku Horiuchi, Devin Walker, TBD

a. What astrophysics do we need to understand better to improve DM searches?
b. How would we go after it? Can include both theoretical and observational work

8. Ultraheavy particle dark matter / probing the heaviest particle dark matter candidates - Coordinators: Andrea Albert, Dan Carney

“Big Questions”: Slack channels!

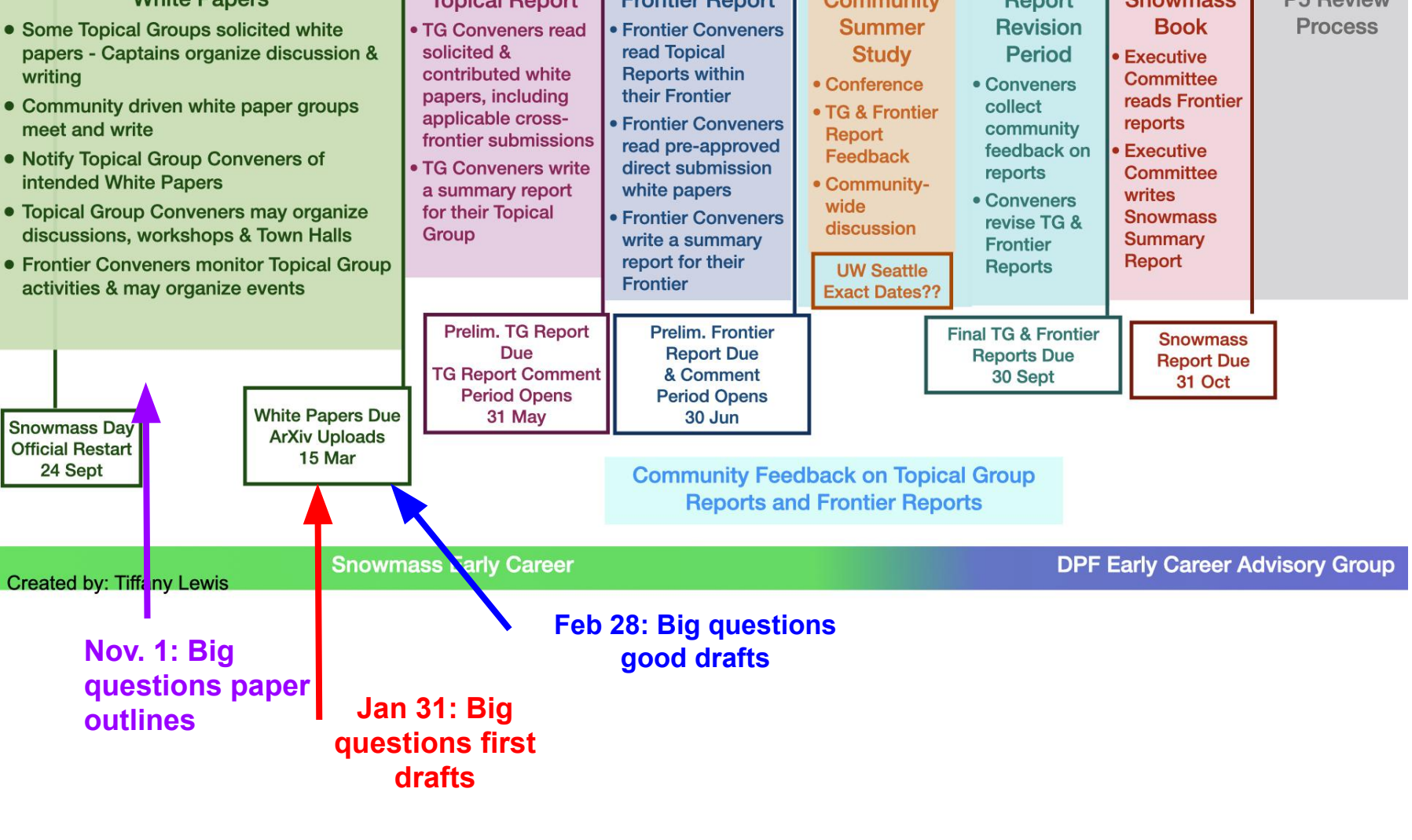


Length and format of “Big Questions” white papers

- Varies by topic
- Aiming for as succinct and impactful as possible - the community welcome to provide details and flesh out studies in additional white papers

Are the “Big Questions” the only white papers for CF1?

- **No!** Additional white papers can and should be submitted as part of the Snowmass record.
- Please work together, and to keep us informed of what you’re doing.
- For feedback into the CF1 summary report, the science should be mentioned in the “Big Questions” white paper


White Papers
Some Topical Groups solicited white papers - Captains organize discussion & writing
Community driven white paper groups meet and write
Notify Topical Group Conveners of intended White Papers
Topical Group Conveners may organize discussions, workshops & Town Halls
Frontier Conveners monitor Topical Group activities & may organize events
Topical Report
TG Conveners read solicited & contributed white papers, including applicable cross-frontier submissions
TG Conveners write a summary report for their Topical Group
Frontier Report
Frontier Conveners read Topical Reports within their Frontier
Frontier Conveners read pre-approved direct submission white papers
Frontier Conveners write a summary report for their Frontier
Community Summer Study
Conference
TG & Frontier Report Feedback
Community-wide discussion
UW Seattle Exact Dates??
Report Revision Period
Conveners collect community feedback on reports
Conveners revise TG & Frontier Reports
Snowmass Book
Executive Committee reads Frontier reports
Executive Committee writes Snowmass Summary Report
P5 Review Process
Snowmass Day Official Restart 24 Sept
White Papers Due ArXiv Uploads 15 Mar
Prelim. TG Report Due
TG Report Comment Period Opens
31 May
Prelim. Frontier Report Due & Comment Period Opens
30 Jun
Final TG & Frontier Reports Due
30 Sept
Snowmass Report Due
31 Oct
Community Feedback on Topical Group Reports and Frontier Reports
Snowmass Early Career
DPF Early Career Advisory Group
Created by: Tiffany Lewis
Nov. 1: Big questions paper outlines
Jan 31: Big questions first drafts
Feb 28: Big questions good drafts

Always interested in more contributors

https://docs.google.com/forms/d/e/1FAIpQLSeGTq6r1JLs-Yfayt2R0MVbVy5czXlkvUgMCfHXYBHDdRYATg/viewform?usp=sf_link

- Google poll used before pause still open - Please fill out to express interest in being a contributor
- Feedback on structure of big science questions

Questions?