CF1: Town Hall on “Big Questions” White Papers

Nov 6, 2020

“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!

The next stage of the process is to corral the science in the many LOIs into <10 “Big Question” white papers. Based on the LOIs and the discussion at CPM, we have identified a few broad science themes.

The CF1 summary white paper will be prepared by conveners based **primarily** on these “Big Questions” white papers.

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?)**
    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**
    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

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

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

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

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

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

Length and format of “Big Questions” white papers

- Varies by topic
- Aim for as succinct and impactful as possible - you are 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.
- You are encouraged to 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

Contributing to the “Big Questions” white papers

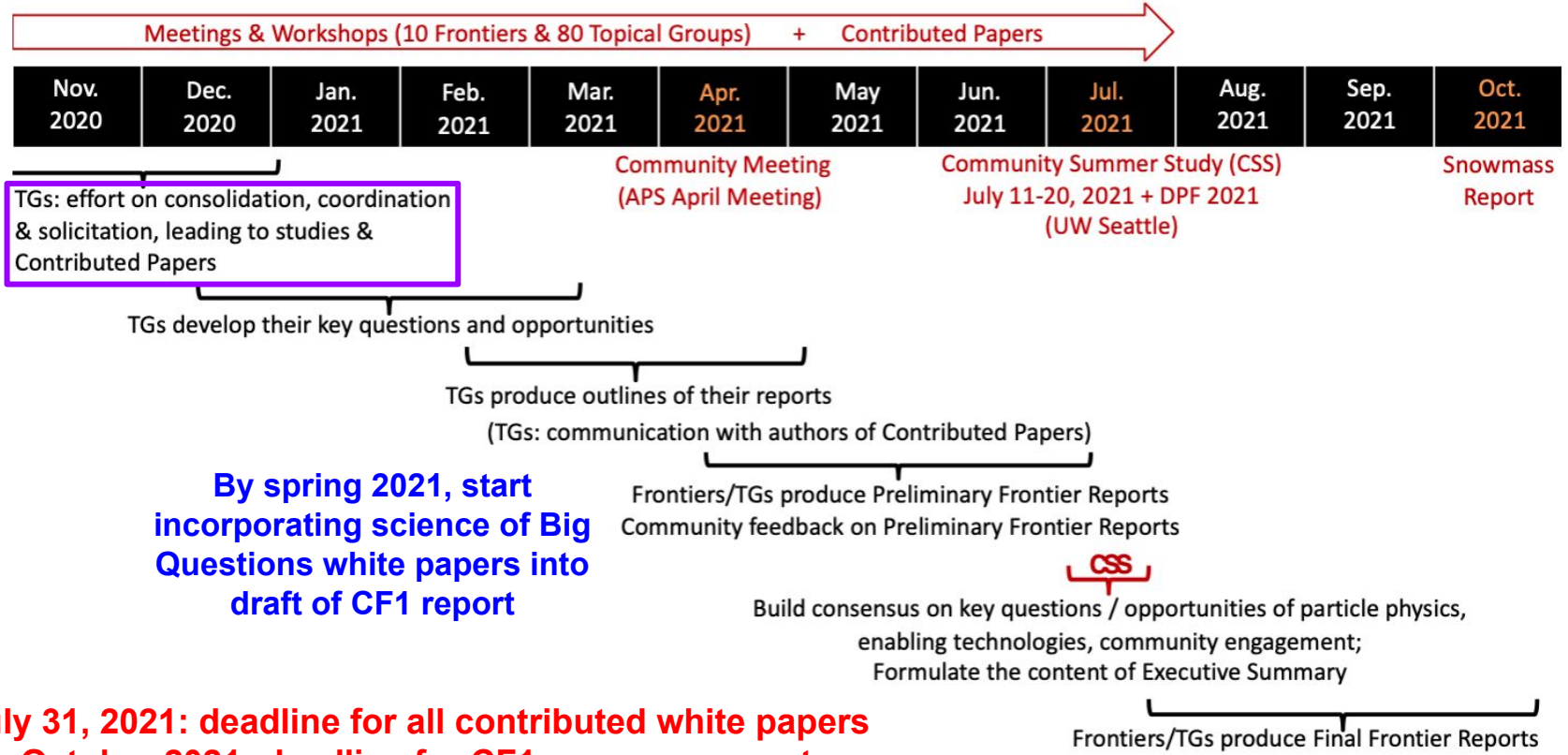
We are seeking your involvement as

- **Co-Coordinators** - we envision each white paper to have a handful of co-coordinators who will be responsible for *organizing* the sub-working group, for being the points of contact, and for delivery of final report.
- **Contributors** - contribute writing, content

Fill out the Google Forms to indicate your interest or give feedback: https://docs.google.com/forms/d/e/1FAIpQLSeGTq6r1JLs-Yfayt2R0MVbVy5czXlkvUgMCfHXYBHDdRYATg/viewform?usp=sf_link

Preliminary Snowmass Timeline / Process

Starting point for discussion with the community during CPM



By spring 2021, start incorporating science of Big Questions white papers into draft of CF1 report

July 31, 2021: deadline for all contributed white papers
October 2021: deadline for CF1 summary report

Fill out the Google Forms by Nov 13 to get involved

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

- Indicate interest in being a contributor or coordinator for white papers
- Feedback on structure of big science questions

Questions?