CF dark matter strategy
Delve deep, search wide

Deep coverage of high priority remaining **axion**, **WIMP** parameter space.

Significant inroads will be made into vastly expanded parameter space including new dark sector models.

Enabled by a versatile, wide-ranging program of complementary terrestrial, indirect, and cosmic probes.
Delve deep, search wide

**Surprise!** These are all small/mid-size experiments with 5-10 year horizon. Even adding them all up barely makes a large experiment. Why is the overall dark matter program so small???

NB: for Cosmic Frontier, dark matter is equally high priority science as cosmic acceleration. Simply doesn’t reach arbitrary $500M threshold for CF talk on large projects.
Why is the overall U.S. dark matter program so small???
Is this not one of the clearest signs of BSM physics?

- Previously, scale was limited by mature technologies available to probe a well-motivated targeted model parameter space
- Now, theory-targeted DM parameter space has grown, and many new technologies are available including in national priorities like quantum sensing
- Tremendous opportunity to nurture this field and its workforce ... and make high-impact discoveries!
- Valuable hardware training for students at approachable scale → easy path to academia or lucrative instrumentation careers
- Significant engagement from theorists spawn innovative techniques
- Cross-disciplinary collaborations (AMO, CM, as well as astrophysics/astronomy) needed to harvest low hanging fruit – how to fund these efforts?
CF small/mid experiments menu targets a variety of science goals

Dark matter:
• Direct detection – next gen “large scale” WIMP detectors, next gen axion, broader program via dark matter new initiatives
• Indirect detection from the ground and from space, also DMNI?
• Cosmic (observational) probes

Cosmic collider, cosmic inflation, dark energy:
• Optical spectroscopy, e.g. DESI 2
• Line intensity mapping, e.g. LuSEE-Night

Extreme universe, dark phase transitions, etc:
• Cosmic neutrino and gamma ray observatories
• LIGO upgrades, future GW observatories and pathfinders
Possible path forward to search wide: Expand Dark Matter New Initiatives

Example of funding competition for a broad, coordinated program of small experiments

- 2019: Following Basic Research Needs white paper, DOE FOA was issued. 6 ideas for few $10M scale projects selected for “cd0” and 2-year design study.
- Ideas spanned portal DM, axion DM, fixed target dark sectors expts.
- Still need to actually fund the experiments beyond the design studies. Reviewed in 2022, but not inserted into DOE budget yet.
- Experimental duration ~ 5 years << 10-year scale of Snowmass/P5.

- Good recipe to remain nimble as new technologies and ideas mature.

- **Need to broaden this program to accomplish portfolio of small experiments in order to achieve significant and coordinated logarithmic coverage of DM parameter space.**