DaMaSC IV

Panel Discussion II:
Expanding Dark Matter Searches
Beyond the WIMP Paradigm
Theory Space of Particle DM is Vast

- What motivations should guide decisions about which spaces to investigate? How do we decide what is a “good” DM candidate?

- Which directions should technology R&D be motivated?

- Which directions should theory R&D resources be focused?

- To what extent should resources be transferred from WIMP searches to other DM paradigm searches?
Other Categorizations of DM Candidates Can Be More Appropriate

Figure due to E.-K. Park, adapted by Conrad & Reimer, Nature Physics 13, 224–231 (2017)
WIMPs

• How should WIMPs be defined?

• Are WIMPs no longer satisfactory DM candidates?

• Do we (still) care about naturalness when discussing WIMPs? Are “natural” WIMPs still viable? If so, for how long?

• Is there a point where we dump WIMPs? When?
Beyond WIMPs

• Guiding physical principles for theories and experiment designs?

• Are theories with mechanisms similar to the WIMP paradigm preferred?
  – WIMP -> weak scale mass, weak scale interactions
Sub-GeV Dark Matter

• Is expansion into sub-GeV mass domains good to do right now?

• How do we feel about the explosion of growth and ideas in this area of research?
Ultralight DM, Axions, Axion-Like Particles (ALPs)

- New ideas for detection are being developed.
- What are the most exciting developments?
Primordial Black Hole DM

• Do the LIGO observations of merging black holes point to 30 $M_\odot$ black hole dark matter?

• What other mass ranges are viable for dark matter being predominantly black holes?
Non-Trivial Dark Sectors

• i.e., multicomponent DM, composite DM, self-interacting DM, dynamical DM

• Are certain frameworks particularly motivated or interesting?

• What frameworks are actively being pursued?
Where Do “Anomalies” Point Us?

- Under what circumstances should these anomalies inform DM searches?
  - To what extent should we act now or wait for stronger evidence?

Cuoco+, arXiv:1704.08258

Astroparticle Anomalies

Kaplinghat, Tulin, Yu, PRL 116, 041302 (2016)

Small Scale Structure Anomalies

Abazajian, arXiv:1705.01837

Nuclear Anomalies

Feng+, PRD95, 035017 (2017)

$\alpha' = \alpha_{EM}$

$\mu^\mu$ preferred $m_H = 200$ GeV

Broggio+, JHEP 1411 (2014) 058
Models Miscellaneous

• Are there important/interesting DM models have been so far overlooked by all of the above considerations?
  – If so, what is interesting about them; how are they motivated?
  – Is there a way to expand the “interesting DM model” criteria to include them?

• What experiments or observables are most exciting in the near future for learning about the nature of DM?