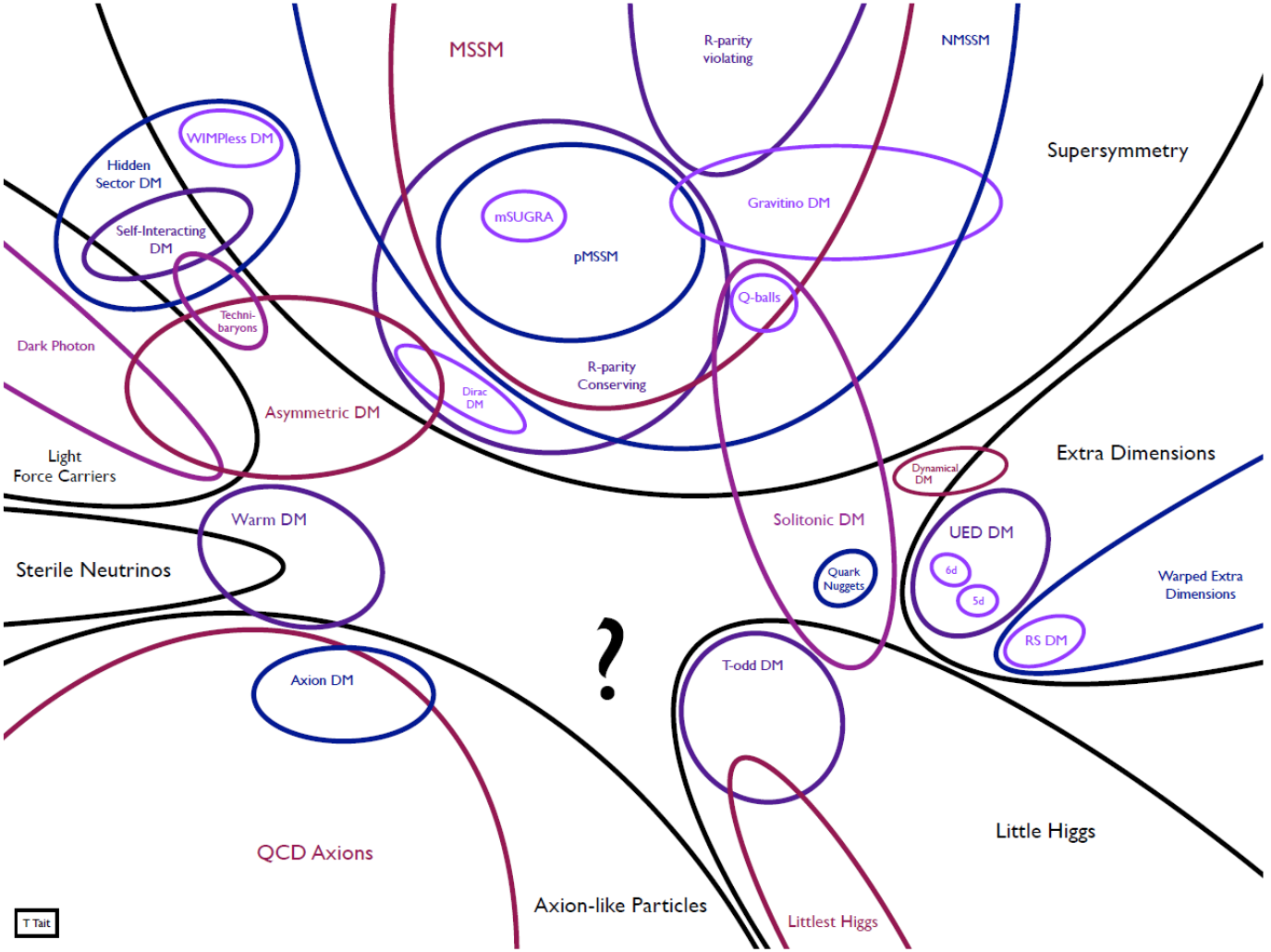
DaMaSC IV

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

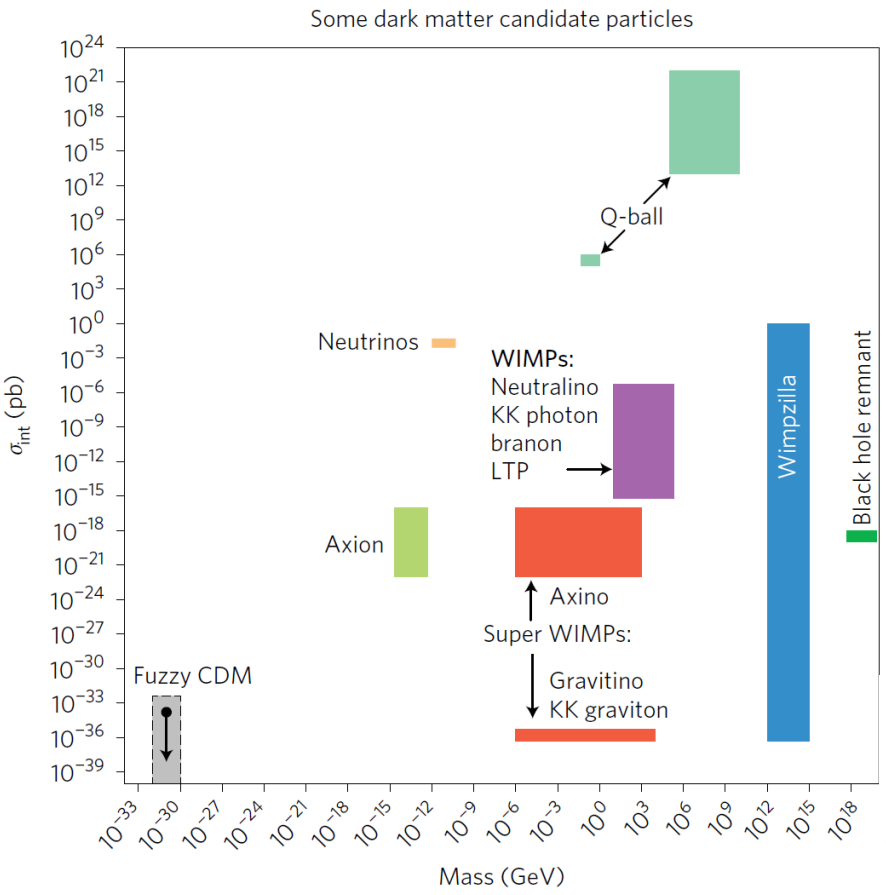
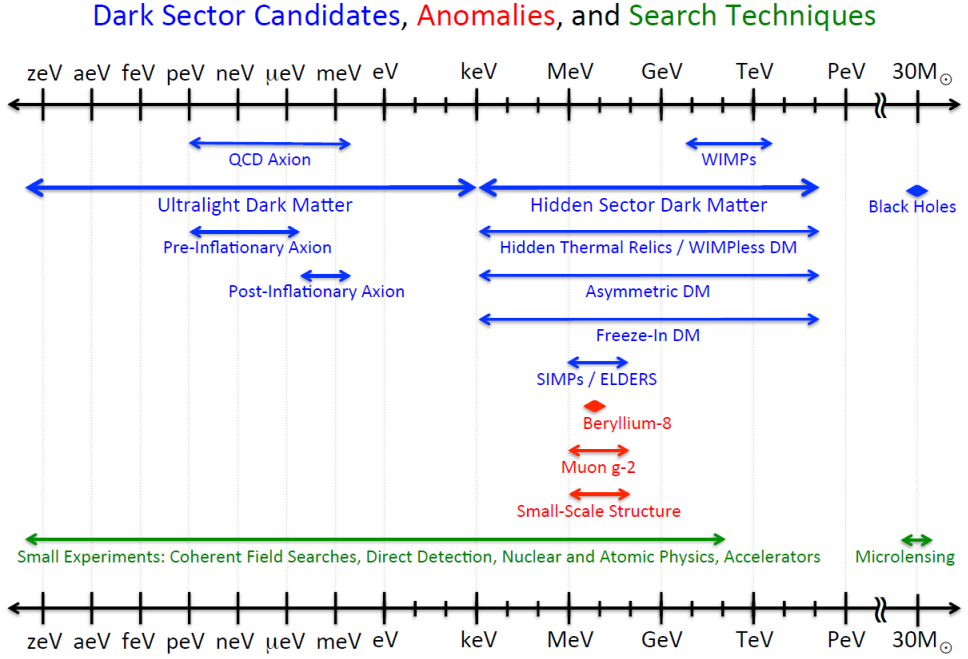
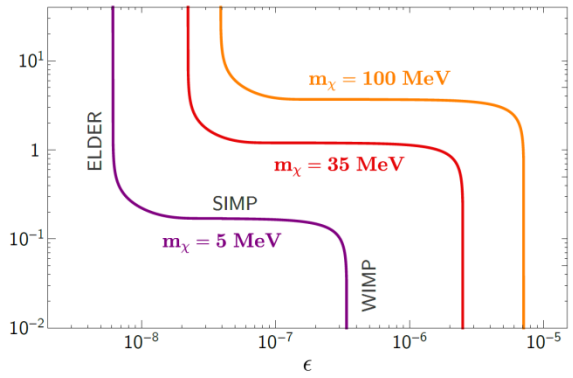


Figure due to E.-K. Park, adapted by Conrad & Reimer, Nature Physics 13, 224–231 (2017)



US Cosmic Visions Comm. Rep. arXiv:1707.04591



Kuflik, Perelstein, Lorier, & Tsai, JHEP 1708 (2017) 078

WIMPs

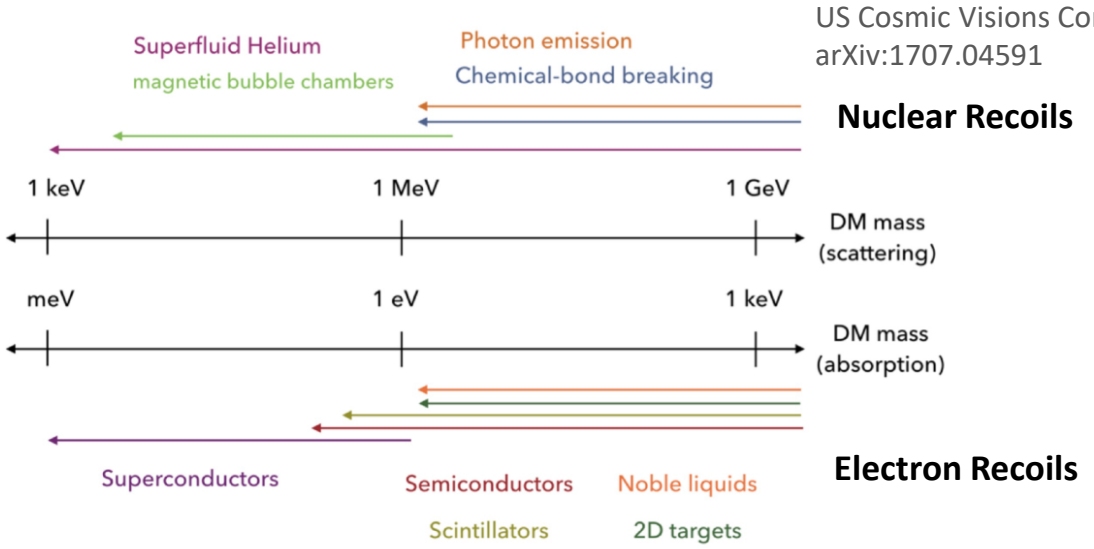
- How should WIMPs be defined?
- Are WIMPs no longer satisfactory DM candidates?
- Do we (still) care about naturalness when discussing WIMPs? Are “natural” WIMPs still viable? If so, for how long?
- Is there a point where we dump WIMPs? When?

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



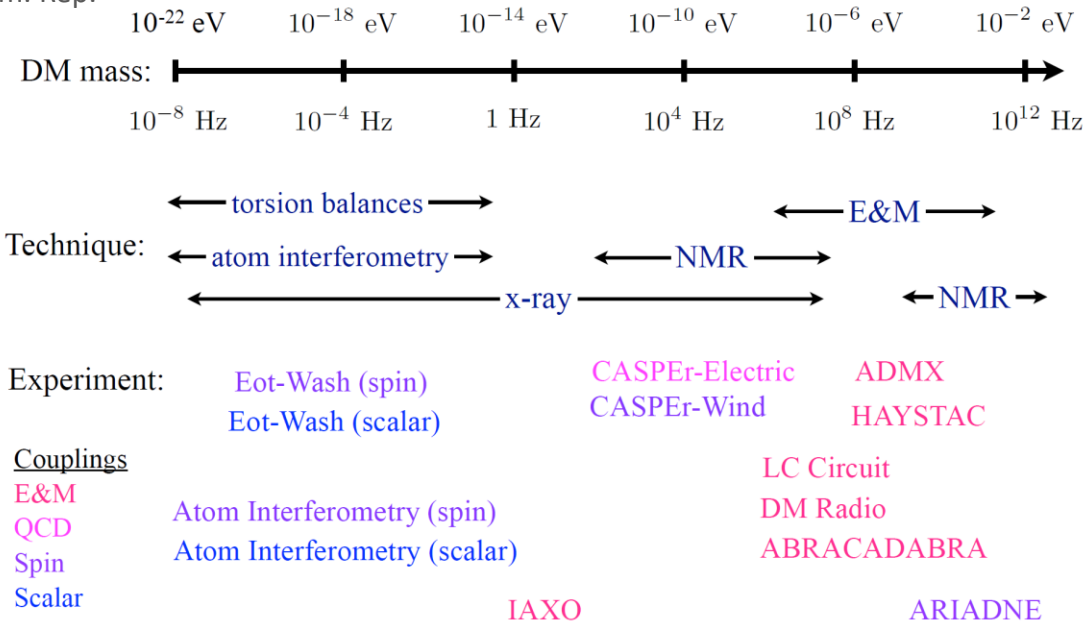
US Cosmic Visions Comm. Rep.
arXiv:1707.04591

- 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)

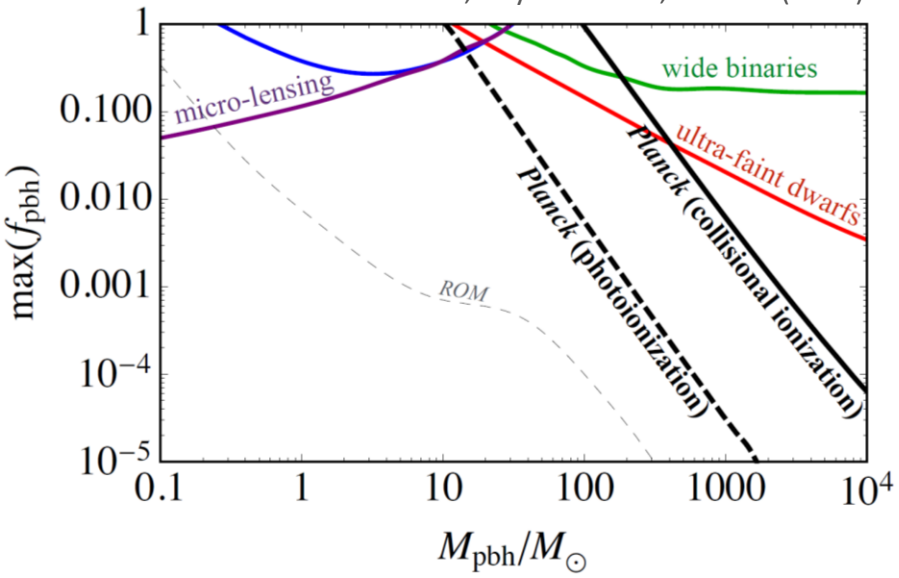
US Cosmic Visions Comm. Rep.
arXiv:1707.04591



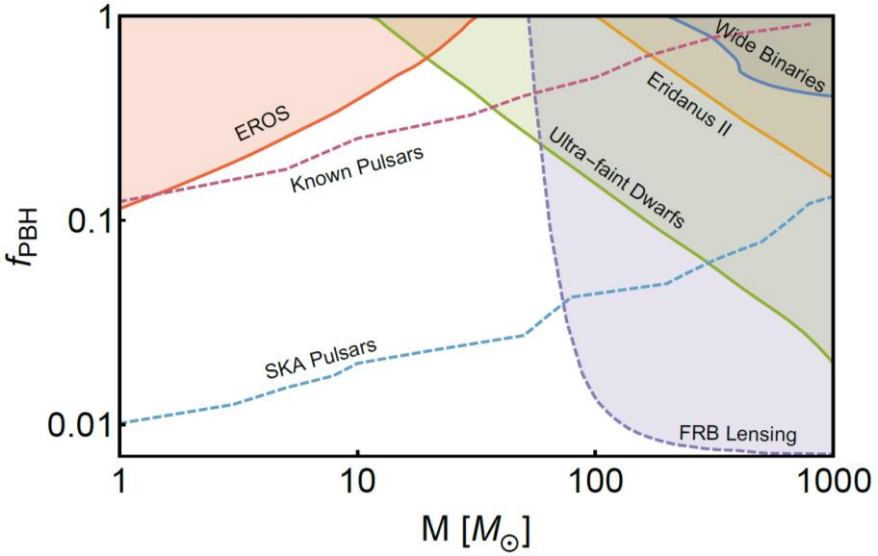
- New ideas for detection are being developed.
- What are the most exciting developments?

Primordial Black Hole DM

Ali-Hamoud & Kamionkowski, Phys.Rev. D95, 043534 (2017)



Schutz & Liu, Phys.Rev. D95, 023002 (2017)



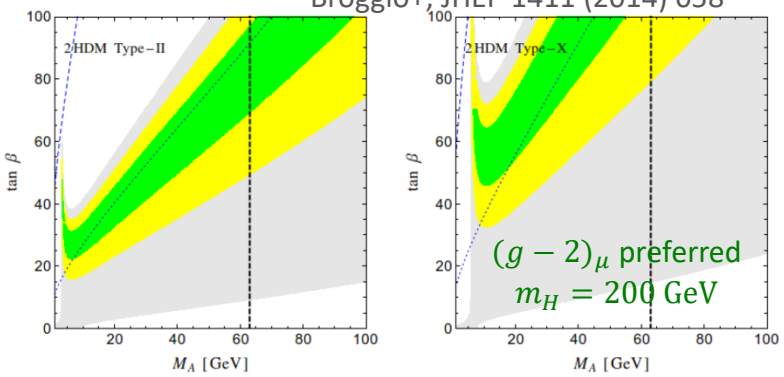
- Do the LIGO observations of merging black holes point to 30 $M_\odot$ black hole dark matter?
- What other mass ranges are viable for dark matter being predominantly black holes?

Non-Trivial Dark Sectors

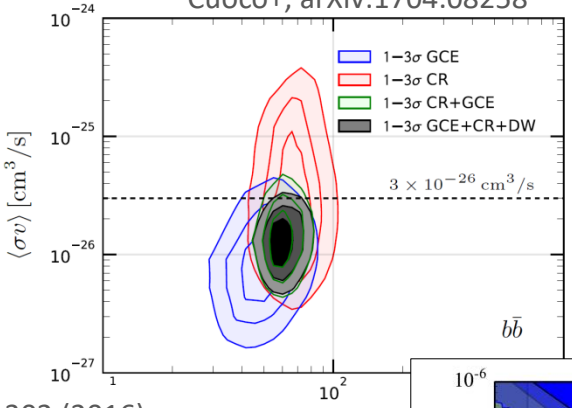
- i.e., multicomponent DM, composite DM, self-interacting DM, dynamical DM
- Are certain frameworks particularly motivated or interesting?
- What frameworks are actively being pursued?

Where Do "Anomalies" Point Us?

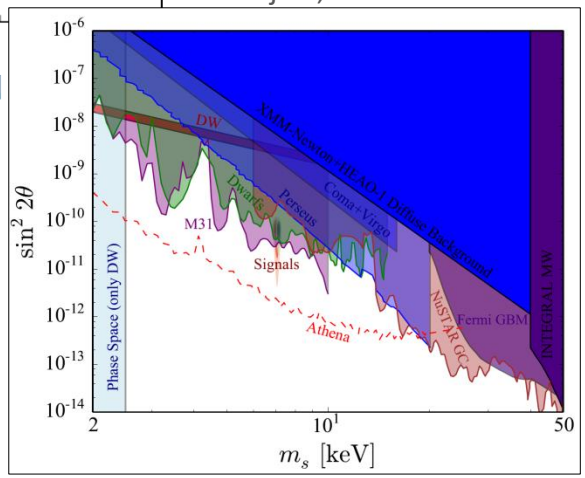
Broggio+, JHEP 1411 (2014) 058



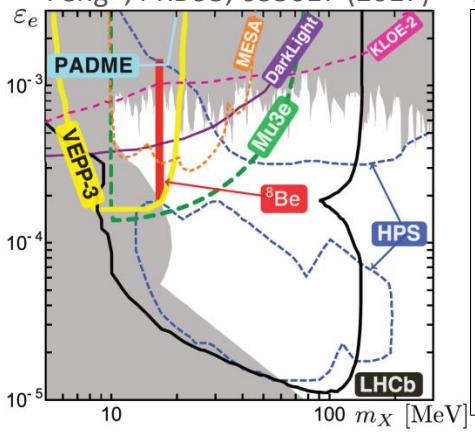
Cuoco+, arXiv:1704.08258



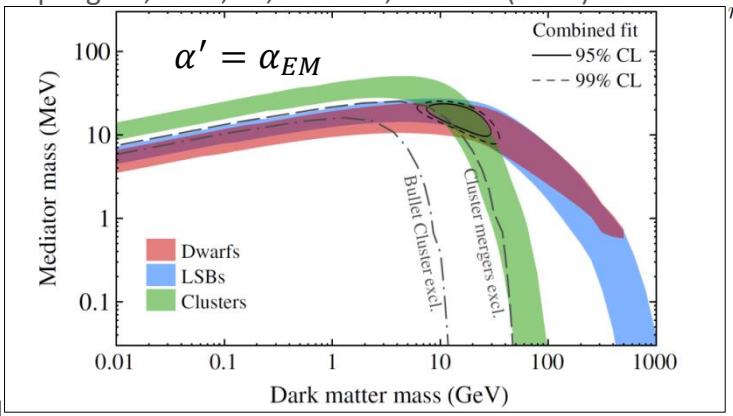
Abazajian, arXiv:1705.01837



Feng+, PRD95, 035017 (2017)



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



Nuclear Anomalies

Small Scale Structure Anomalies

Astroparticle Anomalies

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

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?