

Searches for Dark Sectors

Cross frontier breakout organizers: Brian Batell (RF6), Robert Caldwell (CF5&7), Caterina Doglioni (EF10), Tongyan Lin (CF1), Zhen Liu (EF9), Eric Prebys (AF5), Bangalore Sathyaprakash (CF7), Jessie Shelton (TF9), Ian Shoemaker (NF3), Liantao Wang (EF10)

Moderator: Zhen Liu
Introduction: Tongyan Lin

Goals of this session

- Cross-frontier discussions of complementary searches for dark sectors
- Establish common language for dark sectors across frontiers
- How do we present a coherent & compelling motivation for dark sectors in Snowmass process?

What is a dark sector?

Broadest definition: new fields or particles that don't have direct SM gauge interactions

Examples:

- Feeble BSM operators/interactions, such as axion-like particles
- Small interaction with SM through mixing, such as a kinetically mixed dark photon, the Higgs portal or Heavy Neutral Leptons
- Dark matter interactions mediated by the same operators or particles

Motivated by the existence of dark matter, anomalies in experimental results, solutions to theoretical puzzles, top-down models and theory considerations.

What this session will cover

- Searches for portals & mediators to the Standard Model, **primarily in the $\sim\text{eV-GeV}$ mass range**
- Non-standard neutrino interactions, sterile neutrinos and heavy neutral leptons
- Searches for rich dark sectors (inelastic dark matter, dark higgses, SIMPs)
- Direct detection searches for $\sim\text{eV-GeV}$ scale dark matter
- Gravitational wave probes of dark sectors including phase transitions, cosmic strings

Complementary discussions in other breakouts

- **Some light dark matter searches in rare processes, accelerators**
(#108 - Accelerator probes of light dark matter)
- **Astrophysical probes for SM/BSM neutrino properties and sterile neutrinos, boosted DM searches** (#97 - Neutrinos as Probes of Standard and BSM Particle Physics, #137 - High and ultrahigh energy neutrino experiments)
- **Dark sectors at higher mass scales** (#136 - Particle DM > 10 GeV) **and DM in the regime between axions and WIMPs** (#77 - Quantum sensors for Wave and Particle Detection)
- **Ultralight axions and mediators**
(#74 - Atomic to cosmic: wave dark matter and beyond, #75 - Cosmic probes of dark matter physics)
- **And more...**

Plan for the session

1. **Direct detection of dark sectors (mass > eV)**

Speaker: Rouven Essig

2. **Gravitational wave and cosmic probes**

Speakers: Bangalore Sathyaprakash & Robert Caldwell

3. **Energy frontier probes**

Speaker: James Beacham

4. **Neutrino frontier probes**

Speaker: Kevin Kelly

5. **Rare processes probes**

Speaker: Stefania Gori

10 min talks

+

10 min discussion

Discussion questions

- How do we present a coherent & compelling motivation for dark sectors across many frontiers?
- What are the major common goals and how do we leverage unique capabilities within each frontier?
- Are there particular sets of benchmark models and target lines that help understanding the cross-frontier complementarities?
- What would you like to see as an outcome of the Snowmass process?