RF6: Dark Sectors at High Intensities

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Our plan for the RF6 report was already in place before the Snowmass freeze. The report will be based around 3 Big Ideas:

- Detect dark matter particle production (production reaction or through subsequent DM scattering), with a focus on exploring sensitivity to thermal DM interaction strengths, e.g. DM production through the vector portal, millicharged particles, nu-portal DM production, etc.
- Explore the structure of the dark sector by producing and detecting unstable dark particles: *Minimal Portal Interactions*. This includes scalar portal (e.g. secluded DM), pseudoscalar portal (e.g. SIMP mediator), vector portal (visible signals, e.g. minimal A', iDM, SIMP mediators, etc), fermion portal (e.g. nu-portal fermion decays), …
- New Flavors and Rich Structures in Dark Sectors, e.g. various phobic and philic models, higher-dimensional operators, additional non-minimal dark-sector structure, etc.

In addition, we plan on having a fourth white paper the collects and presents the details on relevant experiments, facilities, tools, etc. (to avoid having to repeat those details).

Benchmarks in Final State x Portal Organization

	DM Production	Mediator Decay Via Portal	Structure of Dark Sector
Vector	*m_χ vs. y [$m_{A'}/m_\chi$=3,α_D=.5]* **$m_{A'}$ vs. y** [α_D=0.5, 3 m_χ values] m_χ vs.α_D [$m_{A'}/m_\chi$=3, y=y_{fo}] m_χ vs. m_A [α_D=0.5, y=y_{fo}] *Millicharge m vs. q*	$m_{A'}$ vs. ϵ [decay-mode agnostic] ***$m_{A'}$ vs. ϵ [decays]***	**iDM m_χ vs. y [$m_{A'}/m_\chi$=3,α_D=.5] (anom connection)** **SIMP-motivated cascades [slices TBD]** $U(1)_{B-L\ /\ \mu-\tau\ /\ B-3\tau}$ (DM or SM decays)
Scalar	m_χ vs. sinθ [λ=0, fix m_S/m_χ, g_D] (thermal target excluded 1512.04119, should still include) Note secluded DM relevance of S→SM of mediator searches	*m_S vs. sinθ* [λ=0] *m_S vs. sinθ* [λ=s.t. Br(H→ss ~10^{-2})]?	Dark Higgssstrahlung (w/vector) scalar SIMP models Leptophilic/leptophobic dark Higgs
Neutrino	e/μ/τ a la1709.07001	*m_N vs. U_e* *m_N vs. U_μ* *m_N vs. U_τ* Think more about reasonable flavor structures	Sterile neutrinos with new forces
ALP	m_χ vs. fq/l [λ=0, fix m_a/m_χ, g_D] (thermal target excluded) What about f_γ, f_G?	*m_a vs. f_γ* *m_a vs. f_G* *m_a vs. f_q=f_l* *m_a vs. f_w*	FV axion couplings

Bold = BRN benchmark, ***italic=PBC benchmark.*** others are new suggestions. Underline=CV benchmarks that were not used in BRN

RF6: Schedule

- ***ASAP***: Appoint lead editors for the 4 solicited white papers.
- ***Fall 2021-Winter 2022***: Solicited white paper editors and RF6 conveners finalize the structure (e.g. benchmarks, topics to include) of these white papers, coordinate with groups contributing material, start putting together very rough drafts on overleaf.
- ***March 15, 2022***: Contributed white papers due. These will be focused on specific efforts and produced by individual groups. They can have whatever format you want.
- ***Mid April, 2022***: Solicited white papers due.
- ***Mid May, 2022***: First draft of the RF6 report available for comments / feedback. (These will be produced by SG and MW following the plan, which proposes to base this report on the executive summaries of the Big Idea solicited white papers.)
- ***May 31, 2022***: RF6 report draft sent to RF conveners and available for discussion at the (hopefully!) in person RF meeting in Cincinnati (June 6-9, alt dates May 9-12 or 16-19).
- ***June 20, 2022***: RF frontier report draft due.
- ***July 17-27, 2022***: (Hopefully!) In person Snowmass meeting in Seattle.
- ***September 30, 2022***: All final reports due.