

RF6 Report

RF6 has not yet restarted. Our plan before the freeze, which we plan to keep, is to base our report around 3 solicited white papers, one for each of the following *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, milicharged 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 that collects and presents the details on relevant experiments, facilities, tools, etc. (to avoid having to repeat those details).

More details can be found [in our RF6 report outline document](#). The final details still need to be hashed out on what precisely goes into each white paper. This will be done in the few coming months. Each solicited white paper will produce an executive summary that, along with a few key plots, will form the backbone of the RF6 report. (Contributed white papers will feed into the solicited white papers.)

Natalia's Benchmarks Table

Benchmarks in Final State x Portal Organization

	DM Production	Mediator Decay Via Portal	Structure of Dark Sector
Vector	m_χ vs. y [$m_A/m_\chi=3, \alpha_D=.5$] $m_{A'}$ vs. y [$\alpha_D=0.5, 3 m_\chi$ values] m_χ vs. α_D [$m_A/m_\chi=3, y=y_{f0}$] m_χ vs. m_A [$\alpha_D=0.5, y=y_{f0}$] <i>millicharge m vs. q</i>	$m_{A'}$ vs. ϵ [decay-mode agnostic] $m_{A'}$ vs. ϵ [decays]	iDM m_χ vs. y [$m_A/m_\chi=3, \alpha_D=.5$] (anom connection) SIMP-motivated cascades [slices TBD] $U(1)_{B-L/\mu-\tau/B-3\tau}$ (DM or SM decays)
Scalar	m_χ vs. $\sin\theta$ [$\lambda=0, \text{fix } m_S/m_\chi, g_D$] (thermal target excluded 1512.04119, should still include) Note seclud DM relevance of $S \rightarrow SM$ of mediator searches	m_S vs. $\sin\theta$ [$\lambda=0$] m_S vs. $\sin\theta$ [$\lambda=\text{s.t. Br}(H \rightarrow \phi\phi \sim 10^{-2})$]	Dark Higgs-sstrahlung (w/vector) scalar SIMP models? Leptophilic/leptophobic dark Higgs?
Neutrino	$e/\mu/\tau$ a la 1709.07001?	m_N vs. U_e m_N vs. U_μ m_N vs. U_τ Think more about reasoanble flavor structures	Sterile neutrinos with new forces?
ALP	m_χ vs. $f q/l$ [$\lambda=0, \text{fix } m_a/m_\chi, g_D$] (thermal target excluded) What about f_γ, f_G ?	m_a vs. f_γ m_a vs. f_G m_a vs. $f = f_1$ (separate?) Think more about reasoanble coupling relations including $f_{W/Z}$	FV axion couplings

+ Neutron portal (See e.g. 2003.02270)? Hidden valleys (or are these out-of-scope?)?

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

N.b., plan to collect all results in a similar way to DarkCast (possibly in DarkCast itself) to enable remaking plots easily at later stages in the Snowmass process.

RF6 Substructure

RF6 substructure prior to the freeze:

- Theory (B Batell, P Schuster)
- e^+e^- experiments (C Hearty)
- Fixed-target experiments (G Krnjaic, P Harris, N Toro)
- Kaon factories (B Dobrich, J Zupan)
- Low-masses @ EF facilities (P Ilten)
- Neutrino experiments (P Coloma, L Koerner)
- Other opportunities

Having sub-conveners was of great value to us prior to the freeze. However, moving forward these people are the most obvious choices for solicited white paper editors. Do we have a need to preserve our substructure? Is our only goal now to obtain the white papers, from which the RF6 conveners will produce the RF6 report? Is there any central Snowmass advice? ...