

Thoughts on Simplified Model Summary Plots common to EF10 and RF6

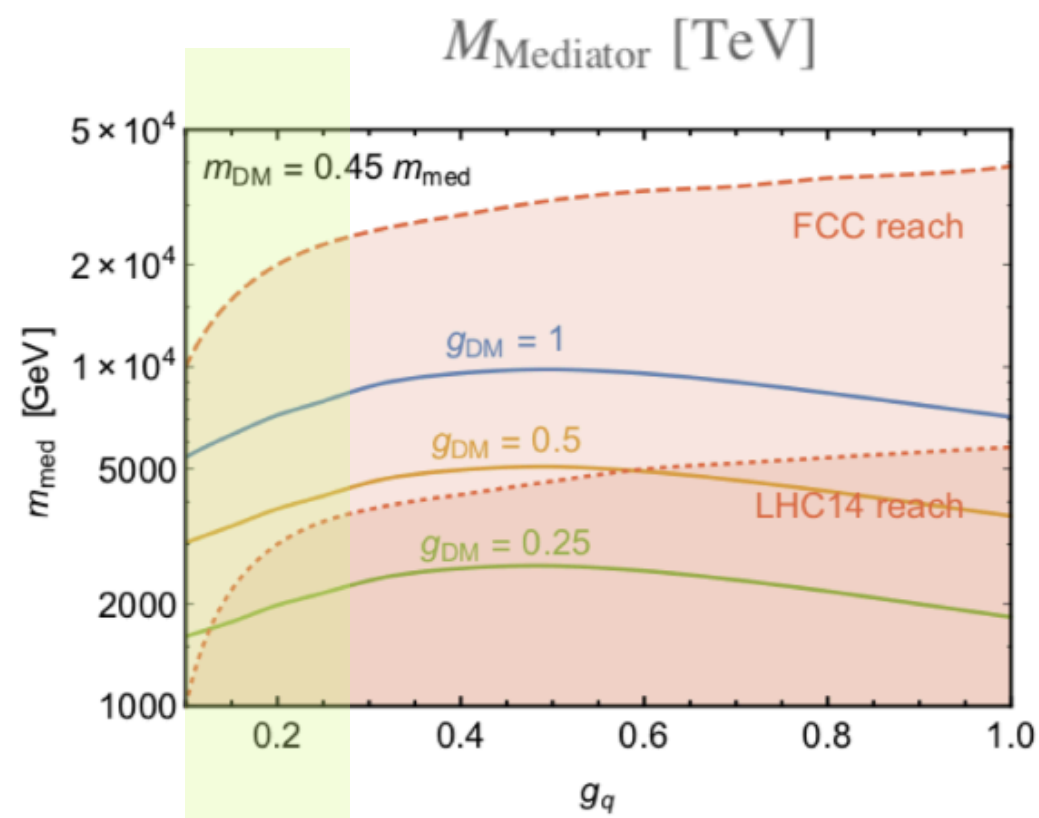
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(Very hastily prepared slides -- apologies for rough spots!)

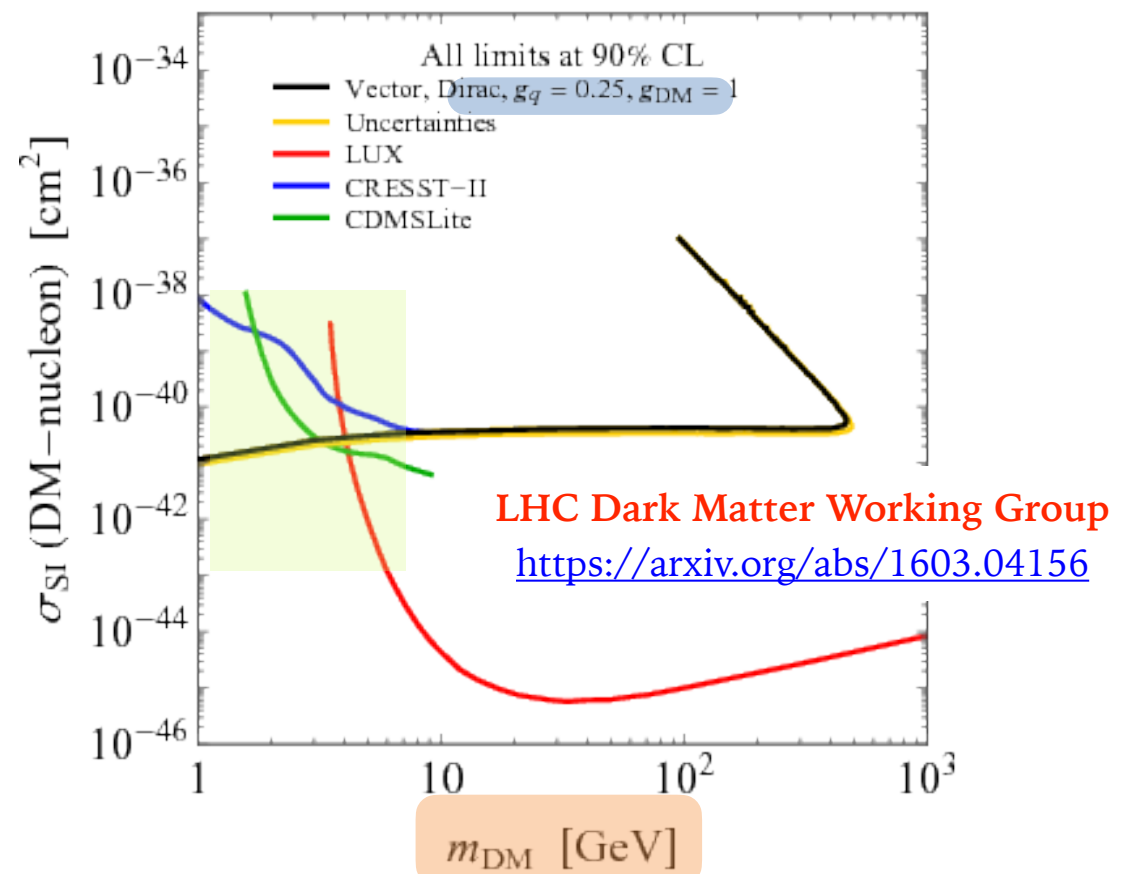
Brief comments about EF10 searches w/ s-channel simplified models

(figs from Caterina's 5/14 slides)

- Simplified model sensitivity of EF searches is coupling-dependent



- Sensitive to wide range of DM masses, but light-ish (≈ 10 GeV) DM is particularly interesting



>GeV? No real lower bound in DM mass

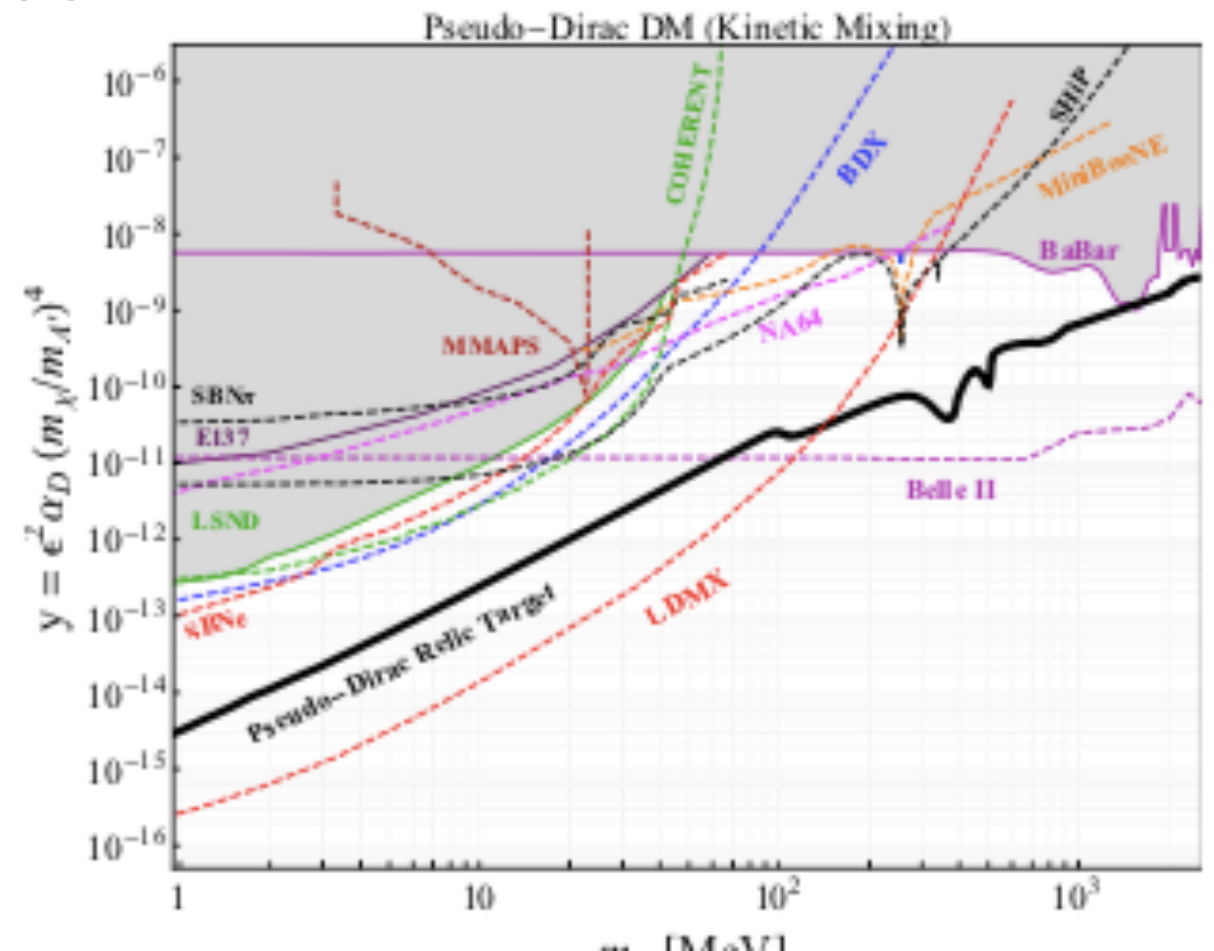
Brief and Unofficial Introduction to RF6 Dark Matter Searches

- DM part of RF6 focused on sub-GeV DM: kinematically accessible to intensity frontier searches
 - experiments: beam dumps, missing energy/momentum (\neq MET!), missing mass (fixed tgt, e^+e^- , meson decays)
 - Focus: models where mediator is **also** light (comparable to DM mass); sensitive to tiny couplings ($g_{SM} \sim 10^{-3}$ to 10^{-8}).

Such small coupling can arise from radiative effects

- Annihilation through mediator gives correct DM abundance: “simplified model” is also a “minimal model”

*plot from [Cosmic Visions 2017](#) report.
See [RF6 wiki](#) for more references.*



EF10/RF6 complementarity

- Obviously EF10 can probe higher DM masses – but simplified models highly constrained by direct detection [if DD is SI, v -indep,..] above ~ 5 GeV (= Belle-II kinematic limit)
- Important and more nuanced complementarity:
Same EFT operator scale can come from heavy, strongly coupled mediator or light, weakly coupled mediator



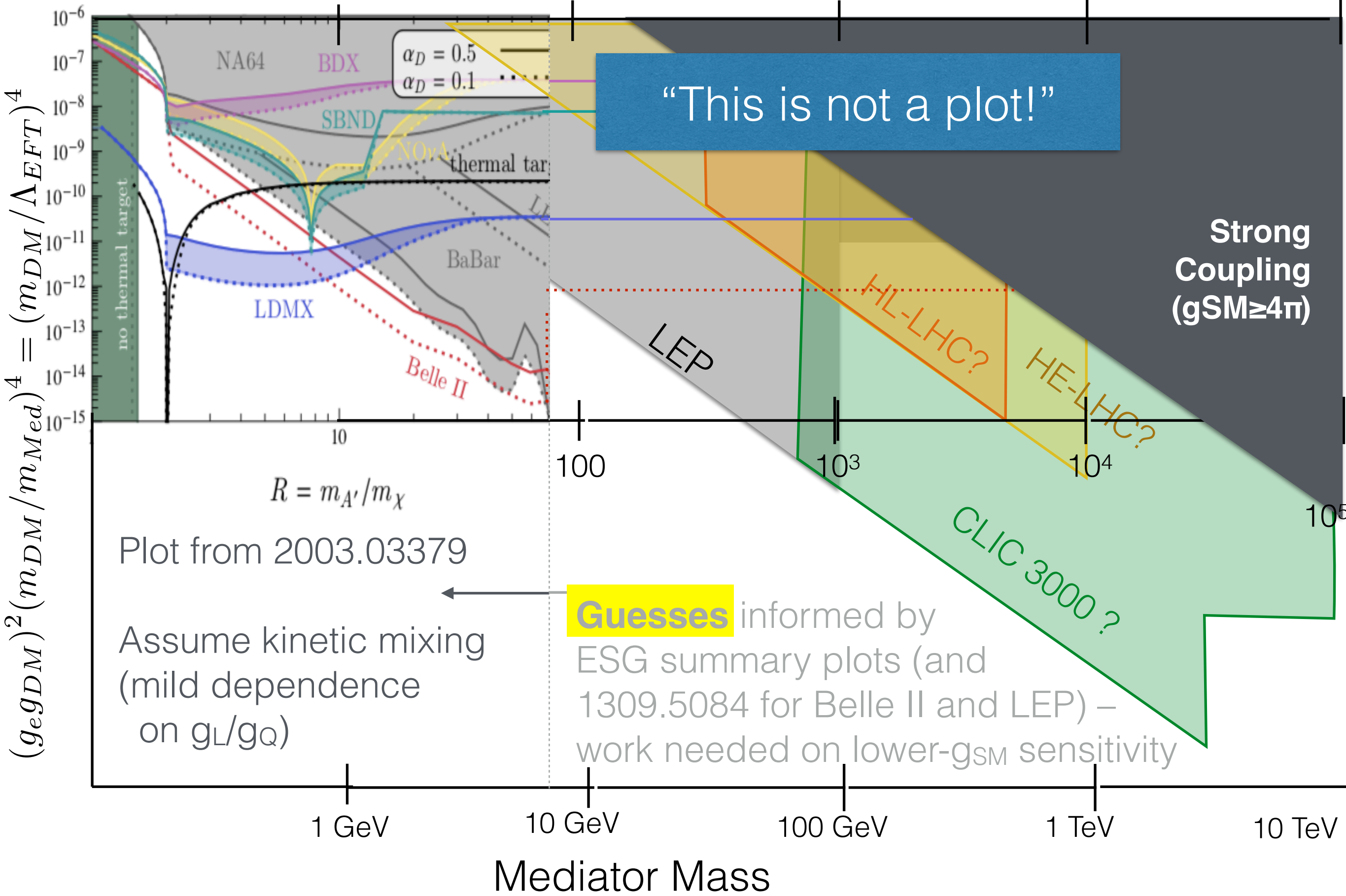
RF6 most sensitive to weakly coupled, light mediators (on-shell production more efficient than EFT regime)

EF10 most sensitive to strongly coupled, heavy mediators (sensitivity to weaker couplings/lighter mediators limited by bkg stats & low-MET backgrounds)

- Exploration of this axis within RF6 scope: 2003.03379 (Berlin, DeNiverville, Ritz, Schuster, NT)

$$R = m_{Med}/m_{DM}$$

100 MeV Dark Matter, $g_D = 1$



$$R = m_{A'}/m_\chi$$

Plot from 2003.03379

Assume kinetic mixing
(mild dependence on g_L/g_Q)

Subtleties

- Note: sensitivity in terms of “EFT cutoff scale” but we are including the mediator mass explicitly in computing constraints (thanks to LT Wang for asking about this)
- RF6 experiments “phase out” as DM mass increased – need multiple plots
- Most hadron collider limits assume $g_L=0$...consider leptophilic/phobic benchmarks as well as $g_L \sim g_Q$ example?
- DD comparison – “flat” on x-axis, but very dependent on spin assumptions
- what about g_D ? With this basis, large g_D (as usually shown) → *weakest* limits, so not so bad...
- Not shown, but visible mediator searches become relevant when $m_{\text{Med}} < 2 m_{\text{DM}}$ (Thanks to P. Harris for mentioning this)
- ...? Probably more illuminated by further discussion