Physics Constraints on BSM Dump

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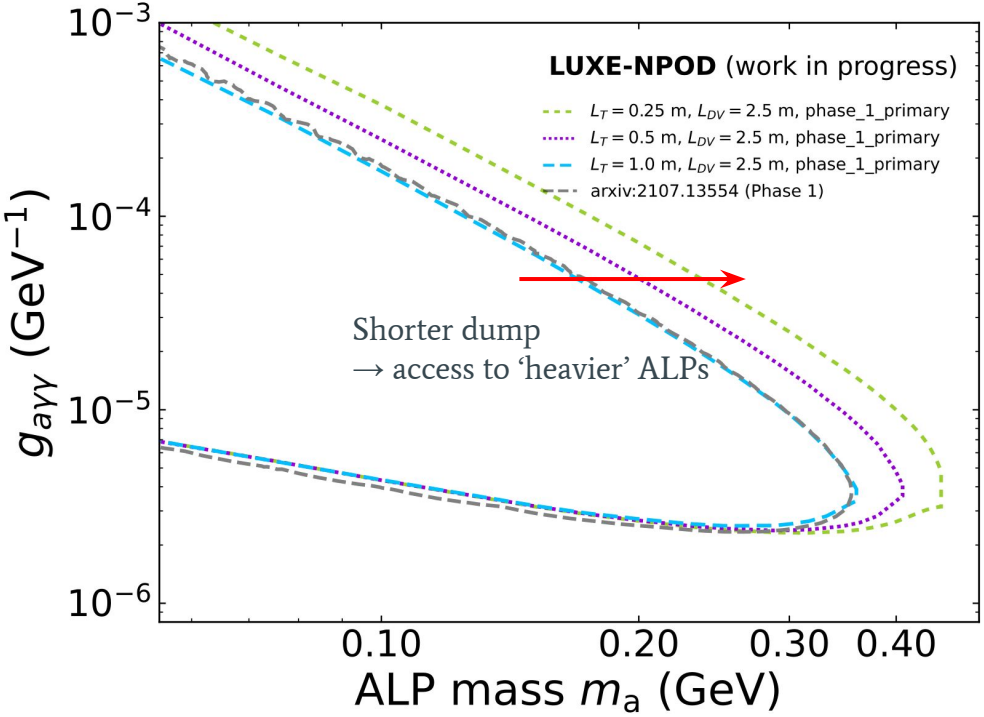
BSM Dump Status

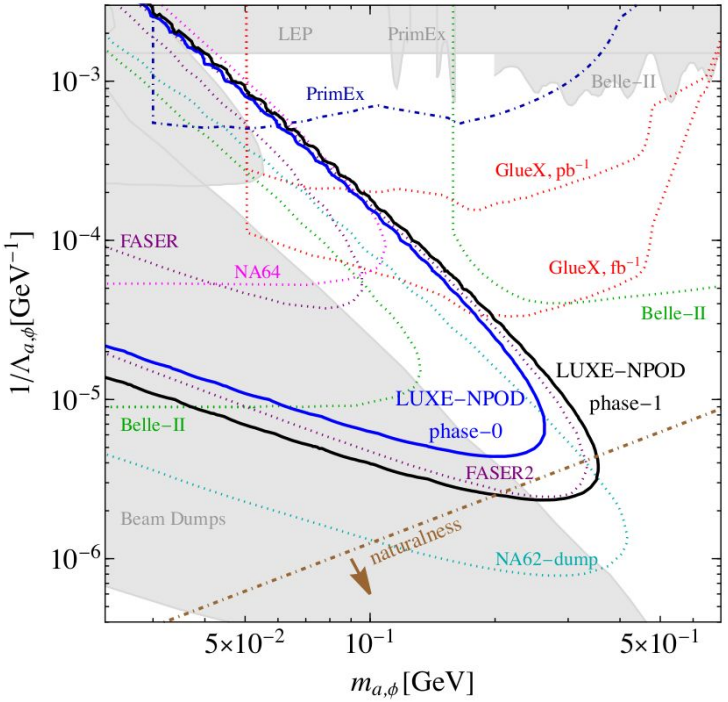
We are doing systematic studies on the BSM dump:

- Assuming zero background reaching the BSM calorimeter, shorter dumps enhance the sensitivity to more massive ALPs
- We need to verify that the zero-background assumption holds
  - The available MC samples simulate only 4 BX and consider only a dump length of 1 m
- At KIT, a postdoc - Raquel Quishpe - is working full time on:
  - Simulating additional BX using ptarmigan
  - Use these additional samples as input to study different dump configurations
  - Length and possibly material

Expected Results in Phase 1: Dump Length

arXiv:2107.13554

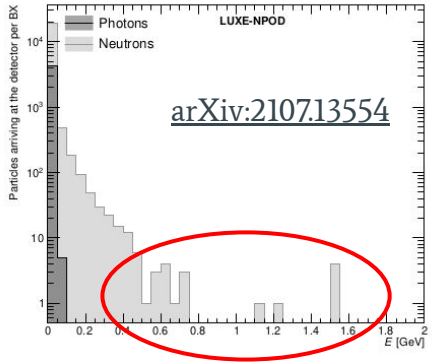


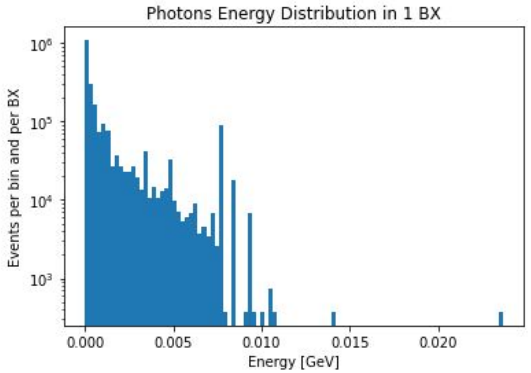


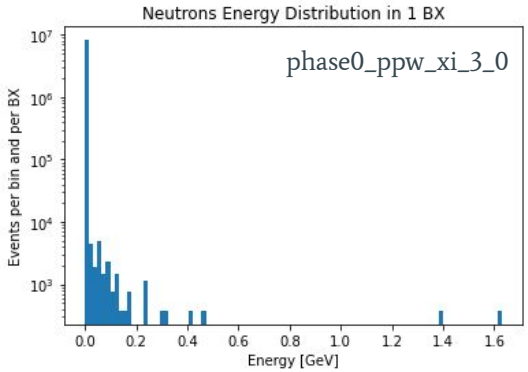
Background Studies

The expected results are obtained assuming zero background:

- Studies in the LUXE-NPOD paper and more recent ones confirm it
- Photons really seem too soft to be a source of background. For neutrons in particular, statistics in $E_n > 0.5$ GeV is extremely low
- We use now **4 BX** but we may want to use more to populate the tail of the distributions





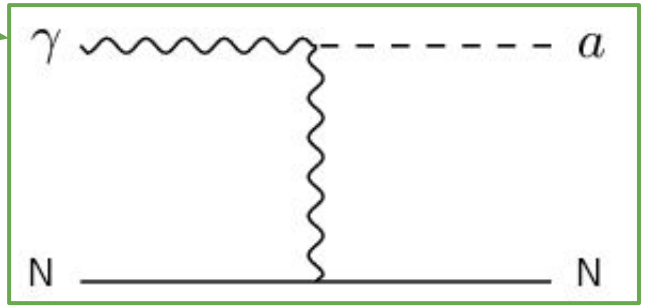


BACK-UP

Signal Definition and Production

ALP production can happen via the Primakoff mechanism:

$$\mathcal{L}_{a/\phi} = \frac{a}{4\Lambda_{a/\phi}} F_{\mu\nu}\tilde{F}^{\mu\nu} + \left(i g_{a/\phi e} a \bar{e} \gamma^5 e \right)$$



$$Na \approx \mathcal{L}_{\text{eff}} \int dE_\gamma \frac{dN_\gamma}{dE_\gamma} \sigma a\left(E_\gamma\right) \left(e^{-\frac{L_D}{L_a}} - e^{-\frac{L_V + L_D}{L_a}} \right) \mathcal{A}$$

$$\mathscr{L}_{eff} = N_e N_p \frac{9\rho_N X_0}{7 A_N m_0}$$