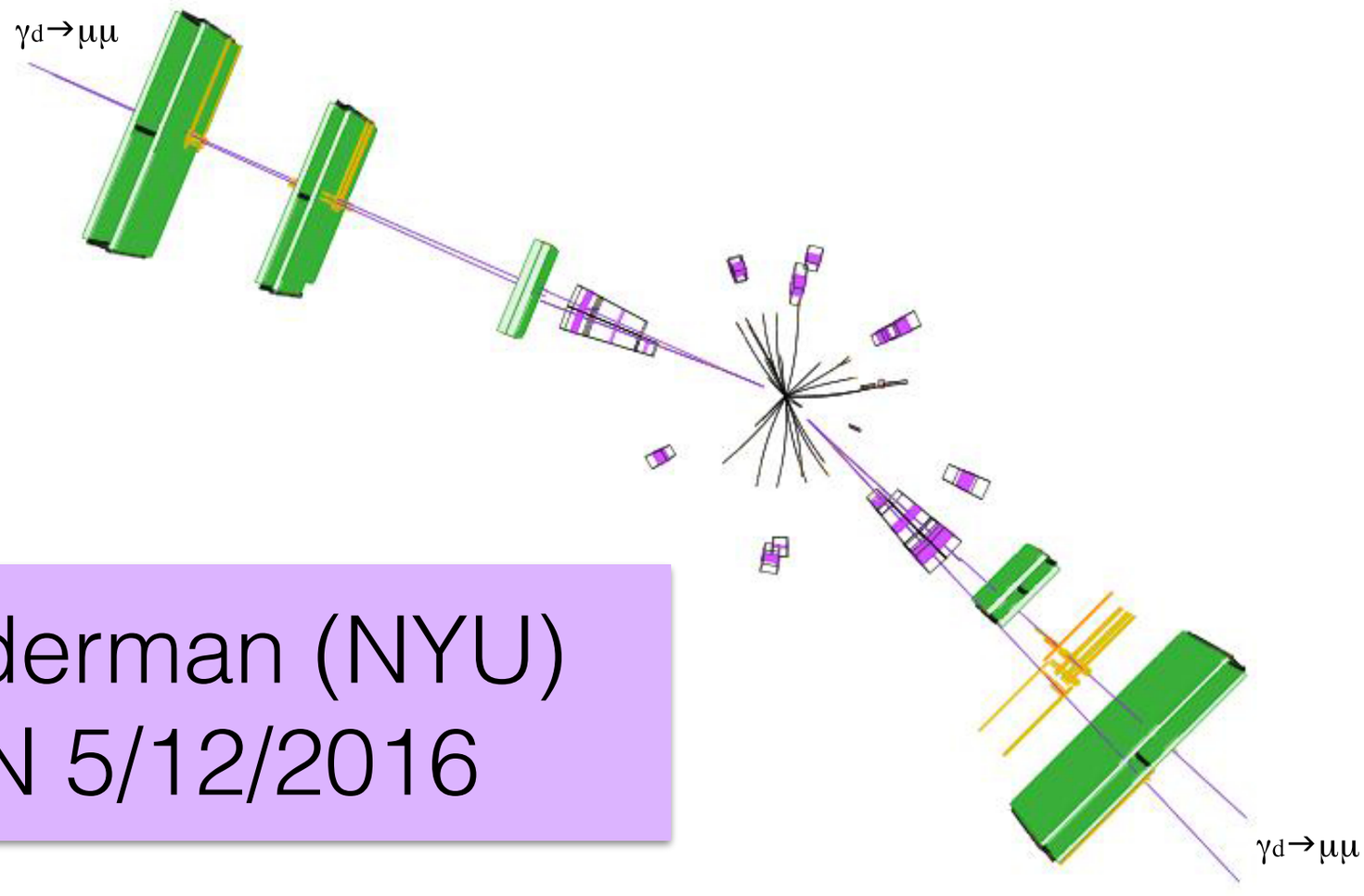
Displaced Lepton Jets at 13 TeV

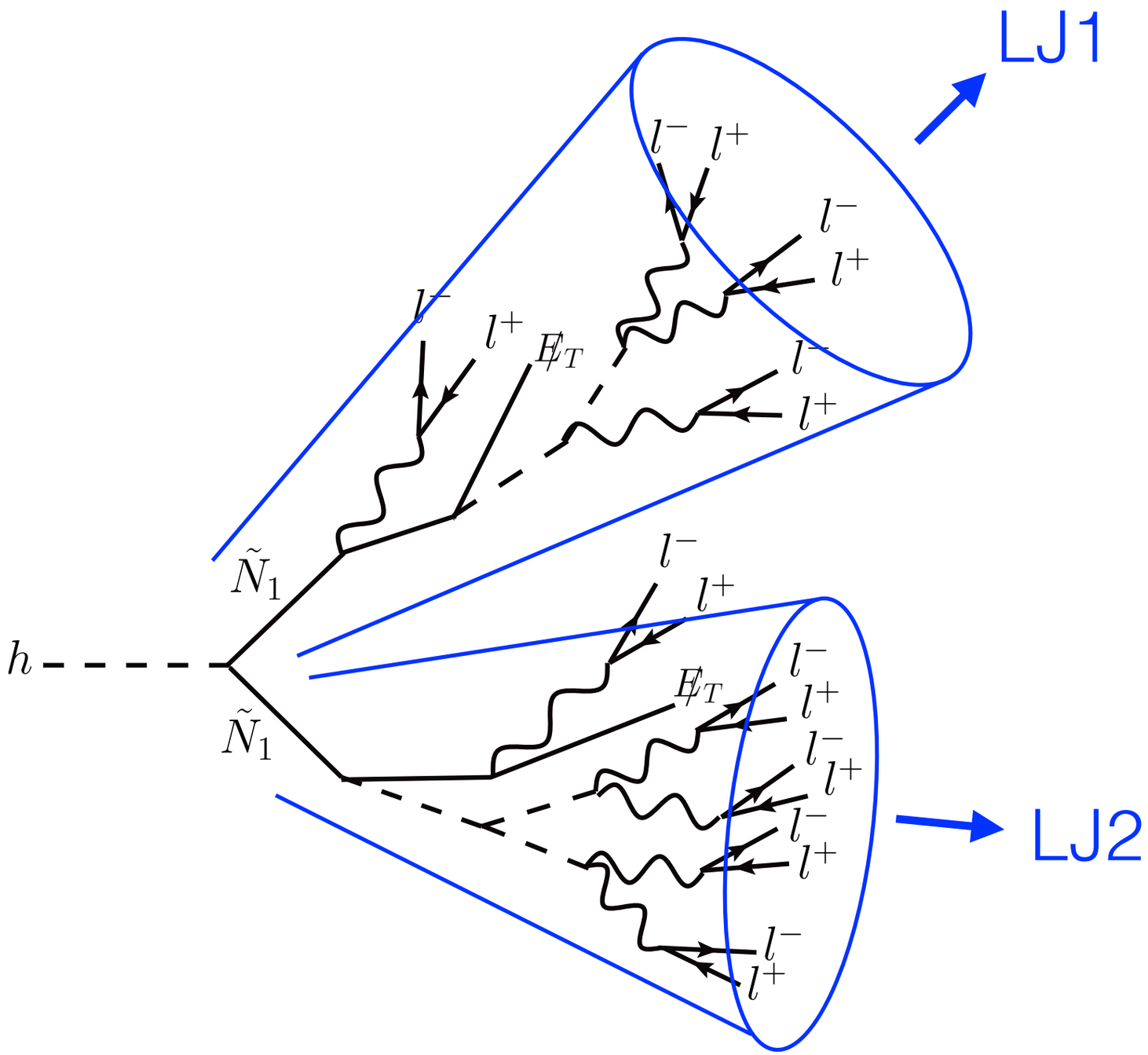


Josh Ruderman (NYU)
@CERN 5/12/2016

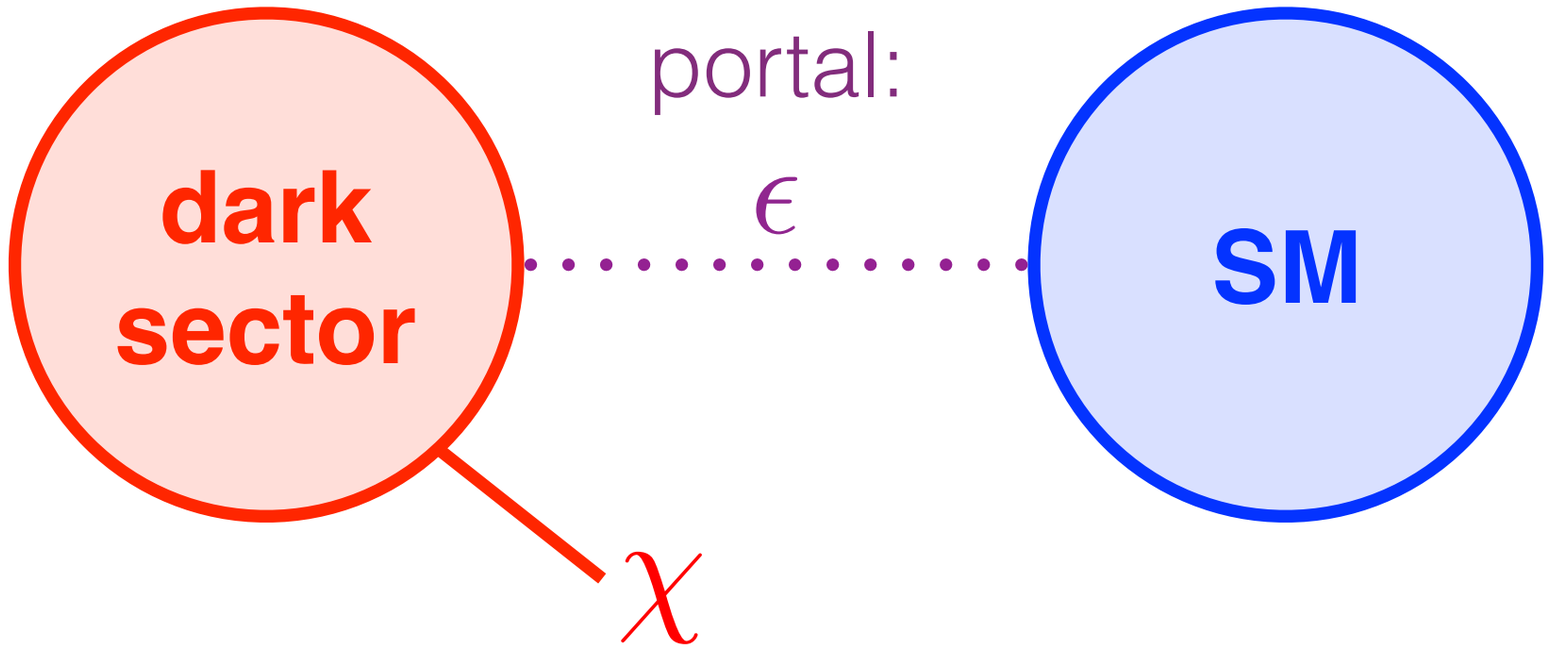
plan

1. lepton jet theory
2. experimental status
3. displaced wishlist

1. lepton jet theory

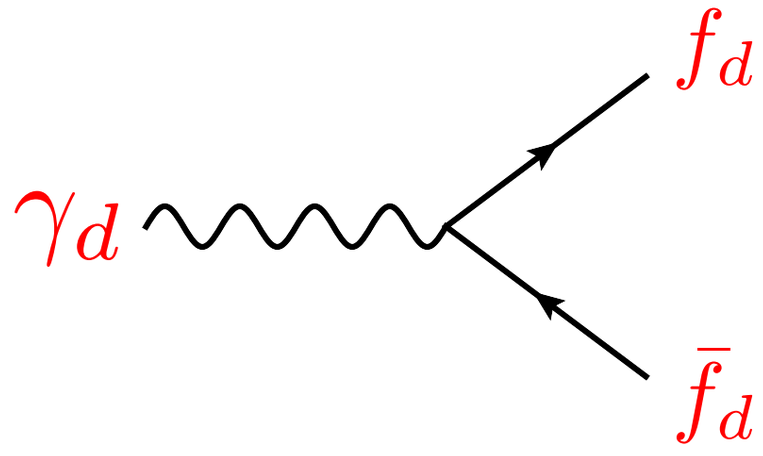


dark sector



ex)

dark QED: $U(1)_d$

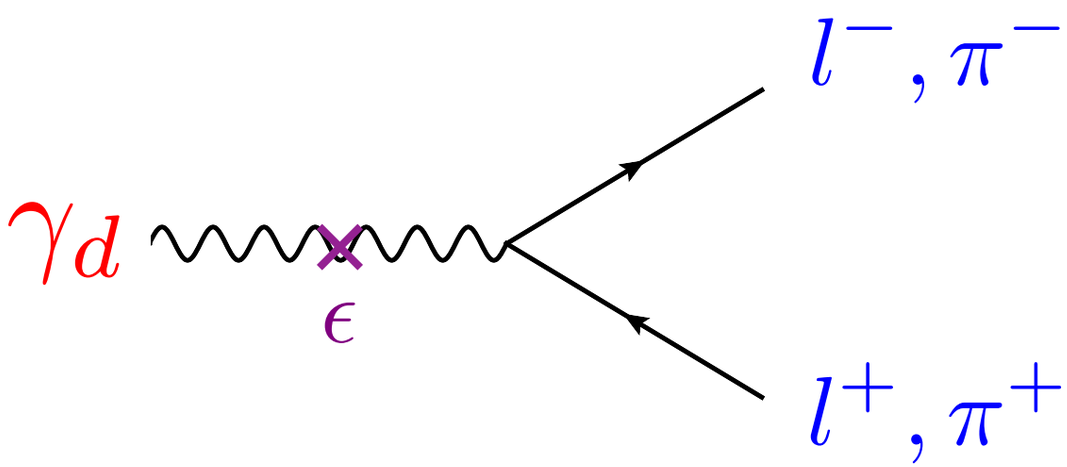


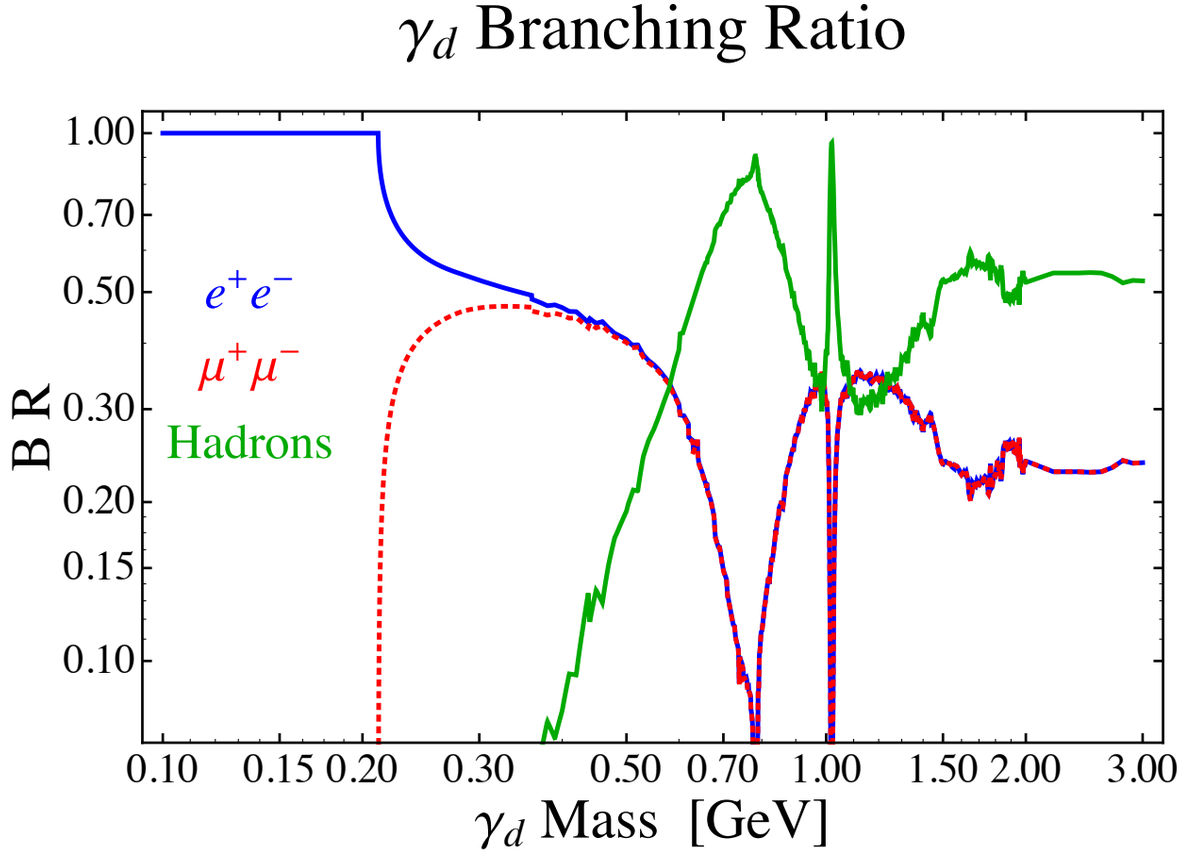
$$m_{\gamma_d} \sim \mathcal{O}(\mathrm{GeV})$$

kinetic mixing portal

$$\mathcal{L} \supset \frac{\epsilon}{2} F^d_{\mu\nu} F^{\mu\nu} \longrightarrow \epsilon \gamma_d^\mu J_\mu^{EM}$$

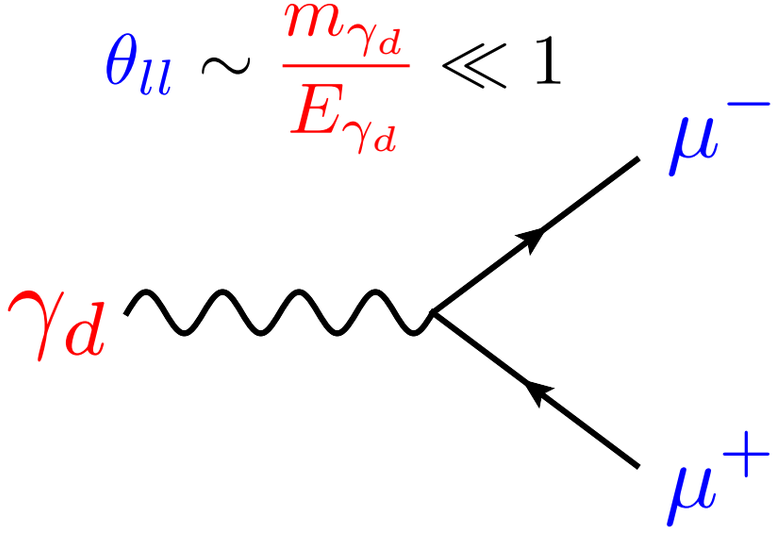
- Holdom **1986**

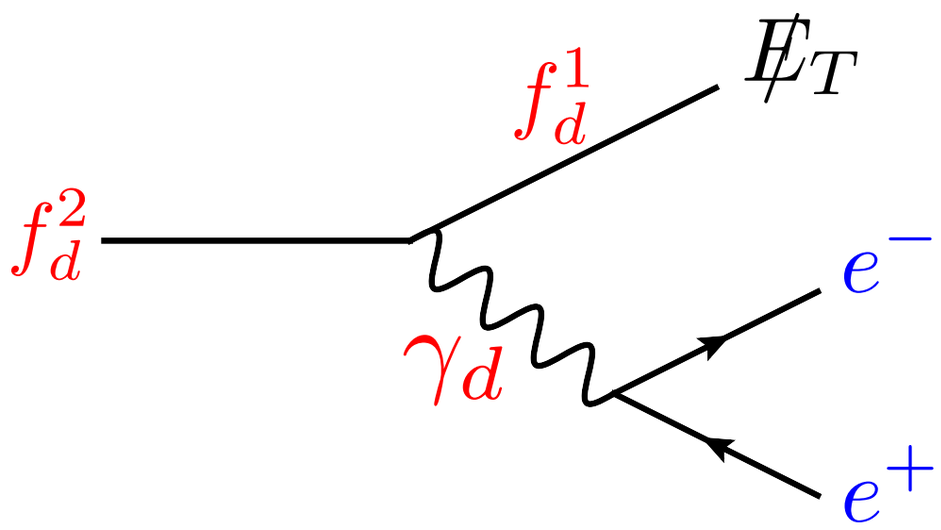


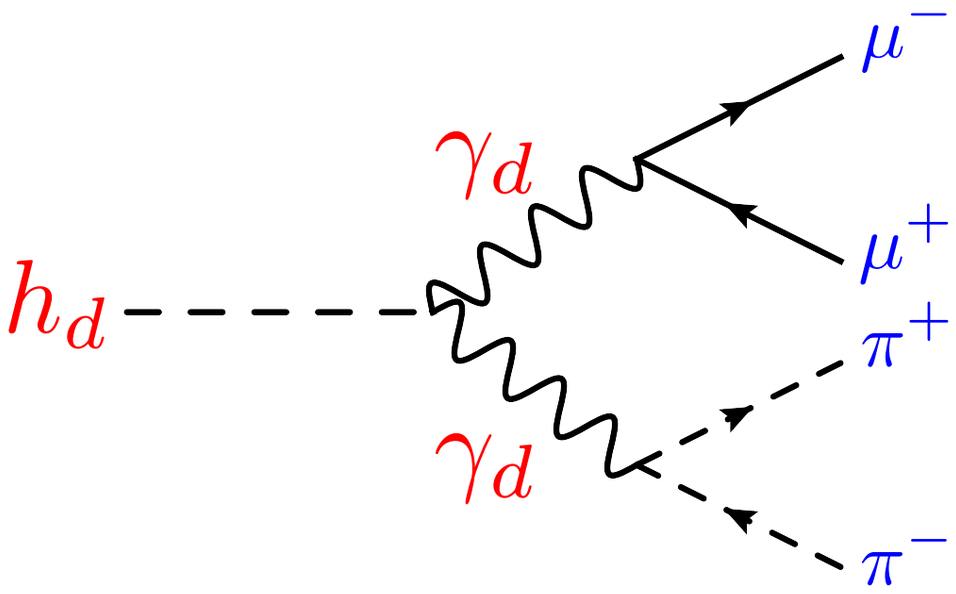


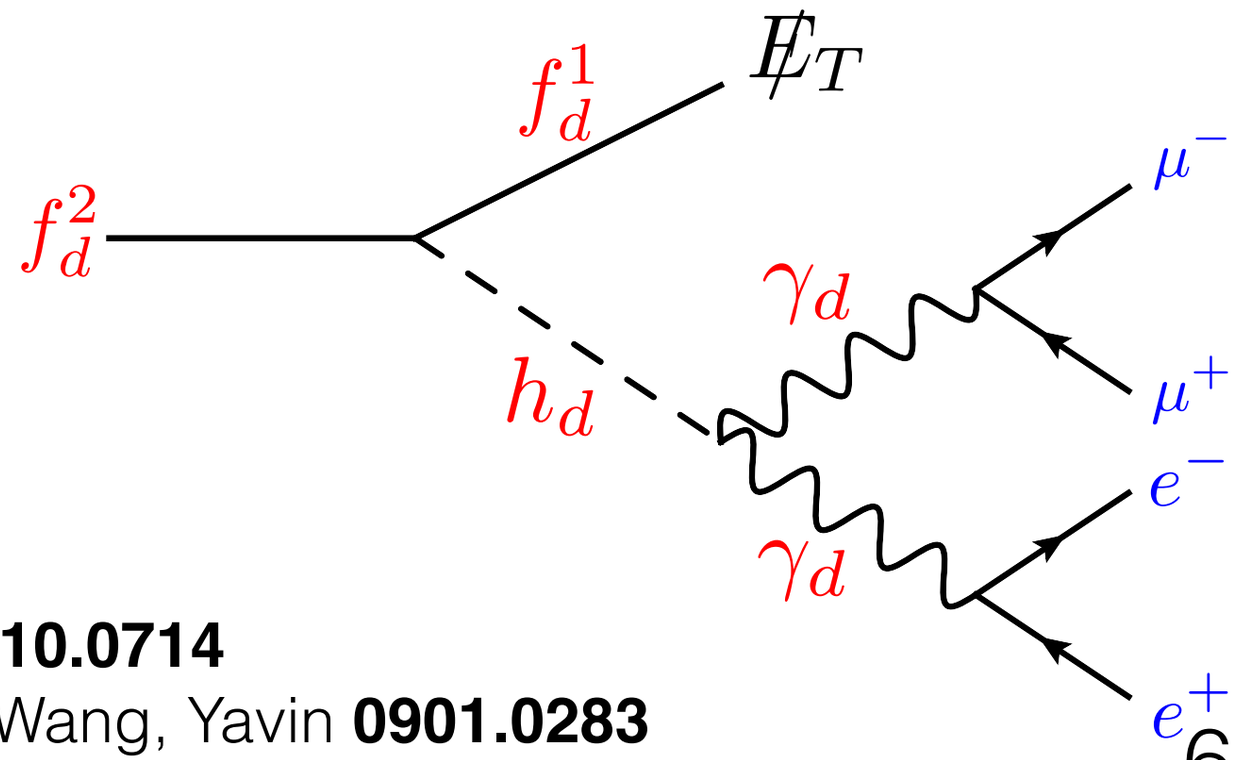
- Falkowski, JTR, Volansky, Zupan **1002.2952**

lepton jets





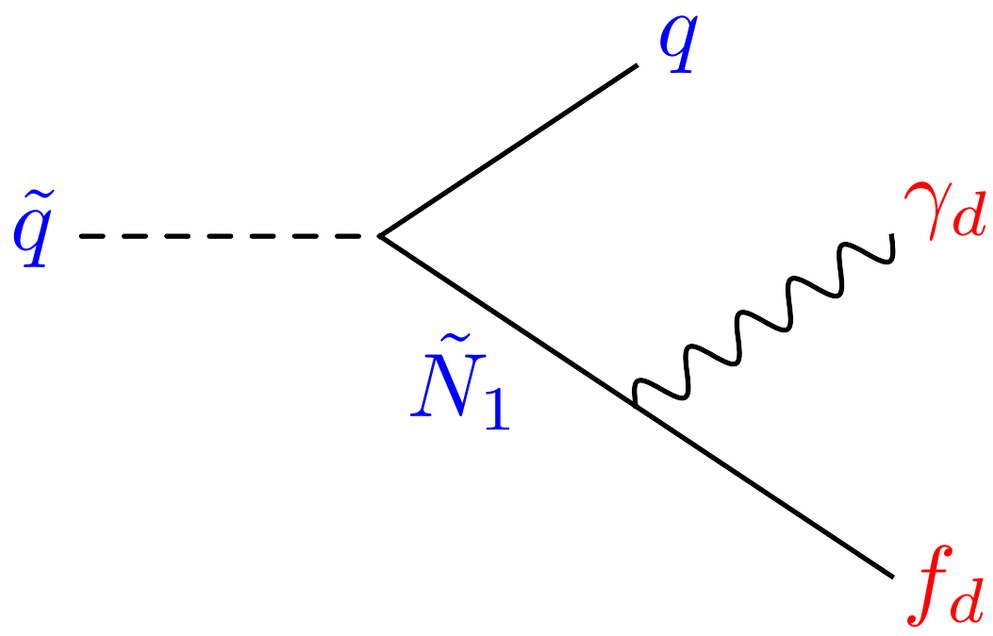




- Arkani-Hamed, Weiner **0810.0714**
- Baumgart, Cheung, JTR, Wang, Yavin **0901.0283**

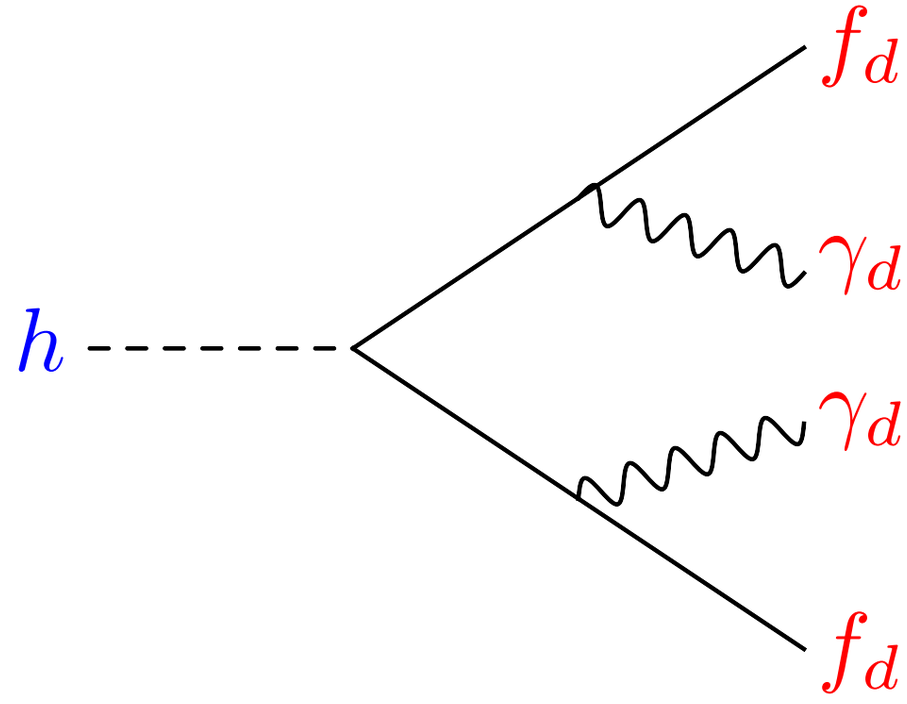
lepton jet production

SUSY



- Arkani-Hamed, Weiner **0810.0714**

Higgs

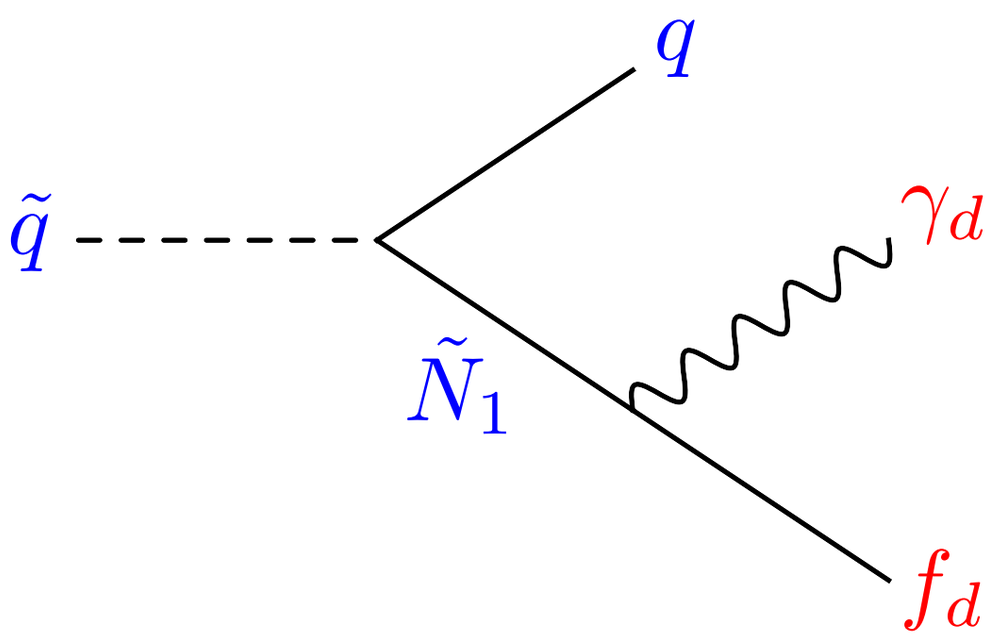


- Falkowski, JTR, Volansky, Zupan **1002.2952**

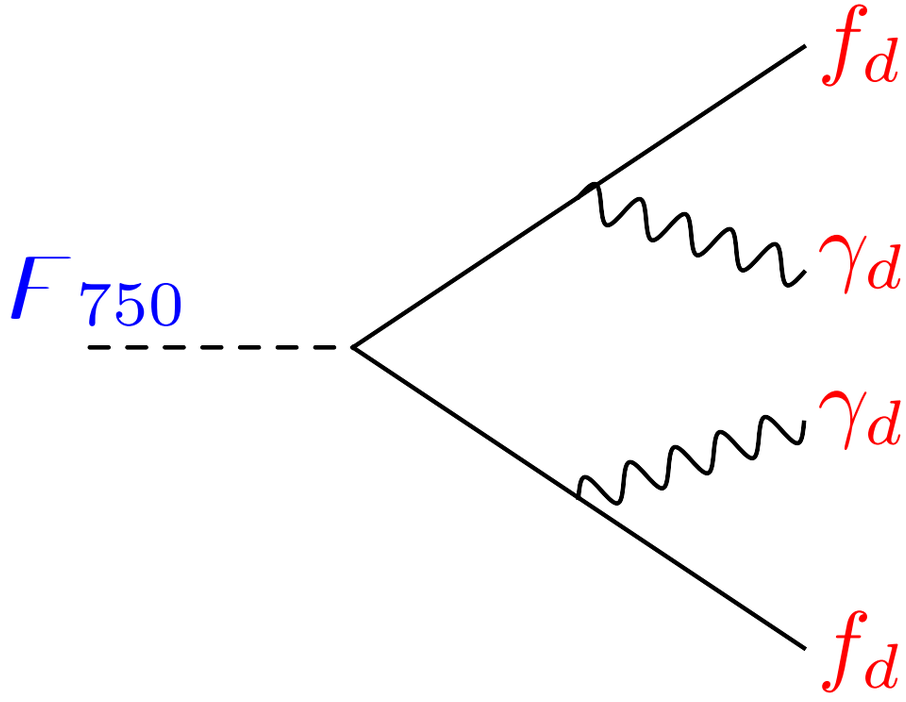
see also: • Gopalakrishna, Jung, Wells **0801.3456**

lepton jet production

SUSY

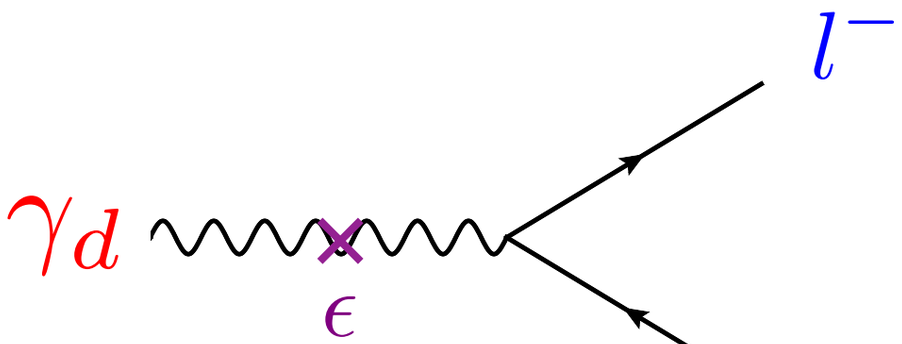


new heavy states?

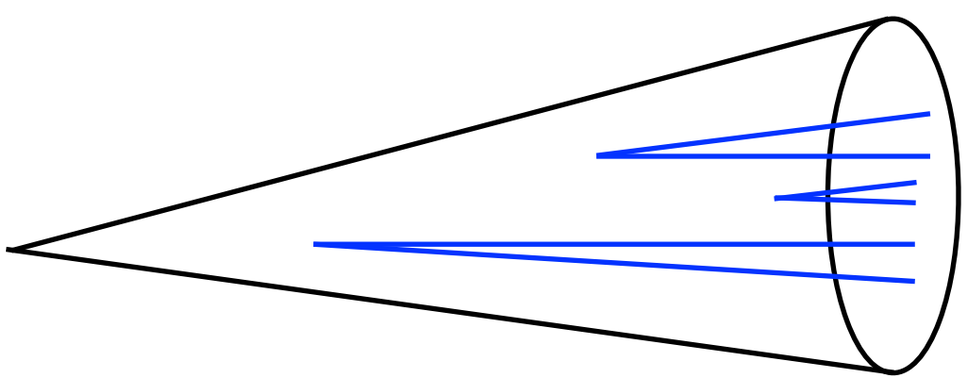


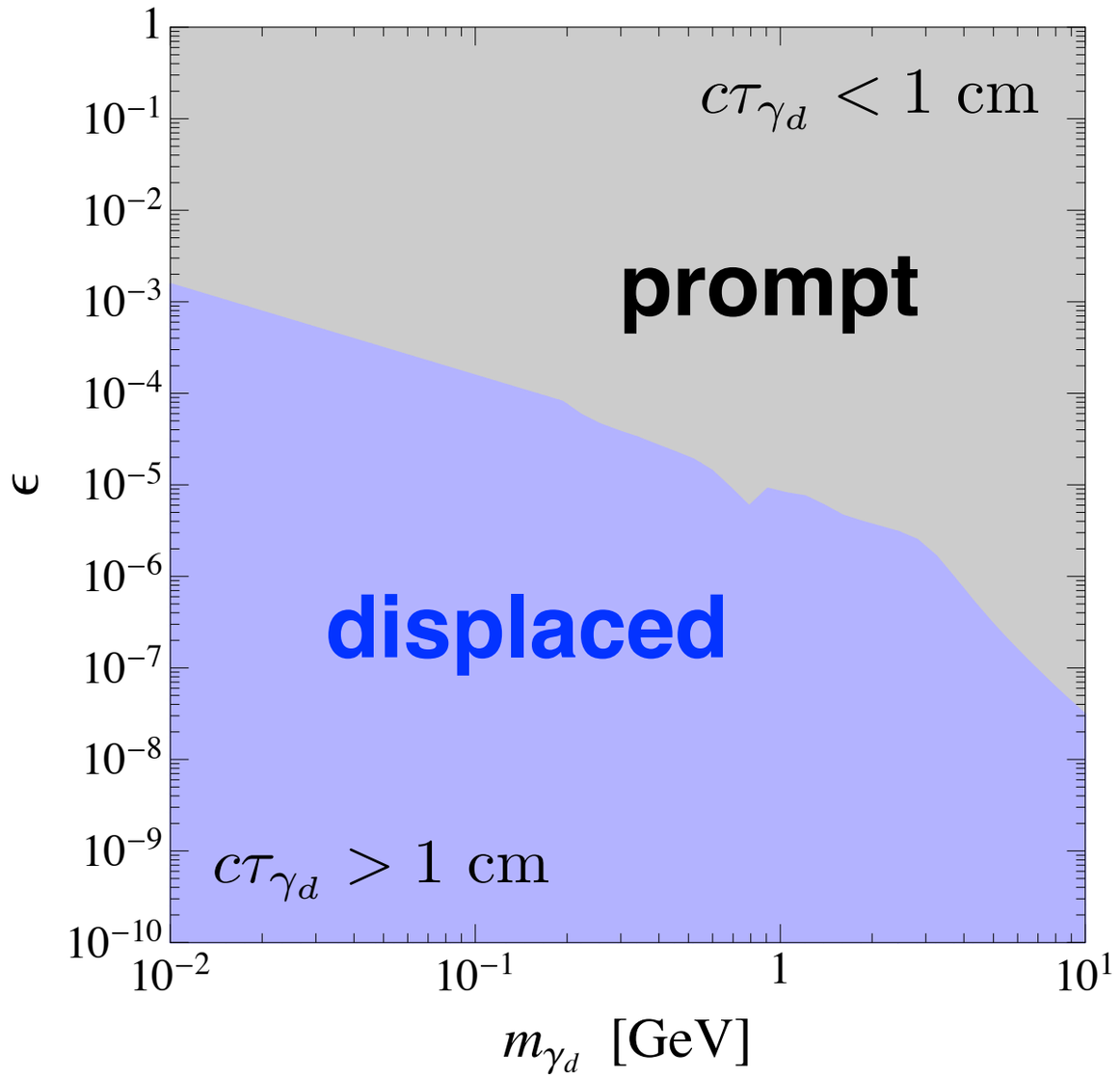
- Arkani-Hamed, Weiner **0810.0714**

displaced lepton jets



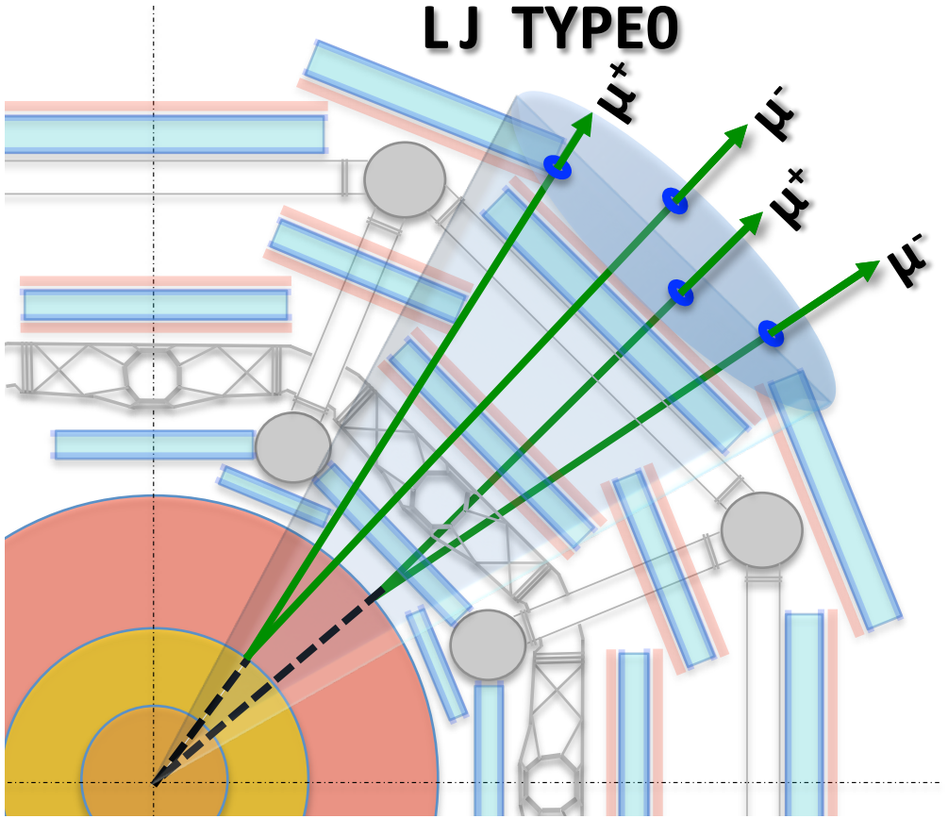
$$\Gamma_{ll} \approx \frac{1}{3}\alpha\epsilon^2 m_{\gamma_d}$$

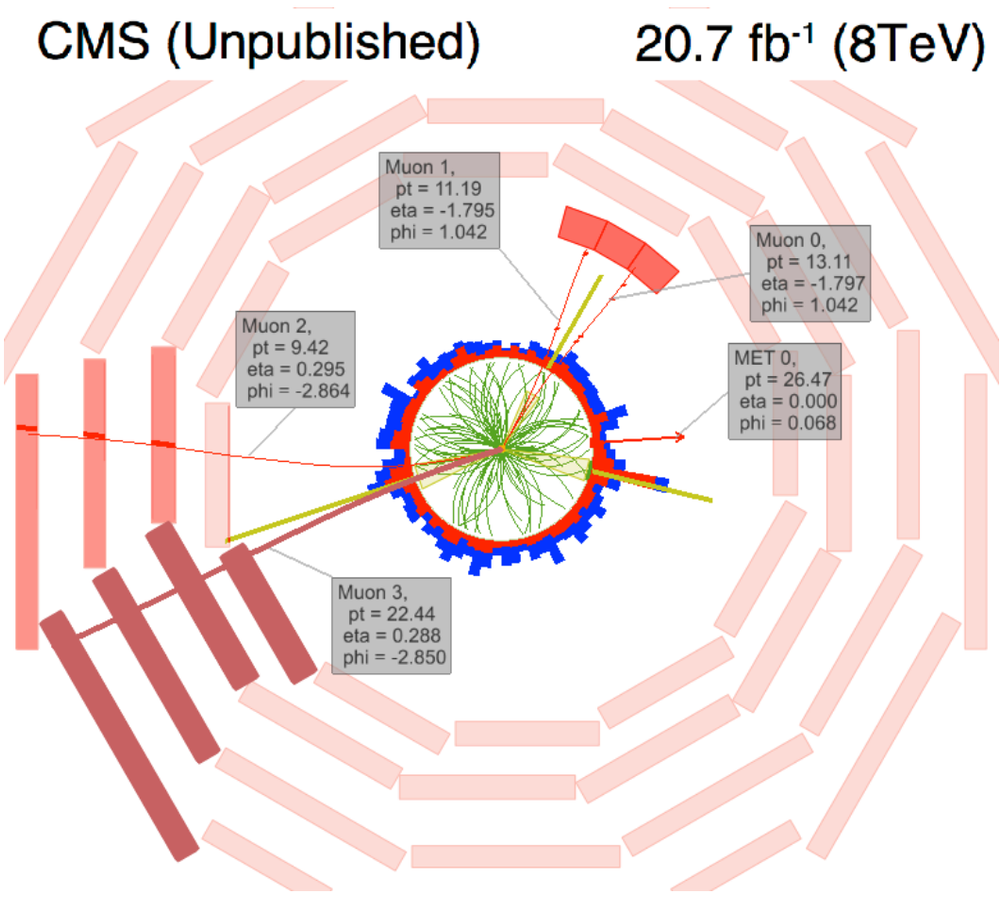




$E_{\gamma_d} = 30$ GeV

2. experimental status



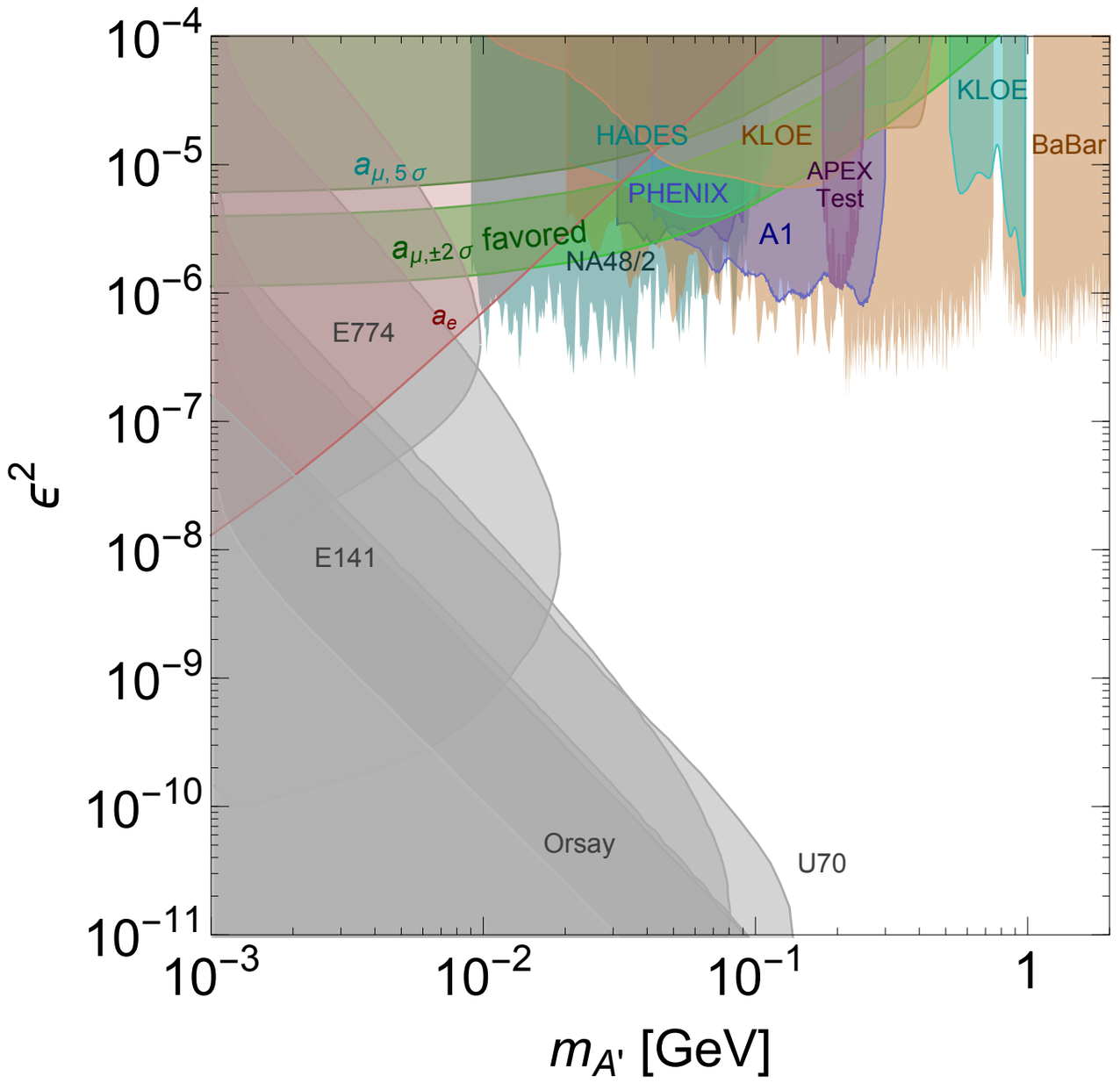


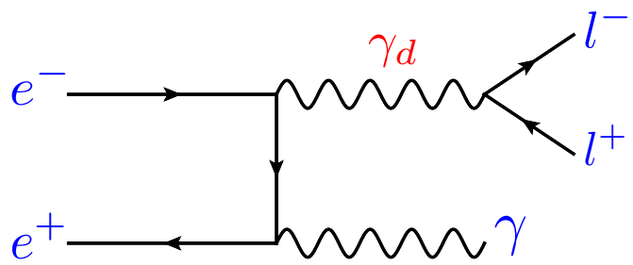
2. experimental status

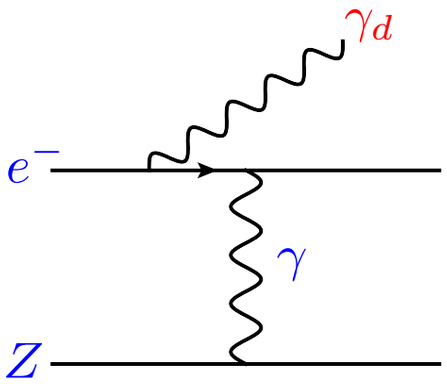
published searches: (prompt + displaced)

D0	**2**
CDF	**1**
CMS	**3**
ATLAS	**5**

dark photons at low energy experiments



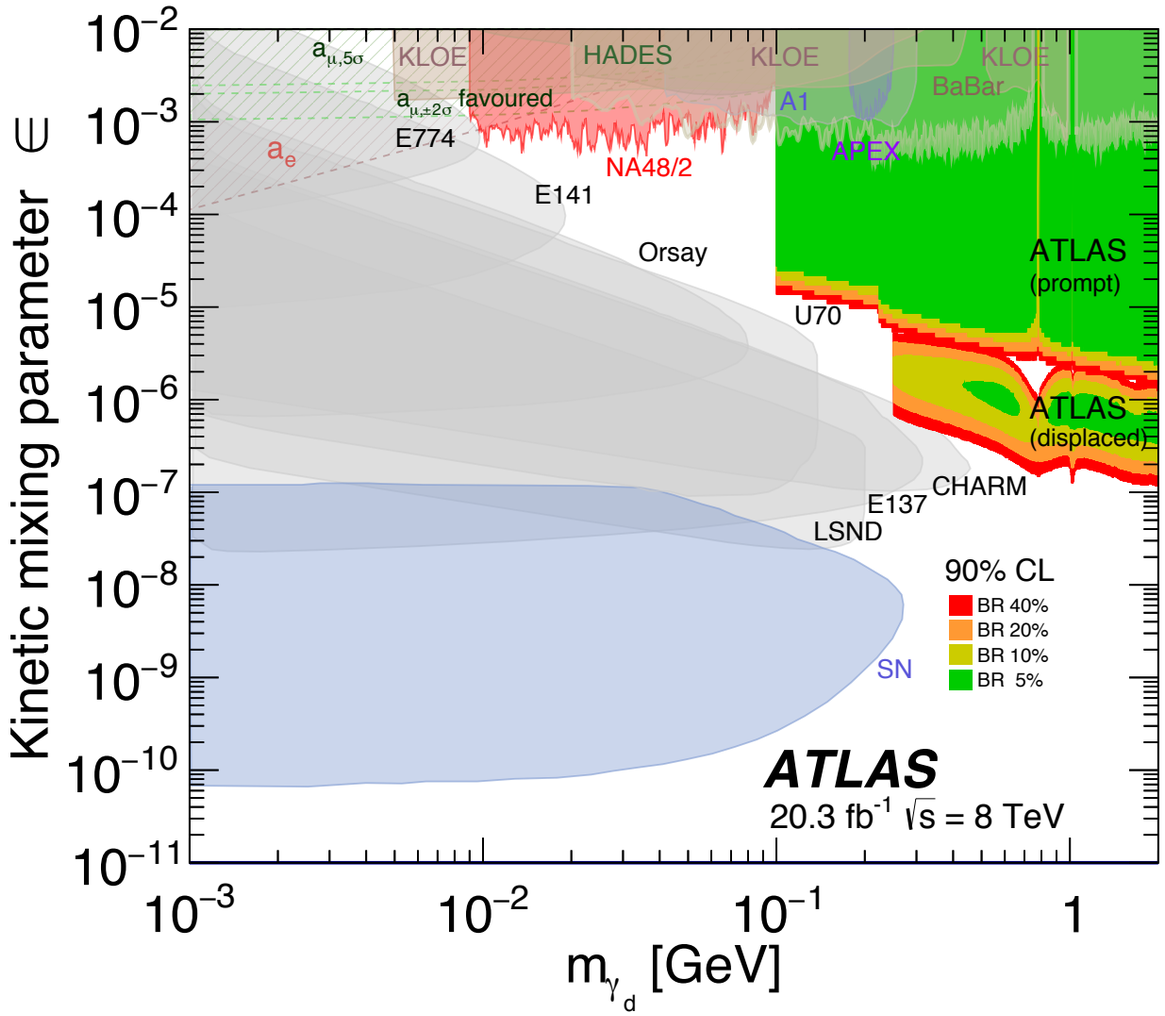




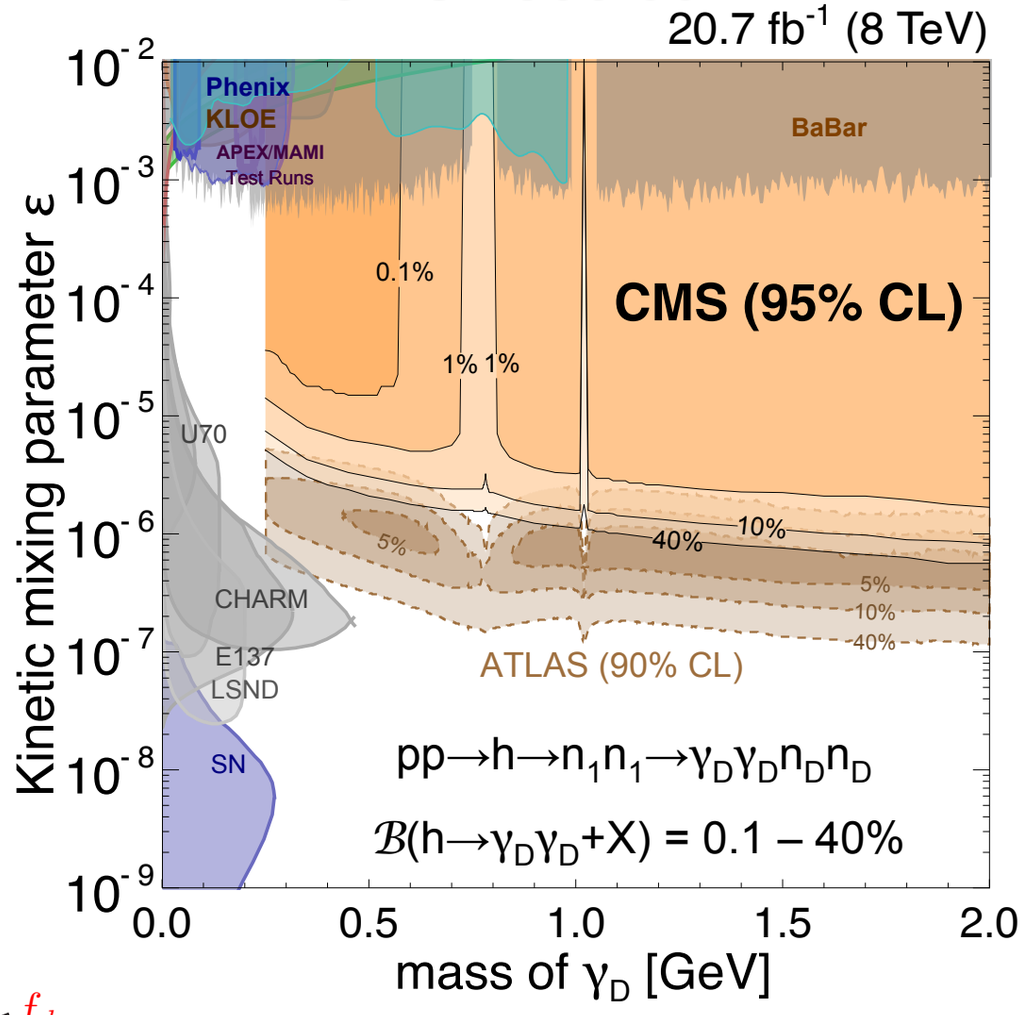
- Natalia Toro, **Dark Sectors 2016**

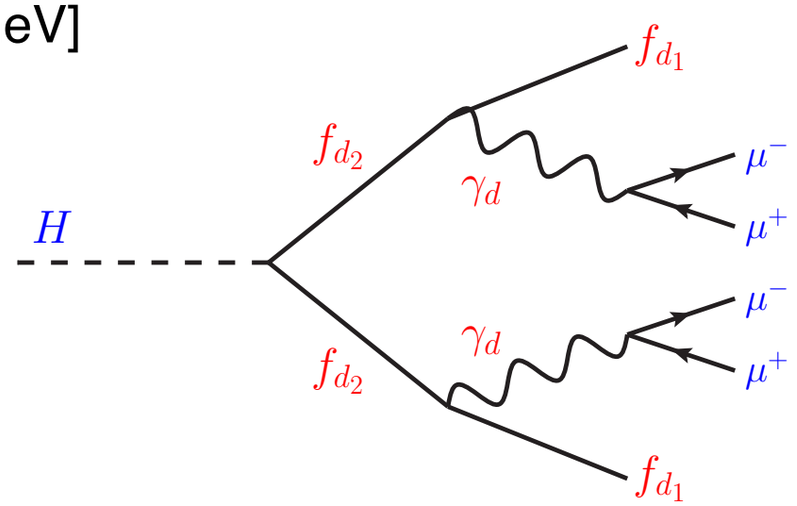
displaced dark photons at the LHC

ATLAS **1409.0746**,**1511.05542**



CMS **1506.00424**

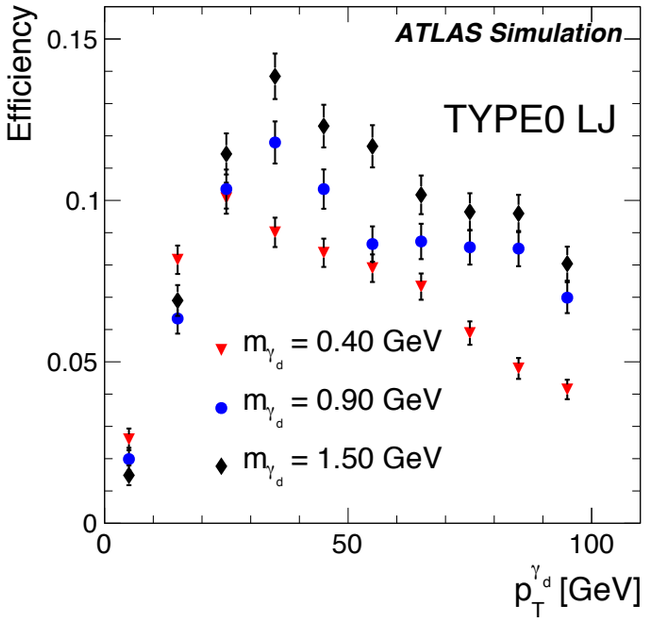


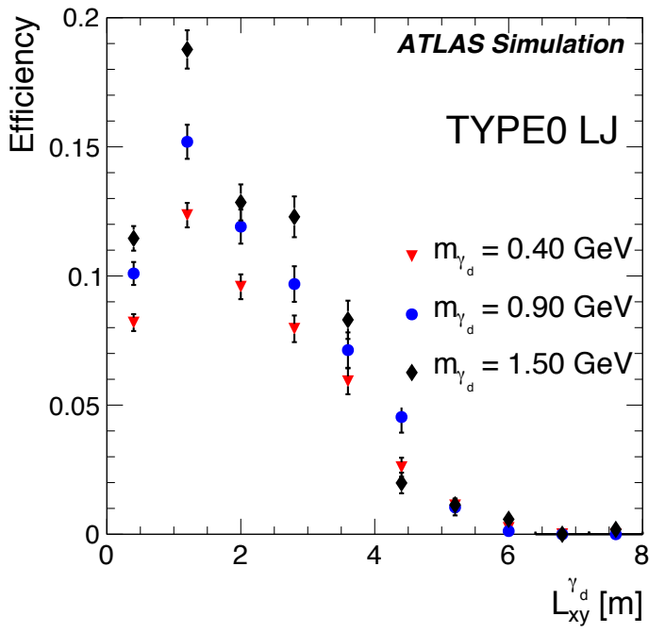


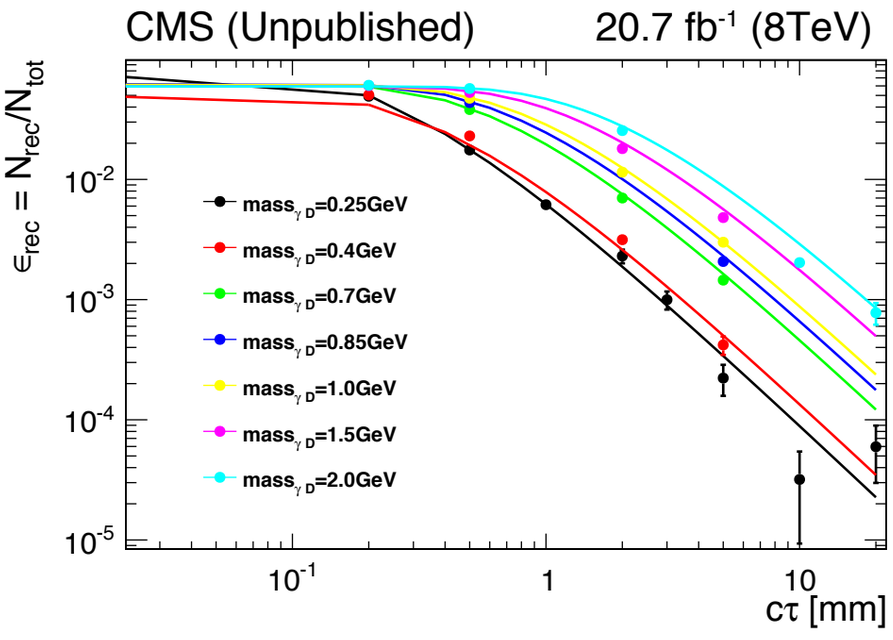
$$m_{f_{d_2}} = 5 \text{ GeV}$$

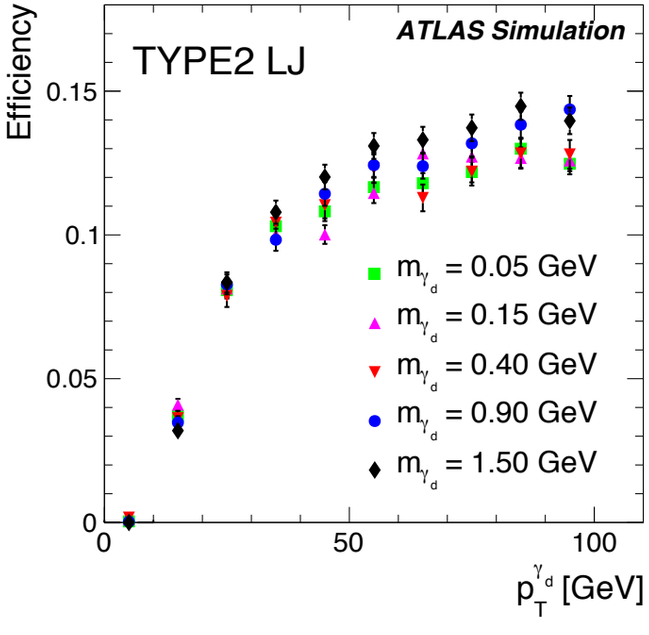
$$m_{f_{d_1}} = 2 \text{ GeV}$$

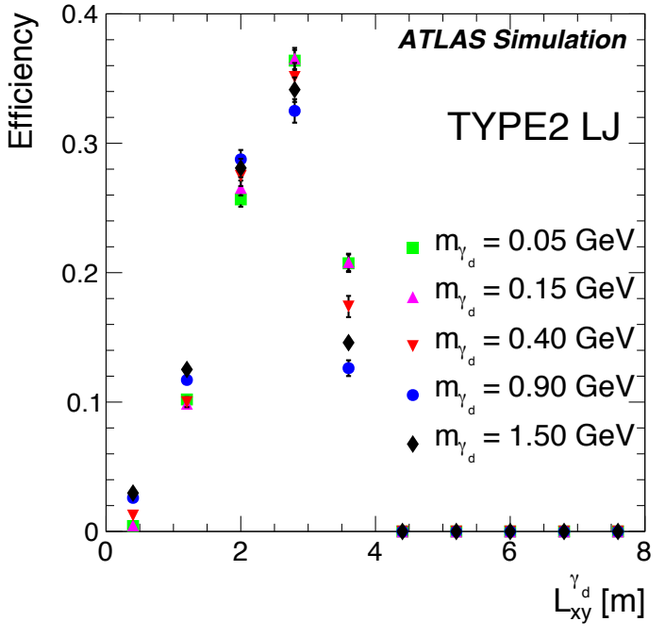
efficiency plots helpful for reinterpretation







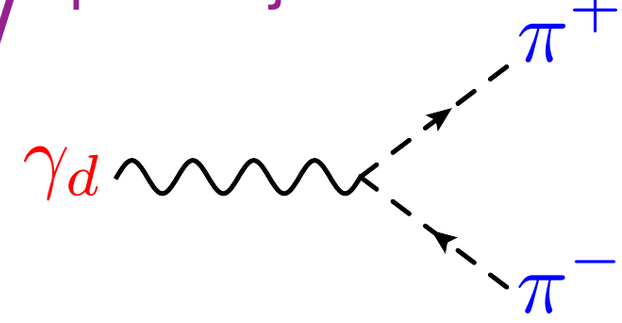


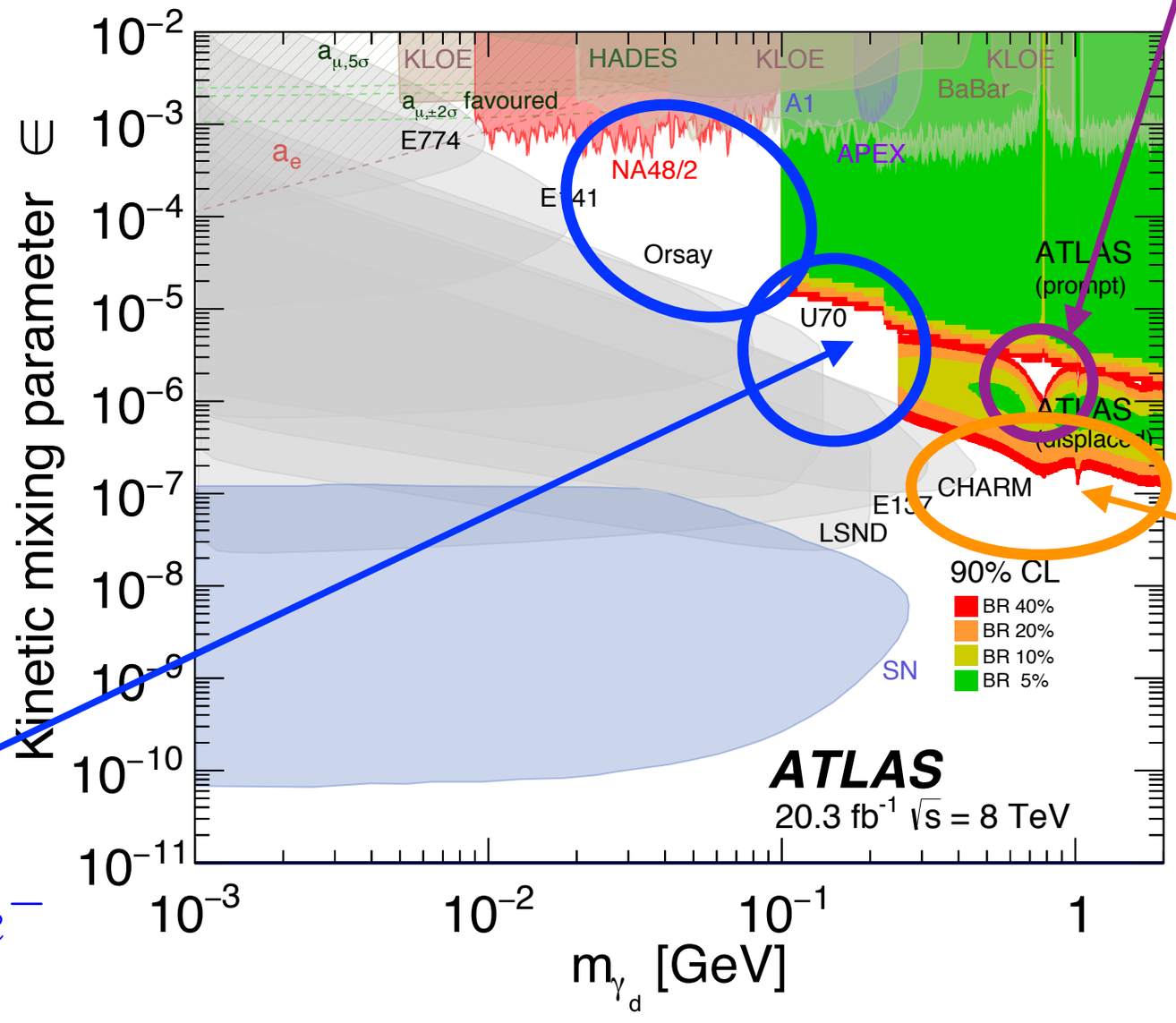


3. displaced wishlist

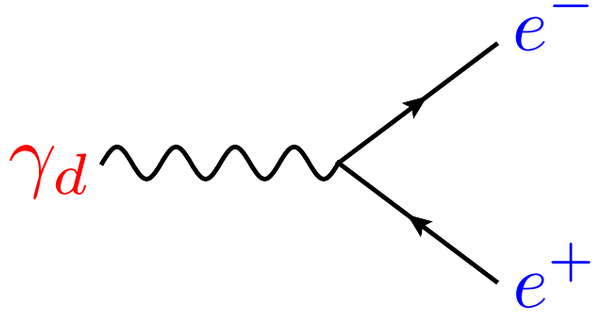
(ϵ, m_{γ_d}) gaps

displaced pion jets





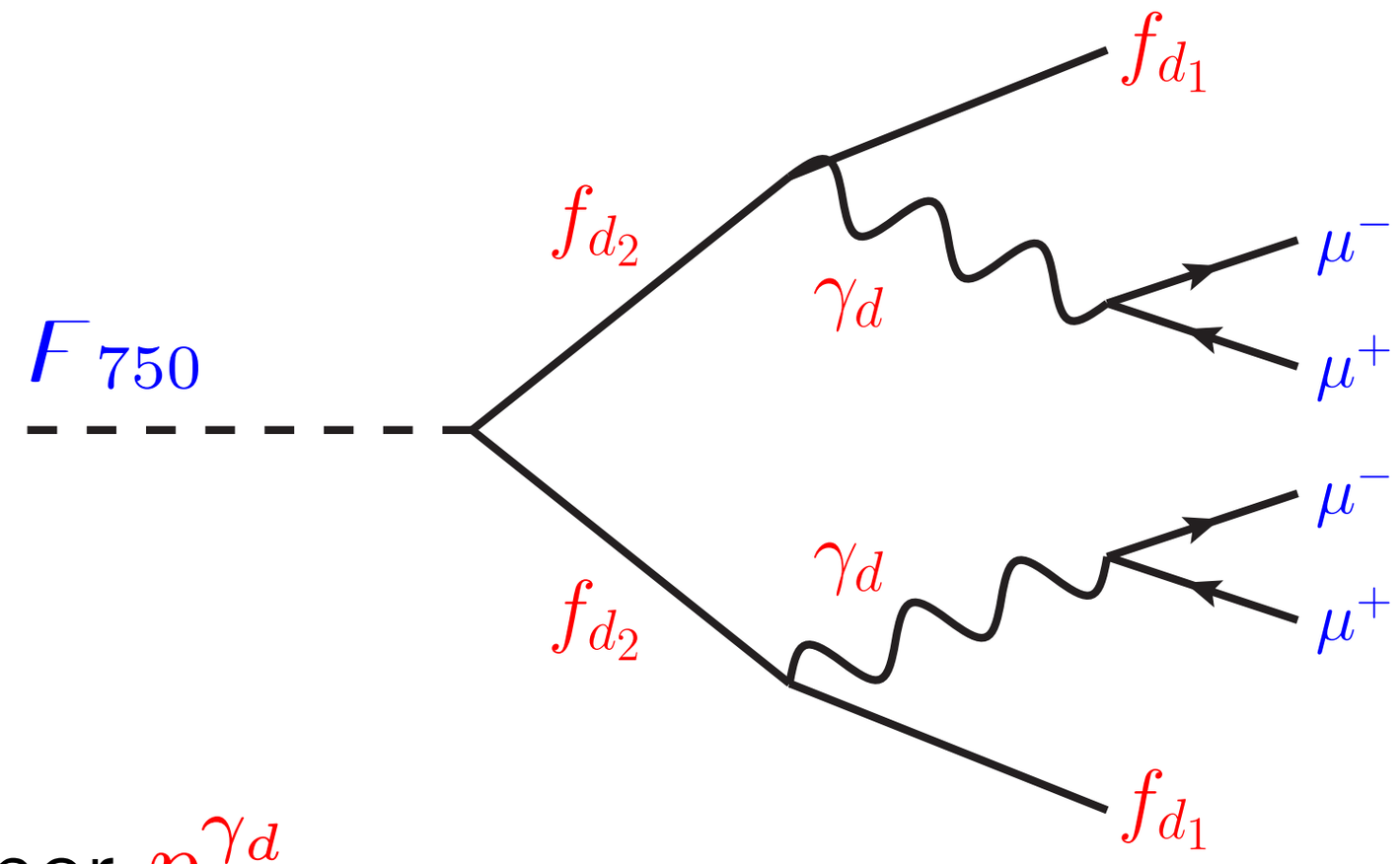
displaced electron jets



highly displaced LJs

(single displaced LJ search?)

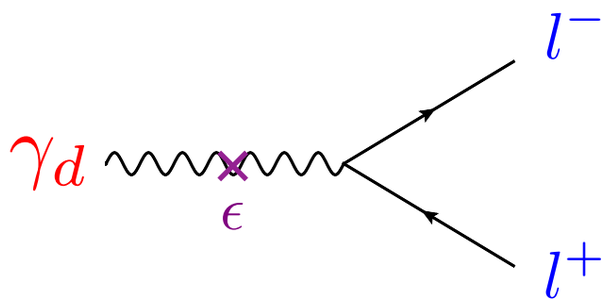
displaced dark photons produced by heavy particles

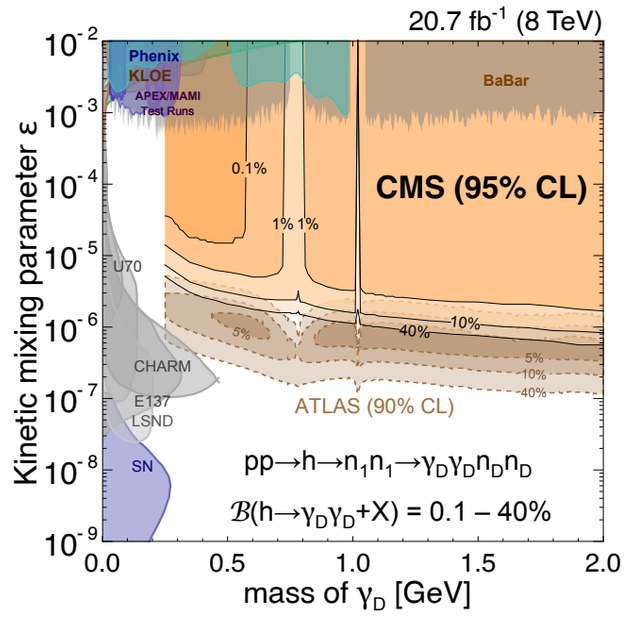


- higher $p_T^{\gamma_d}$
- decay products more collimated

takeaway

- lepton jets are a signal of light hidden sectors





- there was awesome progress at 8 TeV!

- unexplored signature space is waiting for 13 TeV data