ATLAS EXPERIMENT

MILLENNIUM INSTITUTE FOR SUBATOMIC PHYSICS AT HIGH-ENERGY FRONTIER SAPHIR

# Search for long-lived Dark Photons through lepton-jets

## INTERNATIONAL CONFERENCE OF HIGH ENERGY PHYSICS

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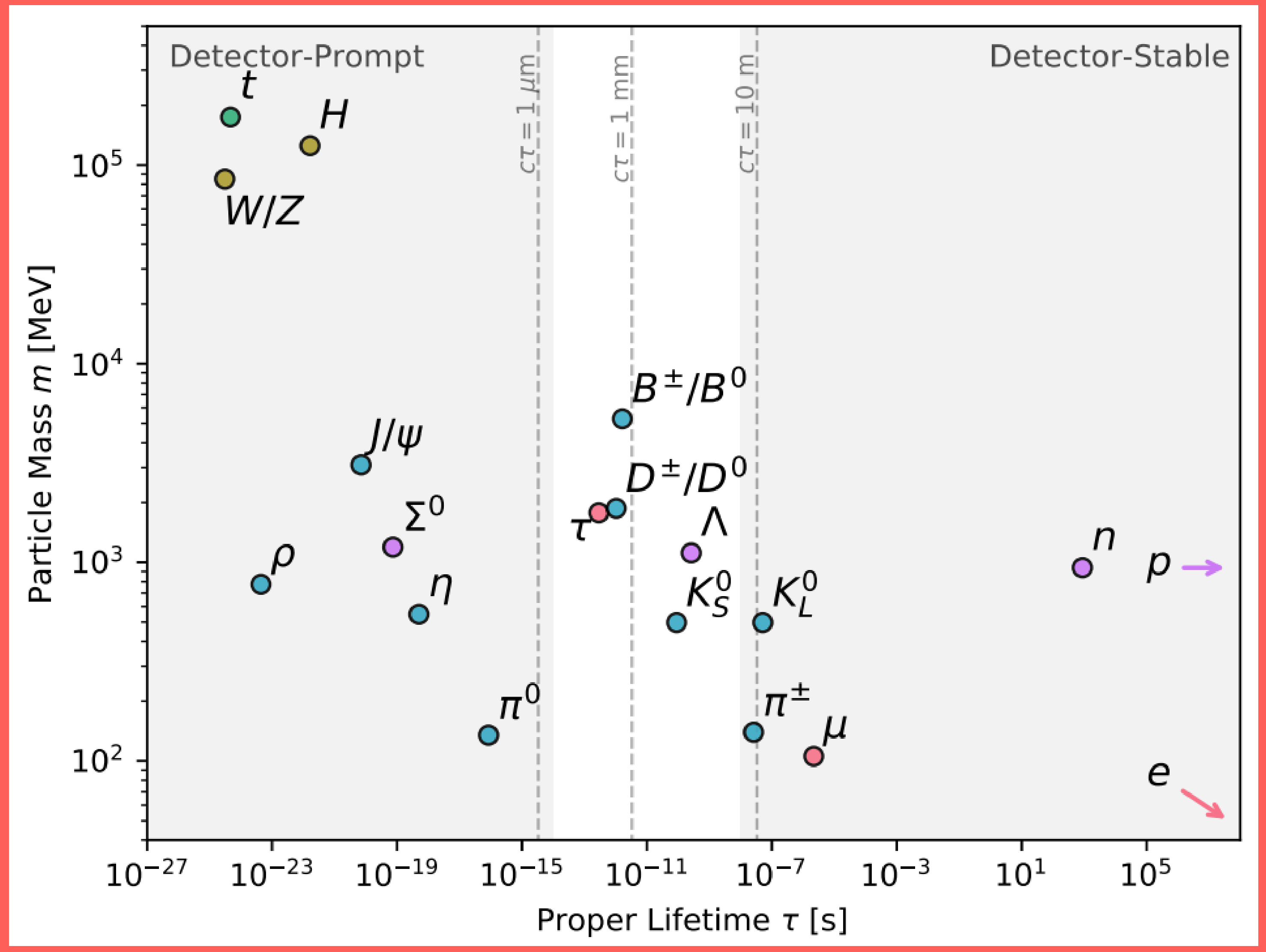
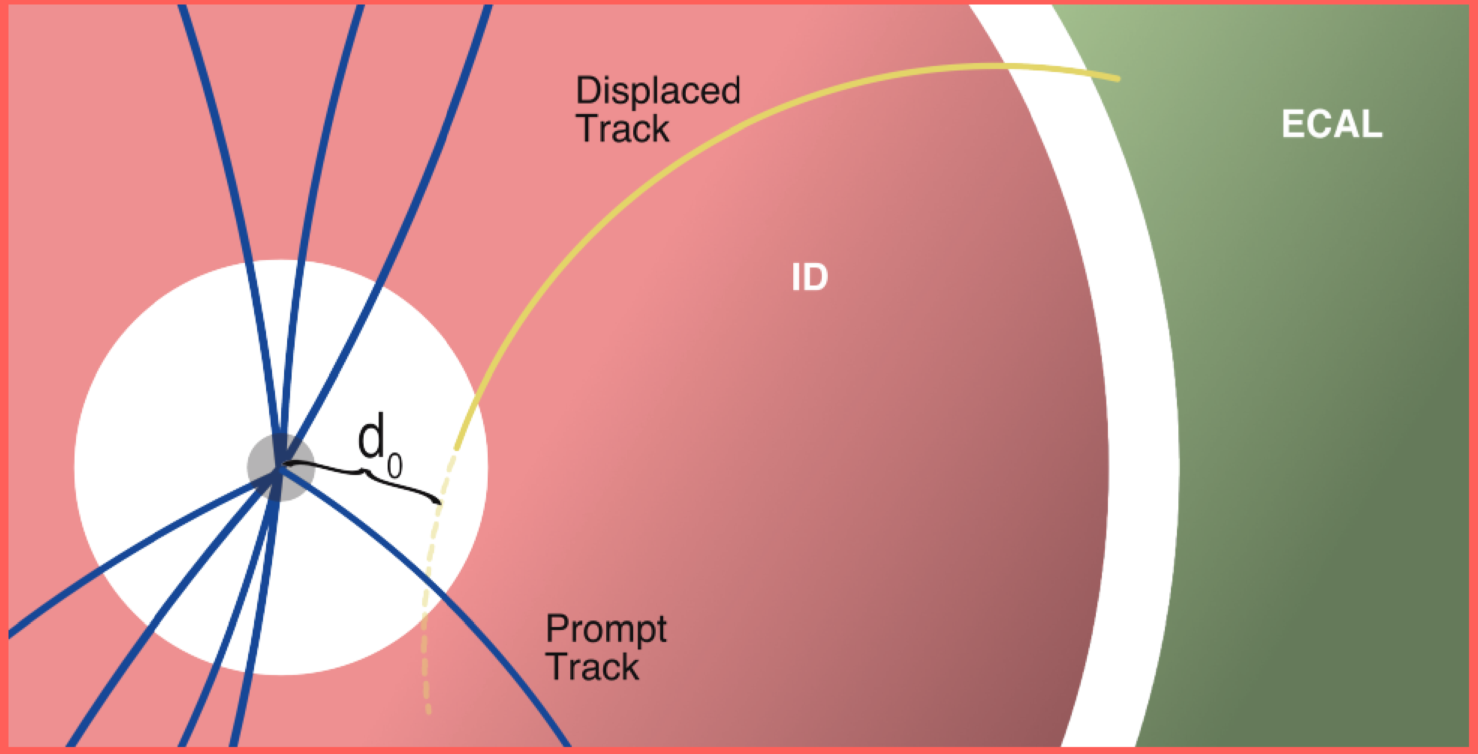
So far most analyses have considered new particles to decay **promptly**, impacting the design of the detector and reco. algorithms

A particle with a displaced vertex of only a few **millimetres** would leave an unsual signature that heavily differ from the SM

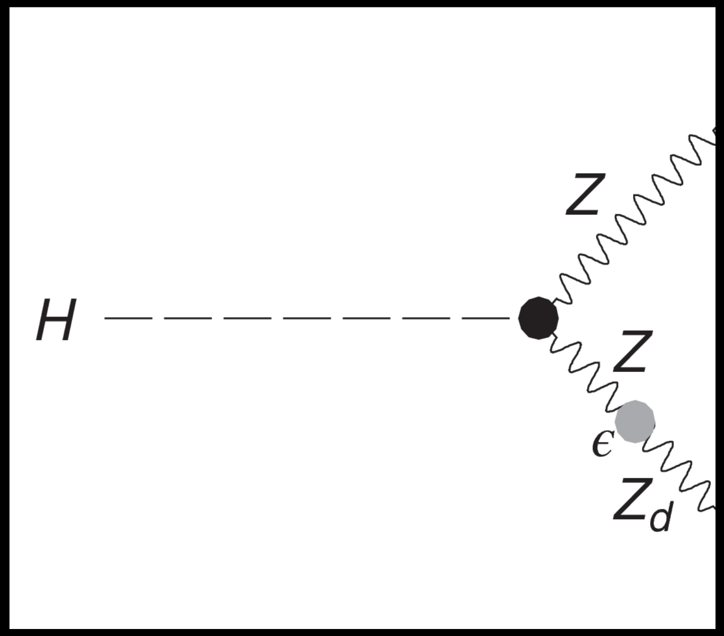
BSM models, as **hidden/dark sectors**, predicts exotic long-lived particles



**Dark Matter** could be part of a hidden sector that interacts with SM particles through subtle mixing

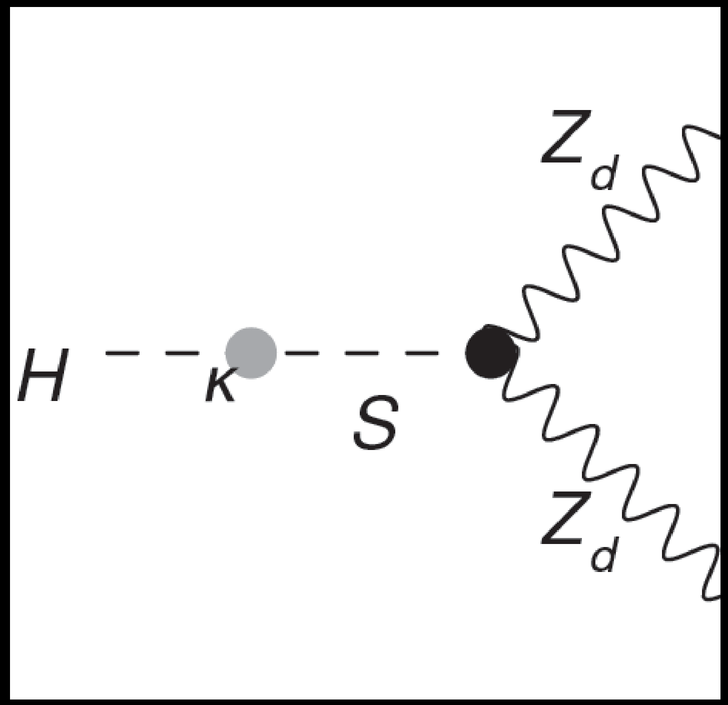
Vector Portal




$$\mathcal{L} \propto \frac{1}{2}\epsilon\gamma_d^{\mu\nu}B_{\mu\nu}$$

The **Higgs boson** could work as a portal to a hidden sector

Higgs portal




$$\mathcal{L} \propto \kappa|\Phi_{SM}|^2\,|\Phi_d|^2$$

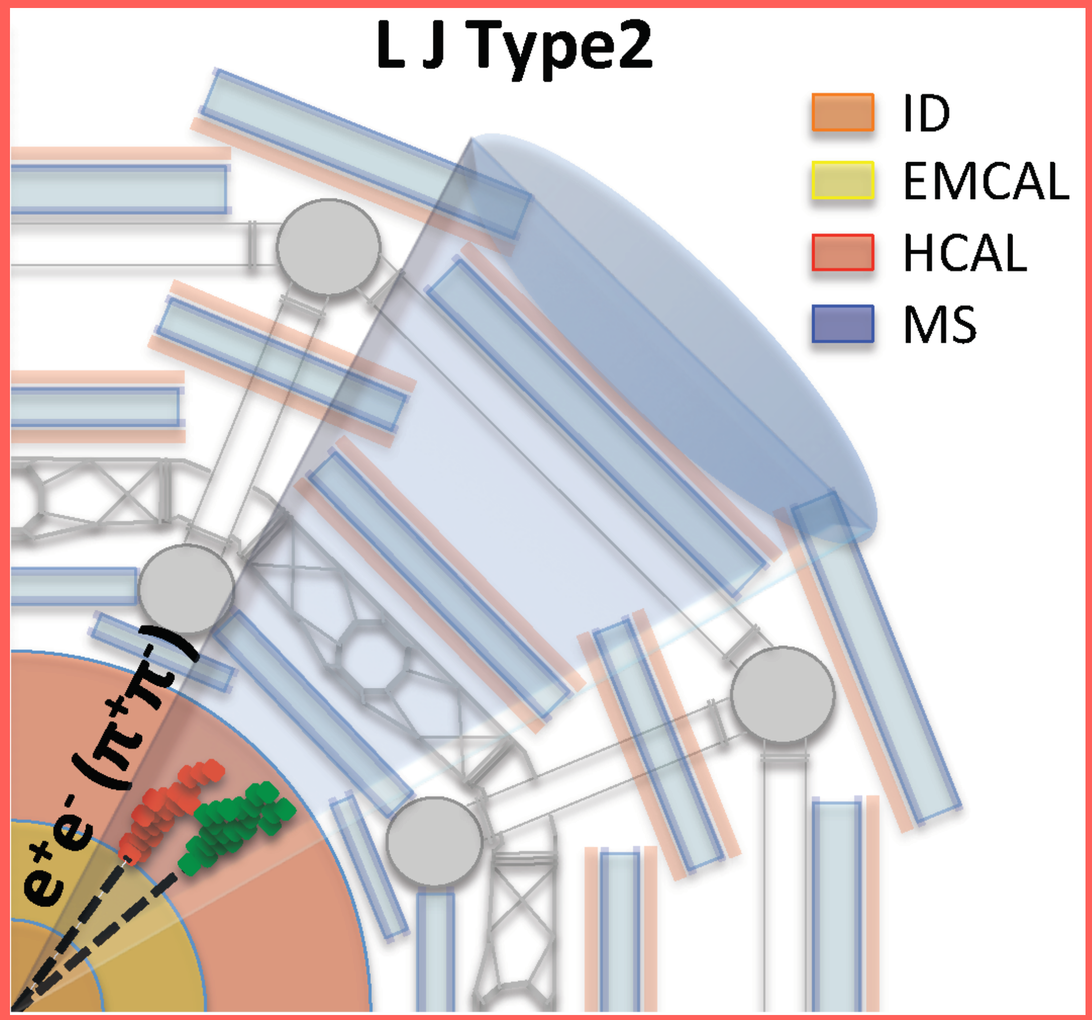
**Lifetime** of the dark photon (Zd) varies with its mass, but mostly

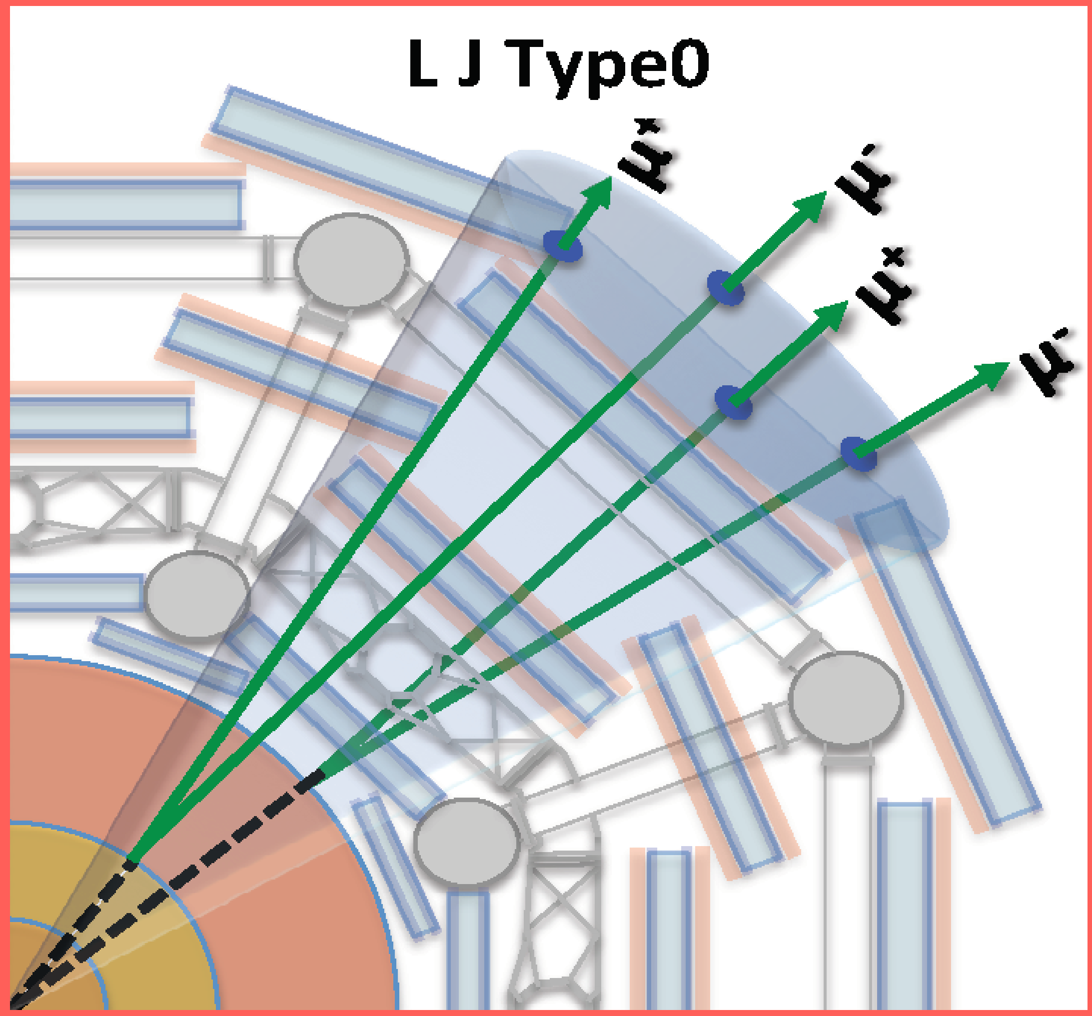
$$c\tau = \frac{1}{\Gamma^{tot}_{Z_D}} \propto \frac{1}{\epsilon^2 m_{Z_D}}$$

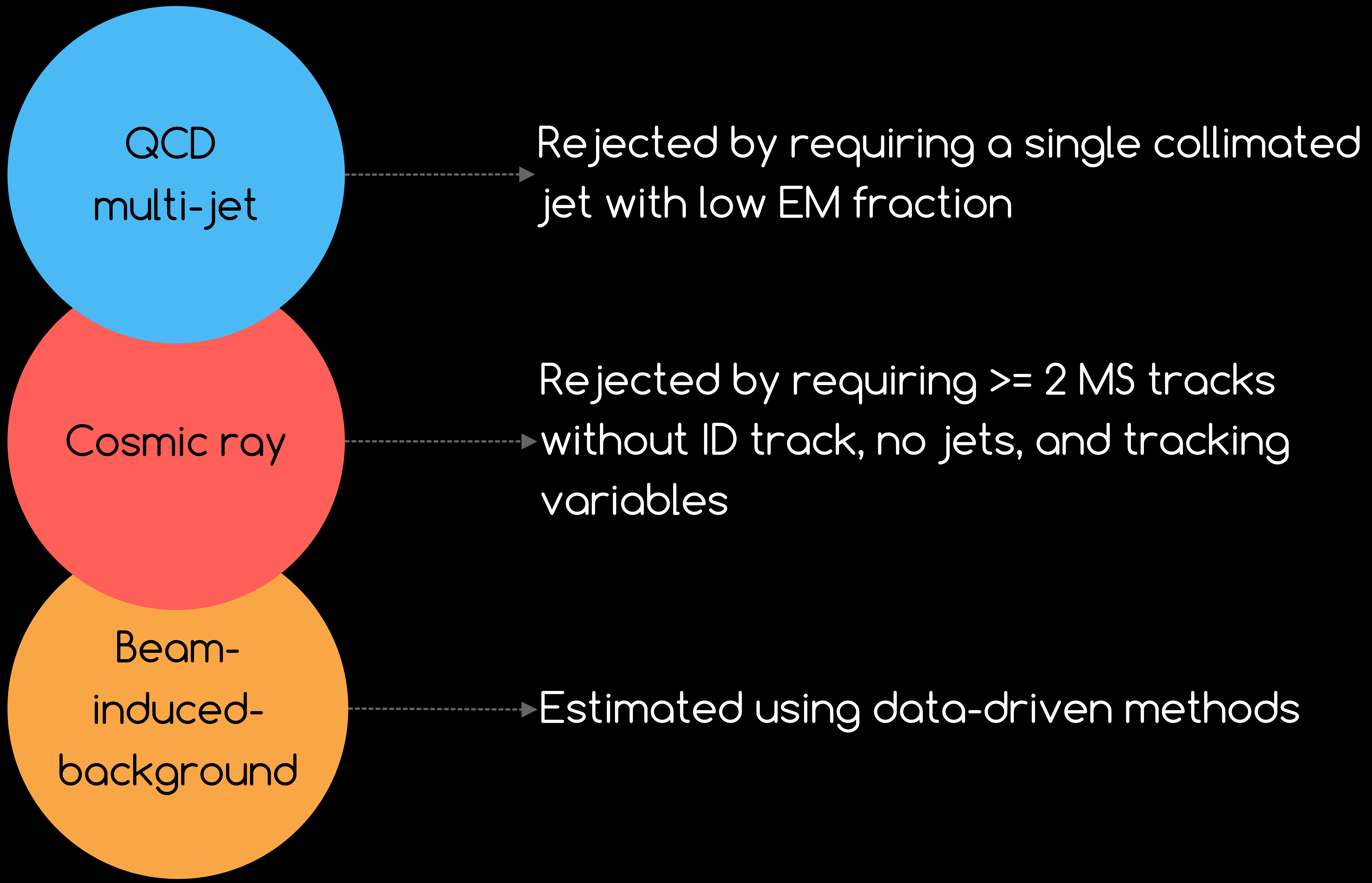
Dark Photons would typically be produced with large boost due to their small mass, forming collimated jet-like structures containing leptons and/or hadrons (**lepton-jets**)

Analysis divides signal lepton-jets (LJ) into categories

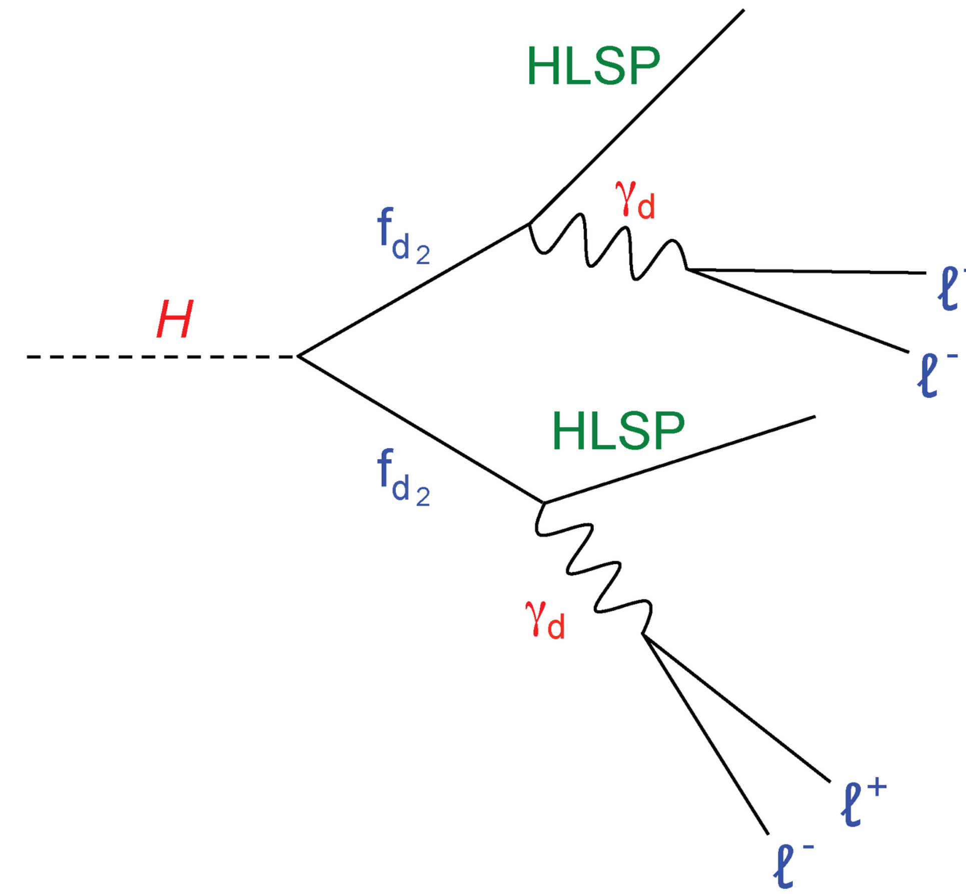
Selection is based on dark photon jets identification, its displaced vertex signatures and a BDT discriminant

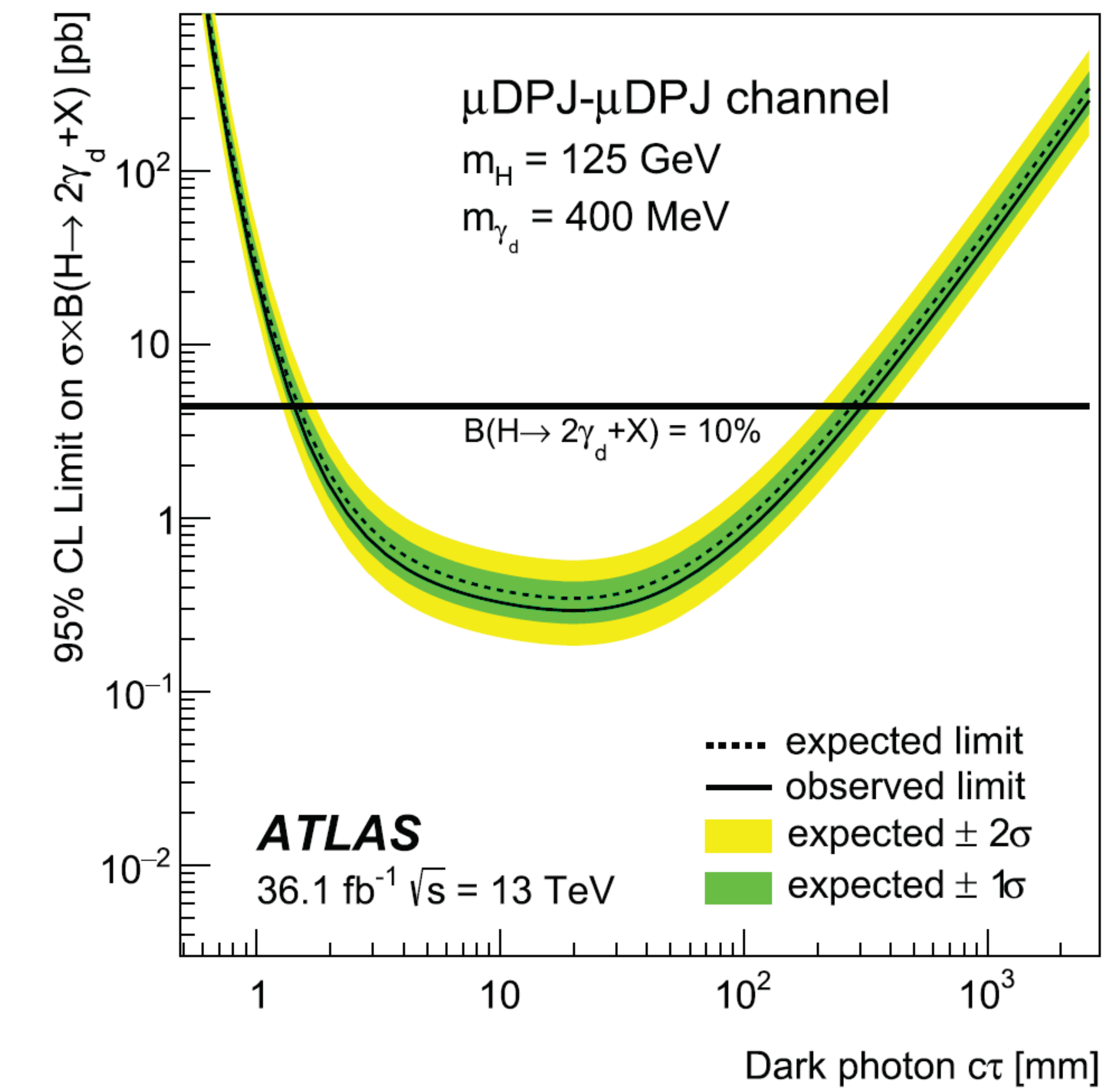



QCD multi-jet
Rejected by requiring a single collimated jet with low EM fraction
Cosmic ray
Rejected by requiring >= 2 MS tracks without ID track, no jets, and tracking variables
Beam-induced-background
Estimated using data-driven methods

Upper limit on the production as a function of the dark photon proper decay lenght for two dark photons

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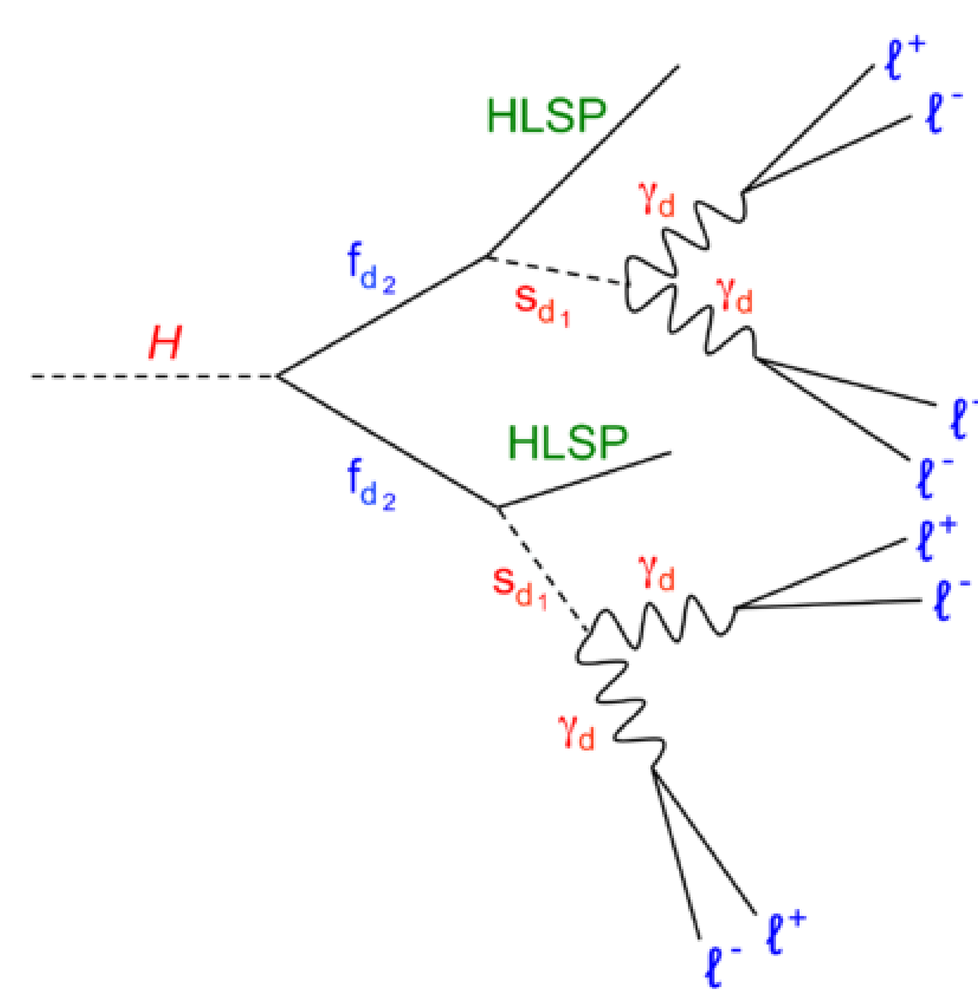
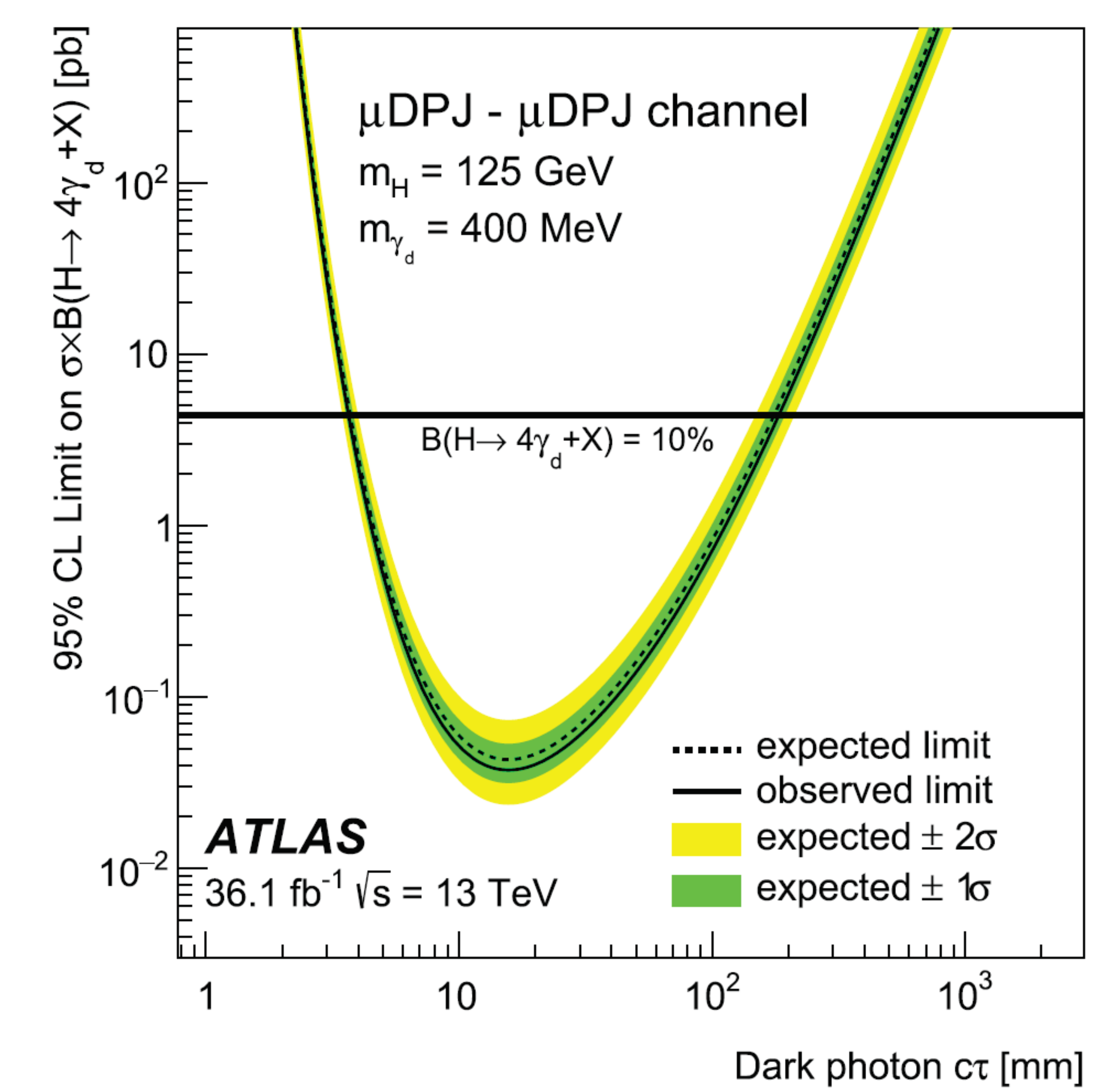
Upper limit on the production as a function of the dark photon proper decay lenght for four dark photons



No significant excess of events compares with the background expectation is observed at 95% CL

An additional interpretation of the kinetic mixing parameter as a function of the dark photon mass is given at 90% CL for the two dark photon process