Search for dark photon in dilepton channel

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Inclusive Dark Photon Search

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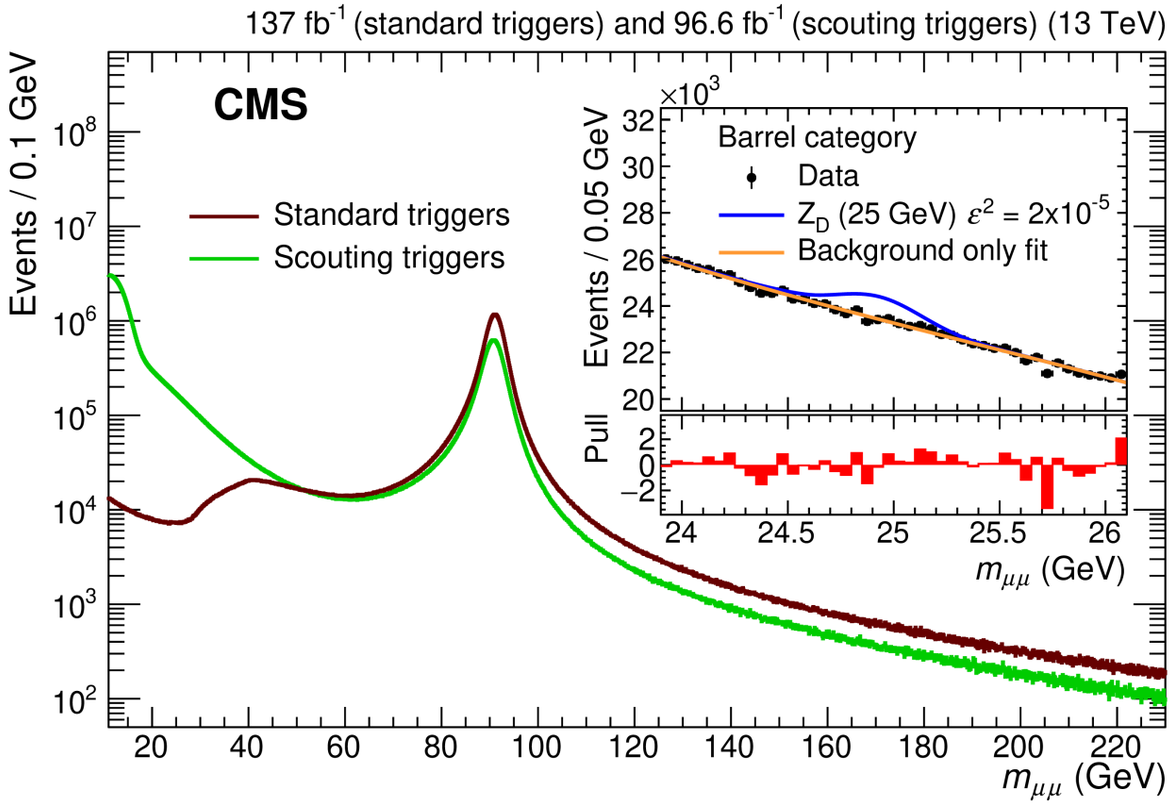
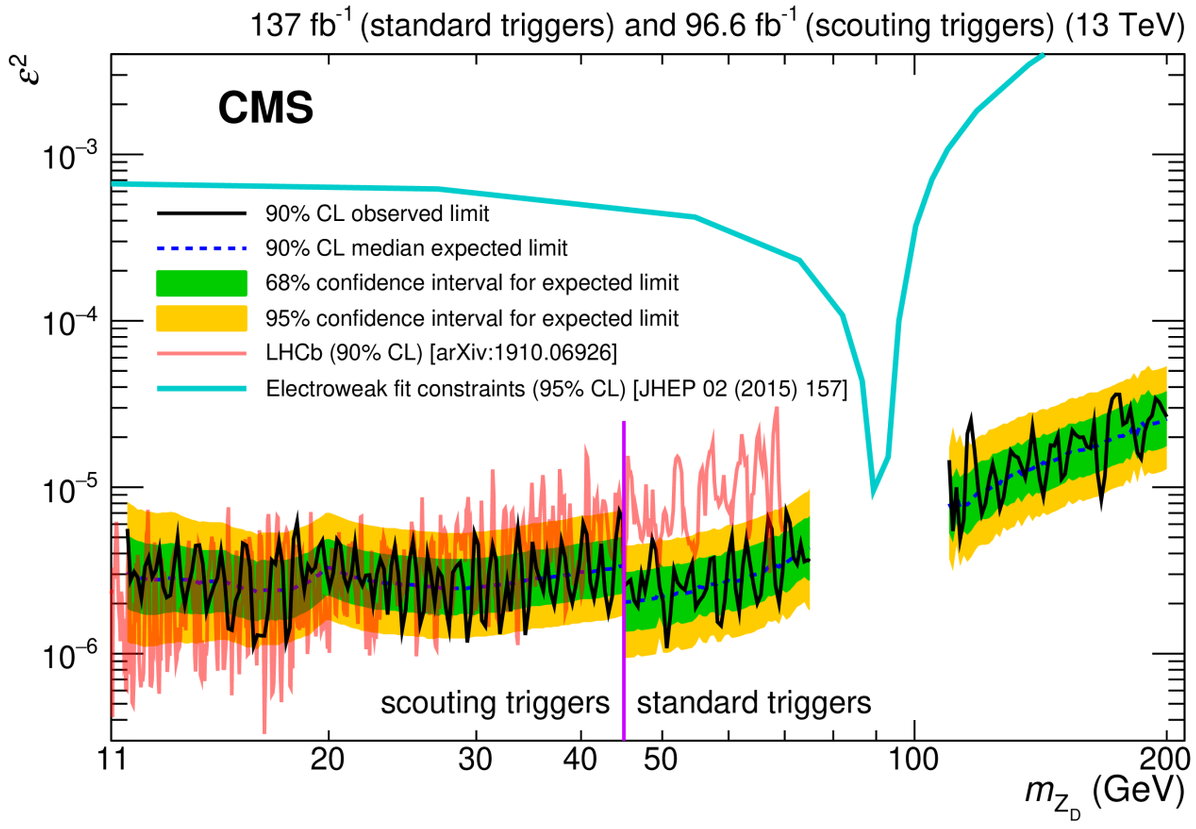
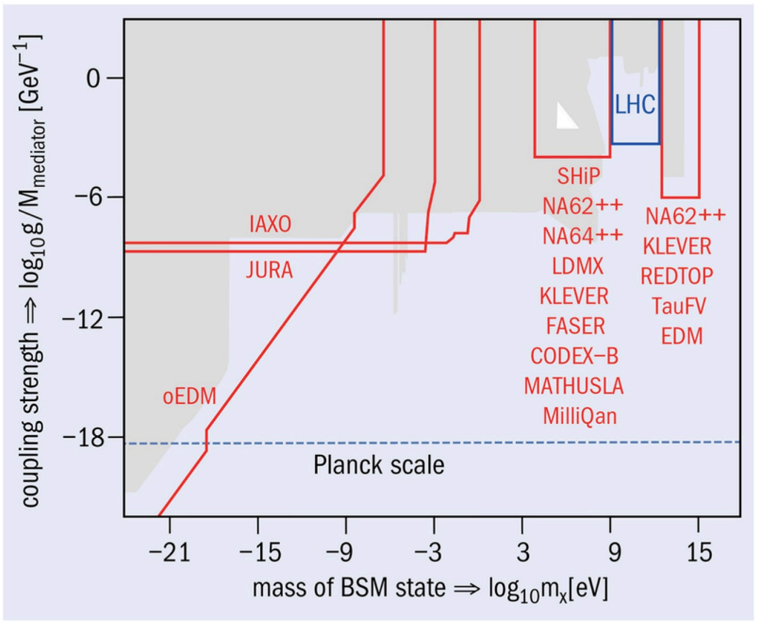
- Inclusive search of a light resonance in the range $11 < m_{Zd} < 200$ GeV excluding the Z boson mass window
- For low masses use special triggers where only limited amount of information is recorded: scouting trigger
- Analysis is performing by fitting dimuon mass distribution around Z_d mass hypothesis





CMS Scouting Trigger

- The light BSM phenomenology is well developed for experiments other than LHC
- Will need effort to map out physics potential of low-pT physics with multi-purpose detector at LHC



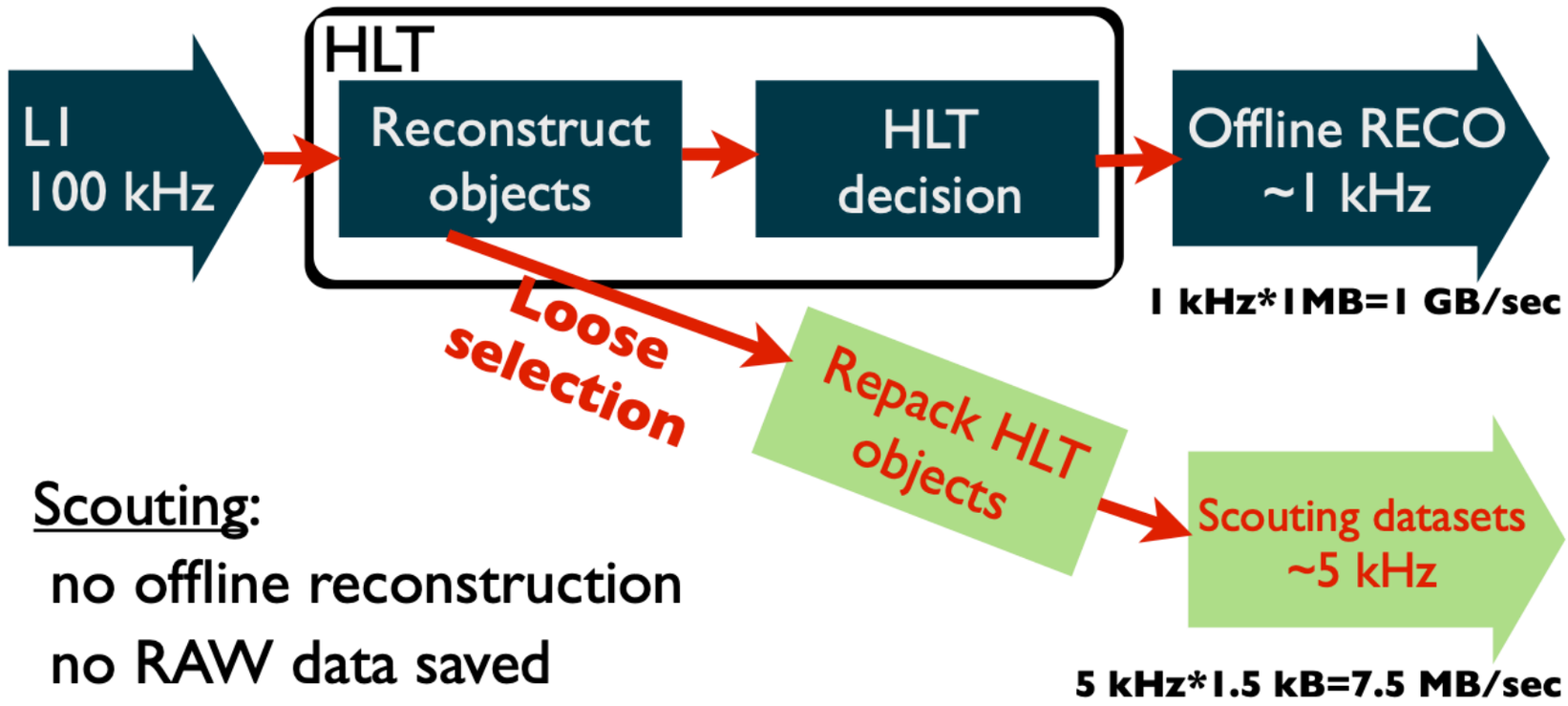
LHC sensitivity for M>10 GeV exclusive for many BSM theories.

Multipurpose experiments also competitive for some models in O(0.1 - 10) GeV range

Trigger Bandwidth = Event Rate × Event Size

~1 kHz × ~1 MB

≈ **1 GB/sec**



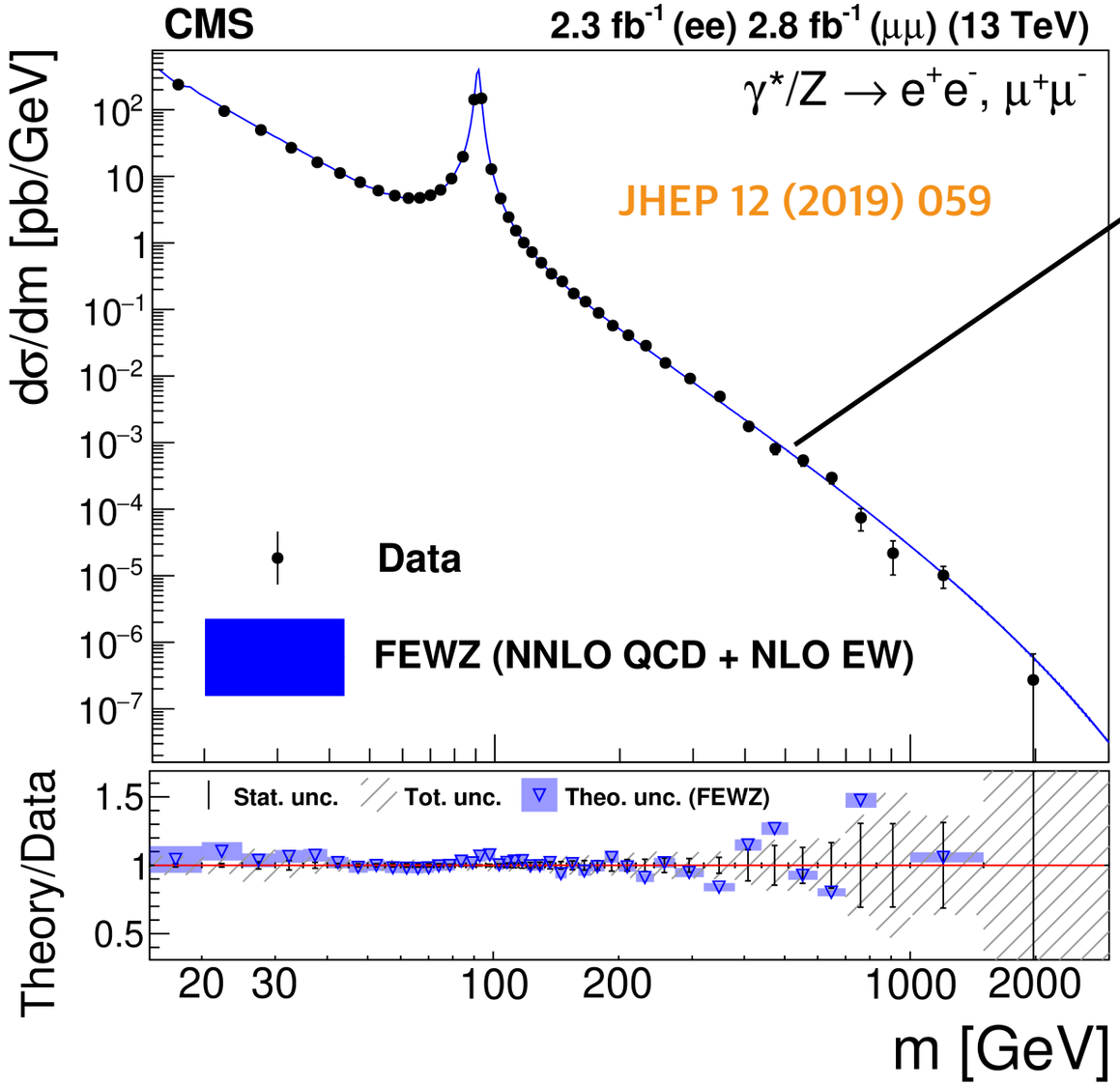
Scouting:

no offline reconstruction

no RAW data saved

Drell-Yan Differential X-section

- Drell-Yan differential cross section measurements in dilepton channel
- Full Run2 data analysis is on-going: low-mass (scouting), high-mass (standard)
  - With various multi-dimensional measurements



Parton distributions in the SMEFT from high-energy Drell-Yan tails

arXiv: 2104.02723

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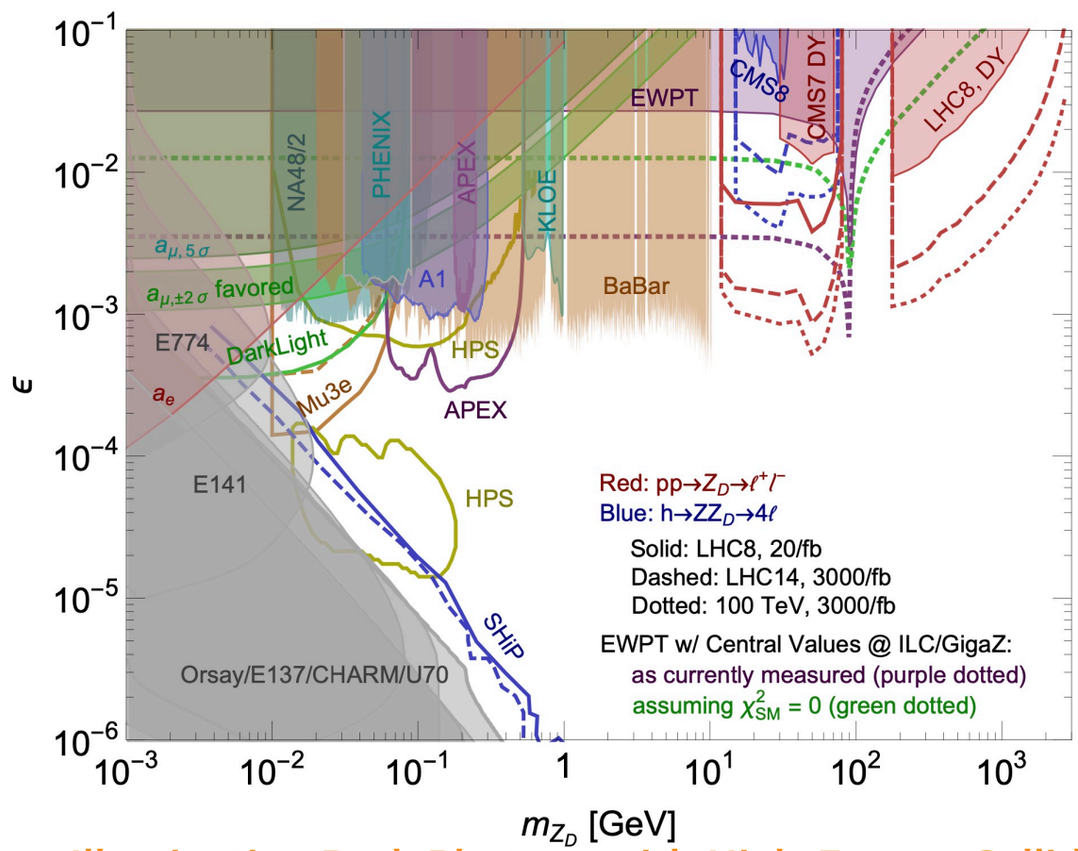
Abstract: The high-energy tails of charged- and neutral-current Drell-Yan processes provide important constraints on the light quark and anti-quark parton distribution functions (PDFs) in the large-x region. At the same time, short-distance new physics effects such as those encoded by the Standard Model Effective Field Theory (SMEFT) would induce smooth distortions to the same high-energy Drell-Yan tails. In this work, we assess for the first time the interplay between PDFs and EFT effects for high-mass Drell-Yan processes at the LHC and quantify the impact that the consistent joint determination of PDFs and Wilson coefficients has on the bounds derived for the latter. We consider two well-motivated new physics scenarios: 1) electroweak oblique corrections ($\hat{W}, \hat{Y}$) and 2) four-fermion interactions potentially related to the LHCb anomalies in $R(K^{(*)})$. We account for available Drell-Yan data, both from unfolded cross sections and from searches, and carry out dedicated projections for the High-Luminosity LHC. Our main finding is that, while the interplay between PDFs and EFT effects remains moderate for the current dataset, it will become a significant challenge for EFT analyses at the HL-LHC.

Keywords: Parton Distribution Functions, Effective Field Theories, Drell-Yan Processes, LHC Phenomenology, High-Luminosity LHC.

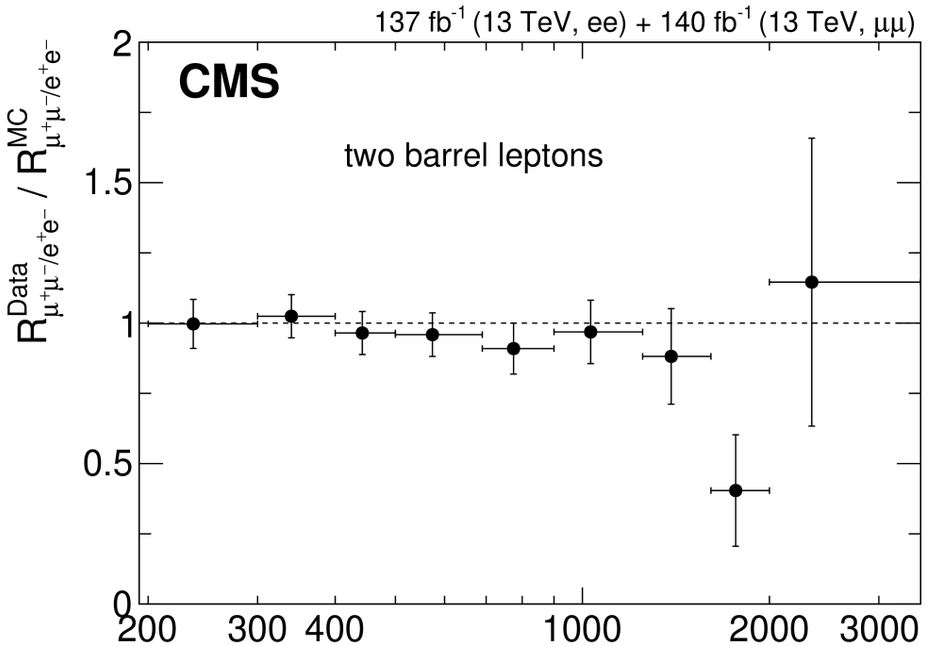


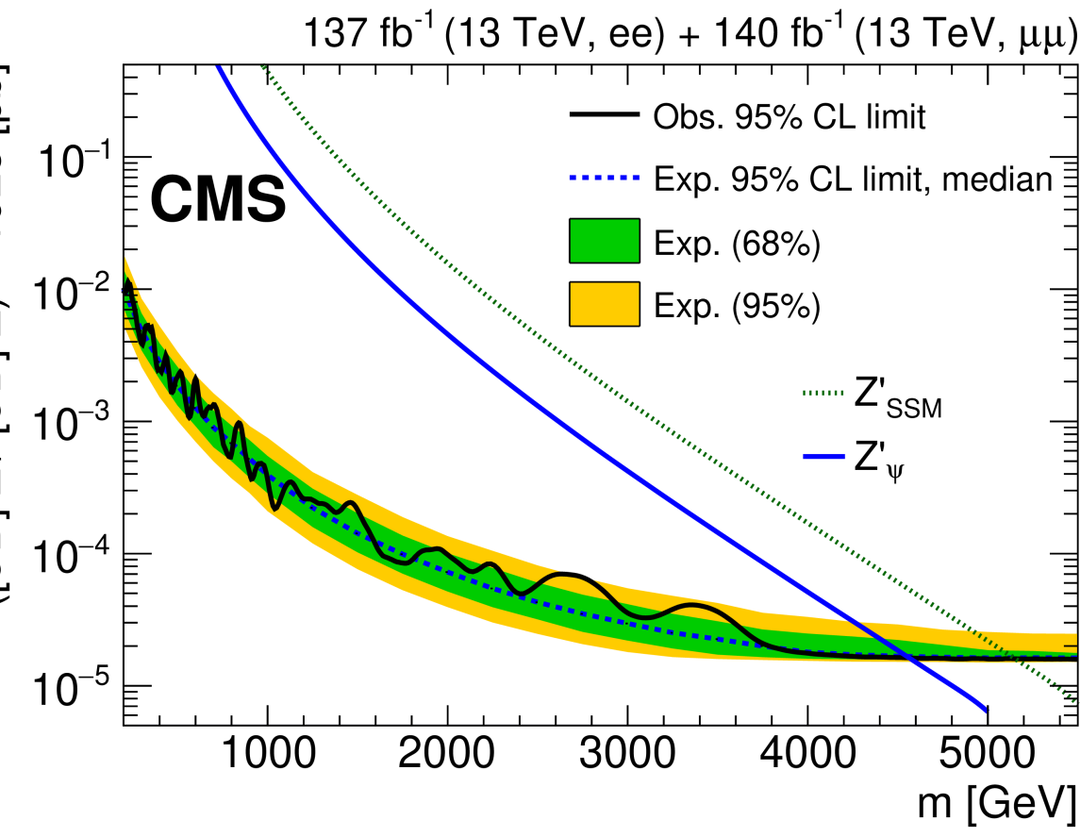
Illuminating Dark Photons with High-Energy Colliders, JHEP 02 (2015) 157

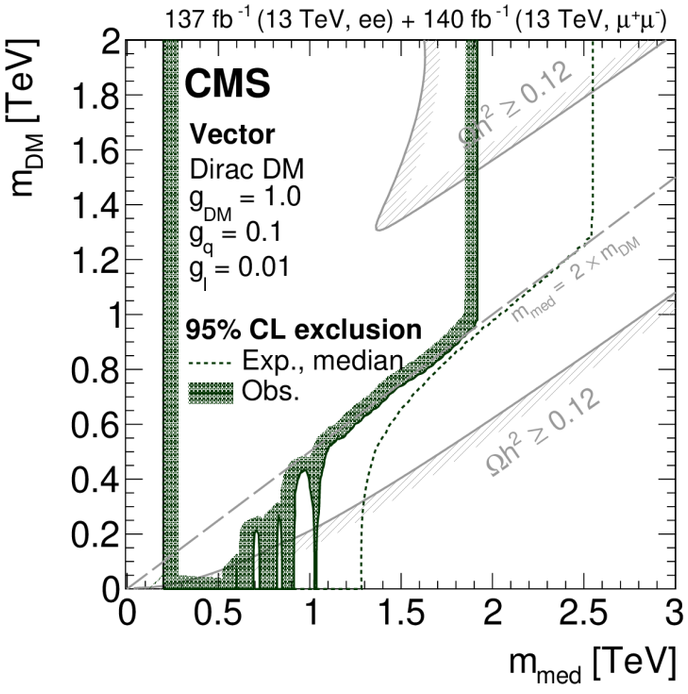
Z' Search

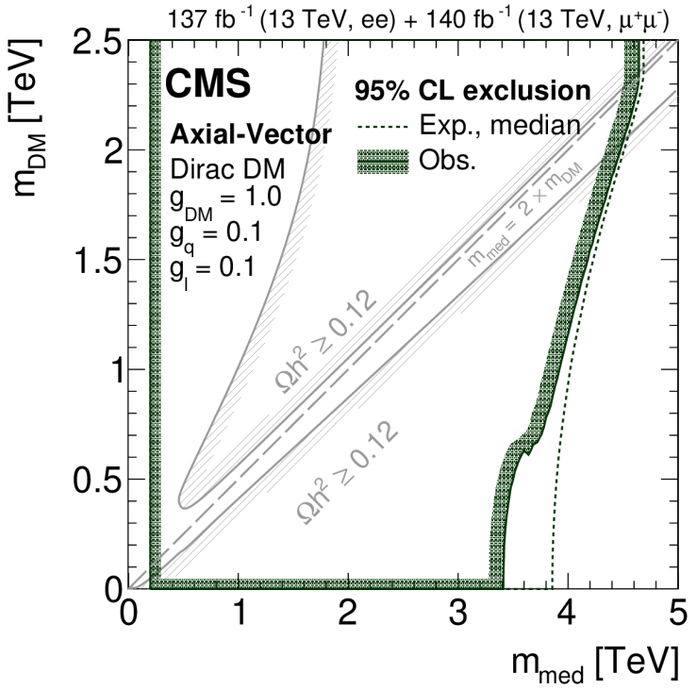
arXiv:2103.02708

- Flagship EXO search in dilepton channel: Z' search
- Probe indirect search for DM: mediator to SM particles
- Also can test the lepton flavor universality between dielctron and dimuon channels



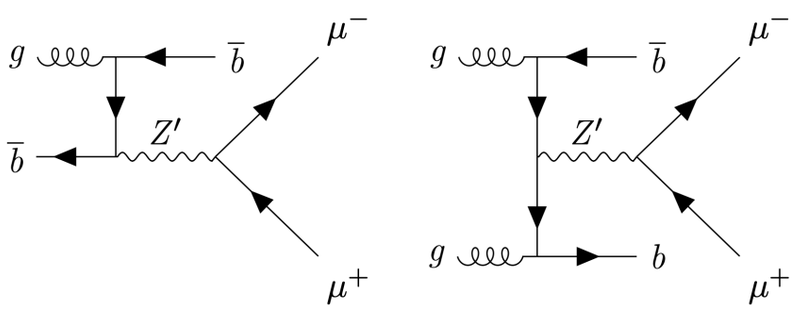


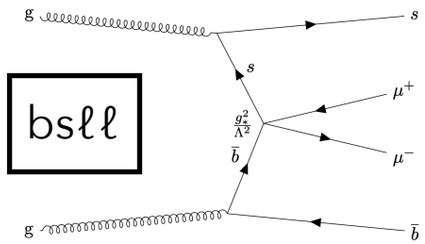


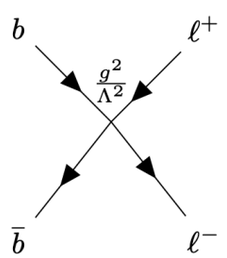


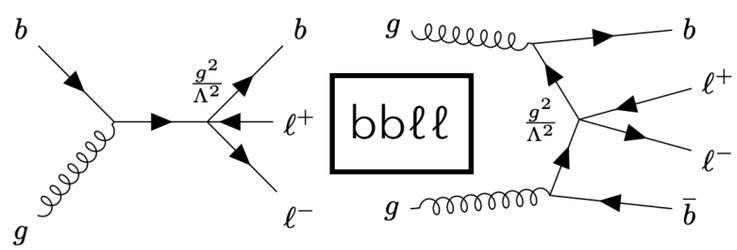
Z′→ℓℓ: N jets multiplicity

- Several interesting new physics models, motivated by B-anomalies, highlighting exclusive signatures with additional (b-)jets
  - For example, four-fermion contact interactions involving 3rd generation quarks (e.g. bsℓℓ and bbℓℓ) can explain the R_{K^*} anomaly (b→sℓℓ transition) observed in the LHCb









Resonant signal with 1 and 2 b-jets

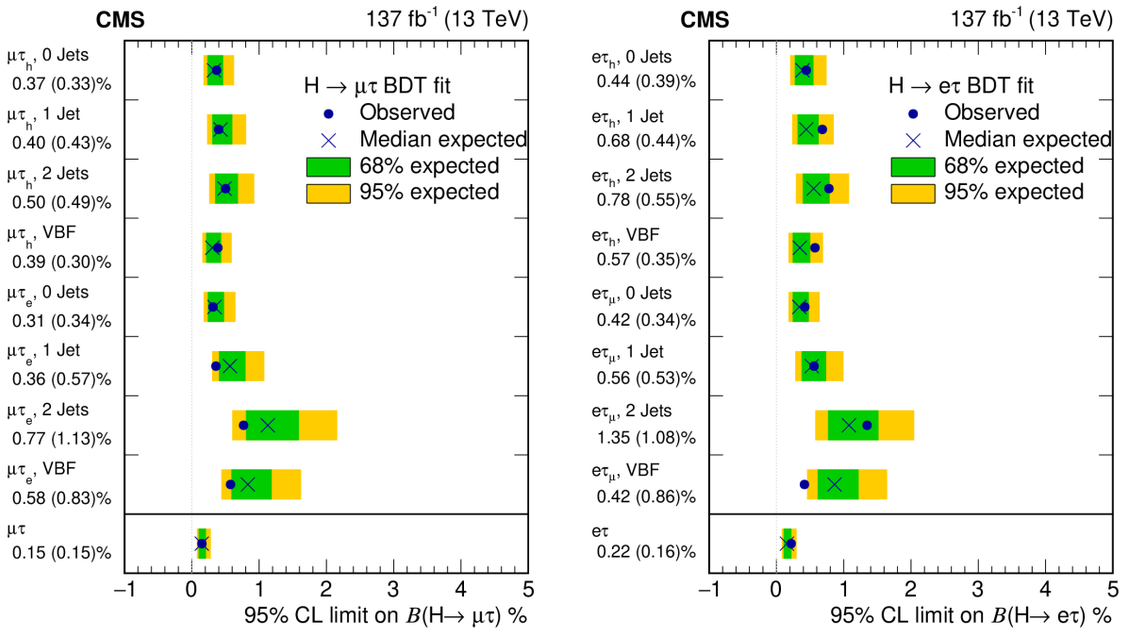
Non-resonant signals with multiple (b-)jets

- In the generic structure of EFT, any qq'ℓℓ contact interaction, resulting final states with dilepton + multiple jets with any flavor, can be considered

- Establishing a Search for b→sℓ+ℓ− Anomalies at the LHC, https://arxiv.org/abs/1805.11402
- Searching for New Physics with bbℓ+ℓ− Contact Interactions, https://arxiv.org/abs/1912.00425
- High pT correlated tests of lepton universality in lepton(s) + jet(s) processes; an EFT analysis, https://arxiv.org/abs/2005.06457
- Search for new phenomena in final states with two leptons and one or no bb-tagged jets at \sqrt{s} = 13 TeV using the ATLAS detector, https://inspirehep.net/literature/1853941

Other Searches

arXiv:2105.03007



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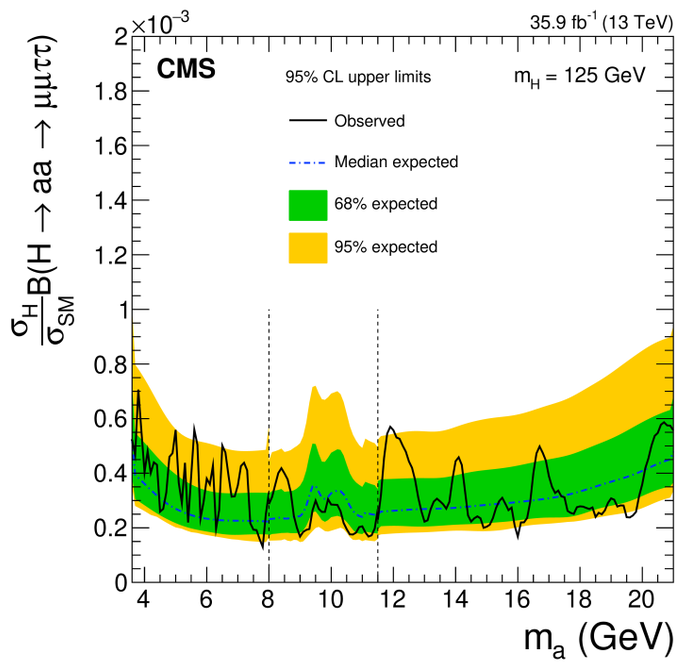
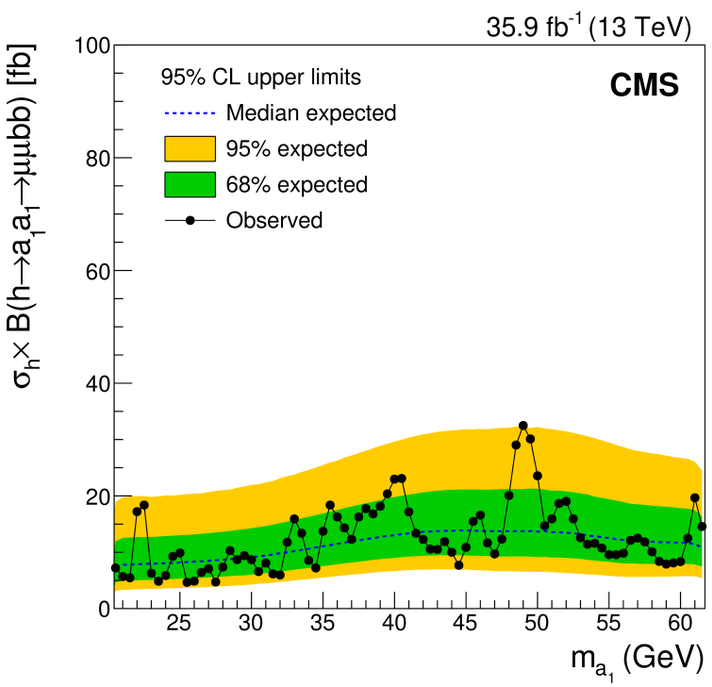


PLB 795 (2019) 398



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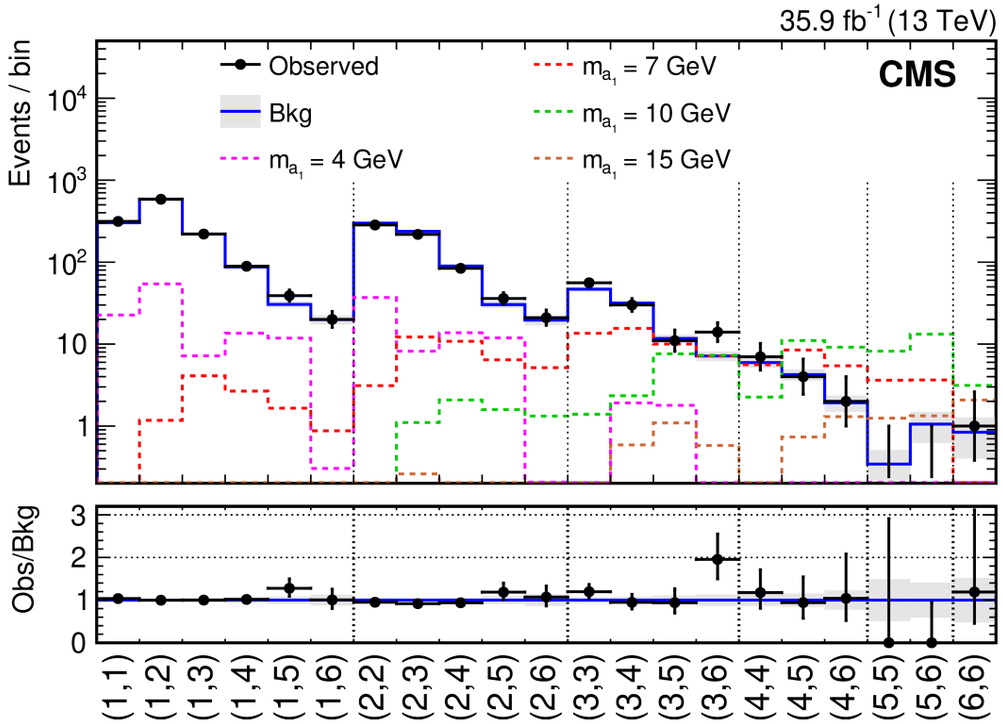
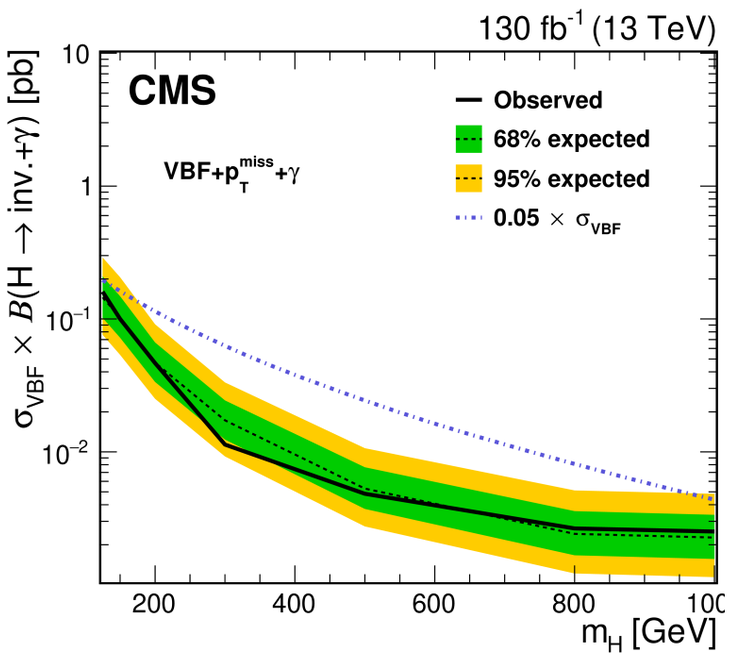


JHEP 03 (2021) 011



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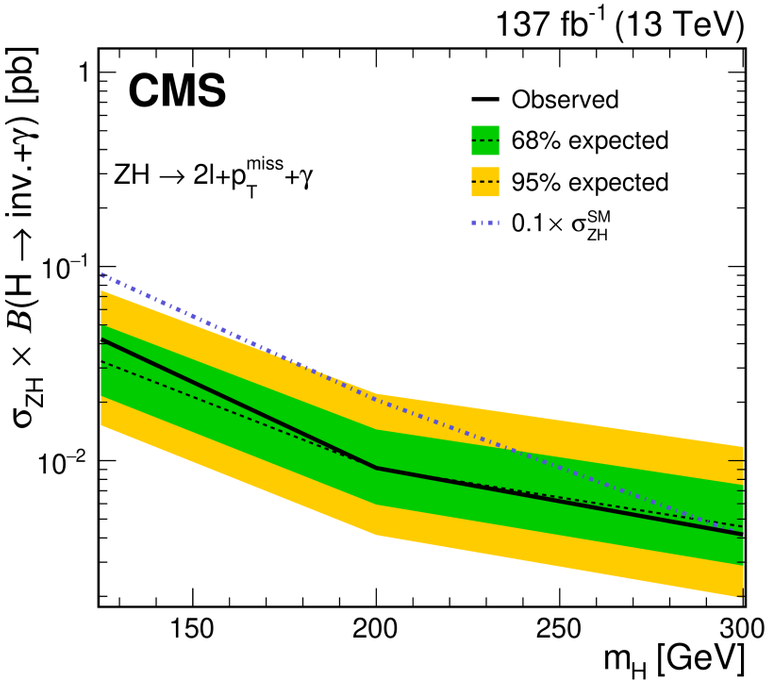


B-Parking

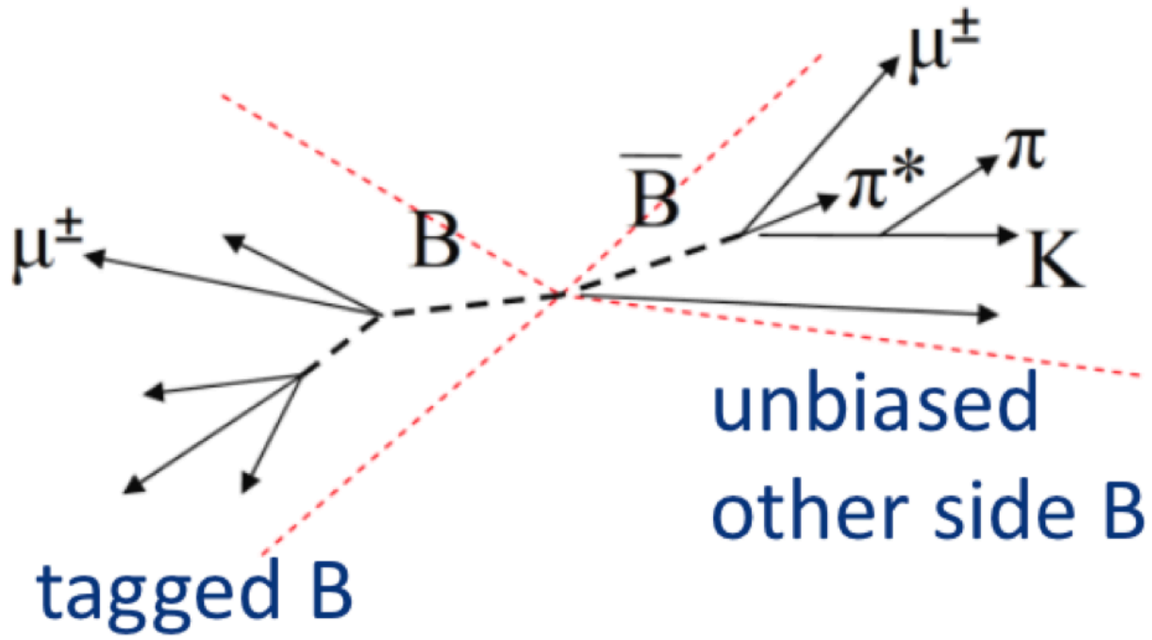
- We are working on it!

1. **Proposal to collect a generic sample of $\mathrm{O}(10^{10})$ B**
2. **hadron decays designed to measure $\mathrm{R_K}$ and $\mathrm{R_{K^*}}$ in**
3. **CMS using data parking in 2018**

Motivation: Study B anomalies. Can be used also for LLP search.

Goal: Collect large (~10^{10} events) unbiased sample of B

Idea: Triggering on muon from B (tag), to collect unbiased B on the other side (probe)



Single copy, 2 kHz to DAQ

Summary

- Various searches in dilepton channels related to the muon anomaly is on-going like dark photon searches
- Many recent suggestions to probe the anomalies with classical approaches like Z', DY
- Trigger design and implementation are the most important thing to initialize and optimize the possibility to probe new idea