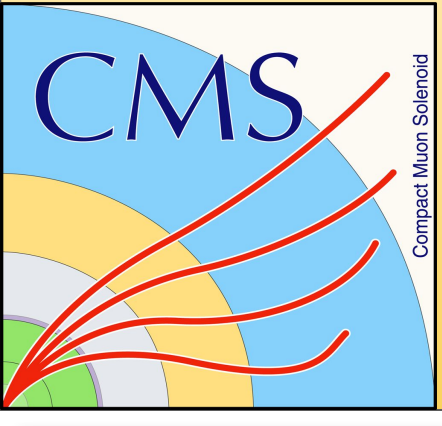


Search for exotic B decays and low mass dimuon resonances using data scouting



Hardik Routray

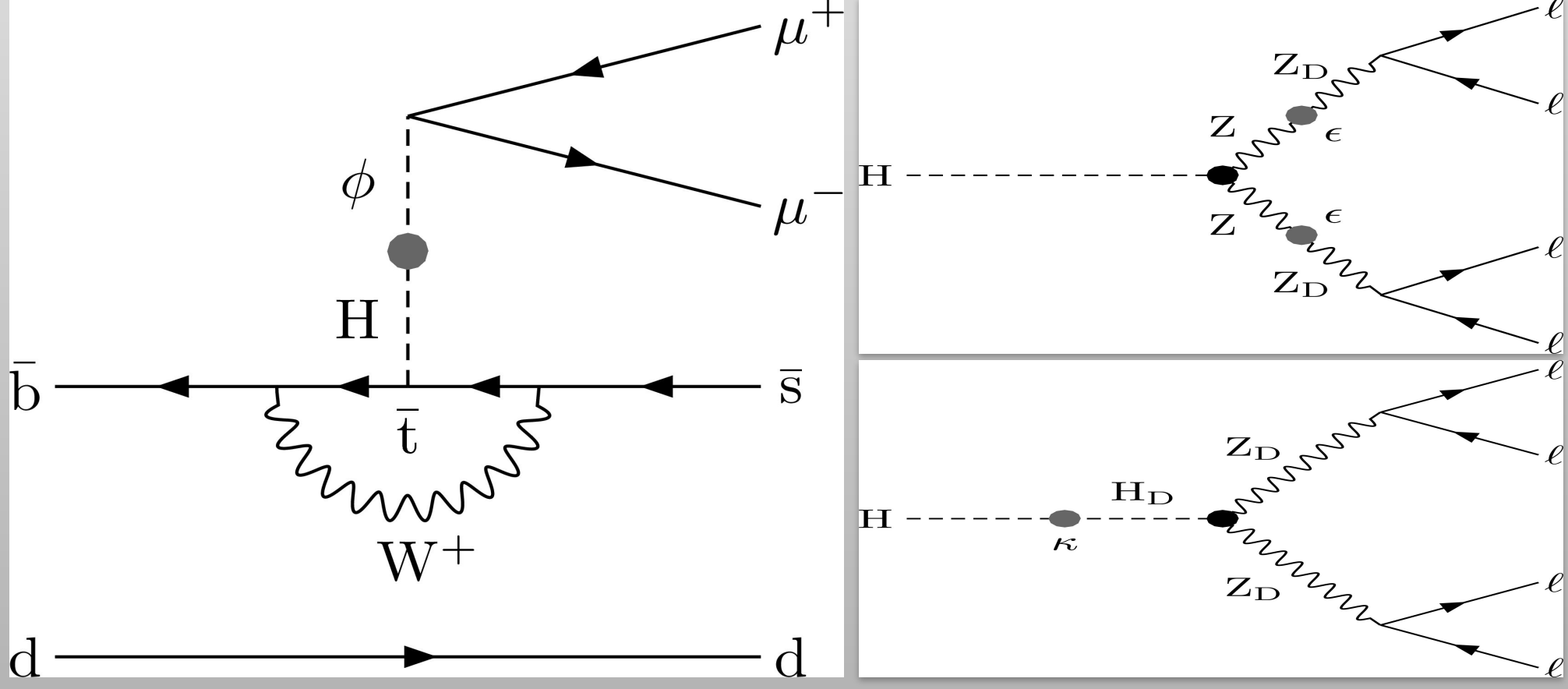
On behalf of the CMS Collaboration

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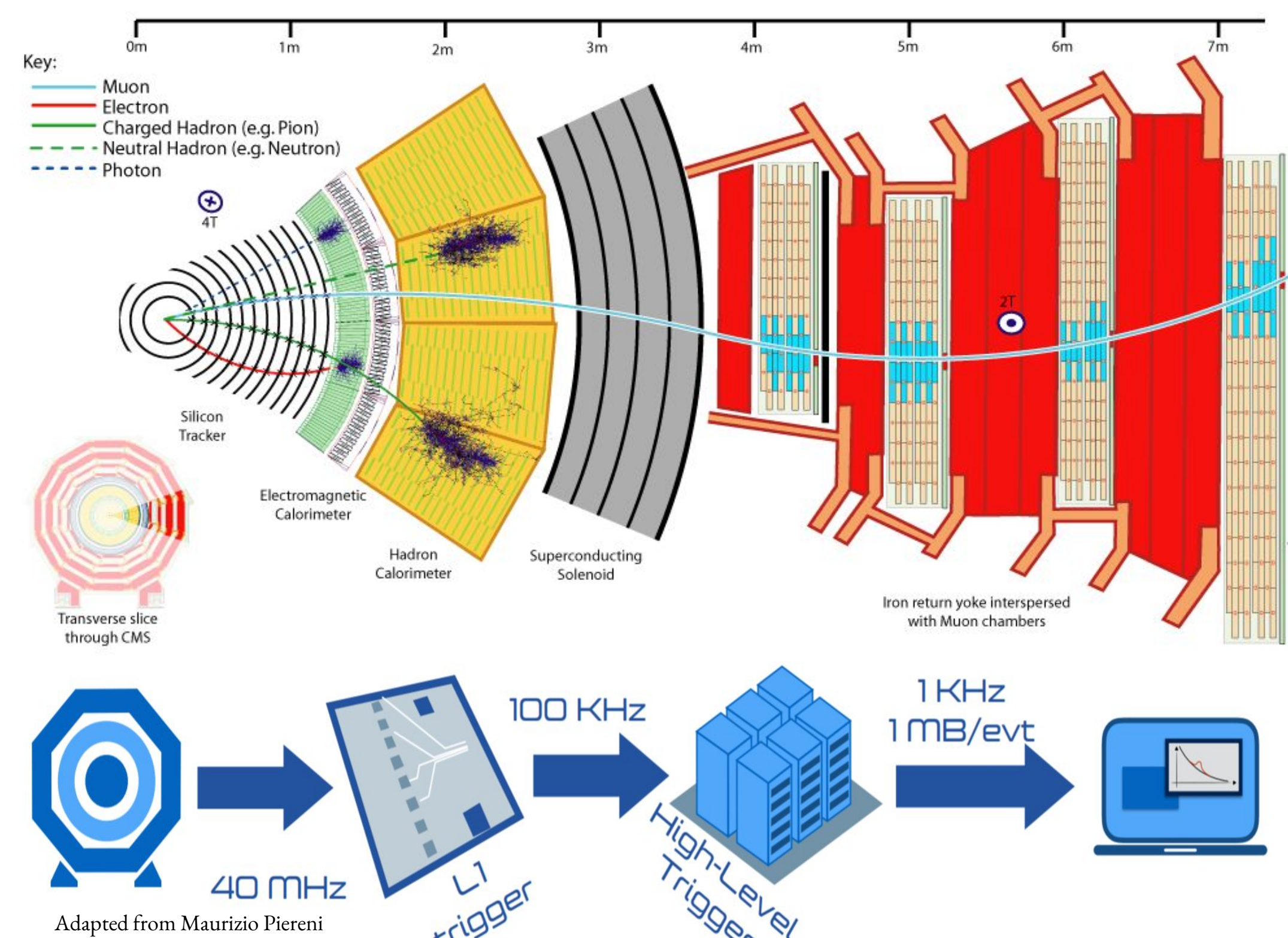
Introduction

- Search focused on two BSM scenarios:
 - $h_b \rightarrow \phi X$ where ϕ is a LLP decaying to $\mu^+\mu^-$.
 - $H \rightarrow Z_D Z_D$ where Z_D is a LLP decaying to $\mu^+\mu^-$.
- An inclusive search instead of focusing on exclusive B decay channels (e.g $B^+ \rightarrow \phi K^+$) to maximize signal acceptance.



CMS Detector and Trigger System

- Highly granular trackers and robust muon system.
- Two level trigger system designed to manage high rate.



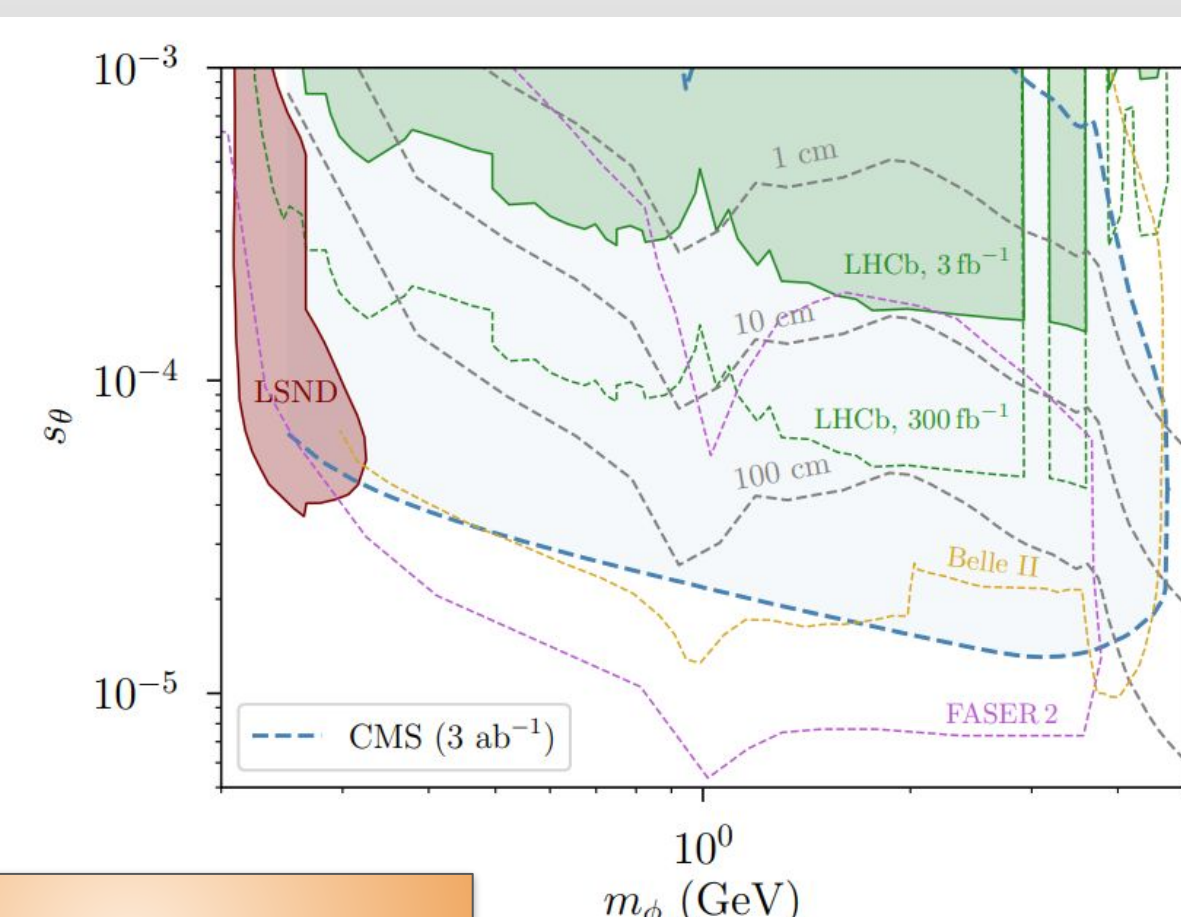
Data Scouting

- Scouting muon trigger: 2 muons with low kinematic thresholds $p_T(\mu) > 3$ GeV and no prompt requirement. Event rate is increased and the event size is reduced (4 kHz x 7 kB) to keeping minimal information.
- Enable access to ultra low mass ($>2m[\mu]$) and long-lived dimuons.

Supplementary

- Model independent upper limits on number of events provided in 20 non-exclusive aggregate regions along-with trigger efficiency and selection efficiency maps to facilitate reinterpretation [hepdata]

- Projected reach at HL-LHC with displaced tracking capability at L1 trigger [1]

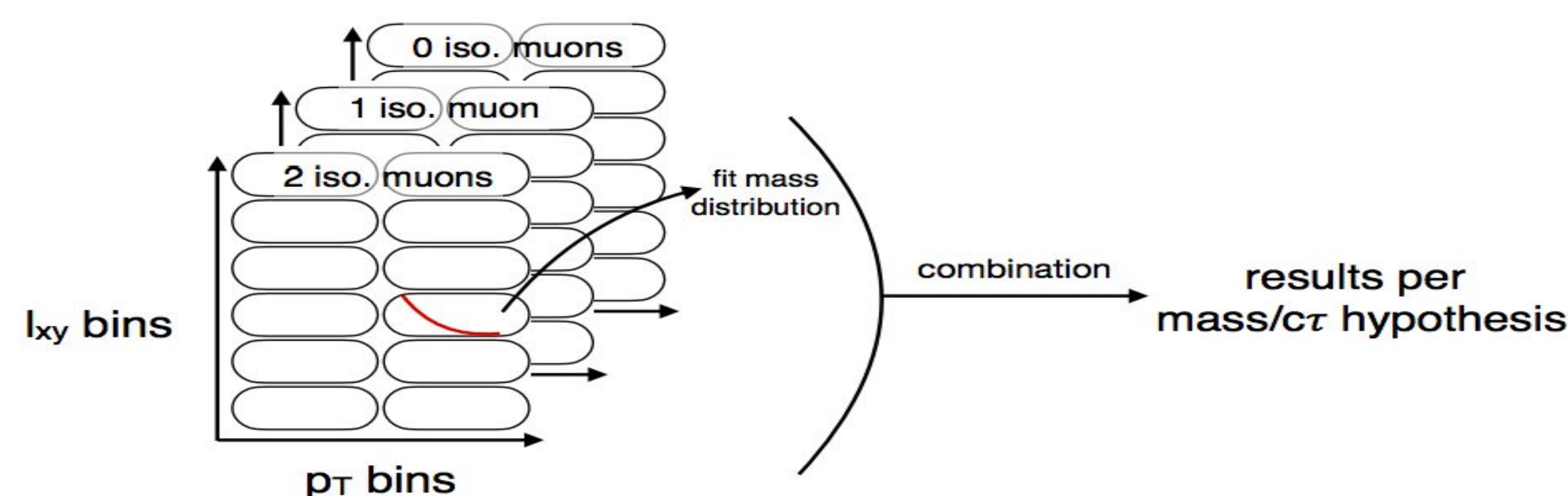


References

- [1] "Searching for exotic B meson decays with the CMS L1 track trigger" Phys. Rev. D 103 (2021) 015026
- [2] "Illuminating Dark Photons with High-Energy Colliders" JHEP 02 (2015) 157
- [3] "The CMS experiment at the CERN LHC" JINST 3 (2008) S08004
- [4] "The CMS trigger system" JINST 12 (2017) P01020
- [5] "Data Scouting: A New Trigger Paradigm" arXiv:1708.06925

Analysis Strategy

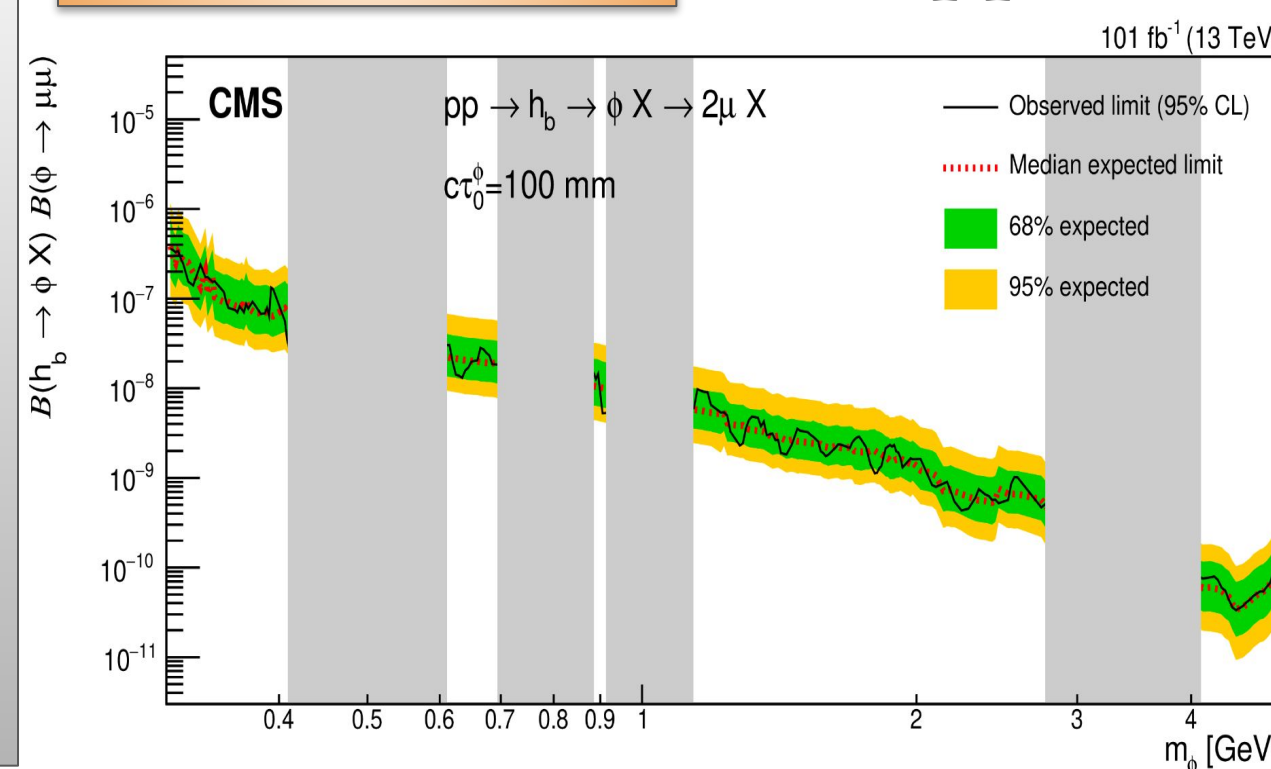
- Events with 2 good muons and 1 associated displaced vertex (SV) are selected. (2nd pair if 4μ final state)
- Events categorized into 36 bins of transverse displacement (l_{xy}), dimuon p_T and isolation. (maximize sensitivity)
 - l_{xy} : [0, 0.2, 1, 2.4, 3.1, 7, 11] cm on tracker geometry.
 - p_T : [0, 25, ∞]
 - Iso: 2 iso. μ , 1 iso. μ , 0 iso. μ
- A simultaneous fit is performed in all event categories to look for a narrow resonant peak over the background continuum.



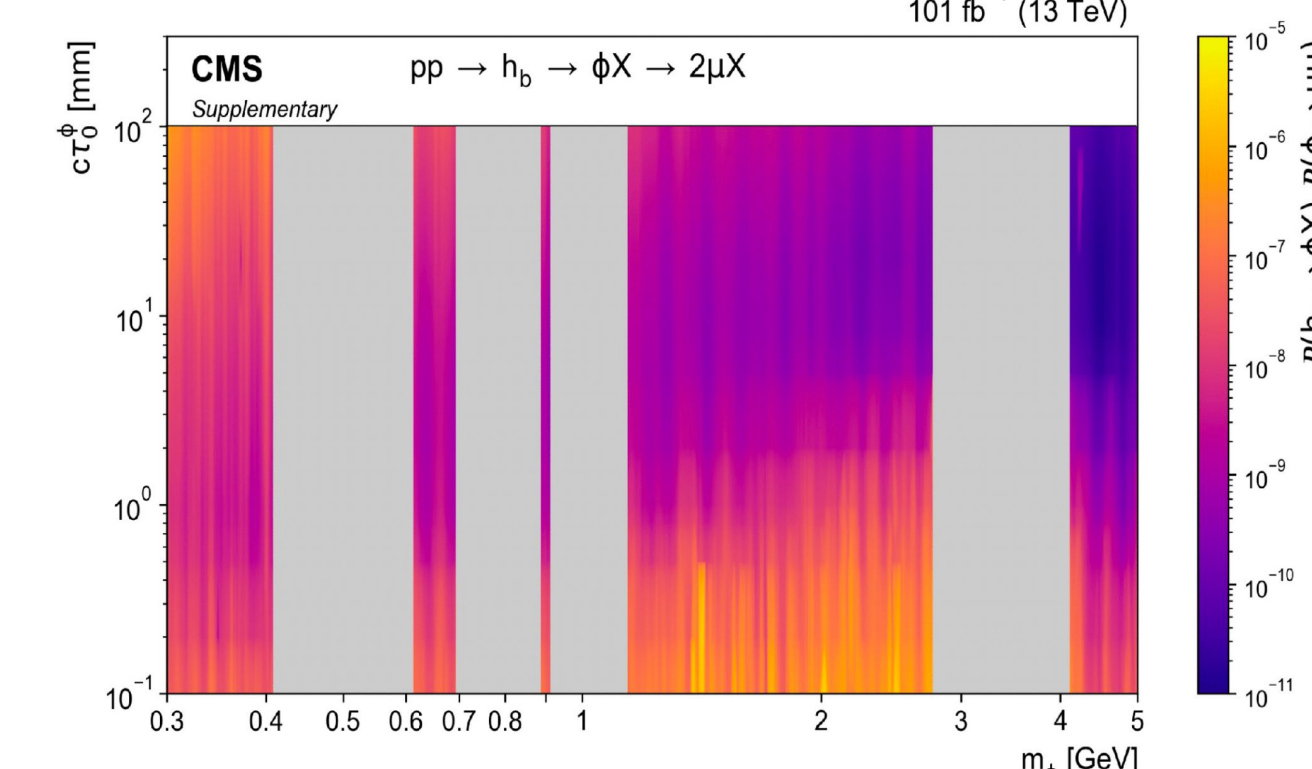
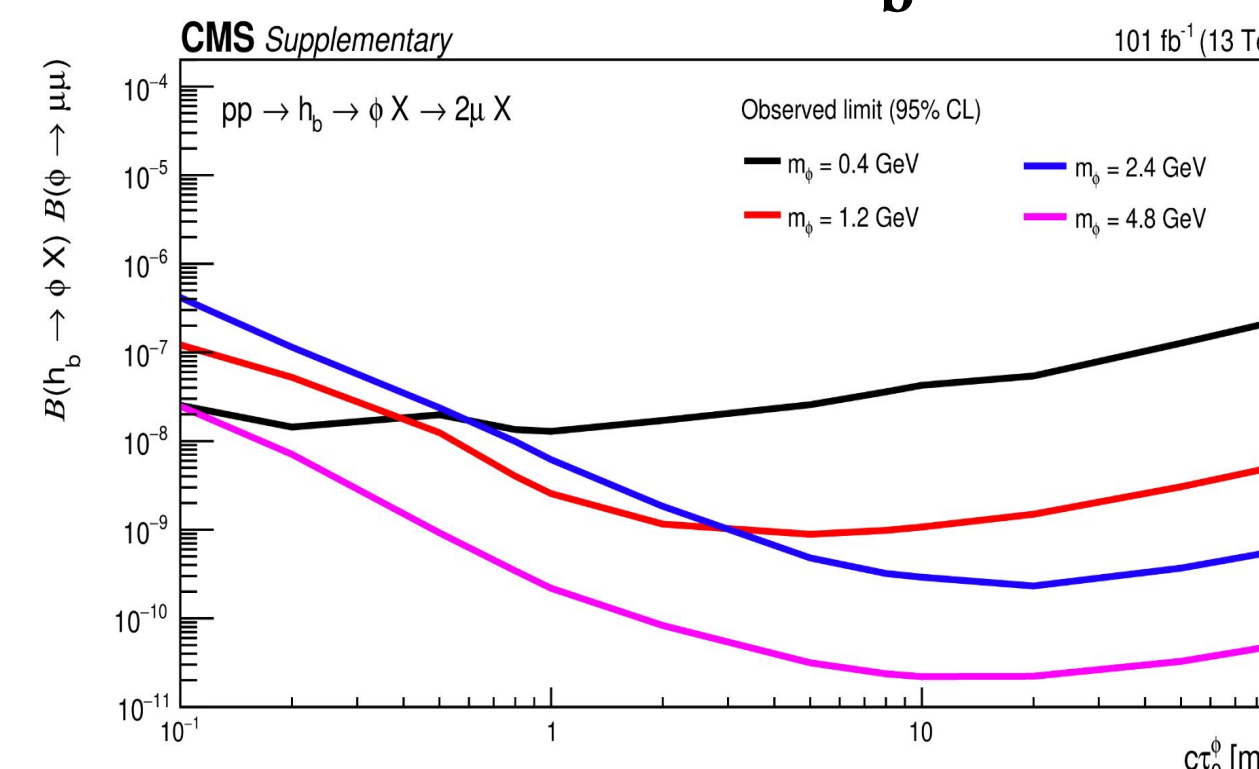
Background

- Fake vertices from accidental crossings of cosmic muons, QCD multijet events, cascade B decays.
 - $\Delta\phi(\mu\mu, SV) < 0.02$ and $\Delta\phi(\mu, \mu) < 2.8$
 - Fake vertices from overlapping PU tracks.
 - $\log_{10}(\Delta\eta / \Delta\phi) < 1.25$.
 - Fake vertices from material interaction.
 - Distance of SV from pixel module > 0.05 cm
 - Prompt muons.
 - $|d_{xy}/\sigma_{xy}| > 2$ and $|d_{xy}/(l_{xy} \cdot m_{\mu\mu}/p_{T,\mu\mu})| > 0.1$
 - SM dimuon resonances. (are masked)
- Fitting Strategy**
- Bkg. Shape: Bernstein and Exponential forms.
 - Fit window: $\pm 5\sigma$ about the mass hypothesis.
 - $\sigma \sim 1.1\%$ of mass and signal shape: dCB+Gaus

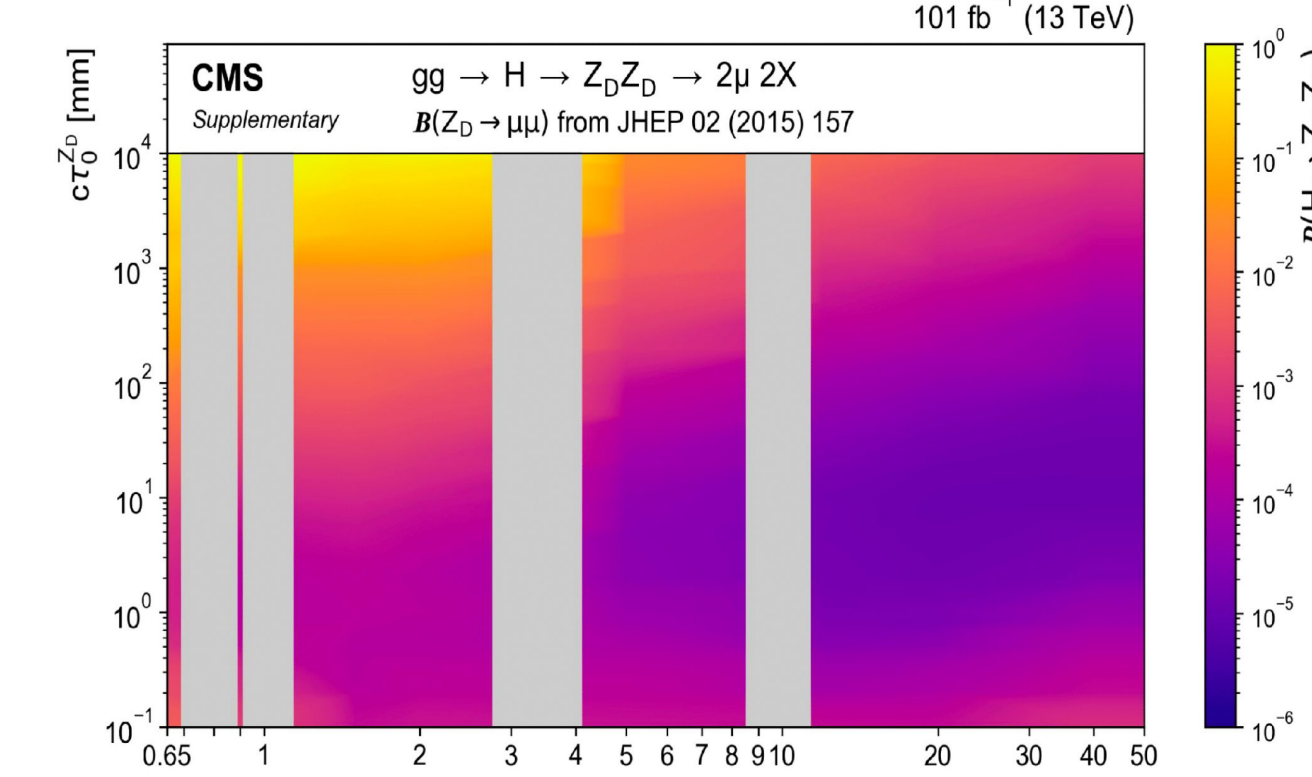
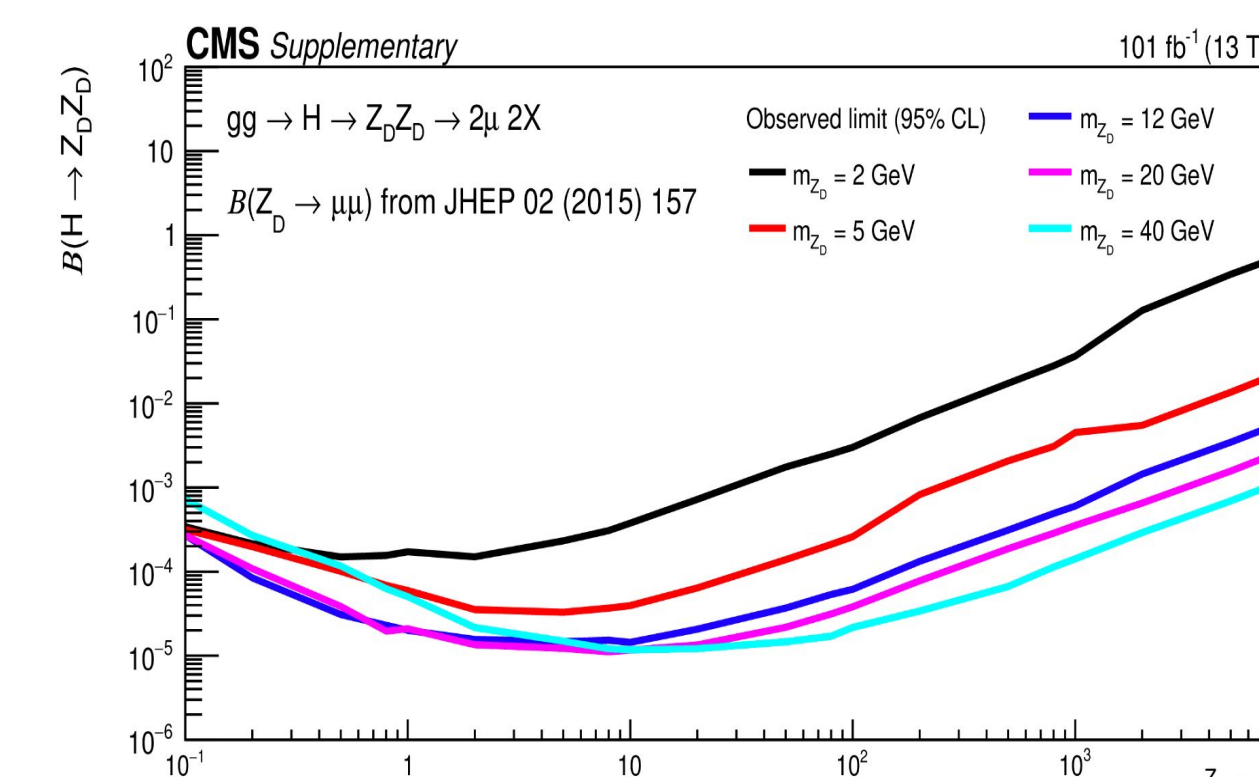
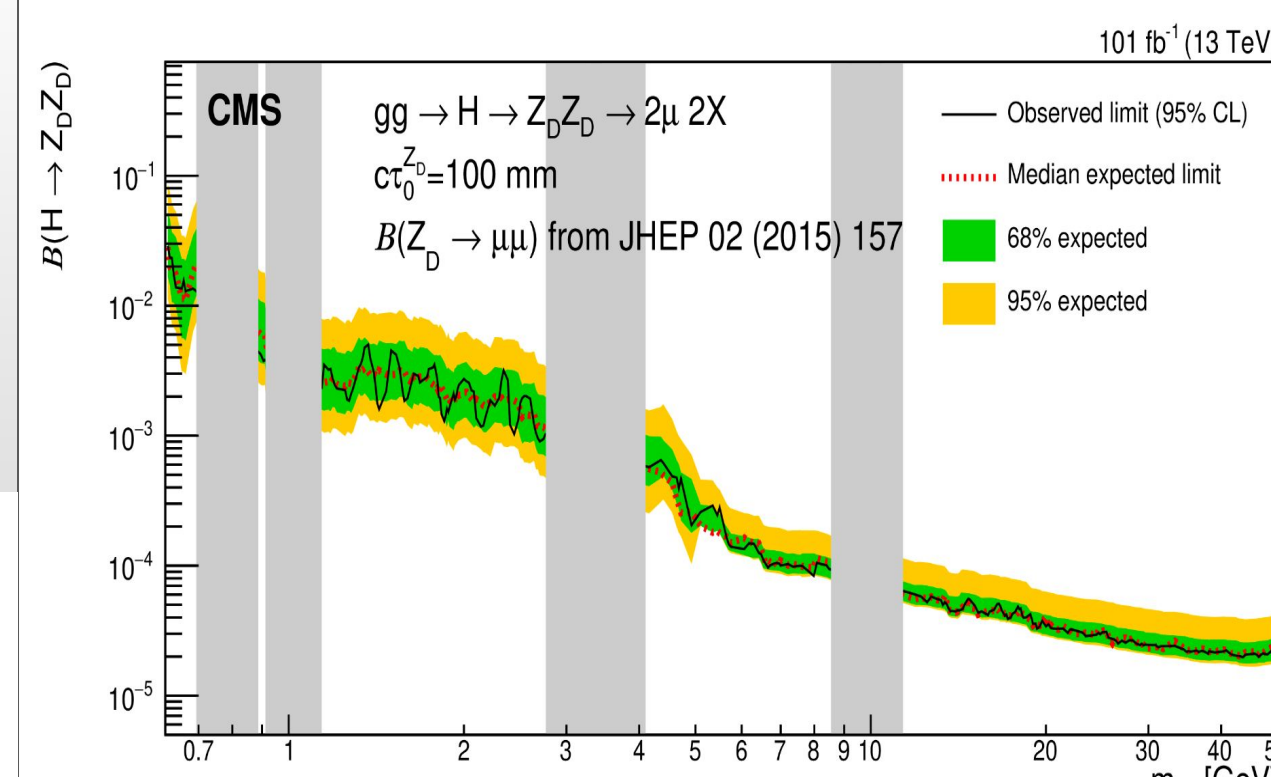
Results



Upper limits at 95% CL on BR(h_b to phi X). BR(phi to mu mu)



Upper limits at 95% CL on BR(H to Z_D Z_D)



CMS vs LHCb

