

YSF: Search for b-associated Z' in the dimuon final state at CMS

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on behalf of the CMS collaboration



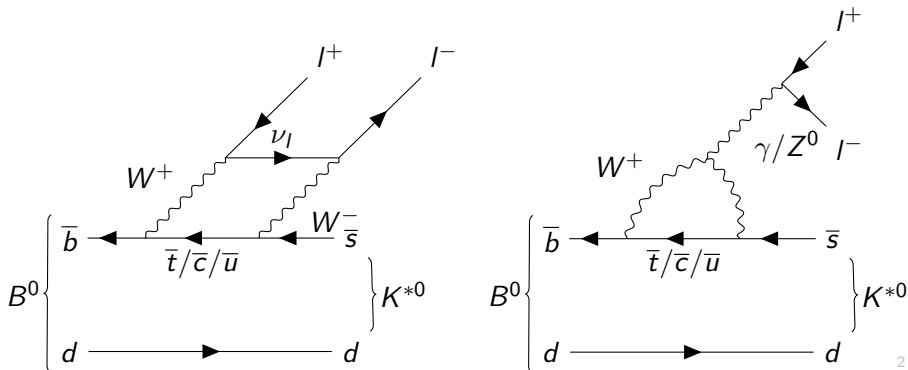
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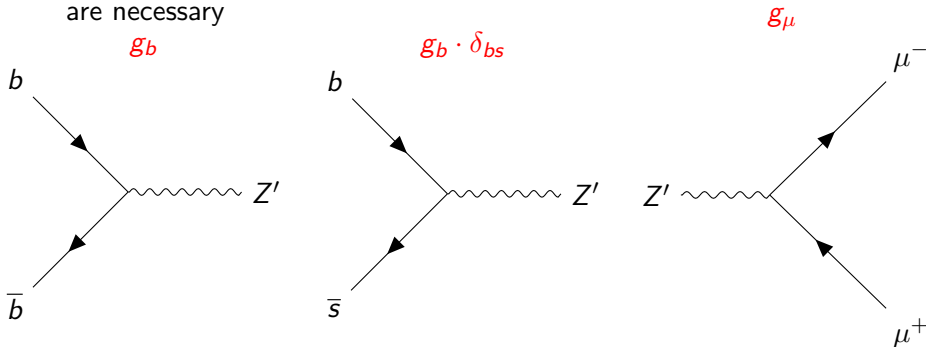
B-flavour anomalies with lepton universality violation

- Hints at new BSM physics are scarce
- LHCb reports an excess in the muon to electron ratio of R_{K^*} ($B^0 \rightarrow l^+ l^- K^*$ [JHEP 08 \(2017\) 055](#)) and R_K ($B^+ \rightarrow l^+ l^- K^+$ [Phys. Rev. Lett. 113, 151601 \(2014\)](#))
- Combining both measurements, the excess may amount to $\approx 4\sigma$ to date [JHEP 1801 \(2018\) 093](#)



A new heavy gauge boson Z' with flavour violation?

- One explanation for such a behaviour could be a new heavy gauge boson Z' with non-universal couplings [arXiv:1707.07016 \[hep-ph\]](https://arxiv.org/abs/1707.07016)
- To explain the observed anomalies, only couplings to third generation quarks, second generation leptons, and a flavour-violating bs -coupling are necessary

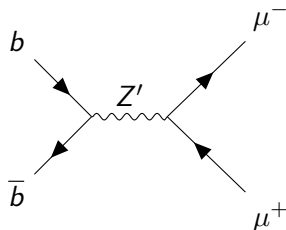


- For this search, I'll only consider the above three couplings (from left to right) g_b , $g_b \cdot \delta_{bs}$, and g_μ

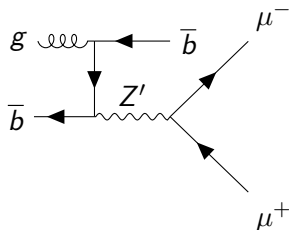
Associated b-jet multiplicity and kinematics

- As light quarks don't couple directly to this kind of Z' , the bottom pdfs and the bottom luminosity from gluon splitting play a major role

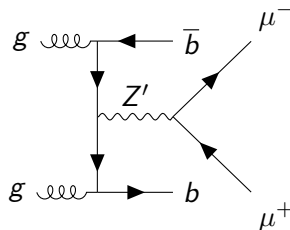
0 assoc. jets



1 assoc. jets



2 assoc. jets

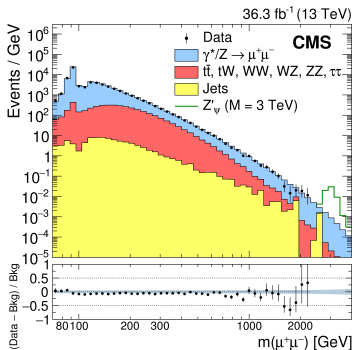


- For a medium b-tag requirement and $p_T(\text{jet}) \geq 30$ GeV, the rate of [0/1/2] associated b-tagged jets is [80.1%/18.5%/1.5%] for a 200 GeV Z' and [71.8%/25.1%/3.0%] for a 500 GeV Z'
- Associated b-tagged jets are central and soft
- For $p_T(b) \geq 20$ GeV: [74.0%/23.8%/2.1%] for a 200 GeV Z'
- The flavour-violating coupling δ_{bs} switches on contributions by s quarks and lowers the relative amount of associated b-tagged jets

Background-suppressing selection requirements

- The main background for the inclusive Z' search in the dimuon channel (shown in the left) is Z^0/γ^* , followed by $t\bar{t}$

arXiv:1803.06292 [hep-ex]

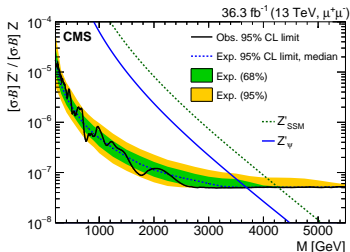


- Further requiring:
 - at least two associated jets ($p_T \geq 30$, $|\eta| \leq 5$) and at least 1 medium bottom tag, reduces $t\bar{t}$ by 1 and Z^0/γ^* by 3 orders of magnitude
 - the larger mass of the most similar permutation of muon-jet masses > 170 GeV reduces $t\bar{t}$
 - SM associated jet spectrum is harder, so require scalar sum of jet momenta H_T to be smaller than scalar sum of lepton momenta L_T
 - $p_T^{\text{miss}}/m(\mu^+\mu^-) < 0.2$ accounts for the signal events having no natural p_T^{miss}

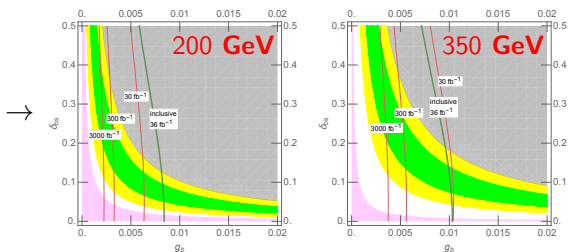
Current reach of CMS inclusive search - and where it may beat dedicated searches

- With this kind of selection, so far only Delphes limits by phenomenology studies are available.
- Still, such studies do motivate where dedicated studies might do better, and where they won't.

arXiv:1803.06292 [hep-ex]



arXiv:1707.07016 [hep-ph]



- For low flavour-violating couplings, a dedicated analysis might be complementary or better for $m(Z') \leq 350$ GeV
- For large δ_{bs} couplings, the inclusive analysis will cover more ground, unless going even closer to the Z peak with the Z' mass

Conclusions & Outlook

- Phenomenology studies suggest a dedicated search for b-associated Z' is beneficial in searching for an explanation of the R_K and R_K^* anomalies
- We are working on such a complementary analysis within CMS
- As this model does not allow coupling to electrons, a data-driven background estimation from dielectron events is work in progress (WIP)
- Defining further search regions, especially exactly 1 associated b-tagged jet (e.g. 12% rate for a 200 GeV Z'), is WIP
- We expect to have results in this channel within the year