Accessing CKM suppressed top decays at the LHC

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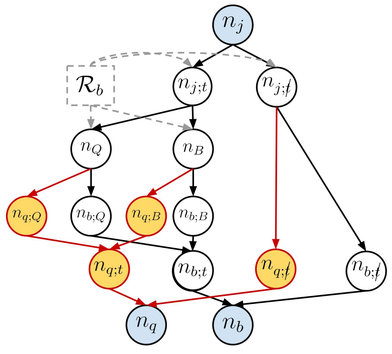
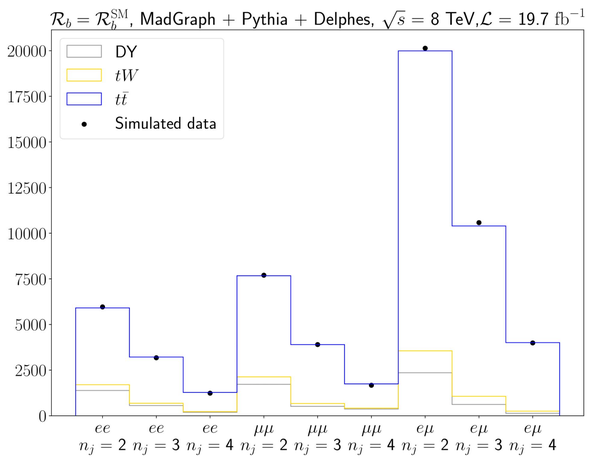
A **simple** extension of an existing strategy to measure $|V_{td}|^2+|V_{ts}|^2$ at the LHC. Main idea: Orthogonal *b*- and *q*-taggers define **complementary observables** that **increase the statistical power** of the analysis. This simple extension allows to **measure a non-null $|V_{td}|^2+|V_{ts}|^2$ at 95% CL at the HL-LHC (and 68% CL with Run 1 data)**

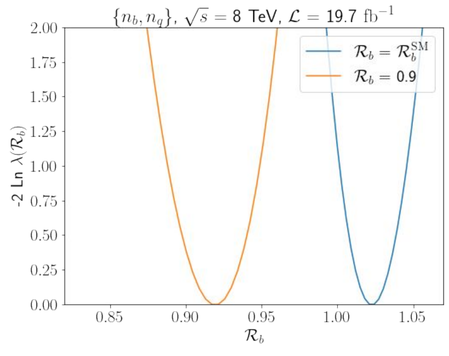
$|V_{tx}|$ can be obtained directly from **on-shell top-quarks decays** by measuring $\mathcal{R}_b \equiv \frac{\mathcal{B}(t\to bW)}{\sum_{j=d,s,b}\mathcal{B}(t\to jW)}$

CMS coll. arxiv:1404.2292, provides the current best measurement using top pair production: $\mathcal{R}_b > 0.955 \ @\ 95\%\ \mathrm{C.L.}$

For top pair production, we obtain the yields per $\{n_j + \ell\ell'\}$ category. We model the expected events per $\{n_b,n_c\}$ category after tagging.





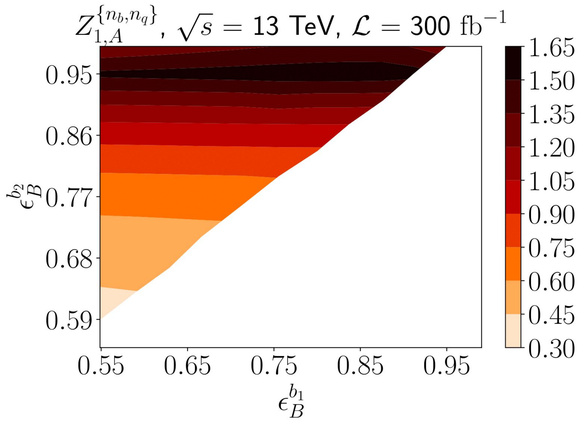


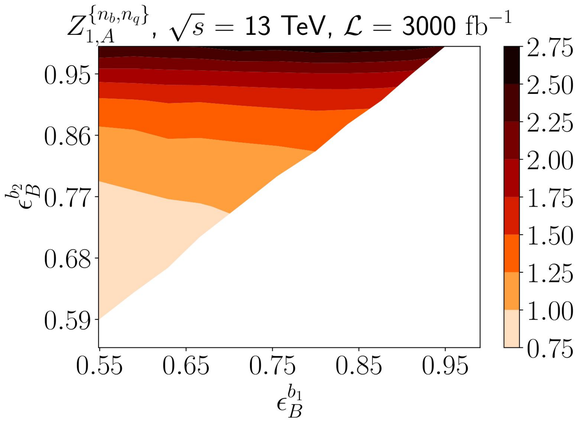
We set limits on $|V_{tx}|$ through a NLL fit. With b-tag only, we reproduce CMS result and with n_b+n_q see **smaller CIs and larger discrimination between different R_b values**.

We validate the model through consistency checks using MC and project its performance assuming it is true: we sample $\{n_b,n_q,n_j, \ell\ell'\}$ counts using the simulated $\{nj, \ell\ell'\}$ event yields, the probabilistic model and specific choices for the parameters.

We mix **b-taggers** and **quark/gluon taggers** to define **complementary orthogonal regions**.

We compute the expected discovery significance of non-zero $|V_{tx}|$ through the Asimov approximation, $Z_{1,A}$. n_q is key and we are **above 2σ for HL-LHC**!





The probabilistic model is incomplete and additional NPs should be included. It could also be extended to be more physical, e.g., the model could incorporate jet kinematics. We have treated tagger efficiency estimation and R_b determination as separate problems. However, they are related and could be treated at the same time

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