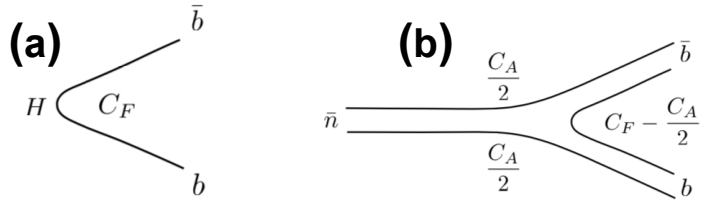
ISMD21, Virtual World, Poster Session

Colouring the Higgs boson

A new colour-sensitive observable to tag colour singlets

Introduction

Studying the colour flow to tag colour singlets (like H→bb) (a) and discriminate other colour configurations (b)



Design

Taking the ratio of the LO matrix elements for the background (B) and the signal (S) processes

$$\frac{|\mathcal{M}_\mathcal{B}|^2}{|\mathcal{M}_\mathcal{S}|^2} = \frac{C_\mathcal{B}}{C_\mathcal{S}} + \frac{\widetilde{C}_\mathcal{B}}{C_\mathcal{S}} \left(\frac{(n_a \cdot \bar{n})(n_b \cdot k)}{(n_a \cdot n_b)(\bar{n} \cdot k)} + \frac{(n_b \cdot \bar{n})(n_a \cdot k)}{(n_a \cdot n_b)(\bar{n} \cdot k)} \right)$$

$$\simeq \frac{1 - \cos\theta_{ak} + 1 - \cos\theta_{bk}}{1 - \cos\theta_{ab}}$$

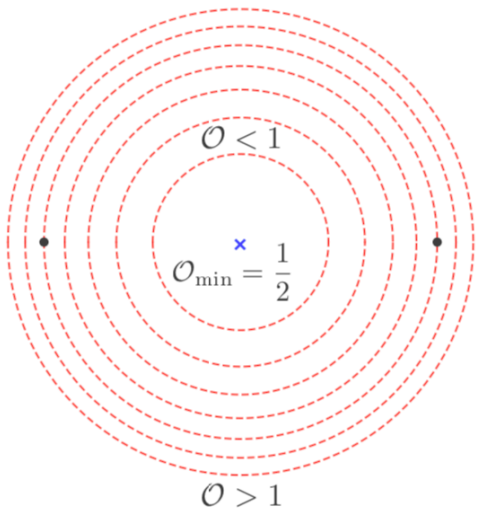
θ_{ak} (θ_{bk}): angles between the soft gluon (k) and each of the hard partons

The Colour Ring[1]

$$\mathcal{O} = \frac{\theta_{ak}^2 + \theta_{bk}^2}{\theta_{ab}^2}$$

Colour-singlet dipole emissions lie inside the $\mathcal{O}$ = 1 circle

Purely directional and systematic uncertainties friendlier observable compared to ECFs



Analysis studies

Testing the Colour Ring:

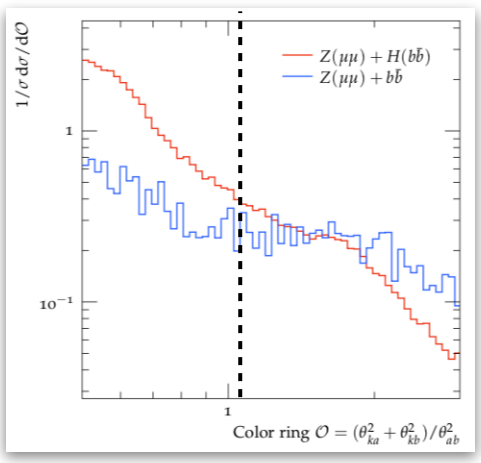
Z(*ll*)+H(→)bb vs Z(*ll*)+bb

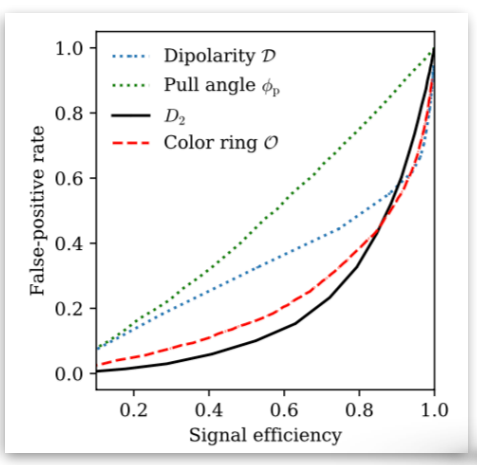
anti-kt jet (R=1) with $p_{TJ} > 2m_V$

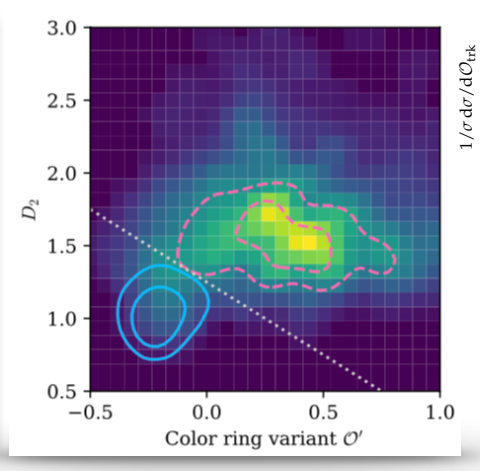
Three track-jets matched to the large-R jet (2 b-tagged plus a proxy for the k emission)

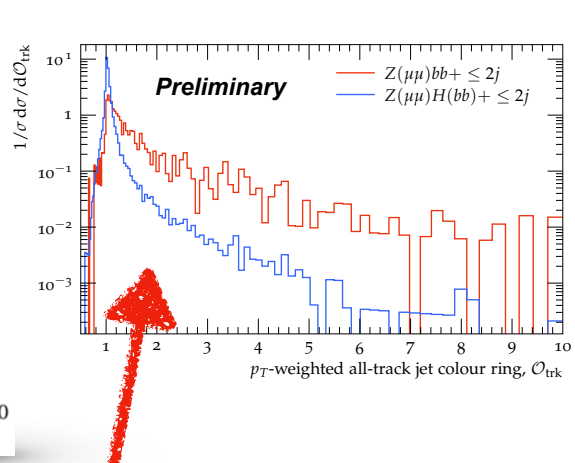
Results

Outperforming the other dipole singlet taggers. Interesting interplay with D2









Possible refinements: combination with D2, track-jet p_T weighted observable?

"Looking for a new tagger? Colour it!"

Novel and approach to build a colour-singlet tagger from the QCD likelihood ratio

Good discriminating power, offering complementary information to D2

Its simplicity permits both theoretical and experimental insights

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[1]SciPost Phys. 9, 026 (2020)