Mistag systematics update

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• This talk follow the previews one done by D. Bloch on may 12 (on mistag evaluation in CMS).

• The method use to evaluate mistag will be briefly summarize.

• In that context, we will study mistag systematics in particular including effect coming from V0 particles.
Mistag estimate

- The goal is to evaluate b-tagging and light tagging efficiencies using the real data in the case where the Monte Carlo does not describe well the data.

- Useful at least at the beginning of the experiment.

- The tagging efficiency is then defined as:

\[ \epsilon^{\text{tag}}(q) = \frac{\text{number of jets of flavour } q \text{ tagged as b jet}}{\text{number of taggable jets of flavour } q} \]

- As the MC may not describe well the Data, the tagging efficiencies are
  - Computed for a limited set of working points (wp)
  - Mainly estimated from the Data (see below for the mistags)
  - Then parameterized: Scale Factor SF (pt, \( \eta \), flavour, wp).
Mistag estimate (2)

- We compute the mistag efficiency by using tracks with positives and negatives IP significances.
- We use a track counting method on qcd MC (~400 000 events) to evaluate scale factor $SF_l$ and then correct the qcd MC

$$\varepsilon_{\text{tag}}^{\text{Data}}(udsg) = SF_l \times \varepsilon_{\text{neg}}^{\text{Data}}(all)$$

$$SF_l = \frac{\varepsilon_{\text{tag}}^{\text{qcdMC}}(udsg)}{\varepsilon_{\text{neg}}^{\text{qcdMC}}(all)}$$

- Sources of systematics:
  - Fraction of remaining b/c after negative tags in the qcd MC
  - Difference between uds and g-jets? (D.Bloch’s talk on may 12, 2006)
  - Long life time particles dependences.
Gluons and lights quarks differences

- Here is shown the tagging efficiency in function of $pt$ and $|\eta|$.
- $\varepsilon_{tag}(uds)$ and $\varepsilon_{tag}(g)$ are not exactly the same.
- Is that coming from tracks multiplicity?
The tagging efficiency in function of tracks multiplicity shows that it still remain differences for the same tracks multiplicity.

Can we explain that difference with the presence of $V_0$ particles?
IP significance

![Graphs showing IP significance for different jet categories.](image-url)

- All tracks in:
  - b jet
  - c jet
  - uds jet
  - g jet

- dsg jets:
  - with V0
  - without V0

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Dependence in VO particles

$\varepsilon_{uds}/\varepsilon_{\text{gluon}}$ in qcd MC

- 50<Pt<80 GeV/c
  - $\chi^2$/ndf: 15.30 / 15
  - $p_0$: 0.060 ± 1.009

- 80<Pt<120 GeV/c
  - $\chi^2$/ndf: 16.87 / 15
  - $p_0$: 0.106 ± 1.049

- 120<Pt<170 GeV/c
  - $\chi^2$/ndf: 21.88 / 15
  - $p_0$: 0.057 ± 1.009

- 170<Pt<230 GeV/c
  - $\chi^2$/ndf: 23.84 / 9
  - $p_0$: 0.104 ± 0.742

- 50<Pt<80 GeV/c
  - $\chi^2$/ndf: 17 / 13
  - $p_0$: 0.072 ± 0.982

- 80<Pt<120 GeV/c
  - $\chi^2$/ndf: 17 / 13
  - $p_0$: 0.072 ± 0.982

- 120<Pt<170 GeV/c
  - $\chi^2$/ndf: 16.38 / 15
  - $p_0$: 1.356 ± 0.089

- 170<Pt<230 GeV/c
  - $\chi^2$/ndf: 15.47 / 15
  - $p_0$: 1.252 ± 0.084
Fraction of jets with $\geq 1 \, V_0$:

- We can study the importance of $V_0$ ($K^0_s$ and $\Lambda$ here) particles on SF1.

- We have shown the fraction of jets with at least one $V_0$ in QCD MC.

- For $p_T \sim 100$ GeV
  - 40% of jets with $\geq 1 \, K^0_s$
  - 18% of jets with $\geq 1 \, \Lambda$
Assuming ±100% uncertainty on the reconstruction on $K_s^0$ and $\Lambda$

\[ \text{udsg-tag efficiency} \]
• The uncertainties on the $b$ and $c$ fractions are assumed to be $\pm$ 20%.

• The uncertainty on the gluon fraction is assumed to be $\pm$10% (and not correlated with $b$ and $c$ fractions).

• The uncertainty from V0 fraction is assumed to be $\pm$10% (and not correlated to the other systematics)
Mistag systematics (2)

- UDsg-tag efficiency

- Systematics:
  - b fraction ± 20%
  - c fraction ± 20%
  - g fraction ± 10%
  - V0 fraction ± 10%
  - Total syst

- Data points for 50 < pt < 80 GeV and 30 < pt < 50 GeV with respective uncertainties.
Conclusion

- Based on the track counting method and QCD MC, the mistag systematics have been re-evaluated.

<table>
<thead>
<tr>
<th></th>
<th>30&lt;pt&lt;50 GeV</th>
<th>50&lt;pt&lt;80 GeV</th>
<th>80&lt;pt&lt;120 GeV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\epsilon_{\text{mistag}} \approx 10^{-2}$</td>
<td>5.5%</td>
<td>4.5%</td>
<td>6.5%</td>
</tr>
<tr>
<td>$\epsilon_{\text{mistag}} \approx 10^{-3}$</td>
<td>10.5%</td>
<td>12%</td>
<td>16%</td>
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Annex Taggability

- **Taggability** = efficiency to have enough tracks pointing to the primary vertex.
- Following Phys TDR1-12.2.1.1, one can require at least 2 tracks with $\text{pt}>1\text{GeV}$, $|\text{IP}|<2\text{mm}$, $\geq 8\text{hits}$, etc…