W emission rate in the collinear limit

1403.4788

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Cargese International School for Theoretical Particle Physics 23.07.2014

W within a QCD jet

- *Sample (Sherpa 2.0.0)*
  - p p --> j j
  - $\sqrt{s} = 14$ TeV
  - 2 anti-k_T R=1.5 jets
  - $p_{T_{\text{jet}}} > 500,\ 750,\ 1000$ GeV

- Physical objects
  - isolated leptons

    $p_{T_{rad}}/p_{T_{lep}} < 0.1$

    $p_{T_{lep}} > 25\ GeV$

    $|\eta_{lep}| < 2.5$

  - visible particles

    $|\eta_{vis}| < 5$

    $p_{T_{vis}} > 0.5\ GeV$

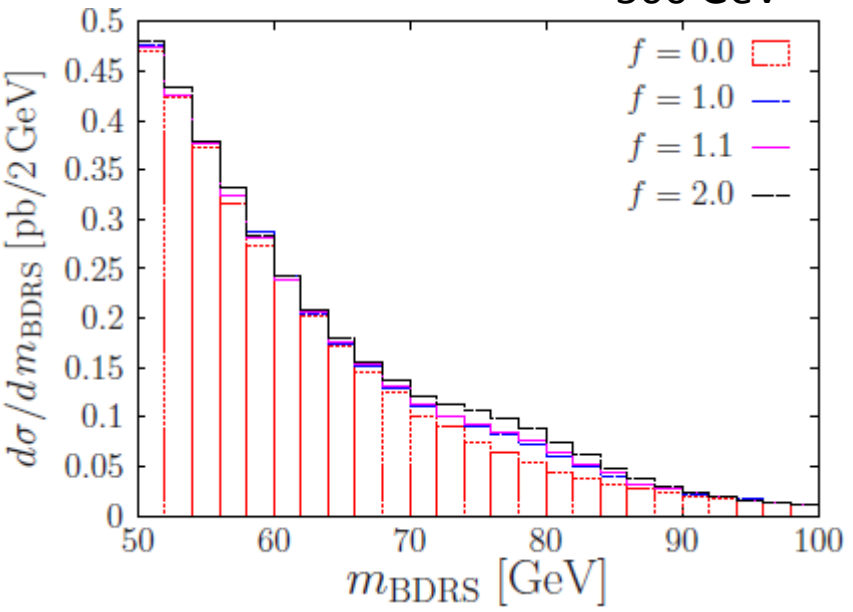
    $0.1\text{x}0.1$ in $\eta - \phi$

Second Boosted Subjet Mass

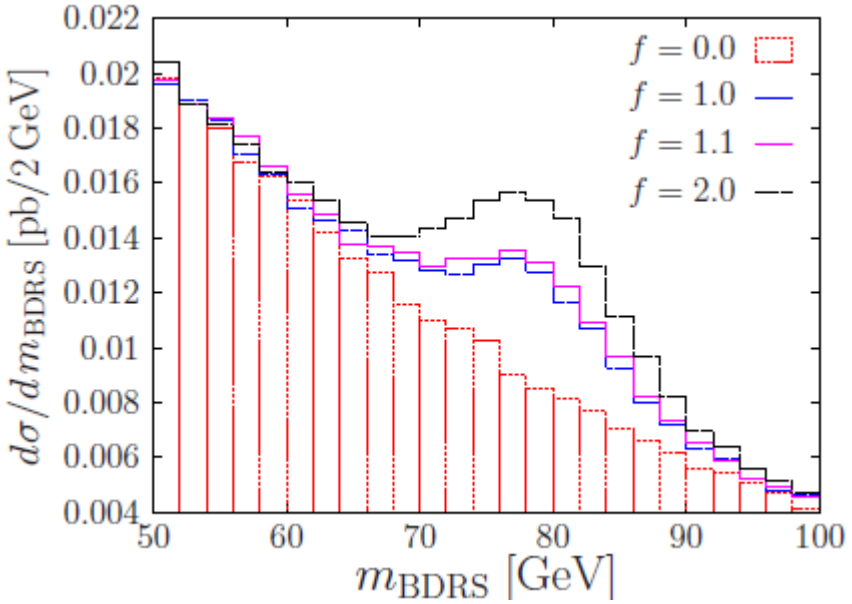
- *Each fat jet is reclustered into C/A R=0.5 pT>200 GeV subjets*
- *Hardest subjet is the quark*
- *Second is the W boson ($p_{TW} > 300$ GeV)*
- *Apply BDRS to the W candidate*

J. M. Butterworth, A. R. Davison, M. Rubin, and G. P. Salam, Phys.Rev.Lett. 100, 242001 (2008), 0802.2470.

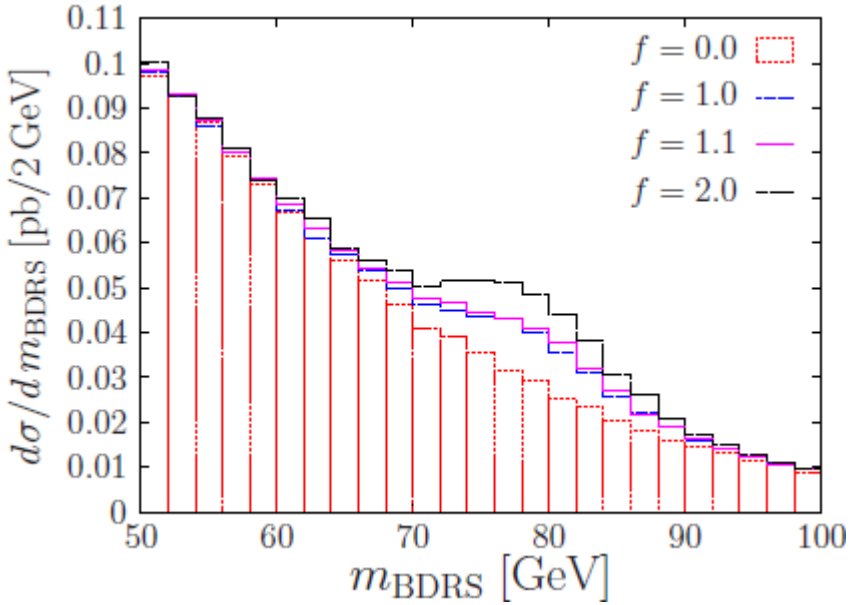
500 GeV



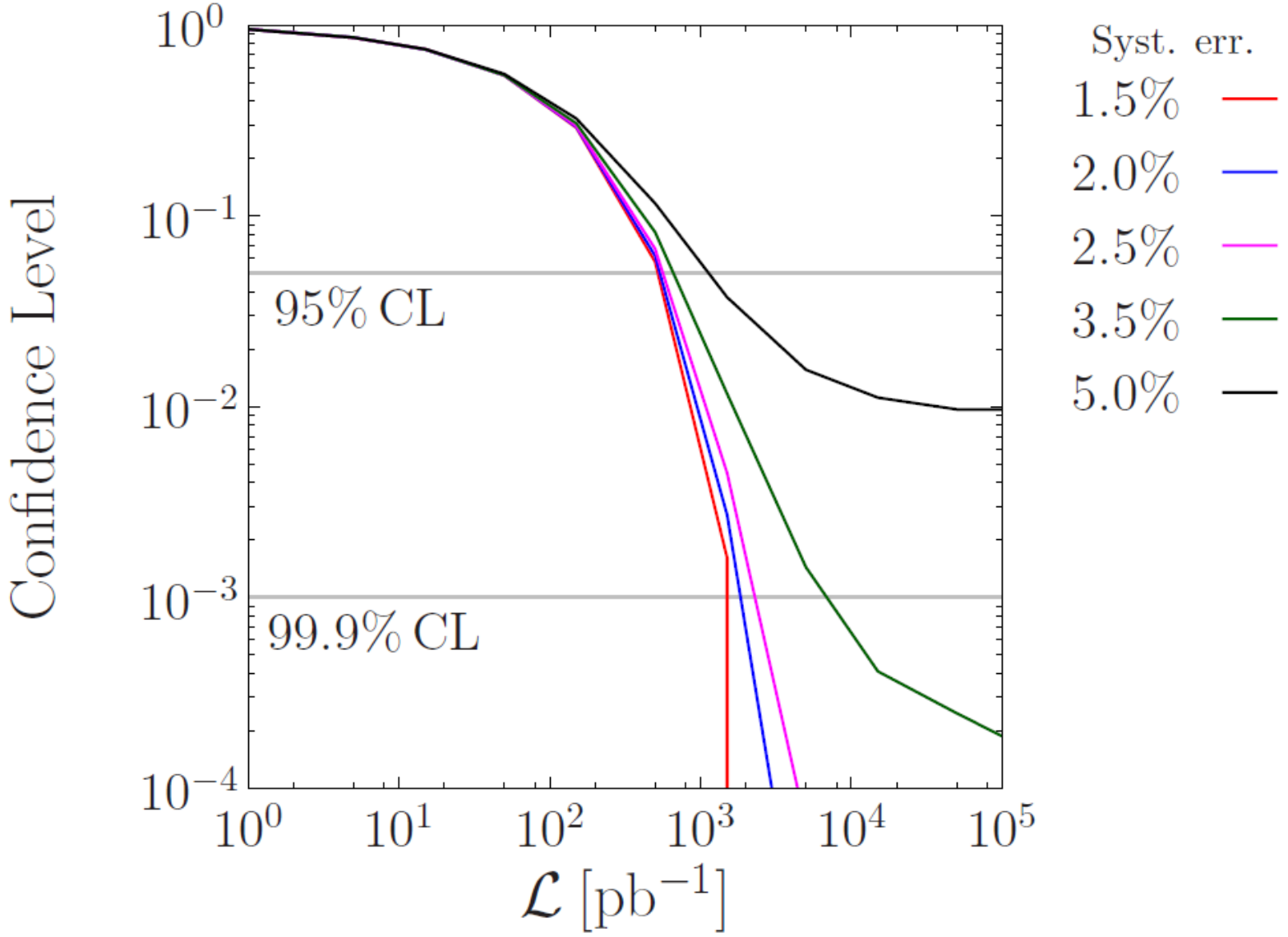
1000 GeV



750 GeV



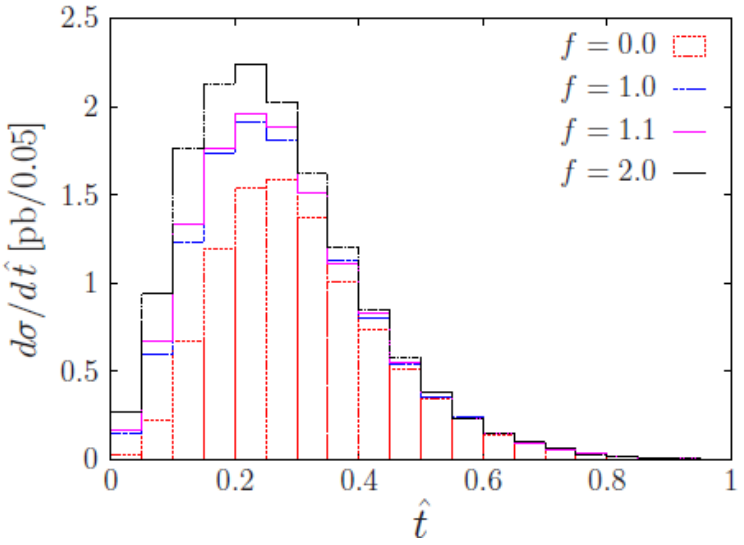
f=2 exclusion with m_{BDRS} reconstruction with 1 TeV selection cut



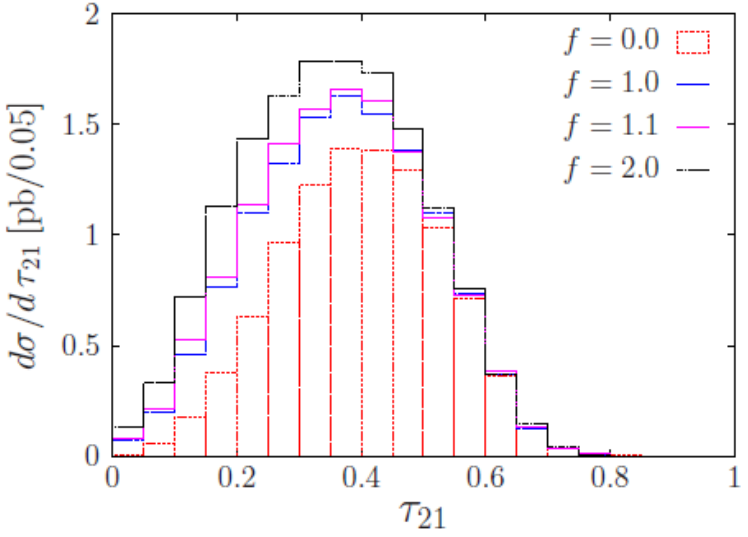
Jet Shapes

- *Jet Shapes supply "orthogonal" to the mass reconstruction information.*

$$\widetilde{t} = \frac{\sum_i |\mathbf{p_{Ti}} \cdot \mathbf{n}_{min}|}{\sum_i |\mathbf{p_{Ti}} \cdot \mathbf{n}_{maj}|}$$



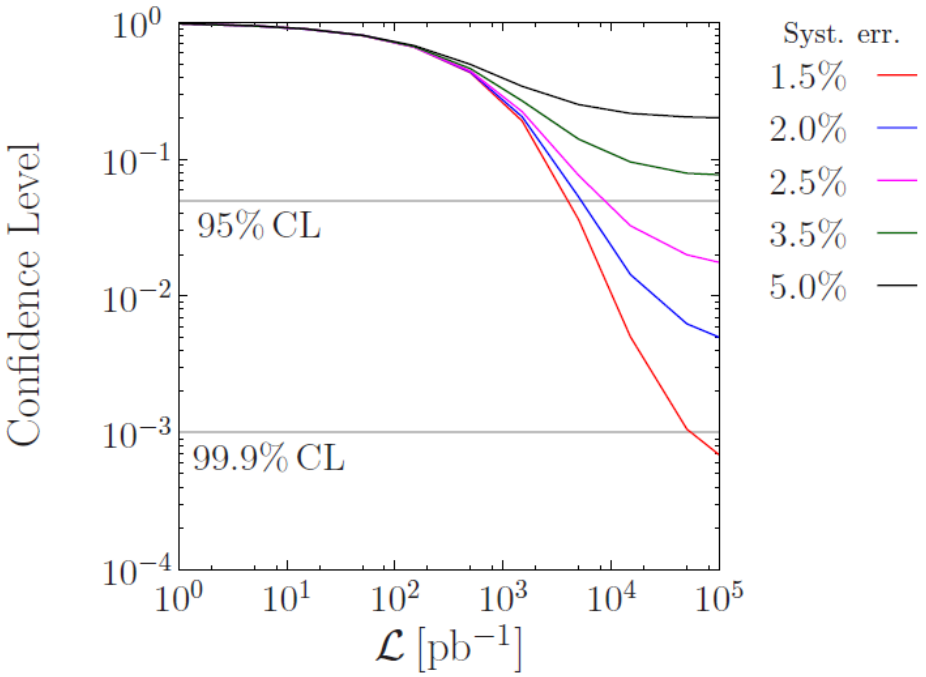
$$\tau_{21} = \tau_2/\tau_1$$



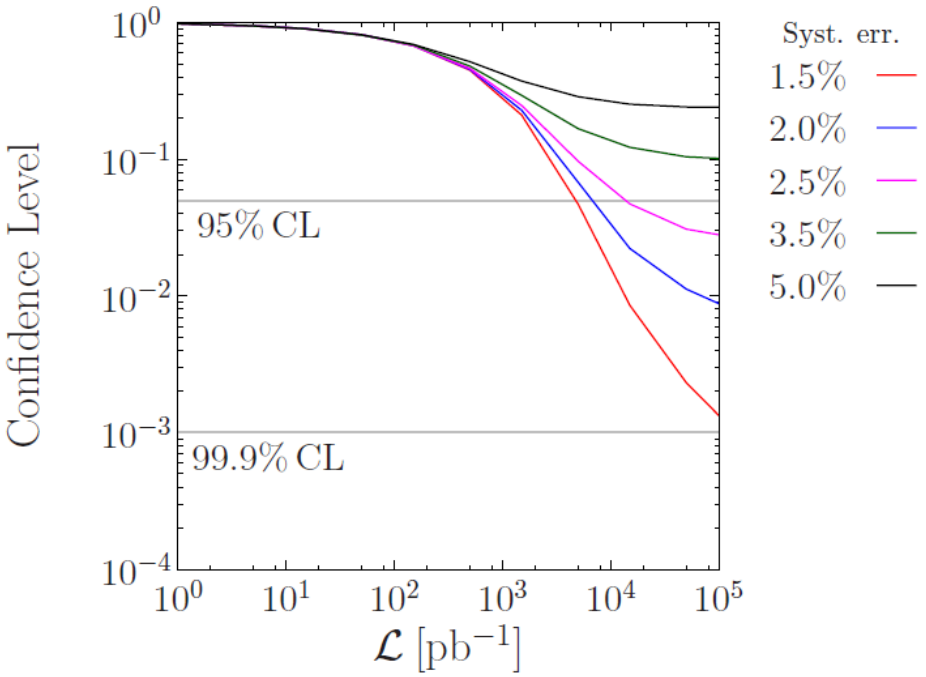
J. Thaler and K. Van Tilburg, JHEP 1103, 015 (2011), 1011.2268

f=1.1 exclusion with JetShapes with 750 GeV selection cut

Ellipticity



τ_{21}

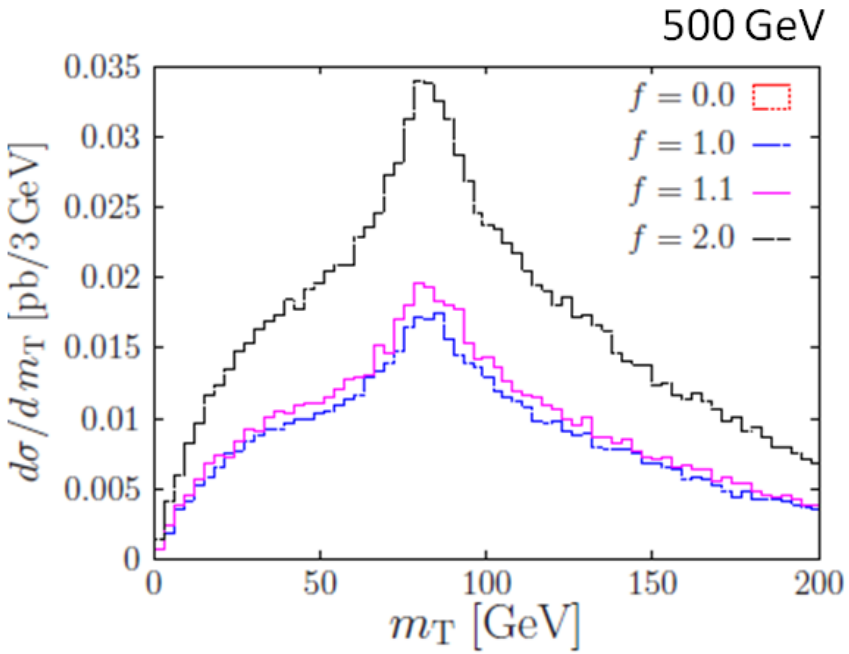


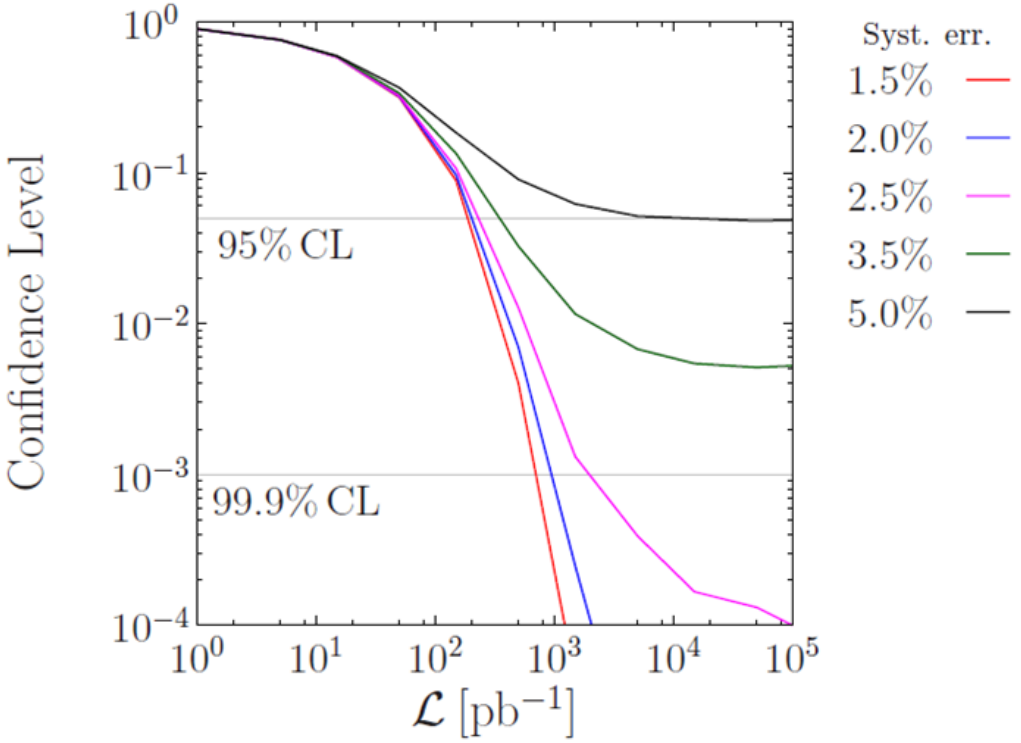
Leptonic W

- S/B>>1 *for 1 isolated hard lepton between SM electroweak shower and QCD-only shower*

- *Smaller cross section, but better background rejection.*
- *Transverse mass*

$$m_T = \sqrt{2E_{Tlep}E_{Tmiss}\,(1-\cos\Delta\phi)}$$





Conclusions

- *Even though W jet tagging techniques have proven very capable, they cannot reconstruct a W radiated in a QCD jet.*
- *In the non-boosted and semi-boosted regimes, hadronic W's mass can be reconstructed with jet substructure techniques.*
- *Jet shapes perform poorly in distinguishing QCD jets with a radiated W from QCD-only jets.*
- *Analysis on leptonically decaying Ws provides best results.*