

# LHC-TI Talk

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1 NLO QCD Calculations and Monte Carlo Event Generator

2 Phenomenology of Quantum Black Hole Production at LHC

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$e^+ + e^- \rightarrow jets$

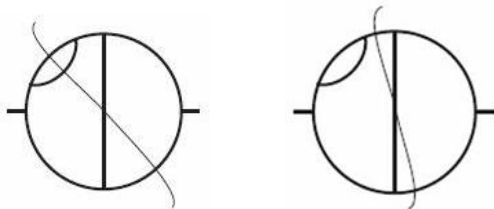
- Three-jet eventshape observable and its expansion

$$\sigma[F] = C_0[F]\alpha_S^B + C_1[F]\alpha_S^{B+1} + C_2[F]\alpha_F^{B+2} + \dots$$

- Monte Carlo event generator

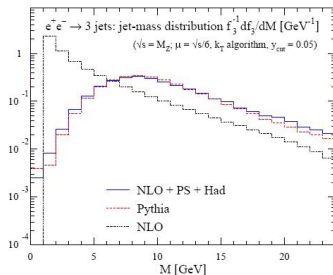
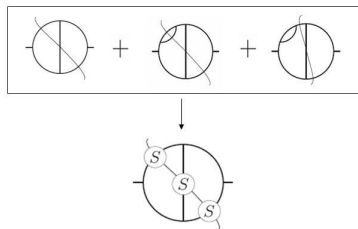
$$\sigma[F] = \frac{1}{N} \sum_{i=1}^N w_i F(\vec{p}_1, \vec{p}_2, \dots, \vec{p}_n)$$

- Pure NLO calculation in Coulomb gauge and divergences



# An Example: Problems and Solutions

- Split LO partons statistically, and maintain the NLO accuracy
- NLO with parton showers and hadronization

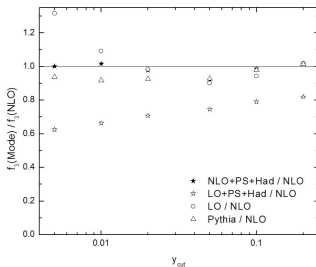
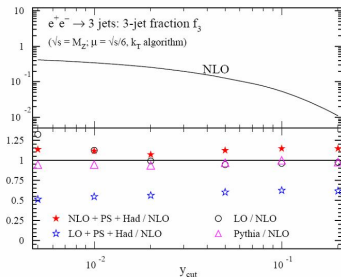


# Important Modification

- A problem with the parton shower algorithm

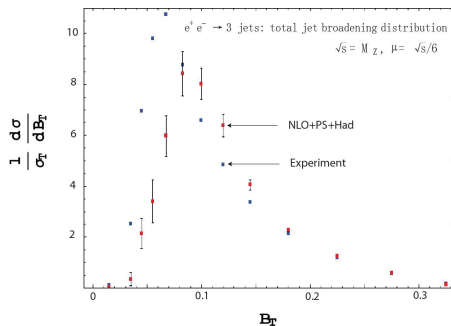
$$\frac{f_3 [\text{LO} + \text{PS} + \text{Had}]}{f_3 [\text{LO}]} \approx \exp \left\{ -3B\alpha_s \left( \sqrt{s}/6 \right) \right\}$$

- Make LO partons split with a bigger probability, and still maintain NLO accuracy



# More Numerical Tests

- An example of 3-jet eventshape observable at  $\sqrt{s} = 91\text{GeV}$



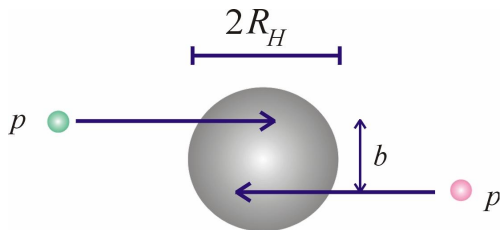
- Calculations near 3-jet region meet expectation; events near 2-jet region need more careful treatment

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# Black Hole Production in Hadron Colliders

- Hoop conjecture



- Extra dimension theories lower Planck scale down to TeV scale, but it is unlikely to see truly thermal black holes at LHC
- Black holes near Planck scale; probing quantum gravity at LHC