Analysis of Exclusive Processes

Andrew Pilkington

THE UNIVERSITY of MANCHESTER

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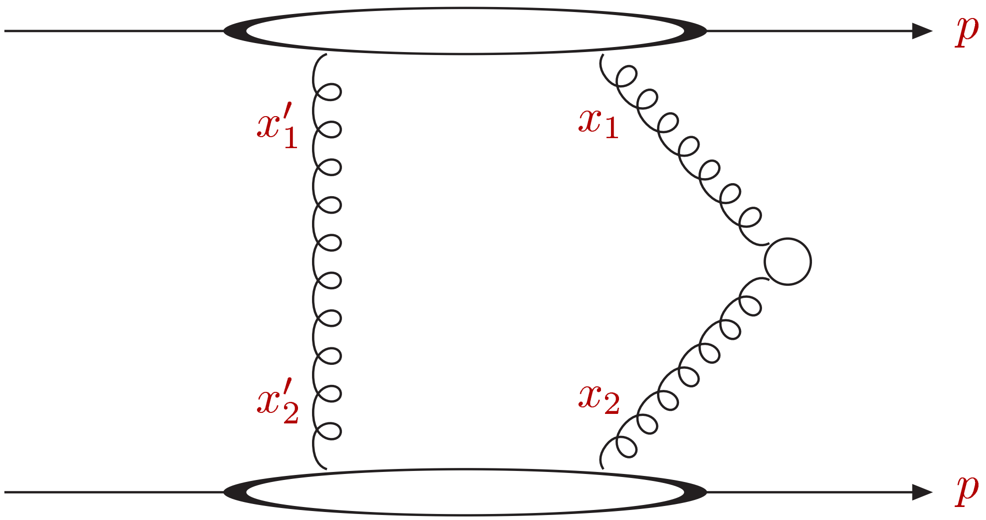
Overview

Two new analysis ideas:

- An exclusive Monte Carlo.
  - To decide whether exclusive higgs can be seen at the LHC
- A new exclusive jet definition.
  - New processes need new ideas

The EXHUME Monte Carlo

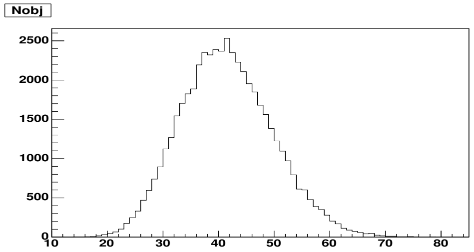
Written with James Monk (also Manchester). EXHUME implements the KMR model.



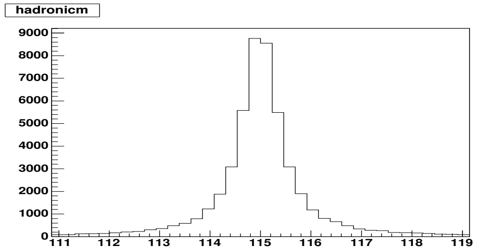
What can EXHUME do?

- Now:
  - Produce the Higgs at parton level.
  - Decay to $b\bar{b}$ and hadronise (using Pythia).
- Soon:
  - Produce $b\bar{b}$ and gg background.
- A bit after that:
  - Produce the bbg background
  - Allow other decays - not just $b\bar{b}$
- And finally:
  - Hadronise via Herwig (just for fun).

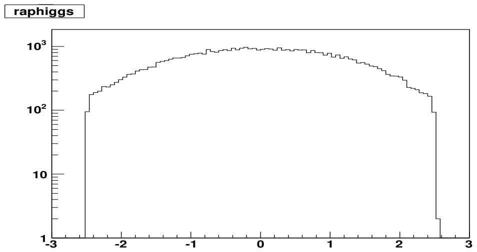
Current Output



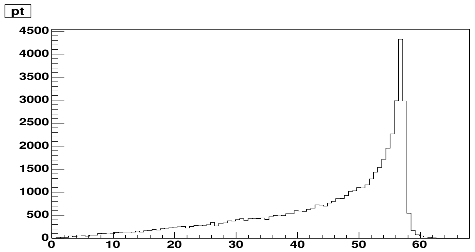
(a) multiplicity



(b) Invariant mass of final state particles



(c) Rapidity of the higgs particle



(d) Transverse momentum of the b quark

Jet Definitions

Why?

- Analysis of Exclusive Higgs and Backgrounds at the LHC
- Exclusive dijet analysis

  - At the LHC for the exclusive higgs analysis, but also

  - At HERA and the Tevatron too?

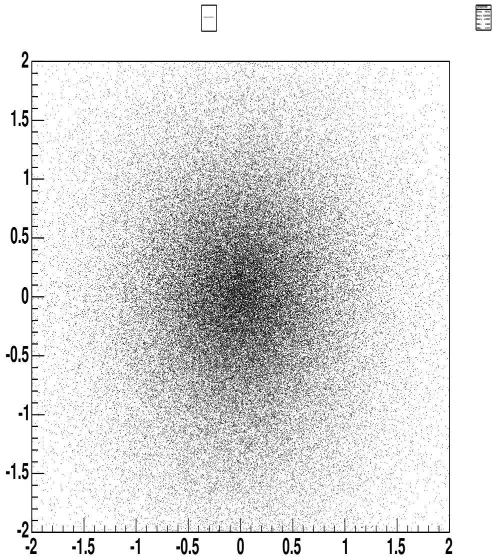
  How?

- Current Jet Finding done mainly by cones but also by clustering algorithms

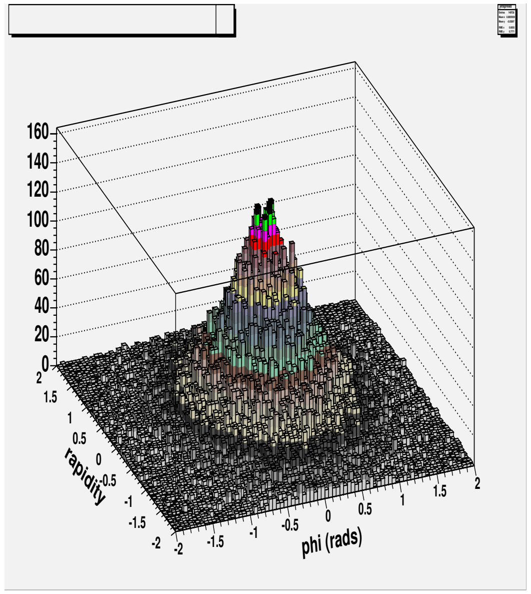
Jets by Cones

- Cone defined in rapidity/phi space
  $\Delta R^2 = \Delta\phi^2 + \Delta\eta^2$
- R defines a spatial extent of the jets.
- Certain amount of cone ovelap allowed.

Distribution of Particles within 15 - 20GeV jets



(e)



(f)

Clusters by KTJet

- All particles, k, and all pairs of particles, kl, are given resolution variables

  $d_{kB} = 2E_k^2 \left(1 - \cos\theta_{kB}\right)$

  $d_{kl} = 2min\left(E_k^2, E_l^2\right)\left(1 - \cos\theta_{kl}\right)$

- the d_{kB} are scaled by a factor R^2.

- Particles are merged into jets by:

  - minimum resoloution, d_{min}, found.

  - if d_{min} is a d_{kl} then these two objects are merged.

  - if d_{min} is a d_{kB} then the object k is defined to be a jet and removed from the list.

Defining Exclusive Jets

- Cone or Cluster......
  - both have radius like R parameters to define jet extent.
  - both find jets but some particles left out ('out of cone radius').
- Exclusive events defined as (CDF):
  - 2 highest Et jets have a mass 0.8 of the missing mass (from roman pots).

A new Jet Definition for Exclusive Events

- Run KTJet algorithm in e^+e^- mode

  - tagged protons mean all particles belong in the analysis.

- Define

  - a stoppping parameter $y_{cut} = \frac{Q_0^2}{E^2}$

  - the particle pair resolution $y_{kl} = \frac{d_{kl}}{E^2}$

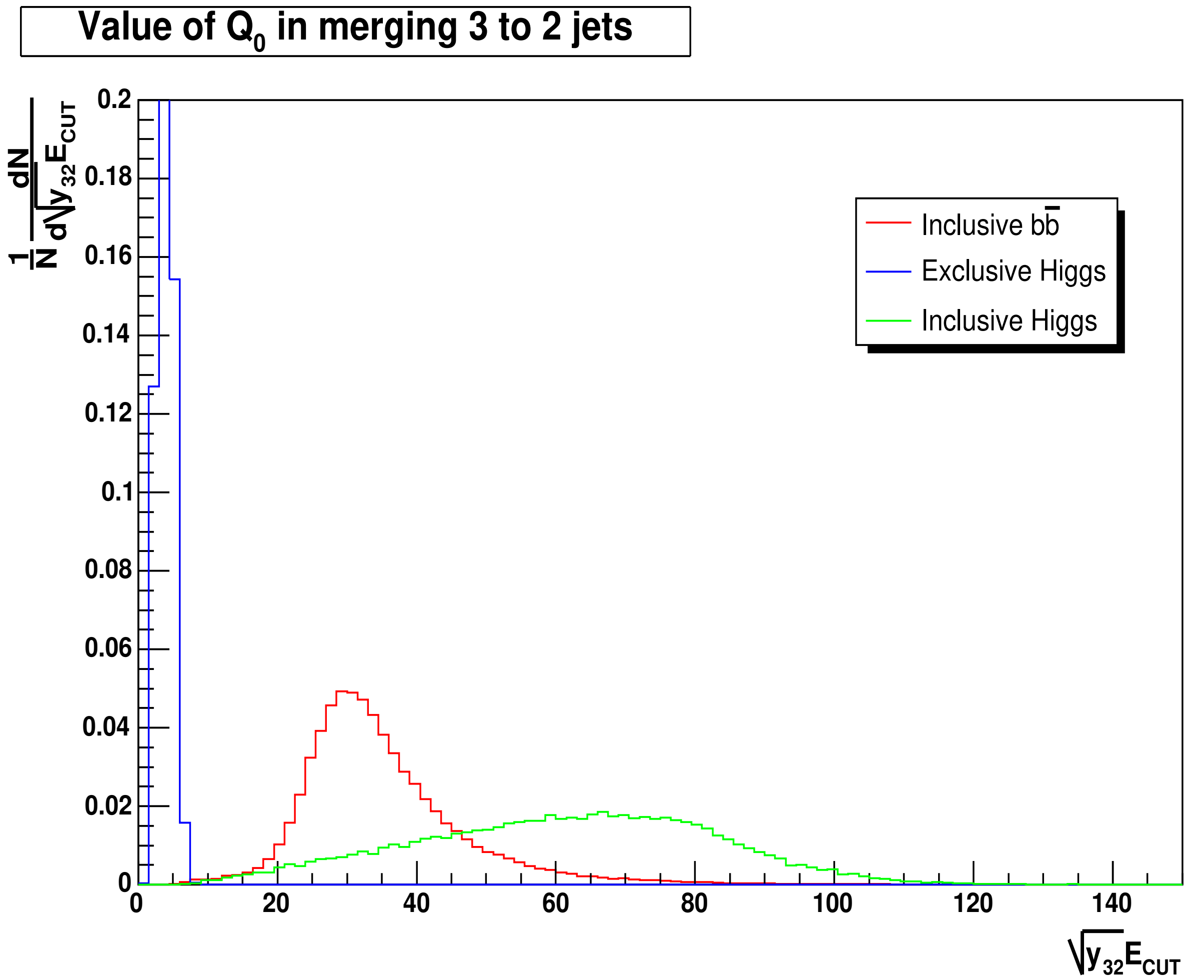
- Objects merged until the minimum value of y_{kl} is larger than y_{cut}

- All remaining objects declared as jets.

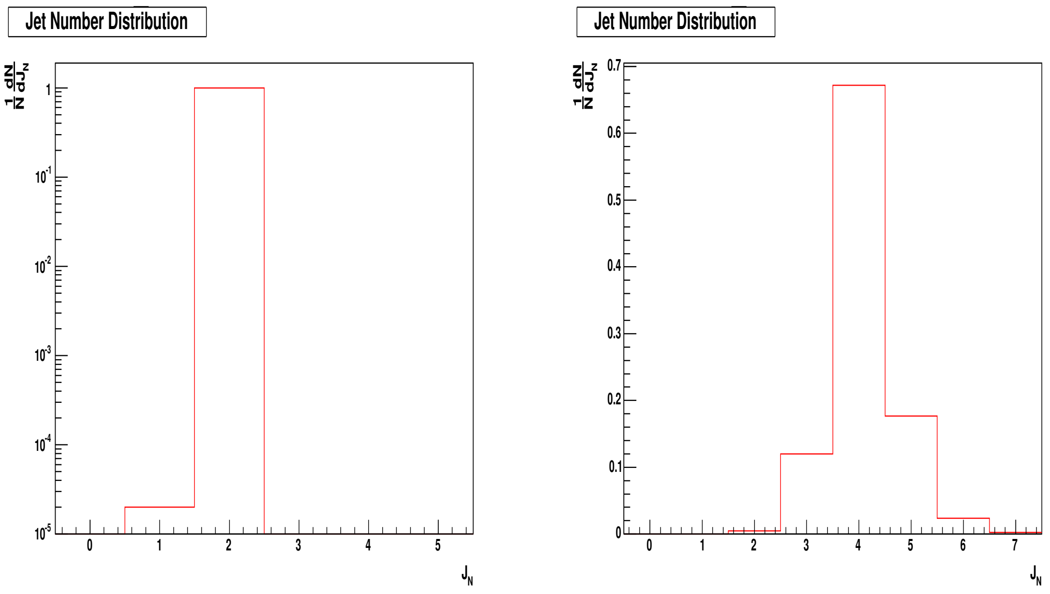
The Analysis

- Exclusive Events generated with EXHUME.
- Double Pomeron Events generated with POMWIG
- What we want: y_{cut} at the onset of 2 jets (y_{32})

The Results


Value of Q_0 in merging 3 to 2 jets
$\frac{1}{N}\frac{dN}{d\sqrt{y_{32}}E_{CUT}}$
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
20
40
60
80
100
120
140
$\sqrt{y_{32}}E_{CUT}$
Inclusive $b\bar{b}$
Exclusive Higgs
Inclusive Higgs

for my 'inclusive background' ....



(g) exclusive

(h) Inclusive $b\bar{b}$

Figure 1: Number of jets found with a resolution of $Q_0 = 10$.

So it works - How well?

- Does it work better than the other method of defining exclusive events?

  Possibly....

- Defining exclusive events this way keeps $\approx 100\%$ of the signal

  But

- The inclusive background is larger than that found by the cone method.
- Cone algorithm also performing well on unsmeared data.

  However

- When smearing occurs the advantage will be with the new jet definition.
- More on this very soon......

Summary

- KMR-type exclusive events will soon be available in Monte Carlo format
- Jet Definitions are important in exclusive analysis.