Beam-Background Analysis in Jet/Etmiss Signatures

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Goals:

- Study jet/Etmiss signatures from machine induced backgrounds: beam-halo and beam-gas.

- Compare beam-background Monte Carlo simulations with real LHC data produced in single-beam runs in September 2008.

- **Develop jets clean-up cuts for beam-gas and beam-halo using both single-beam data and simulations**.

Single-Beam Analysis

- Analyzed 3 single-beam runs: 87863, 88069, 88153.

  87863: Messy run. RF capture OFF, therefore lots of beam-scrapping events. Cleaner towards the end. We' ve managed to see many halo events (in event displays) considering jet multiplicity < 3.

  88069: **Best run for triggered beam**. RF capture ON (clean run). Definitely the **best run to understand real LHC backgrounds**. High Statistics (~ 150.000 events). Drawback: lacks LAr.

  88153: Complicated trigger issues. High contamination of cosmic rays, but RF capture ON.
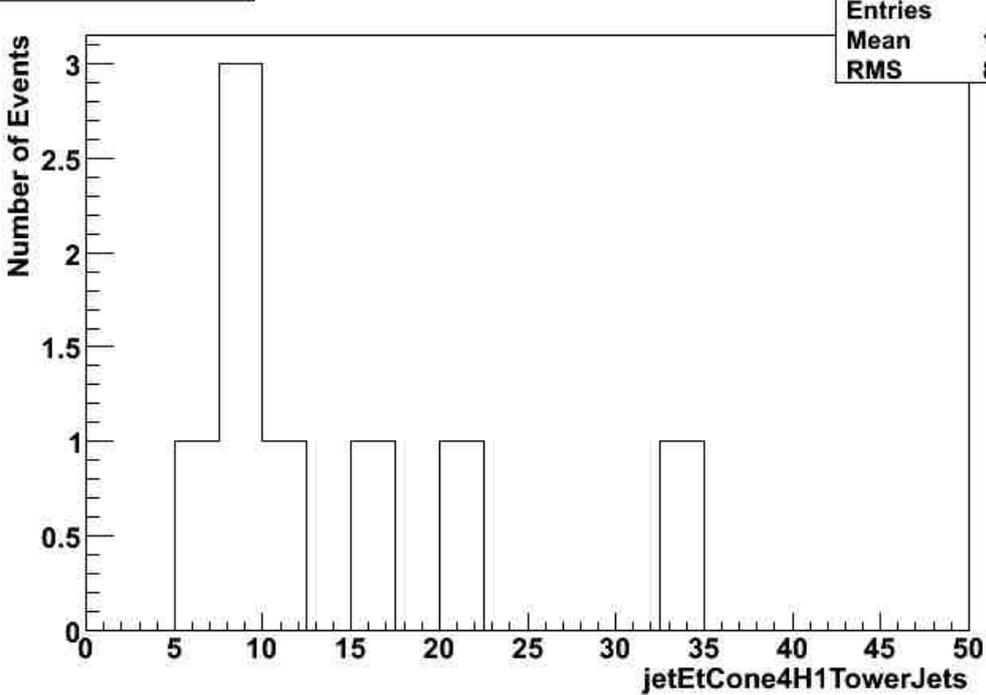
Jet distribution and 3D event display
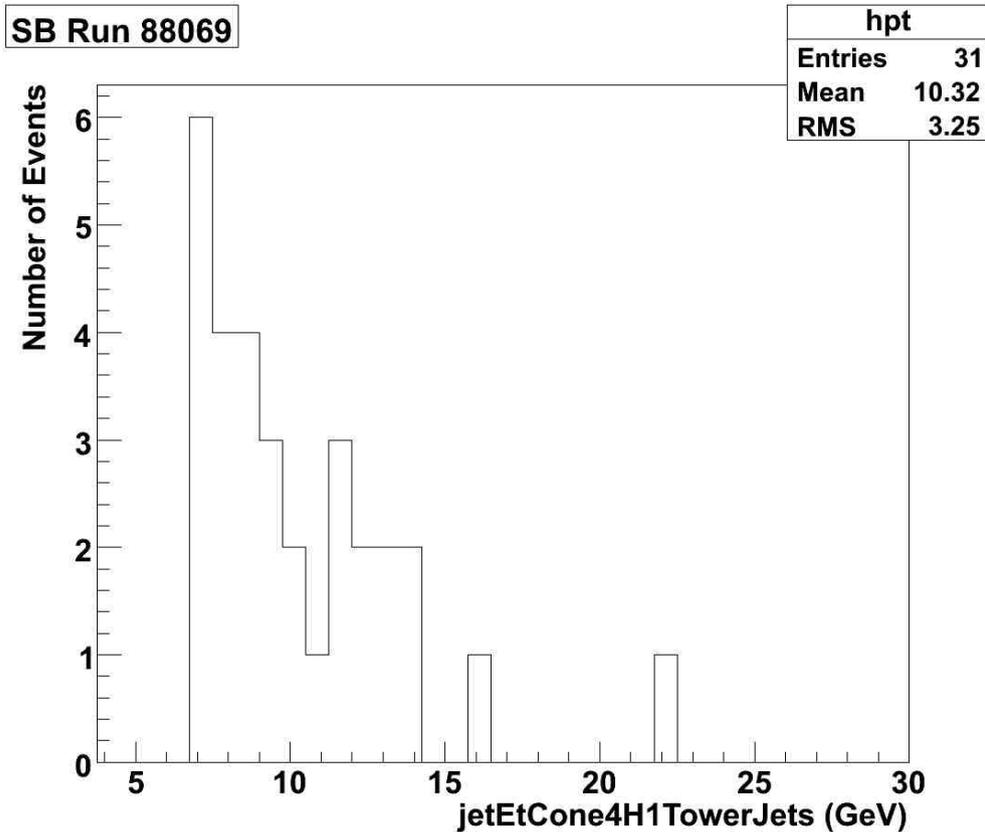
Jet et distribution and a dijet beam-halo event in run 88069. As this run was very close to LHC conditions it offers a first idea of what to expect, always keeping in mind LAr was out.
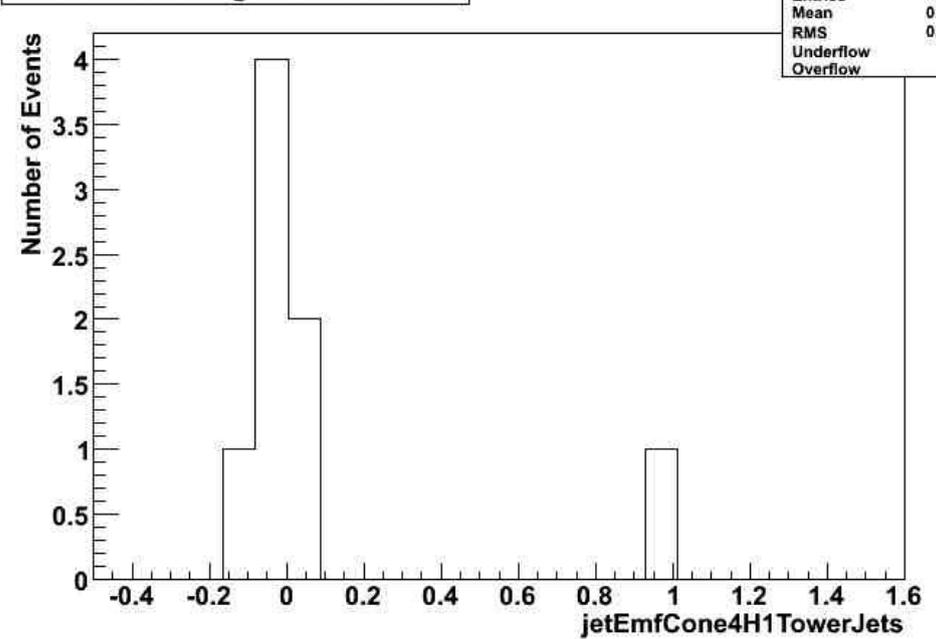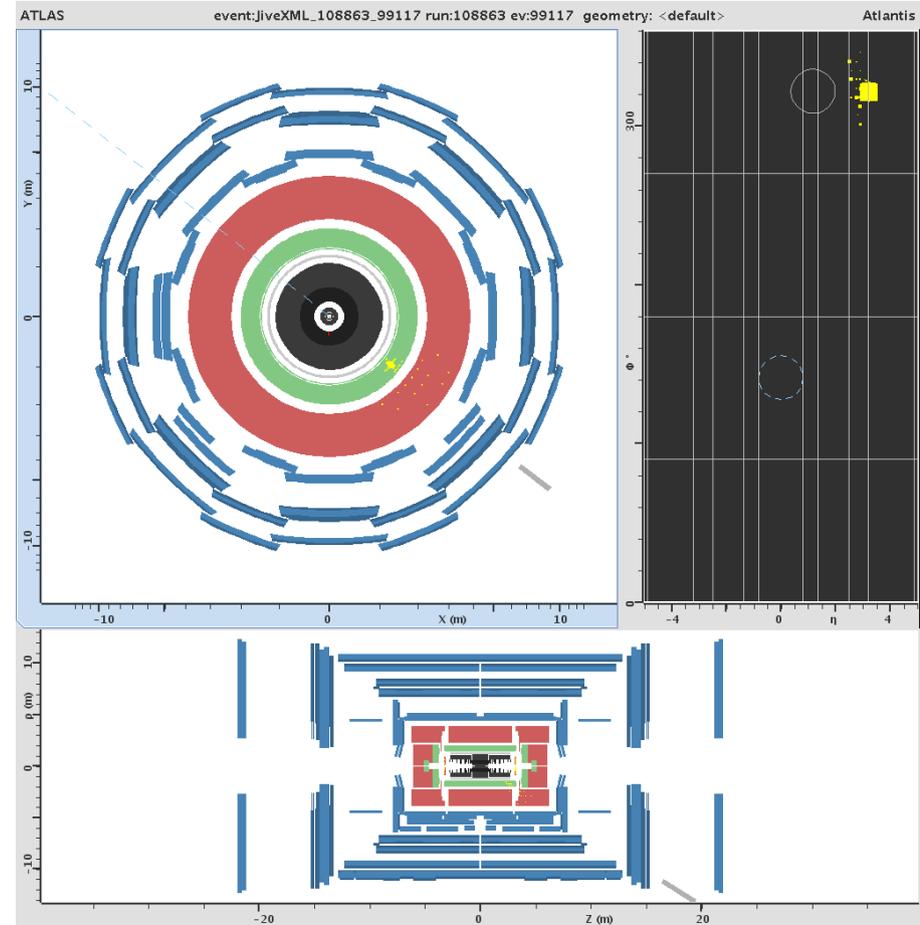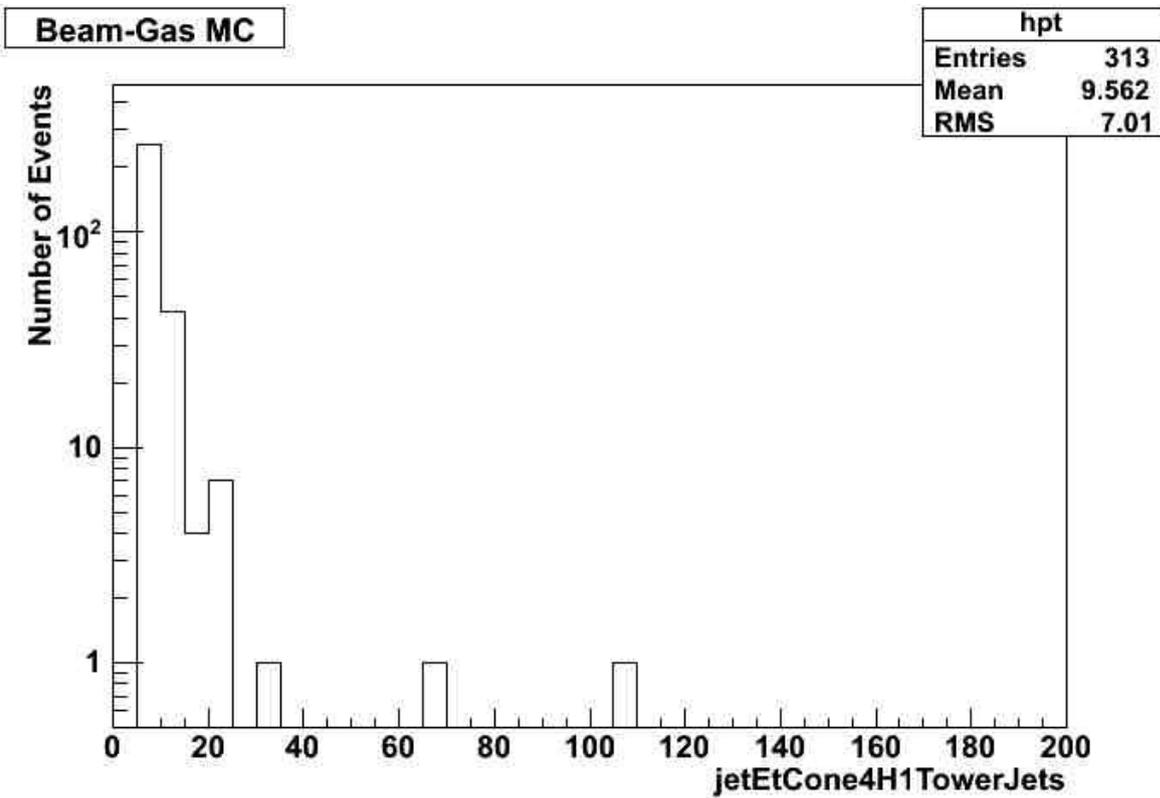
Monte-Carlo Beam-Halo studies

Beam-halo MC studies so far not conclusive. Very low jets statistics (in a 100.000 events sample).

Monte-Carlo Beam-Gas Studies

Beam-Gas simulations (100.000 events) predicting few
high energy jets (> 100 GeV, reco for event display).
Jet EM fraction cuts do NOT appear to work here (look like J0, J1).

Jet clean-up cuts results (preliminary!)

- Jet EM fraction > 0.1
  - Beam-Halo MC: 88% (???)
  - Run 87863: 78%
  - Run 88153: 73%
  - cosmics: 81%
  - QCD dijets: 1.5%

- Etile10/Etotal < 0.5
  - Run 87863: 86%
  - Run 88153: 79%
  - Run 88069: 87%
  - cosmics: 79%
  - QCD dijets: 0.2%

Etile2/Etotal < 0.1
  - Run 87863: 72%
  - Run 88153: 58%
  - Run 88069: 52%
  - cosmics: 47%
  - QCD dijets: 0.7%

Future Plans

- Use new tools to suppress beam-halo and beam-gas events: **Primary vertex, timing, charge fraction**.

- Better understand beam-halo and beam-gas events MC generators.

- Use **TMVA** (Toolkit for Multivariate Data Analysis with ROOT) to optimize clean-up cuts (http://tmva.sourceforge.net/)

- Use **new** beam-halo simulated **samples** (already in CASTOR).

- Work closer to "beam-background team" to solve problems such as low statistics for jets distributions in beam-halo MC samples (larger samples if needed).

- Perform overlap studies (QCD + halo + gas). Main problem will be to decide event rates (halo/QCD, gas/QCD).

Back-up

Other Variables

- We have also tried other variables used in the SUSY CSC chapter: "Estimation of QCD Backgrounds to Searches for Supersymmetry".

$$\text{Etile2/Etotal} = \frac{\text{Energy deposited in TileCal outermost layer}}{\text{Energy Deposited in all Layers}}$$

$$\text{Etile10/Etotal} = \frac{\text{Energy deposited in TileCal 2 outermost layers}}{\text{Energy Deposited in all Layers}}$$