Diffractive Higgs Events in the L1 Trigger

(Work in progress)

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- Exclusive Diffractive production of a light higgs boson is very attractive in certain (B)SM physics scenarios:

    - $J_z=0$ suppression gg->bb$_{bar}$ background

    - Mass measurement via 'missing mass' method with Roman Pot far detectors

- Can we expect to trigger on these events at L1 with the central (CMS) detector?

- Currently looking at the characteristics of signal sample.

- C. Hogg, M. Grothe, S. Dasu (Wisconsin) carrying out QCD background studies.

Data Sets

• ~100,000 exclusive diffractive higgs events (no pileup) available at Wisconsin (H(120)->bb$_{bar}$). Generated with the EDDE montecarlo of Petrov and Ryutin, interfaced to CMKIN.

• Also, have small data sample (20,000 events, no pileup) produced with Exhume MC, which implements the KMR Durham model for diffractive exclusive production.

• Full OSCAR / ORCA simulation.

• 3 M(higgs) = 115Gev samples also available: Pile up equivalent to 2x1033, 1x1033, and no pileup.

• L1CaloTrigger code produces a root ntuple containing the relevant L1 quantities.

Level-1 Jets

HCAL — Trigger tower

ECAL

PbWO4 crystal

$\Delta\eta, \Delta\phi = 0.348$

$\Delta\eta, \Delta\phi = 1.04$
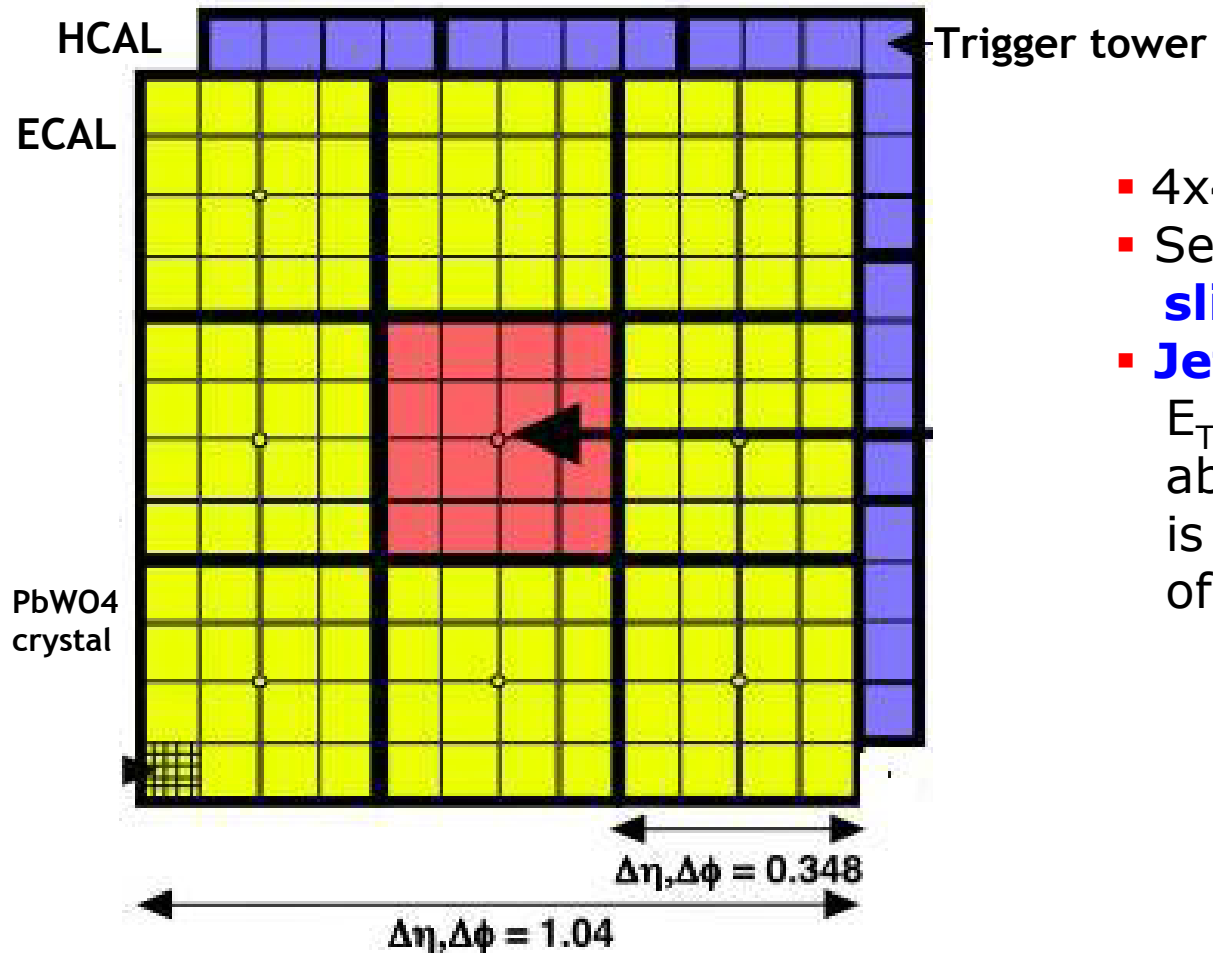
- 4x4 trigger towers = **region**
- Search for jets with a **sliding 3x3 regions window**
- **Jet** = 3x3 region where the E_T in the central region is above some threshold and is bigger than the E_T in any of the 8 outer regions
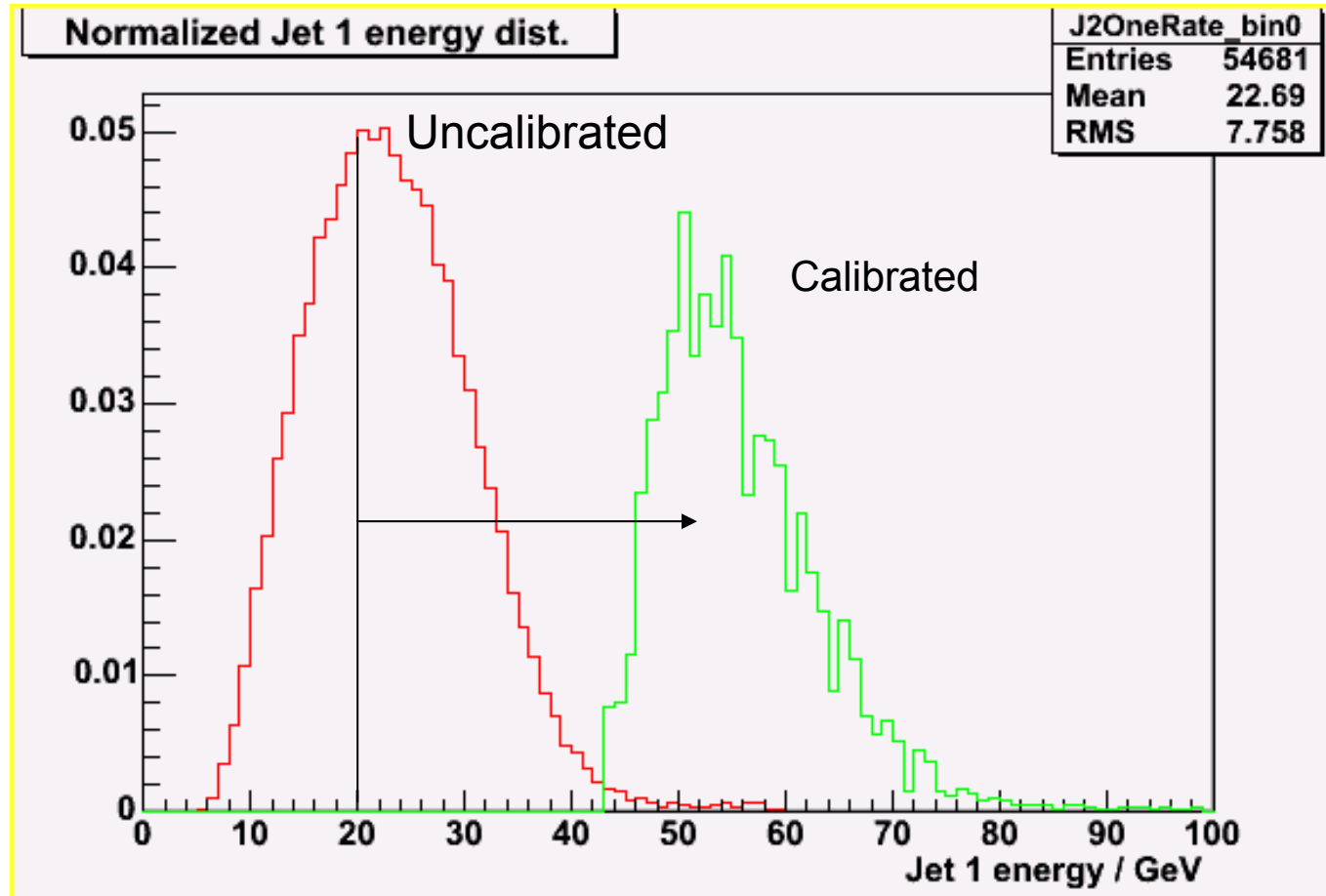
A jet = 144 trigger towers, with typical tower dimensions $\Delta\eta \times \Delta\phi = 0.09 \times 0.09$
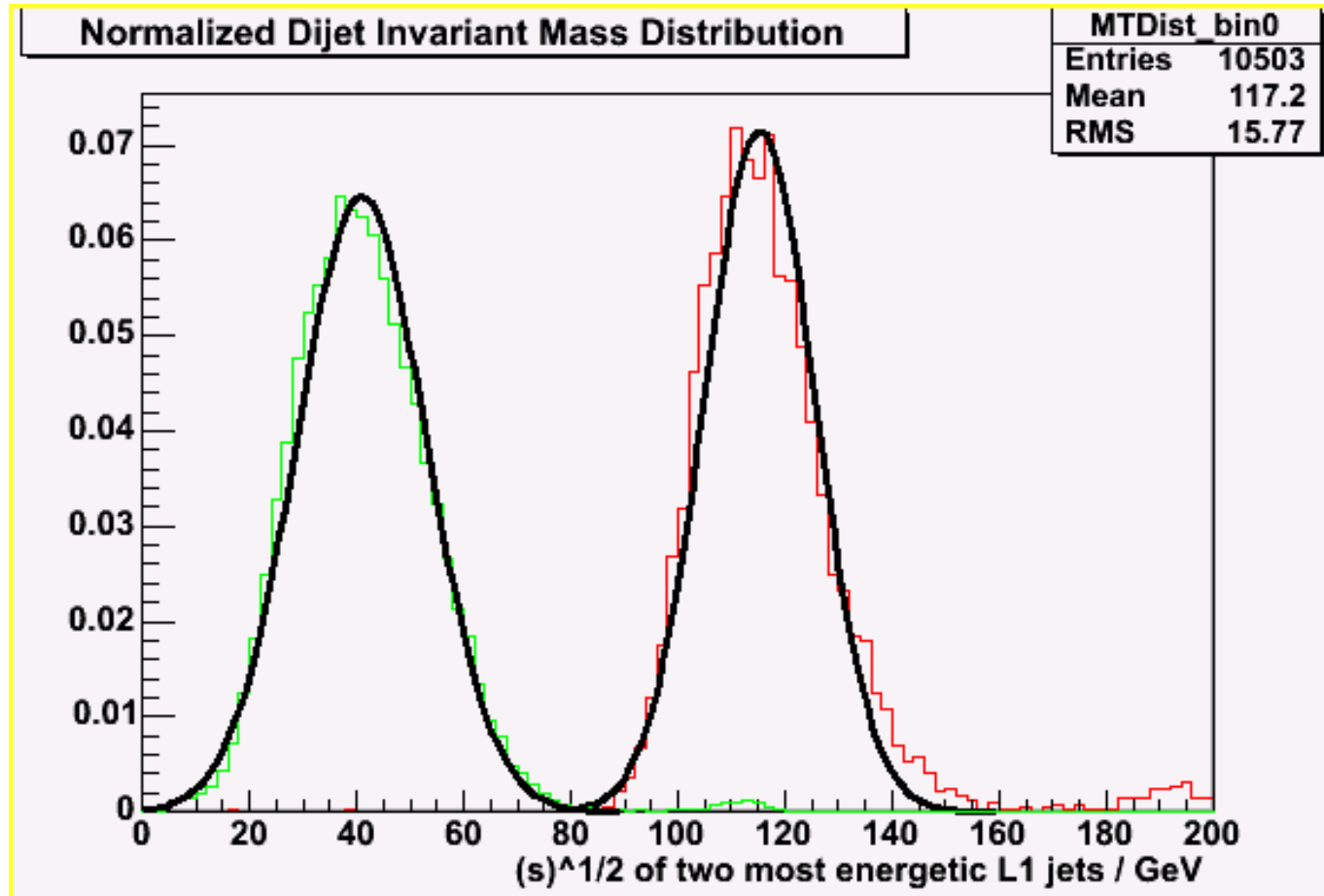Hence typical jet dimensions: $\Delta\eta \times \Delta\phi = 1 \times 1$

EDDE Et Dist.

Note that preliminary calibration used is not valid for L1 Jets with Et < 20 Gev

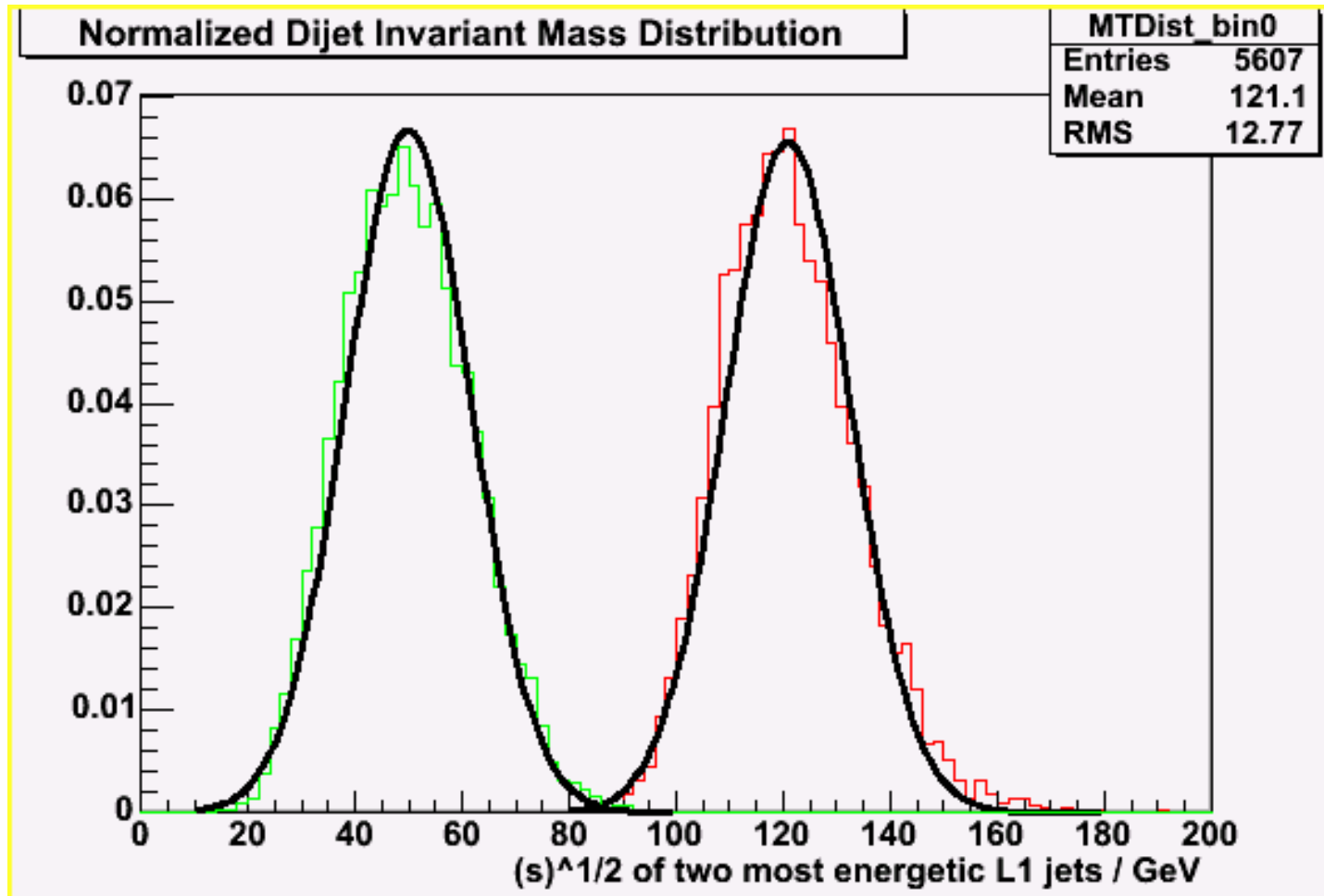R. Croft, Exclusive Diffractive Higgs Signal at L1, Jan 2005

Invariant Mass L1 Dijets

EDDE

Reconstruction of invariant higgs mass from level 1 jets

Plot shows peak before (green) and after (red) calibration.

Normalized Dijet Invariant Mass Distribution

| MTDist_bin0	
Entries	5607
Mean	121.1
RMS	12.77

(s)^1/2 of two most energetic L1 jets / GeV

Exhume

- Plots include Monika Grothe's preliminary L1 Et calibration.

- Higgs peak coarse object at L1.

• Preliminary

• Applies offline jetfinder algorithm to generated partons to determine 'true' jet energy.

• Matches reconstructed jets to genLevel jets according to the distance criterion SQRT($(\Delta\eta)^2$ + $(\Delta\varphi)^2$) < 0.5 for central jets and < 0.3 forward jets.

• Central Jets: -3 < eta < 3

• Determines the ratio Et(rec) / Et(gen) in bins of eta, as a function of L1 jet Et.

• Fits only valid above Et(rec) = 20 GeV.
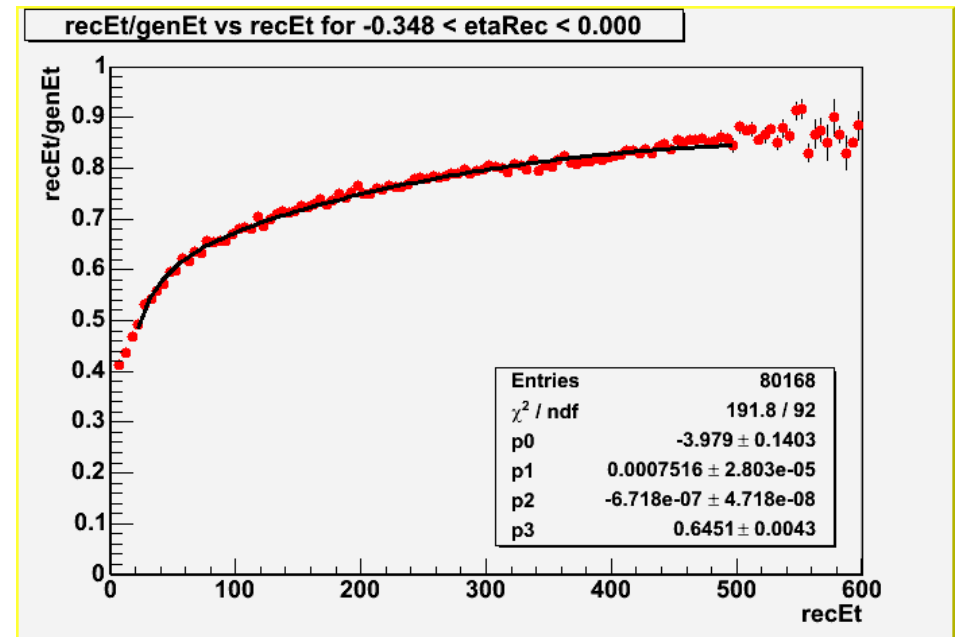
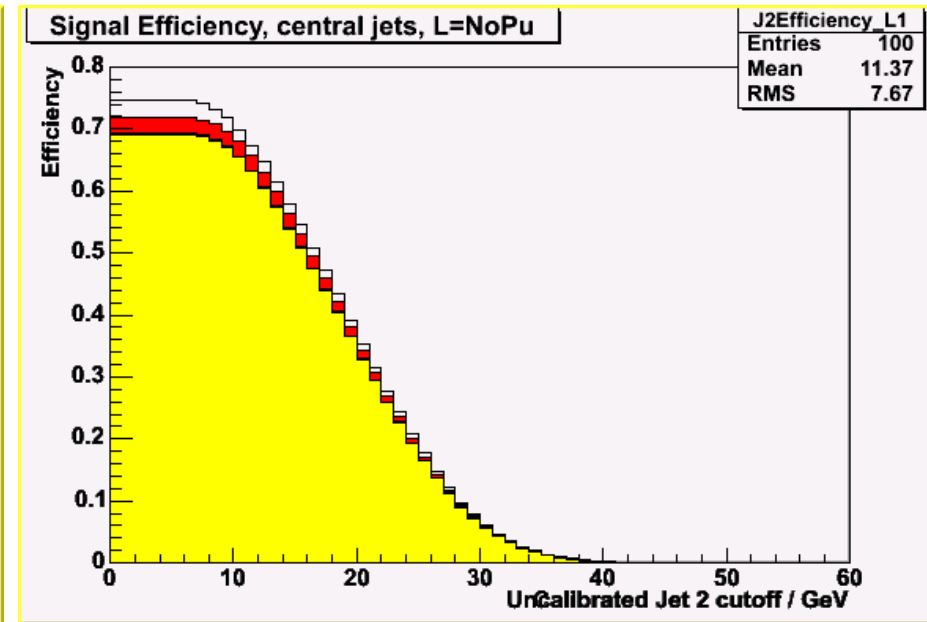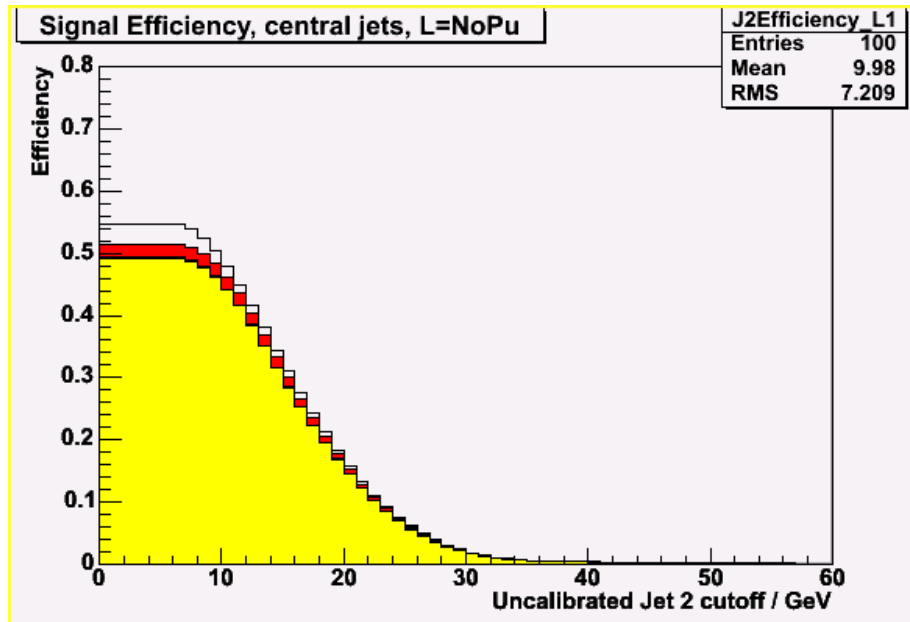*M. Grothe, L1 Jet Response Without Pileup, LPC Trigger Meeting 11/5/04*

L1 Signal Sample Efficiency Plots

Uncalibrated EDDE

Uncalibrated Exhume

Dijet signal efficiency: No cut (w), (Et1 + Et2)/Ht > 0.7 (r), 0.8 (g), 0.9 (m), 0.95 (y)

- Plot is integrated and not 'per bin'.

- Exhume shows greater efficiency for central jets

L1 Signal Sample Efficiency Plots

- Ht = sum of scalar Et of all jets with Et(jet) > threshold

- Advantages over total scalar Et:

  - Sums only over Et around local energy maxima

  - More robust against noise and minimum bias events

- A cut on Et / Ht is used to help control the QCD two-jet rate, (see C. Hogg, M. Grothe, S. Dasu, Status of L1 Trigger Studies with EDDE, CMS Week 06/04).

- Cuts have been included in plots to put them in context with background studies

•A calibrated efficiency plot would give a much clearer idea of how much energy is available in these events, and how flexible we can be with cuts, at L1.

•However, calibration used so far only valid for Et(rec) > 20GeV.

•Need to define a jet correction below this level.

• Perhaps just divide jets into several Et Bins and take average value of Et(rec) / Et(gen) in each bin as correction factor. Simple, if a little crude.
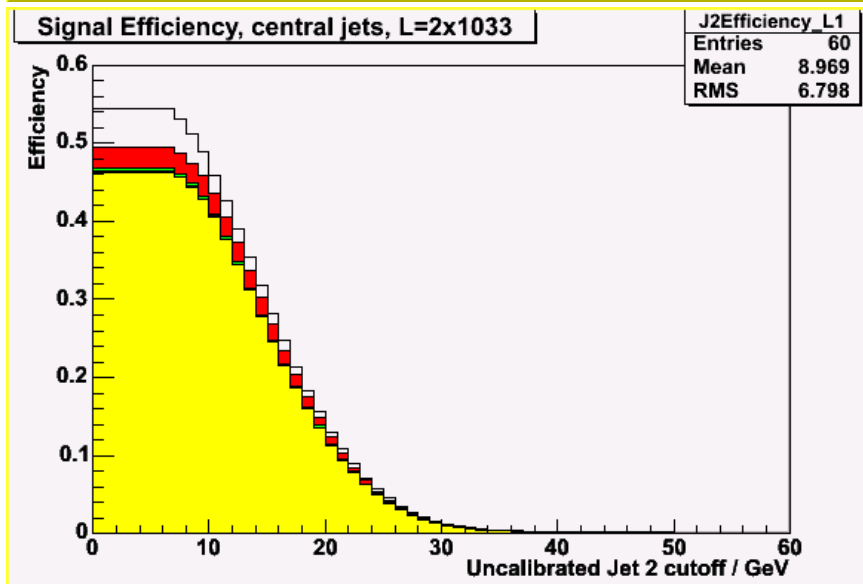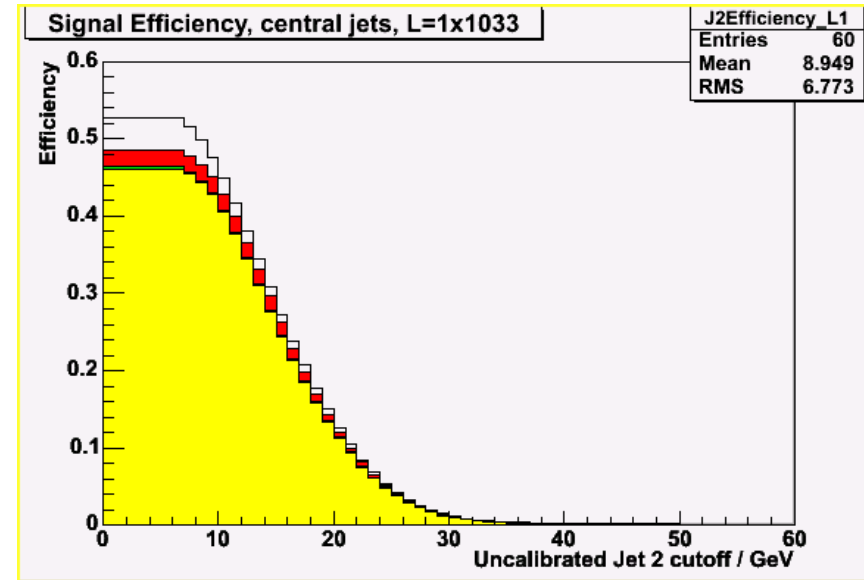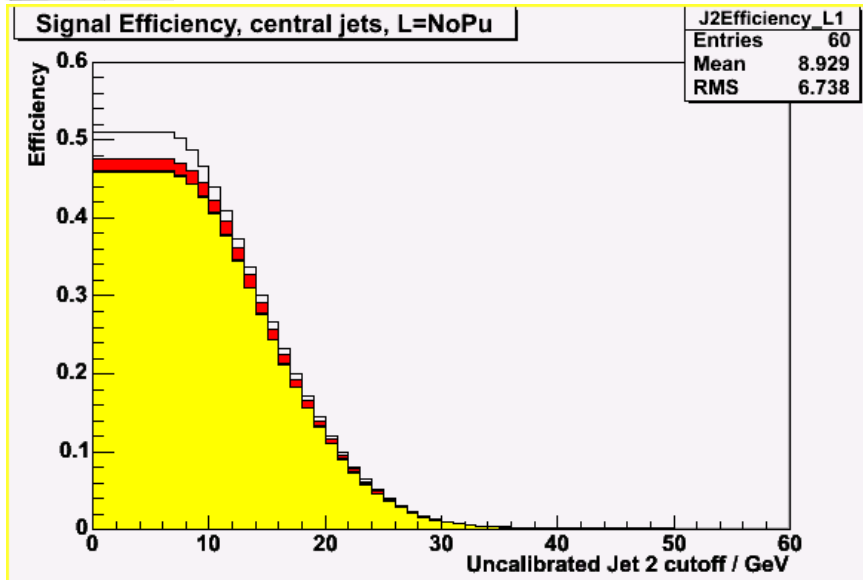
- M(higgs) = 115GeV (EDDE)

- Uncalibrated.

- Conclusion: Efficiency doesn't change much with pileup

R. Croft, Exclusive Diffractive Higgs Signal at L1, Jan 2005

• Efficiency plots help set the scale for what we can expect to achieve in terms of triggering.

• The Exhume montecarlo is clearly more efficient for jets in the central region.

• Need to introduce correction factors for L1 jets with Et < 20 GeV and produce fully calibrated efficiency plots.

• So far we have considered the central CMS detector only. Will now start work on defining additional constraints at L1 by making use of the Totem RP information on acceptances etc that is now available.