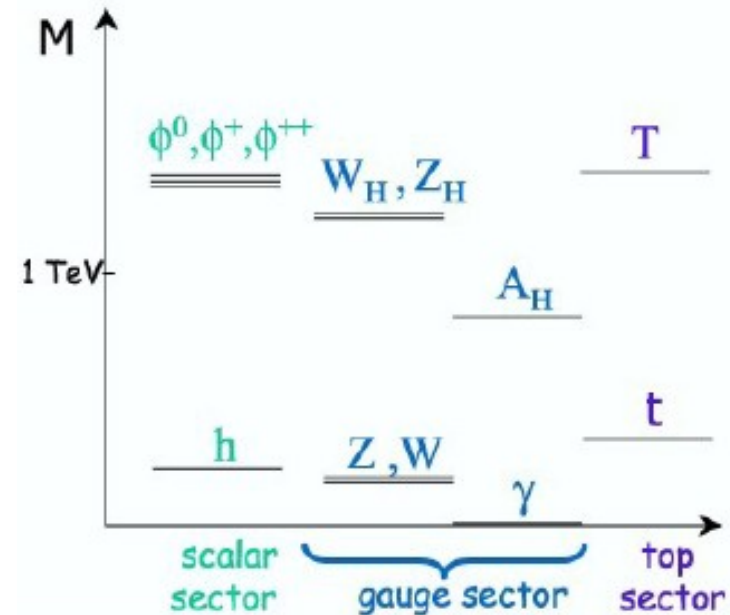

ATLAS Little Higgs Analysis Status at IFIC

Santiago González de la Hoz, Elena Oliver,
José Salt, Eduardo Ros, Miguel Villaplana,
Marcel Vos

Instituto de Física Corpuscular
(CSIC-UEG)

Little Higgs Model

- This model solves hierarchy problem of SM including new particles to cancel radiative corrections:
 - T quark with charge 2/3.
 - Heavy gauge bosons.
 - Scalar particles, including Higgs.
- Only **two** parameters: mass and angle between W_H and Z_H .
- Littlest Higgs: **minimum** particles are needed.



This plot shows Littlest Higgs Model with quarks top and T, four gauge bosons and four scalars.

W_H and Z_H are interesting because they have a **high cross section**.

General Description

- Athena 12.0.6, UserAnalysis-00-09-10
- Simulation Pythia 6.4 (GRID, Tier-2), **20000** events
- Signal Channel (Littlest Higgs) semileptonic:

$$Z_H \rightarrow t \bar{t} \rightarrow W^+ b, W^- \bar{b} \rightarrow l \nu, jj \quad m_{Z_H} = 1 \text{TeV}$$

- Irreducible Background of high energy:

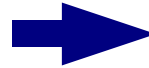
$$g g \rightarrow t \bar{t} \quad \sqrt{s} > 500 \text{GeV} \quad p_t > 100 \text{GeV}$$

Target: to **discriminate** Signal from Irreducible Background.

Steps

- Discriminant variables

- Angle between tops
- Subtraction momenta
- Relations lepton and top
- ΔR

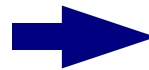


Analysis in **Full Simulation**

TruthParticleContainer

- Reconstruction Z_H boson.

- Btagging performance



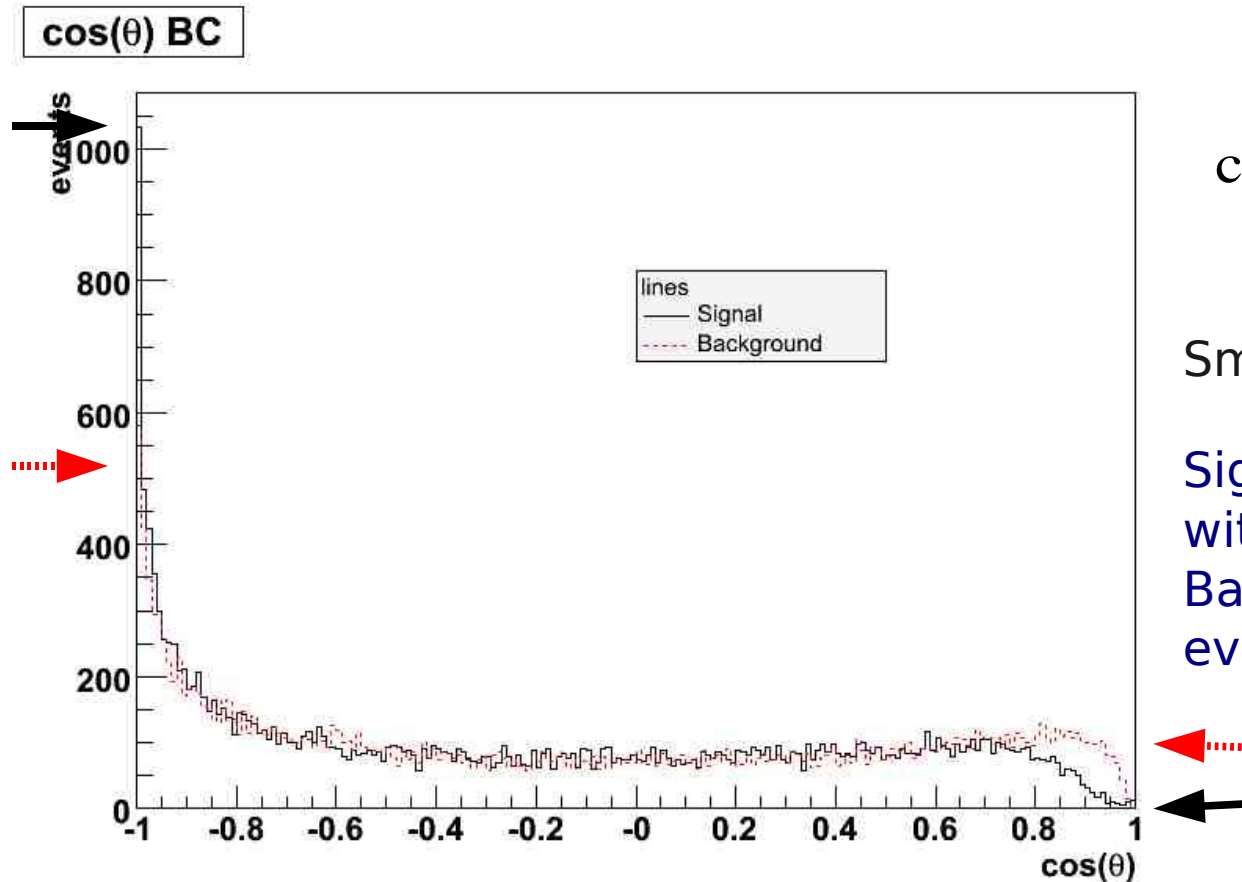
Analysis in **Full Simulation**

Electrons: ElectronCollection

Muons: MuonCollection

Jets: Cone4TowerParticleJets

Angle between top and antitop

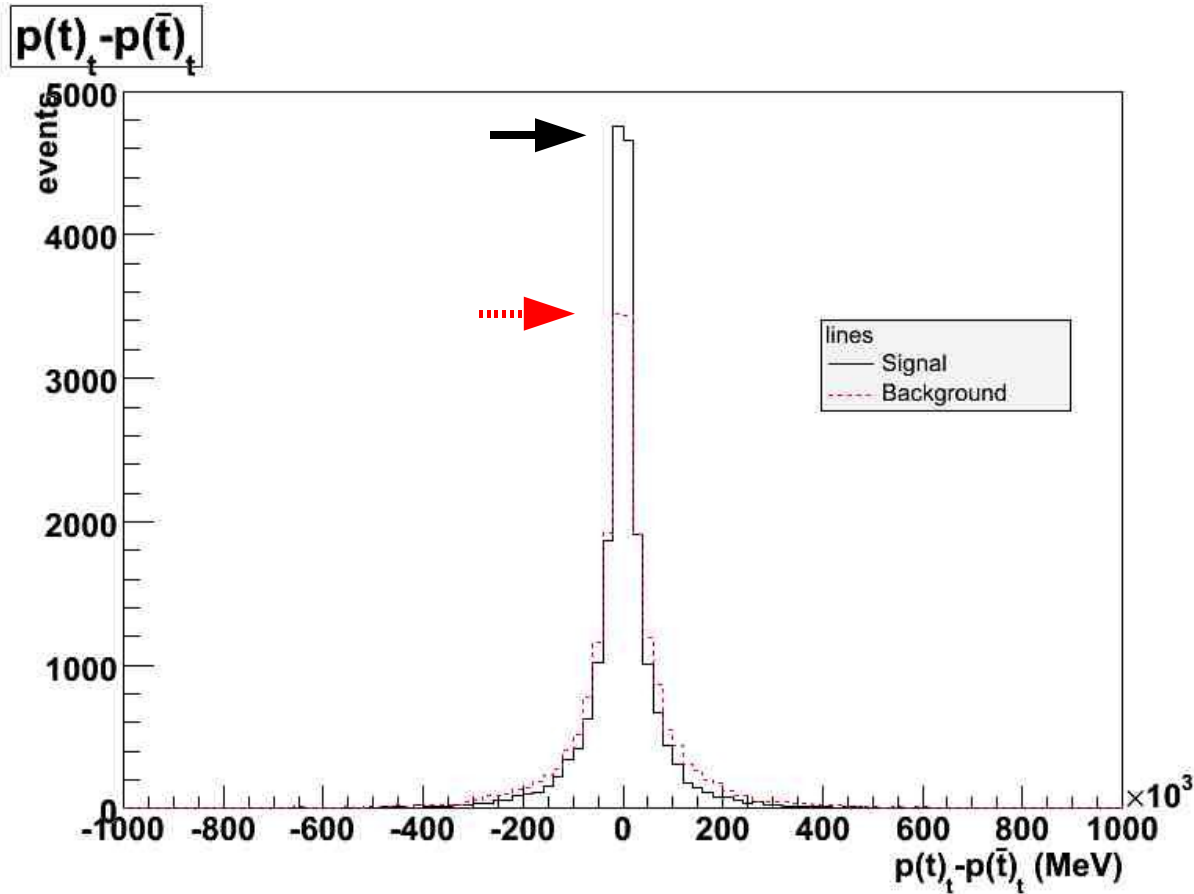


$$\cos \theta = \frac{\vec{p}(t) \cdot \vec{p}(\bar{t})}{|\vec{p}(t)| |\vec{p}(\bar{t})|}$$

Small differences:

Signal has more events
with $\cos(\theta) = -1$ and
Background a little bit more
events with $\cos(\theta) = 1$

Subtraction Momenta

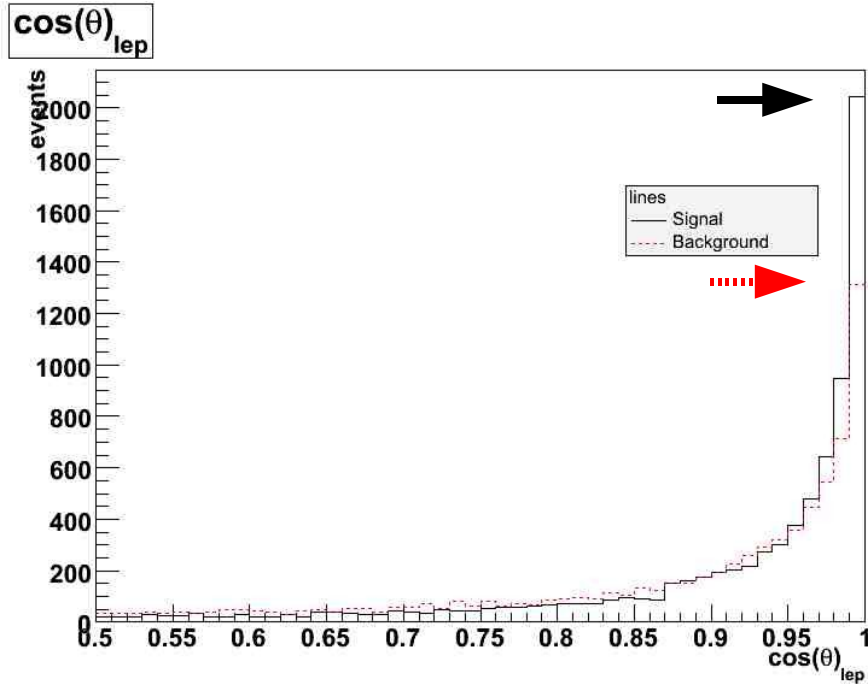


$$p_t(t) - p_t(\bar{t})$$

Small difference:

Signal has more events
with value zero

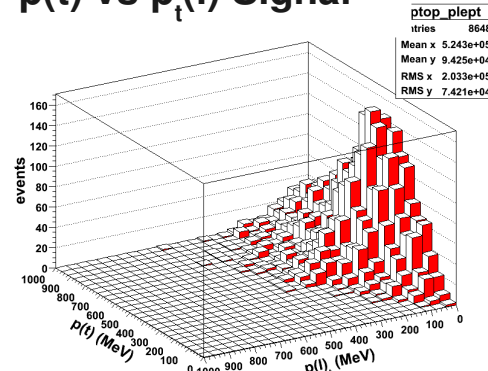
Relations lepton (e, μ) and top



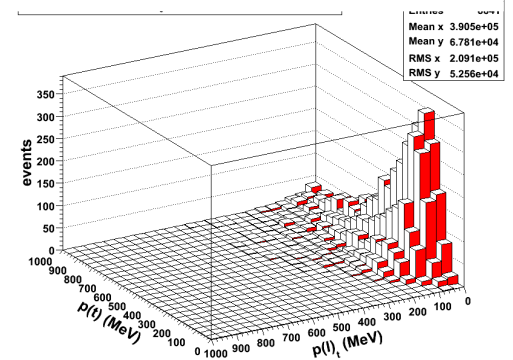
$$\cos \theta_{lep} = \frac{\vec{p}(t) \cdot \vec{p}(l)}{|\vec{p}(t)| |\vec{p}(l)|}$$

Difference:
Signal has more events with value 1

p(t) vs p_t(l) Signal



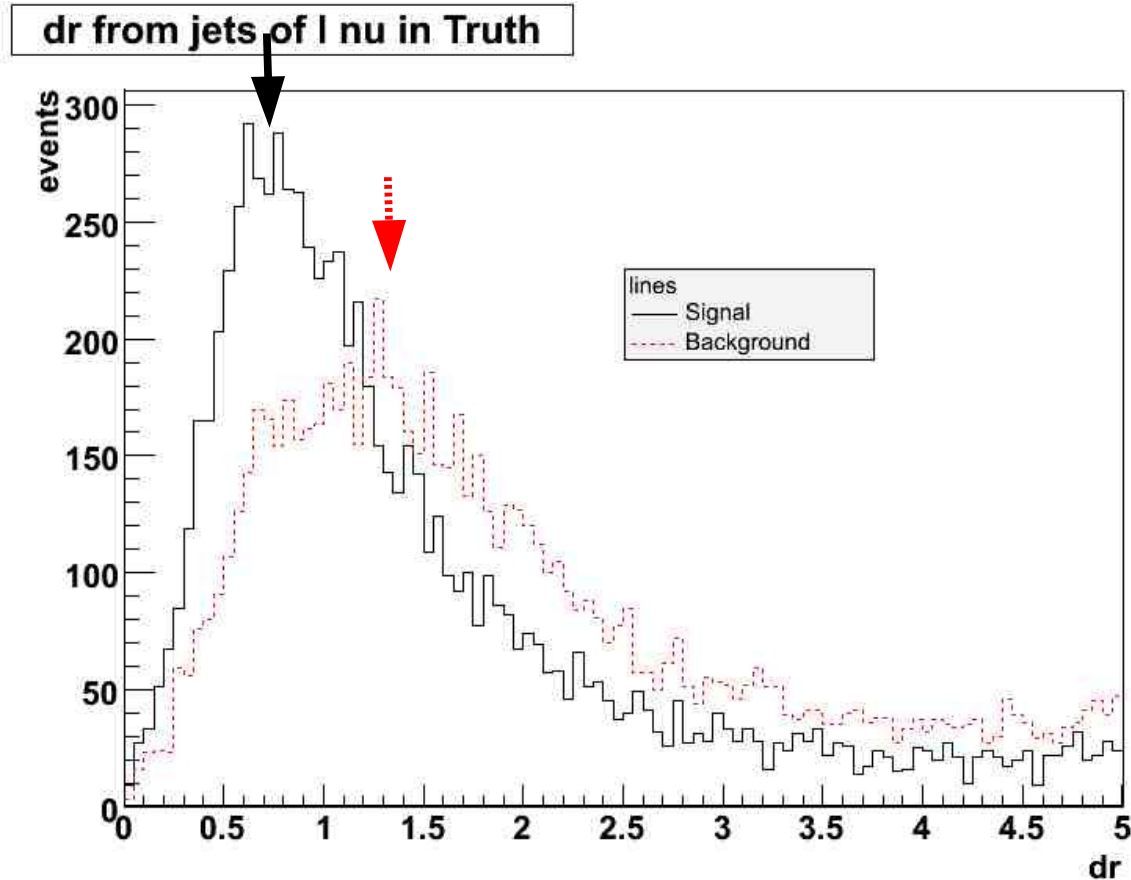
p(t) vs p_t(l) Background



$$|\vec{p}(t)| \text{ vs } p_t(l)$$

Difference:
No differences, same behavior

DeltaR



$$\Delta R = \sqrt{(\Delta \eta)^2 + (\Delta \phi)^2}$$

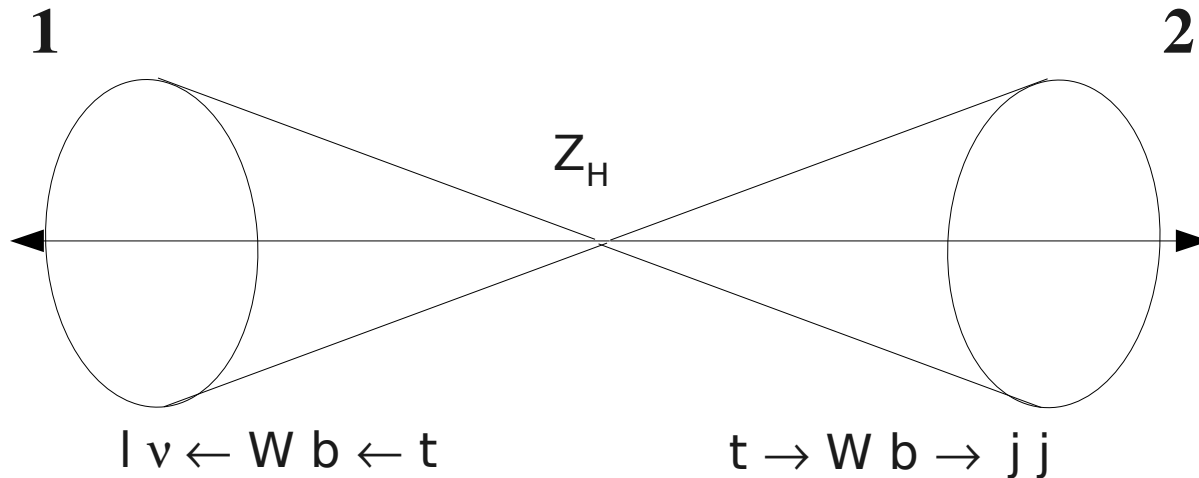
Difference:
Means are different

Signal mean = 0.9
sigma = 0.5

BKG mean = 1.3
sigma = 0.9

Reconstruction Z_H

Semileptonic Signal



$$\Delta R = \sqrt{(\Delta \eta)^2 + (\Delta \phi)^2}$$

bjet closer to the lepton

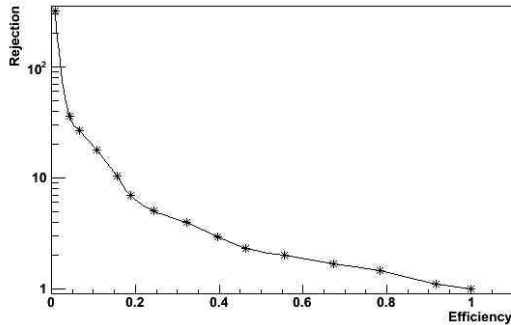
$$bjet1 \quad 0.05 < \Delta R < 2$$

$$bjet2 \quad \Delta R > 2$$

Searching a better high pT btagging

5 GeV

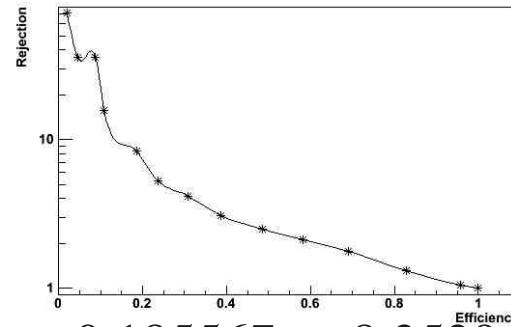
Rejection vs Efficiency, IP3DTrackSelector.pTMin=5GeV



$e = 0.187668$ $r = 7$

10 GeV

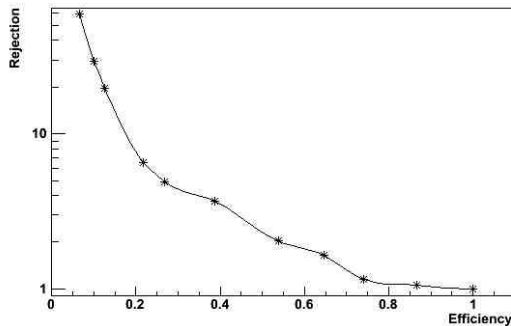
Rejection vs Efficiency, IP3DTrackSelector.pTMin=10GeV



$e = 0.185567$ $r = 8.35294$

20 GeV

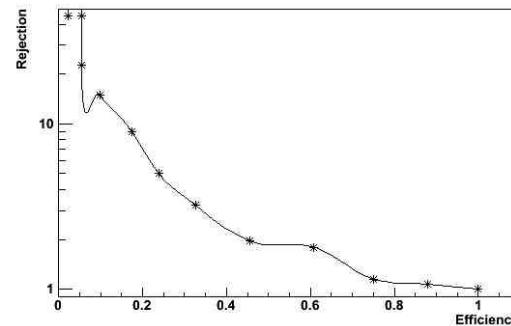
Rejection vs Efficiency, IP3DTrackSelector.pTMin=20GeV



$e = 0.218487$ $r = 6.55556$

30 GeV

Rejection vs Efficiency, IP3DTrackSelector.pTMin=30GeV



$e = 0.173913$ $r = 9$

Rejection vs Efficiency.

Target: The best rejection is got for an efficiency around 0.20.

Adding IP3D+SV1 of 2 bjets

Several Values of IP3DTrackSelector.pTM in

Over 30 GeV, statistic is missed.

Conclusions

- Change other btagging variables to improve rejection vs efficiency.
- Study reconstruction with :
 - Cuts around $\cos \theta \sim -1$
 - Cuts around $p_t(t) - p_t(\bar{t}) \sim 0$
 - Cuts around $0.4 \leq \Delta R \leq 1.2$
 - Do not consider the other discriminant variables.
- Study other reconstruction ways.