MC Studies: ALPGEN as Main Generator for V+Jets ?

Top Workshop
12/06/2002

- Introduction to ALPGEN
- Comparison with VECBOS
- Some “Features”
- Summary

Why ALPGEN ?

- QCD evolution effects in the event (hard gluon radiation) constitutes the dominant (physics) systematic uncertainty in the RunI top mass measurement (3.1GeV including 2.5 GeV from W+jets background)
- ALPGEN
  - ME-based MC (same as VECBOS)
  - Covers much more processes
    - nW + $m$$Z$ + $l$$H$ + Njet
    - WQQbar + Njet
    - QQbar + Njet
    - ...
  - Interface to both Herwig and Pythia (D0: only Herwig available at the moment)

Comparison with Vecbos

- VECBOS and ALPGEN should contain the same physics (both are LO ME generators)
- But: Need to check if actual distributions and cross-sections agree.
- Common set of Cuts:
  - Process: W+ NJets ($W \rightarrow e\nu$)
  - $\sqrt{s}$=1960 GeV, PDF=CTEQ5L, $Q^2 = M_W^2$
  - Partons: $p_T > 10$GeV, $|\eta|<3.5$, $\Delta R(j,j)>0.5$
  - Lepton: $p_T>10$ GeV, $|\eta|<10$

Cross-Section

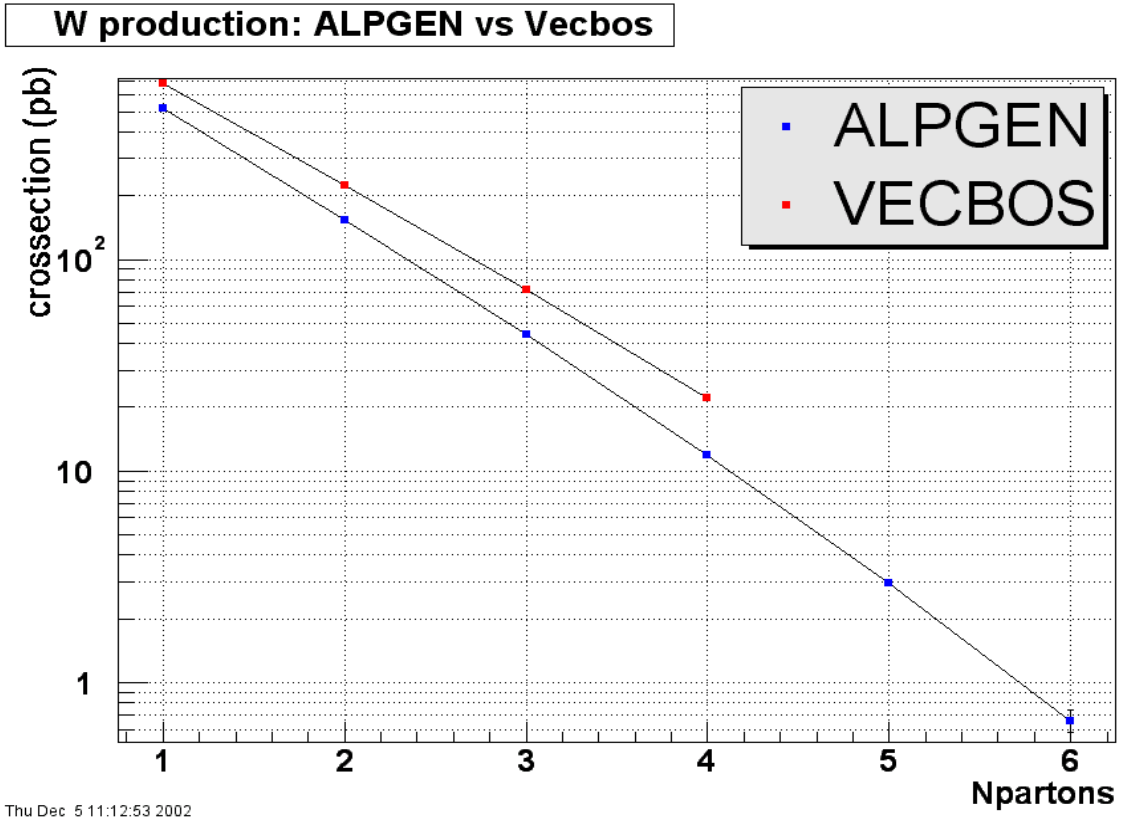
Significant discrepancy in total cross-section versus jet multiplicity !

M.Mangano claims he had good agreement. But different set of cuts:

PDF: MRSEB (Vecbos)
MRS200 (Alpgen)

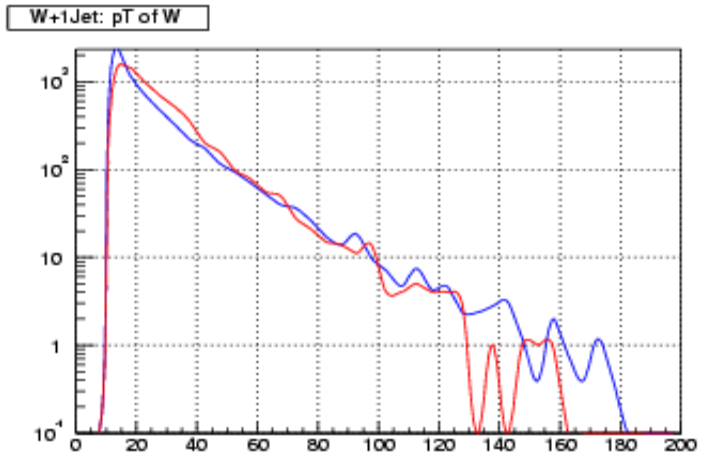
Partons: p_T>15GeV
$|n| < 2$
$\Delta R(j,j)>0.7$

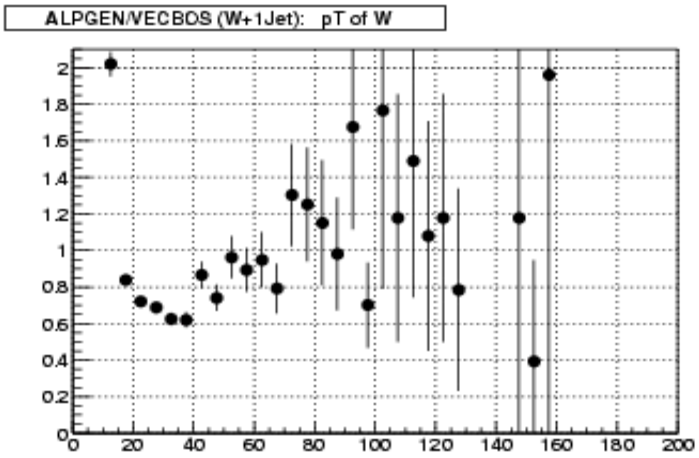
Lepton: p_T>20 GeV
$|n| < 1$
MET > 20 GeV



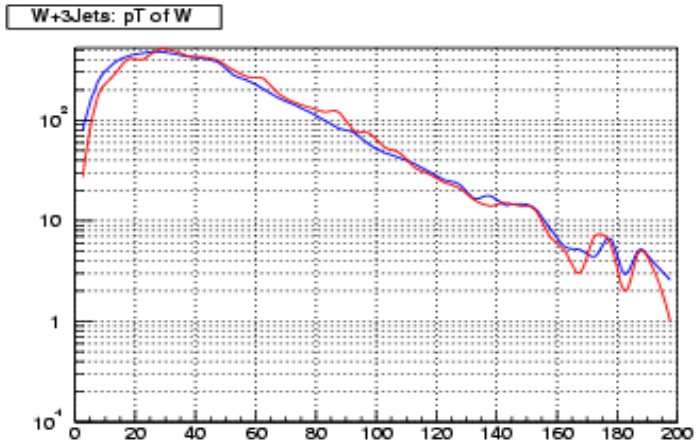
pT of W in W+1Jet and W+3Jets

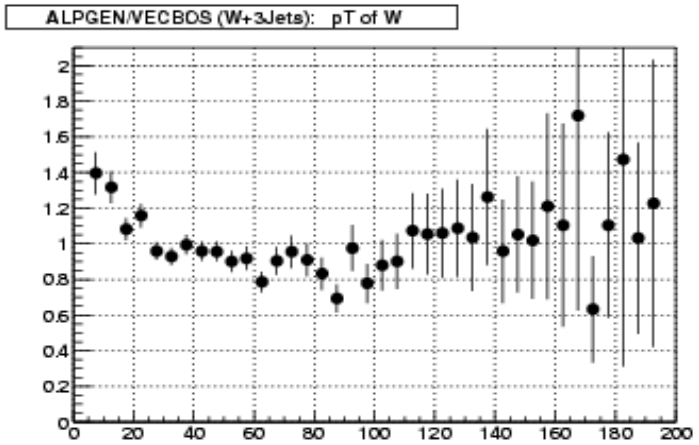
pT spectrum of W softer in ALPGEN than in VECBOS !





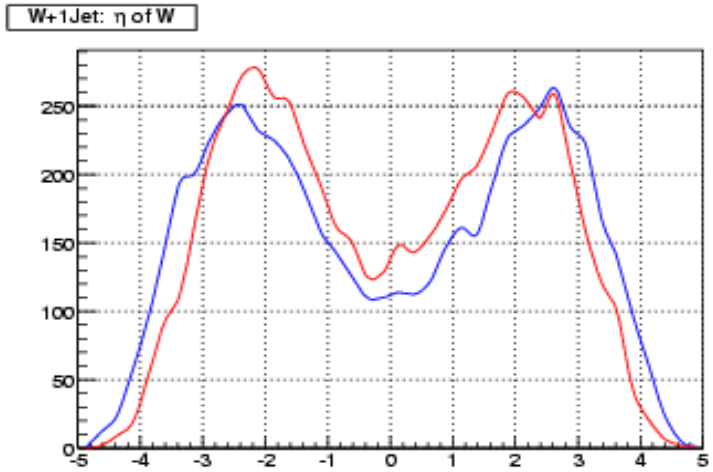
Effect “smeared out” by increased jet multiplicity

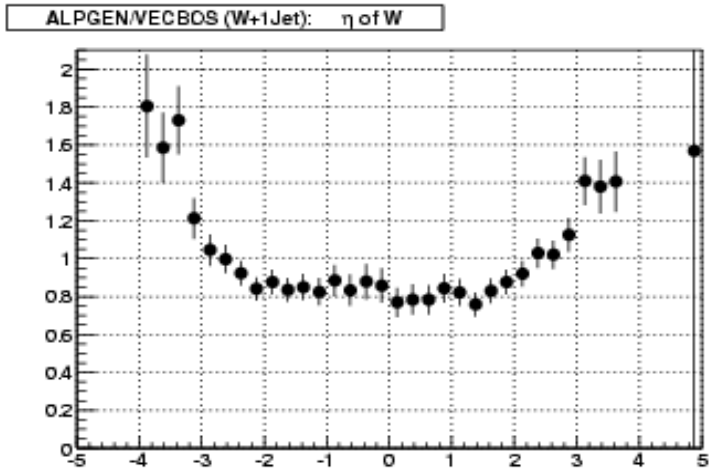




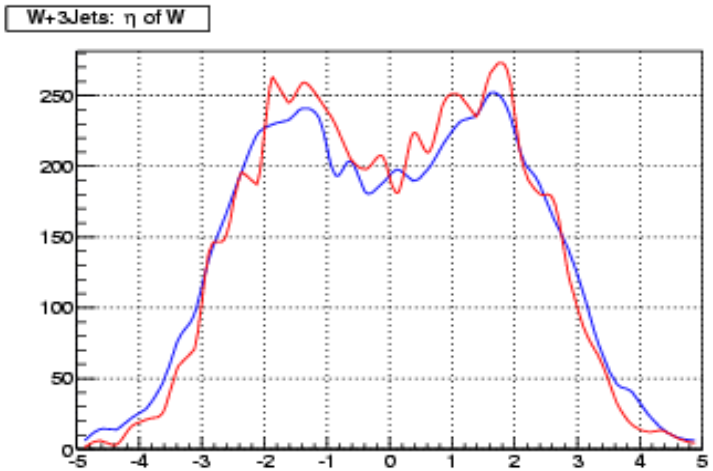
η distribution of the W

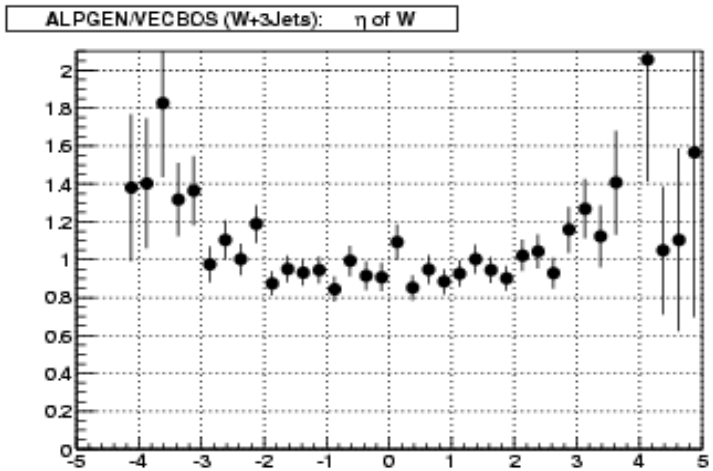
W looks more forward in ALPGEN than in VECBOS





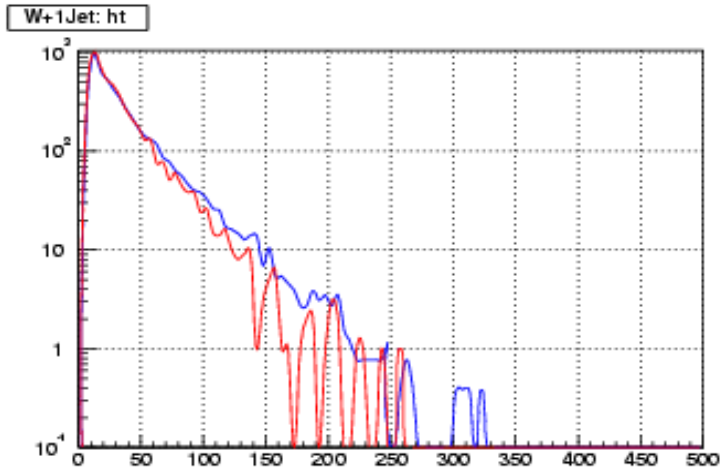
Better agreement for higher multiplicity:

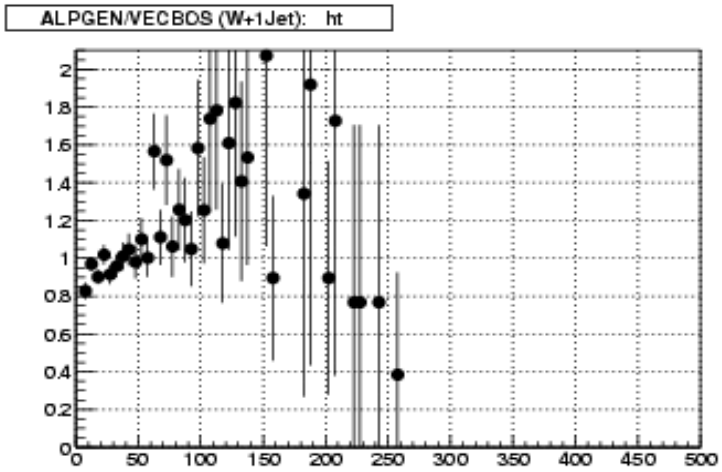


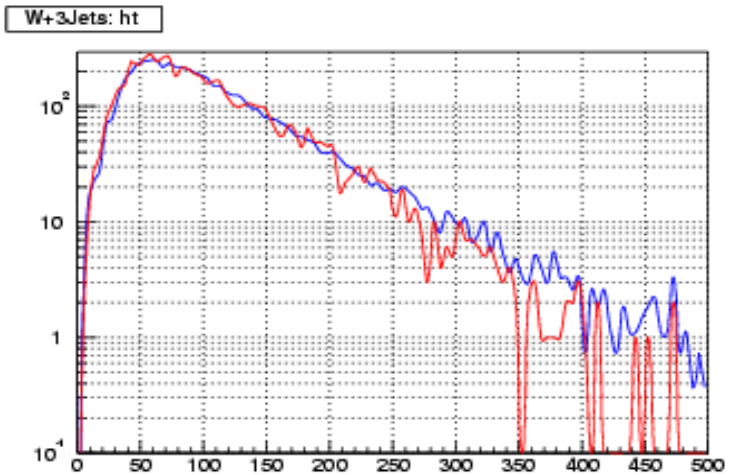


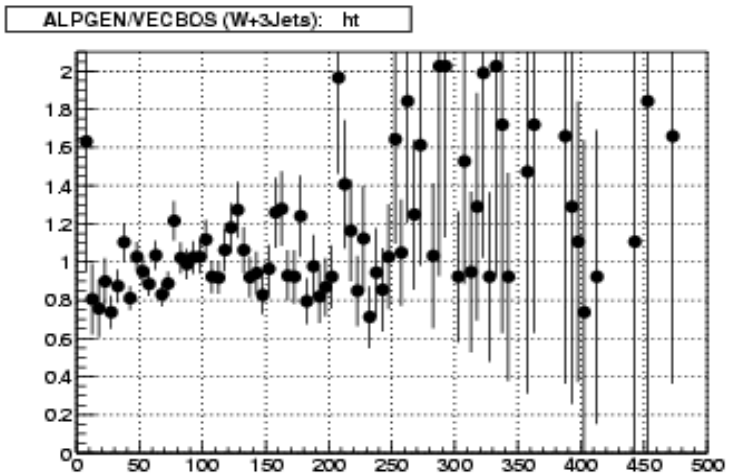
HT distributions for ALPGEN & Vecbos

For HT the agreement between ALPGEN and VECBOS is better !









Bias due to generation cuts

- Want to avoid biasing the distributions due to cuts on generator level
  - Process: $W \rightarrow e\nu$ + 2 partons
  - Parton Cuts: > 2GeV
    >10GeV
  - No lepton cuts
  - Herwig 6.4 used for shower evolution

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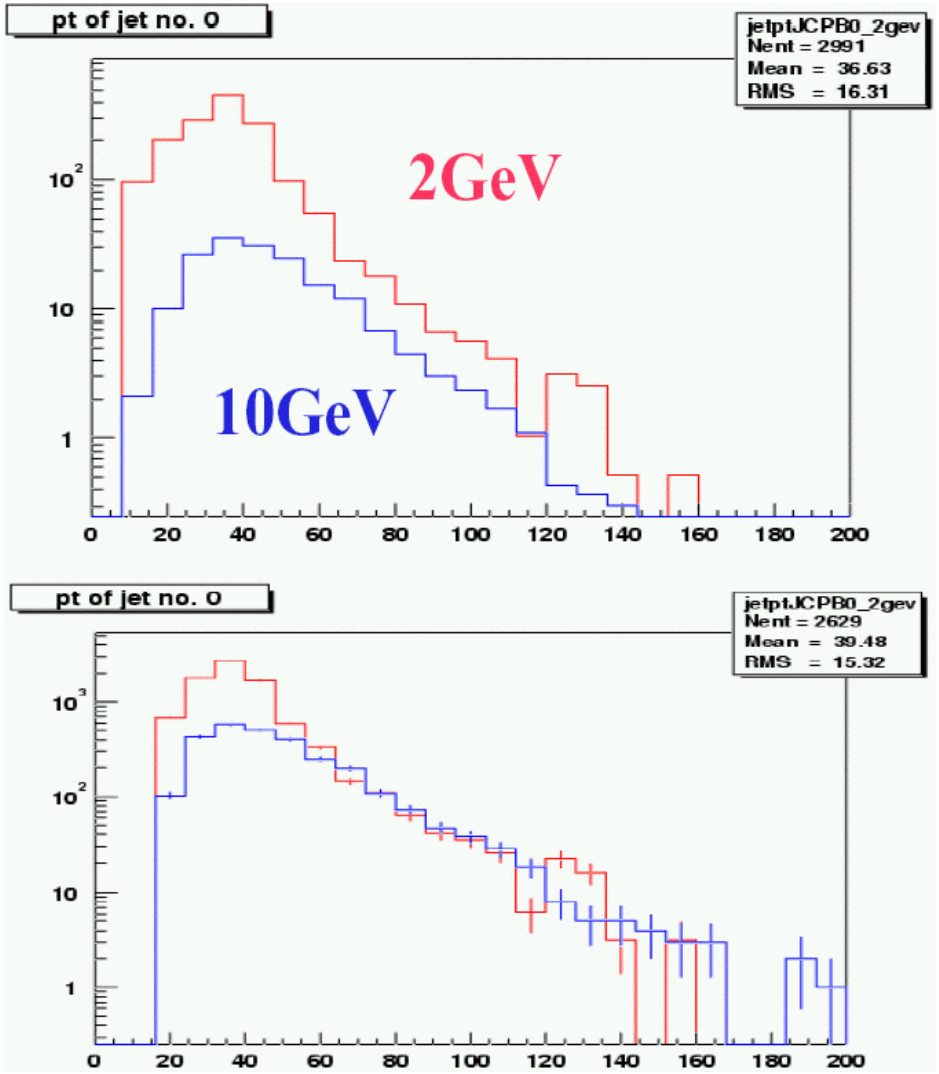
Bias due to generation cuts

- Large difference in total cross-sections
  - relative normalization derived from high-pT part of Jet spectrum
- Agreement in shape for leading jet pT spectrum occurs at very high pT (>70 GeV)
- How to decide what is a resonable choice ?



Cross-Section (II)

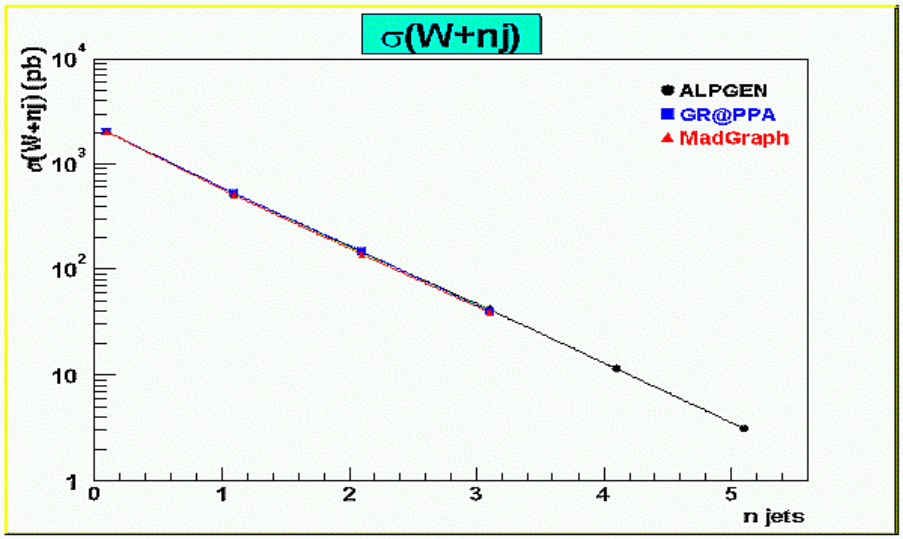
- Fully simulated Events
- accepted x-section: acceptance cuts on fully simulated jets
  - 2 or more jets with ET >20 GeV, $|\eta|<2.5$

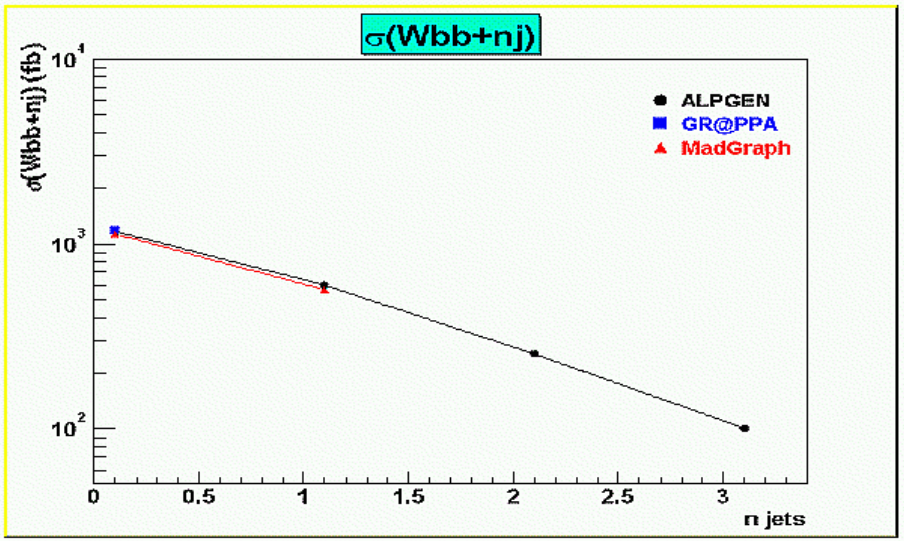
sample	σWxB(W->eν)	accepted x-sect
2Gev light	1544pb	61pb
10GeV light	178pb	27pb
2GeV bb	3.43pb	0.20pb
10GeV bb	1.27pb	0.18pb

Comparison with other MCs (CDF)

- Other MC generators: GR@PPA and MadGraph
- $\sqrt{s}$=1960 GeV, PDF=CTEQ5L, $Q^2=M_W^2$

  Partons: pT>10 GeV, $|\eta|<2.5$, $\Delta R(j,j)>0.2$

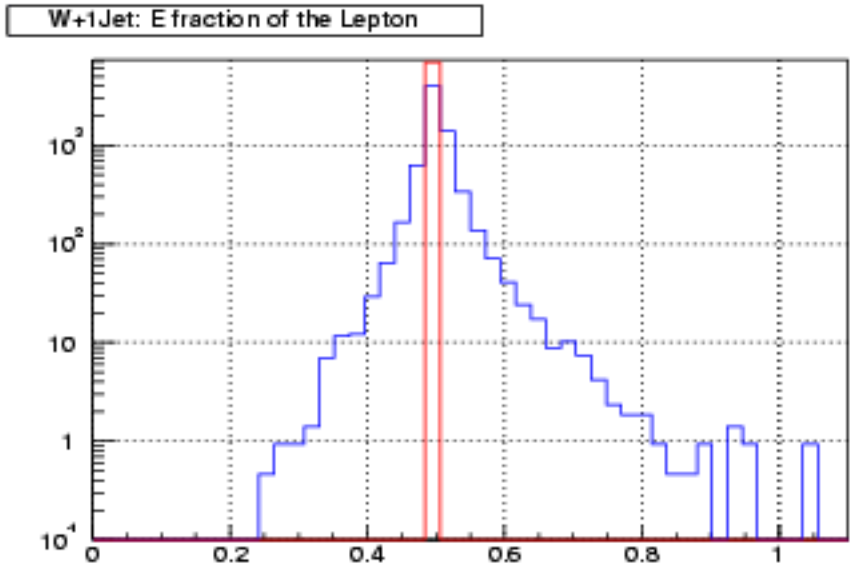




- Observe in general rather good agreement in total cross-section
- MadGraph gives systematically lower cross-section for W processes

Problem with Herwig Interface

- Alpgen provides 4-momenta of partons, lepton and neutrino (not the W itself !)
- D0 version of Herwig reads in these 4-momenta, performs the shower evolution and writes out the corresponding MCKineChunk
- Energy fraction of the Lepton in the restframe of the W is not equal to 0.5 for ALPGEN (VECBOS is ok)



Summary

- ALPGEN is a more versatile ME generator than VECBOS
- VECBOS and ALPGEN shapes agree in most distributions (except p_T and η of the W)
- ALPGEN cross-section:
  - disagreement with VECBOS
  - light jets: large difference in relative cross-section for cuts at 2 GeV and 10 GeV
- Problem with D0 interface to Herwig (violation of Energy conservation in the W decay)