ETH Institute for Particle Physics

gg→H for different MCs including CASCADE: uncertainties due to jet veto

Giovanna Davatz, ETH Zurich

HERA/LHC Workshop, DESY 21nd -24th March 2005

Outline

- **gg→ H → WW → lνlν channel needs jet veto**

- **new: get uncertainty of jet veto efficiency with PYTHIA, HERWIG, MCatNLO and CASCADE**

- **try to understand different shapes!**

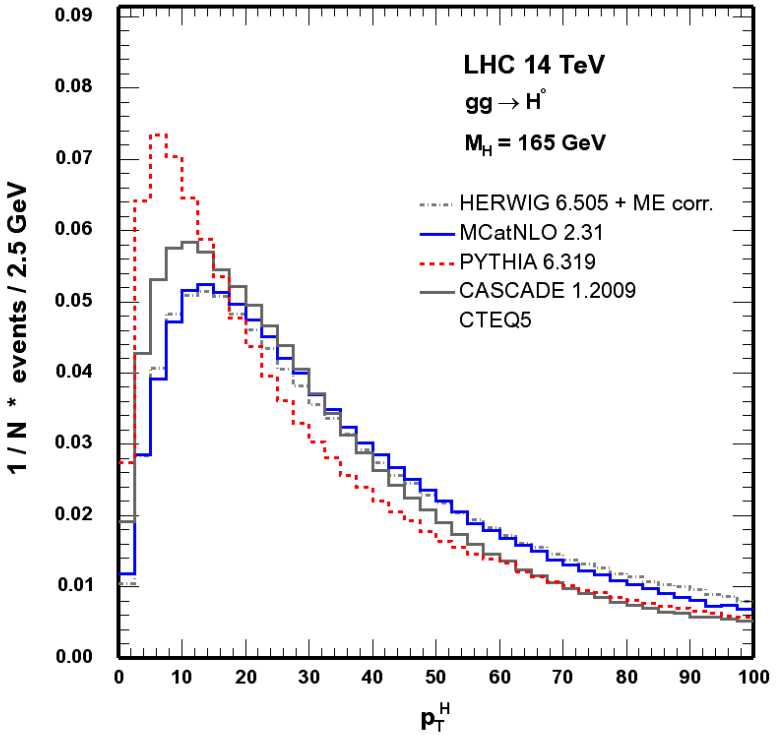
- **Conclusion**

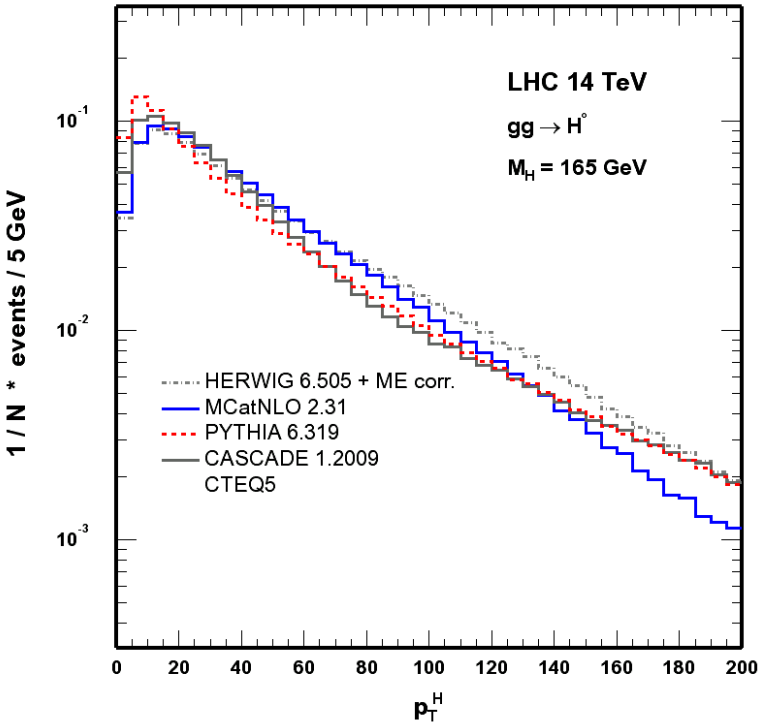
PYTHIA 6.319, HERWIG 6.505 + ME correction, MCatNLO 2.31 and CASCADE 2.009

- **NO underlying events**
- **M(Higgs) = 165 GeV, M(top) =175 GeV**
- **CASCADE 2.009 with PYTHIA final state parton shower**

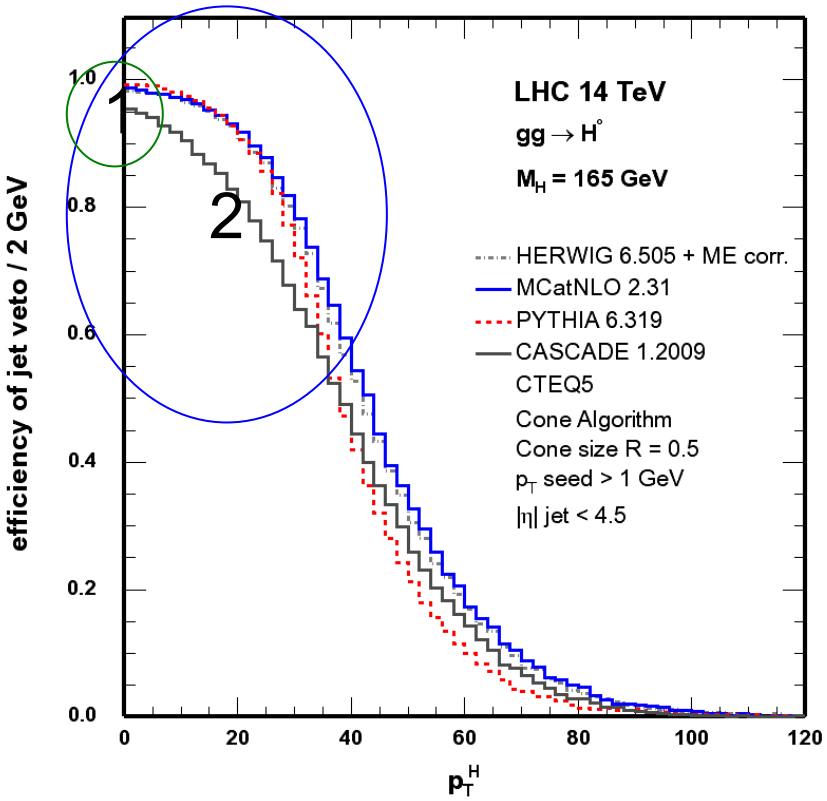
pdf	**MCatNLO:** **PYTHIA, HERWIG, CASCADE :**		**CTEQ 5M1** **CTEQ 5L**
CTEQ5M1 (NLO)	α_s**(Mz)=0.118**	Λ_{QCD}^4 **= 0.326**	Λ_{QCD}^5 **= 0.226**
CTEQ5L (LO)	α_s**(Mz)=0.127**	Λ_{QCD}^4 **= 0.192**	Λ_{QCD}^5 **= 0.146**
Λ_{QCD}	**PYTHIA:**	MSTP(3)=**2 (**Λ_{QCD} **=** Λ_{QCD} **of pdf)**	
	HERWIG:	QCDLAM=**0.18**	
	MCatNLO:	LAMDAFIVE=**0.226**	
	CASCADE	PARU(112)=**0.2**	

p_T Higgs spectrum of the 4 Monte Carlos



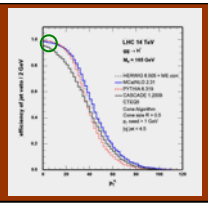


Efficiency of jet veto with CASCADE



Jet veto at 30 GeV

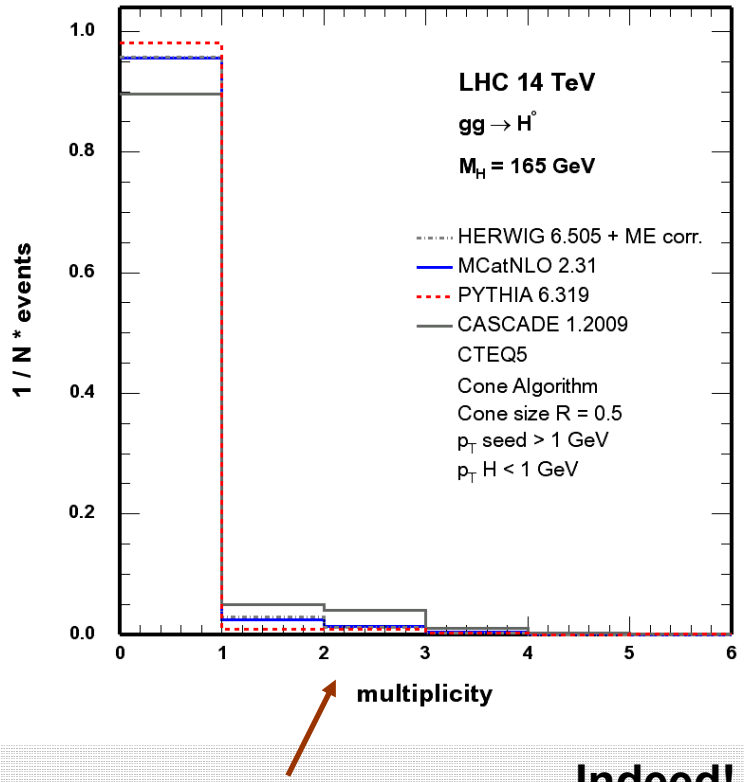
We get a much nicer spectrum than before!
Thank you Hannes!

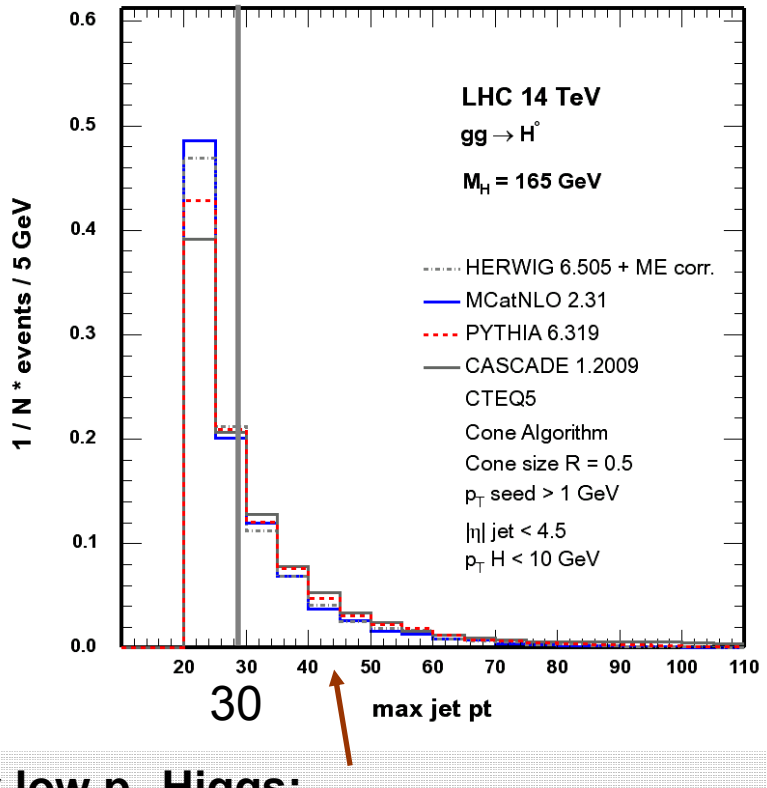


1. Efficiency at p_T Higgs = 0 GeV

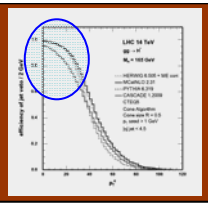
Why is the efficiency not 1 at p_T Higgs = 0 GeV ?

Possible answer: p_T Higgs balanced by more than 1 jet. Σ p_T jets = 0 (≈ p_T Higgs), but at least one jet has a p_T higher than 30 GeV → jet veto removes event





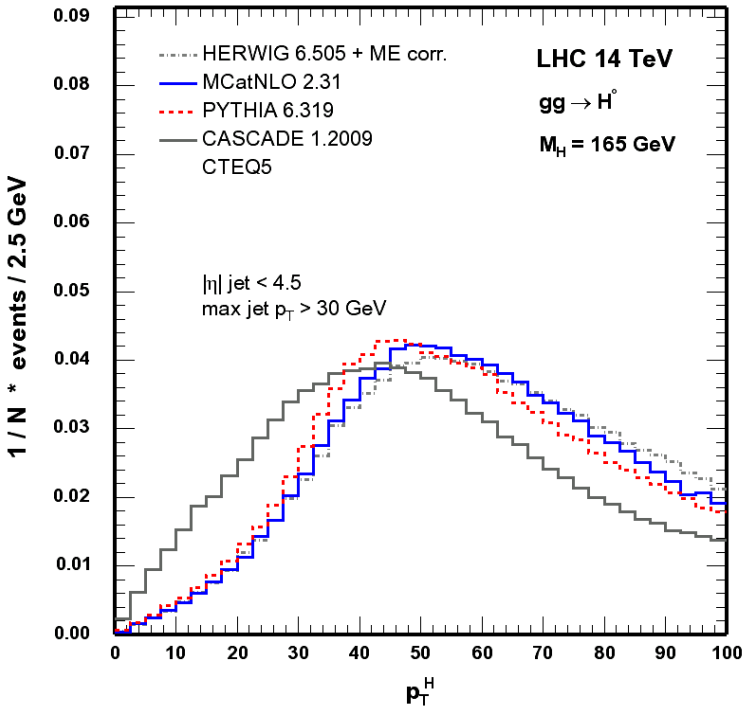
Indeed! At very low p_T Higgs:
CASCADE has more events with jets and the jets are harder than in other MCs



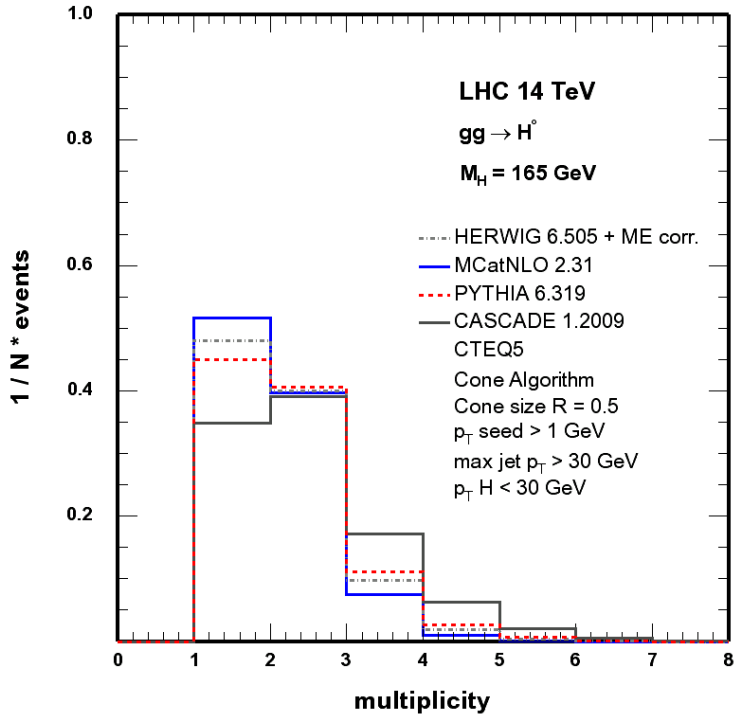
2. Efficiency for CASCADE between p_T Higgs 0 and 30 GeV

p_T Higgs spectrum for max jet pt > 30 GeV:

more events at low p_T Higgs with a max jet pt > 30 GeV in CASCADE than in the other MCs
those events will be removed → jet veto for CASCADE more efficient

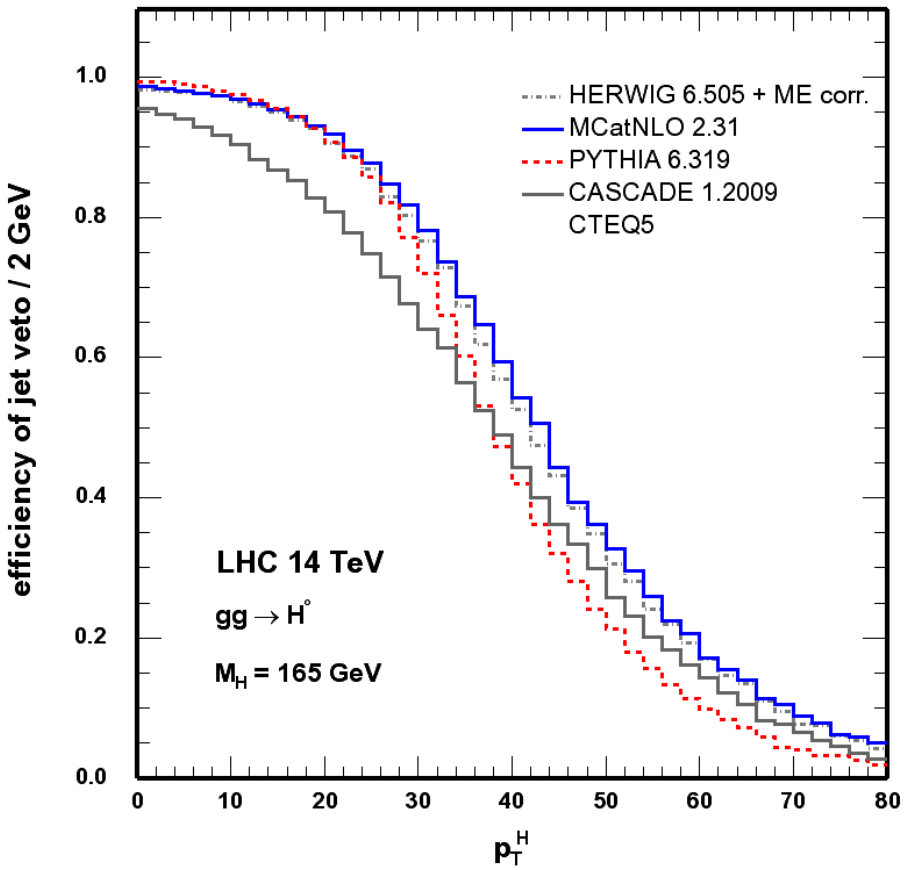


max jet pt > 30 GeV



max jet pt > 30 GeV, p_T Higgs <30 GeV

Efficiency numbers of the jet veto



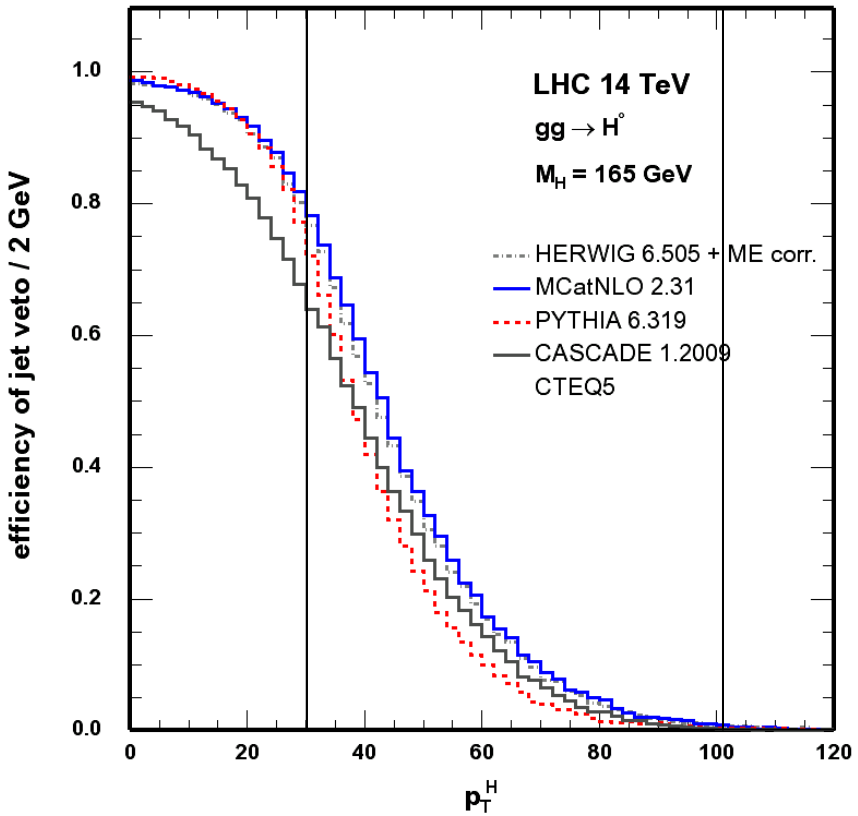
Differences vary over the pt spectrum:

Integrated efficiency over whole p_T spectrum and up to a p_T Higgs of 80 GeV:

	ε total	ε up to 80 GeV
PYTHIA	**0.61**	**0.72**
HERWIG	**0.54**	**0.68**
MCatNLO	**0.59**	**0.69**
CASCADE	**0.56**	**0.65**

→ efficiency spread ≈ 10%

Look at different p_T Higgs regions



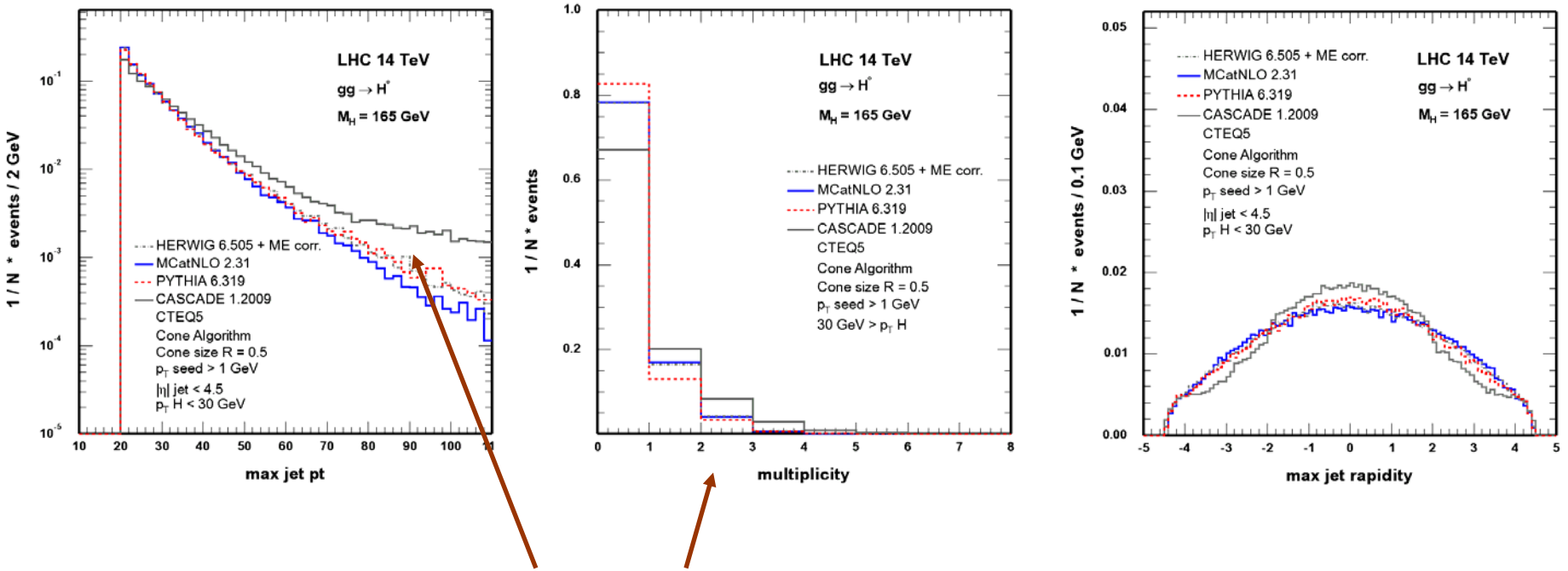
A) p_T Higgs < 30 GeV

B) 30 GeV ≤ p_T Higgs < 100 GeV

C) p_T Higgs ≥ 100 GeV

A) p_T Higgs < 30 GeV

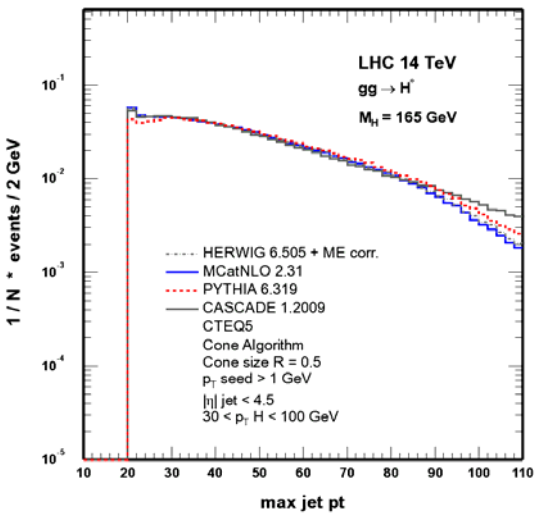
max jet pt | **multiplicity** | **max jet rapidity**



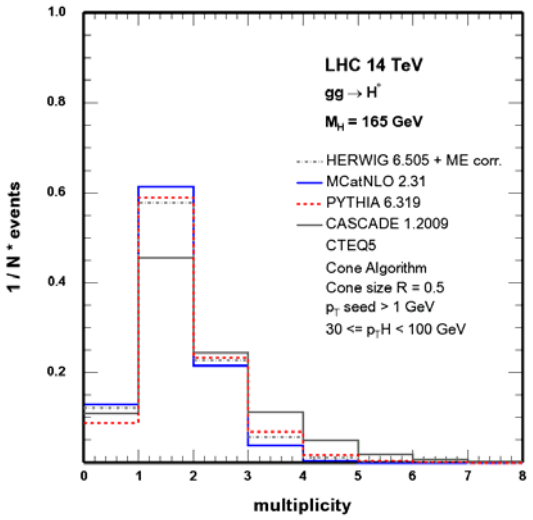
CASCADE harder pt spectrum, less events without jet

B) 30 GeV ≤ p_T Higgs < 100 GeV

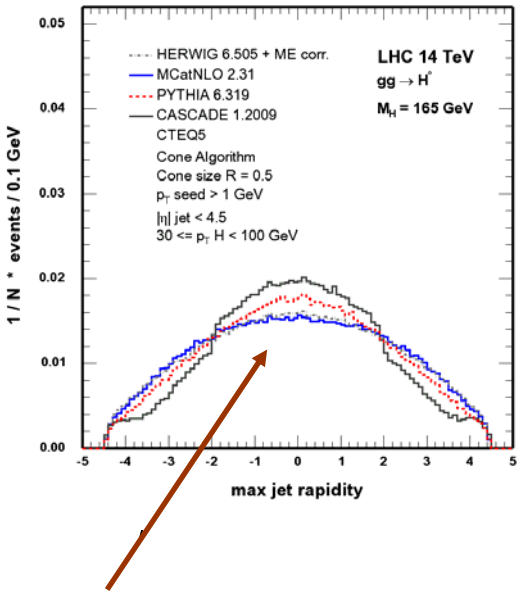
max jet pt



multiplicity



max jet rapidity

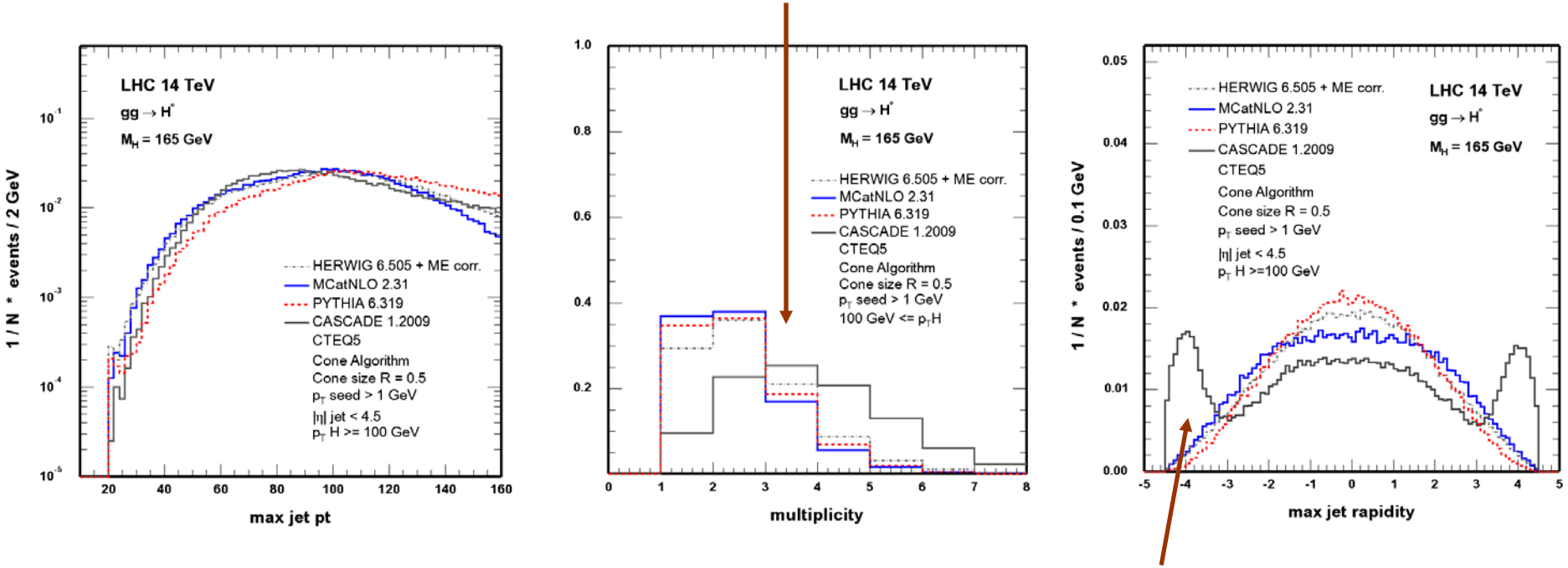


CASCADE has more central jets

C) 100 GeV ≤ p_T Higgs

max jet pt **multiplicity** **max jet rapidity**

CASCADE has more jets than other MCs



CASCADE has many jets with high rapidity

How can different rapidity at high pt be explained?

PYTHIA, HERWIG and MCatNLO with DGLAP parton shower.
→ at high rapidity only partons with low pt emitted.

CASCADE CCFM:
The cascade is not pt-ordered.
There can be jets with high pt produced even at high rapidity
(close to beam axis)

Which method is more physical?

Conclusion

- CASCADE has more and harder jets than the other MCs
- Many high p_T jets in CASCADE from high rapidity region
- CASCADE has more central jets than other MCs in low p_T Higgs region
- Overall efficiency spread is ≈ 10 %,
  also in region important for Higgs signal selection (low p_T)