Exclusive DPE Higgs generators in fast CMS simulation

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1. Comparison of DPEMC, ExHuMe and EDDE at parton, hadron and detector levels

2. Event yields for H->bb and H->WW

DPE Higgs event generators

1. **DPEMC 2.4** (M.Boonekamp, T.Kucs)
   - Bialas-Landshof model + rap.gap survival probability
   - Herwig for hadronization

2. **EDDE 1.2** (V.Petrov, R.Ryutin)
   - Regge-eikonal approach
   - Pythia for hadronization

All three models available now in the fast CMS simulation!

3. **ExHuMe 1.0** (J.Monk, A.Pilkington)
   - KMR model for exclusive diffraction
   - Pythia for hadronization

   (At the moment, ExHuMe reaches only ~70% of KMR cr.s.)

FAMOS_1_2_0_pre4

Fast CMS simulation program has seen a lot of effort and improvement last year. While still being improved and debugged, it can (and it is) already used for physics analyses.

Main chapters:

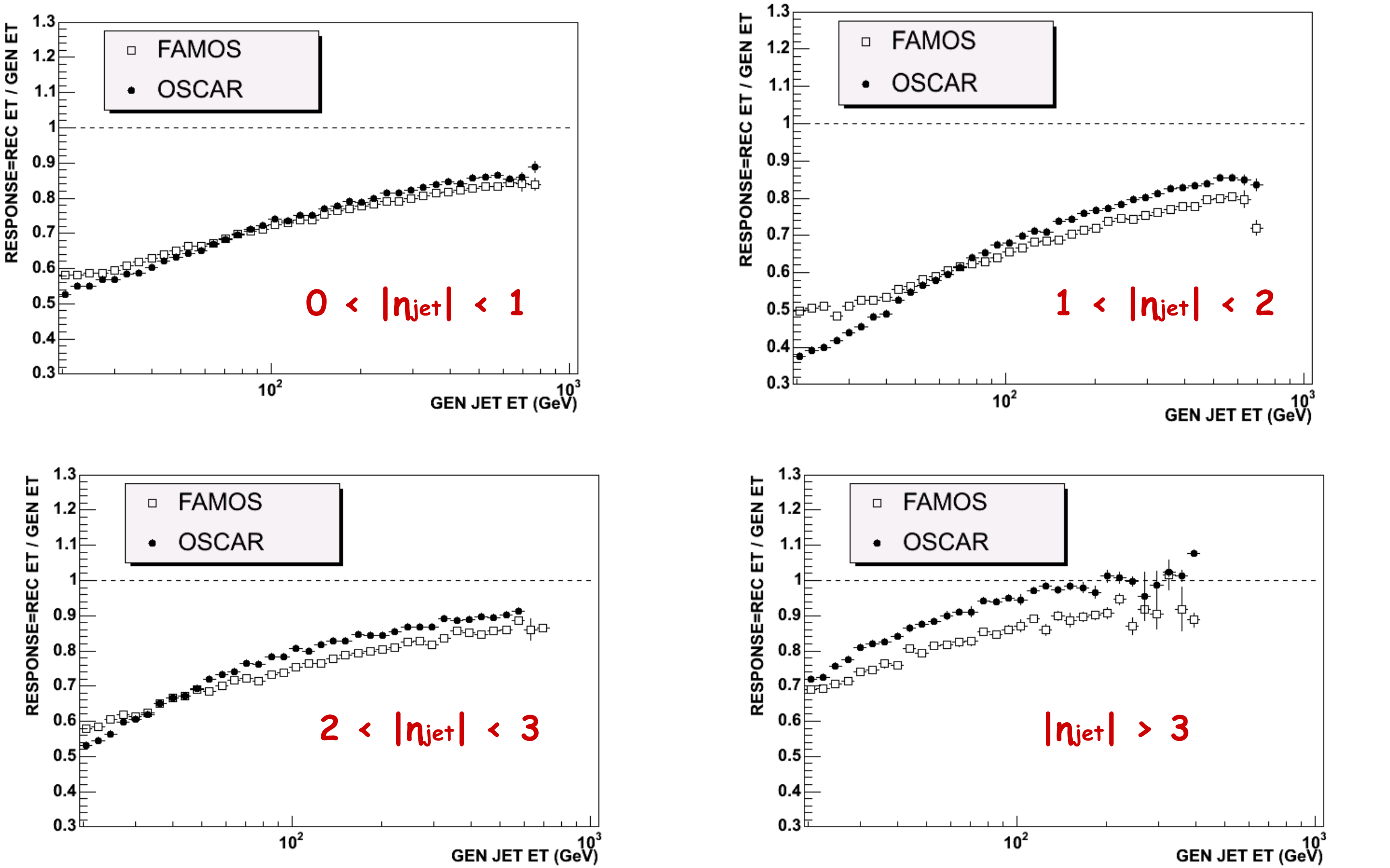
- Fastcalorimetry, FastElgamma, FastElMatching
- FastTsim, FastBtag
- FastJets, FastMET, FastHLTMET
- FastMuon, FastMuonTrigger
- FastTotem (just Roman Pots)

Jet algorithm:

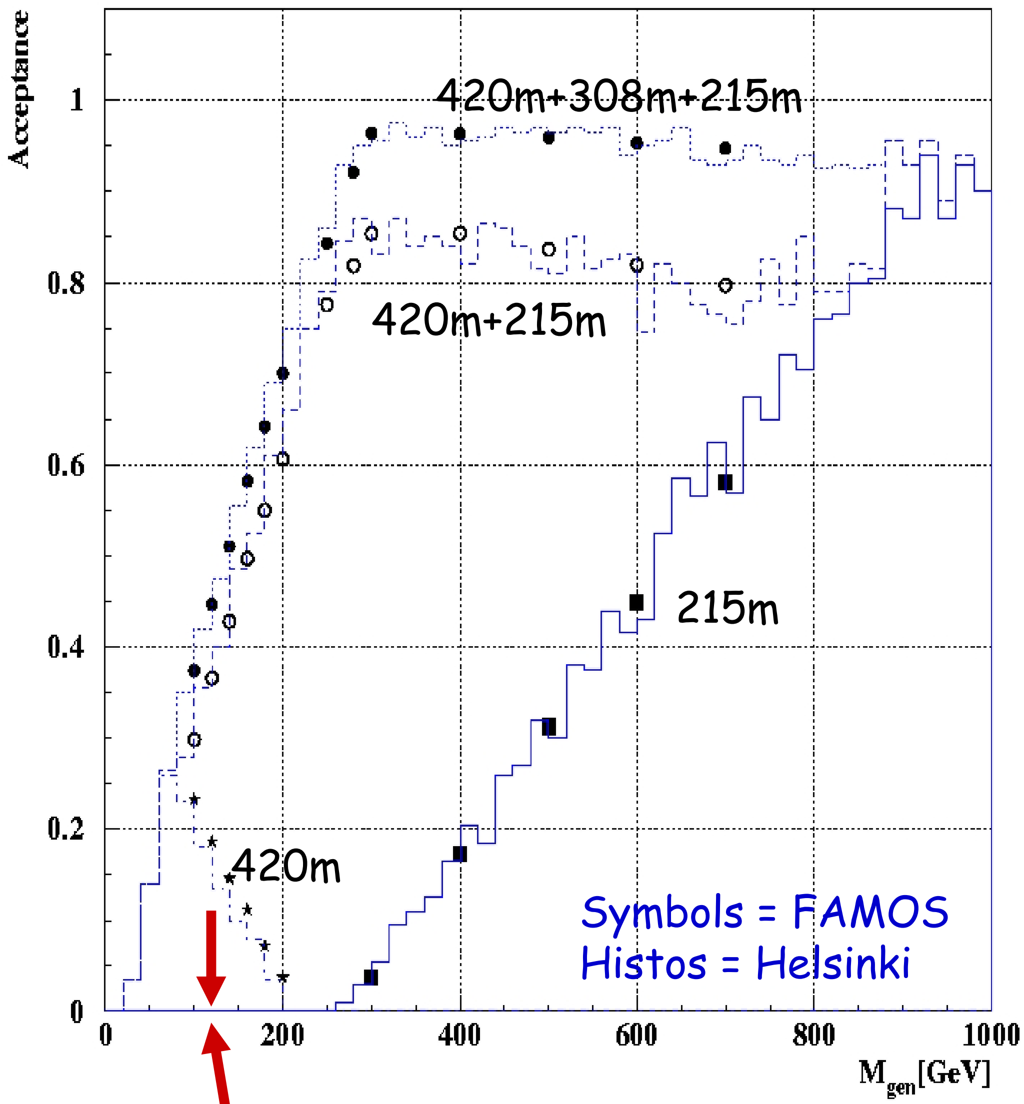
o) Iterative cone

o) Cone radius = 1.0

FAMOS: Jet Energy Scale Correction



3.CHECK: M_H Acceptance



SM Higgs! Needs new RPs at 300/400m ?
= technical challenge: cold region, trigger

M_H acceptance and resolution depend on ξ_1 and ξ_2 acceptances and resolutions through

$$M_H^2 = \xi_1 * \xi_2 * s$$

Hence

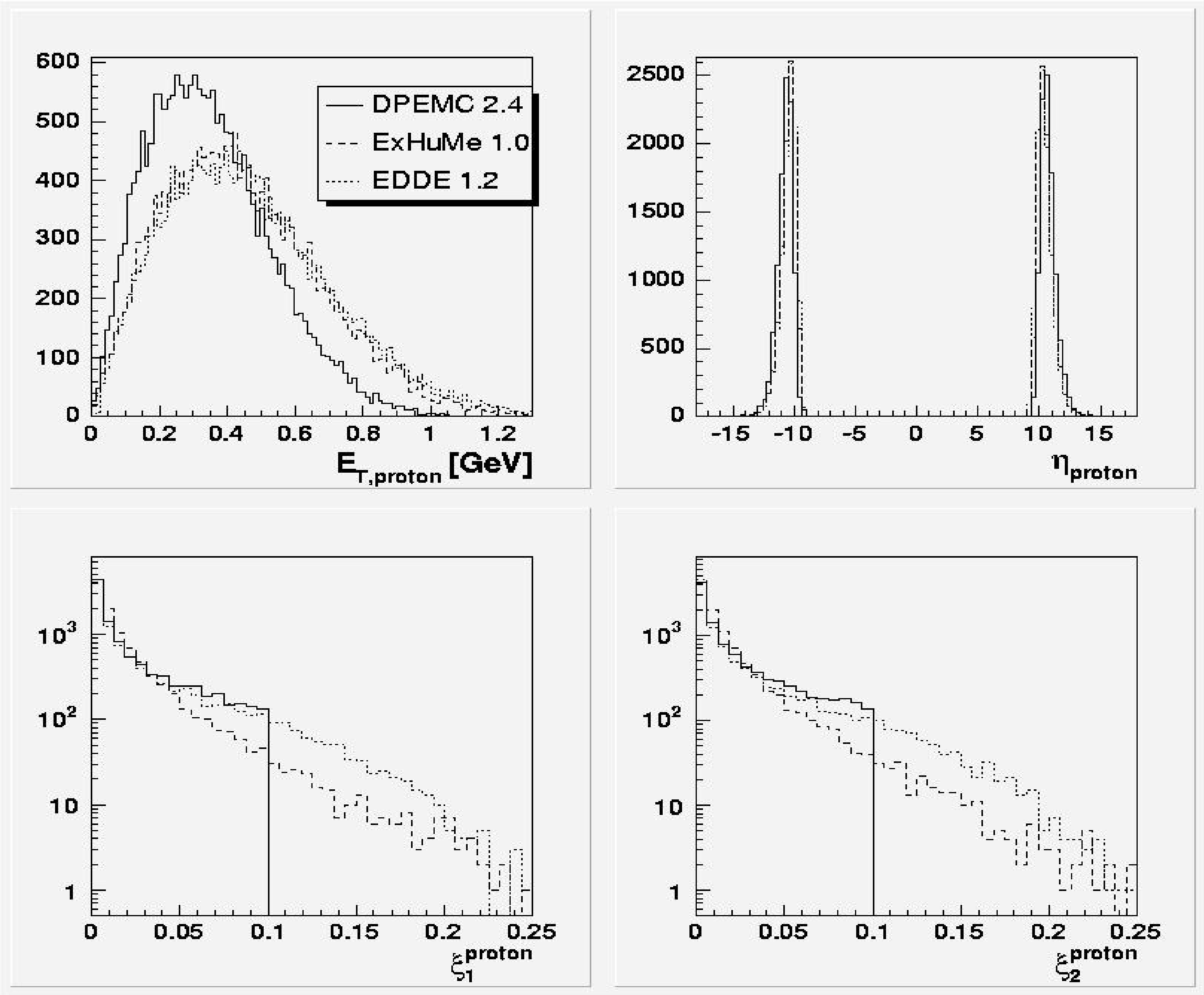
$$M^2_{gen} = \xi_{gen1} * \xi_{gen2} * s$$

$$M^2_{sim} = \xi_{sim1} * \xi_{sim2} * s$$

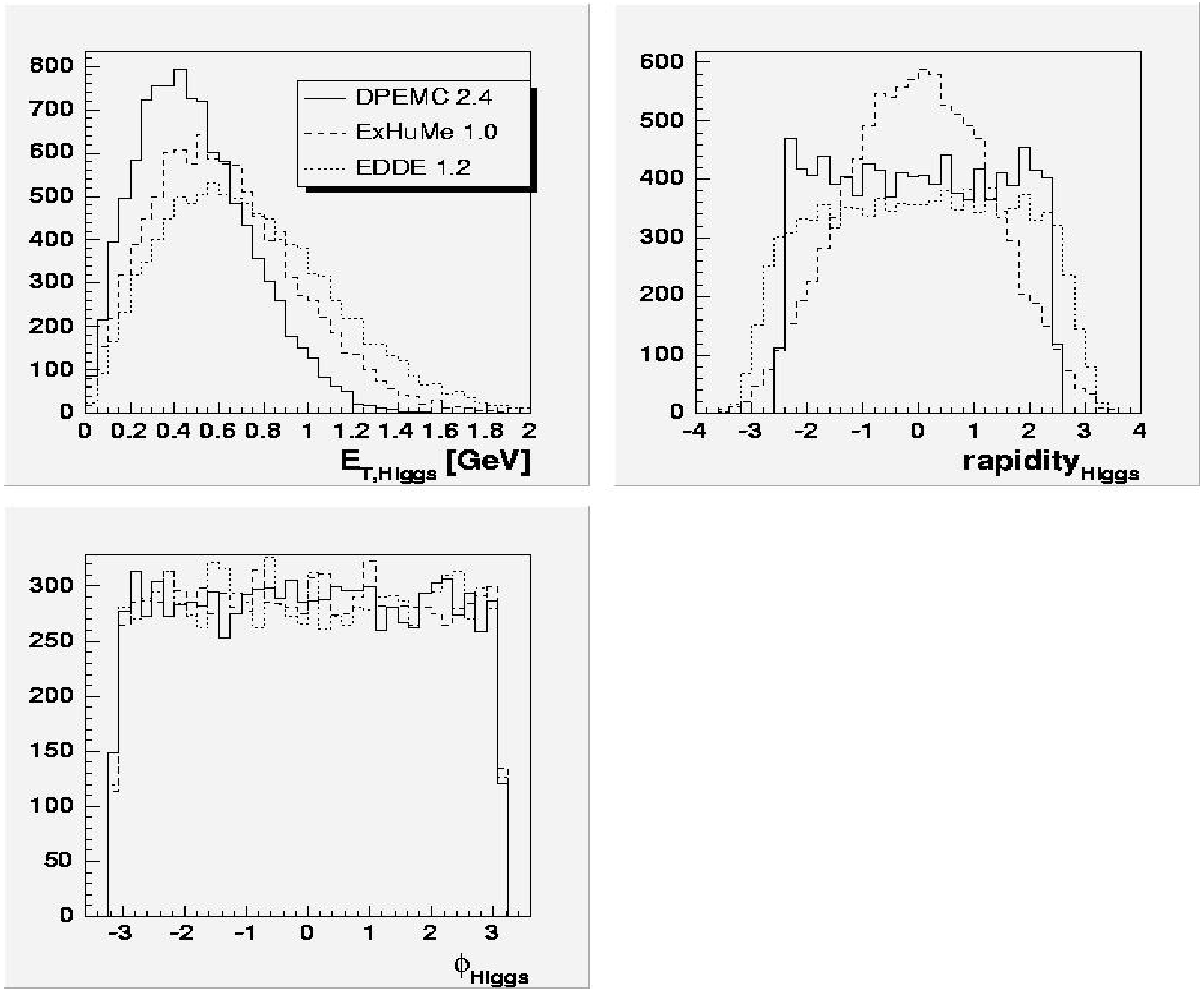
RP selection sequence:

If ξ_{gen} falls into acceptance regions of more RPs, the most distant RP is taken (because of better resolut.).

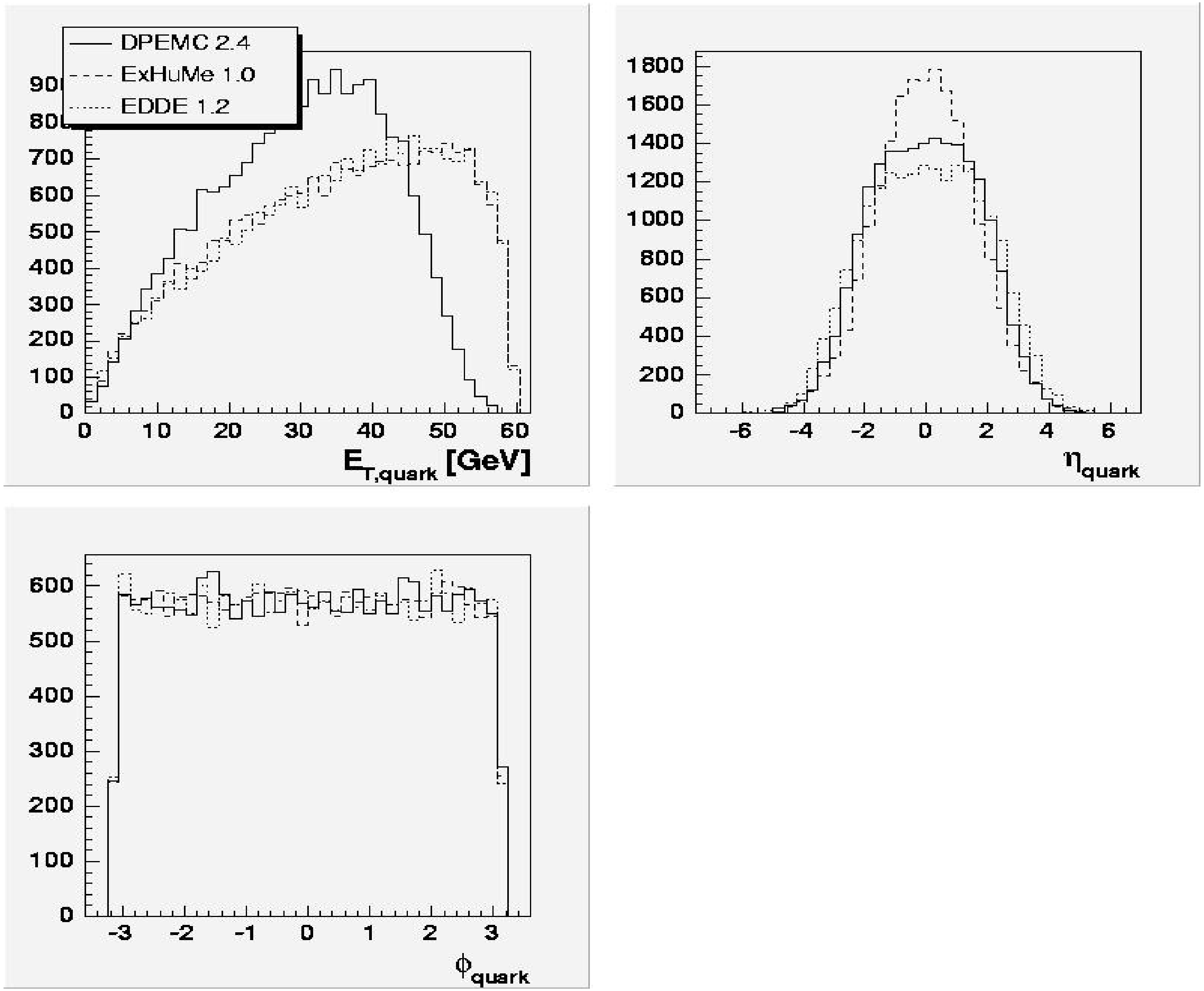
H->bb, mh=120 GeV: Protons



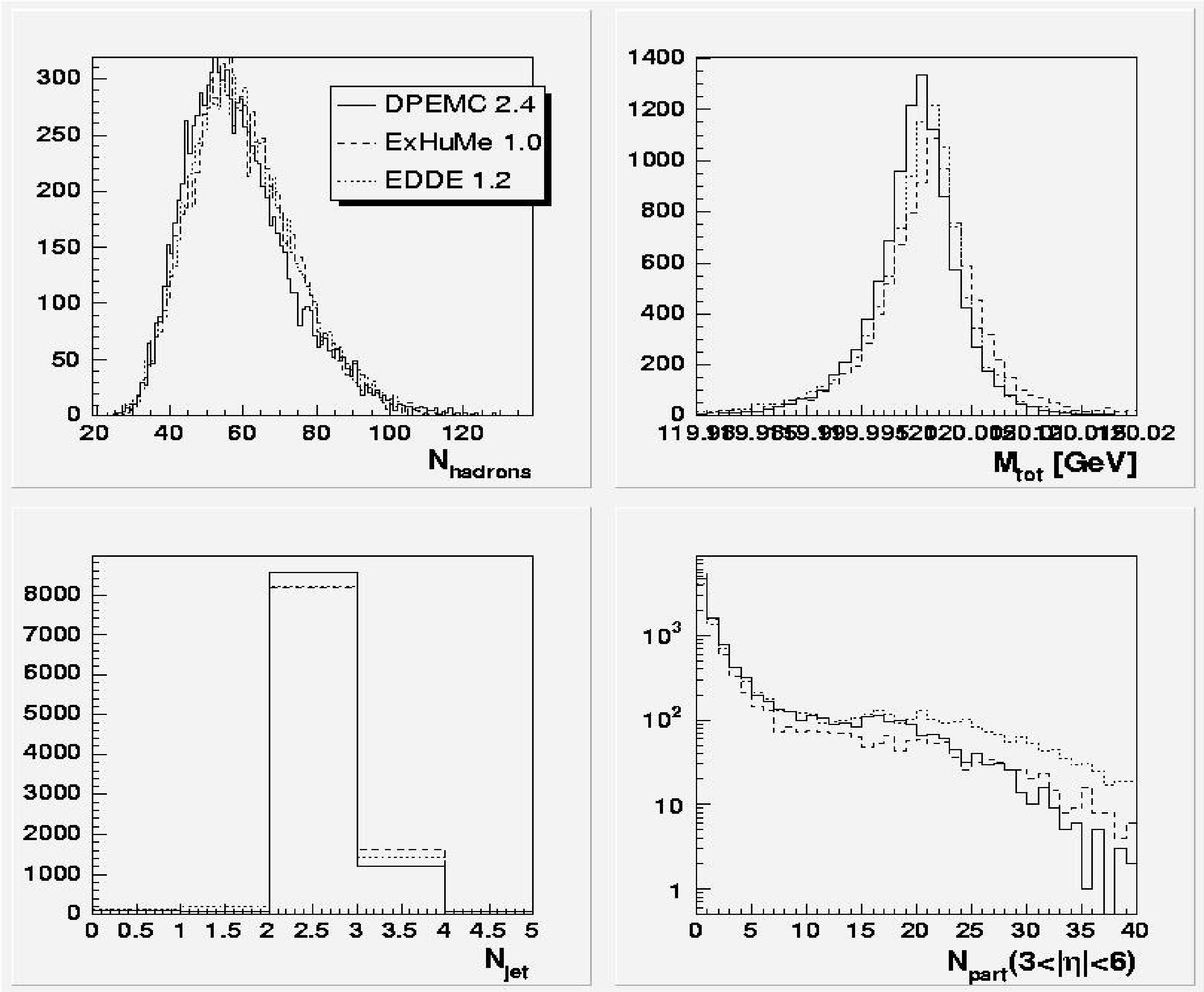
H->bb, mh=120 GeV: Higgs



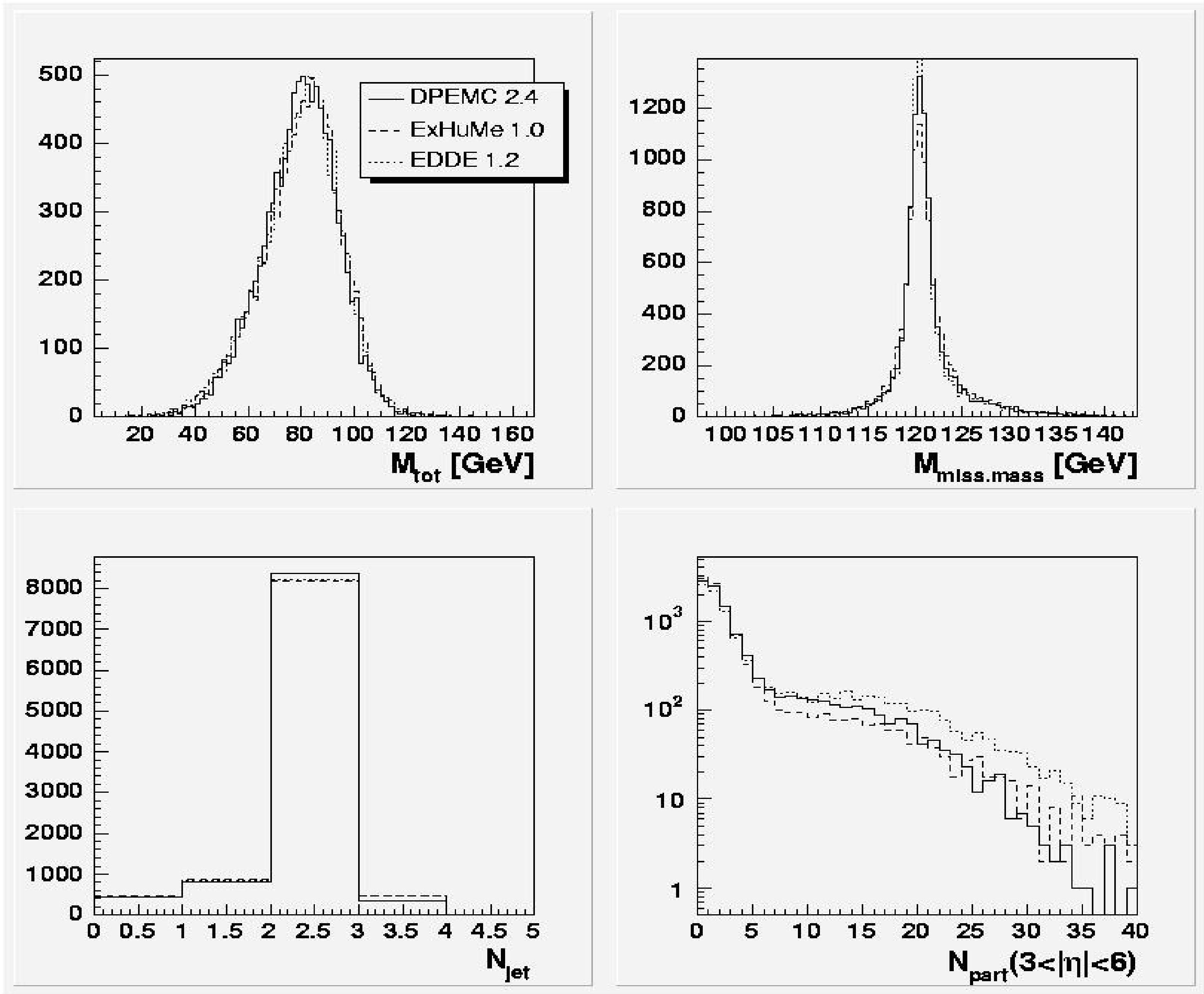
H->bb, mh=120 GeV: b-quarks after FSR



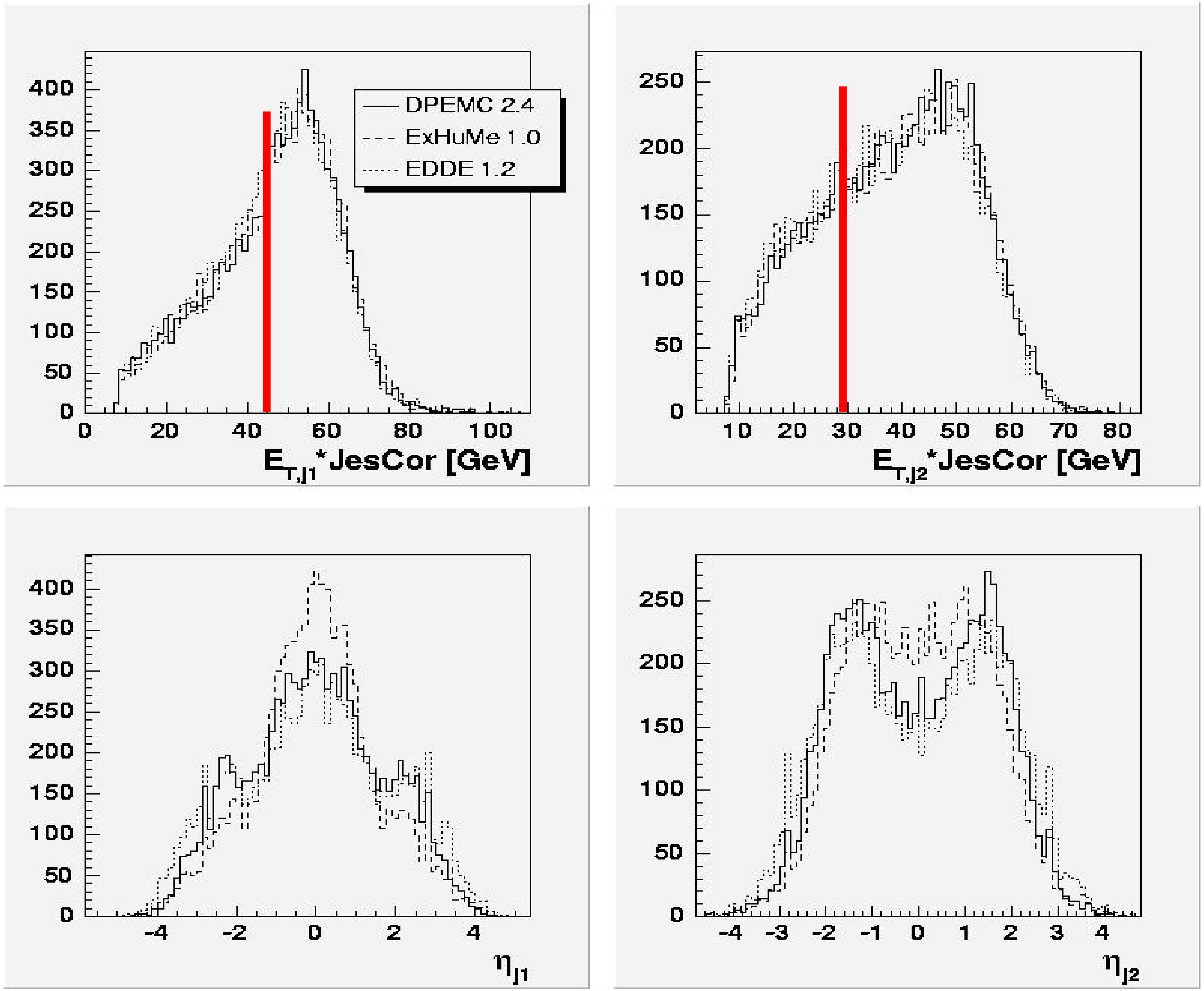
H->bb, mh=120 GeV: hadron level



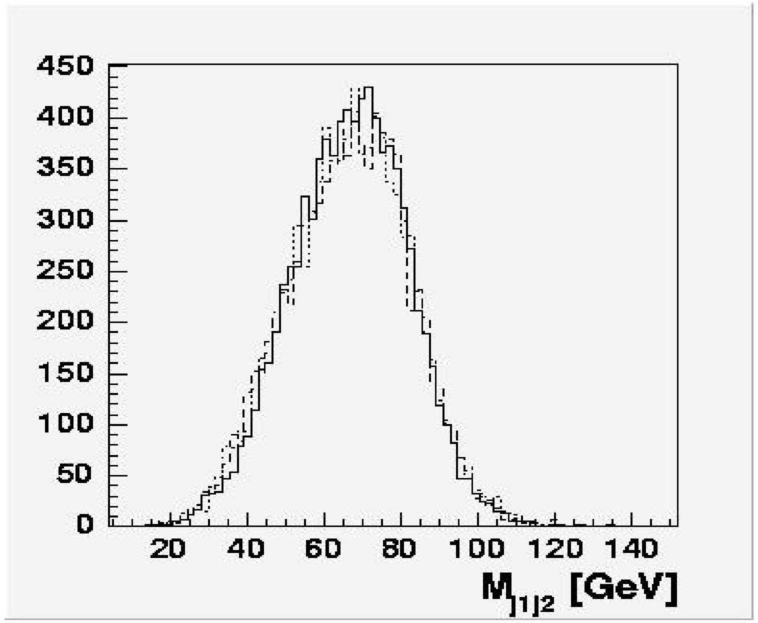
H->bb, mh=120 GeV: detector level

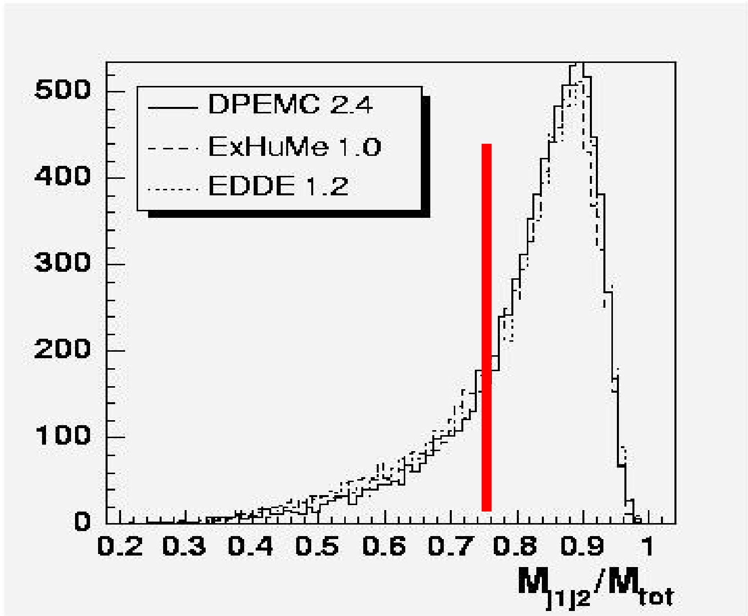


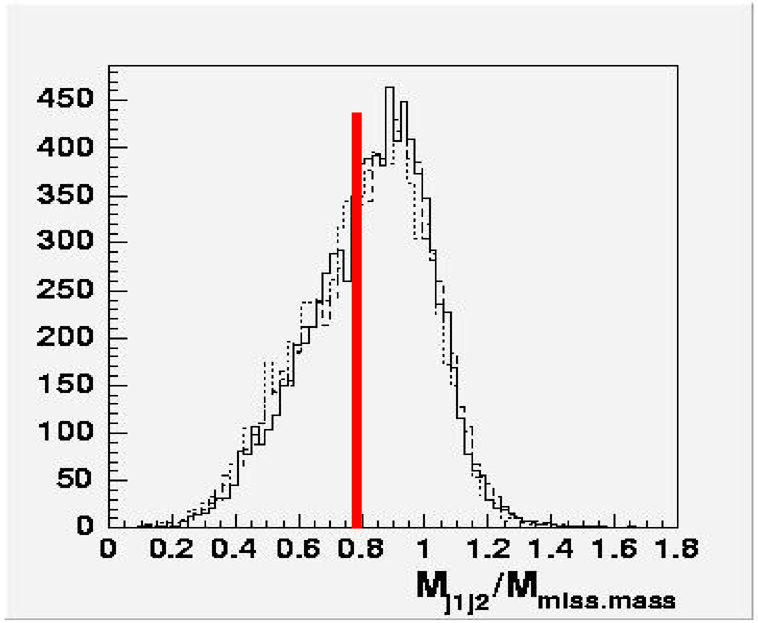
H->bb, mh=120 GeV: detector level b-jets



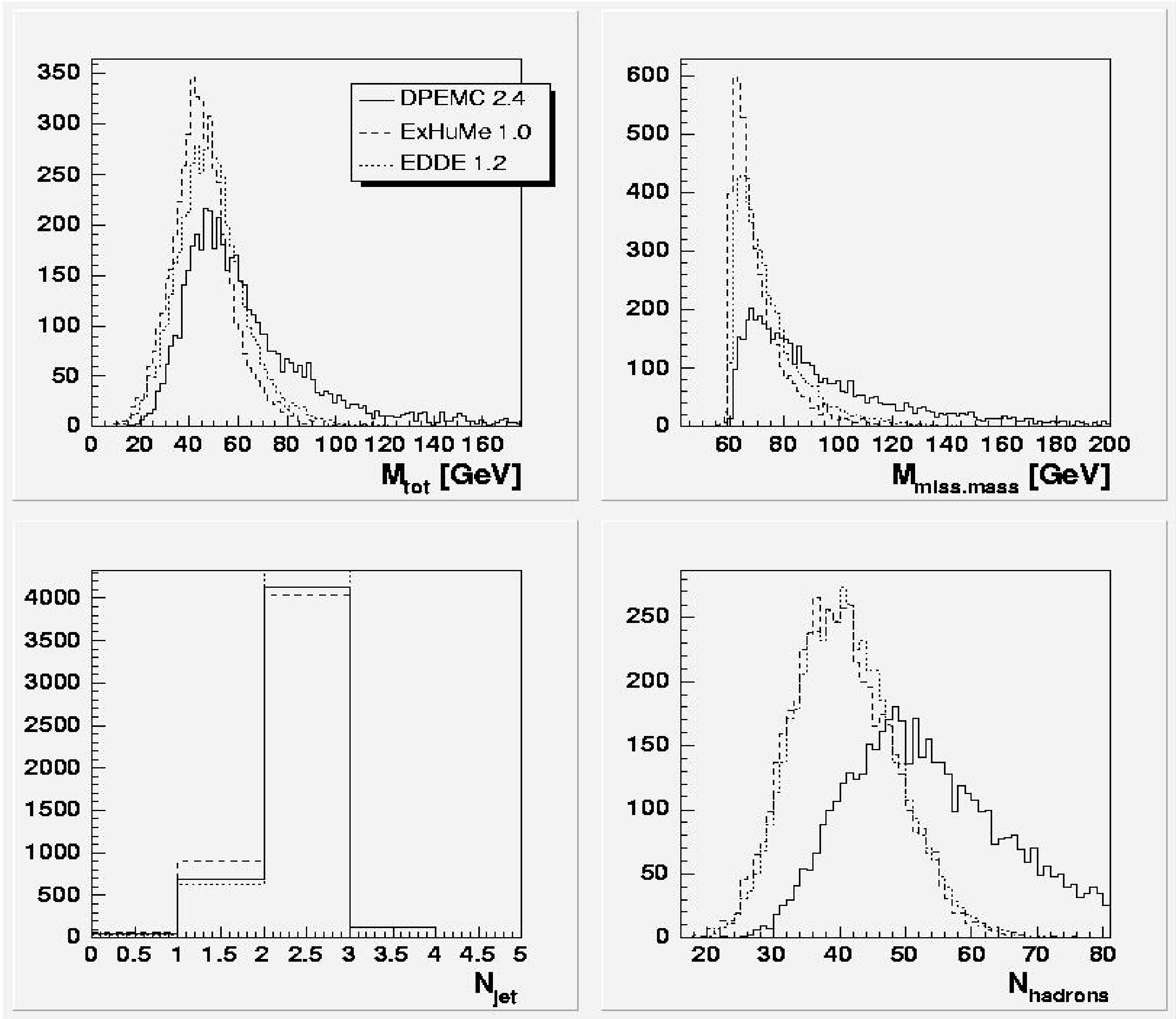
H->bb, mh=120 GeV: detector level



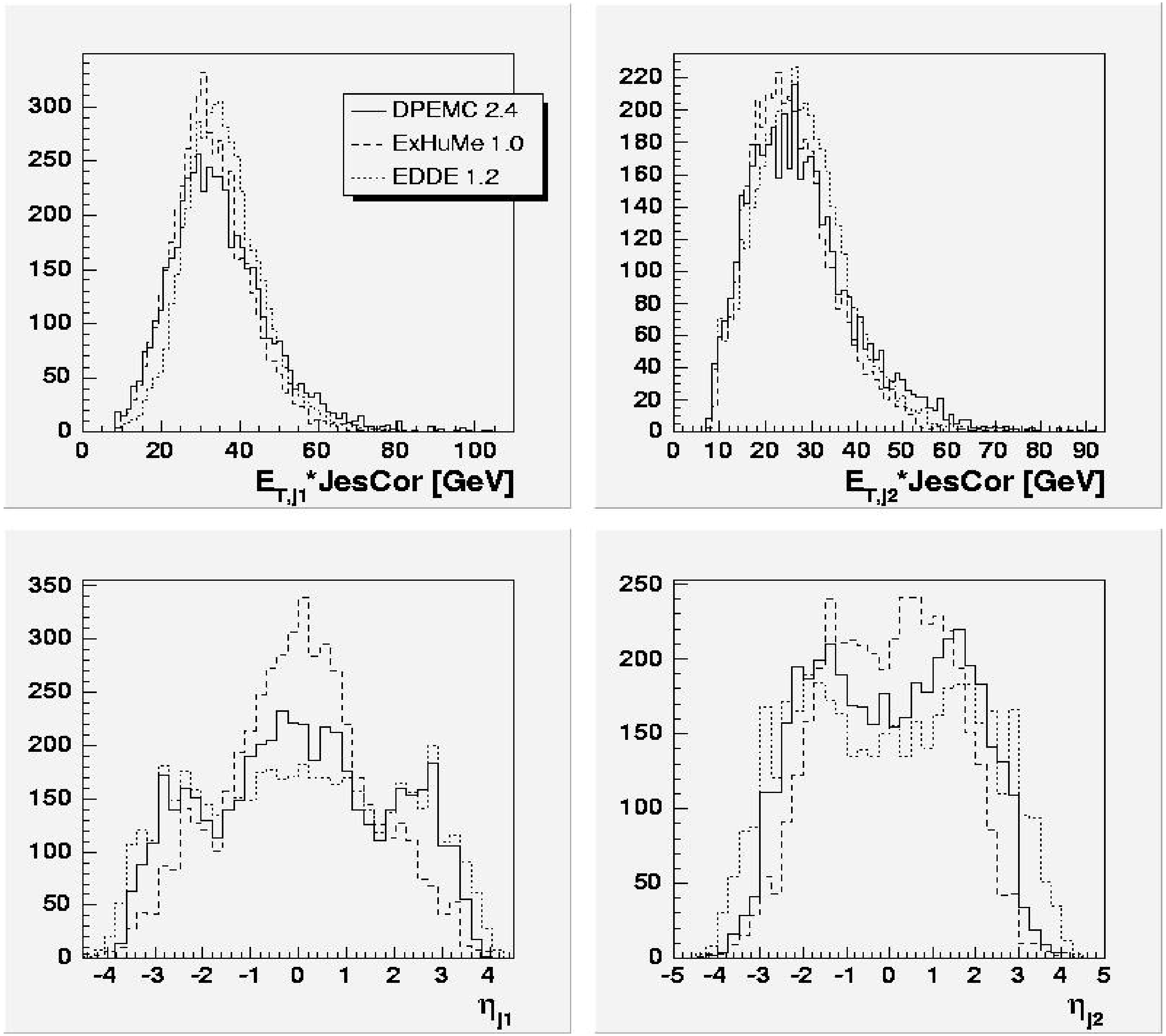




BG to H->bb: Excl.DPE gg->bb



BG to H->bb: Excl.DPE gg->bb



Excl.DPE H->bb: Event yields per L=10 fb-1

- Selection cuts at detector level for mh=120 GeV:

0) Both protons accepted in one of two (220,420) RP stations
1) $N_{jet} > 1$
2) $45 < Etj1*JESCor < 85$ GeV, $Etj2*JESCor > 30$ GeV
3) $|\eta_{j1,2}| < 2.5$
4) $|\eta_{j1} - \eta_{j2}| < 0.8$
5) $2.8 < |\varphi_{j1} - \varphi_{j2}| < 3.48$
6) $M_{j1j2}/M_{tot} > 0.75$
7) $M_{j1j2}/M_{miss.mass} > 0.8$
8) $N_{part}(3<|\eta|<6) = 0$
9) $118 < M_{miss.mass} < 122$ GeV

No b-tagging yet!

Details on the next slide

Generator	σxBR[fb]	Acc1*Acc2>0	gg->H->bb	gg->bb	gg->gg
DPEMC	2.27	49%	0.5	2.6	0.3
EDDE	1.94	44%	0.4	0.2	0.06
ExHuMe	1.44	61%	0.5	0.9	0.8

BG to H->bb: Excl.DPE gg->bb, gg->gg

- The main problem: Large cross sections require large statistics to get reliable predictions. More than 1 mil.events analyzed!

gg->bb:

DPEMC: ptmin=30GeV: 2.64 ev., ptmin=40GeV: 2.44 ev. ->**2.6 ev**

ExHuME: **theta_min=acos(0.75), 60<M<200: 1.03 ev.**
theta_min=acos(0.65), 60<M<200: 0.71 ev.
theta_min=acos(0.55), 60<M<200: 0.93 ev. **->0.9 ev**
theta_min=acos(0.55), 70<M<200: 0.92 ev.

EDDE: ptmin=30GeV: 0.12 ev., ptmin=40 GeV: 0.21 ev. -> **0.2 ev**

gg->gg:

DPEMC: ptmin=30GeV: 0.3 ev. -> **0.3 ev.**

ExHuME: **theta_min=acos(0.55), 60<M<200: 0.78 ev.**
theta_min=acos(0.65), 60<M<200: 0.78 ev. **-> 0.8 ev.**

EDDE: ptmin=30GeV: 0.04 ev., ptmin=40GeV: 0.07 ev. -> **0.06 ev**

Excl.DPE H->WW:Event yields per L=10 fb-1

- **Both protons accepted in one of two RP's (220, 420)**
- (L1 muons taken from FAMOS. El.+quarks correspond to parton level)
- Various cut scenarios acc.to current CMS L1 thresholds:

- C1) single e: pt>29 GeV, $|\eta|<2.5$
- C2) two e: pt>17 GeV, $|\eta|<2.5$
- C3) single μ: pt>14 GeV, $|\eta|<2.1$
- C4) two μ: pt> 3 GeV, $|\eta|<2.1$
- C5) single e: pt>20 GeV, $|\eta|<2.5$ + 2 quarks: pt>25GeV, $|\eta|<5$
- C6) single μ: pt>10 GeV, $|\eta|<2.1$ + 2 quarks: pt>25GeV, $|\eta|<5$

Excl.DPE H->WW:Event yield for L=10fb-1 Exhume 1.0

Mh [GeV]	σxBR [fb]	Acc. [%]	C1	C2	C3	C4	C5	C6	Total
120	**0.29**	61	0.11	0.01	0.23	0.02	0.02	0.03	**0.4**
135	**0.57**	65	0.26	0.02	0.50	0.05	0.06	0.08	**1.0**
140	**0.63**	67	0.35	0.02	0.60	0.06	0.08	0.10	**1.2**
150	**0.71**	69	0.48	0.04	0.73	0.07	0.13	0.13	**1.6**
160	**0.75**	71	0.62	0.04	0.83	0.07	0.21	0.23	**2.0**
170	**0.64**	73	0.61	0.03	0.77	0.07	0.20	0.22	**1.9**
180	**0.50**	74	0.45	0.03	0.62	0.06	0.14	0.15	**1.4**
200	**0.27**	77	0.26	0.02	0.33	0.03	0.08	0.09	**0.8**

Summary

- Recent versions of DPEMC, EDDE and ExHuMe generators made available in the fast CMS simulation.

- Event yields for H->WW channel provided by DPEMC, ExHuMe (and possibly by EDDE). Muon L1-trigger incorporated, but the electron identification still has to be taken

- Event characteristics for H->bb very similar in the three models, except for $\xi_{\mathbf{proton}}$ and y_{Higgs} variables. A good news: the event yields are also very similar.

Despite the large numbers of events analyzed, predictions for bg processes differ significantly between models