# Comments on jets in Top Monte Carlo

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Top Mass meeting
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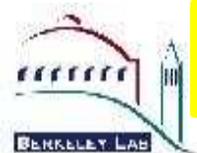
Jets in HERWIG and PYTHIA

- b jets deviation from tree level partons (ΔR)

- b jets and light jets mass

- W mass at parton and hadron level
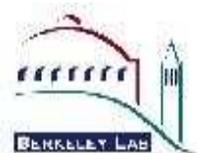
HERWIG $t\bar{t}$ event: following the partons. Subscript 0 refers to tree level, subscript 1 to the adjusted parton

line	Part.	Code	stdep	parent	Da1	Da2	mo1	Mo2	Px	Py	Pz	E	M
46	$\bar{t}$	-6	155	94	47	48	20	38	1.9	-110.0	92.7	228.8	177.9
47	W_0	-24	123	-6	49	47	46	47	18.6	-132.8	34.7	164.1	88.0
48	$\bar{b}_0$	-5	124	-6	50	46	46	46	-16.7	22.8	58.0	64.7	4.85
50	$\bar{b}_1$	**94**	144	-5	52	53	48	46	-16.6	16.8	66.5	71.2	**9.45**
Note that the W_0 decay jets are missing!													
49	W_1	-24	195	-24	54	55	47	46	18.4	-126.8	26.2	157.6	87.9
54	q_1	-2	123	-24	56	56	49	55	52.5	-90.9	26.1	108.1	0.3
56	q_2	**94**	143	-2	58	59	54	49	52.3	-90.7	26.0	107.9	**2.15**
55	$\bar{q}'_1$	1	124	-24	60	54	49	54	-34.1	-35.9	0.1	49.5	0.3
60	$\bar{q}'_2$	**94**	144	1	62	64	55	29	-33.9	-36.1	0.2	49.7	**4.2**

W1 and b1 have been adjusted from W0 and b0 to take into account parton shower effects
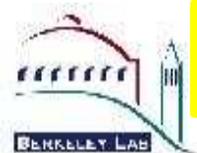
PYTHIA $t\bar{t}$ event: following the partons. Subscript 0 refers to tree level, subscript 1 to the adjusted parton

line	Part.	Code	stdep	parent	Da1	Da2	Mo1	Mo2	Px	Py	Pz	E	M
7	t	-6	3	2	0	0	4	5	27.1	-173.8	-148.5	290.0	176.4
10	W_0	-24	3	-6	0	0	7	0	57.1	-144.5	-167.3	241.8	79.6
11	$\bar{b}_0$	-5	3	-6	44	47	7	0	-30.2	27.2	20.8	45.9	4.85
44	$\bar{b}_1$	-5	2	-5	101	101	11	0	-5.1	-12.6	22.7	26.9	4.85
45	gluon	21	2	-5	101	101	11	0	-0.9	-0.0	-0.1	0.9	0.
46	u	1	2	-5	101	101	11	0	-10.8	-9.4	-12.4	18.9	0.
47	$\bar{u}$	-1	2	-5	108	11	0	108	-6.5	-17.3	-6.2	19.5	0.
						W_0 decay jets are missing as in HERWIG							
17	W_1	-24	2	-24	55	60	10	0	50.2	-132.3	-150.6	221.4	79.5
14	q_1	1	3	-24	0	0	10	0	-18.4	-27.0	-53.3	62.5	0.
15	$\bar{q}'_1$	-2	3	-24	0	0	10	0	68.6	-105.3	-97.3	158.9	0.

Here partons 44-47 will be added to compare with the b1 of HERWIG (ID=94 b parton).
Partons 14-15 will be modified (as in HERWIG) in the next step.
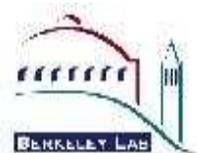
B jet direction changes in MC

ΔR(Tree level – ID=94)   ΔR(Tree level - Simulation)   ΔR(Id=94-Simulation)

HERWIG
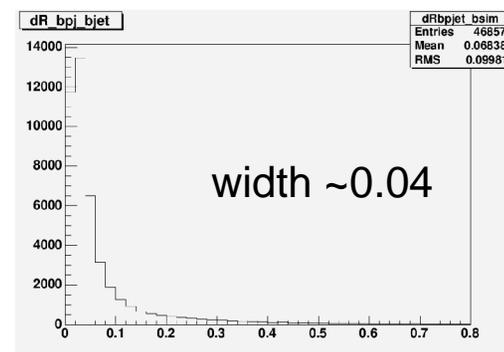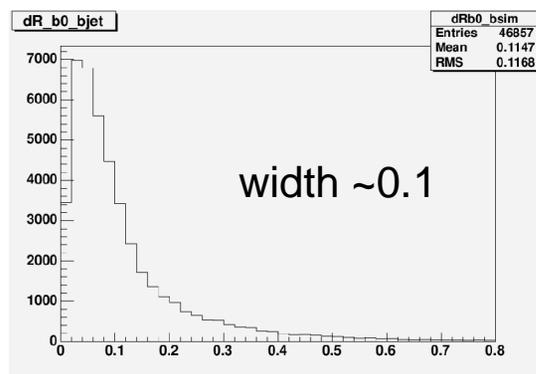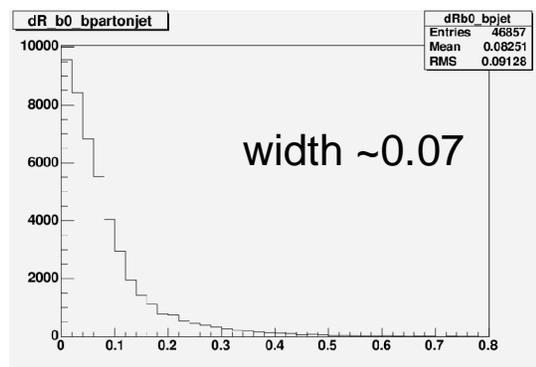
PYTHIA
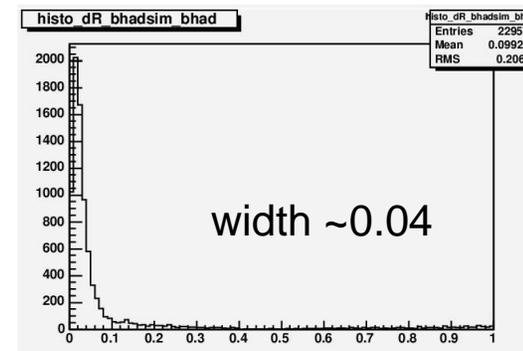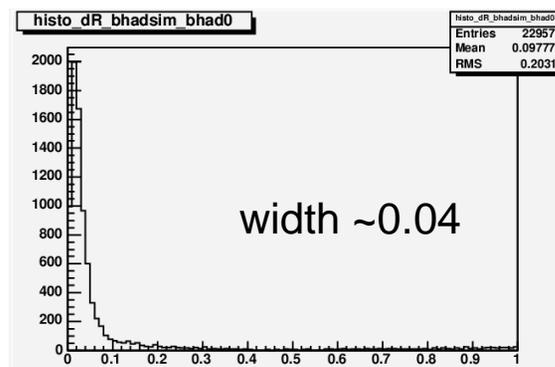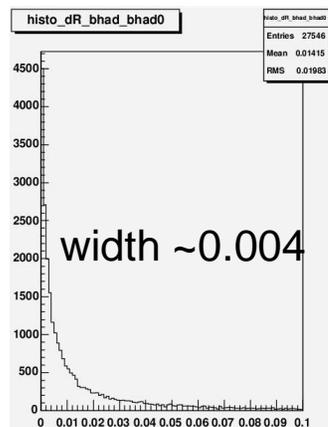

width here refers to the width at half maximum. Tree level to simulation
is different in PYTHIA and HERWIG: different physics effects?
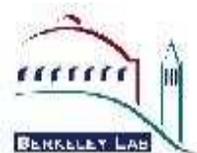
The b jet directions at hadron level

ΔR at hadron level : b0-had level jet and simulation

Physics effects

Detector effects

parton to particles

width ~0.1

particles to jets

resolution ~ 0.04

HERWIG

parton to particles

width ~ 0.02

particles to jets
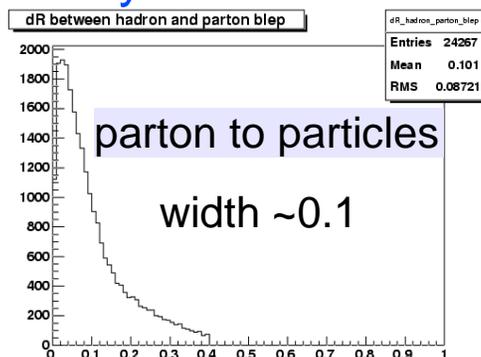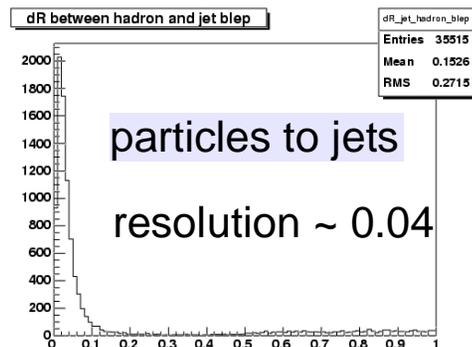
resolution ~ 0.04

cone of 0.4 used
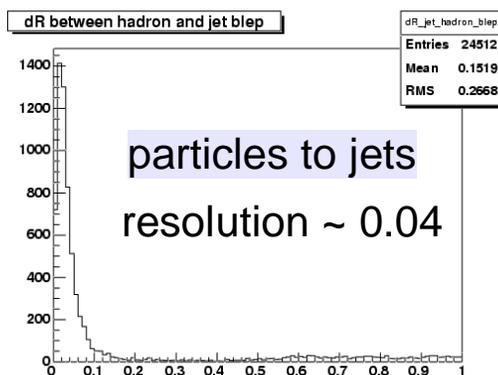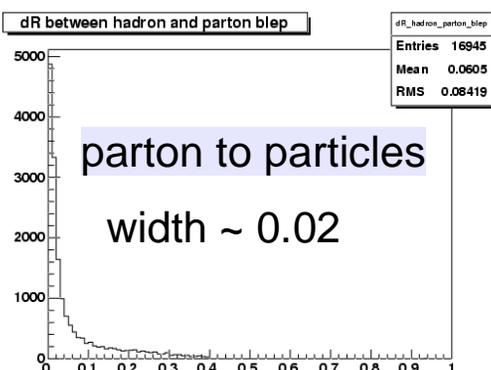
PYTHIA

Jets in HERWIG get large angle deviations (~0.1) when they acquire a mass
- Effect seen at the parton level as well as the hadron level
- Detector effects (resolution) are a small part of the ΔR we observe.

PYTHIA angle deviation is small(~0.02), detector effects same as HERWIG
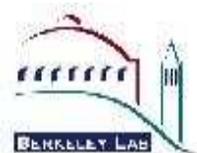
b masses in HERWIG and PYTHIA

b parton-jet (ID=94)

b JETCLU mass include
detector resolution
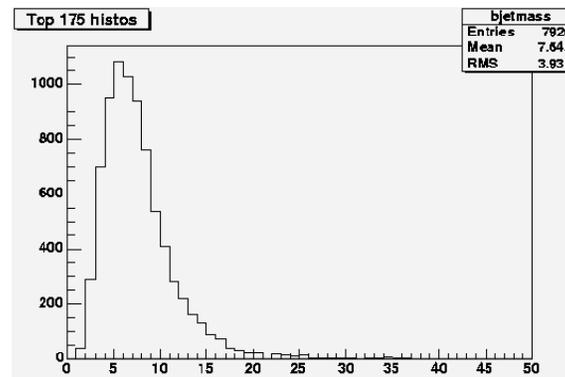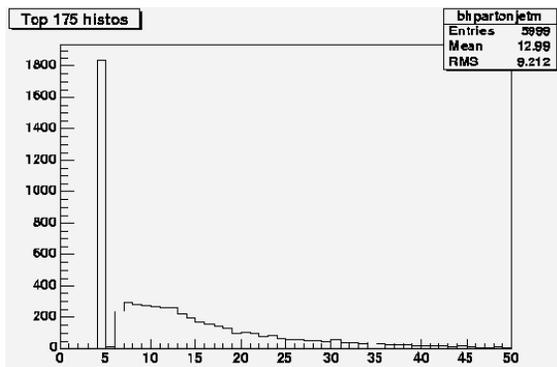
HERWIG
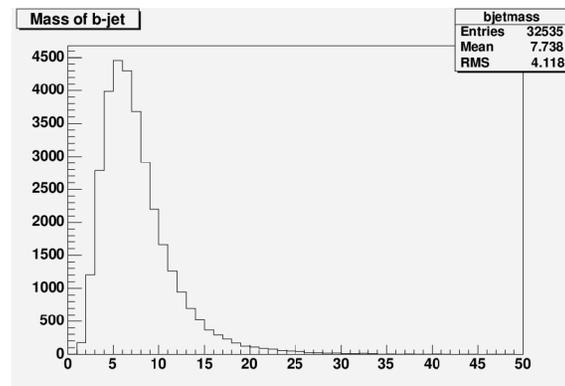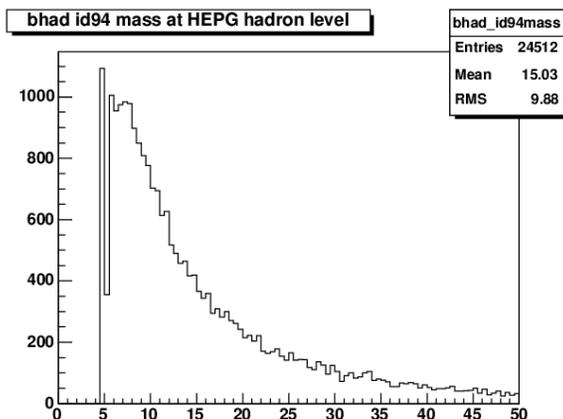
PYTHIA

Jet mass for simulated jets is about the same, not so for ID=94 parton

# PYTHIA b Mass varying PARJ(82)

PARJ(82)=1.0

PARJ(82)=2.0

PARJ(82)=3.0

PARJ(82)=4.0

PYTHIA default
PARJ(82)=1.0
tuned on LEP data

mass for
PARJ(82)=3-4
looks like the
HERWIG b mass.

Sjostrand and Mrenna point out that we can only make comparisons between the two MC at hadron level, i.e. after the parton shower and hadronization are complete (see next page)
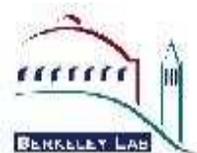
Jet masses at hadron level

Use cone algorithm to find jets at <u>particle level</u>, compute the mass for jets with cone=0.4

b jet mass Δm=0.5GeV

q jet mass Δm=0.01GeV
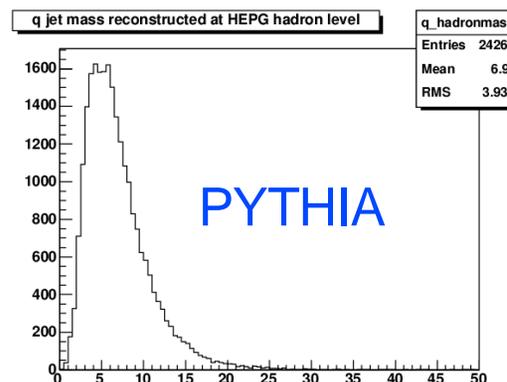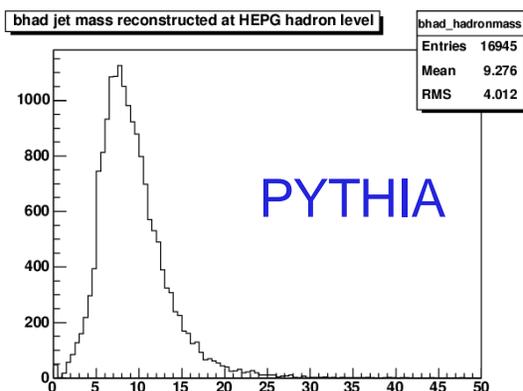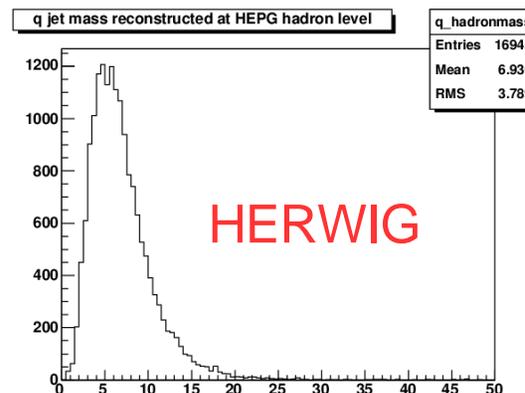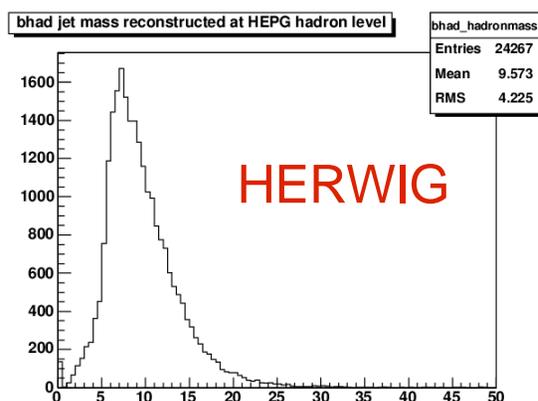

b jet mass in HERWIG is larger by 0.5 GeV
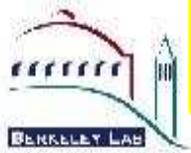
Parton level HEPG studies

W mass studies

- Use JetClu at HEPG level

- Top: Herwig Bottom: Pythia

- Left: partons Right: hadrons

- These plots show lack of η-dependence at HEPG level

parton level

hadron level

HERWIG

parton level
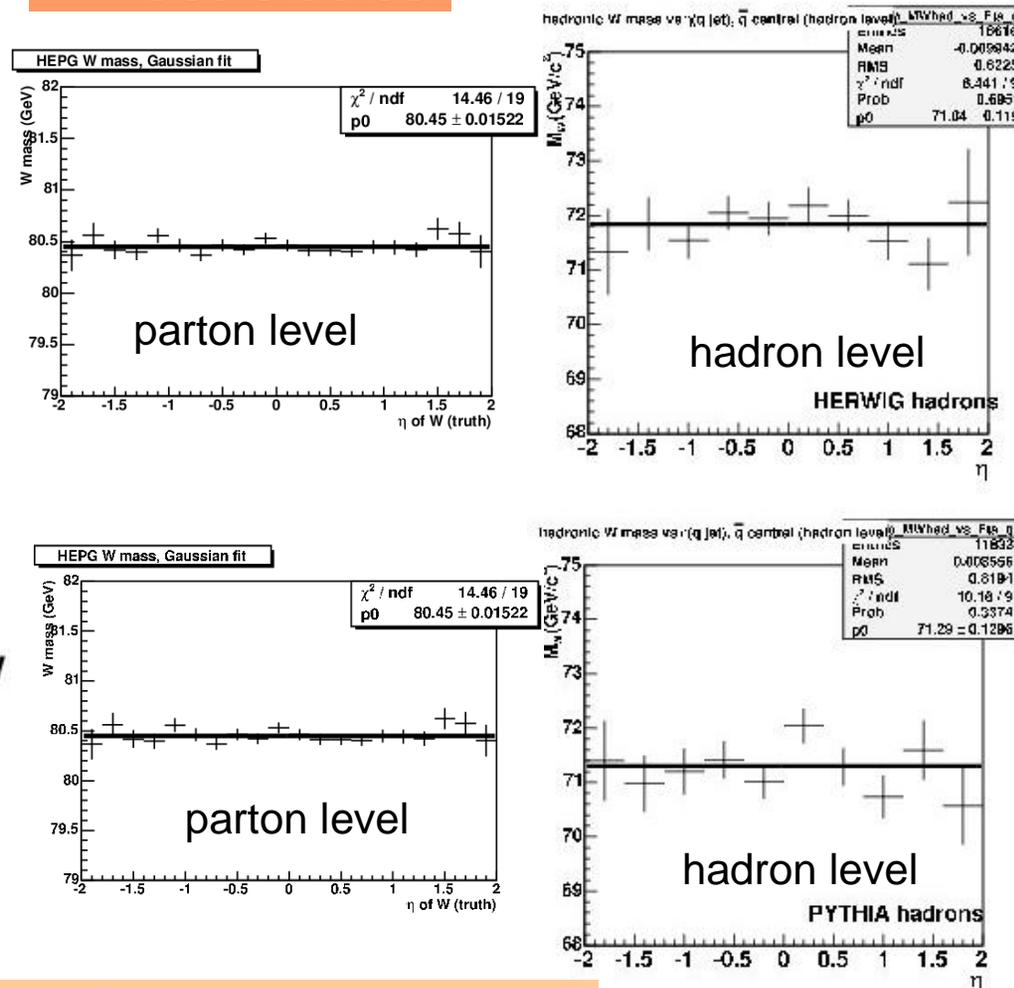
hadron level

PYTHIA

Mass difference Δm=0.5 GeV at hadron level

Paul Lujan, Pedro Movilla Fernandez, 02/16/05
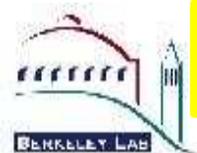
W mass at hadron level

jet cone =0.4   Δm=0.5 GeV   jet cone =0.7   Δm=0.7 GeV
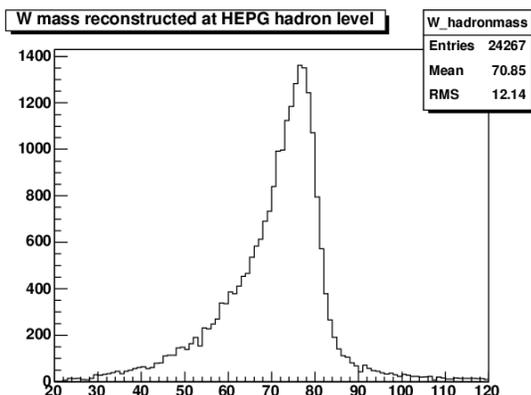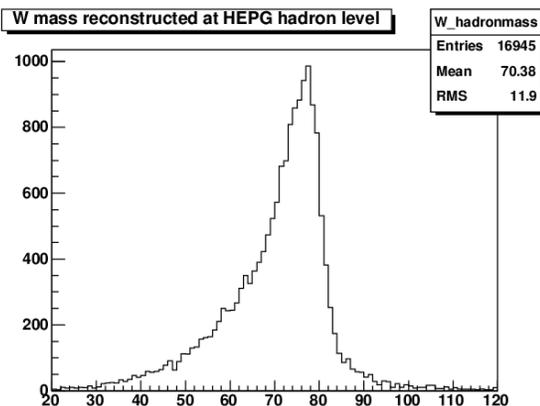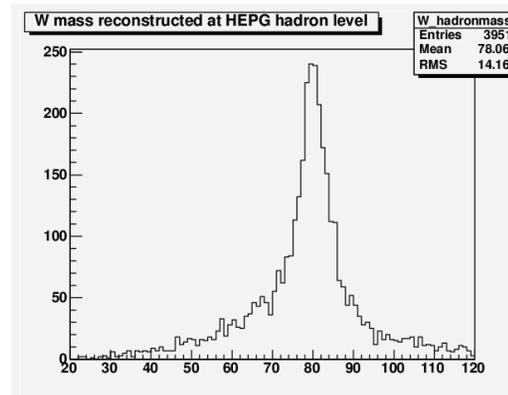
HERWIG

PYTHIA
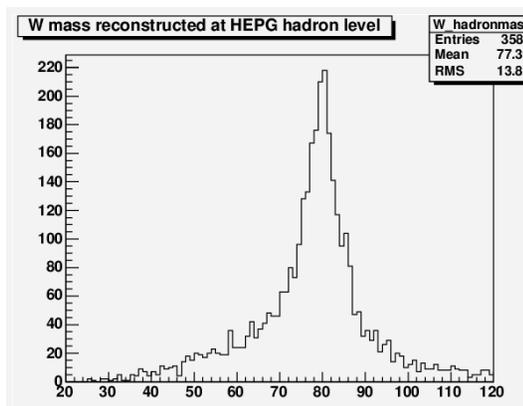
W mass at hadron level is larger for HERWIG than for PYTHIA
Not from underlying event (see Rick Field)
Parton shower and fragmentation?, production?
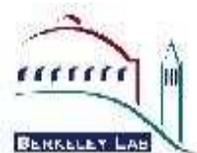
Summary

We have compared jets and W mass in HERWIG and PYTHIA MC

- Hadron Jet direction in HERWIG is away from the tree level parton by $\Delta R \sim 0.1$. In PYTHIA it deviates only by $\Delta R \sim 0.02$. Is this due to different physics?

- Jet resolution (i.e. from Simulation+reconstruction) $\sim \Delta R = 0.04$

- Jet masses at the <u>parton level</u> cannot be compared in HERWIG and PYTHIA, as the parton shower and frag. are done differently and only at the end they can be compared

- b jet masses at <u>particle level</u> differ by ~ 0.5 GeV.

- W mass, reconstructed at hadron level, is 500 MeV larger in HERWIG than in PYTHIA: needs to be understood (in simpler final state, perhaps)