Fast simulation for M_W systematics?

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Need high MC statistics for many systematics, esp.

model dependent hadronisation/CR.

How much can/dare we trust "fast" detector simulation?

Depends on:

- good modelling of significant variables/correlations
- complexity of event selections

$\Longrightarrow$ may not be appropriate every expt., final state, M_W method

$\Longrightarrow$ to verify each case separately…

e.g. OPAL 189 GeV qqqq selection (4 variable likelihood)

Event samples

$\sqrt{s}$=189 GeV throughout

- $10^5 \times 4q$, Koralw1.42 (grc4f CC03 M.E.) + JETSET74
- --- " --- +Sjostrand-Khoze Type I, ρ=100 (94% reconn.)
- --- " --- + Sjostrand-Khoze Type II

These samples identical events to end of parton shower

- 2.10^5 all modes, ARIADNE (PYTHIA CC03) + Jetset74,
- --- " --- + AR2 model (CR for $E_{gluon} \leq \Gamma_W$)

Process all events through FULL and "FAST" det. sim.

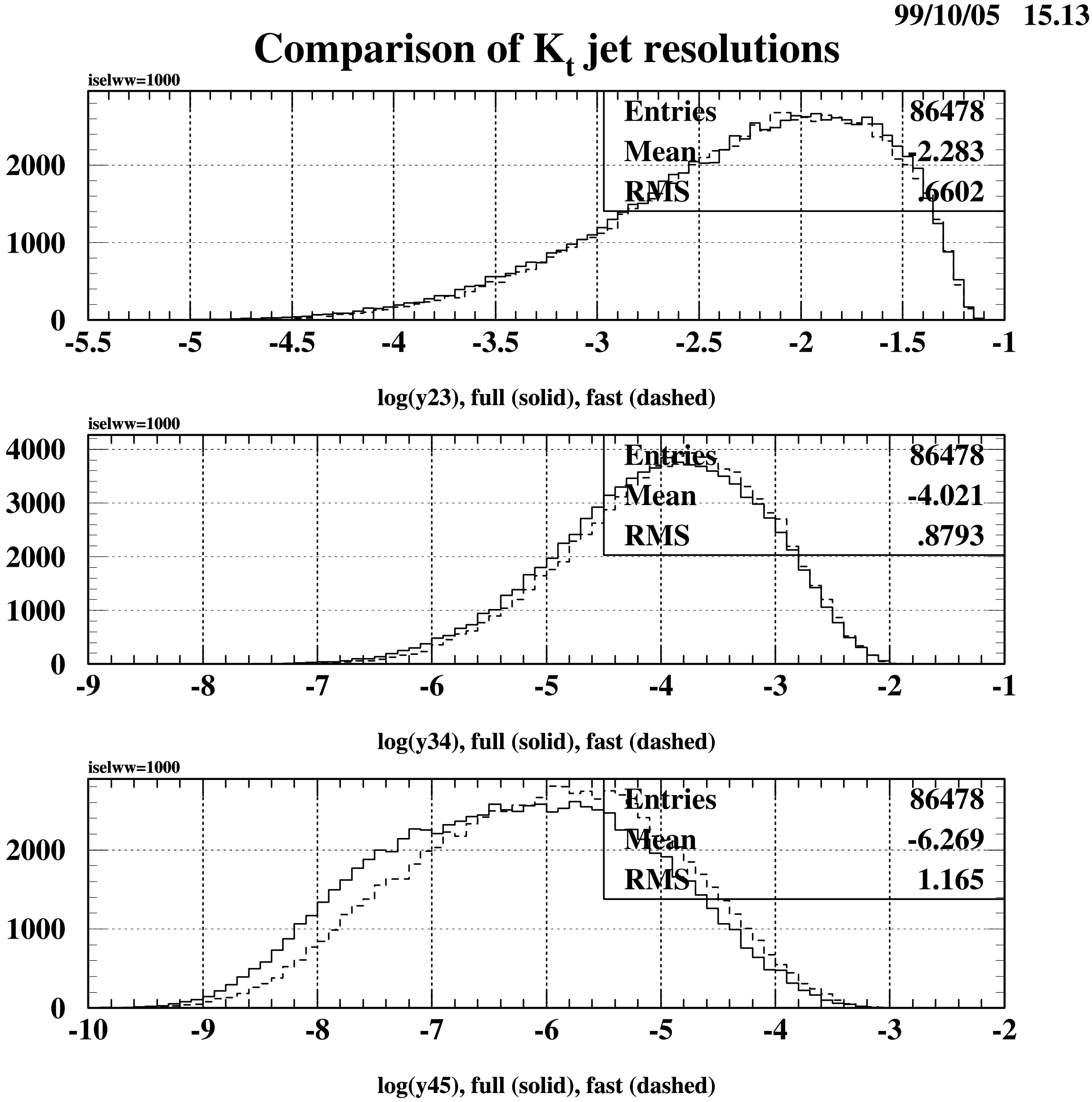
Identical selection/analysis procedures

Selection efficiencies differ ~ few % (absolute)

- $\varepsilon \approx 86.5$ % FULL
- $\varepsilon \approx 84.2$ % FAST

Jet resolutions

Durham scheme, KORALW non-CR sample



Differences increase as more jets resolved

$\Longrightarrow$ Careful in M_w analyses separating 4j/5j events

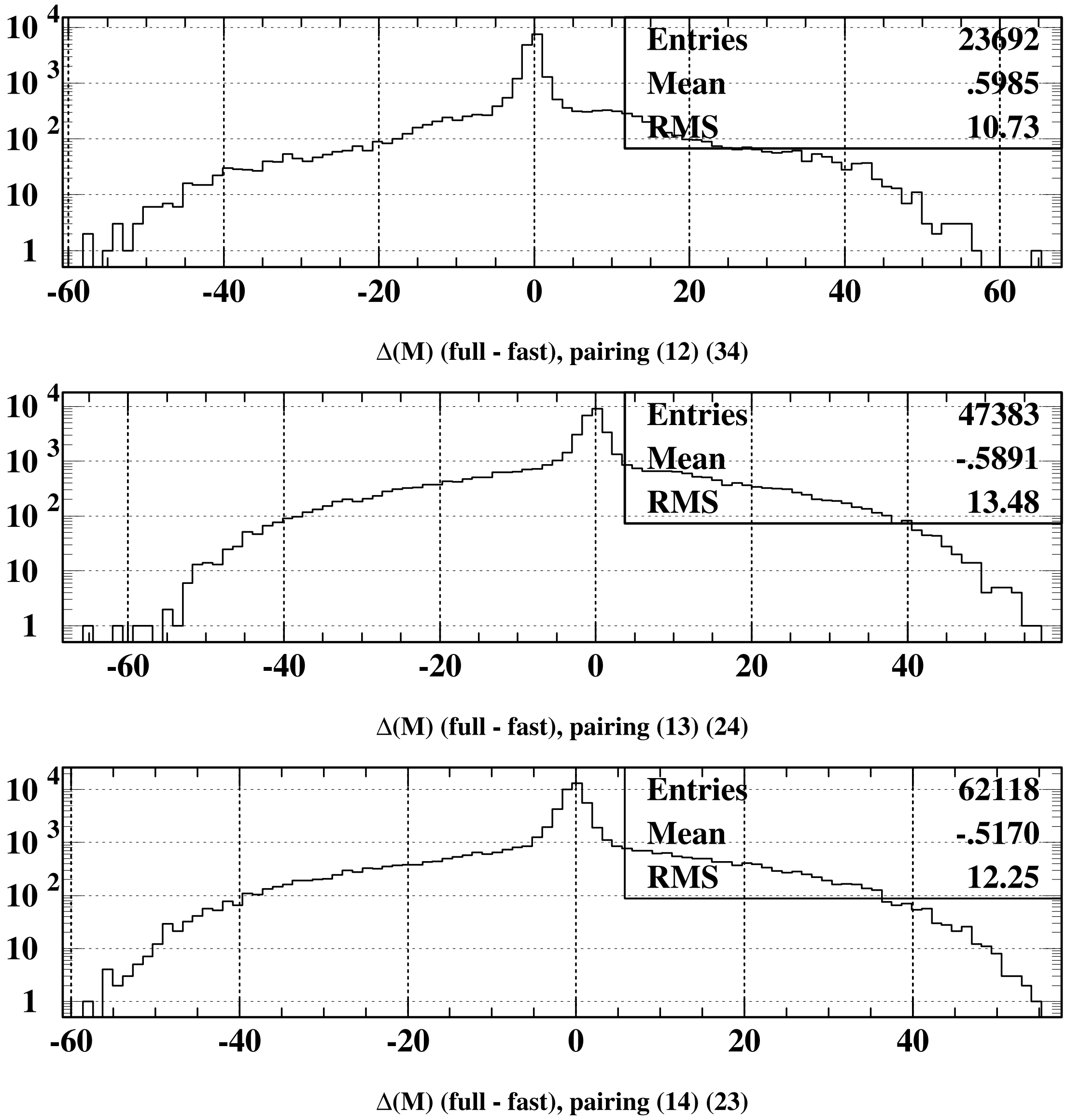
5c kinematic fits

For events selected as $W^+W^- \rightarrow qqqq$, prob(5c)>0.01

in both FULL and FAST sim., Δm (FULL – FAST)

99/10/05 14.44

Event-by-event comparison of 5c fit masses

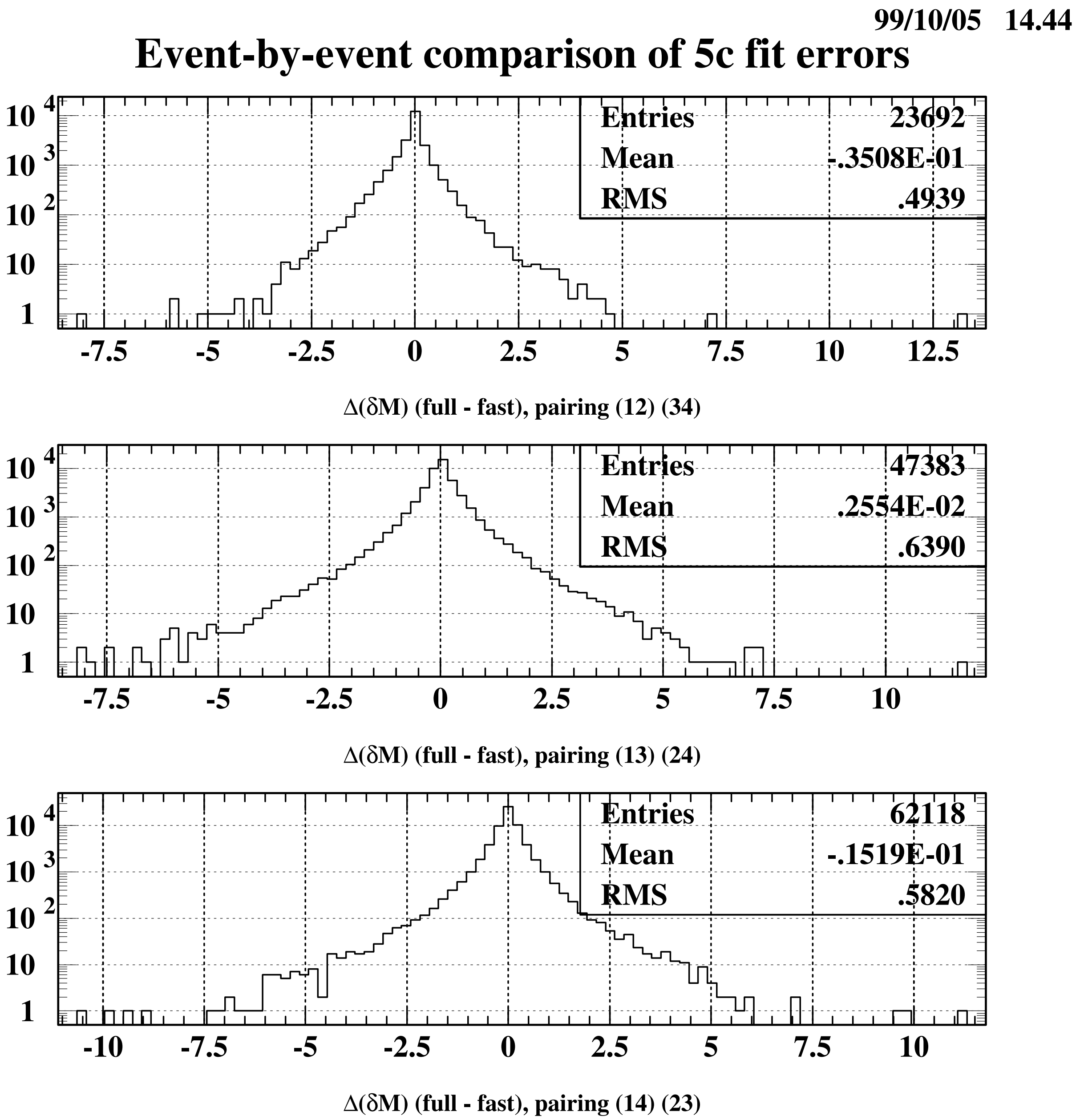


Mean differences ~ 0.60±0.05 GeV

Significant tails found:

perhaps where jet ordering differs FAST ⇔ FULL?

Similarly, errors from kinematic fits



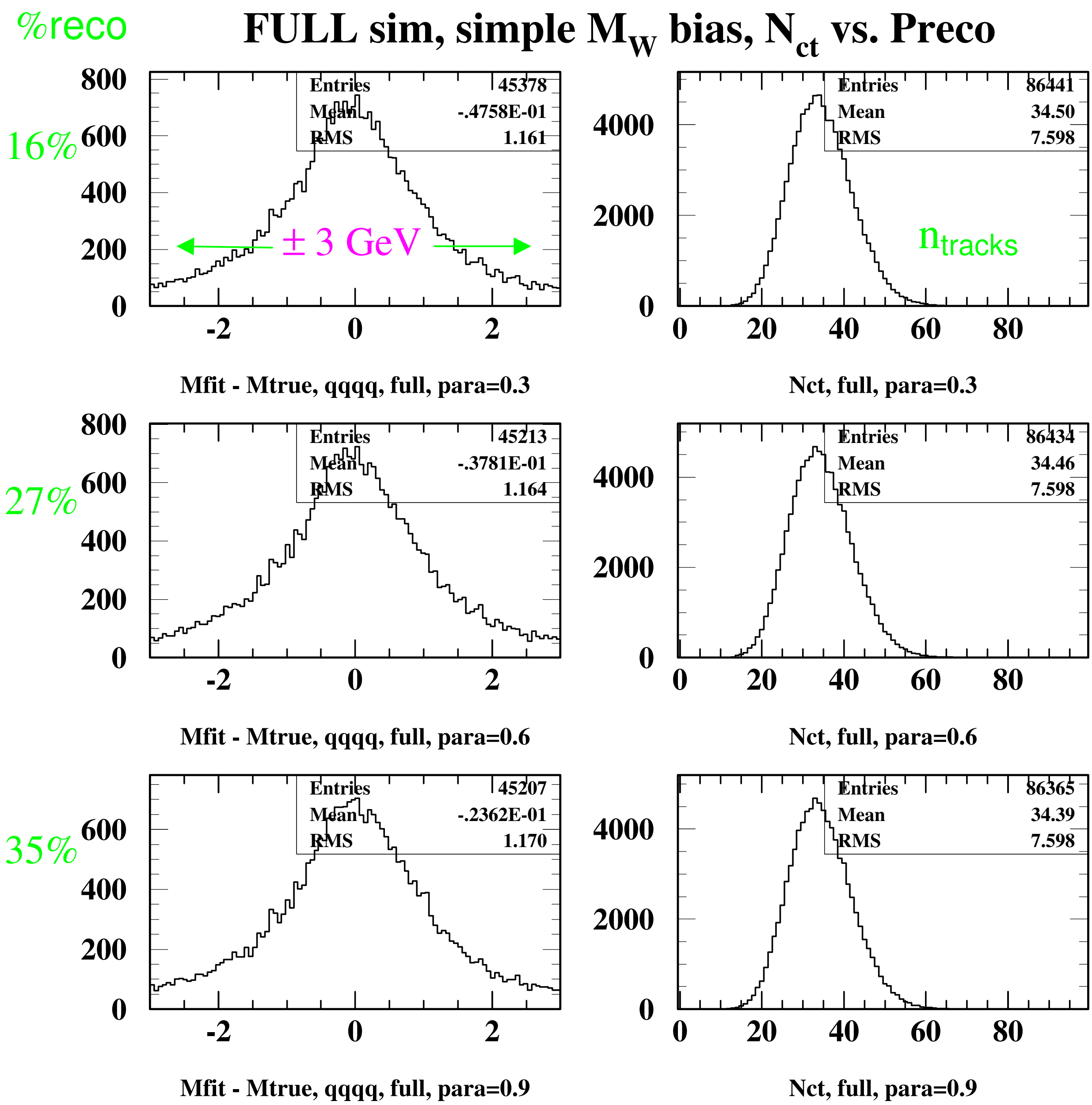
Arguably less important, as fit uncertainties often not explicitly used in M_w analyses.

M_W bias

Event-by-event estimator [Phys.Lett. B453('99)138]

$$\text{bias} \equiv \langle\, m(5c\ \text{fit}) - \tfrac{1}{2}(m(W^+) + m(W^-))\,\rangle$$

Truncated mean, $\pm$ 3 GeV

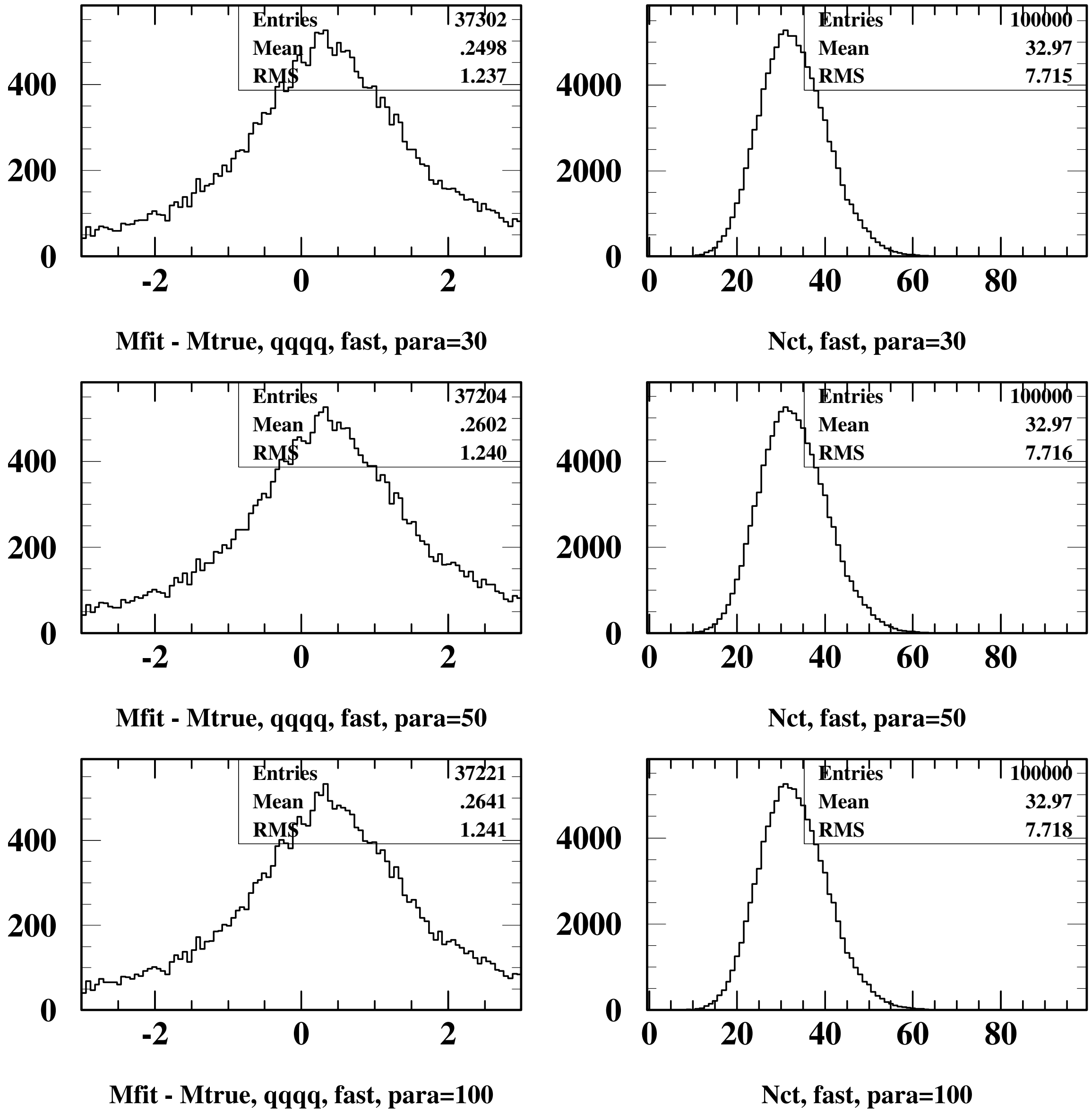


Study using SK I model, take CR version of event

where (1-exp(-ρV)) > rand() [≅suggested by Aleph]

Repeat using FAST simulated events…

FAST sim, M_W bias, N_{ct} vs. Preco



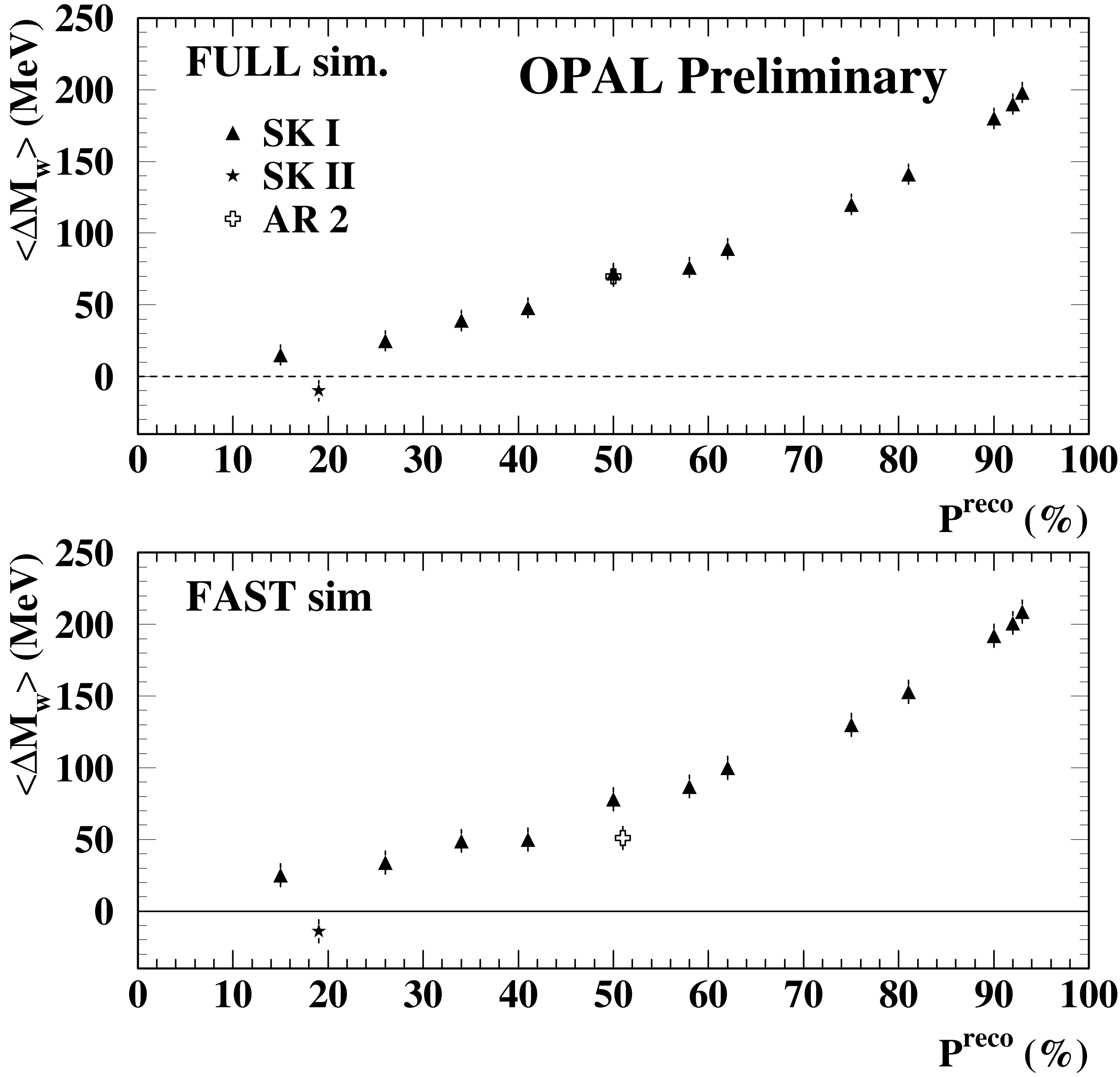
and also SK II, SK II′, ARIADNE, AR2, AR3,…

Compare KORALW1.42 biases,

- −63±7 MeV FULL
- +57±8 MeV FAST

Significant difference no surprise (jet parametrisation…)

Form CR bias as bias (CR) – bias(normal)



Relative changes in mass bias, very good agreement

➡ OPAL FAST sim. OK for CR/hadronisation studies

[189 GeV $W^+W^- \rightarrow qqqq$ selection]

➡ No guarantee FAST sim. OK elsewhere or at higher precision!