Fully hadronic decay
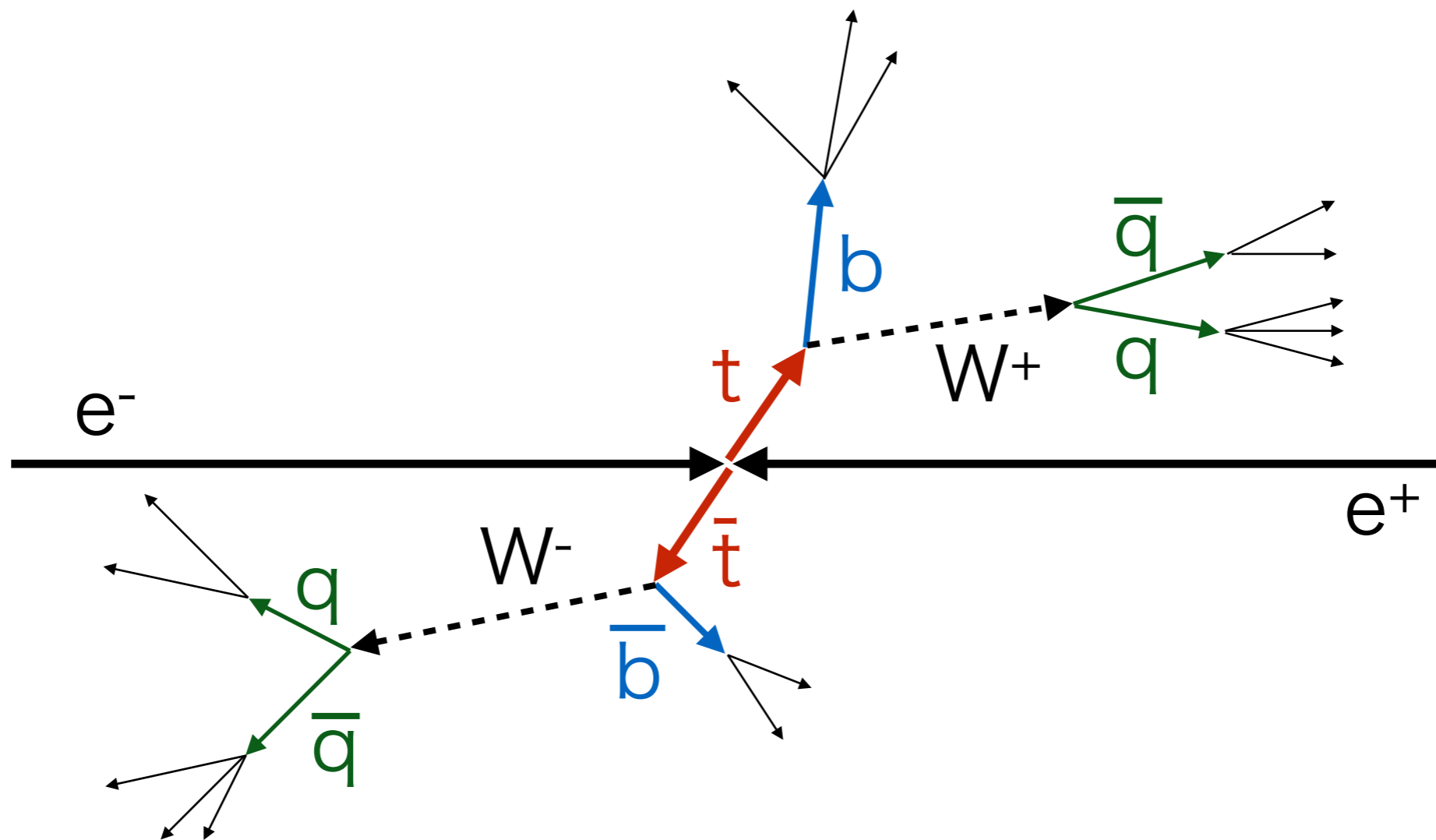
Takaaki Yasui

Internship subject

Study of fully hadronic decays in the process ee->tt.
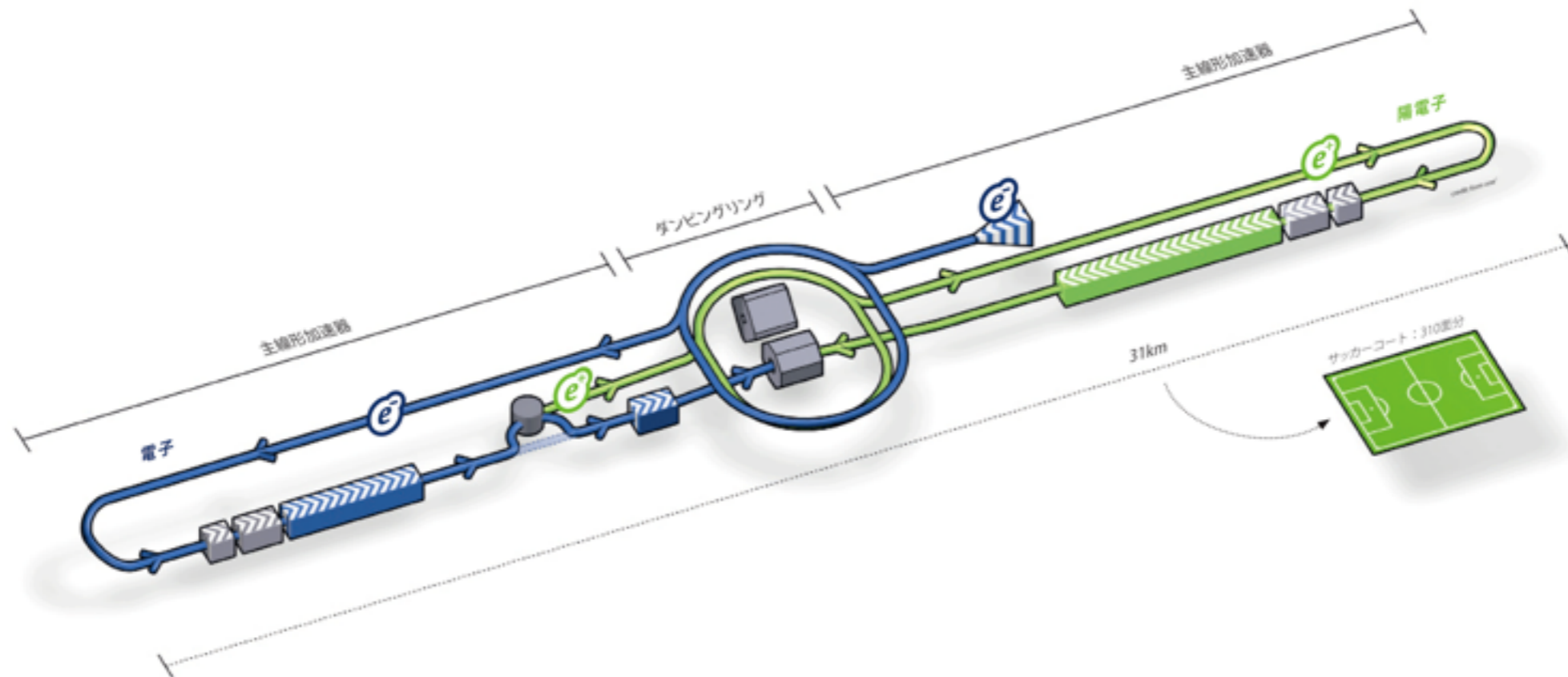
Status

<u>top quark</u>

・charge : +2/3   spin : 1/2

・**mass : 173 GeV**

・life time : 0.5×10^{-24} sec (weak interaction) -> no hadronization

・decay to bottom (99.8%)

<u>Hadronic decay (tt->bqqbqq)</u>

・46% of the top quark decay

・Kinematic variables can be reconstructed precisely.
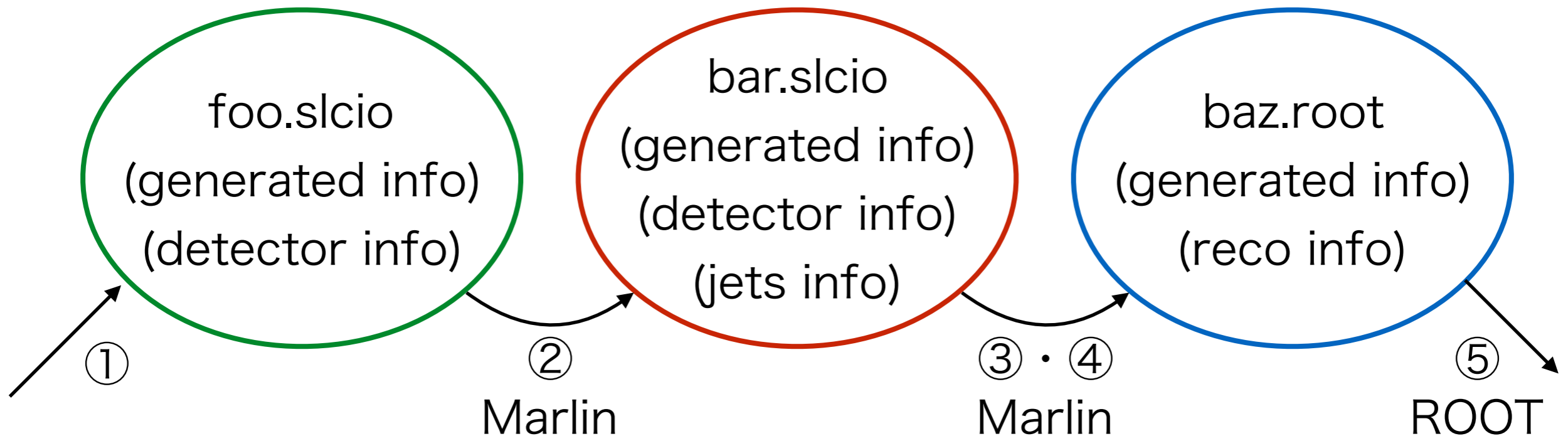
ILC

- High energy linear accelerator proposed to construct in Japan.

- Start at $\sqrt{s}$ = 250 GeV, then upgrade to <u>$\sqrt{s}$ = 500</u>, 1000 GeV.
    my study

- Luminosity : 0.75 - 1.8 $cm^{-2}s^{-1}$

- e^- beam polarization : 80%, e^+ beam polarization : 30%
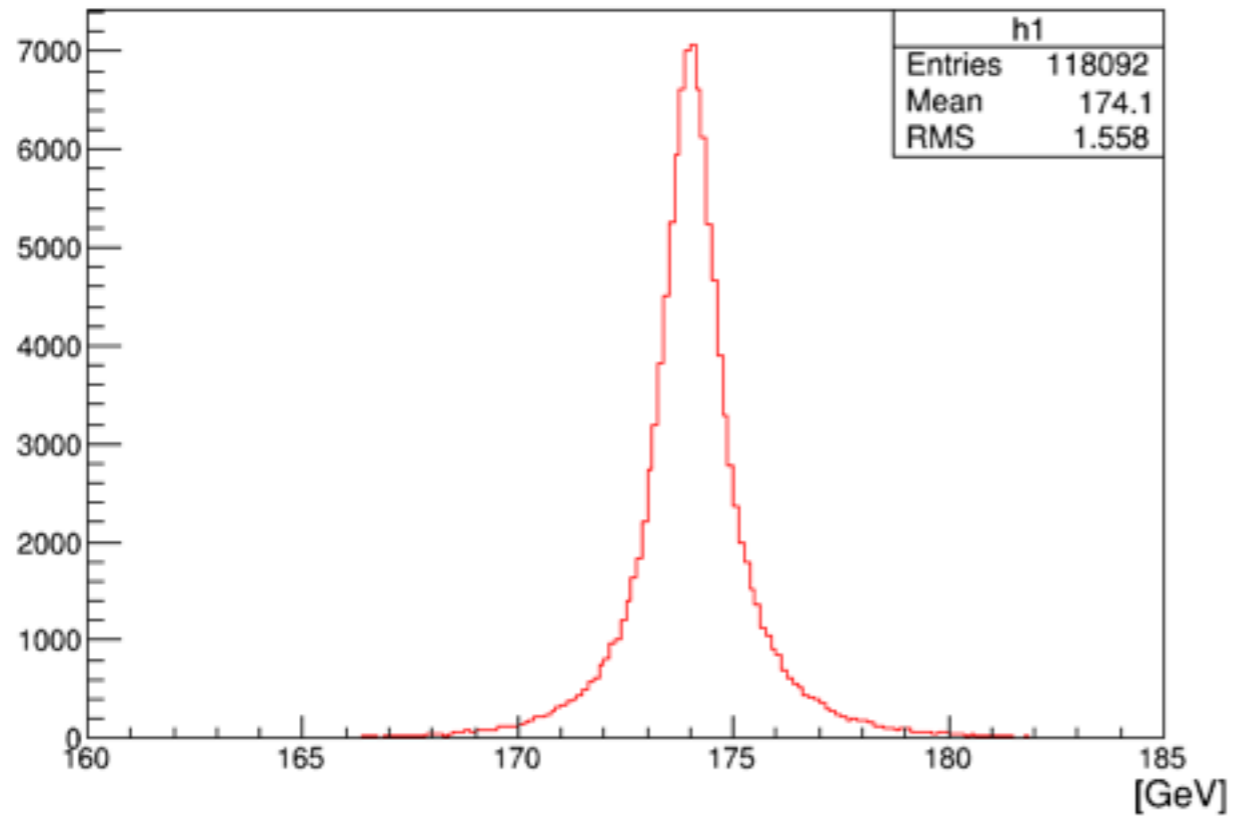
Study method

1. Make detector simulation data.

2. Jet clustering and flavor tagging. (6 jets)

3. b tagging and reconstructing W bosons. (4 jets)

4. Reconstruct tops by choosing minimum χ^2.
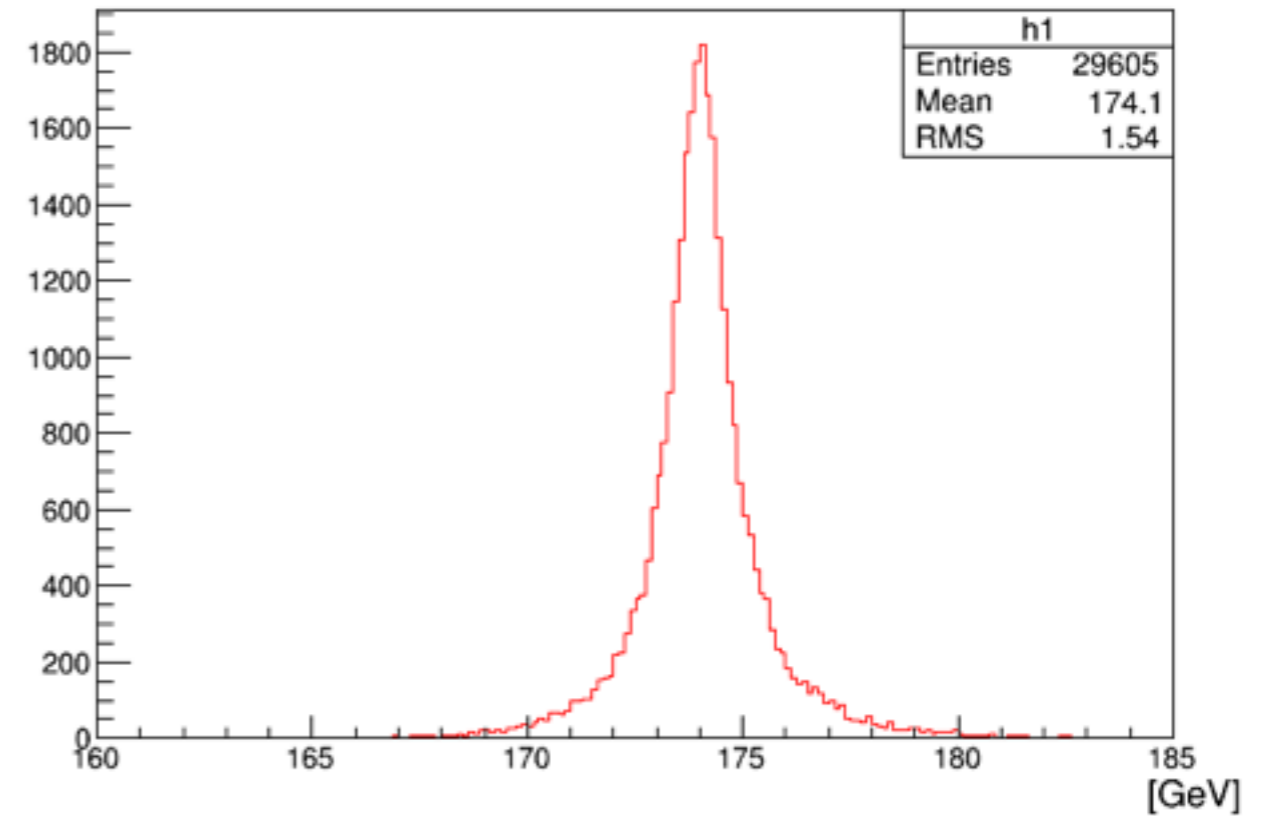
5. Compare the reconstructed data with generated data.

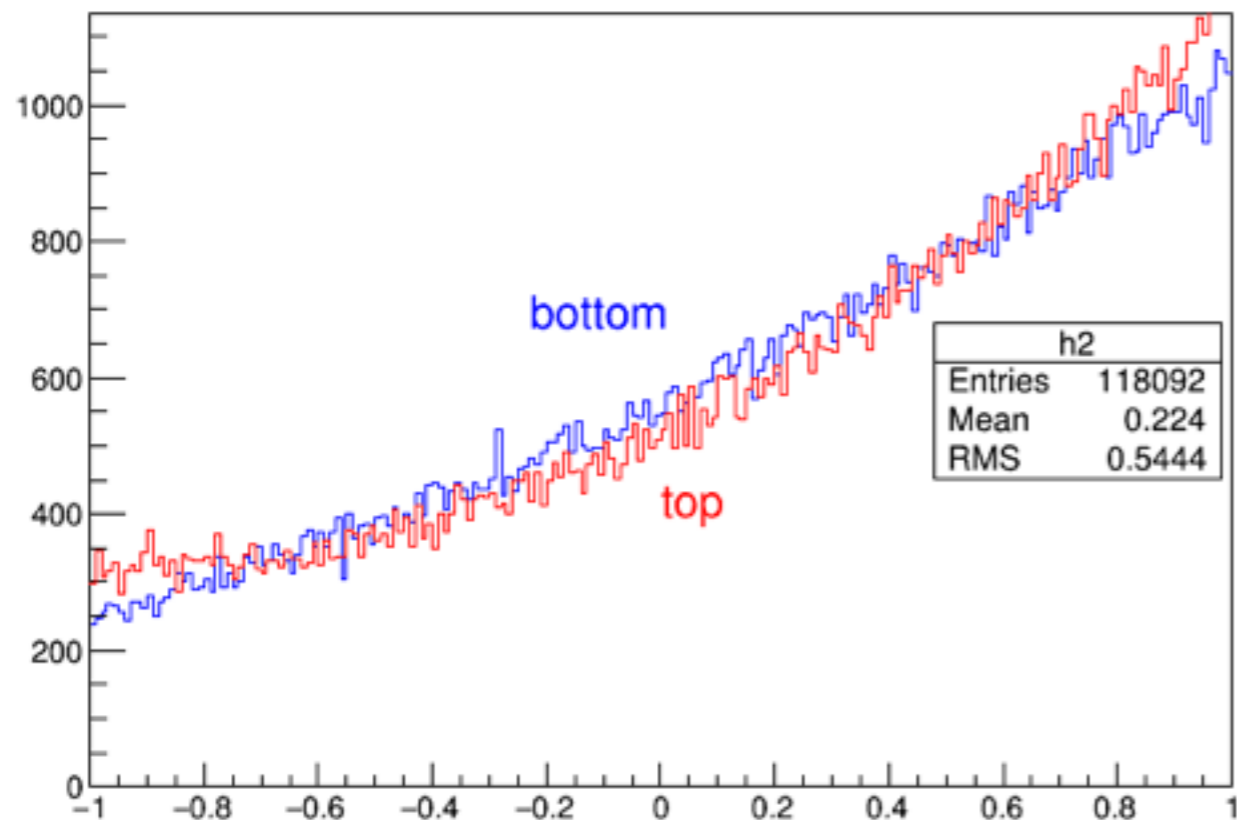# Generated data

First, I checked generated data.

Generated data

Polar angle

h2	
Entries	118092
Mean	0.224
RMS	0.5444

bottom

top

e⁻ : Left   e⁺ : Right

Polar angle

h1	
Entries	29605
Mean	0.2906
RMS	0.5332

top
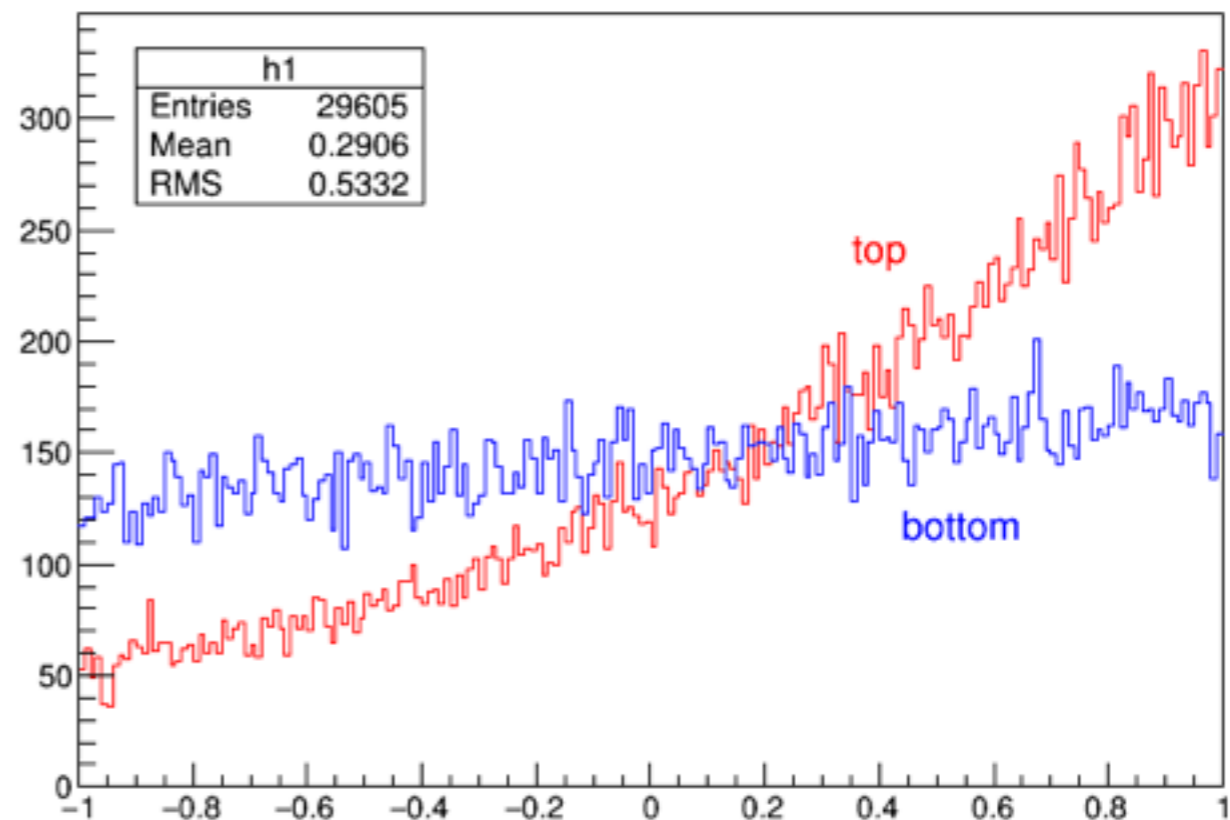
bottom

e⁻ : Right   e⁺ : Left

Cuts for reconstructing

1. btag1 > 0.8,   btag2 > 0.3

2. 140 GeV < m_{top} < 210 GeV

3. $\chi_1{}^2$ < 30, $\chi_2{}^2$ < 30

$$\chi^2 = \left(\frac{m_{top} - 174 \text{ GeV}}{\sigma_{m_{top}}}\right)^2 + \left(\frac{E_{top} - 250 \text{ GeV}}{\sigma_{E_{top}}}\right)^2 + \left(\frac{P_b^\star - 69 \text{ GeV}}{\sigma_{P_b^\star}}\right)^2$$
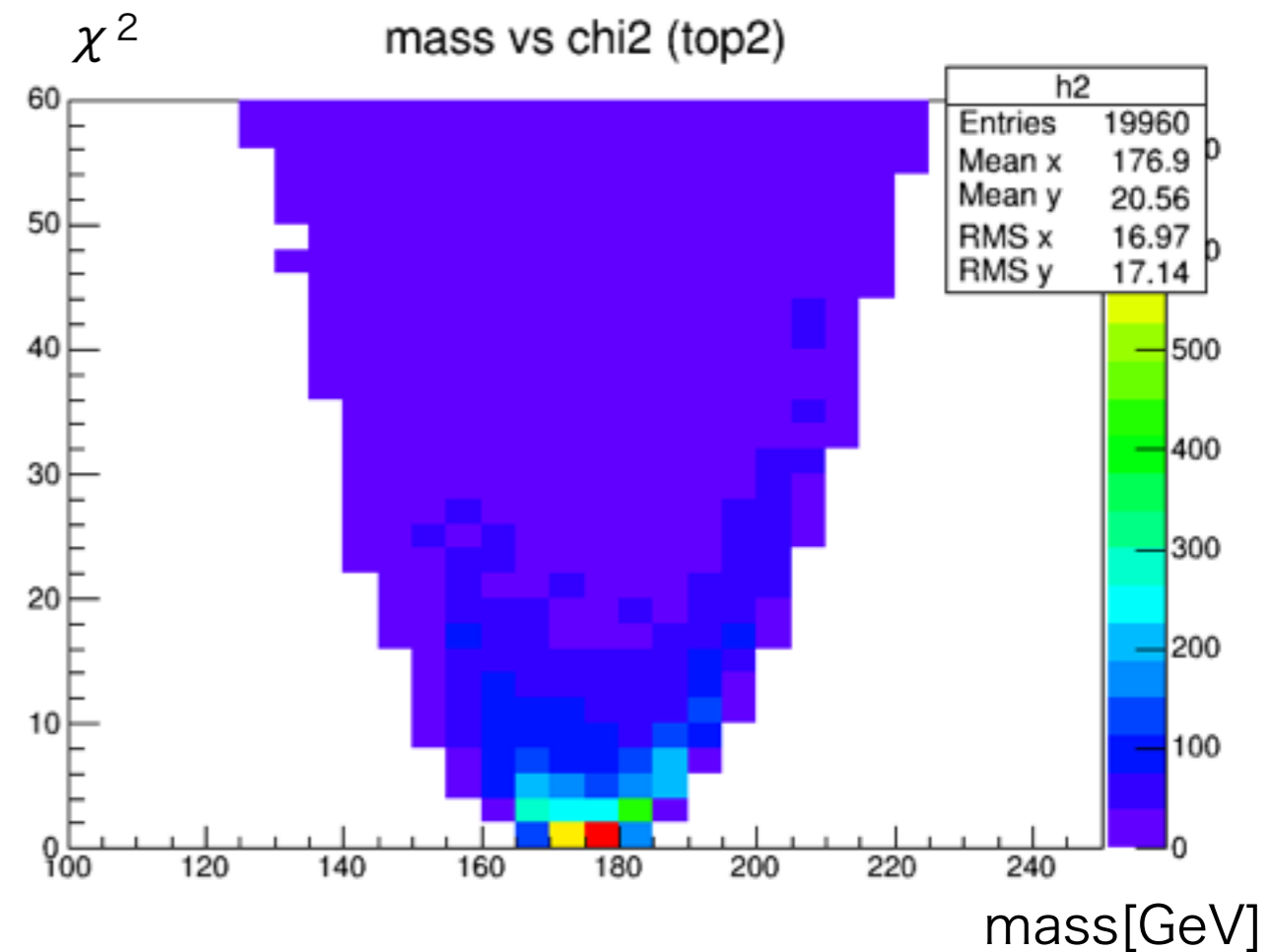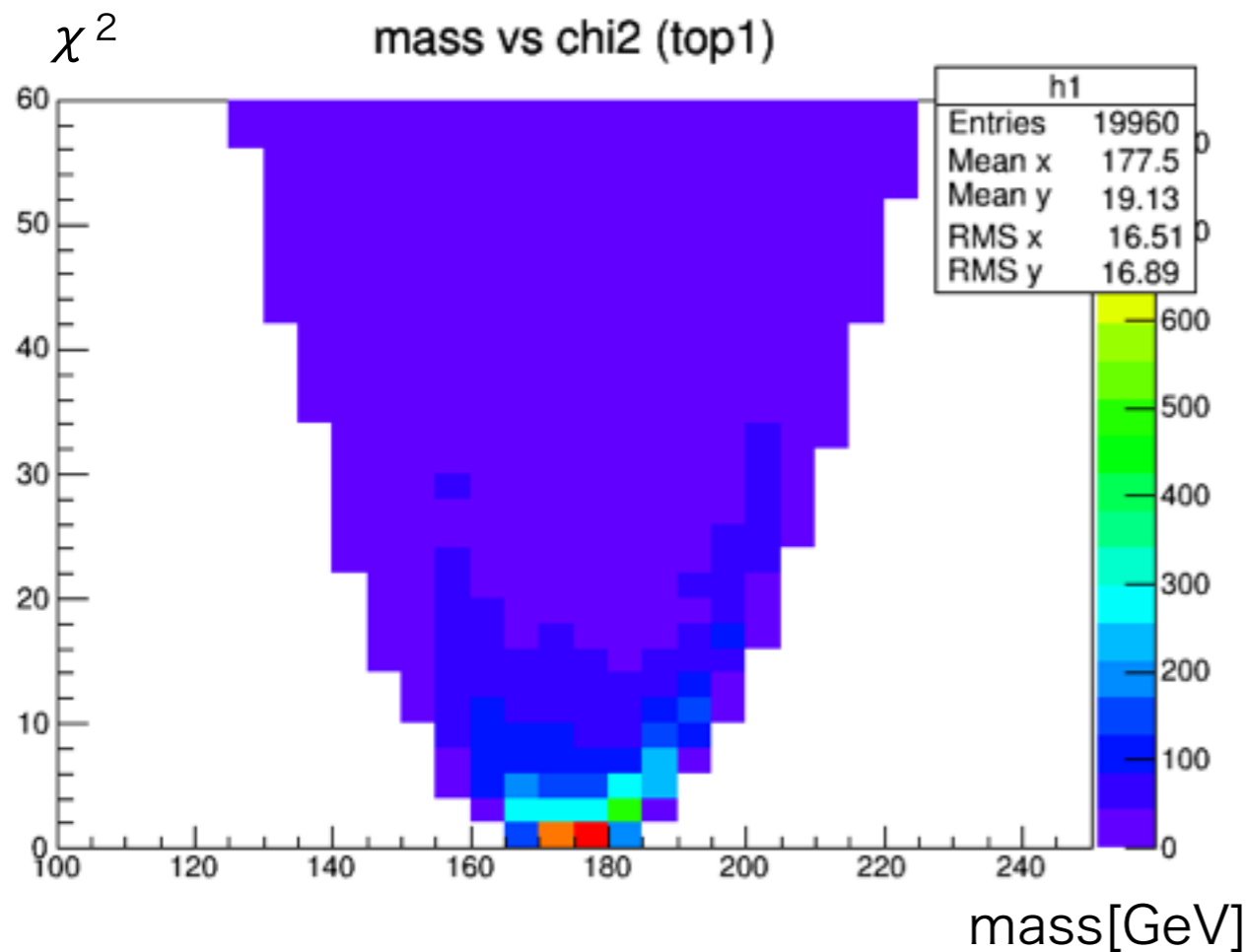
P_b* : bottom momentum at the rest frame of top

$$P_b^\star = \gamma P_b (1 - \beta_t \cdot \cos(\theta_{tb}))$$

$$\sigma_{m_{top}} = 6.3 \text{ GeV}, \qquad \sigma_{E_{top}} = 8.0 \text{ GeV}, \qquad \sigma_{P_b^\star} = 10 \text{ GeV}$$
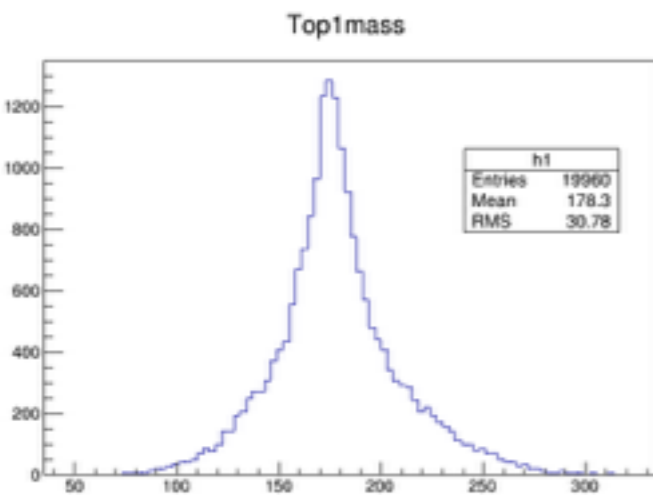
Cuts for reconstructing

1. btag1 > 0.8,   btag2 > 0.3

(2.   140 GeV < m_{top} < 210 GeV)

3. $\chi_1{}^2$ < 30, $\chi_2{}^2$ < 30

Cuts for reconstructing

	number of data	Amjad's thesis
before cuts	19960 (100%)	162128 (100%)
after b-tag	14578 (73.0%)	104710 (64.9%)
after mass cut	9434 (47.3%)	80780 (49.8%)
after χ^2 cut	5632 (28.2%)	56598 (34.9%)
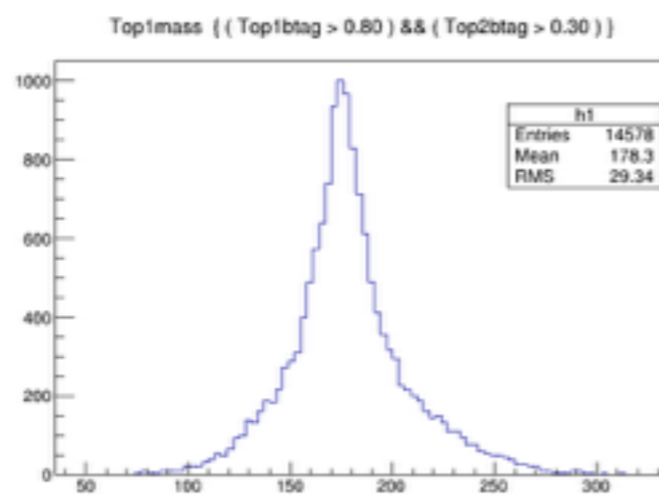
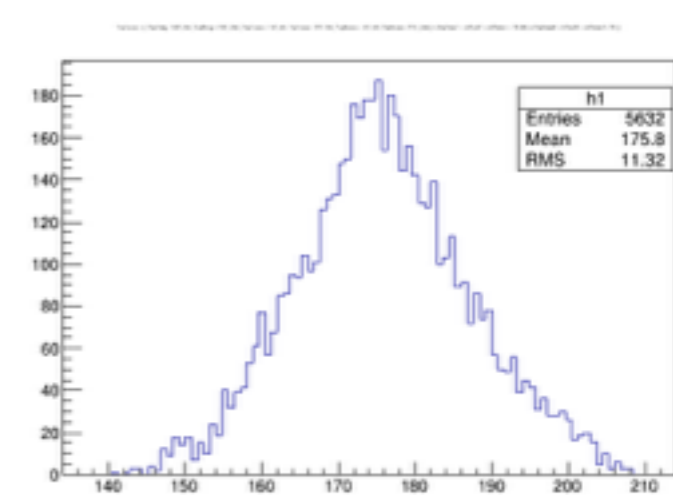before cuts   after b-tag   after mass cut   after χ^2 cut
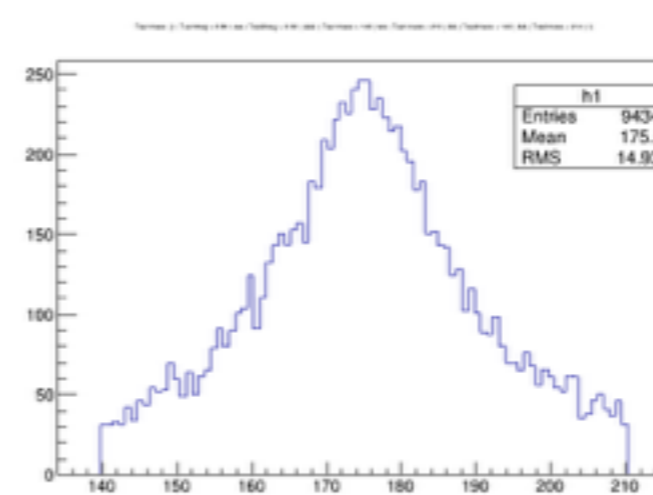
Data selection by charge

Charge : Q_1, Q_2

- $Q_1 > 0$ && $Q_2 > 0$ or $Q_1 < 0$ && $Q_2 < 0$
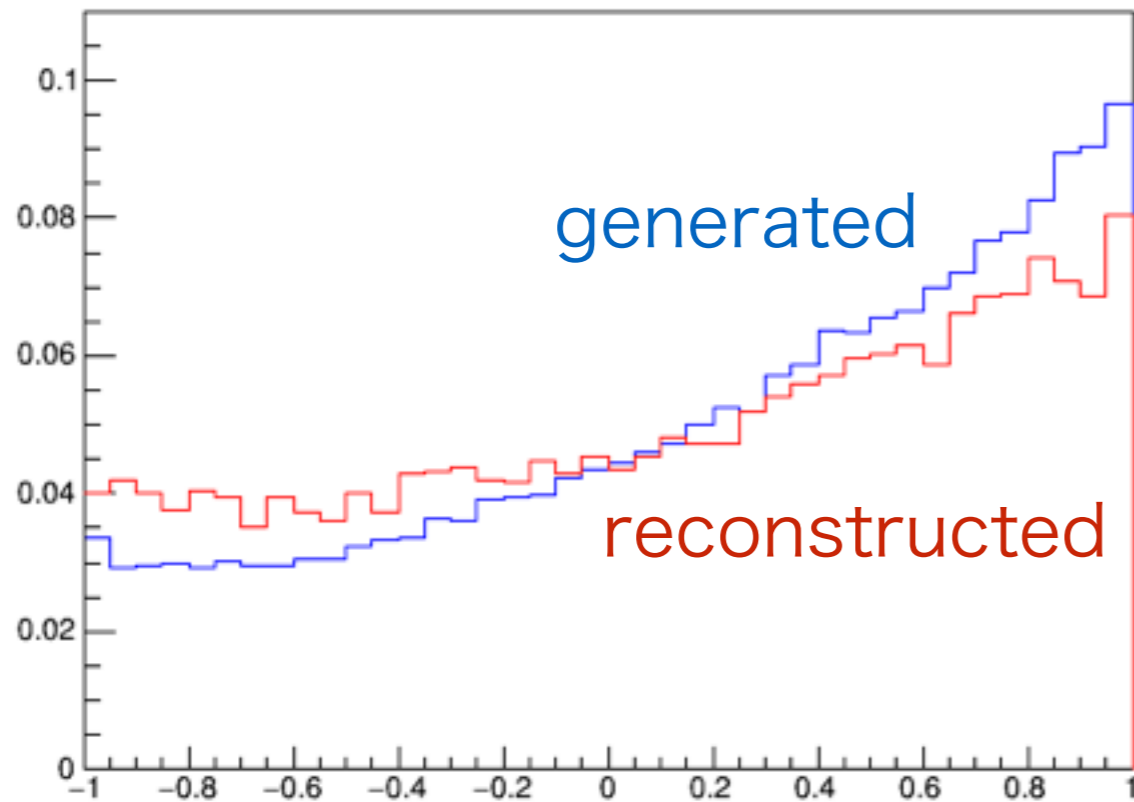
  -> not used (14.2%)
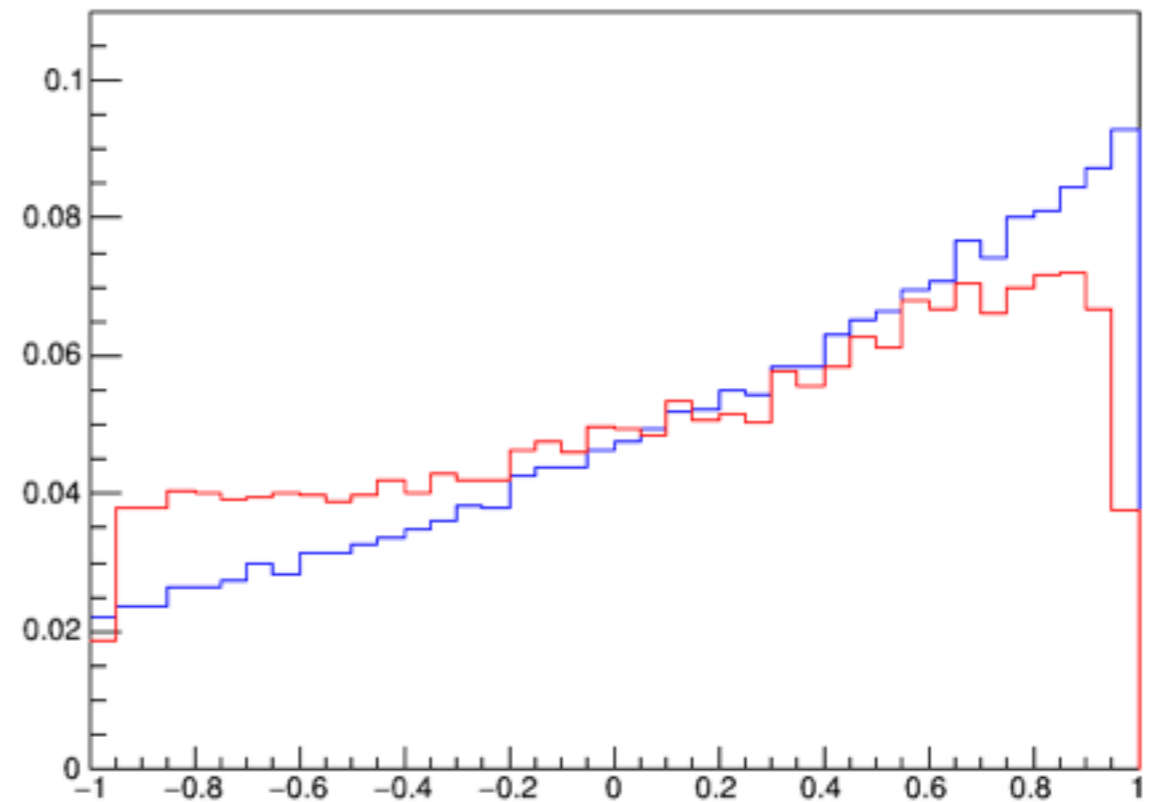
- $Q_1 = Q_2 = 0$

  -> not used (13.5%)

- The others

  -> used   (72.3%)

Reconstructed data

top polar angle (Rec:Red Gen:Blue)

generated

reconstructed

bottom polar angle (Rec:Red Gen:Blue)
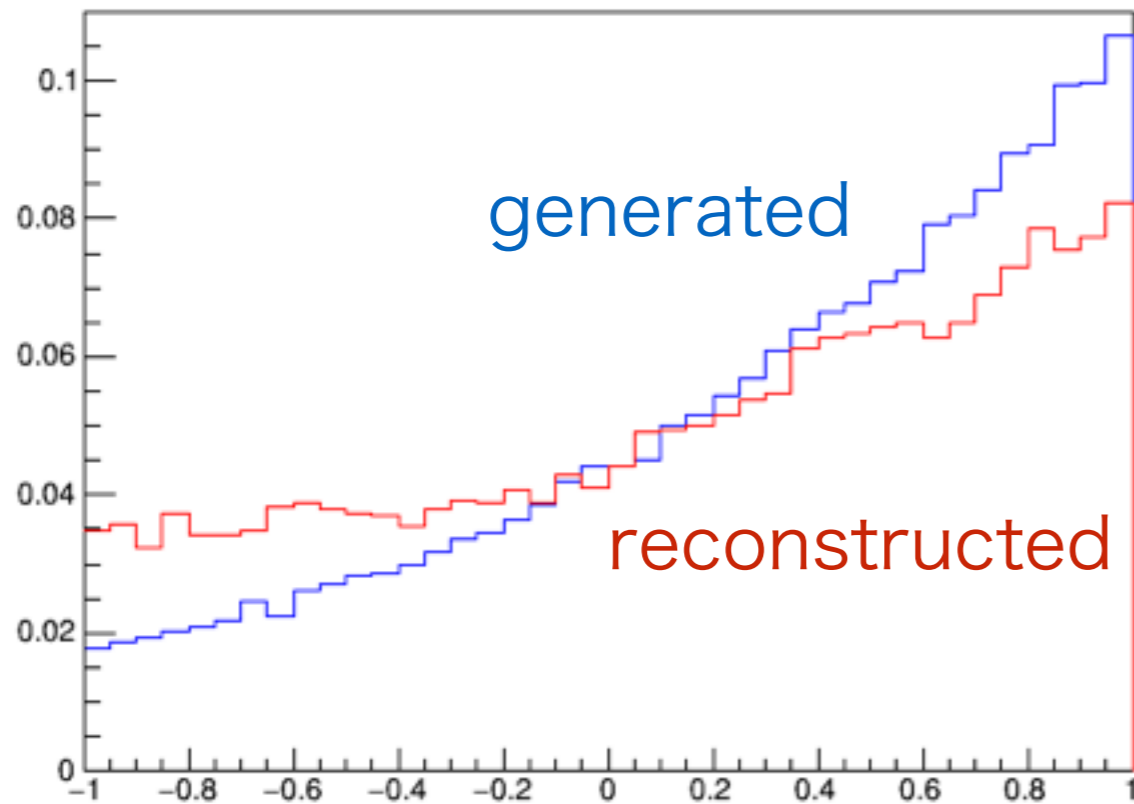
e^- : Left e^+ : Right

AFB(reconstructed) : 0.189
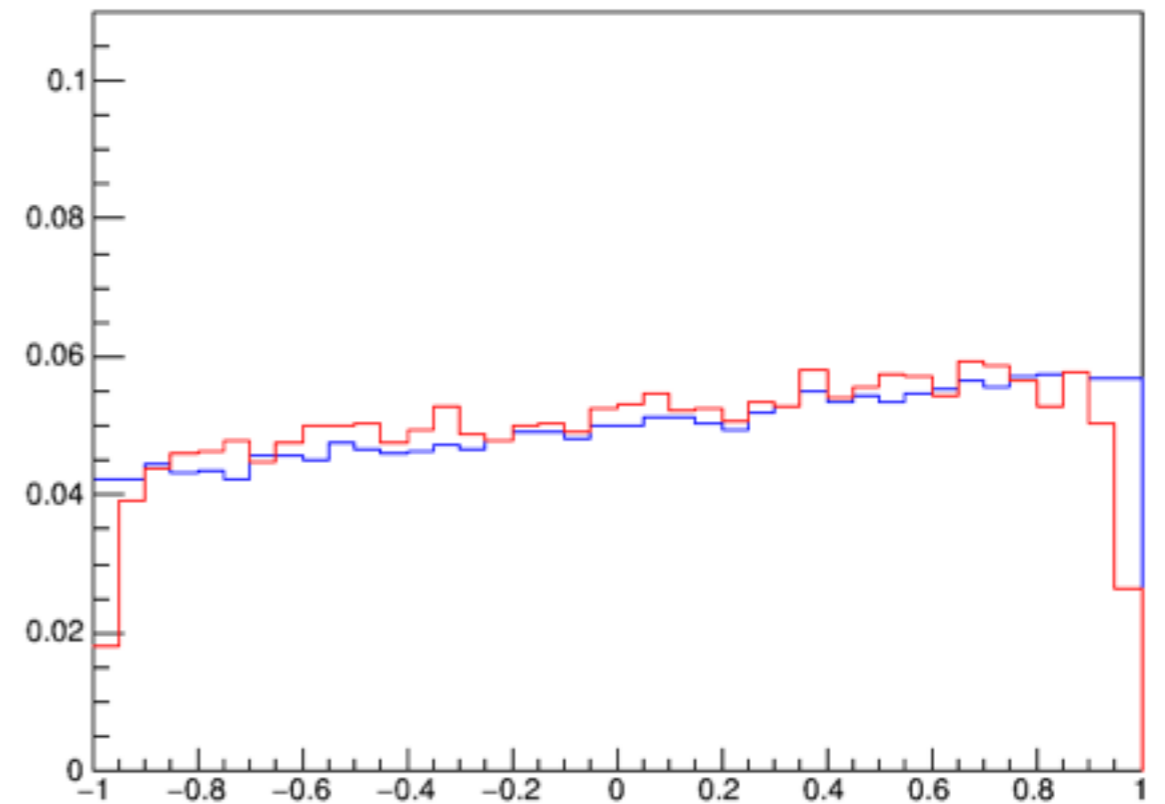
AFB(generated) : 0.323

AFB(reconstructed) : 0.189

AFB(generated) : 0.340

Reconstructed data

top polar angle (Rec:Red Gen:Blue)

generated

reconstructed

bottom polar angle (Rec:Red Gen:Blue)

e$^-$: Right   e$^+$: Left

AFB(reconstructed) : 0.252   AFB(reconstructed) : 0.068

AFB(generated) : 0.434   AFB(generated) : 0.082

fin