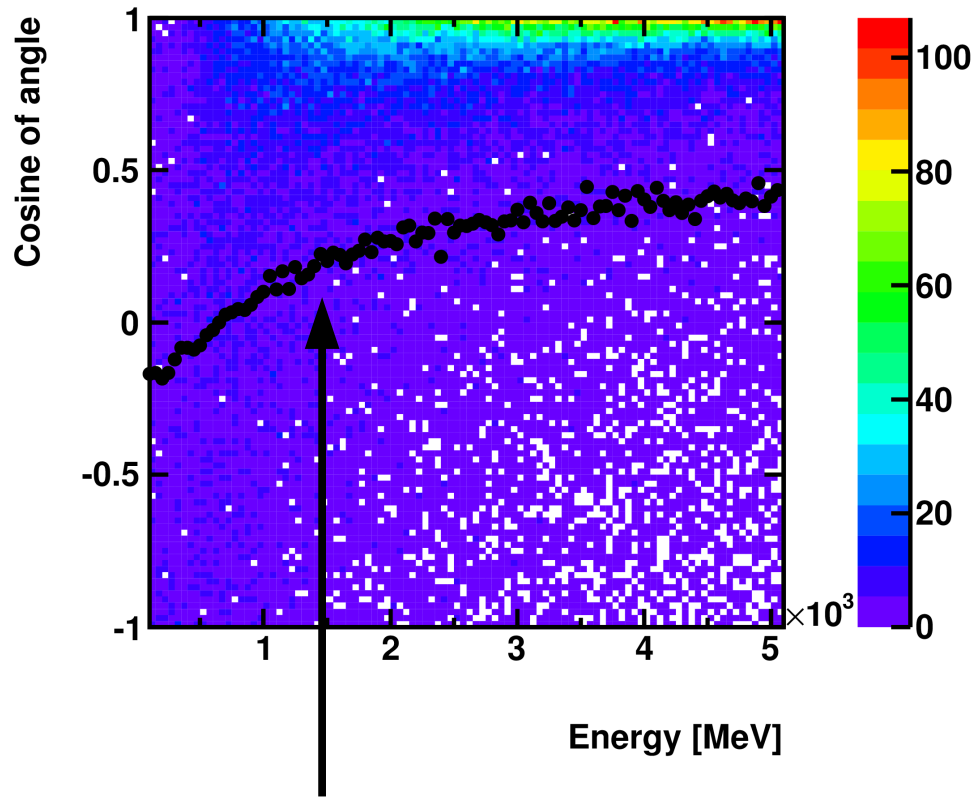


Neutrino direction algorithm test using KLG4

- Test criteria:
 - Neutrino flavor: ν_e
 - Targets: ^1H , ^{12}C
 - Energy: 100 MeV \sim 5 GeV
 - Fully contained event condition: < 5 OD hits
 - No fiducial volume cut
 - No nhit cut

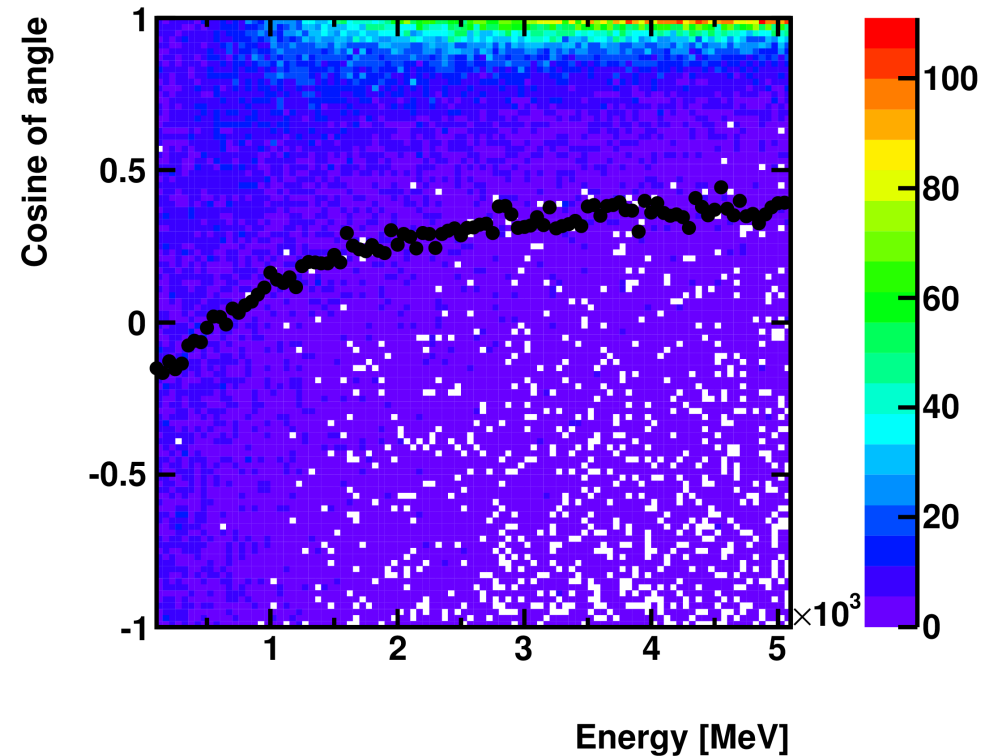
Angle deviation from true neutrino direction (ν_e 100 MeV \sim 5 GeV)

Target:H1



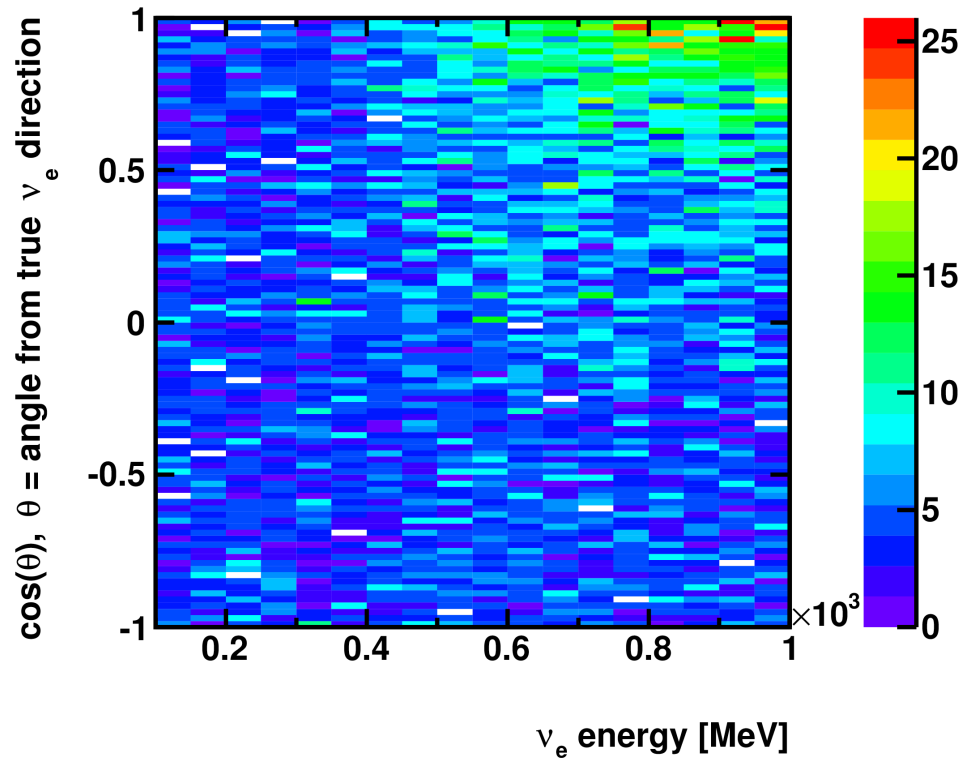
1 σ of cosine distribution

Target: C12

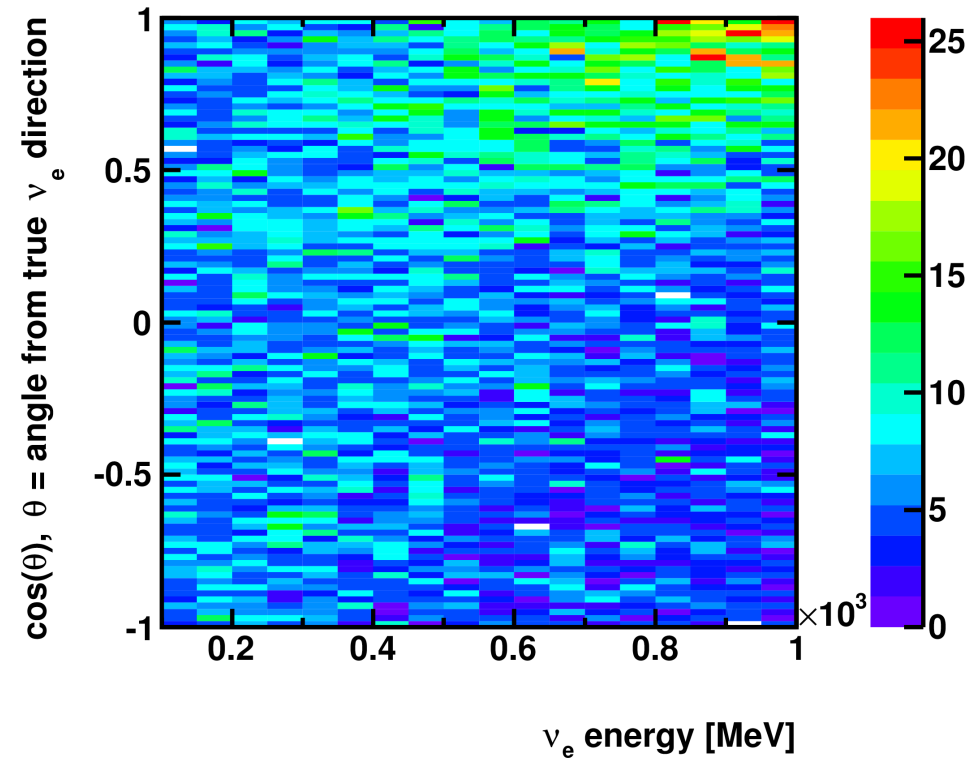


100 MeV \sim 1 GeV

Target:H1

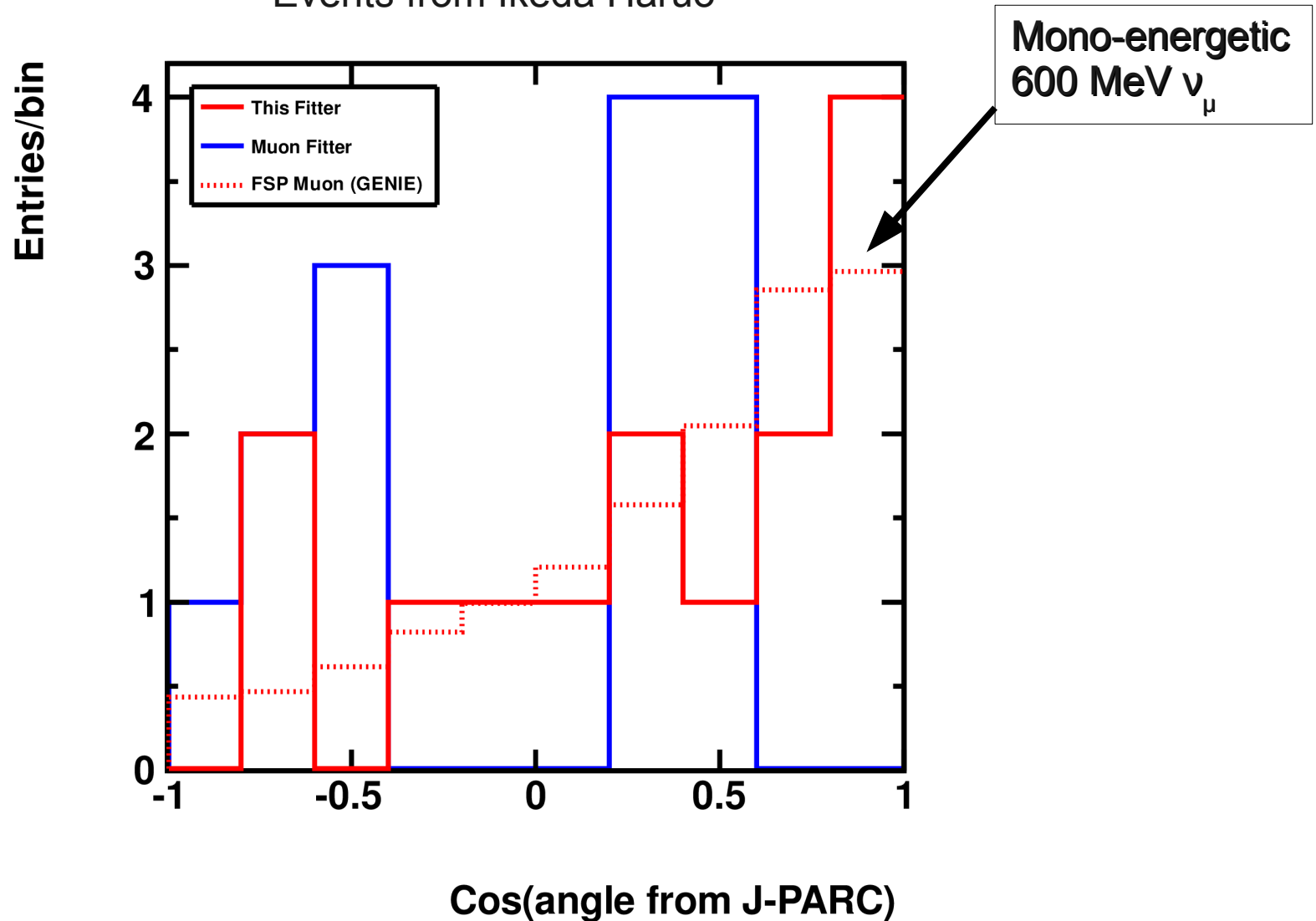


Target: C12



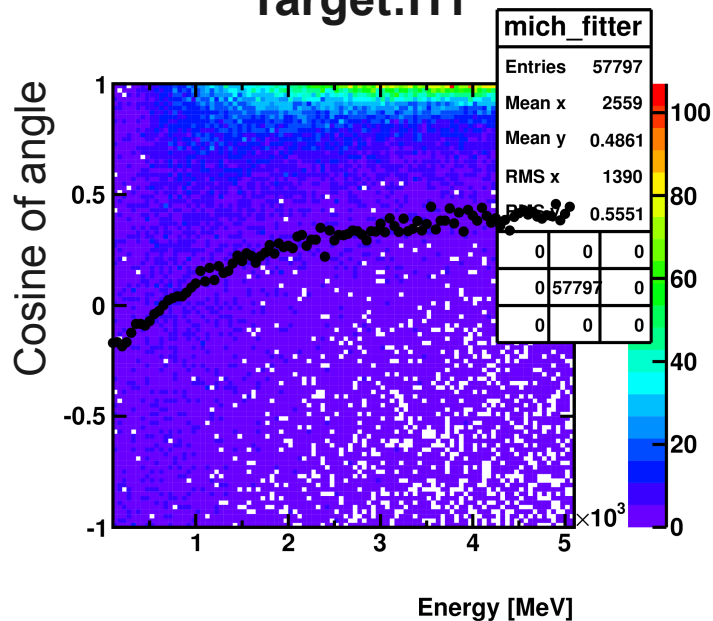
Reconstructed T2K Event Direction

Events from Ikeda Haruo

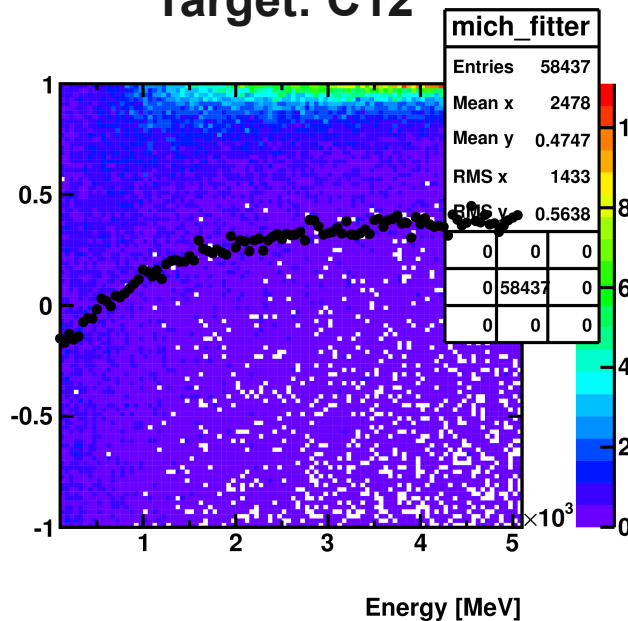


Fiducial volume cut to improve direction fit

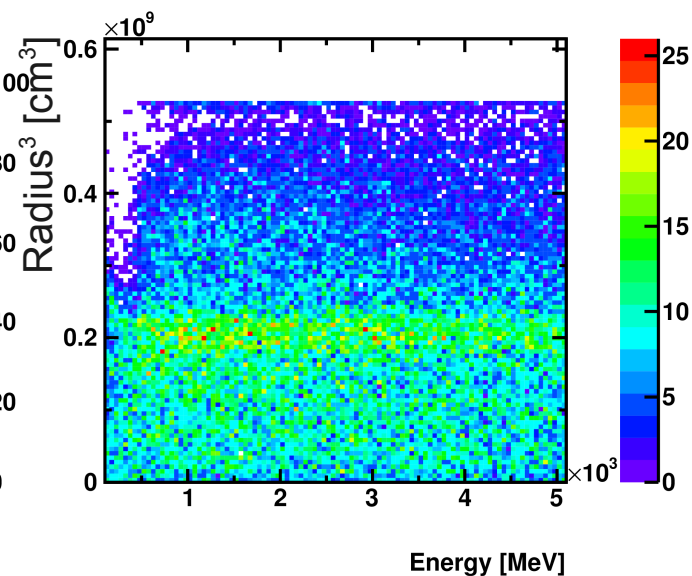
Target:H1



Target: C12

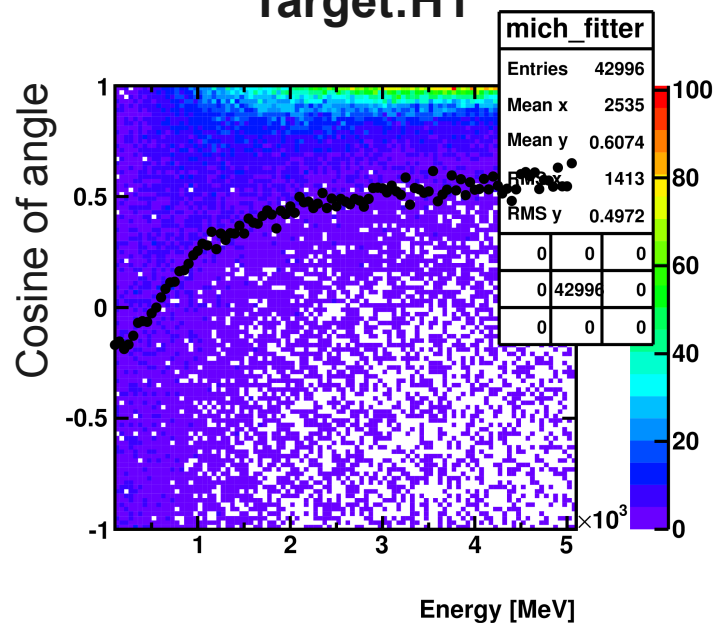


R³ vs Energy

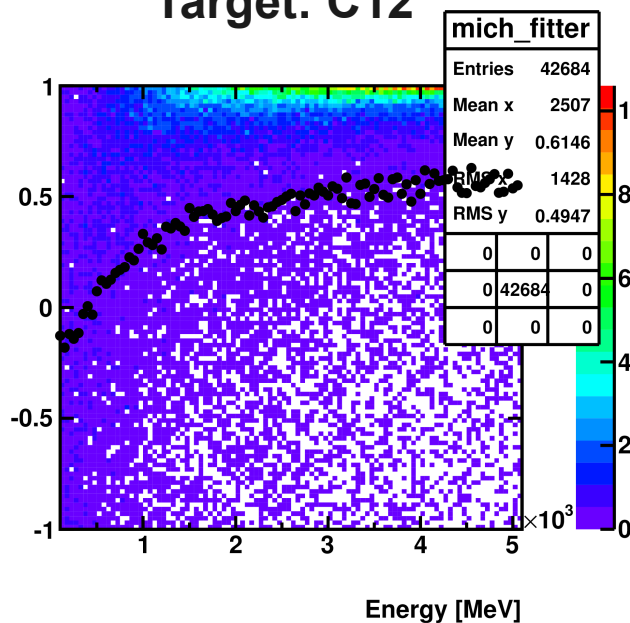


$$R < 650 \text{ cm}$$

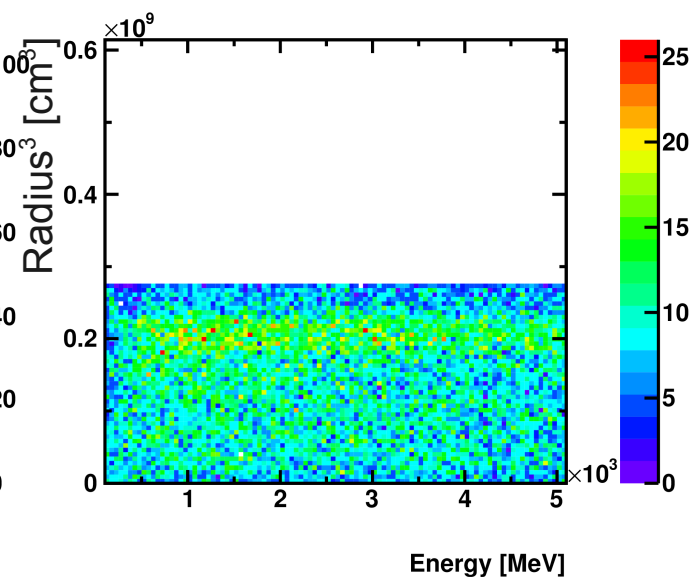
Target: H1



Target: C12

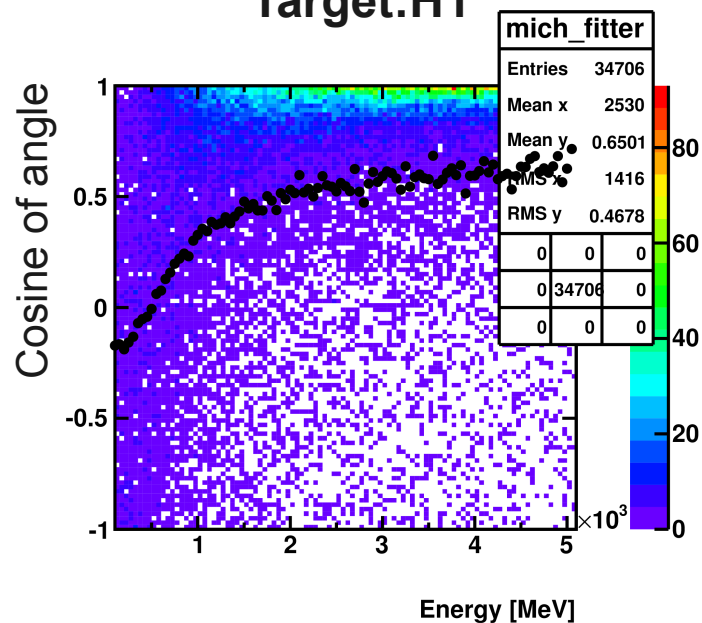


R^3 vs Energy

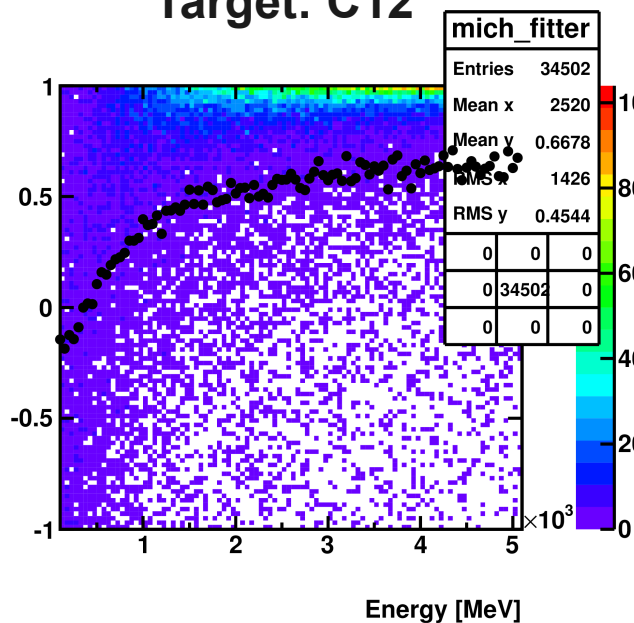


R < 600 cm

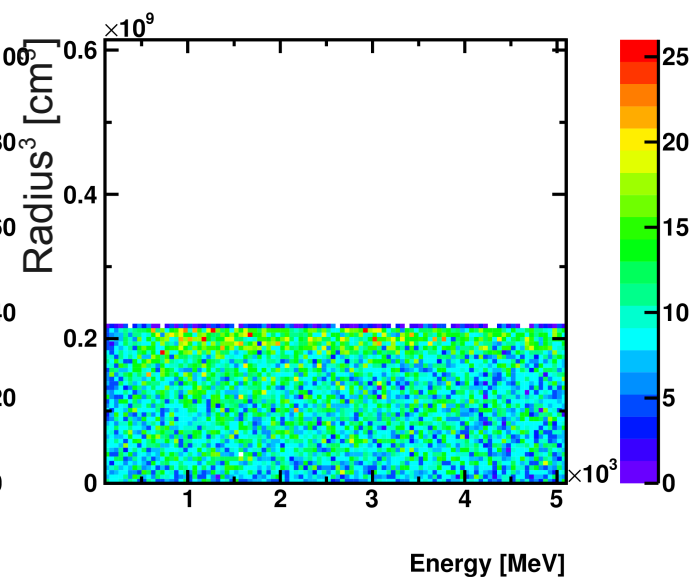
Target: H1



Target: C12



R³ vs Energy



Can we use cosmic ray muon for high energy calibration?

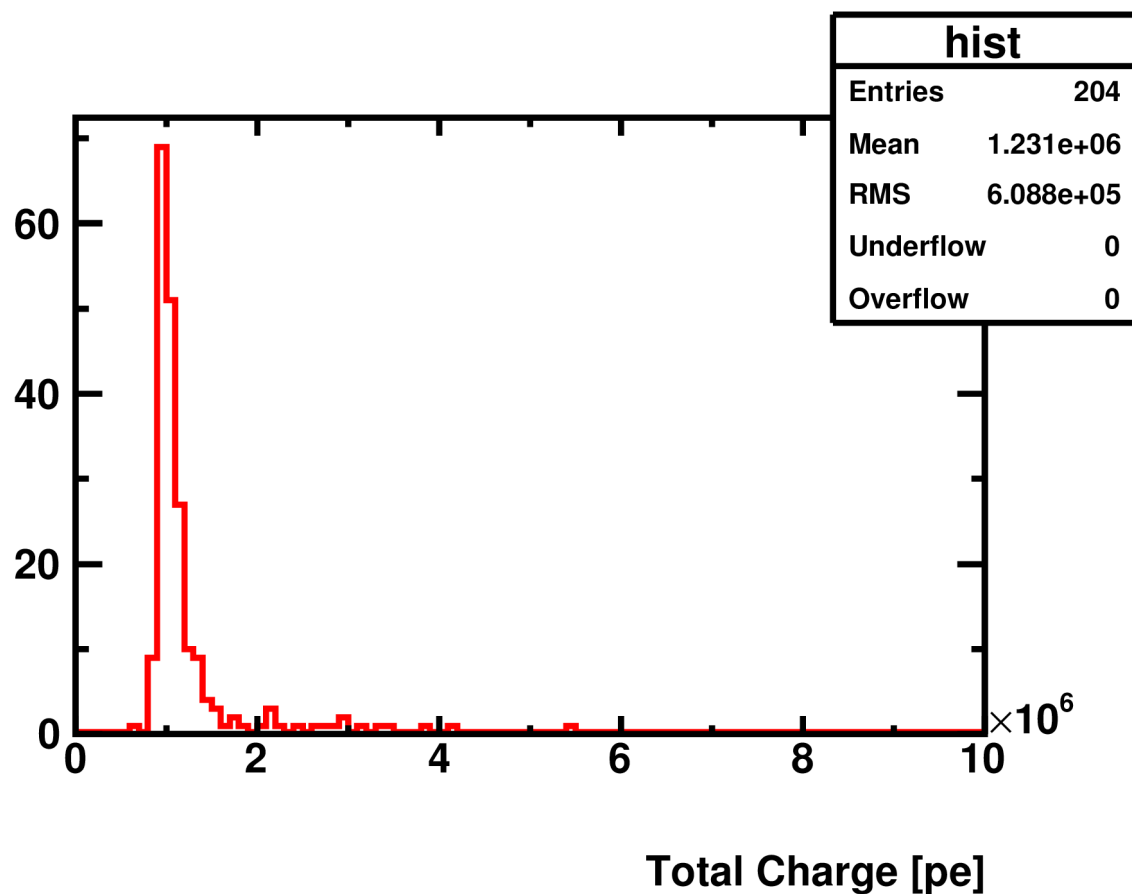
Goal:

- PE/cm for muon \rightarrow PE/MeV

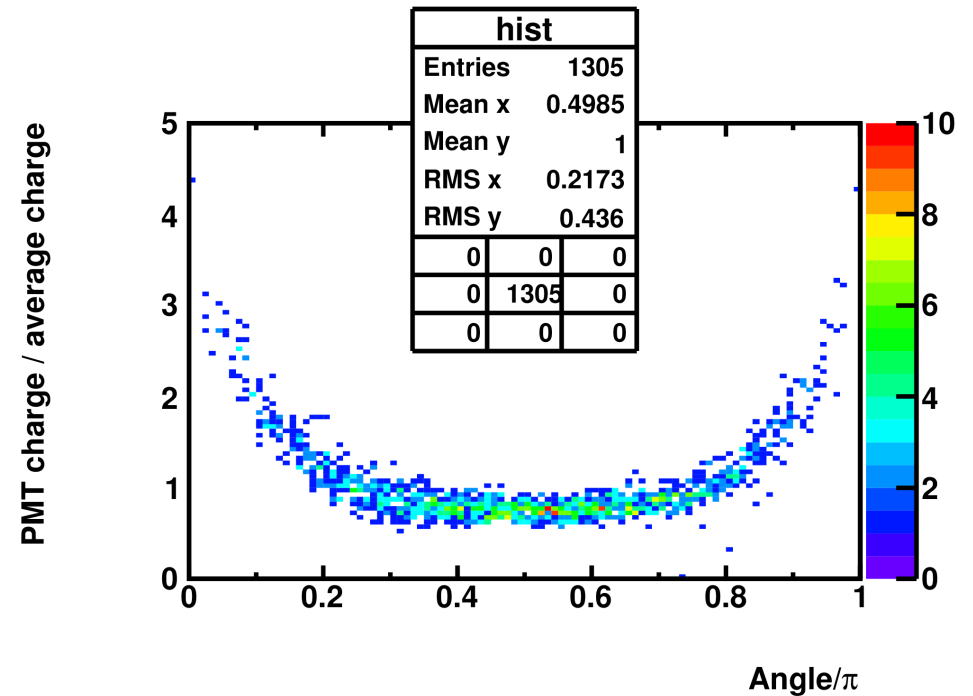
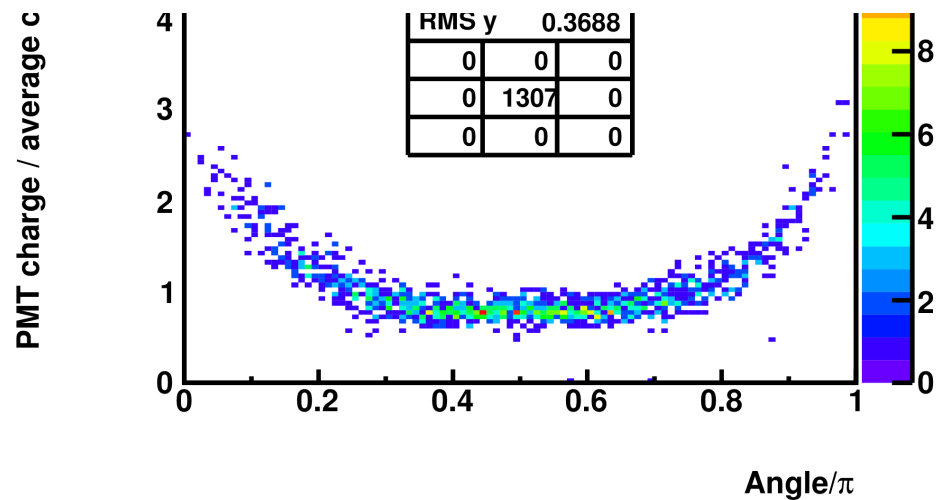
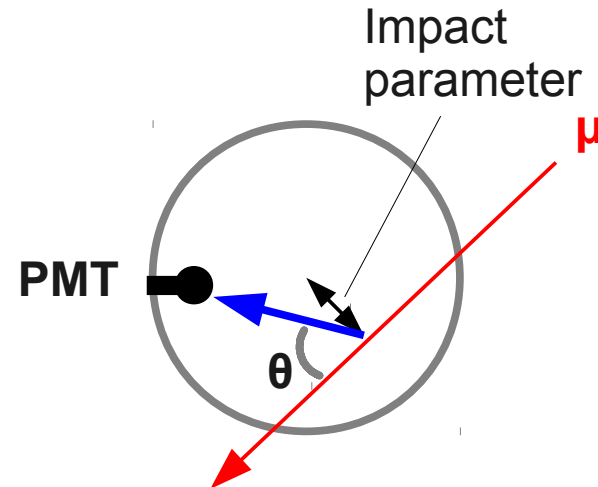
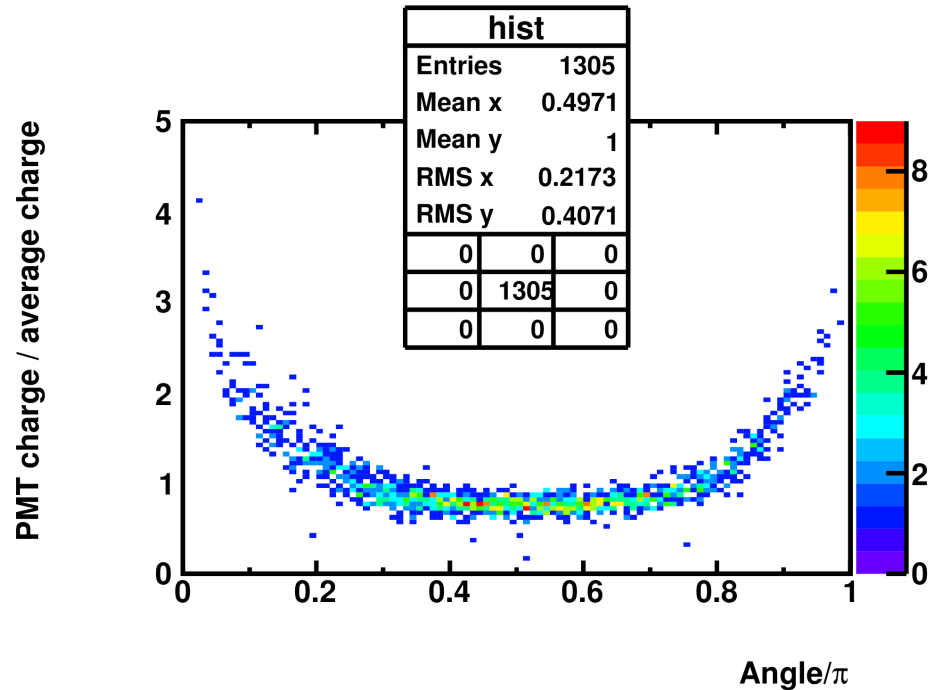
Data selection with KAT Muon Fitter criteria:

- Badness < 20
- Impact parameter < 50 cm
- Runs 5000 ~ 5010
- 204 muon events selected

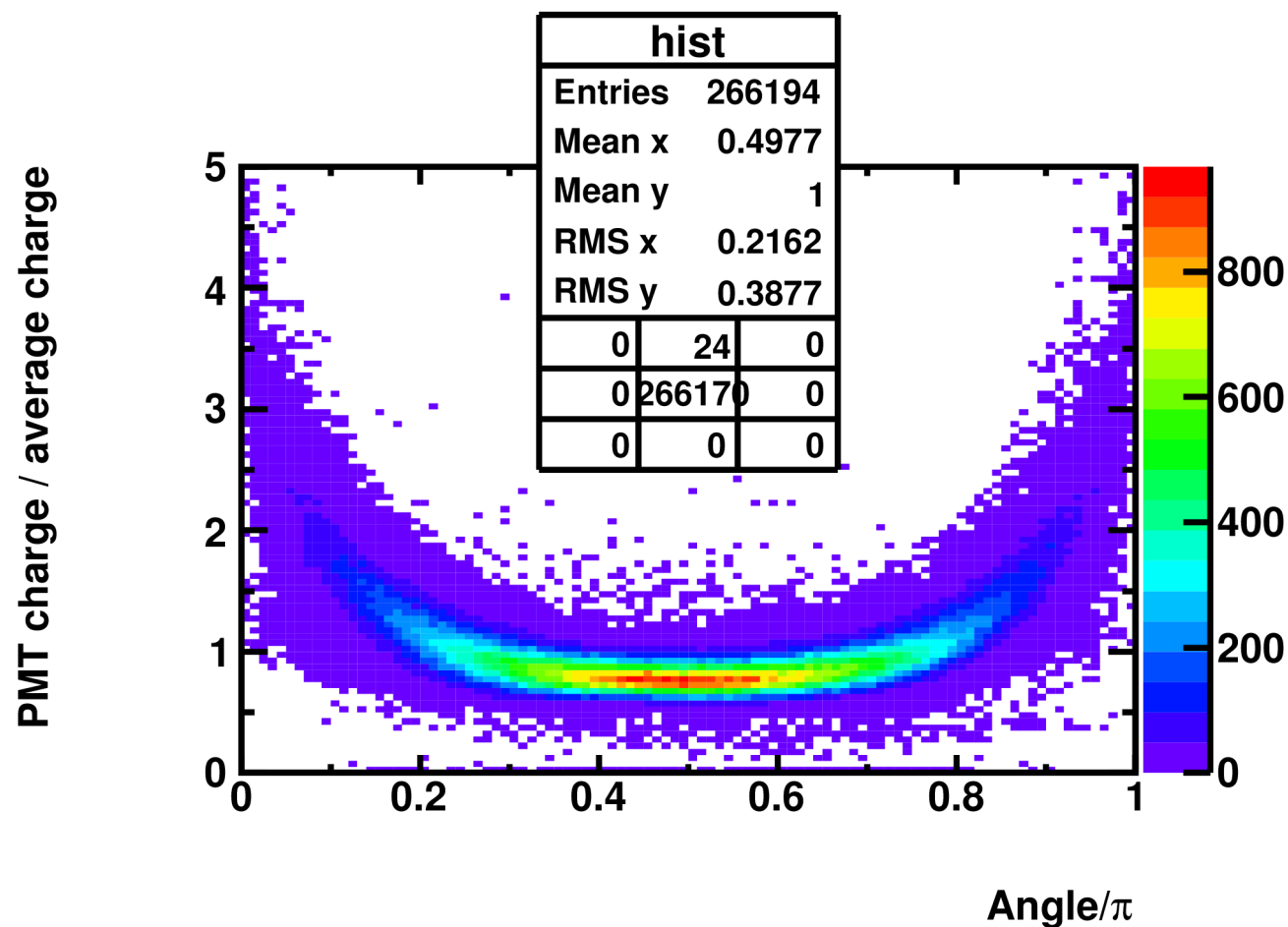
Charge per muon event



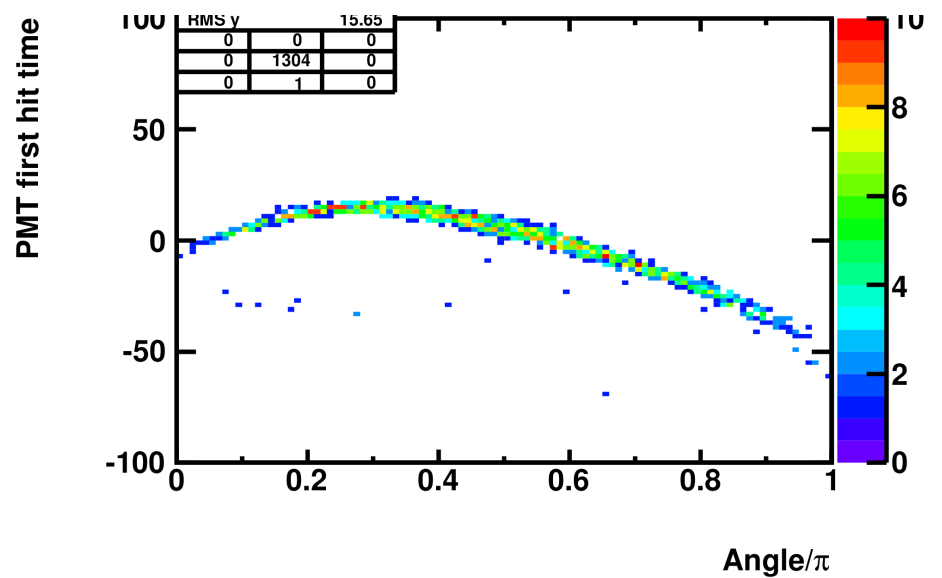
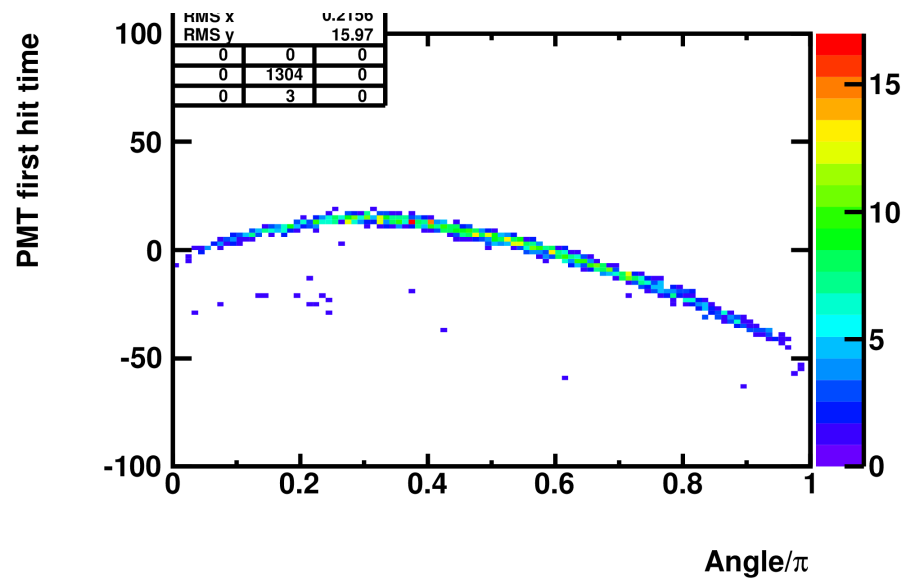
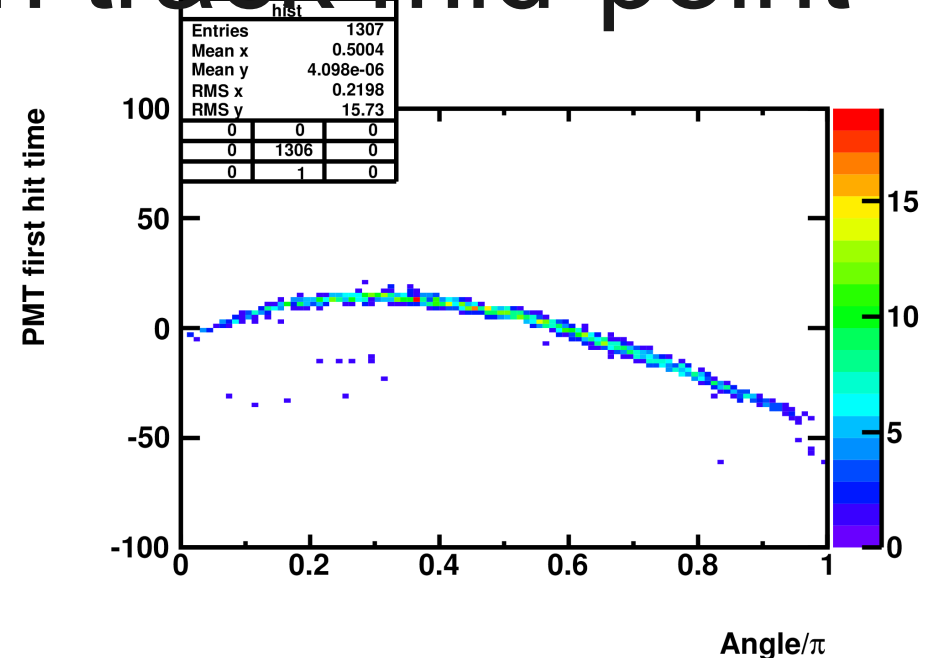
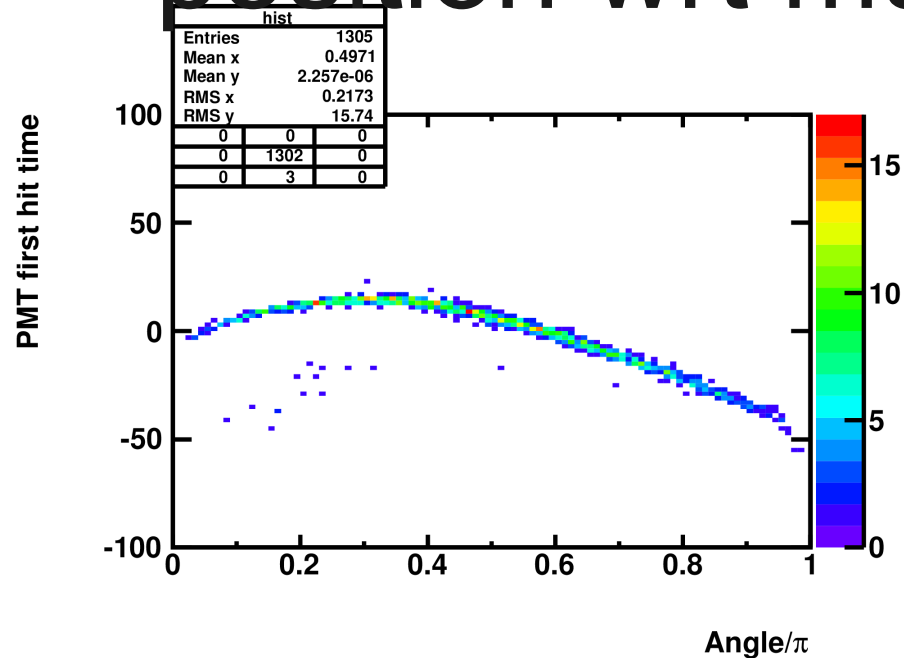
PMT charge vs angle of PMT position wrt muon track mid-point



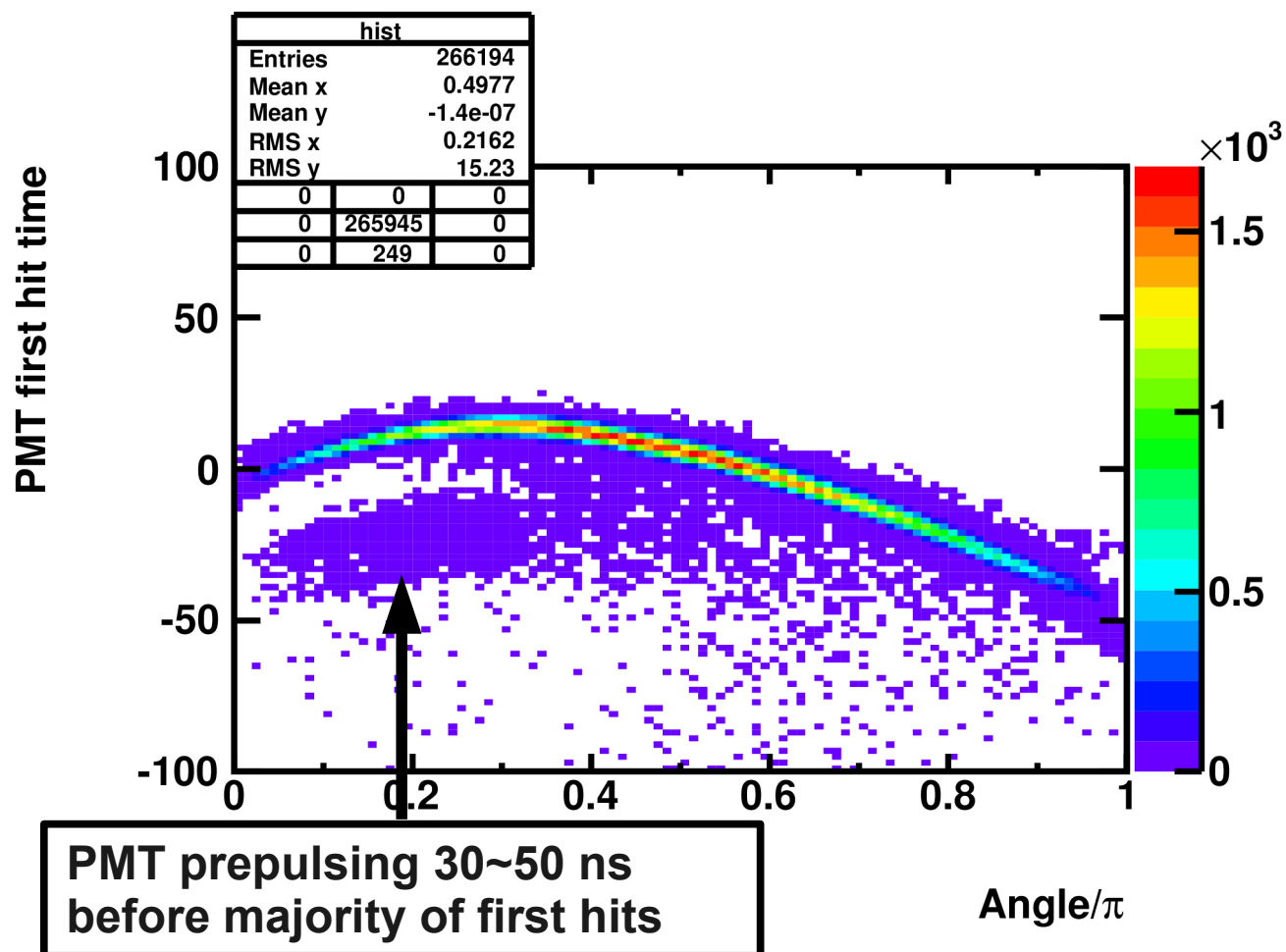
Overlaid all 204 events



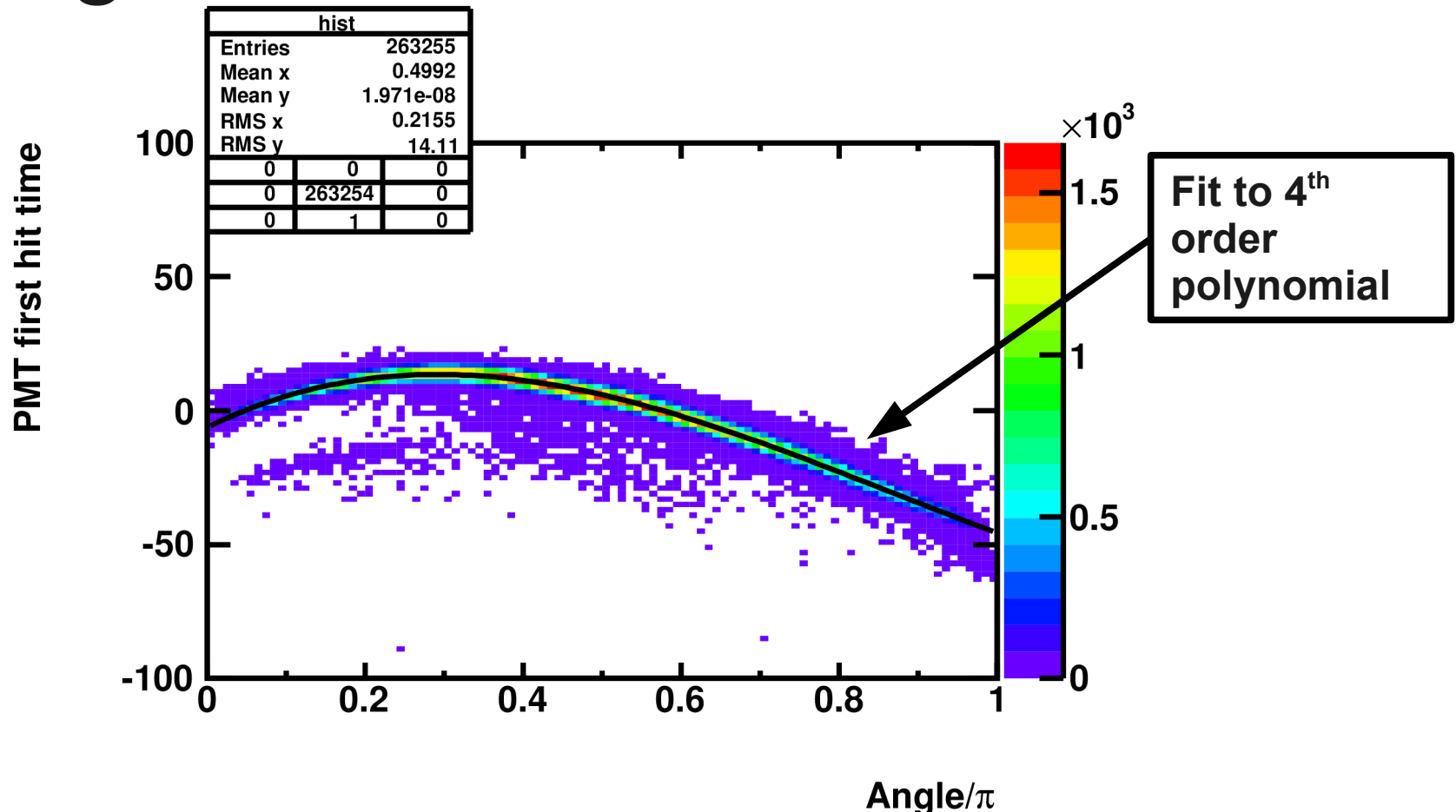
PMT first hit time vs angle of PMT position wrt muon track mid-point



Overlaid all 204 events

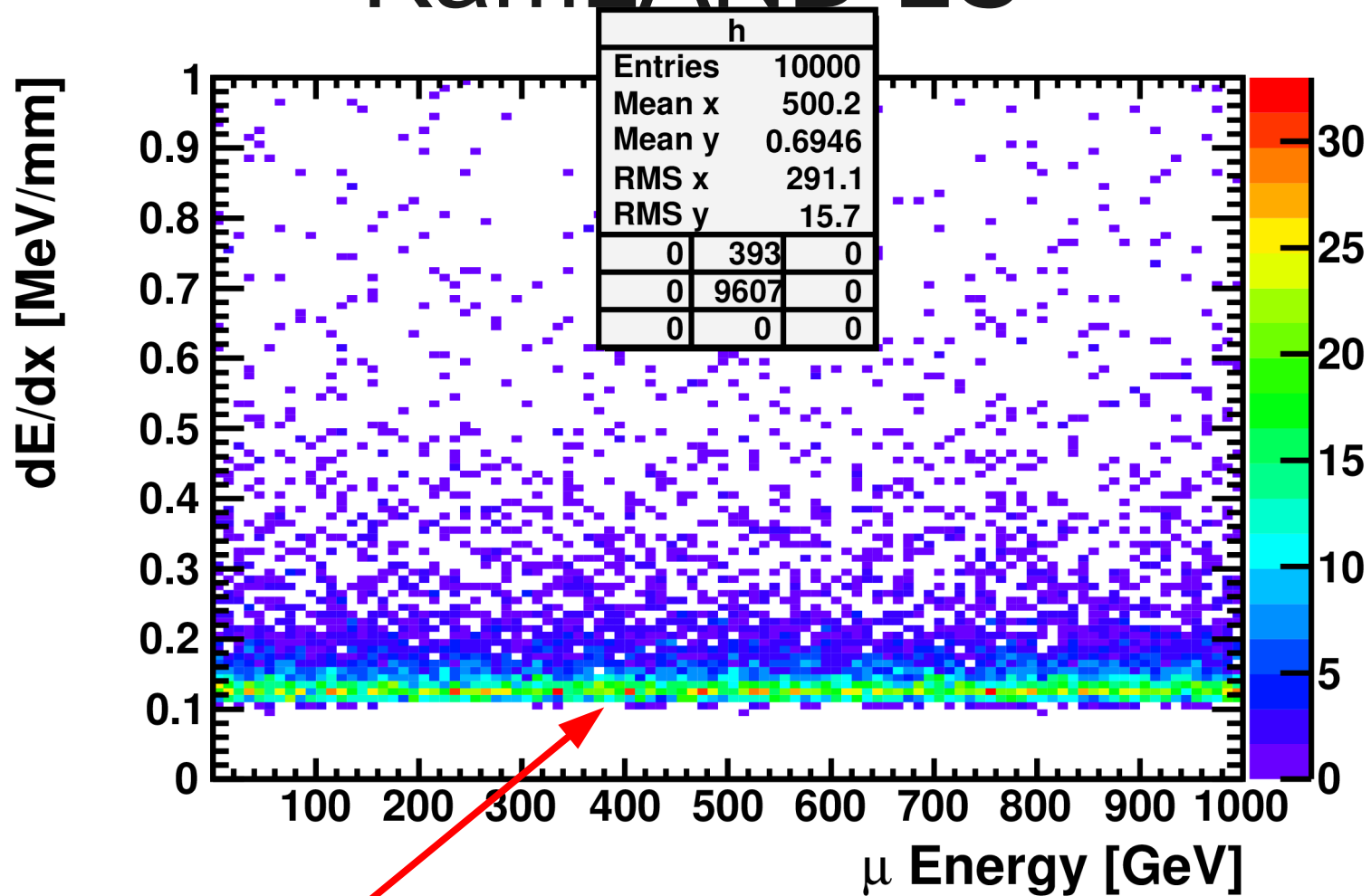


3σ cut wrt average of first hits of neighbor PMTs within 200cm



Time difference between entry/exit points: $\Delta t = 39.4$ ns
Muon speed = $2 \times 8.5\text{m} / \Delta t = 4.3\text{e}8$ m/s
Unfortunately, faster than light in vacuum by 43%!

KL G4 μ stopping power in KamLAND LS



Is it supposed to be this flat?