Summary of nnbar studies at Nevis

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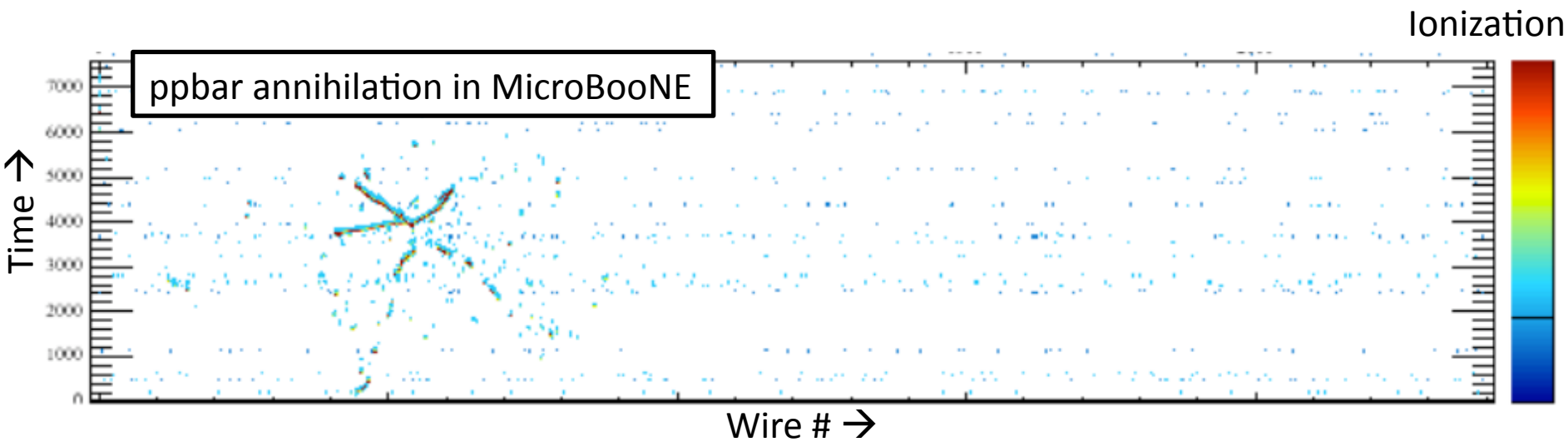
Work by Nadine Ayoub, Summer 2011

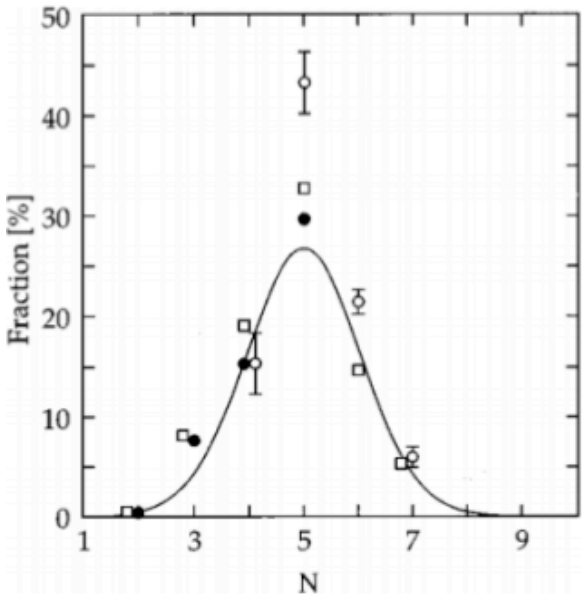
www.nevis.columbia.edu/reu/2011/AyoubReport.pdf

(Supervisors: GK, Leslie Camilleri)

- Very preliminary study of nnbar signatures in MicroBooNE
- Starting with ppbar annihilation (pbar generated at rest in LAr)
- Then nnbar annihilation (nbar generated at rest in LAr)
- Not the same process as nnbar oscillation+annihilation within Ar nucleus!

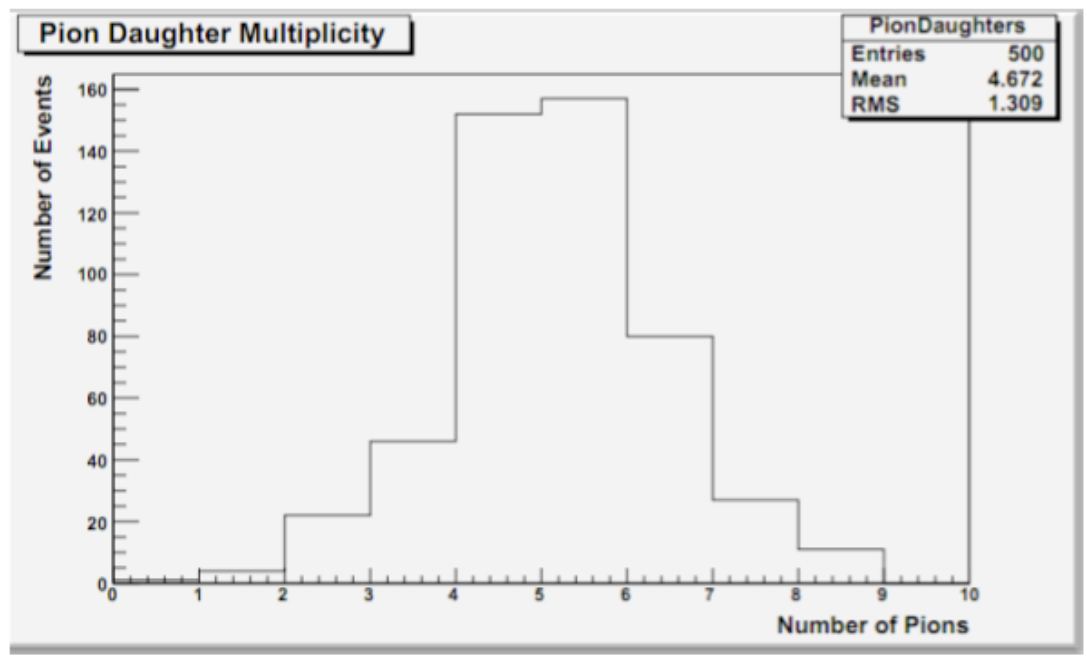


Starting with ppbar: cross checks

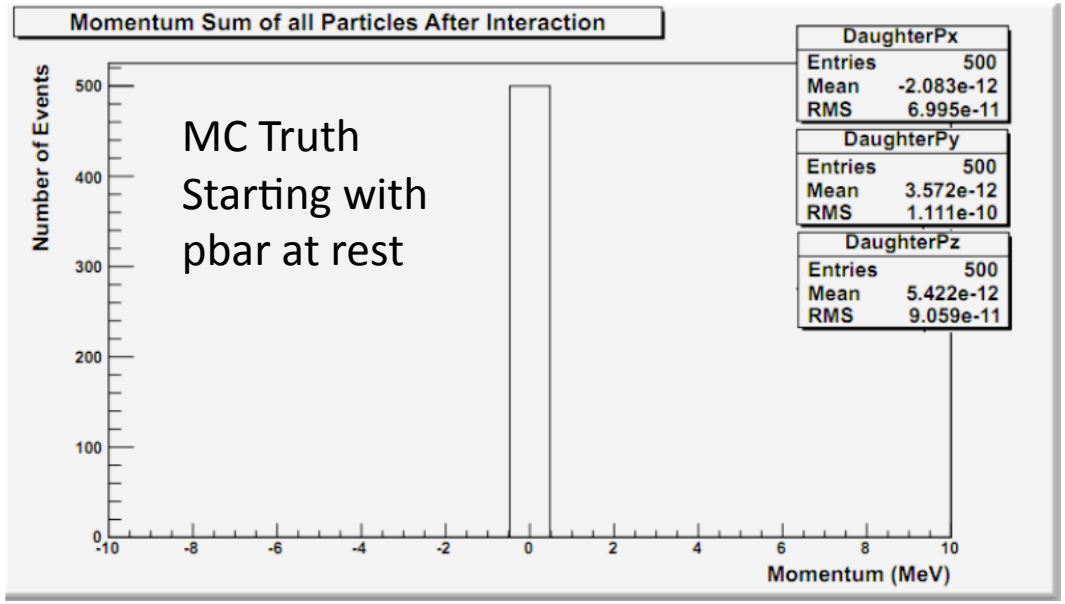


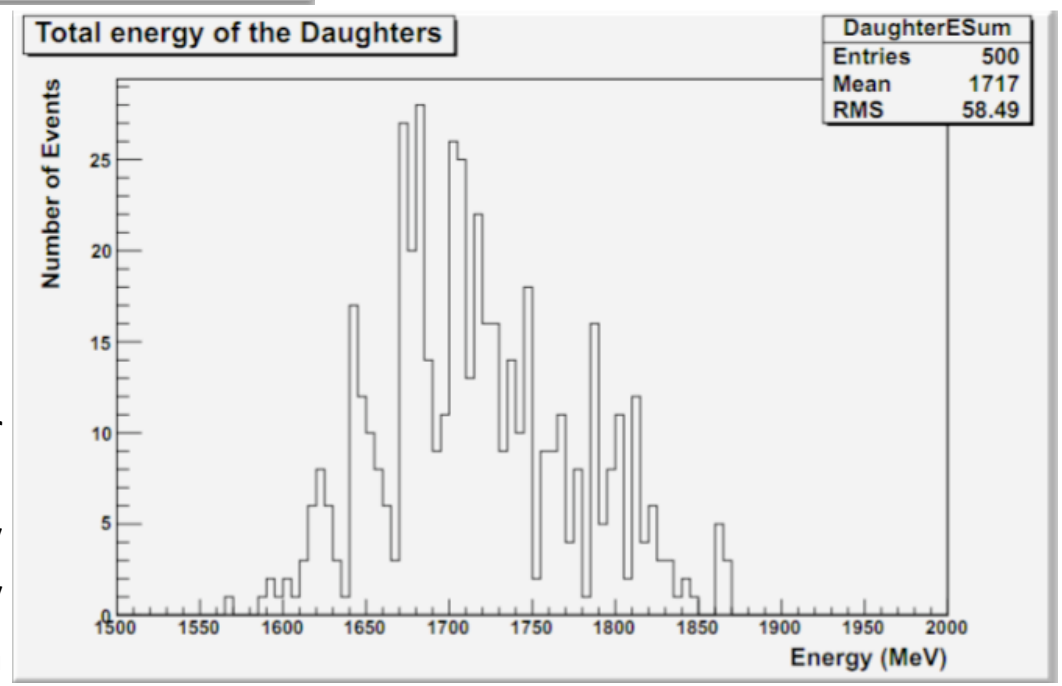
Rev. Mod. Phys., Vol. 70, No. 4, Oct. 1998

- Crystal Barrel experiment at CERN: 5 pion daughters.
- 500 antiproton events using LArSoft: Mean of ~5 pion daughters.



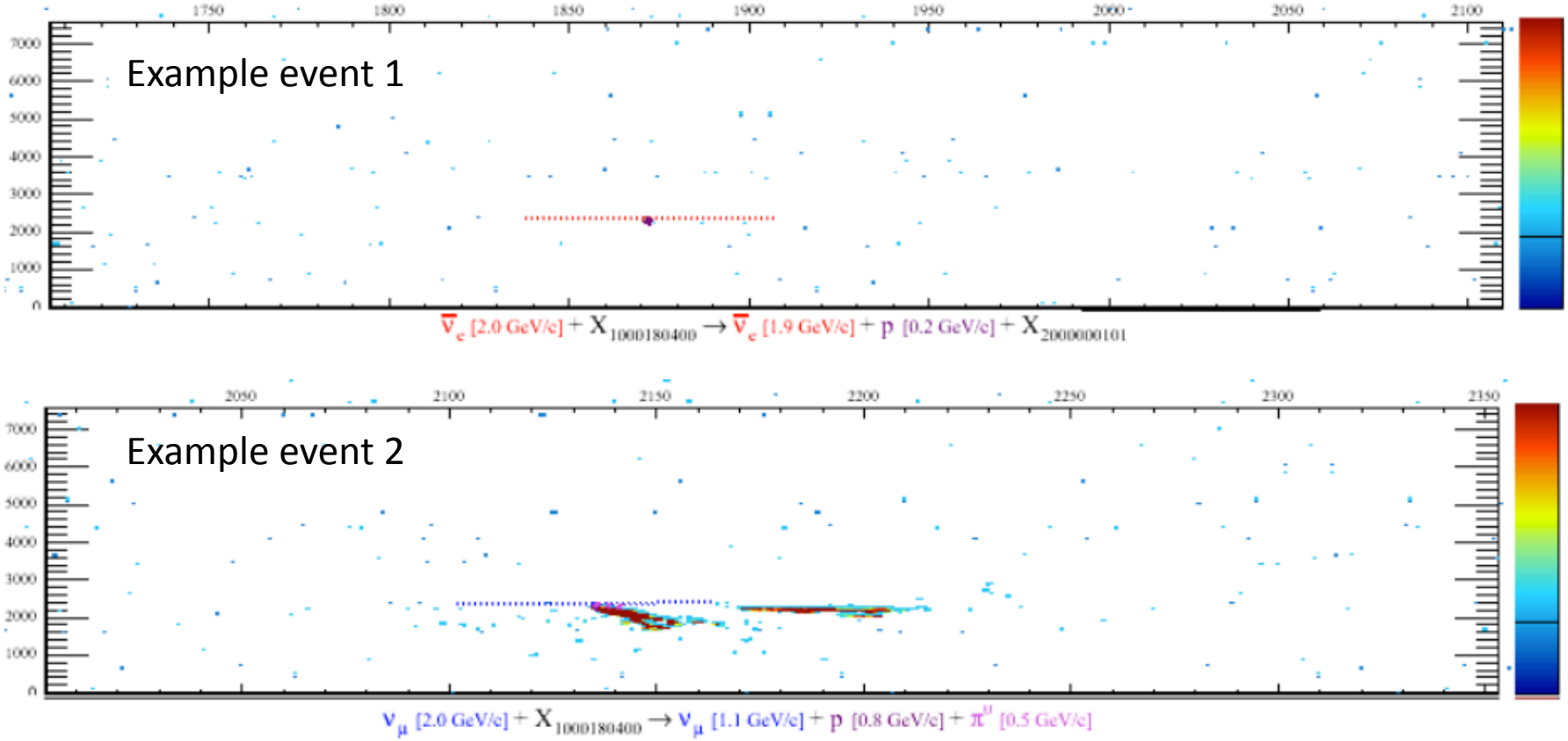
Starting with ppbar: cross checks





Total energy (minus mass of observer nucleons) before the interaction:
$2m_p$ = 1876MeV
Total energy after: ~1717MeV
Missing energy: Binding energy of Argon

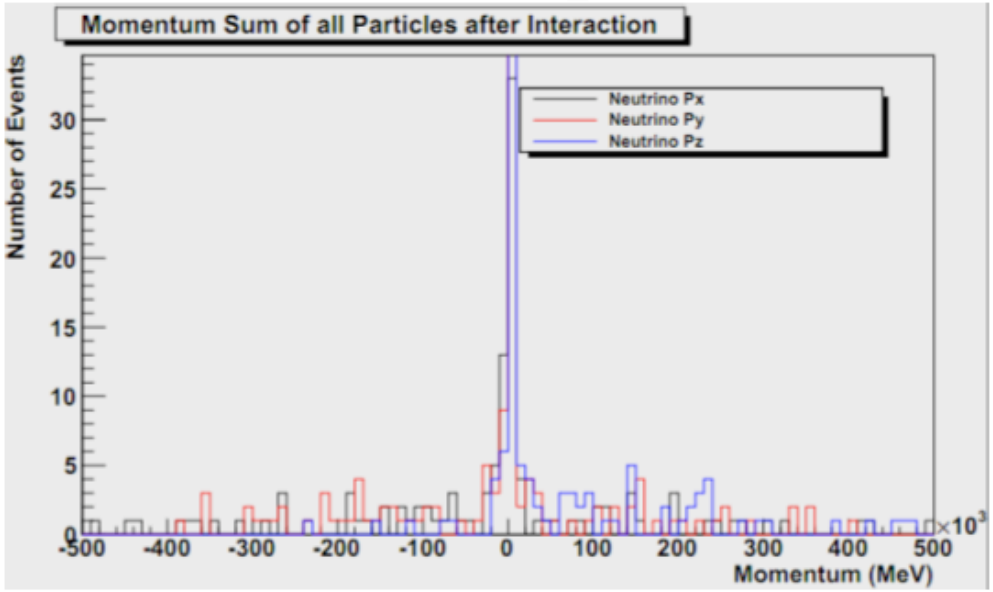
Background study: atmospheric neutrinos (NC)

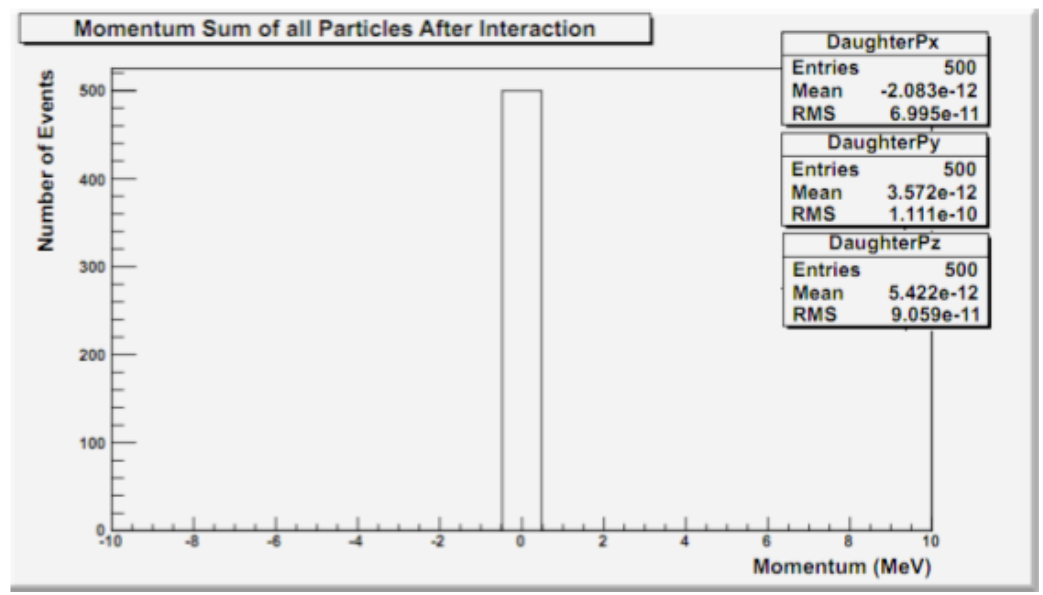


Key differences:

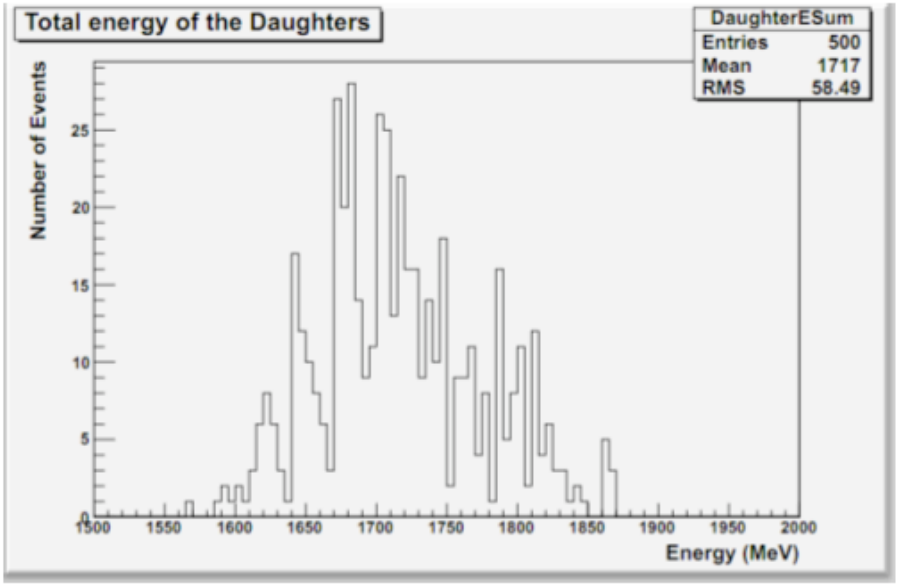
- Momentum sum ≠ 0
- Energy sum varies from $2m_p$
- Less “spherical” events

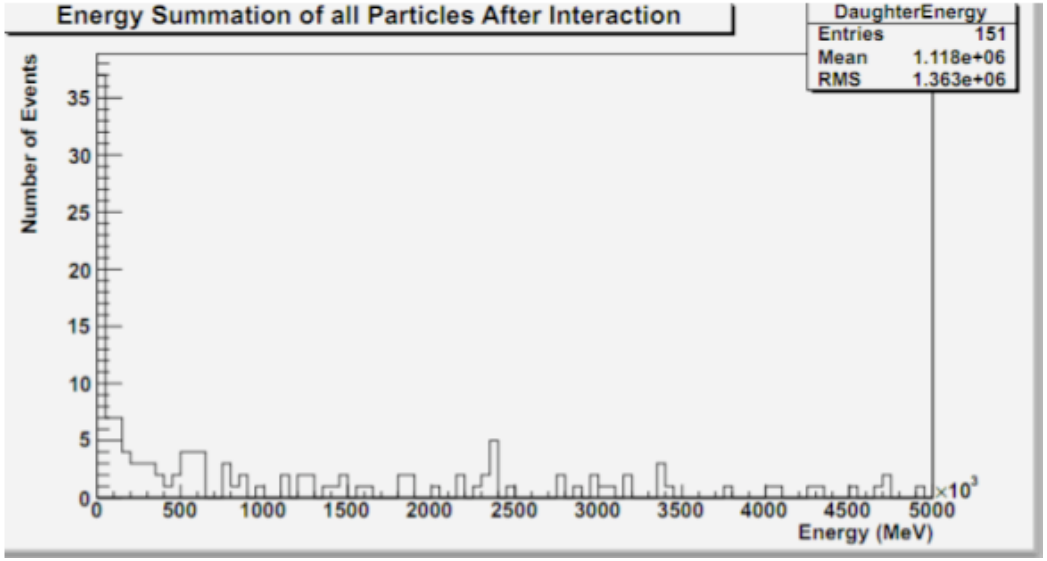
$\bar{p}$ *vs* ν: Momentum

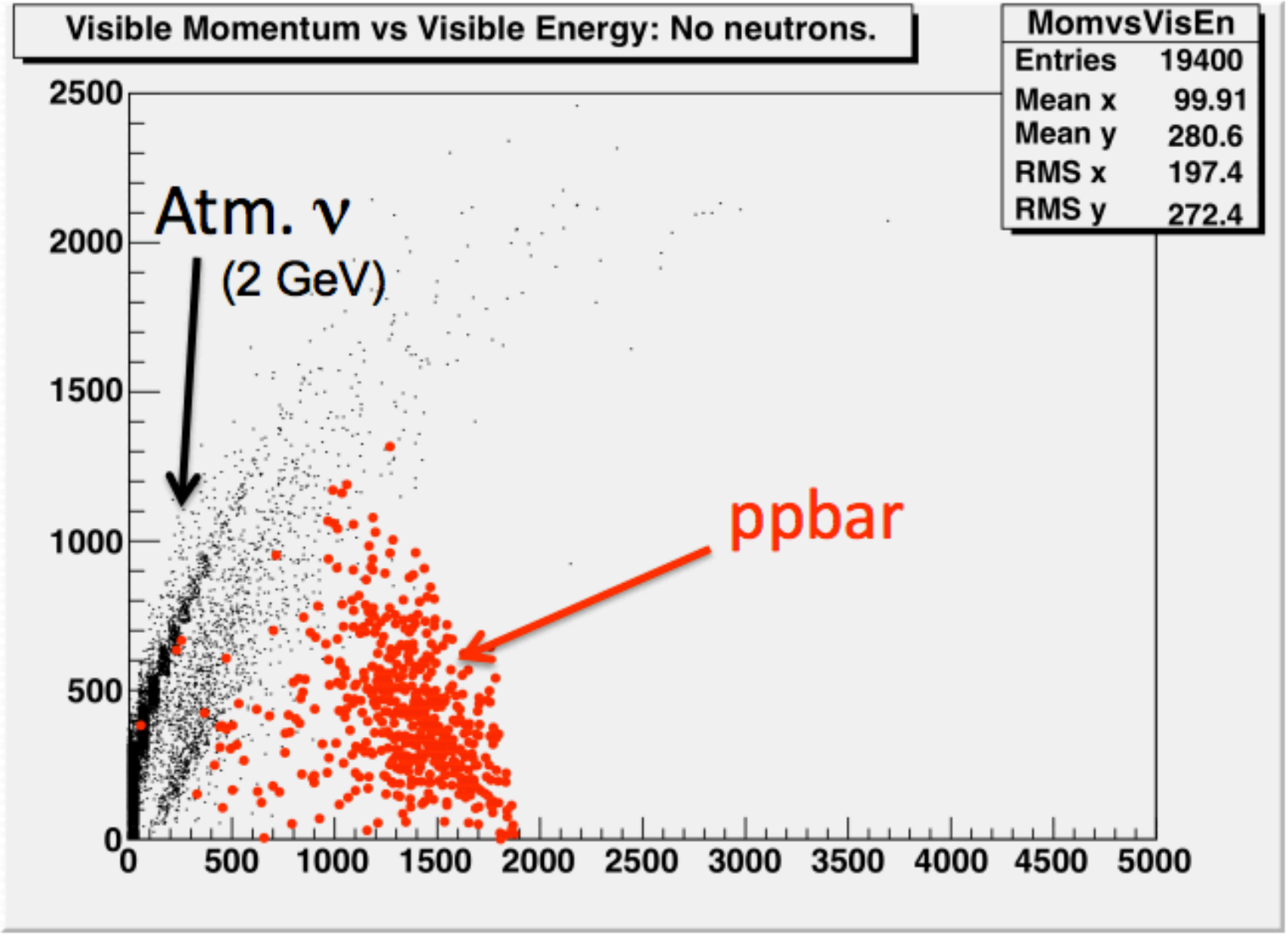
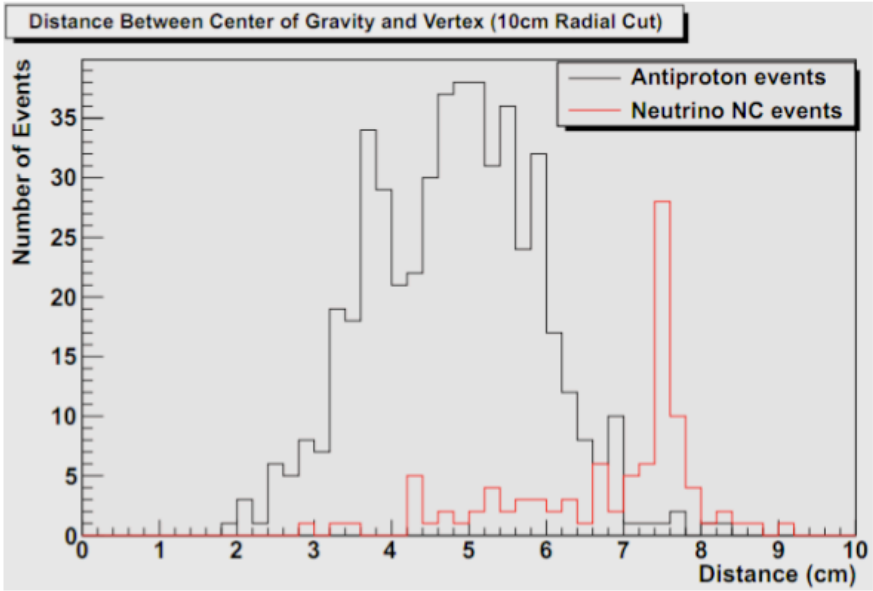
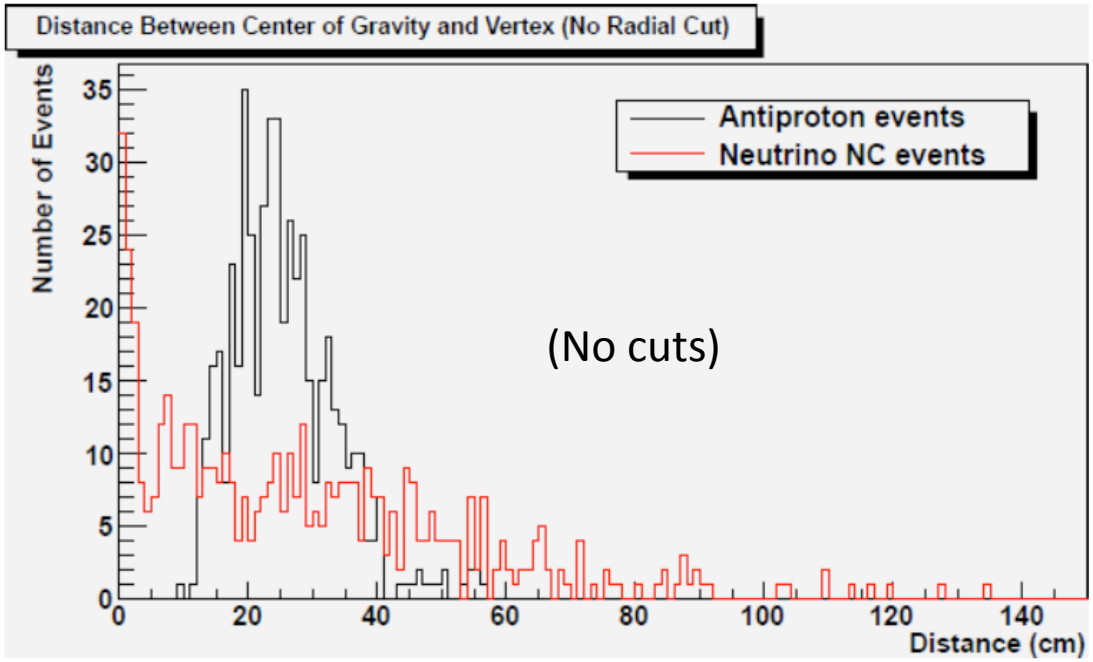




$\bar{p}$ $vs.$ ν: Energy






Visible Momentum vs Visible Energy: No neutrons.
MomvsVisEn
Entries 19400
Mean x 99.91
Mean y 280.6
RMS x 197.4
RMS y 272.4
Atm. ν
(2 GeV)
ppbar
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

$\bar{p}$ *vs.* ν: Center of Gravity - Vertex