Quasielastic neutrino scattering:
Low energy results
(and interpretations)

Outline:

- overview of CCQE process
- previous experiments
- MiniBooNE/SciBooNE results
- a sampling of other relevant results
- mysteries, interpretations
- future

R. Tayloe,
NuFact'09
Chicago, IL
7/09

Detailed outline:
- CCQE overview
    - process (Ncel also)
    - models: SM + RFG, PWIA, DWIA, superscaling, spectral functions
- previous experiments
    - NOMAD summary table
    - lower energy (quasielastic?): LSND, KARMEN, etc
- current results on CCQE
    - MiniBOONE
        - description of method
        - results (from TK)
    - SciBooNE
        - description of method
        - prelim results
- quick look at Ncel
    - MiniBooNE (prelim) results
    - SciBooNE (prelim) results
- Discussion
    - model independence (or not) of results
    - M_A
- Future
    - desire more model-ind cross sections
    - future experiments
   - Minerva, T2K
        - SciNOvA
- Conclusions

For SciBooNE:
- In this draft I show just SciBooNE plots
- All plots with preliminary results on CCQE/NCel have been approved and shown at Nuint09

DRAFT VERSION

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Preliminary CCQE results from SciBooNE
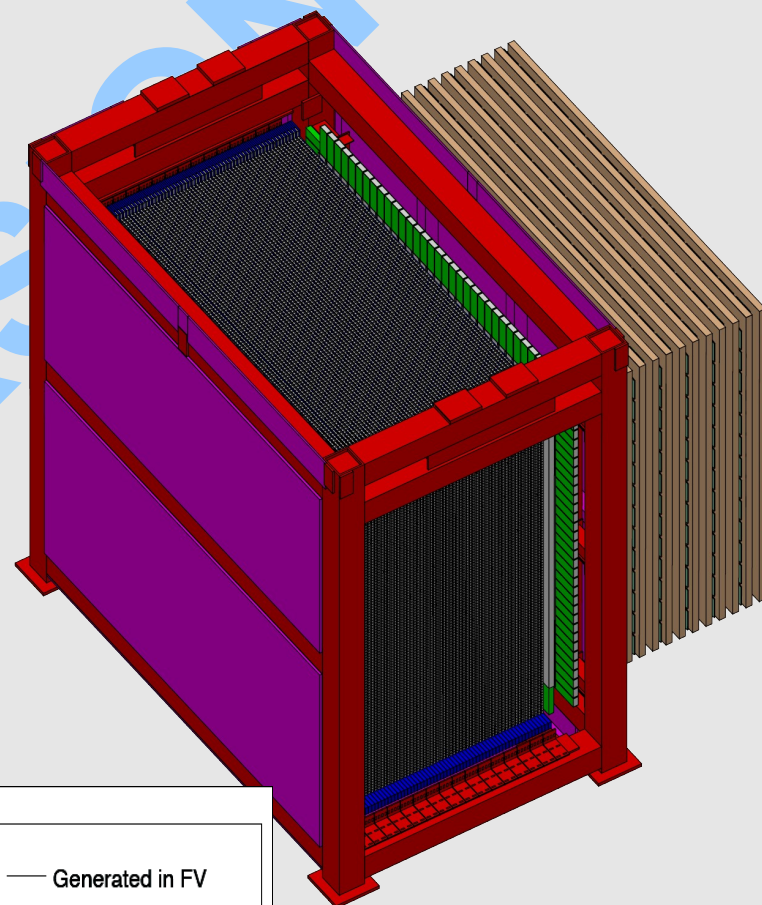
SciBooNE display of a typical muon neutrino CCQE event candidate.
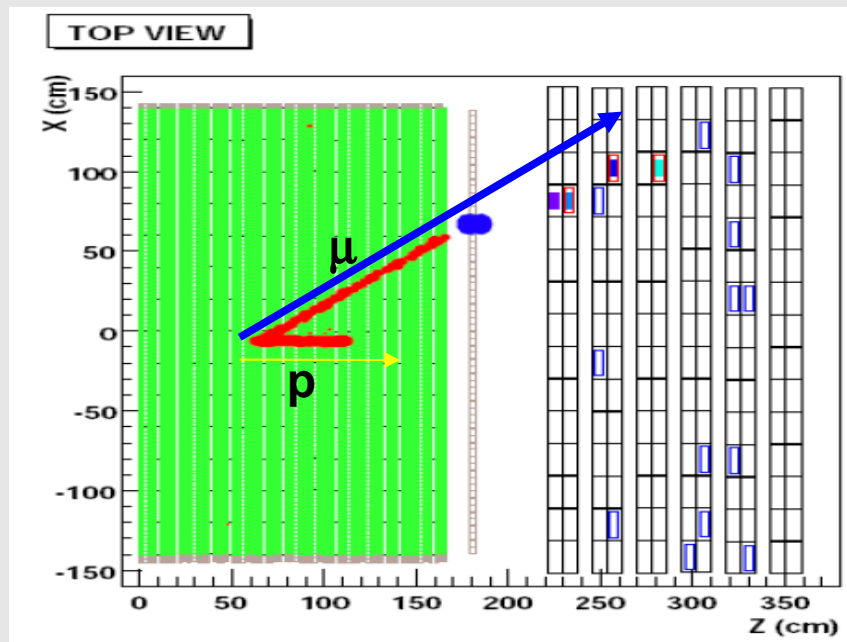
- booster nu beam
  (as MiniBooNE)
- a precision (~1cm) tracking
  detector
  - CCQE samples:
  both 1 (mu) and 2 (mu,p)
  observed
  - both scibar-stopped
  and MRD-tracked
 event samples
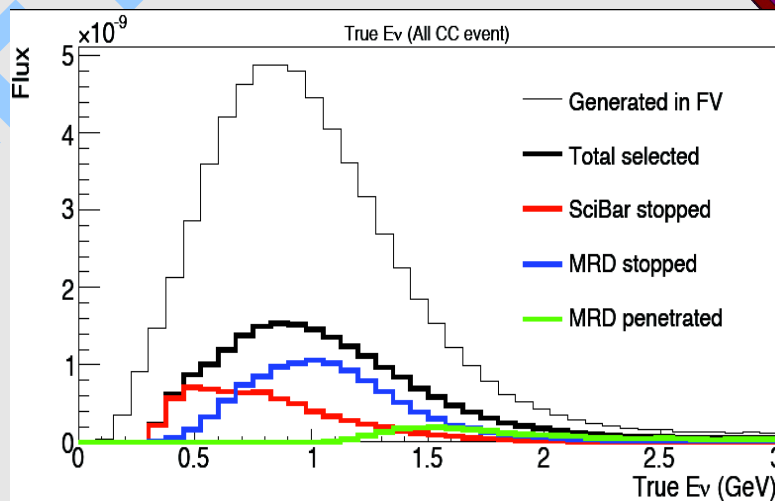
Nakajima

From recent work of
J. Walding, J. Alcaraz,
presented at Nuint09

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Preliminary CCQE results from SciBooNE

- **Neutrino Flux MC**

  - π^+ production: Extrapolated from HARP data (same as MiniBooNE) with Sanford-Wang errors

- **NEUT MC**

  - CCQE interaction: Llewellyn-Smith Model

    - M_A = 1.2 GeV

  - CC1π : Rein-Sehgal Model

    - CC coherent interactions suppressed by 0.33 in MC

      - Consistent with SciBooNE
      - *Phys Rev D **78** 112004 (2008)*

  - Nuclear Model: Smith-Moniz Relativistic Fermi Gas Model
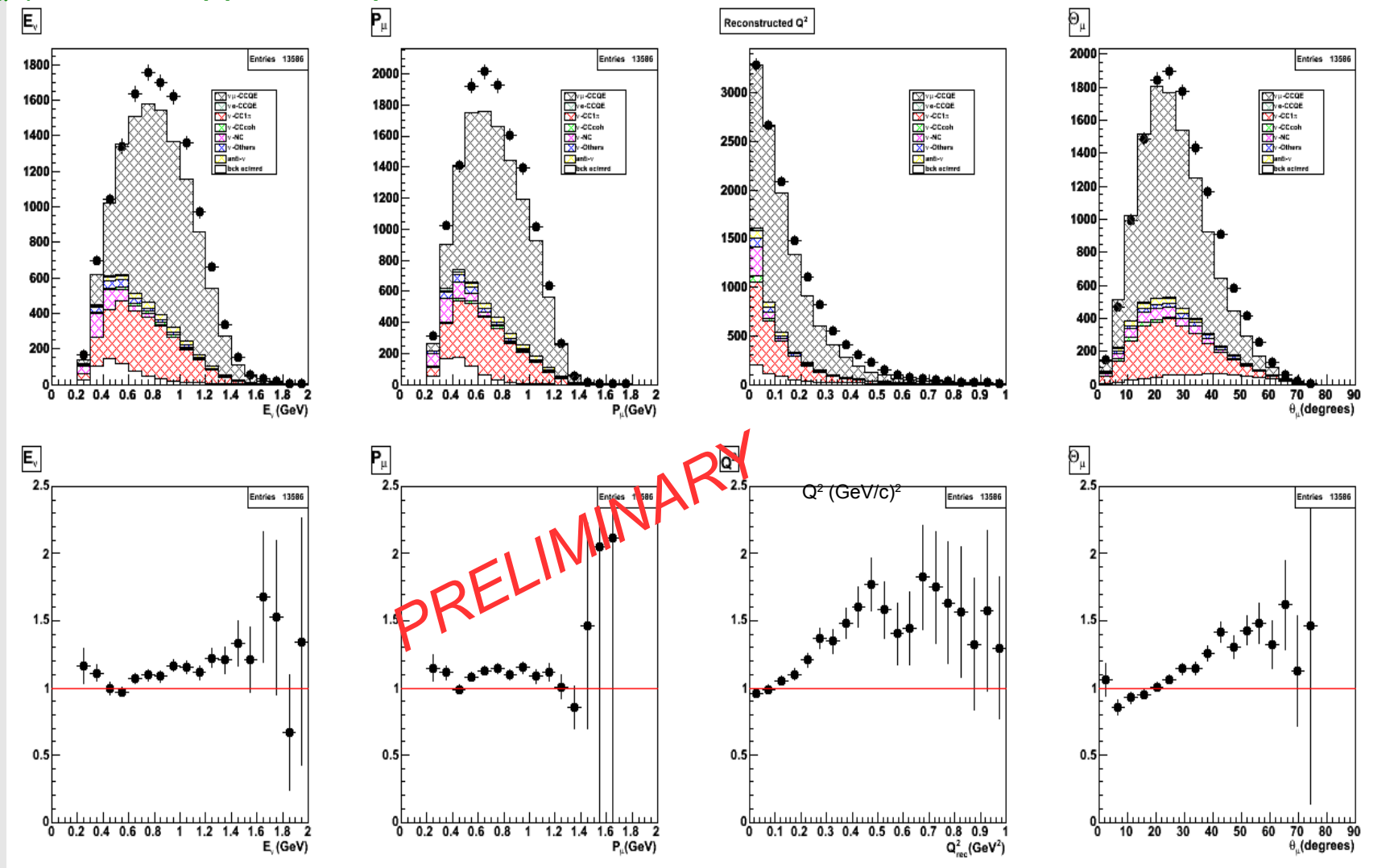
  - FSI: Formation Zone Parametrisation

Neutrino Flux Prediction
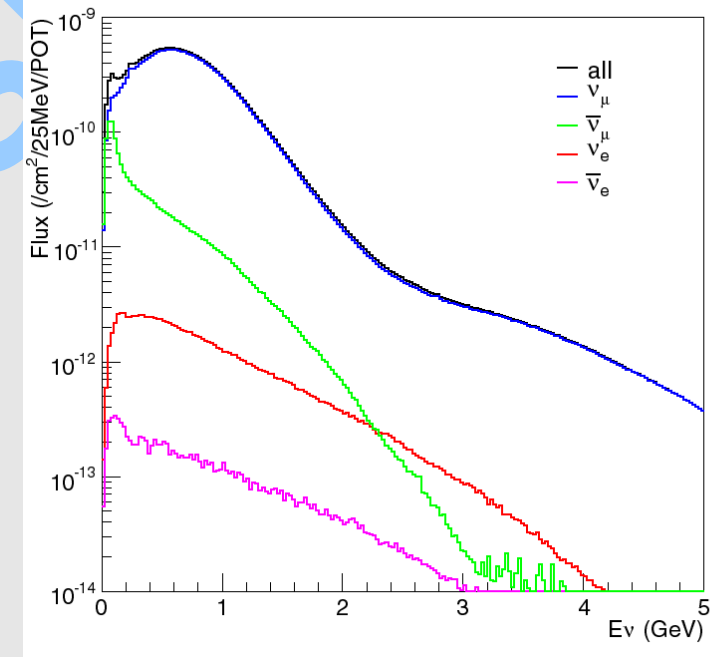
*Phys. Rev. D **79** 072002(2009)*

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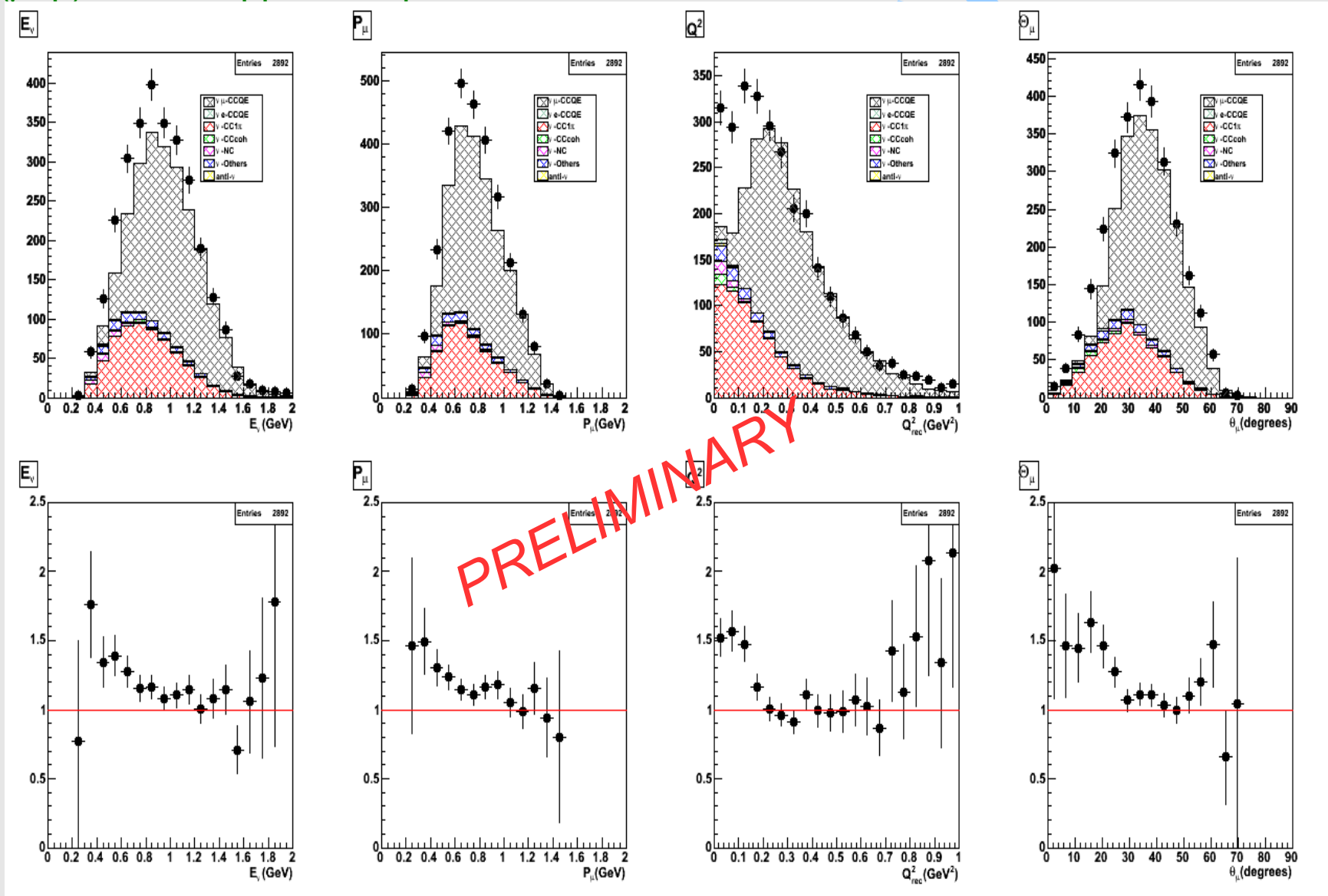# Preliminary CCQE results from SciBooNE

- 1 track (μ) MRD-stopped sample

- total measured rate data in excess compared to Neut MC (MA=1.2)
- excess of data at Q2>0.2 GeV^2
- both are (qualitatively similar to MiniBooNE observations)

DRAFT VERSION

Preliminary CCQE results from SciBooNE

- 2 track (μ+ p) MRD-stopped sample

- total measured rate data in excess compared to Neut MC (MA=1.2)
- excess of data at low Q2
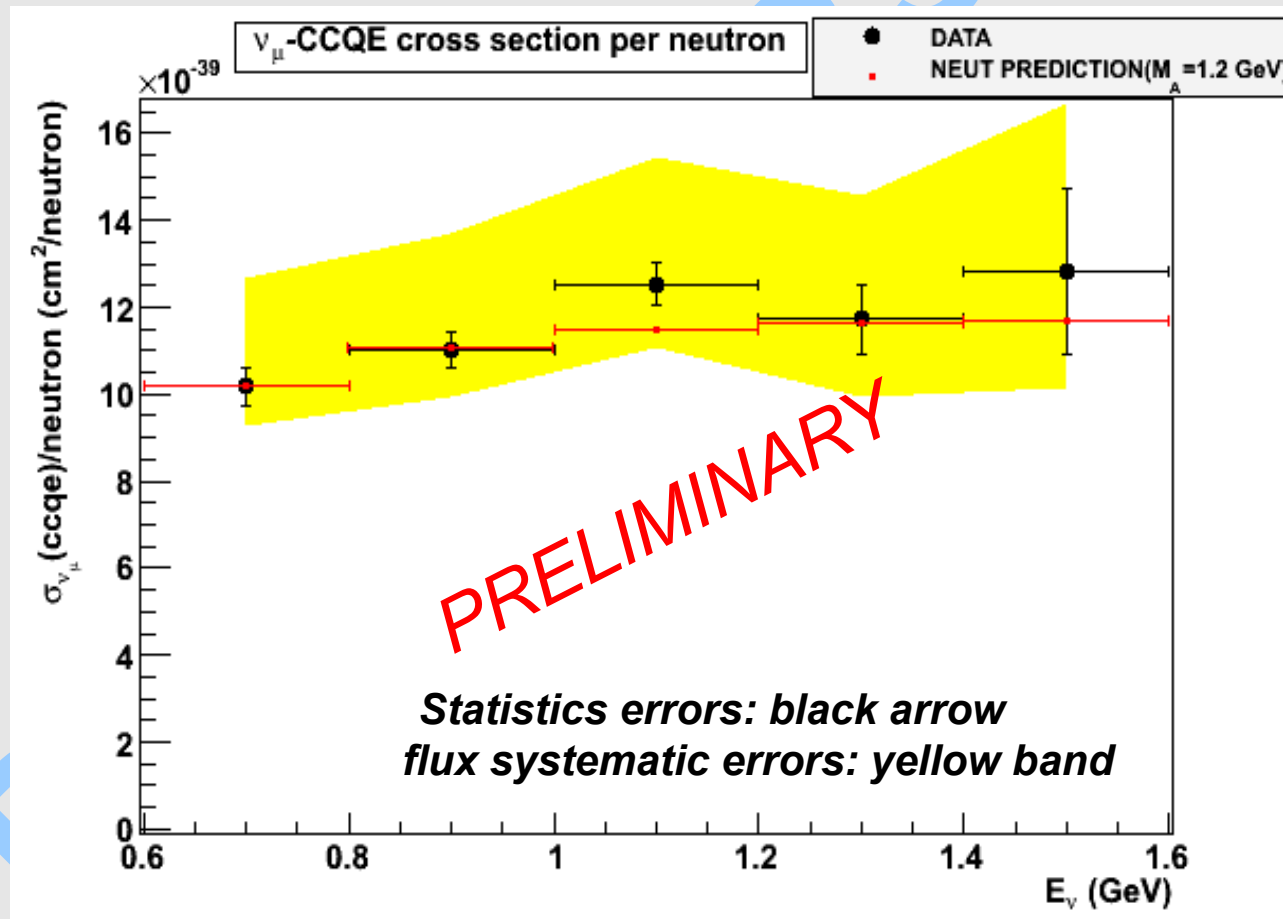- this sample is not separable (from 1 track) in MiniBooNE

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Preliminary CCQE results from SciBooNE

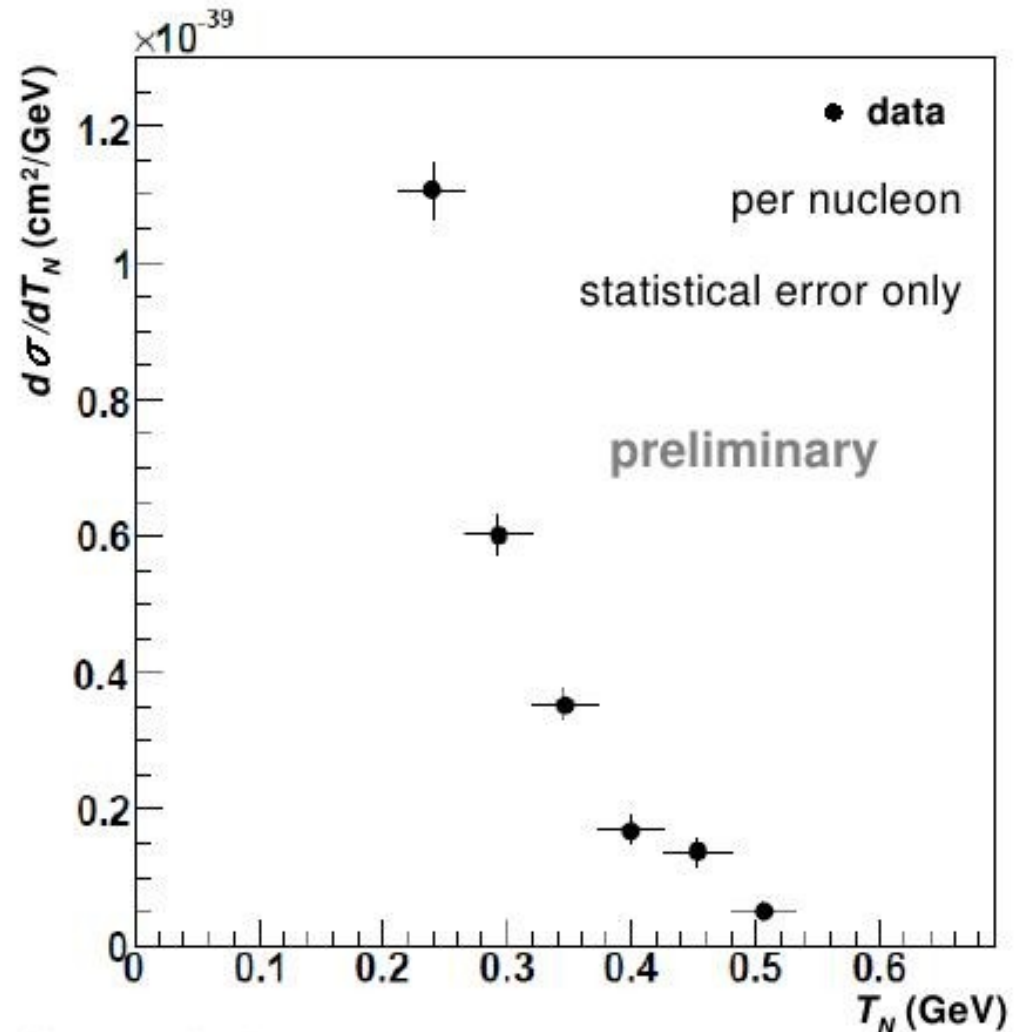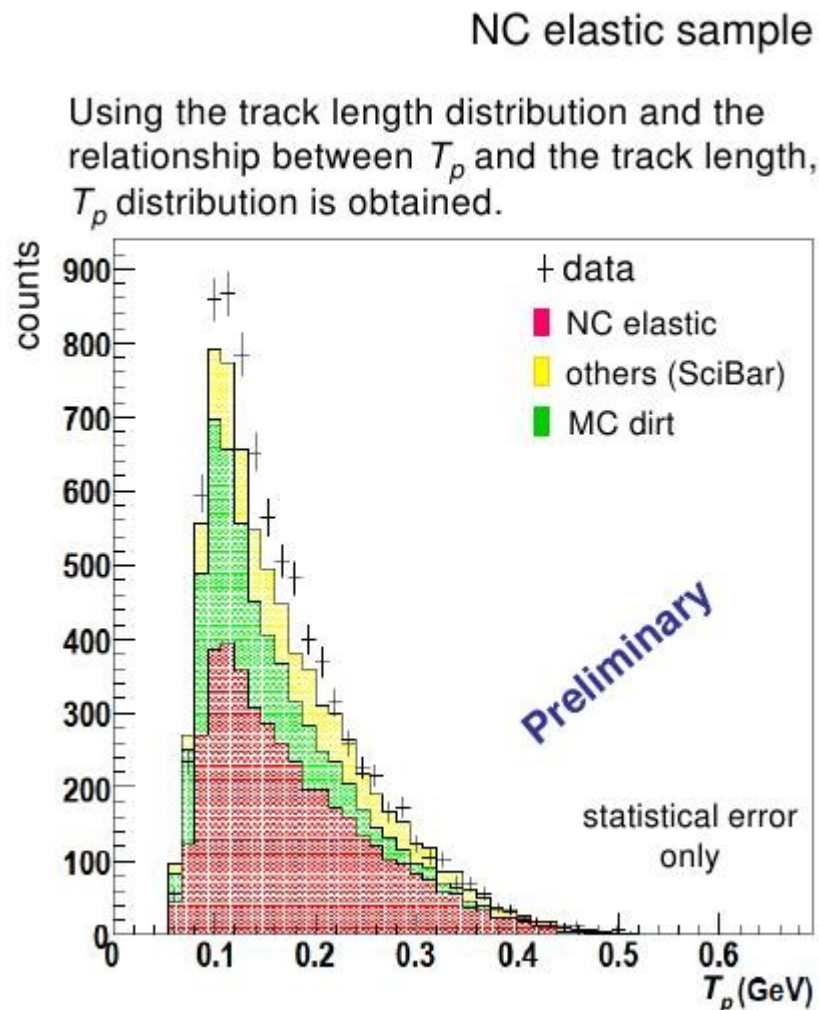Fit of CCQE data to 1,2 track CCQE, 2 track CCπ
- while adjusting:
   - CCQE total cross section as function of Enu (result below)
   - CCπ overall scaling (result=1.45+-0.07)

ν_μ-CCQE cross section per neutron

DATA
NEUT PREDICTION(M_A =1.2 GeV)

Statistics errors: black arrow
flux systematic errors: yellow band

PRELIMINARY

Preliminary NCel results from SciBooNE

- NC elastic scattering results

From recent work of
H. Takei, presented at Nuint09