DONUT Status

Director's Review of Fixed Target Experiments

February 26, 2003

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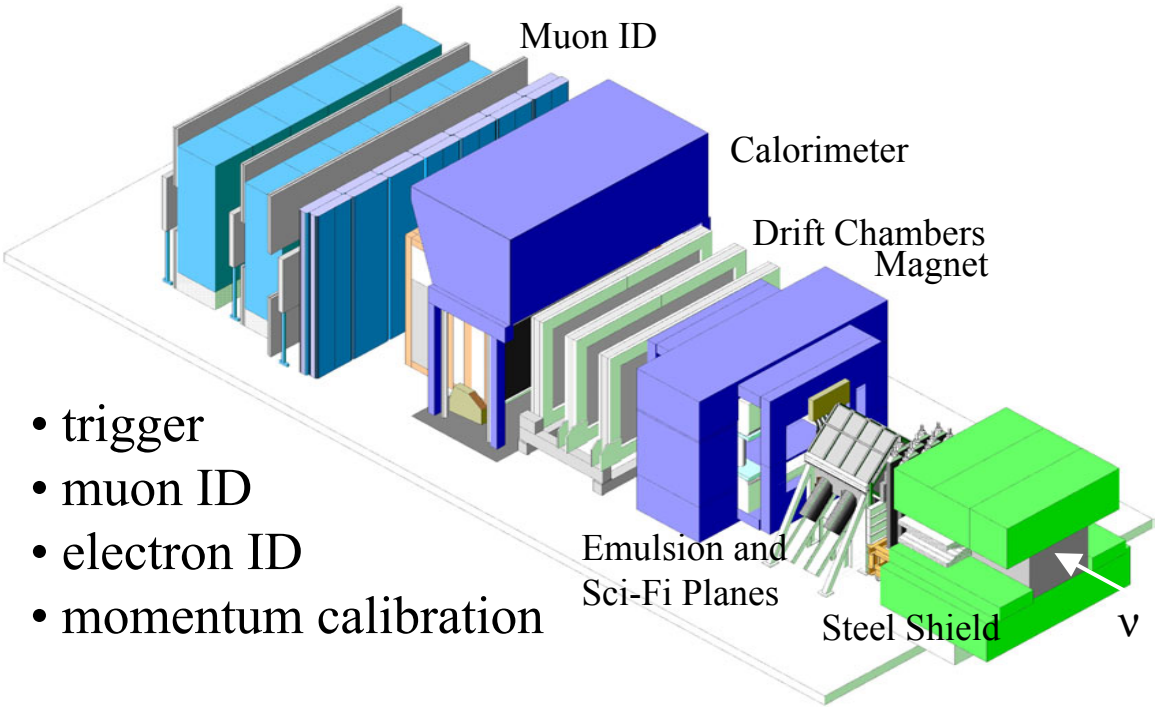
Outline

- Overview of the experiment & contributions
- Papers published & media coverage
- On-going analysis
- Degrees awarded past and future
- Needs & Data Policy

Experiment Overview



- trigger
- muon ID
- electron ID
- momentum calibration

- Detector is 35m from proton dump

$$D_s \rightarrow \nu_\tau + \tau$$

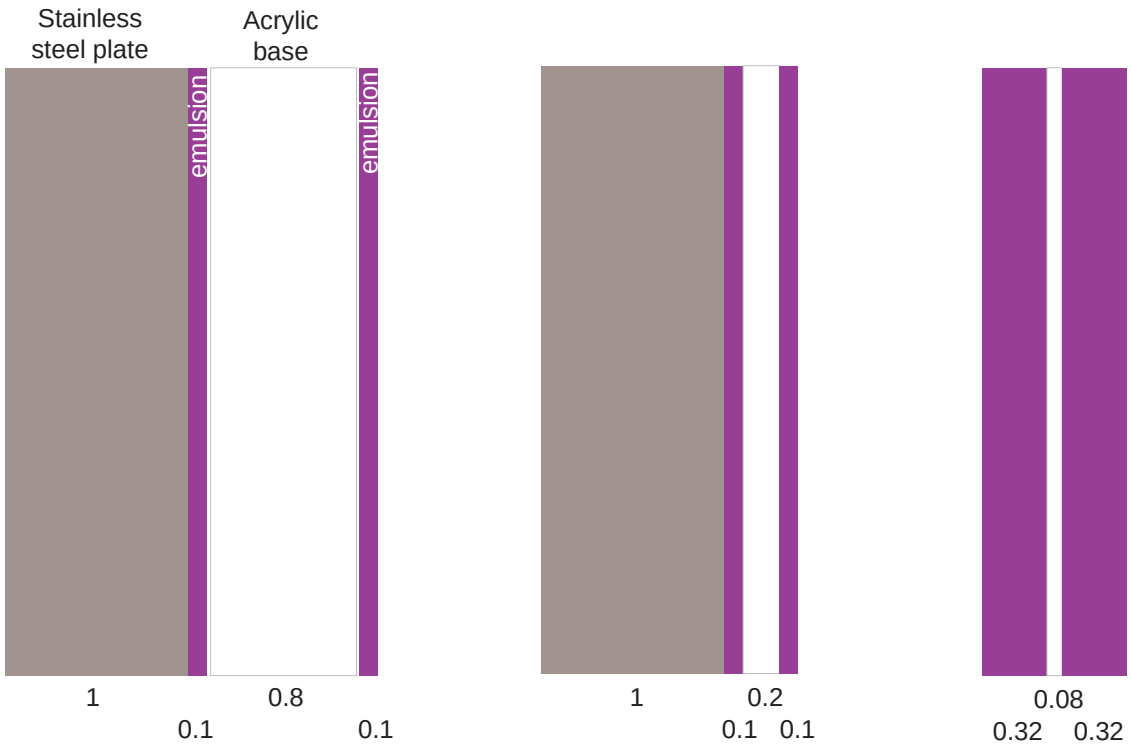
- $\langle E_\nu \rangle \sim 53$ GeV
- Identify

$$\tau \rightarrow e\nu\nu$$

$$\tau \rightarrow \upsilon\nu\nu$$

- $C\tau_\tau \sim 2.3$ mm
- Tag lepton from τ decay

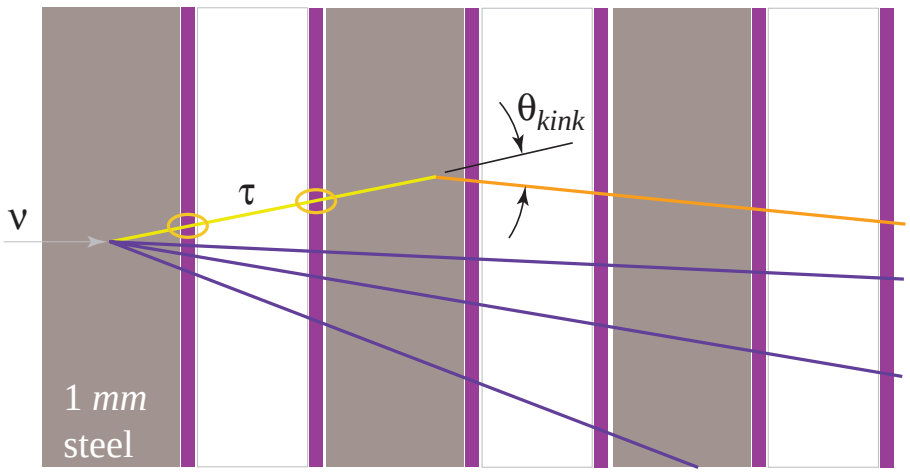
Target Design

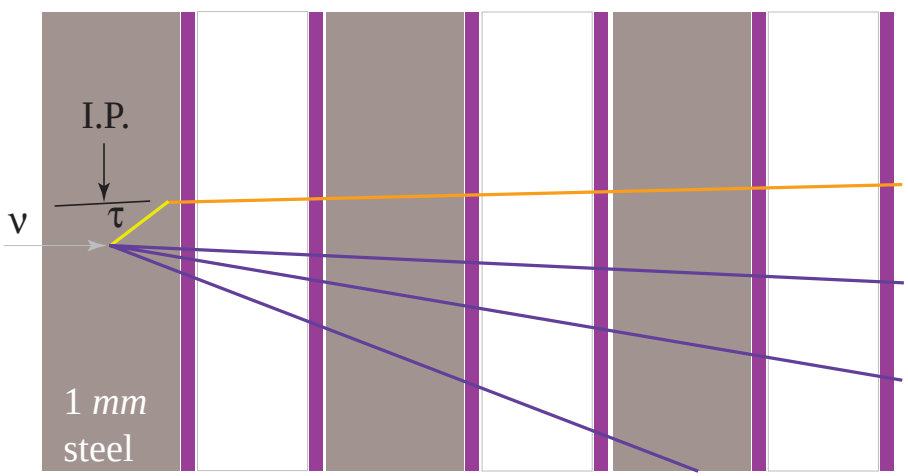


"ECC 800" "ECC 200" "Bulk"

- 3 target types
- Bulk 95% emulsion
- ECC 5% emulsion

Decay Search



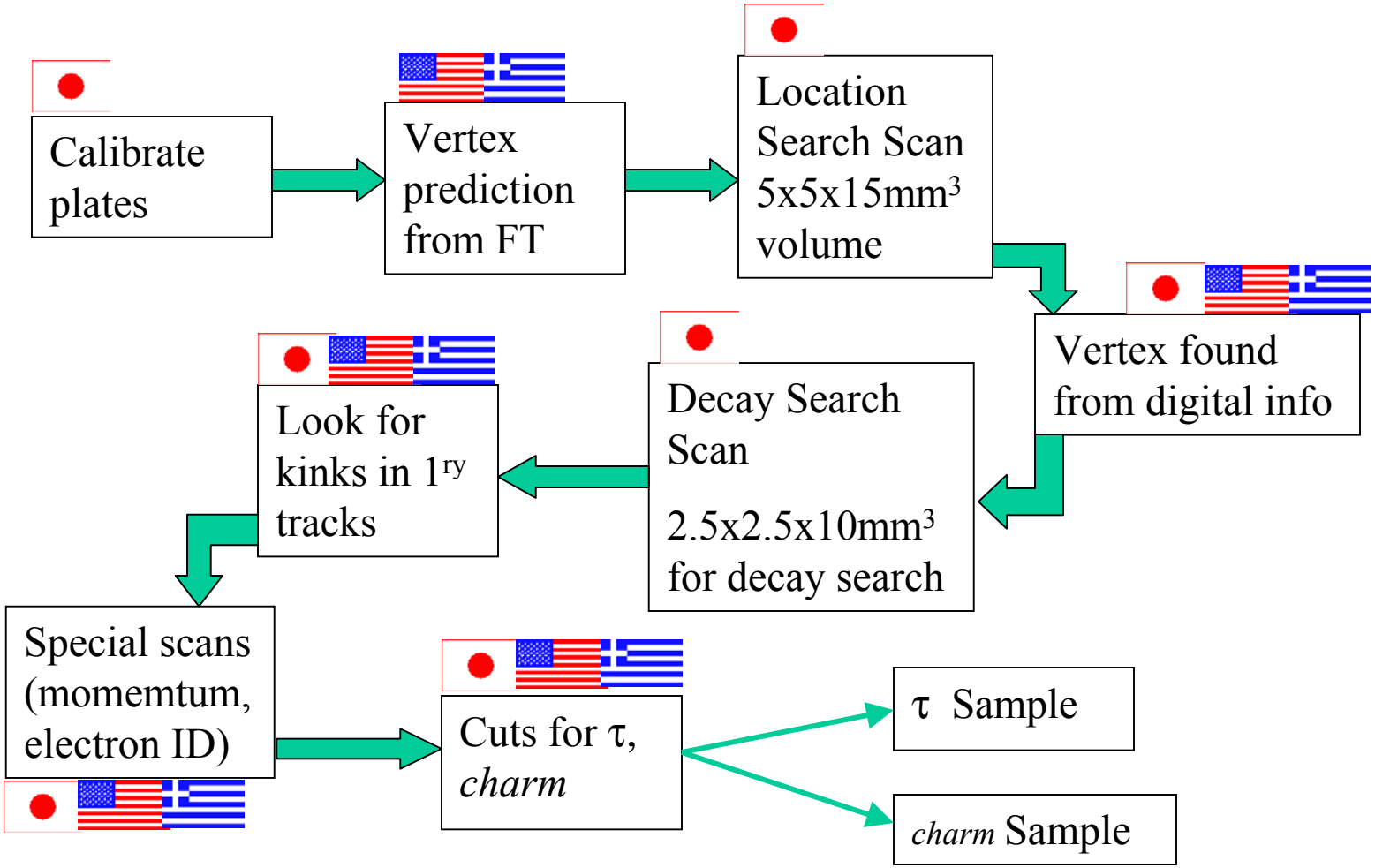


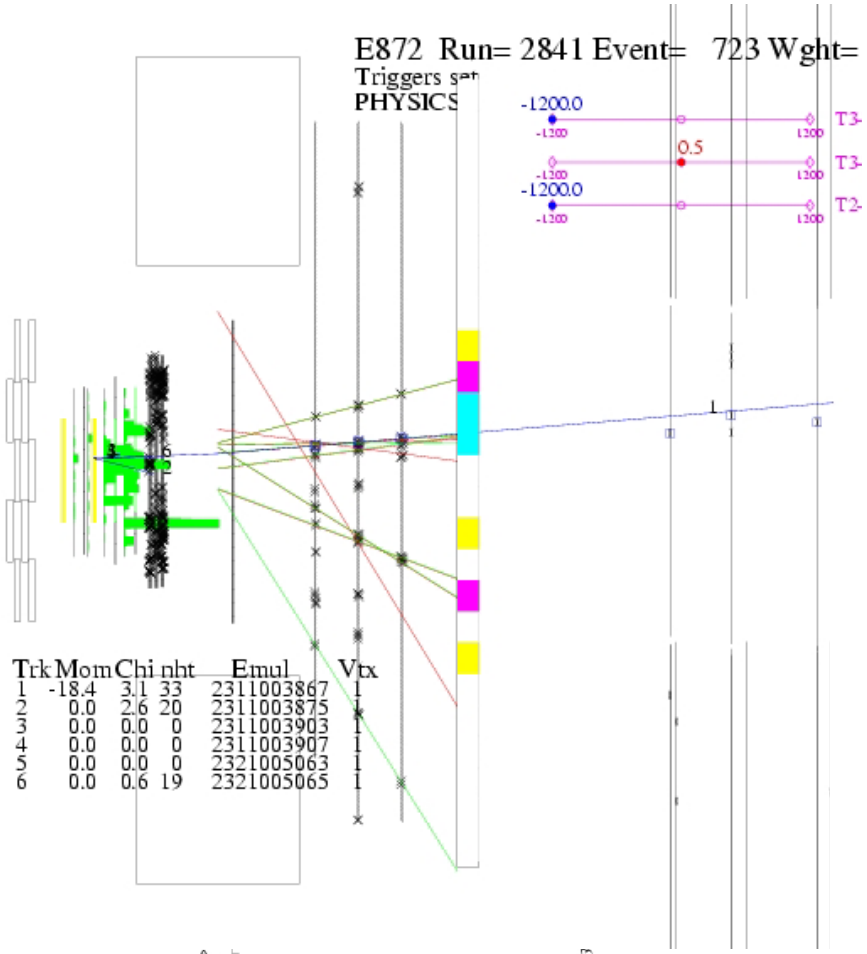
Phase 1

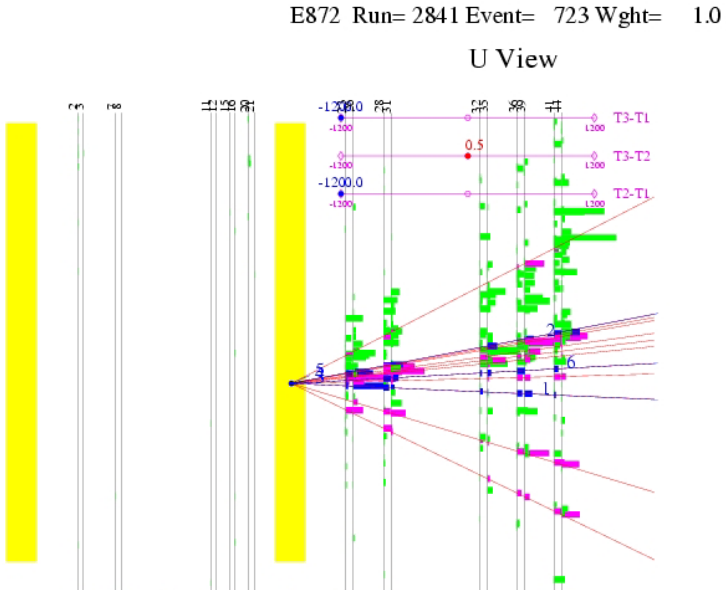
1. *Long Decays*
   - parent measured
   - kink resolved
   - $\tau \Rightarrow$ no 1^{ry} *lepton*
   - ~75%

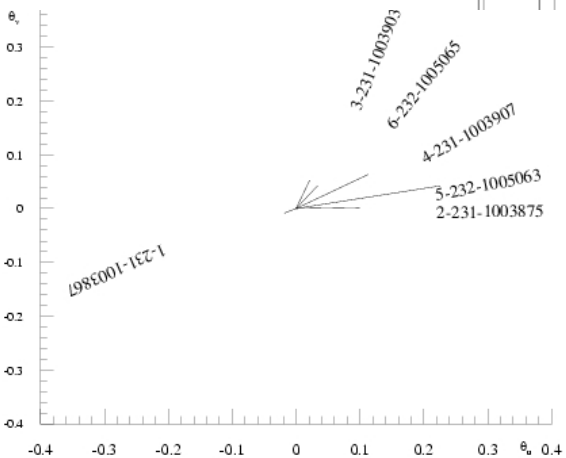
2. *Short Decays*
   - IP wrt 1^{ry} vertex
   - only daughter meas.
   - daughter seen in spect.
   - ~25%

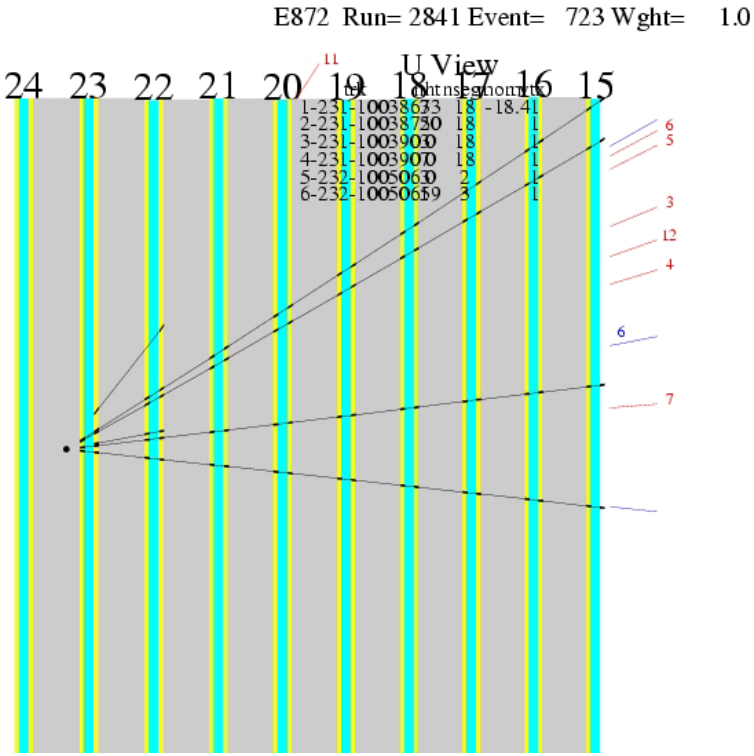
Digital Emulsion Analysis

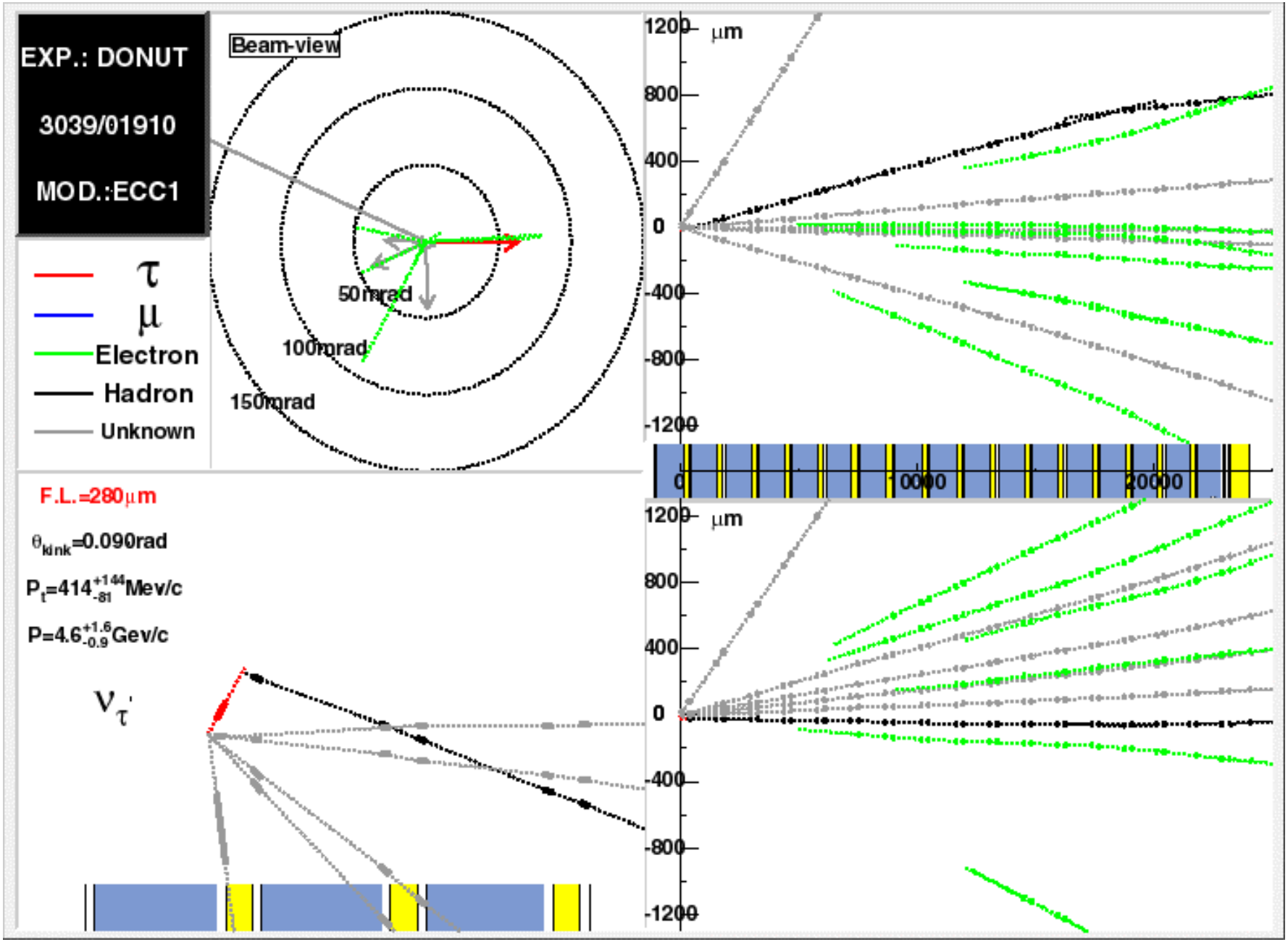



E872 Run= 2841 Event= 723 Wght=
Triggers set
PHYSICS
-1200.0
0.5
-1200.0
T3-
T3-
T2-
Trk Mom Chi nht Emul Vtx
1 -18.4 3.1 33 2311003867 1
2 0.0 2.6 20 2311003875 1
3 0.0 0.0 0 2311003903 1
4 0.0 0.0 0 2311003907 1
5 0.0 0.0 0 2321005063 1
6 0.0 0.6 19 2321005065 1


E872 Run= 2841 Event= 723 Wght= 1.0
U View
T3-T1
T3-T2
T2-T1
0.5
-1200.0


3-231-1003903
6-232-1005065
4-231-1003907
5-232-1005063
2-231-1003875
1-231-1003867


E872 Run= 2841 Event= 723 Wght= 1.0
U View
24 23 22 21 20 19 18 17 16 15
1-231-1003867 33 18 -18.4 1
2-231-1003875 30 18 1
3-231-1003903 30 18 1
4-231-1003907 30 18 1
5-232-1005063 30 2 1
6-232-1005065 19 3 1


EXP.: DONUT
3039/01910
MOD.:ECC1
Beam-view
τ
μ
Electron
Hadron
Unknown
50mrad
100mrad
150mrad
1200
800
400
0
-400
-800
-1200
μm
0
10000
20000
F.L.=280μm
θ_{kink}=0.090rad
$P_t=414^{+144}_{-81}$Mev/c
$P=4.6^{+1.6}_{-0.9}$Gev/c
ν_τ

DONUT Impact

- DONUT confirmed the existence of the ν_τ in July 2000
  - 4 ν_τ events in a sample of 203 neutrino interactions – *Phase 1*
  - Charm background 0.2 ± .03 events, hadronic interactions background 0.20 ± .04
- Scientific impact
  - 29 citations in SLAC Spires database
- Public impact
  - 44 articles in Fermilab News Review
    - NY Times, LA Times, Washington Post, USA Today, Der Spiegel

On-going Analysis

- Continuing tau search in Phase 2
  - 203 (Phase 1) + ~200 (Phase 2) events
  - Currently have ~7 tau, ~8 charm events
- Deferring difficult to locate events (~400) to Phase 3
  - Next generation of scanning stations at Nagoya will be running this spring
  - Scan 3 cm x 3 cm emulsion area/plate
  - ~100x larger data sets for location search

On-going Analysis

- Electron ID
  - Tag via bremsstrahlung conversions in emulsion
  - SFT “calorimeter” & EMCal
- Momentum analysis
  - 25% of primary tracks are momentum analyzed in the spectrometer
  - Excellent emulsion resolution (0.3 – 0.4 μm) allows 35% measurement below ~20 GeV
  - Scanning all tracks through the emulsion targets

Publications

- **OBSERVATION OF TAU NEUTRINO INTERACTIONS. Phys.Lett.B504:218-224,2001**
- **A NEW UPPER LIMIT FOR THE TAU - NEUTRINO MAGNETIC MOMENT. Phys.Lett.B513:23-29,2001**
- **DETECTION AND ANALYSIS OF TAU NEUTRINO INTERACTIONS IN DONUT EMULSION TARGET. Nucl.Instrum.Meth.A493:45-66,2002**
- **IDENTIFICATION OF NEUTRINO INTERACTIONS USING THE DONUT SPECTROMETER.** Submitted to **Nucl.Instrum.Meth.**
- **OSERVATION OF THE TAU NEUTRINO Submitted to Ann. Rev. Nucl. Part. Sci**

Degrees Awarded & Anticipated

- PhD awarded
  - R. Schwienhorst (U. Minn), K. Okada (Nagoya), P. Berghaus (Kansas State), J. Sielaff (U. Minn), N. Nonaka (Nagoya)
- Masters awarded
  - M. Skender (Tufts), N. Hashizume (Nagoya), T. Yamamori (Nagoya), K. Nakajima (Nagoya), H. Iinuma (Nagoya), K. Itoh (Nagoya), N. Saoulidou (U. Athens)
- Future PhD's
  - N. Saoulidou (2003, U. Athens), E. Maher (2004, U Minn), + ?? (Nagoya)

Needs & Data Policy

- Requesting travel funds for FY03
  - Fermilab collaborators (Baller, Lundberg, Rameika)
  - 2 international trips
  - 2 domestic collaboration meetings (3 people)
  - $10k for FY03, $10k for FY04
- We have no policy on data availability to the public
  - Emulsion data is available on the web