Proposal for a PRD Paper by the DONUT Collaboration:

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DONUT Collab. Meeting August 8-9, 2003

"A Measurement of nutau CC total Cross Section"

CONTENTS

I. INTRODUCTION

- Physics Intro, Significance, connection to tau lepton
- Indirect evidence from e+e- experiments: Michel parameters from PETRA, TRISTAN, LEP, CLEO
- Previous attempts of nutau detection, previous experiments
- Plan of cross section measurement
- Structure of the paper

II. THE NEUTRINO BEAM

- Beam Dump, Structure, goals, ref to previous beam dumps
- Overall schematic (layout), description **FIG**
- Problems (neutrons, gammas), Fixes
- MC Calculation of fluxes
- Moon energy spectrum **FIG**
- Moon energy spectrum at target area (L = 35 m) **FIG**
- Moon flux sources, neutrino flux sources, MC predictions
- Neutrino energy spectra **FIG**
- Neutrino energy spectra at target **FIG**
- Neutrino (interacted) energy spectra at Emulsion target **FIG**
- All spectra separate for numu, nue, nutau, numu non-prompt **FIG**

III. HYBRID EMULSION SPECTROMETER

- Description, overall schematic, goals **FIG**

a. Target

- Description, schematic, goals, **FIG**
- Emulsion target types **FIG**
- Preparation, processing, alignment, background sources
- Readout, image processing, segment reconstruction **FIG**
- Spatial resolution, reconstruction efficiency

Target (Continued)

- Track detection efficiency vs no of segments **FIG**
- Vertex detection efficiency vs no of “tracks” **FIG**
- Vertex background vs no of “tracks” **FIG**
- Vertex detection efficiency vs neutrino energy **FIG**

b. Scintillating Fibers

- Structure, Schematic, goals **FIG**
- Readout with II, FADCS, Imaging
- "Hit" definition (position, energy)
- Tracking with SciFi, resolution
- Efficiency vs Ecut, no. of hits
- Vertex reconstruction, resolution

SPECTROMETER

Magnet, PT kick

DRIFT chambers (refs)

- Description, electronics, readout
- Track reconstruction, resolution **FIG**
- Tracking efficiency **FIG**
- Systematics

EMCAL

- Description, schematic **FIG**
- Calibration, Energy Resolution, Position resolution
- Shower Reconstruction, clustering
- e-ID, gamma ID

Muon Identifier

- Muon reconstruction, resolution, ID, efficiency

Trigger

- Trigger counters, trigger types

General

- Acceptance
- Trigger efficiency vs neutrino energy: numu, nue, nutau **FIG**
- e/pi/mu separation efficiencies vs energy **FIG**

IV. EXPERIMENT RUNS/ ANALYSIS

- Data collection
- Calibration runs
- Calibration EMCAL **FIG**
- Alignment, SciFi, Emulsion, Spectrometer **FIG**
- General plan of the analysis
- Goals: Neutrino interaction detection, vertex prediction in spectrometer, vertex location in emulsion, muon ID, e-ID, Decay search, momentum measurement, neutrino event ID for (i) located and (ii) non-located events, background estimation

V. SPECTROMETER ANALYSIS

- Data reduction, analysis filters, visual scan, selection by ANN
- Data and MC
- Event reconstruction in spectrometer
- Momentum and energy measurements
- Vertex prediction
- Quality of reconstruction (resolution, systematics) **FIG**
- Efficiency of reconstruction vs visual energy **FIG**

VI. EMULSION ANALYSIS

- Emulsion scanning
- Event location, efficiency vs number of tracks **FIG**
- Efficiency vs position in target **FIG**
- Efficiency vs Evis **FIG**
- e-ID from the emulsion mesurements, efficiency **FIG**
- Distortion corrections
- Momentum measurement from emulsion **FIG**
- Validation from test beams **FIG**
- Comparison with spectrometer momentum meas **FIG**
- Decay search, efficiency **FIG**

VII. COMBINED ANALYSIS

- Neutrino event ID for located and non-located events
- Use info from spectrometer and emulsion
- Selection criteria
- numu-ID from Muon-ID and ANN
- numu prompt vs non-prompt
- nue from emulsion and spectrometer (ANN)
- NC from ANN
- kink and multiprong decay events from decay search
- Backgrounds
- Selection criteria for tau, charm, scatter
- Cuts, parameter analysis, ANN **FIGS**
- Final sample: Non-located events (numu, nue, NC) **TAB**
- Final sample: located events
  - numu, nue, NC, nutau, charm,
- Efficiencies

VIII. CROSS SECTION MEASUREMENT

- Estimate number of numu, nue, NC from efficiencies
- Visible energy distributions for numu, nue, NC **FIG**
- Compare with MC distributions **FIG**
- Do combined fit with folded in known cross sections
- Extract neutrino flux
- Estimate total nutau CC cross section
- Use charm to compare and cross check