A STUDY OF DIMUON EVENTS IN THE NOMAD EXPERIMENT

Roberto Petti [a], Oleg Samoylov [b]

[a] Univ. of South Carolina, Columbia SC, USA
[b] JINR, Dubna, Russia

Workshop "Neutrino physics at accelerators"
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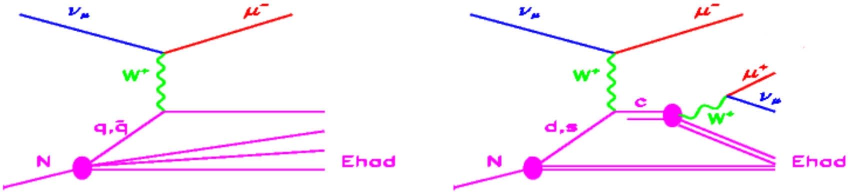
Outline

OUTLINE



CHARM PRODUCTION

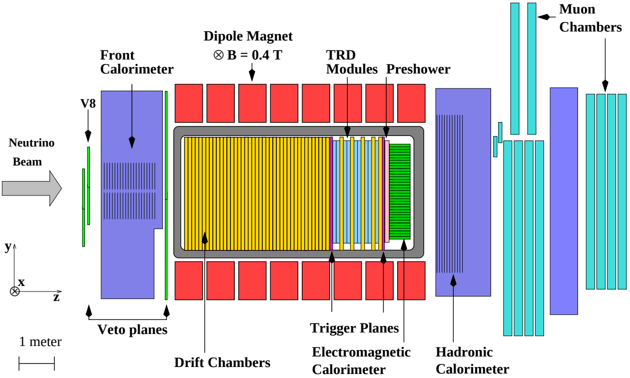
1. Main content from strange see distributions $Cos^2\theta_c \simeq 0.95$
2. Decaying into $\mu^+ X$ in $\sim 10\%$ cases

WHAT GETTING

1. Nucleon strange quark distributions $xs(x)$
2. Mass of the charm m_c (mesuared from $R(s)$ on e^+e^- at DESY)
3. The Cabibbo-Kobayashi-Maskawa (CKM) matrix element $|V_{cd}|$
4. Semi-leptonic branching ratio B_μ

All the DATA results

Experiment	Opposite sign dimuon events
CDHS (CERN)	~ 600
CCFR & NuTeV	~ 5000
NOMAD	~ 15000 expected



1. The lagre sample of neutrino interactions interpolated to FCAL, $\sim$ 10M ($\sim$ 50k opposite sign dimuon)
2. Good calorimetry, $\Delta E/E \simeq 3.2\%/\sqrt{E[\mathrm{GeV}]}$
3. Good reconstruction quality of individual tracks, $\varepsilon \gtrsim 95\%$, $\Delta p/p \simeq 3.5\%$

OUTLINE

1. INTRODUCTION
   - Motivation
   - Experimental review
   - NOMAD experiment
2. ANALYSIS
   - Main idea
   - Till 2007
   - During 2007
3. CONCLUSIONS

Main idea

Charm dimuon production

$$n_{\mu_c^+} = \frac{dN(\nu_\mu s(d) \to \mu^- c \to \mu^- \mu^+ X)/dx}{dN(\nu_\mu N \to \mu^- X)/dx} \simeq \frac{N(\nu_\mu N \to \mu^- \mu^+ X)}{N(\nu_\mu N \to \mu^- X)}(x),\ x = E_\nu, x_{B_j}, \sqrt{\hat{s}}$$

The charm dimuon DATA

– $N_c^{DATA} = N_{\mu^-\mu^+}^{DATA} - N_{bg}^{DATA}$
– All the background is produced by leptonic decaying π^+, K^+-mesons into $\mu^+\nu_\mu$.

– $N_{bg}^{DATA} = N_{\mu^-\mu^-}^{DATA} \cdot \frac{N^{MC}_{\mu^-\mu^+_{bg}}}{N^{MC}_{\mu^-\mu^-}}$

The charm dimuon MC

Using one MC sample N_c^{MC} with reweighting to cross section

DATA TACKING

CUTS

1. Fiducial volume of the FCAL:
   $|x_{ext}^{PV}| < 80$ cm, $|y_{ext}^{PV}| < 90$ cm
2. Time correlation between two muons:
   $dt < 5$ ns
3. Muon energy:
   $E_{\mu} > 3$ GeV
4. Kinematic cuts:
   $Q^2 > 1$ GeV^2/c^2, $x_{b_j} < 1$

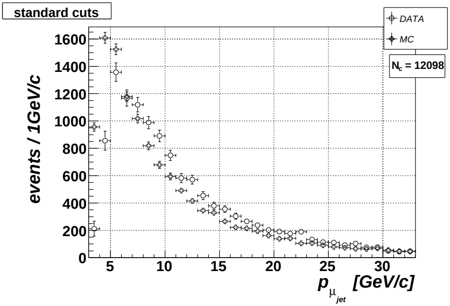
Roberto & Hubert

Till 2007

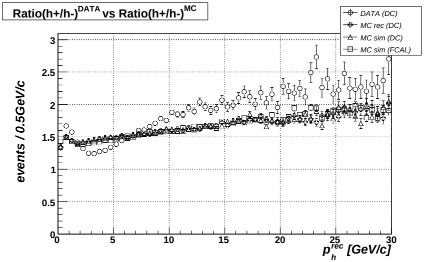
1. Complete reprocessing of the raw data and recovering of events
2. Ntuples production from DST
3. MC generation and theory studying
4. Development of the fitting program to extract m_c & κ_s

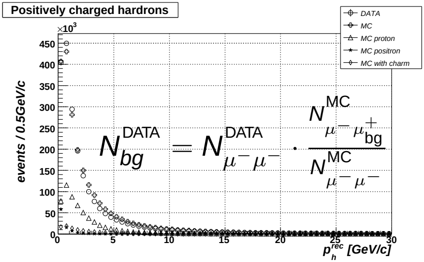
Problems

1. Not clearly undestanding of the extrapolation of the muon's tracks into FCAL and also in Muons Chambers
2. Discrepancy of the p_{μ^+} at low momenta, DATA vs MC

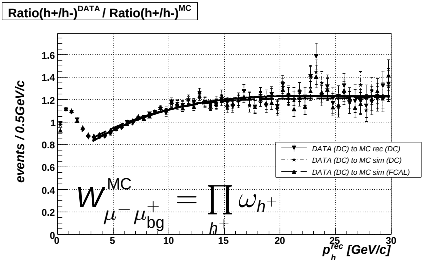


Ratio h^+/h^-

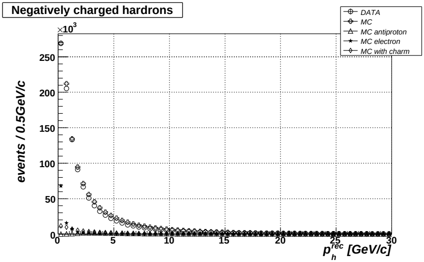




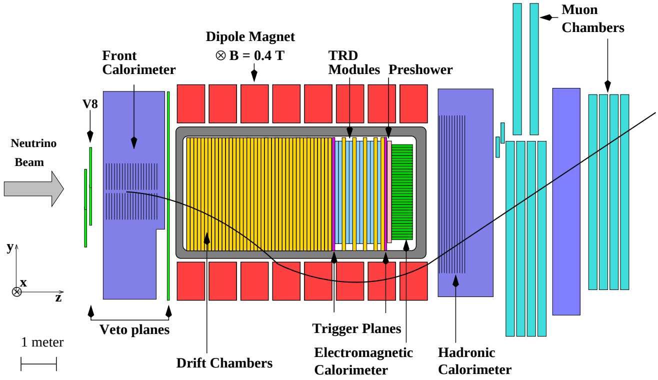
$$N_{bg}^{\mathrm{DATA}} = N_{\mu^-\mu^-}^{\mathrm{DATA}} \cdot \frac{N_{\mu^-\mu^+_{\mathrm{bg}}}^{\mathrm{MC}}}{N_{\mu^-\mu^-}^{\mathrm{MC}}}$$



$$W_{\mu^-\mu^+_{\mathrm{bg}}}^{\mathrm{MC}} = \prod_{h^+} \omega_{h^+}$$

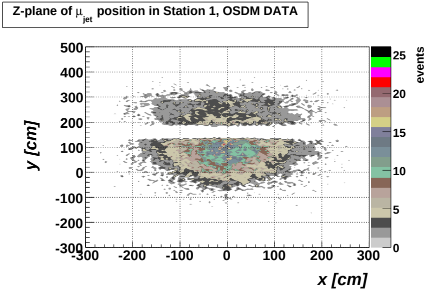


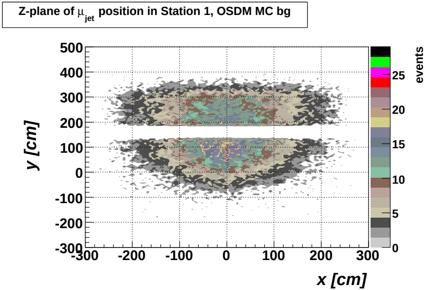
Iron of the Magnet shell

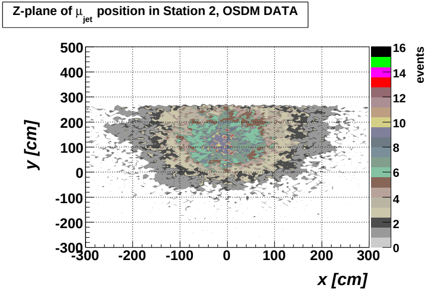


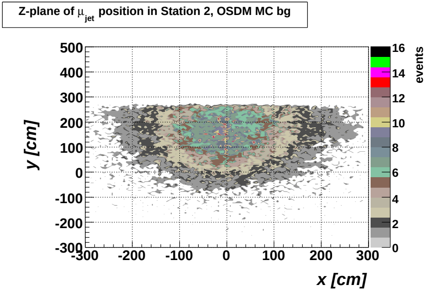
A muon changes its helix trajectory if it crosses over the iron shell of the magnet

Position of the muon’s track in Muon Chambers splited to Stations

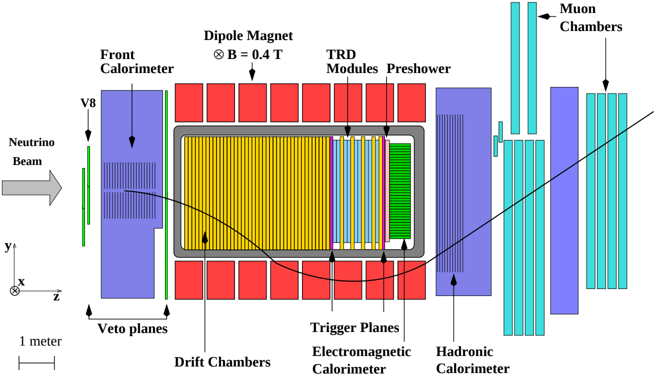








EXCLUDE IRON OF THE MAGNET REGION

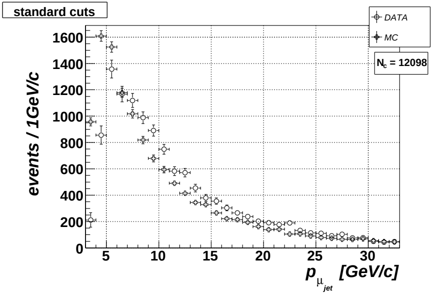


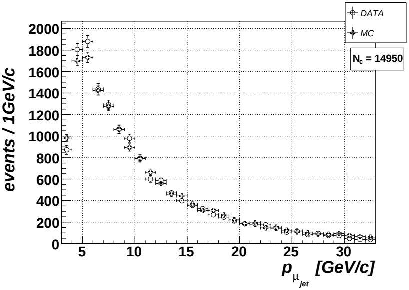
We exclude a muon's track if its trajectory crosses over the iron shell of the magnet

OUTLINE

Summary

1. Reweighting to Ratio h^+/h^-
2. Excluding the Magnet region





SUMMARY

1. Reweighting to Ratio h^+/h^-
2. Excluding the Magnet region
3. Plan to begin physics analysis

$$n_{\mu_c^+} = \frac{dN(\nu_\mu s(d) \to \mu^- c \to \mu^- \mu^+ X)/dx}{dN(\nu_\mu N \to \mu^- X)/dx} \simeq \frac{N(\nu_\mu N \to \mu^- \mu^+ X)}{N(\nu_\mu N \to \mu^- X)}(x),$$

$$x = E_\nu, x_{B_j}, \sqrt{\hat{s}}$$