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Charm Physics using MINERVA

Charm physics will be limited to study of opposite sign dimuon events…(Direct decay search out of question)

□□N □>□X c □> □Y

What physics can be done with dimuons: **N(□□) ~ B□· □charm(E□,mc,Vcd)**

Extract : $B_{\square}$ - average semileptonic branching ratio

V_{cd} (and V_{cs} difficult?) - CKM Matrix Element

m_c- Charm quark mass

Charm production in neutrino charged-current interactions have been studied in many experiments:

E531, CDHS, CCFR, CHARM(I and II), NOMAD, NuTeV and CHORUS

The most recent numbers are:

$B_{\square}$ = 0.095 +/- 0.007 +/- 0.014 (NOMAD[1])

0.116 +/- 0.007 (NuTeV and CCFR combined[2])

0.093+/- 0.009 +/- 0.009 (CHORUS[3])*

0.099 +/- 0.012 (PDG[4])

m_c = 1.3 +/-0.3 +/-0.3 GeV/c^2 (NOMAD[1])

1.38+/- 0.13 GeV/c^2 (NuTeV and CCFR combined[2])

1.0 - 1.5 GeV/c^2 (PDG[4])

V_{cd} = 0.219 +/- 0.022 (CHORUS[3])

0.224 +/- 0.016 (PDG[4])

Note all these measurements are for $E_{\square}$ > 15 GeV and samples on the order of a few thousand dimuon events….

[1] Phys. Let. B 486(2000)35-48

[2] Phys. Rev. D 64(2001)112006

[3] Phys. Let. B 549(2002)48-57

[4] URL:http://pdg.lbl.gov/ June 18, 2002

Issues for MINERVA…..

Must produce a charm quark therefore must have a neutrino of energy at least 7-8 GeV - Only the tails of the LE beam configuration spectrum will have enough energy, but flux low.

Assuming 2.5 x 10^{20} POT/year (From Steve Boyd's Charm MC):

(1 ton detector)

Beam	**DIS**	**Dimuons**
LE	100K	50
ME	340K	100
HE	770K	650

(I did similar calculations using LEPTO for LE and obtained (very)roughly the same number)

You already see the problem here….. No Cuts, No Background Considerations, etc… Yield small

Our beam does have one advantage….

Our charm will almost all be produced close to or at threshold… Good for m_c extraction!

….But why use MINERVA? - low mass and bad for containing muons

These measurements are much better done with MINOS Near Detector….

An Aside:

A magnetic detector is useful for determining the background in the dimuon sample from pion decay… Look for same sign dimuons