Working Group Three

Non-Oscillation Neutrino Physics: Physics and Detector

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NUFACT 2002
1st – 6th July 2002
Role of Non-Oscillation $\nu$ Physics

- Exploit exponential growth of $\nu$

<table>
<thead>
<tr>
<th>Beam</th>
<th>$\langle E_\nu \rangle$ [GeV]</th>
<th>$\nu$ flux per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>NuTeV/CCFR</td>
<td>100</td>
<td>$\sim 10^{14}/m^2$</td>
</tr>
<tr>
<td>CHORUS/NOMAD</td>
<td>30</td>
<td>$\sim 3 \times 10^{15}/m^2$</td>
</tr>
<tr>
<td>MINOS Near LE</td>
<td>5</td>
<td>$\sim 3 \times 10^{16}/m^2$</td>
</tr>
<tr>
<td>MINOS Near HE</td>
<td>15</td>
<td>$\sim 10^{17}/m^2$</td>
</tr>
<tr>
<td>Neutrino Factory†</td>
<td>12</td>
<td>$\sim 5 \times 10^{19}/m^2$</td>
</tr>
</tbody>
</table>

† $\sim 2 \times 10^{20} \mu$/yr, 20 GeV

- Provide understanding of neutrino interactions crucial for oscillation physics

  $\leftrightarrow$ Measure low-energy neutrino cross-sections (superbeams)

  $\leftrightarrow$ Understand far detector response

  $\leftrightarrow$ Measure backgrounds to oscillation searches

  * CP violation searches will almost certainly be limited by these!
Physics of $\nu$ Interactions

- QCD Studies with Neutrinos
  - Huge fluxes allow weaning of neutrinos experiments from massive targets
    - Low Z targets: nuclear dependence, separate $\nu_p$, $\nu_n$
    - Polarized targets: flavor spin SFs
  - Discussions at NUFACT 2002:
    - Nuclear effects: experiment (NUMI) and theory (Tuesday am)
    - Status and Prospects for polarized and unpolarized nucleon SFs (Tuesday noon, pm)
    - Higher Twist effects, low $Q^2$ QCD (Wednesday, am and noon)
    - DIS Sum Rules, tests of QCD (Wednesday, am and noon)

- “The NuTeV Train Wreck”
  - $\sin^2 \theta_W^{\nu N}$ far off SM expectation
    - Physics beyond electroweak? Wacky QCD?
  - Discussions at NUFACT 2002:
    - The measurement (Wednesday pm)
    - ’Old and New Physics” interpretations (Wednesday pm)
Near Detectors & $\nu$ Oscillations (Joint with Working Group 2)

• Why is this important?
  → This limits our knowledge today!
    ∗ $\pi^0$ appearance at Super-K $\Rightarrow \nu_\tau$?
    ∗ LSND+SNO+Super-K$\Rightarrow'''3+1''$ scenario, requires $\sim 10\% \nu_\mu$ disappearance at LSND!
  → Need for knowledge grows more acute with Superbeam $\nu$ oscillation program

• Focus here on (mostly) next-generation Superbeams (sub–few GeV, $\pi$ beams)
  → Report from the frontiers: K2K and NUMI
     (Thursday noon, post-coffee)
  → Phenomenology of Cross-Sections at Low energy
     (Thursday noon)
  → Quasi-elastic and Resonance $\nu_\mu$ and $\nu_e$ detection
     (Thursday pm)
  → Fluxes: absolute and far/near ratios
     (Thursday pm and post-coffee)
  → Near detectors for cross-section and flux
     (Thursday post-coffee)