Neutrino Factory Front End (IDS) and Variations

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Outline

Front End for the IDS Neutrino Factory

- Using newer initial beams
  - H. Kirk from “latest” MARS, from study 2A, ISS
  - More μ/p than previous version ??

Front End Comments

- Losses/shielding
  - B/V variation ...
- Mitigation
Drift ($\pi \rightarrow \mu$)

“Adiabatically” bunch beam first (weak 320 to 232 MHz rf)

$\Phi$-E rotate bunches - align bunches to ~equal energies
- 232 to 202 MHz, 12MV/m

Cool beam 201.25 MHz
Simulation results

- H. Kirk provided initial files (+, - particles) from Mars 15.xxx (8GeV p n Hg jet)
  - 0, 1, 2, 3, 4 ns
- Check to study initial $\Delta t$ sensitivity
- Kept only $\mu$, $\pi$
  - 10000 particle simulation
- ~10% loss “0” to 4 ns
- Obtain more $\mu/p$ than previous initial distribution
  - 0.080 $\rightarrow$ 0.096/0.094 ??
- Initial beam has 75MeV/c cut off

<table>
<thead>
<tr>
<th>Case</th>
<th>$\mu/p$ at 230m</th>
<th>$\mu/p$ at 245m</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu^+$, 0 ns</td>
<td>0.103</td>
<td>0.109</td>
</tr>
<tr>
<td>$\mu^+$, 1 ns</td>
<td>0.097</td>
<td>0.104</td>
</tr>
<tr>
<td>$\mu^+$, 2 ns</td>
<td>0.102</td>
<td>0.104</td>
</tr>
<tr>
<td>$\mu^+$, 3 ns</td>
<td>0.096</td>
<td>0.101</td>
</tr>
<tr>
<td>$\mu^+$, 4 ns</td>
<td>0.089</td>
<td>0.092</td>
</tr>
<tr>
<td>$\mu^-$, 0 ns</td>
<td>0.101</td>
<td>0.105</td>
</tr>
<tr>
<td>$\mu^-$, 2 ns</td>
<td>0.100</td>
<td>0.105</td>
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<td>0.091</td>
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</tr>
</tbody>
</table>
Initial cut off

Fi(rms) = 1.8167  L = 0.000 m
\(dE = 0.6876\) GeV  \(Ebar = 0.5906\) GeV
\(X_{rms} = 0.039082m\)  \(P_{x, rms} = 0.159002\) GeV/c

19998 particles
9665 between 0.0800 and 0.3500 GeV

75 MeV/c
Beam losses along Front End - half-full?

- Start with 4MW protons
  - End with ~25kW $\mu^+ + \mu^-$
    - plus p, e, $\pi$, ...
    - ~20W/m $\mu$-decay
  - ~0.5MW losses along transport
    - 0.2MW at $z>50m$

- "Hands-on" low radiation areas if hadronic losses < 1W/m
  - Booster, PSR criteria

- Simulation has >~100W/m
  - With no collimation, shielding, absorber strategy

- Need more shielding, collimation, absorbers
  - Reduce uncontrolled losses
  - Special handling
Comments on Front End Losses

- First ~70m has 30cm beam pipe within ~65cm radius coils
  - ~30+ cm for shielding
  - Radiation that penetrates shielding is what counts ...
    - < 1W/m ?
  - Could the shielding handle most of the losses in the first ~70m?

- Should add proton absorber
  - After $\pi$-Decay - z= 50m?
  - Stop p, $\pi$, ...; transmit $\mu$ ...
    - With chicane ??

- Thickness allowed ??
  - Need to properly track reference particles through absorbers
Comments on Losses

- After protons stopped, most losses are $\mu$'s and $e$'s from $\mu$-decay
  - Less dangerous in terms of activation
    - $> 1$W/m OK?
  - $\mu$'s would penetrate through more shielding
Summary

- **IDS front end**
  - Newer MARS-generated particles
    - Initial bunch length dependence
  - Newer version has more $\mu/p$

- **Radiation problems**
  - "mitigation strategies"

- **Questions ??**