Neutrino Factory Front End (IDS)

Chicane update

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Outline

- Front End for the IDS Neutrino Factory
  - Losses - control
    - Chicane, proton absorber
    - rematching OK
  - Re-Match includes chicane + absorber
    - similar to baseline
    - less background beam
  - Discretized rf version
    - New today
    - fewer rf frequencies
Add chicane and absorber

- **ICOOL version**
  - 2 Bent Solenoids - 10m
  - 5m, 1.5T, 12.5°, 0.27GeV/c
  - 5m, 1.5T, -12.5°, 0.27GeV/c
    - bend radius is 22.92m (1/r=0.043636)
    - B_y=0

- **Be Absorber – 10cm thick**

- **ICOOL BSOL element:**

```plaintext
SREGION ! bentsol
5.0 1 1e-2
1 0. 1.0
BSOL
1 1.5 0.0 1 0.27 0.0 0.043636 0.0 0.0 0.0 0. 0. 0. 0. 0.
VAC
NONE
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
```

![Diagram](image-url)
Front End with Absorber-Rematch

with absorber

- particle 1-270 MeV/c
- particle 2-185 MeV/c
  - absorber at 29m
    - 10cm Be
    - particle 1-237 MeV/c
    - particle 2-144 MeV/c
  - Bunch N=10
  - Rotate N=10.045
  - Cool -201.25MHz
    - $p_{\text{ref}}=230$ MeV/c
This compares absorber only (10cm Be) to chicane (BSOL) + absorber

1.0 GeV/c

z=38m

z=137m

z=255m

z=38m

z=137m

z=255m
ICOOL Simulation results

- Similar to without absorber
  - ~10m shorter drift
  - ~10% fewer \( \mu \)'s within acceptance
  - drop of ~20% intensity at absorber
  - but longitudinal emittance also reduced
    - surviving \( \mu \)'s are stretched in longitudinal phase space

- To do
  - include chicane + absorber
  - establish beam loss improvement - \( \mu \) loss level
  - decide optimal configuration
Discretization Exercise

- Reduce number of frequencies to make implementation more “practical”
- Buncher is 33m (44 rf cavities)
  - reduce to 14 frequencies
  - 358.92, 341.02, 328.73, 317.27, 306.63, 296.65, 287.31, 278.53, 270.28, 262.50, 255.16, 248.21, 241.63, 235.40

- Rotator is 36m (48 rf cavities)
  - reduce to 18 frequencies
  - 231.55, 228.01, 224.87, 222.06, 219.60, 217.31, 214.82, 212.26, 210.10, 208.27, 206.75, 205.49, 204.47, 203.65, 203.03, 202.57, 202.28, 202.13

- Performance slightly reduced
  - more sensitive to rotator discretion
Rf Buncher/Rotator/Cooler requirements

- **Buncher**
  - 44 cavities (14 frequencies)
  - 13 power supplies (~1—3MW)

- **RF Rotator**
  - 48 cavities (18 frequencies)
  - 13 MV/m, 0.5m
  - ~2.5MW (peak power) per cavity

- **Cooling System – 201.25 MHz**
  - 100 0.5m cavities (75m cooler), 16MV/m
  - ~4MW/cavity - most expensive item

<table>
<thead>
<tr>
<th>Front End section</th>
<th>Length</th>
<th>#rf cavities</th>
<th>frequencies</th>
<th># of freq.</th>
<th>rf gradient</th>
<th>rf peak power requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buncher</td>
<td>33m</td>
<td>44</td>
<td>358.9 to 235.4</td>
<td>14</td>
<td>0 to 12</td>
<td>~1 to 6 MW/freq.</td>
</tr>
<tr>
<td>Rotator</td>
<td>36m</td>
<td>48</td>
<td>231.5 to 202.1</td>
<td>18</td>
<td>13</td>
<td>~2.5MW/cavity</td>
</tr>
<tr>
<td>Cooler</td>
<td>75m</td>
<td>100</td>
<td>201.25MHz</td>
<td>1</td>
<td>16 MV/m</td>
<td>~4MW/cavity</td>
</tr>
<tr>
<td>Total</td>
<td>~240m</td>
<td>192</td>
<td>201.25MHz</td>
<td>33</td>
<td>~1000MV</td>
<td>~550MW</td>
</tr>
</tbody>
</table>
Summary

- Neutrino Factory Front End:
  - Discretized version of front end + Chicane/absorber presented
  - 201.25 MHz version
Phone meetings ...

DILBERT

I CAN'T HEAR YOU. THERE'S TOO MUCH BACKGROUND NOISE AND ECHO ON YOUR END.

GERPLE MURMP

I SEE A SMUDGY THING THAT MIGHT BE YOUR HEAD, BUT I DON'T KNOW WHAT YOU'RE SAYING.

BY SCOTT ADAMS

YOUR ACCENT IS TOO THICK. I CAN'T...

MUWA FLAMEL GUAPEN

I DIDN'T UNDERSTAND WHAT YOU SAID, AND I CAN'T TELL WHICH ONE OF YOU IS TALKING.

WHY DON'T...

OKAY, YOU GO.

WHAT?

DID YOU SAY...

URGAM...

EKPLUM

MUNGOW

PLURB

YOU'RE ACTING AS IF I AGREED TO SOMETHING, BUT I DON'T EVEN KNOW WHAT THE TOPIC IS.

I SEE YOU WAVING GOODBYE, SO YOU MUST THINK WE'RE DONE.

WAS YOUR CALL A SUCCESS?

BETTER THAN ANYTHING I'VE DONE ALL WEEK.