RF Test of Standing Wave Deflecting Cavity with Minimized Level of Aberrations.

Poster THPO079

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Deflecting structures find applications for the bunch rotation with the purposes of diagnostic for the longitudinal distribution, the emittance exchange and the luminosity improvements in colliders. For these applications it should provide the minimal, as possible, own distortions in the original transverse emittance.
LEADING PHYSICAL IDEA

The concept was introduced at Linac 2012 Conference (TUPB002)

1 – keep the bunch closer to the cavity axis;
2 – minimize the level of nonlinear additives in deflecting field;
3 – improve RF efficiency.

\[ E_d = E_x - \beta Z_0 H_y, \quad Z_0 = \sqrt{\frac{\mu_0}{\epsilon_0}}, \]

\[ \delta \psi_d(z) = \psi_d(z) + \frac{\Theta_0 z}{d}, \quad \Psi_d = \max(|\delta \psi_d(z)|), \]

\[ E_{def}(z) = E_{d0} \cos(\psi_d(z)) \sim E_{d0}(1 - \frac{\Psi_d^2}{2}), \]

\[ E_{rot}(z) = E_{d0} \sin(\psi_d(z)) \sim E_{d0} \Psi_d, \]
# DESIGN PARAMETERS

## Table 1: Cavity design parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating frequency</td>
<td>MHz</td>
<td>2997.925</td>
</tr>
<tr>
<td>Energy of electrons</td>
<td>MeV</td>
<td>5</td>
</tr>
<tr>
<td>Operating phase advance</td>
<td>radian</td>
<td>π</td>
</tr>
<tr>
<td>Active cavity length</td>
<td>mm</td>
<td>≈ 210</td>
</tr>
<tr>
<td>Total cavity length</td>
<td>mm</td>
<td>270</td>
</tr>
<tr>
<td>Calculated quality factor</td>
<td></td>
<td>12550</td>
</tr>
<tr>
<td>Maximal phase deviation</td>
<td>radian</td>
<td>0.033</td>
</tr>
<tr>
<td>Separation with nearest mode</td>
<td>MHz</td>
<td>13.68</td>
</tr>
<tr>
<td>Effective shunt impedance, DS</td>
<td>MOm</td>
<td>43.2</td>
</tr>
<tr>
<td>Effective shunt impedance, cavity</td>
<td>MOm</td>
<td>7.58</td>
</tr>
<tr>
<td>Input RF power</td>
<td>kW</td>
<td>5</td>
</tr>
<tr>
<td>Expected deflecting voltage</td>
<td>kV</td>
<td>190</td>
</tr>
</tbody>
</table>

- **Accepted deflecting structure**
- **Rms beam size, (0.06% $V_d(0.0)$**
- **Deflecting field along cavity axis**
- **Uniformity of deflection voltage**

![Deflecting field along cavity axis](image1)

![Uniformity of deflection voltage](image2)
CONSTRUCTION AND RF TUNING

Before brazing, manufactured CANDLE SRI, Yerevan

RF tuning, field distribution

1 2 3 4
100:100, 08:100, 04:99, 86

driving loops
3D printing
RF TEST

Cavity at the REGAE beam-line

RF amplifier

Control signal and signal from cavity
SUMMARY
For the first time was realized and RF tested the deflecting cavity specially optimized for minimal transverse emittance perturbation during rotation of bunch. These performances are requested in the facilities with unique bunch parameters. The successful test of the cavity at the nominal RF power was carried out. The cavity is ready for operation by purpose.
Thank You for attention!

For more details -

welcome to poster

THPO079!