SUPERFISH Calculation for the Rossendorf SRF Gun Cavity

- Field profiles for beam dynamic simulations
- RF simulations for cavity tuning
Rossendorf 3.5 cell cavity
### Generation of Input files for SUPERFISH

#### Elliptische Resonatoren - Inputparameter fuer SUPERFISH

<table>
<thead>
<tr>
<th>Auswahl</th>
<th>Parameter (in mm)</th>
<th>Ergebnisse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonator-Typ</td>
<td>Z0</td>
<td>12.65</td>
</tr>
<tr>
<td>Variante</td>
<td>Z1</td>
<td>25</td>
</tr>
<tr>
<td>3.5 Zellen ohne Kühle</td>
<td>R1</td>
<td>102577</td>
</tr>
<tr>
<td></td>
<td>R2</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>a1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>b1</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>a0</td>
<td>11.396</td>
</tr>
<tr>
<td></td>
<td>a0</td>
<td>11.396</td>
</tr>
<tr>
<td></td>
<td>R0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>d0</td>
<td>30</td>
</tr>
</tbody>
</table>

### Notes

- The image shows a software interface for generating input files for the SUPERFISH program.
- The interface includes a table with parameters for elliptical resonators.
- The software is used to input specific geometrical parameters for the resonators.

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**Explanation of Parameters**

- **Z0, Z1, Z2, Z4**: These are likely the lengths or distances in the resonator design.
- **R1, R2**: Possibly the radii of curvature or other dimensions.
- **a2, a4**: These could be related to the aspect ratios or other geometric proportions.
- **b2**: This might be a secondary dimension.
- **LTube**: The length of the tube in the resonator design.
- **P0, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13**: These could represent specific points or outputs in the design process.

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**Usage**

This software is likely used by engineers or scientists to design and simulate resonators for various applications, such as in microwave or RF systems.
Electric axis fields for ASTRA simulation

![Graph showing electric axis fields with various positions and without cathode.](image-url)
Pass band frequencies and field profiles of detuned cavity
Tuned Gun cavity

<table>
<thead>
<tr>
<th>Moden</th>
<th>1/4(\pi)</th>
<th>2/4(\pi)</th>
<th>3/4(\pi)</th>
<th>(\pi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequenz / MHz</td>
<td>1265.98</td>
<td>1280.66</td>
<td>1292.53</td>
<td>1297.88</td>
</tr>
<tr>
<td>Amplitude Zelle 1 (Halbzelle)</td>
<td>4.17</td>
<td>-3.96</td>
<td>-1.68</td>
<td>-1.24</td>
</tr>
<tr>
<td>Zelle 2</td>
<td>2.46</td>
<td>0.47</td>
<td>1.94</td>
<td>1.92</td>
</tr>
<tr>
<td>Zelle 3</td>
<td>0.81</td>
<td>2.53</td>
<td>0.42</td>
<td>-1.89</td>
</tr>
<tr>
<td>Zelle 4 (Endzelle)</td>
<td>0.19</td>
<td>1.45</td>
<td>-2.49</td>
<td>1.85</td>
</tr>
</tbody>
</table>
df/dL = 2.06 MHz/mm

df/dL = 2.31 MHz/mm

df/dL = 6.32 MHz/mm

TESLA-Cavity: 0.315 MHz/mm (Aune et al., 2000)
For one cell: 2.84 MHz/mm
\[
\begin{pmatrix}
1 + k_{12} & -k_{12} & 0 & 0 \\
-k_{21} & 1 + k_{21} + k & -k & 0 \\
0 & -k & 1 + 2k & 0 \\
0 & 0 & -k & 1 + k
\end{pmatrix}
\begin{pmatrix}
I_1 \\
I_2 \\
I_3 \\
I_4
\end{pmatrix}
= \lambda
\begin{pmatrix}
I_1 \\
I_2 \\
I_3 \\
I_4
\end{pmatrix}
\]

\[
\lambda_{n/4\pi} = \left( \frac{f_{n/4\pi}}{f_0} \right)^2
\]

**Tuning**

\[
(L + P)X_\pi = \lambda_\pi X_\pi
\]

\[
X_\pi = \begin{pmatrix}
0.6 \\
-1 \\
1 \\
-1
\end{pmatrix}
\]

\[
P = \begin{pmatrix}
-0.042 & 0 & 0 & 0 \\
0 & -0.005 & 0 & 0 \\
0 & 0 & 0.000 & 0 \\
0 & 0 & 0 & 0.019
\end{pmatrix}
\]

\[
\Delta f_4 = 11.90 MHz, \quad \Delta L = 5.78 mm
\]

\[
\Delta f_2 = -3.13 MHz, \quad \Delta L = -1.35 mm
\]

\[
\Delta f_1 = -26.32 MHz, \quad \Delta L = -4.16 mm
\]
1.1 GHz 3.5-Zellen-Gun-Resonator, komplet

\[ \pi \text{-mode} \]

- electric field / a.u.
- \( z / \text{cm} \)

**Graphical Information:**
- Graph showing electric field (a.u.) vs. \( z / \text{cm} \).
-峰值频率：所有单元 \( f = 1276.72 \text{ MHz} \).
gun resonator (gun4165c.af, 30.05.2005)
gun cell frequency 1276.72 MHz

\[ \pi \text{-mode} \]
1.1 GHz 3.5-cellen-Gun-Resonator, komplett $f = 1297.3636$ MHz

Graph showing the electric field in a.u. along the z-axis in cm, with a peak at $\pi$-mode.