1.1 General method for RF cavity design
- Generate the basic parameters of acceleration cell.
- Optimization of the cavity structure.
- Study of the beam dynamics with the field from RF analysis.

Some time consuming iterations are necessary to obtain reasonable solution.

1.2 Code for design of periodic acceleration structure
- Based on VBA and CST EM Studio.
- The 3-m-long section electrode with trapezoidal modulation of a deuteron beam RFQ has been designed by this code.

Table 1: Main parameters for deuteron beam RFQ.

<table>
<thead>
<tr>
<th>Parameter/Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Energy</td>
<td>20 keV/u</td>
</tr>
<tr>
<td>Output Energy</td>
<td>1.7 MeV/u</td>
</tr>
<tr>
<td>Frequency</td>
<td>162.5 MHz</td>
</tr>
<tr>
<td>Vane Voltage</td>
<td>65 kV</td>
</tr>
<tr>
<td>Average Radius</td>
<td>4.8 mm</td>
</tr>
<tr>
<td>Length</td>
<td>5.25 m</td>
</tr>
<tr>
<td>Bunching</td>
<td>Internal</td>
</tr>
</tbody>
</table>

Five segments.
The last 3.25-m-long section will use trapezoidal modulation.

1.3 Advantages
- Implement repetitive work by code.
- Open-ended and extensible.
- Can be used to design other periodic acceleration structures.
- Can be used for special structures.

(2) The Design of Deuteron Beam RFQ

The Design of RFQ Electrode with Trapezoidal Modulation

1997 IHEP [1]
2012 Argonne [2]

(3) The Design of RFQ Electrode with Trapezoidal Modulation

Figure 2: The longitudinal section of one cell trapezoidal modulation RFQ electrode and the 3D model.

Figure 3: The axial component of the electrostatic field for different proportion of the flat part.

Figure 4: Parameter sweep of trapezoidal modulation factor (L=30 mm).

Figure 6: (a) phase difference between cells before adjustment (b) phase difference between cells after adjustment (c) energy at the exit of each cell (d) ultimate cell length of each cell.

Length 3252 mm
74 cells

(4) Fabrication Test

Figure 8: Substitute the sinusoidal transition part by two arcs and their internal common tangent.

Figure 9: Fabrication and measurement of the trapezoidal modulation RFQ electrode.