BEAM DYNAMICS INVESTIGATION FOR A NEW PROJECT OF COMPTON BACK SCATTERING PHOTON SOURCE AT NRNU MEPhI


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COMPACT RING-BASED LIGHT SOURCE

Required e-beam parameters

\( \varepsilon_{x,rms} = 100 \text{ nm} \)

\( \sigma_{x,rms} = 30 \text{ um} \)

Straight section length > 1.5 m

Beam energy: 20-60 MeV

\[ \beta_x = \frac{\sigma_{x,rms}^2}{\varepsilon_{x,rms}} \]

\[ \sigma_{x,rms}^2 = \beta_x \varepsilon_{x,rms} + D_x^2 \left[ \left( p - p_0 \right) / p_0 \right] \]

\( D_x = 0 \)
Momentum compactification factor - 0.0671
frequency - 4.1 MHz
circumference - 10,568 m
νₓ = 3.545; νᵧ = 4.931
ξₓ = -12,564; ξᵧ = 4,937
Dynamic aperture

Momentum acceptance

$U = 300$ kV
LINAC INJECTOR

<table>
<thead>
<tr>
<th>Cells</th>
<th>E, kV/cm</th>
<th>$\phi_{inj}$</th>
<th>$W_{max}$, MeV</th>
<th>$\Delta W/W$, %</th>
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</thead>
<tbody>
<tr>
<td>3.5</td>
<td>600</td>
<td>2.0</td>
<td>6.2</td>
<td>1.8</td>
</tr>
<tr>
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<tr>
<td>5.5</td>
<td>700</td>
<td>2.8</td>
<td>8.2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

S.M. Polozov, V.I. Rashchikov, M. Krasilnikov. An Improved Model for Photoemission of Space Charge Dominated Picosecond Electron Bunches: Theory and Experiment. IPAC-2021, ID: 1089
Second linac section: BAS ($L = 2.1$ m, 40 accelerating cells, RF field gradient is 400 kV/cm: RF power supply is 20 kW), energy gain is about 45 MeV

Particle distribution in longitudinal phase space and energy spectrum of electrons (duration 1 ps) after 5.5-cell-photogun and BAS
Thank you for attention