Overview:

• Mechanical Assembly

• Magnetic Measurements
  Pole Height / Trajectory Optimization
  Hor. Field Shimming
  Phase Adjustment

• Summary of Results
Phase 2 / I: SASE at 6 nm

Phase 2 / II: Seeding at 6 nm

6 Segments SASE 400-900

3 Segments SASE 100-300

6 Segments SASE 400-900
Specifications for TTF 2 Undulator Systems

Parameters:
• $E = 1\text{GeV}$
• $\lambda = 27.3 \text{ m}$
• $K \geq 1.2$
• $\lambda_{\text{Rad}} = 6\text{nm}$
• $\rho \approx 2 \times 10^{-3}$
• Gap $\geq 12\text{mm}$
• $L_{\text{Mag}} \approx 27\text{m}$

Requirements:
Trajectory Overlap: 20% of RMS beam size $\wedge 12\mu\text{m} \wedge 36 \text{Tmm}^2$
• Peak Field, K-Value of different segments to agree within $\rho$
• Phase match better $10^\circ$
• Hor. Field negligible
• Kick Errors $< 0.05 \text{Tmm}$
• Vertical Alignment $\cong 0.15 \text{mm}$
Trajectory Optimization of SASE 500

\[ I_{2,RMS} = \frac{B_{\text{peak}}}{\sqrt{2}} \left(\frac{\lambda}{2\pi}\right)^2 \]

\( \lambda = 27.3 \text{mm}, \ B_{\text{peak}} = 0.486 T \Rightarrow I_{2,RMS} = 6.5 T\text{mm}^2 \)

1 µV ≡ 1 µT over 5m corresponds to 12.5 T mm\(^2\)
Optical Phase

\[ \delta(x) = \frac{360^\circ}{\lambda} \left( \frac{x}{2\gamma^2} + \frac{\int z''(x')dx'}{2} \right) \]

\[ z'(x) = \frac{v_z}{c} = \frac{e}{\gamma mc} \left[ \int_{-\infty}^{x} B_y(x')dx' + C_0 \right] = \frac{.3 I_1[Tmm]}{E[MeV]} = .586 \frac{I_1[Tmm]}{\gamma} \]

\[ \delta(x) = \frac{360^\circ}{\lambda_0(1 + 0.5K^2)} \left[ x + \left( \frac{e}{mc} \right)^2 \int_{-\infty}^{x} \left[ \int_{-\infty}^{x''} B_y(x')dx' + C_0 \right] dx'' \right] \]

\(?_0: \text{Radiation wavelength}\)

\(?_0: \text{Undulator period length}\)

\(K: \text{Undulator } K\text{-parameter}\)

\(?: \text{relativistic factor for } 1\text{GeV }\neq 1956\)

e: electron charge; m: electron mass; c: Velocity of light
Phase Jitter and Field Errors

\[ \lambda = 6\text{nm} \]
\[ E = 1000\text{MeV} \]

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<thead>
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<th>Fieldintegral Error [Tmm]</th>
<th>Phase Error / Meter [°]</th>
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Results for SASE 500

Gap 12.4 mm
Peak Field: 0.48591 T
K-Parameter: 1.2285
ΔB/B: 0.0047
$B_Y$ 2nd Fieldintegral: 6.74 Tmm² RMS
$B_7$ 2nd Fieldintegral: 1.43 Tmm² RMS