CSR in the RTL of SuperKEKB

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Acknowledgements:

N. Iida

Emittance preservation task force meeting, Sep. 13, 2018
1. Single-bunch effects: Longitudinal: CSR

➤ CSR at RTL of SuperKEKB

- Impedance calculated by CSRZ
- Chamber: \( w=90 \) mm, \( h=21 \) mm, \( R=7.71 \) (BSE1), \( 4.75 \) (BRS), \( 3.36 \) (BL1S&BL2S), \( 3.64 \) (BC1E2) m
- RMS bunch length: 23 ps - 2 ps
- Maximum bunch charge: 4-8nC

<table>
<thead>
<tr>
<th>DR design</th>
<th>Injection</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \varepsilon_x(nm) )</td>
<td>1300</td>
<td>41.5</td>
</tr>
<tr>
<td>( \varepsilon_y(nm) )</td>
<td>1200</td>
<td>2.1</td>
</tr>
<tr>
<td>( \sigma_x(mm) )</td>
<td>( \pm 30^* )</td>
<td>6.6</td>
</tr>
<tr>
<td>( \sigma_\delta(%) )</td>
<td>( \pm 1.5^* )</td>
<td>0.055</td>
</tr>
</tbody>
</table>

* Full width

Positron Target+FC

N. Iida, KEKB MAC’18
1. Single-bunch effects: Longitudinal: CSR

➤ CSR at RTL of SuperKEKB

● Dispersions in dipoles create emittance exchange between X and Z directions
1. Single-bunch effects: Longitudinal: CSR

- **CSR at BSE1:**
  - Gaussian bunch $\sigma_z=6.35$ mm, $V_{rf}=21.5$ MV, $Q=0.7$ nC
1. Single-bunch effects: Longitudinal: CSR

➤ CSR at BRS.{1,2,3}:

- Gaussian bunch $\sigma_z \sim 6.25$ mm, $V_{rf}=21.5$ MV, $Q=0.7$ nC
1. Single-bunch effects: Longitudinal: CSR

➤ CSR at BL1S.\{1,2\}:

- Gaussian bunch $\sigma_z \sim 5$ mm, $V_{rf}=21.5$ MV, $Q=0.7$ nC
1. Single-bunch effects: Longitudinal: CSR

- CSR at BL2S.1:
  - Gaussian bunch \( \sigma_z \approx 2.5 \text{ mm}, V_{rf}=21.5 \text{ MV}, Q=0.7 \text{ nC} \)
1. Single-bunch effects: Longitudinal: CSR

➤ CSR at BL2S.2:

- Gaussian bunch $\sigma_z \sim 0.64$ mm, $V_{rf}=21.5$ MV, $Q=0.7$ nC
- Question: Factor of 2 missing? Need debugging the code
1. Single-bunch effects: Longitudinal: CSR

➤ Tracking without CSR:

● Initial distribution
1. Single-bunch effects: Longitudinal: CSR

➤ Tracking without CSR:

- Distribution at end of RTL
1. Single-bunch effects: Longitudinal: CSR

➤ Tracking without CSR:
  ● Distribution at end of RTL
1. Single-bunch effects: Longitudinal: CSR

- Tracking with CSR:
  - Distribution at end of RTL
1. Single-bunch effects: Longitudinal: CSR

➤ Tracking with CSR:
  - Distribution at end of RTL
1. Single-bunch effects: Longitudinal: CSR

- Tracking without and with CSR:
  - Without CSR
    
    \[
    \begin{align*}
    \text{exrms} &= 41.27557207522119 \text{ nm}, \quad g^{*}\text{exrms} = 88851.52501515325 \text{ nm} \\
    \text{eyrms} &= 3.0551130965656372 \text{ nm}, \quad g^{*}\text{eyrms} = 6576.564395738163 \text{ nm} \\
    \text{CSIX}/2 &= 41.27639663315544 \text{ nm} \\
    \text{CSIY}/2 &= 3.0552498794652325 \text{ nm} \\
    \end{align*}
    \]

  - With CSR
    
    \[
    \begin{align*}
    \text{exrms} &= 41.27582134597261 \text{ nm}, \quad g^{*}\text{exrms} = 88852.06160581189 \text{ nm} \\
    \text{eyrms} &= 3.055113117415658 \text{ nm}, \quad g^{*}\text{eyrms} = 6576.564440620791 \text{ nm} \\
    \text{CSIX}/2 &= 41.27664770159706 \text{ nm} \\
    \text{CSIY}/2 &= 3.0552498903791276 \text{ nm} \\
    \end{align*}
    \]
2. Summary

➤ First tracking with CSR done
➤ Need further debugging of the code