Updated transverse SPS wake and impedance model

Mario Beck – BE-ABP-HSC section meeting - 03.12.2018
Updated SPS IW model

• Code in Python *(Python 3 compatible)*
• Available on GitLab *(you have to be signed in)*
  https://gitlab.cern.ch/IRIS/SPS_IW_model/
• Three versions: 2015, 2018, Post LS2
• Available for three optics *(Q20, Q22, Q26)*
• Wake model file in PyHEADTAIL input format
The model versions I

• 2015 version (legacy):
  • 8 MKEs with 200mm long serigraphy
  • No ZS not included
  • Code reproduces legacy (Matlab) model

• 2018 version:
  • 7 MKEs with 180mm long serigraphy
    (one kicker was removed end of 2015)
  • MKE and MKP model updated
  • ZS included
The model versions II

- Post LS2 version:
  - 7 MKEs with 180mm long serigraphy
  - MKE and MKP model updated
  - ZS with upgrades foreseen for LS2
  - Flanges excluded (shielded)
    (The shielding of the flanges is assumed to be perfect. In reality not all flanges are shielded and the shielding might not be perfect.)
  - An additional MKDV (dump kicker) is included
    (With the moving of the beam dump from LSS1 to LSS5 an additional MKDV will be installed. The MKDS are installed in the same position of the sextant so their $\beta$-values should stay the same.)
## Model versions (overview)

<table>
<thead>
<tr>
<th>Version:</th>
<th>2015 (legacy)</th>
<th>2018</th>
<th>Post LS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of MKE</td>
<td>8</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>MKE ser. Length</td>
<td>200mm</td>
<td>180mm</td>
<td>180mm</td>
</tr>
<tr>
<td>MKE/MKP model</td>
<td>first model</td>
<td>updated model</td>
<td>updated model</td>
</tr>
<tr>
<td>Number of MKDV</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Flanges</td>
<td>included</td>
<td>included</td>
<td>shielded</td>
</tr>
<tr>
<td>ZS version</td>
<td>not included</td>
<td>pre LS2 version</td>
<td>post LS2 version</td>
</tr>
</tbody>
</table>

Components included in the model:

Flanges, BPH-H, BPH-V, RF200, RF800, MKQ kicker, MKD kicker, MKE kicker, MKP kicker, transitions, resistive wall, ZS
Create the model

- Run the script:
  ```bash
  $ python SPS_wake_model.py
  ```

- Choose the version:
  ```
  Choose the version of the SPS wake model:
  Type 0 for the 2015 version (legacy),
  type 1 for the 2018 version,
  type 2 for the PostLS2 version:
  ```

- Choose the optics:
  ```
  Choose the optics:
  Type 0 for Q20,
  type 1 for Q22,
  type 2 for Q26:
  ```

- Choose what to include:
  ```
  Type 0 for the full SPS model,
  type 1 for interactive building of the model:
  ```

- The file containing the model is created:
  ```
  File 'SPS_complete_wake_model_2018_Q26.txt' has been created.
  ```
Create the model

A figure with the model opens:

- Run
- Choose
- Choose
- Choose

The file containing the model is created:

03/10/2018
Updated transverse SPS IW model
Validation of the model

The TMCI threshold in Q22 is reproduced

The effect of the kicker removed in 2015 is reproduced in simulations
Thanks for your attention!
Additional information

- Transitions: Simplified CST model, contributions weighted with corresponding $\beta$-values
- Enameled Flanges: Introduce a cavity and thus contribute to the broadband impedance
- Wall: Different chamber apertures are calculated analytically (calculated for a round beam pipe and adapted by form factors) and weighted with individual $\beta$-values. Indirect space charge (ISC)