SPS Wideband Transverse Kicker

Development and Plan

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Kicker Design Contributors:

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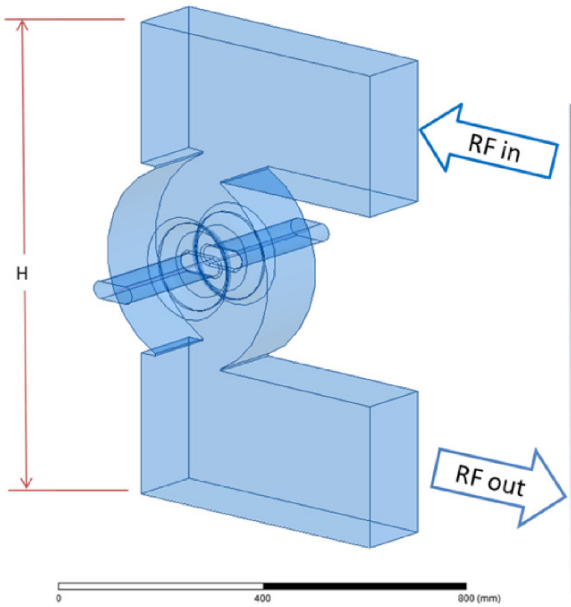
Need for a Wideband Kicker

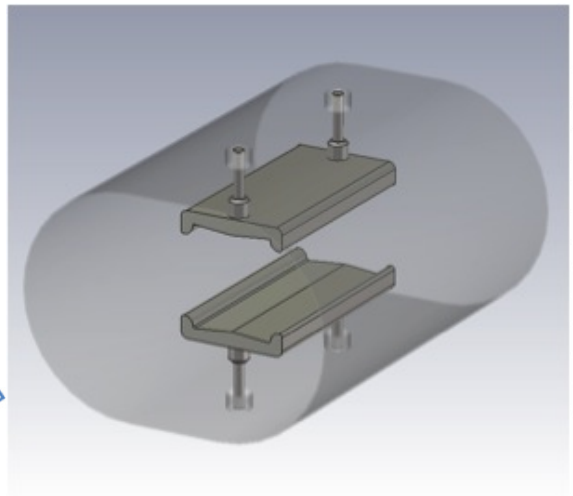
- Establish a baseline for implementation of a vertical kicker system in the super proton synchrotron (SPS)
- Kicker coverage of 1 GHz bandwidth is necessary for intra-bunch dynamics control.
- Investigate three types of structures: cavity, stripline, slotline
- Review, evaluate, and determine the capabilities of several possible implementations with the criteria:

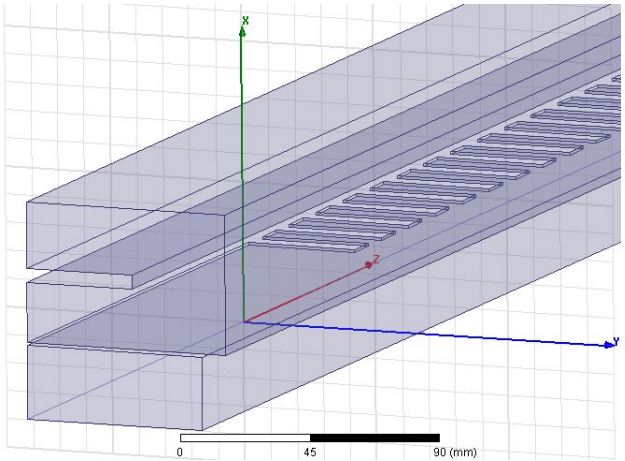
1. Shunt impedance
2. Beam coupling broadband impedance
3. Bandwidth
4. Heating issues
5. Fabrication complexity & complications
6. Vacuum chamber compatibility
7. Ease of coupling to external amplifiers

- Design report to include analysis of each structure and recommendation path for fabrication.

Kicker Structures







Cavity

- Narrowband, high shunt impedance
- Several needed. Requires N parallel channels.
- Requires filling time, utilize 25 ns separation between bunches

Stripline

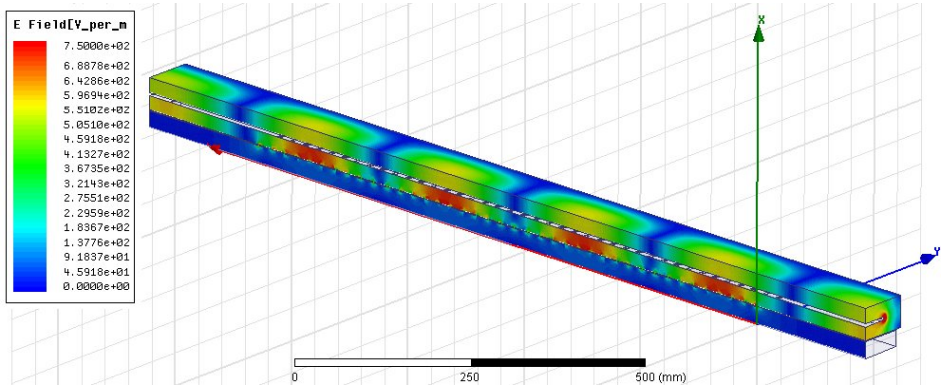
- Broadband, length tailored to meet shunt impedance and bandwidth needs
- High response at DC, but rolls off with frequency
- Must be used in arrays

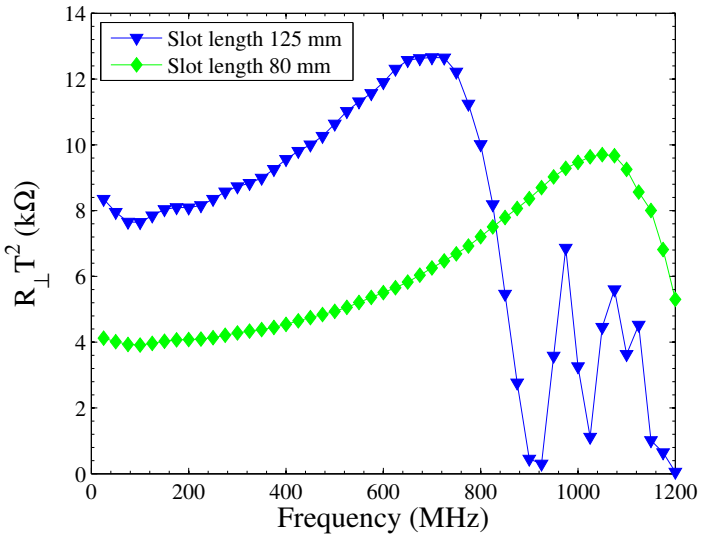
Slotline

- Slotted-coaxial kicker broadband, high shunt impedance
- Only one kicker needed
- Drive signal co-propagates with the bunch

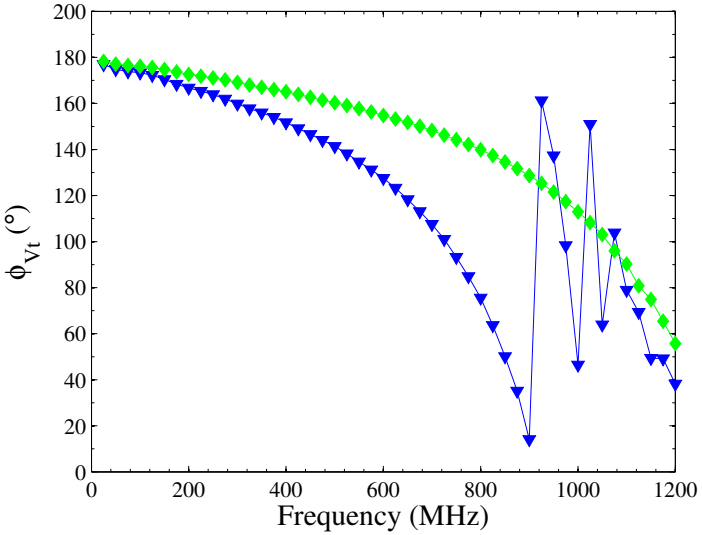
Slotted Kicker - Coaxial, Shunt Impedance

E-field at 500 MHz





- Very good band coverage for nearly DC to over 1 GHz
- High shunt impedance (1000s Ω) over entire operating band!
- Voltage phase response linear or near linear
- Very promising candidate with desirable characteristics and compatible with the signal processing formalism.



Conceptual Design Report

- Each structure has been simulated and analyzed, for results see the references
- The stripline and slotline have been further optimized since they are most compatible with single processing channel path
- Results from all alternatives will be included in the report
- A recommendation will be made of the type of structure(s) CERN should prototype
- Once a design is chosen, more detailed mechanical design is necessary. LNF has shown interest in building a vacuum compatible prototype.
- Design report to be finished by the end of June
- A review of the kicker design is planned for the end of July.
- Goal: to have a prototype ready for installation into the SPS by June 2014

References

1. J. Cesaratto et al., 'A Wideband Slotted Kicker Design for SPS Transverse Intra-Bunch Feedback', IPAC13, Shanghai, China, 2013.
2. J. Cesaratto et al., 'SPS Wideband Transverse Kicker Evaluation and Design: Progress and Plans', LARP CM20, Napa, CA, 2013.
3. J. Cesaratto et al., 'SPS Kicker Design Study', LARP CM18, Fermilab, 2012.
4. S. De Santis et al., 'Study of a Wideband Feedback Kicker for the SPS,' IPAC'12, New Orleans, LA, USA, WEPPP074, p. 2882, 2012.
5. F. Marcellini et al., 'Deflecting cavity as kicker option for the SPS intra-bunch feedback system', LARP CM18, Fermilab, 2012.