C-Band Accelerator

- RF design and wakefield studies

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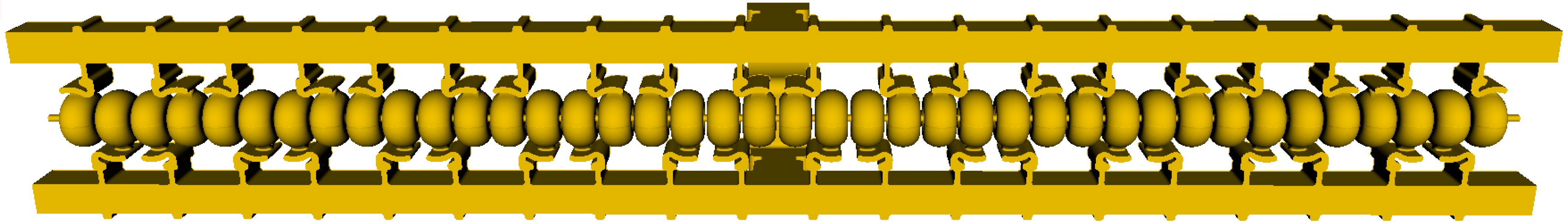
Outline

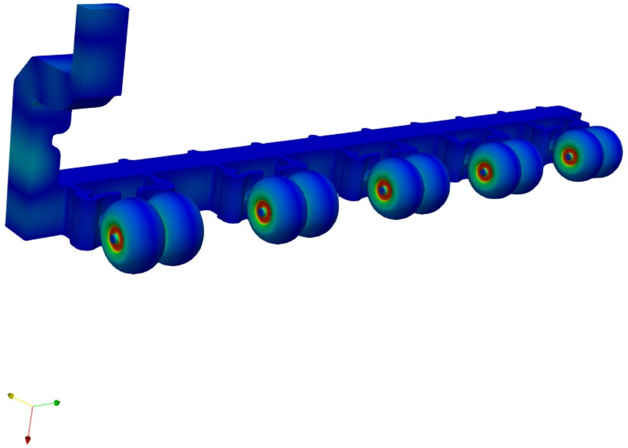
- Linac design with the Parallel Feed scheme
- High efficient cell shapes for parallel feed linac
- Short-range wakefield considerations
- Long-range wakefield damping studies

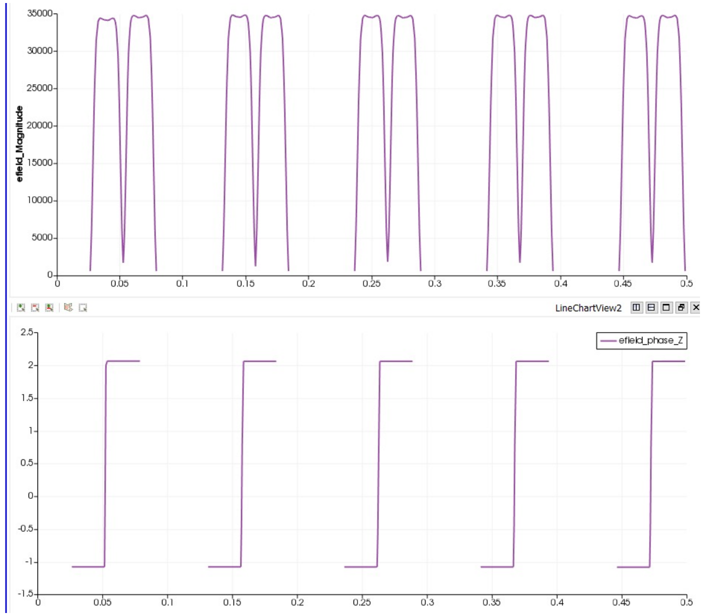
High efficient cell design enabled by parallel feed scheme



- Parallel Feed Structure
  - Cells fed individually
  - Feed waveguide distribute power equally to each cell at180 deg phase difference

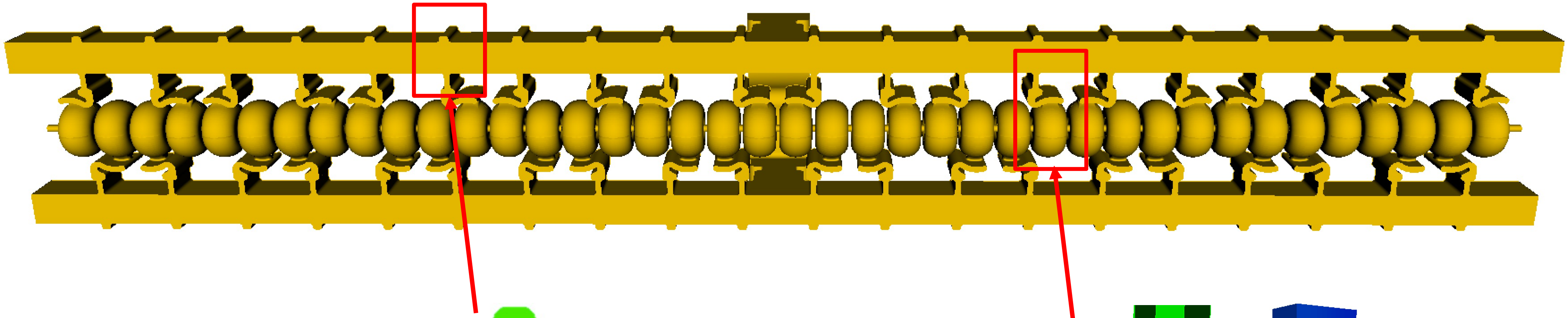
- Advantages
  - Iris radius not dictated by cell-2-cell coupling (short-range wakefield need to be under control)
  - Cell shape can be optimized to achieve higher efficiency Structure can be machine in two halves
  - Less power to achieve a given gradient
  - Structure tuning straight forward



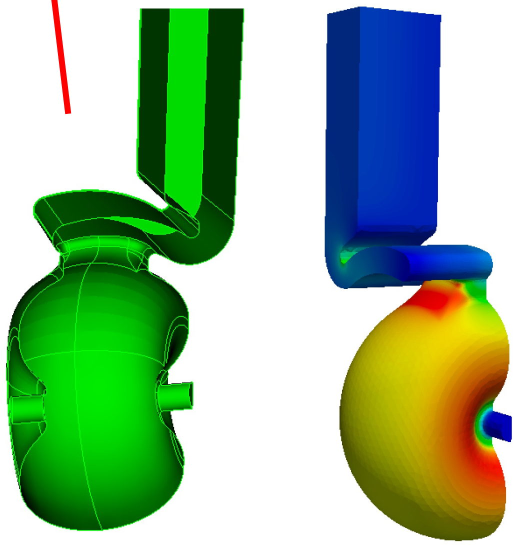


Field amplitude and phase of ¼ of 40-cell C-Band structure

Design of parallel feed structure



Two repeating elements need to be designed

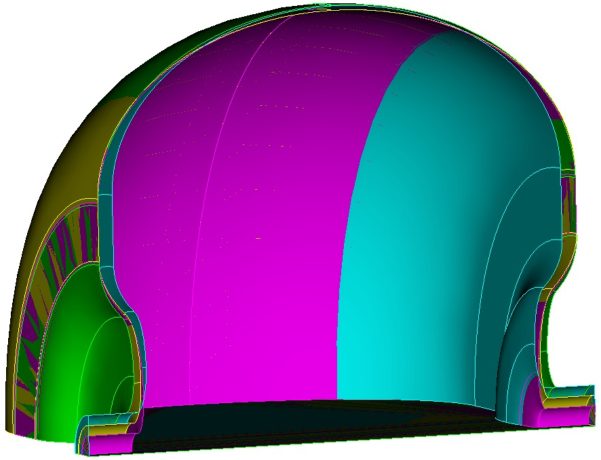


C-Band Cell Optimization

Maximized Shunt Impedance

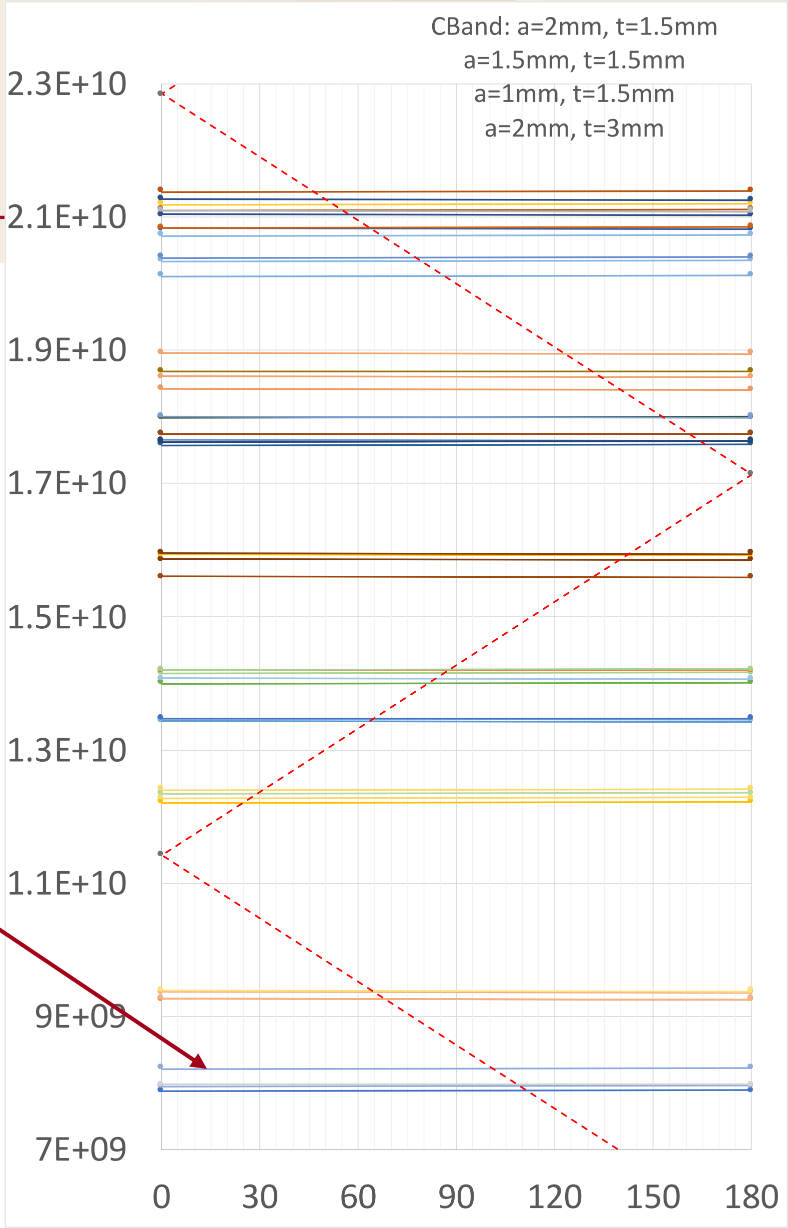
Variation of cell profile if dipole detuning needed

Sami Tantawi



1) a=2mm, t=1.5mm
2) a=1.5mm, t=1.5mm
3) a=1mm, t=1.5mm
4) a=2mm, t=3mm
5) a=2mm, t=2mm
6) a=2mm, t=4mm
7) a=2.5mm, t=1.5mm

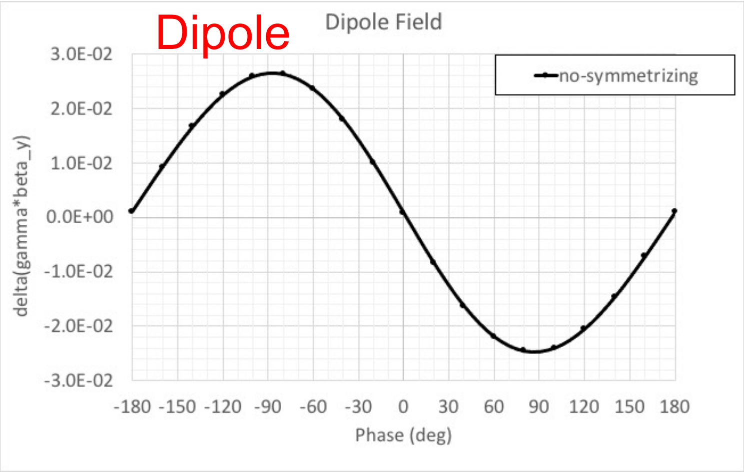
dF1=4.2%

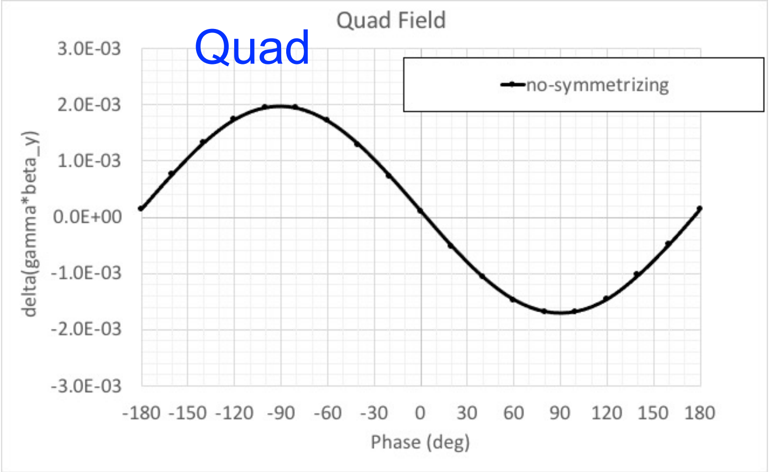


3D Field Symmetrization

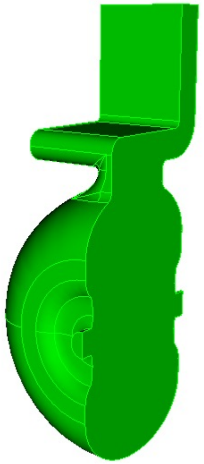
dipole, quad calculated at 50MV/m

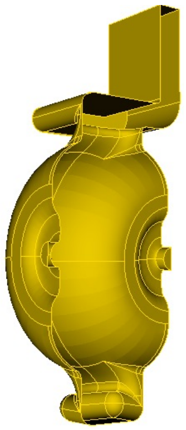
- Single side coupling induce significant dipole and quad fields
- 3D coupler symmetrized
  - Minimizes side effects of 3D acceleration fields
  - Minimizes electric center offset of HOMs



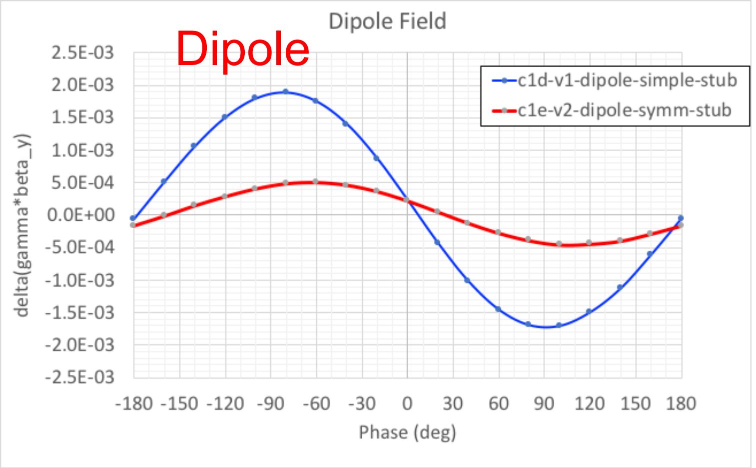


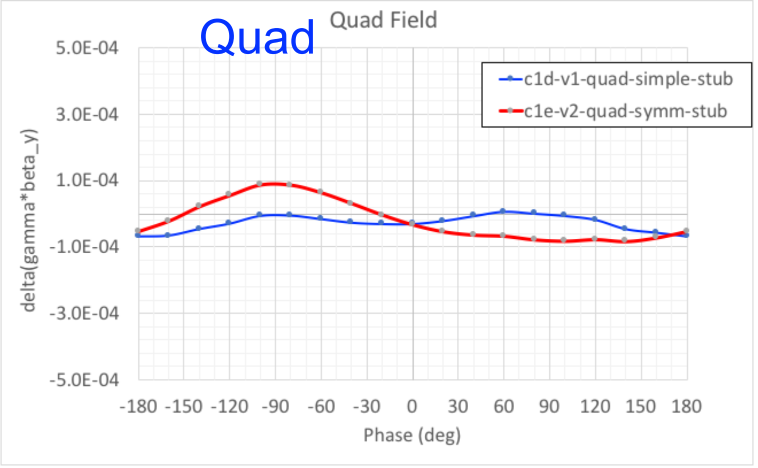
w/o symmetrization





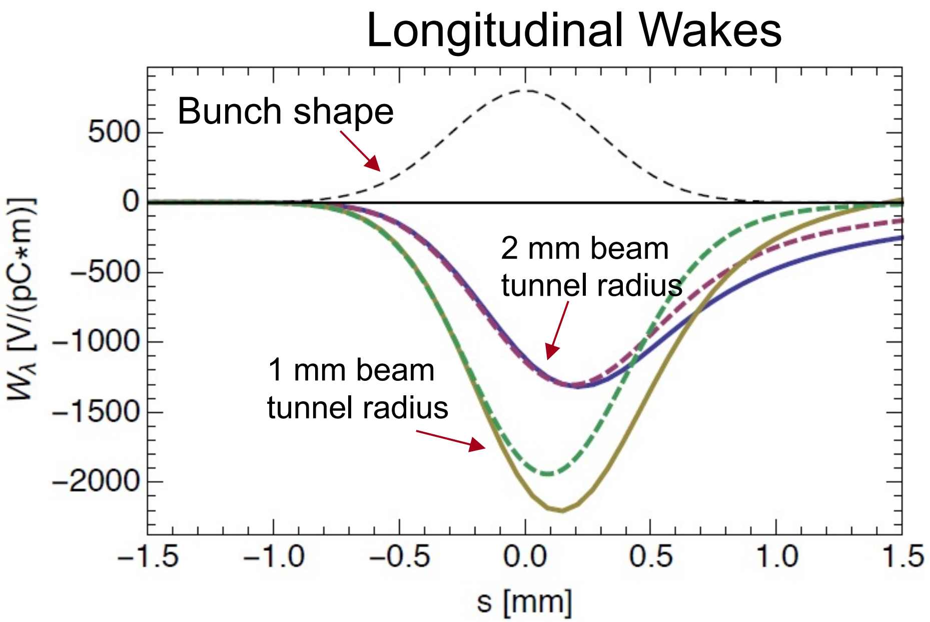
with symm-stub

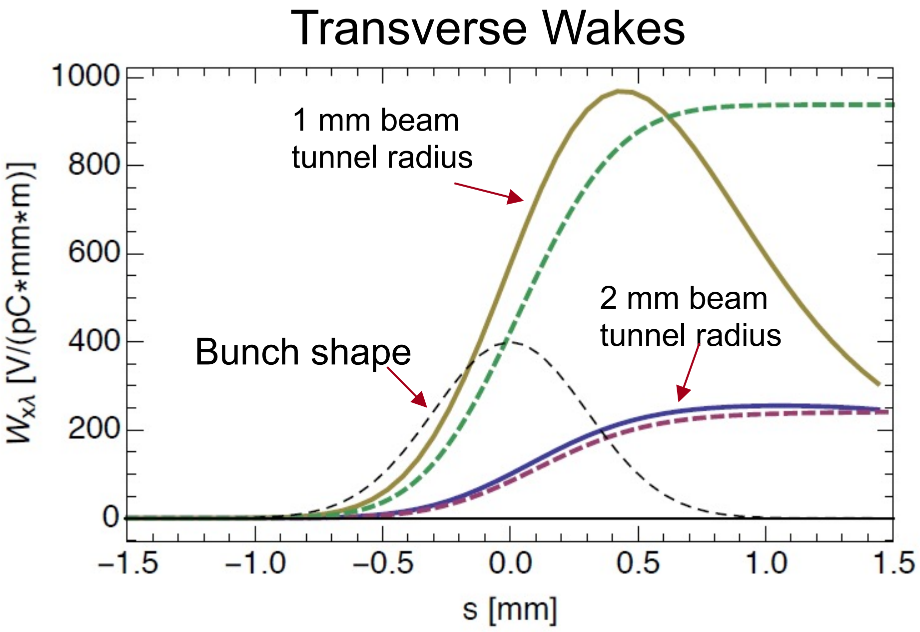




with symmetrization

Short range wake field analysis dictates beam aperture size

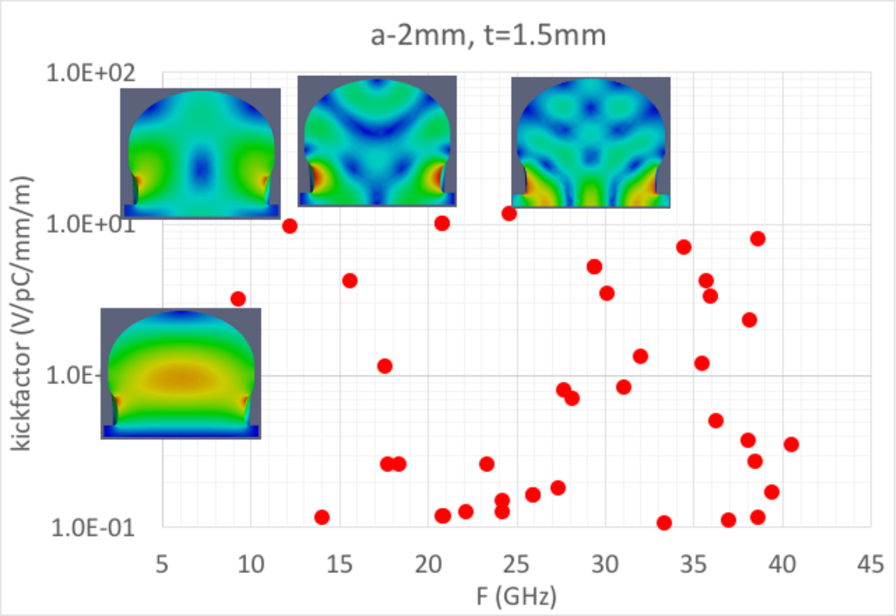




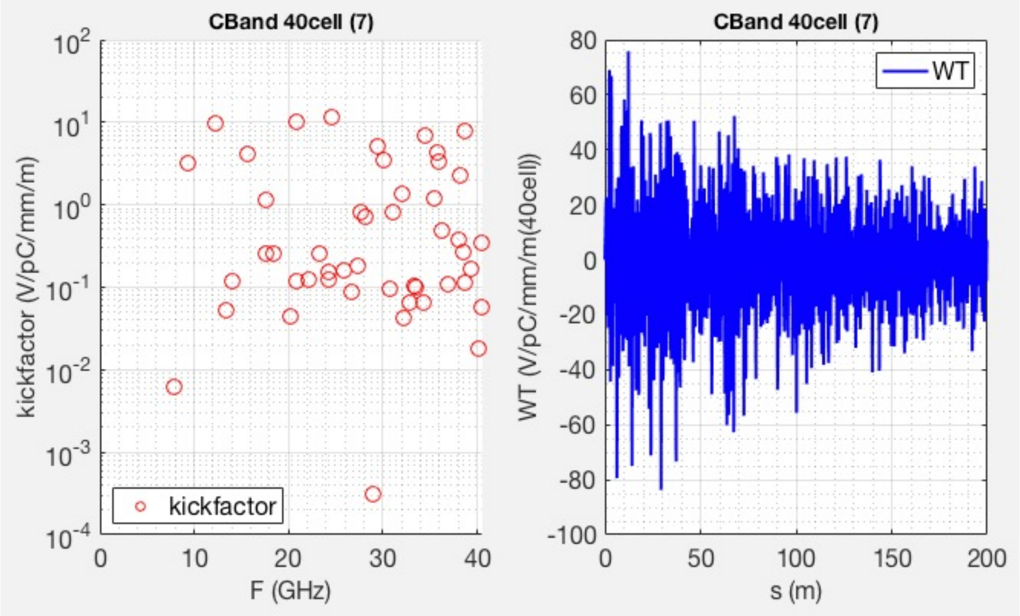
Karl Bane

ECHO wakes (solid) compared with model wakes (dashes).

Long-range Wakefield



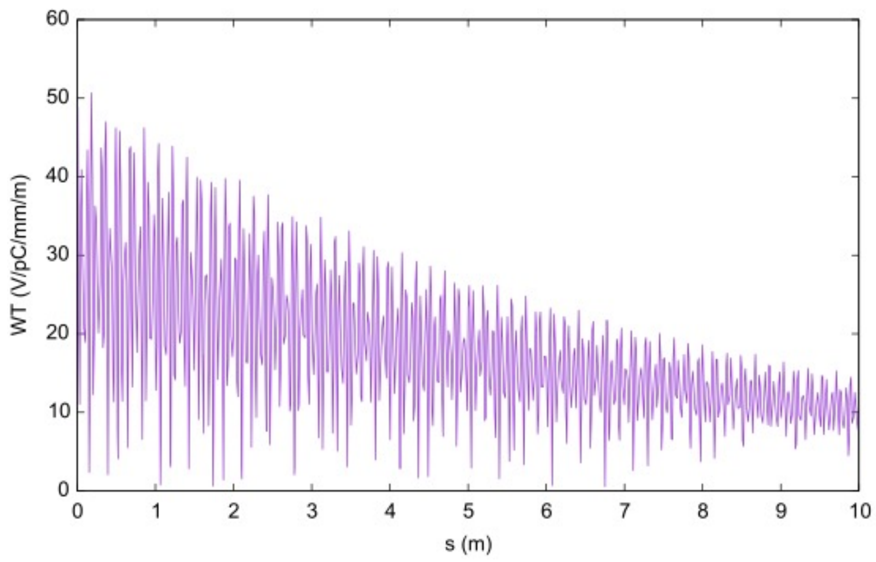
Dipole kickfactor of the CBand cell



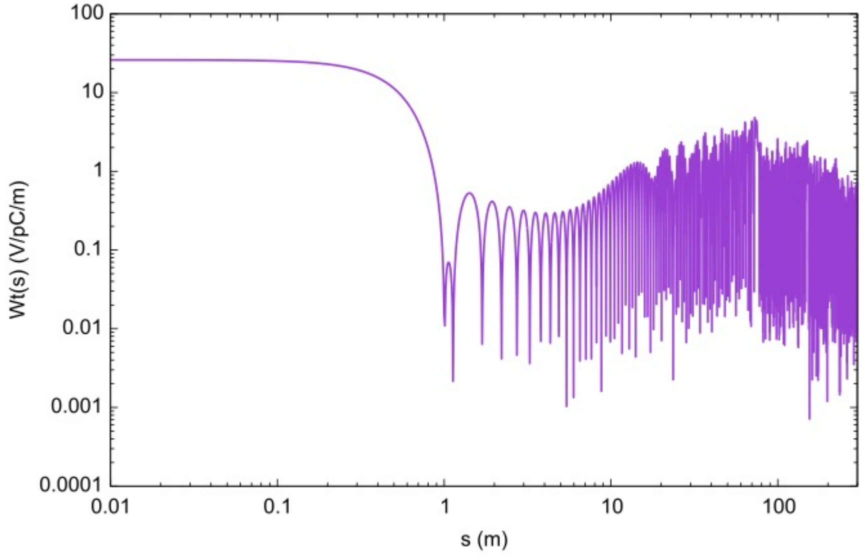
Wakefield of 1-m structure of 40 identical cells

- Dipole modes calculated up to beam tube cutoff frequency
- A 10 micron transverse bunch offset will produce a 28 V of transverse kick to the following bunch, e.g. ~0.006 mrad kick angle at the first structure of the linac (E_beam=5 MeV)

Dipole mode detuning for long bunch train acceleration



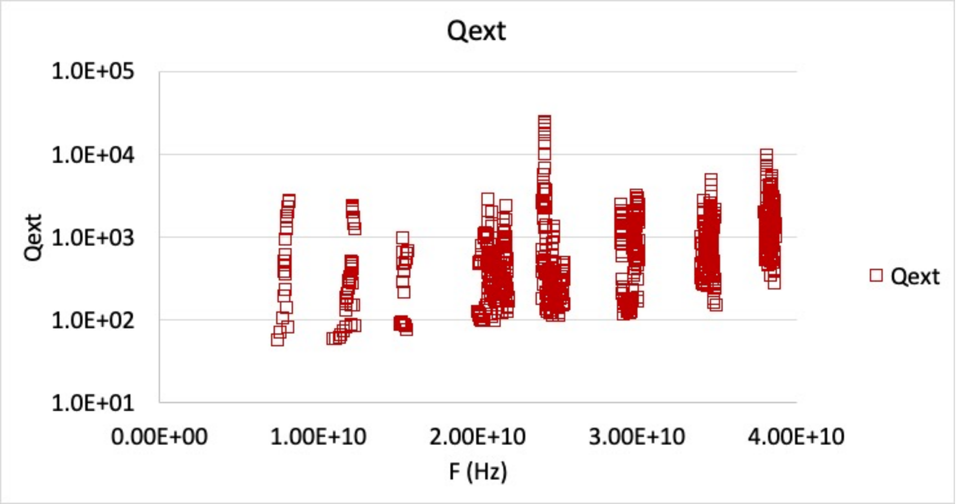
wakefield envelope without detuning

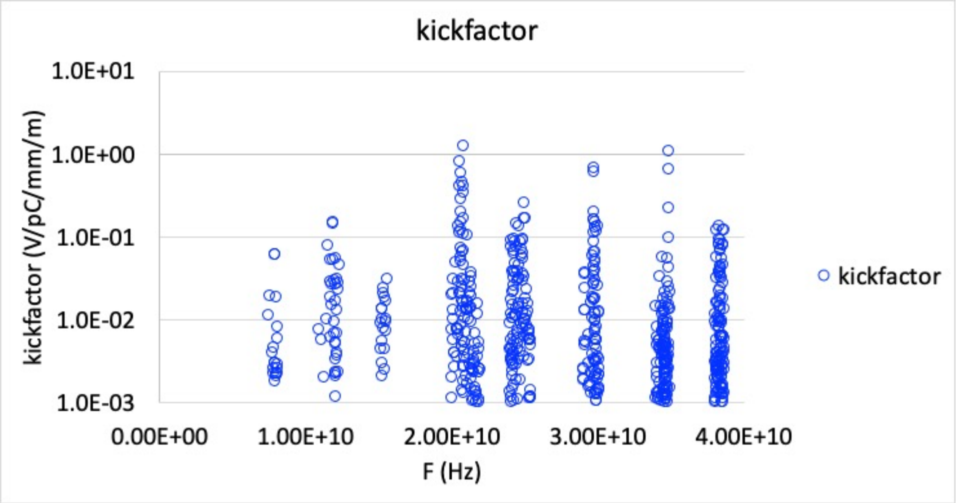


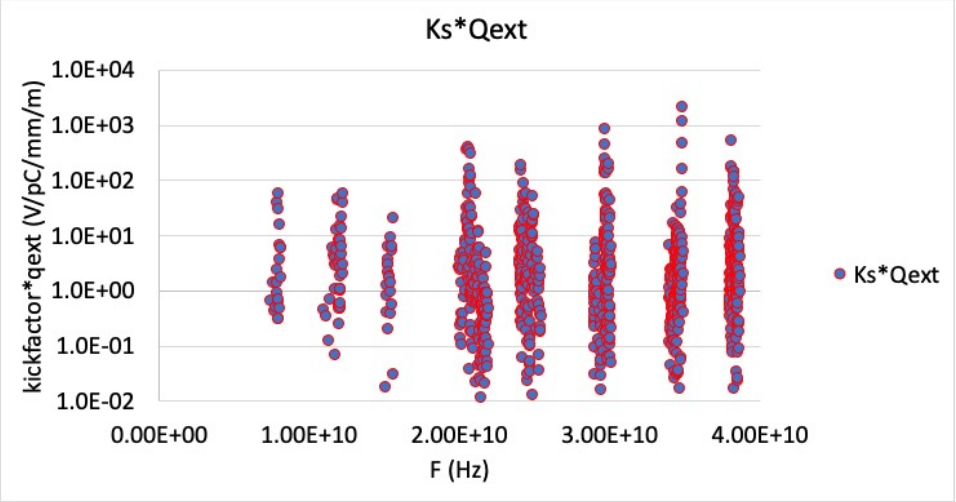
wakefield envelope with detuning

HOM damping study
parallel feed C-Band structures

- Structure machined in two halves
- Naturally can use a gap between the two halves to extract HOM power
- Additionally, add lossy surface in slot to absorb HOM power (sigma=5.8e4)



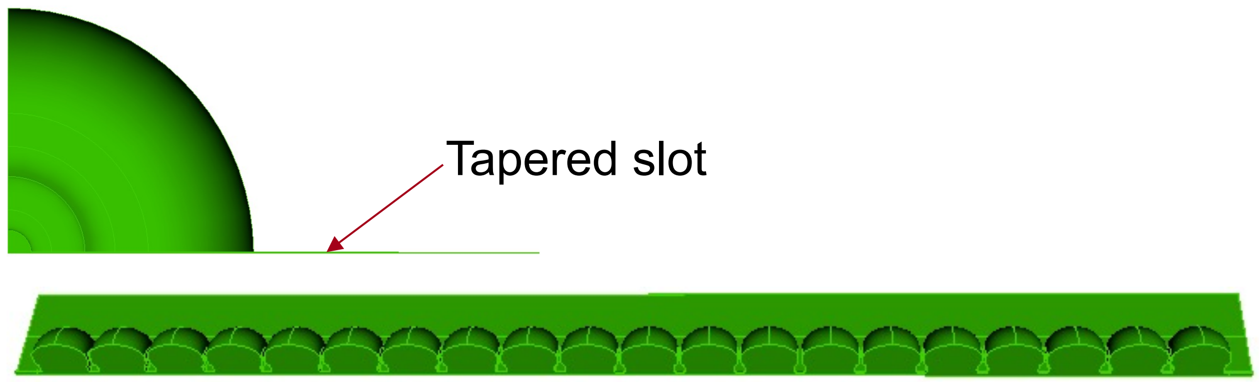


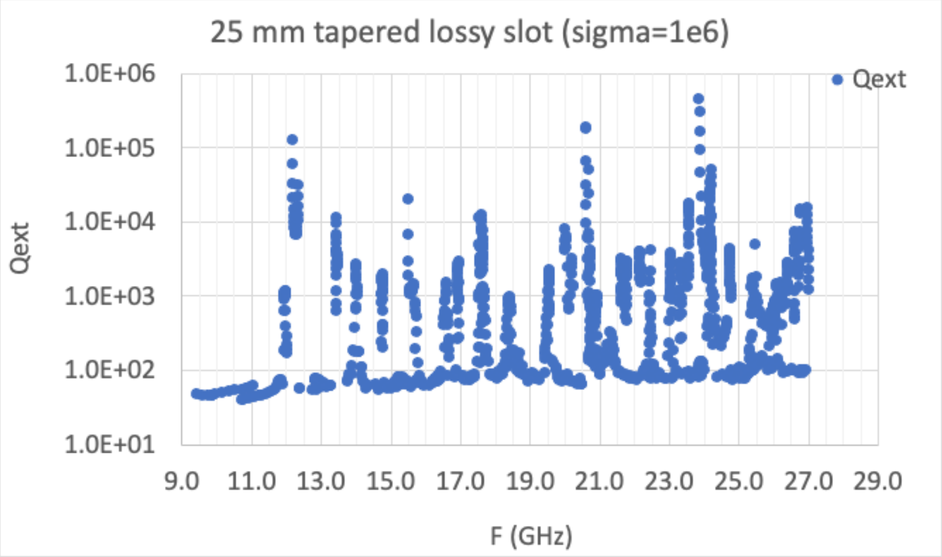


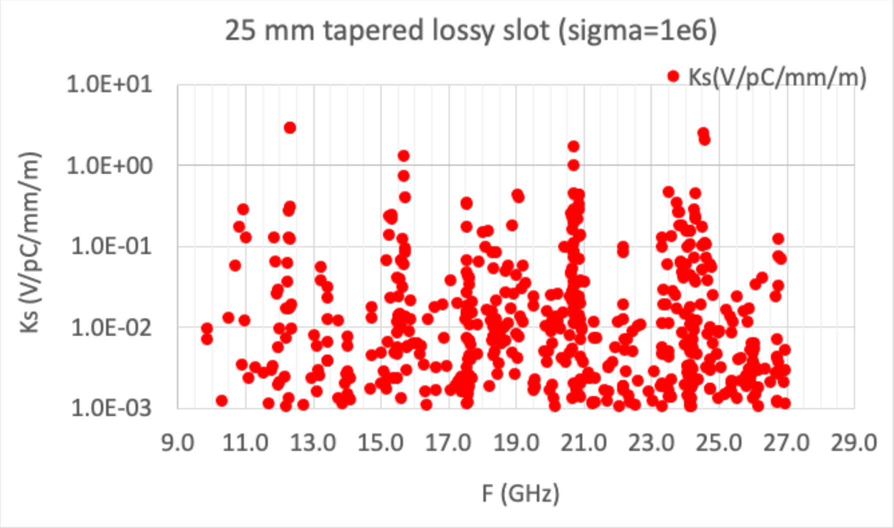
HOM Damping with Tapered Lossy Slot

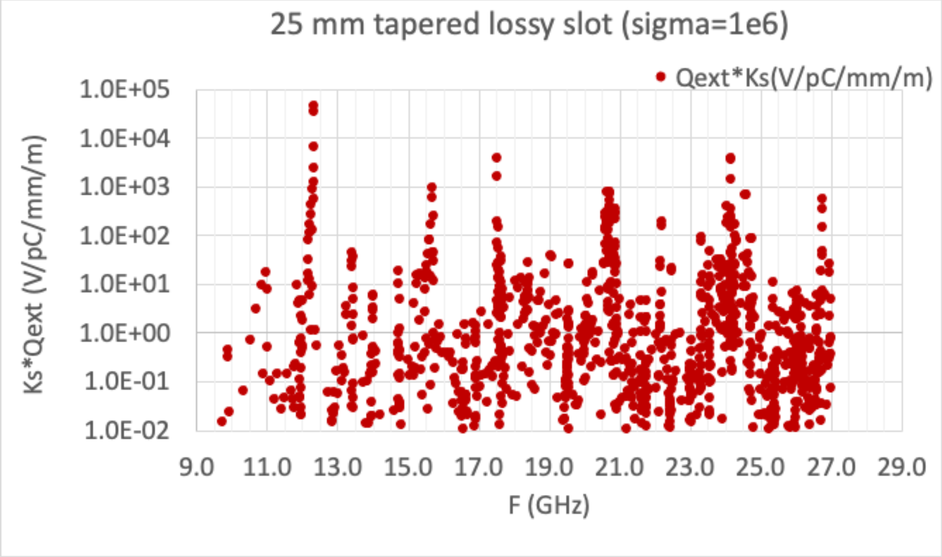
Tapered slot height: from 300 micron to 100 micron

Slot surface conductivity: 1e6

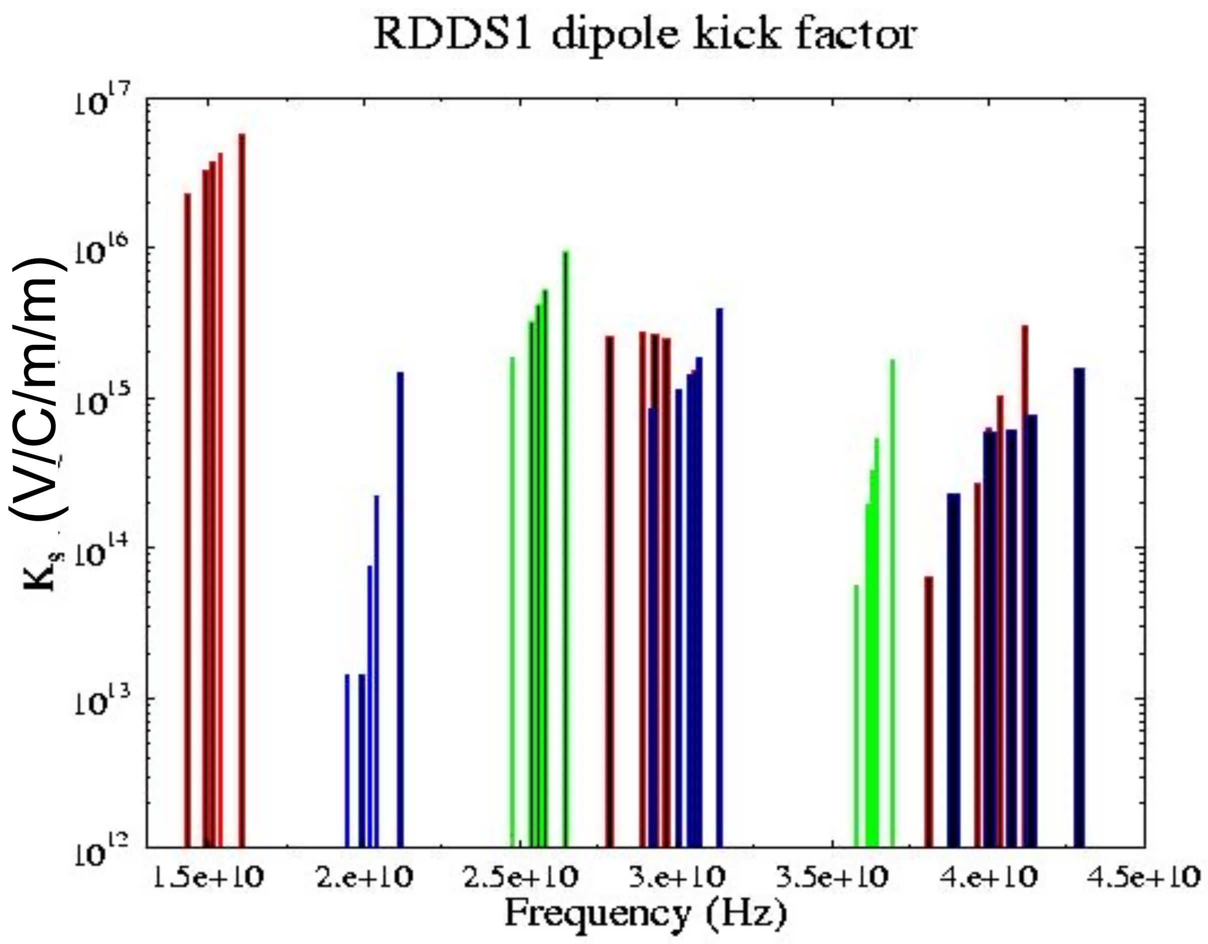








NLC X-Band structure kickfactor – for comparison



Outlook

In collaboration with LANL colleagues, Evgenya Ivanovna Simakov and Dongsung Kim, on wakefield damping optimizations

- Damping slot optimization
- Damping material studies