Overview of the DESY-Zeuthen S2E Workshop

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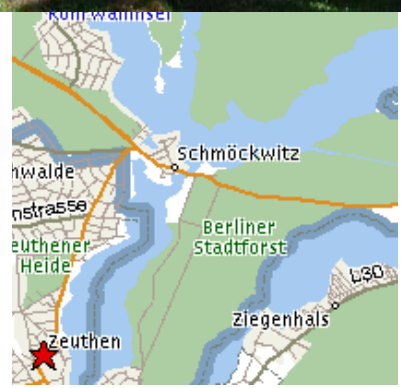
Auspices and Charter

ICFA Future Light Sources Sub-Panel
Mini Workshop on
Start-to-End Simulations of X-RAY FELs

- Discuss and compare simulations of benchmark scenarios;
- Identify and discuss "missing physics" or other approximations in one stage of simulation that may be essential to another stage; and
- Examine the results of "benchmark" calculations as a means of assessing the reliability of start-to-end FEL simulations.

Workshop Venue



Information Access

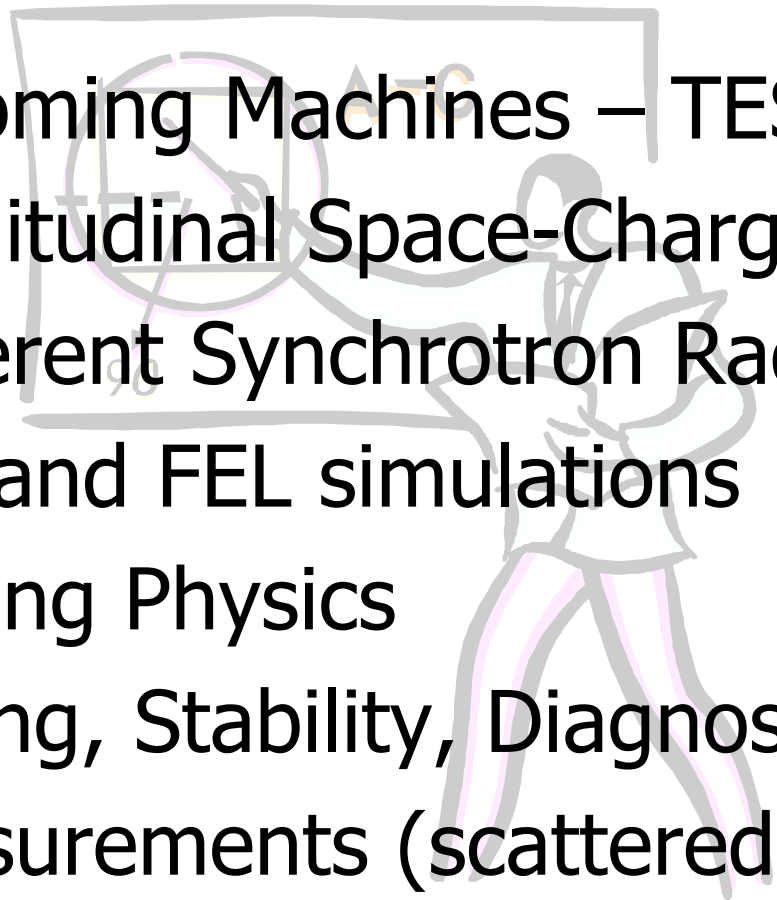
http://www.desy.de/s2e

includes the workshop program

benchmarking scenarios online for LCLS and TESLA; not yet online for LSC simulation models

most talks available online, organized by date presented; file names are semi-intuitive

General Topics Covered



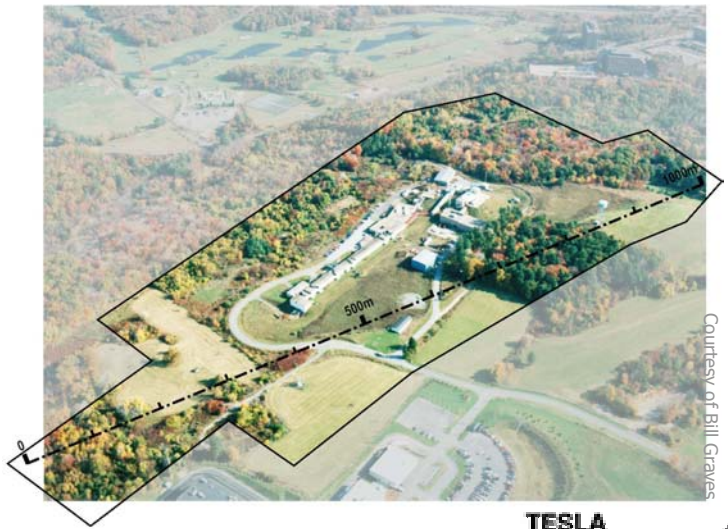
- Upcoming Machines – TESLA, LCLS, etc.
- Longitudinal Space-Charge Issues
- Coherent Synchrotron Radiation
- S2E and FEL simulations
- Missing Physics
- Tuning, Stability, Diagnostics
- Measurements (scattered throughout)

Overviews and State-of-the-Art

- "Injector" codes feature and simulation results comparison
- CSR code operational overviews and details on physics models
- FEL code highlights and differences, and a newer approach described

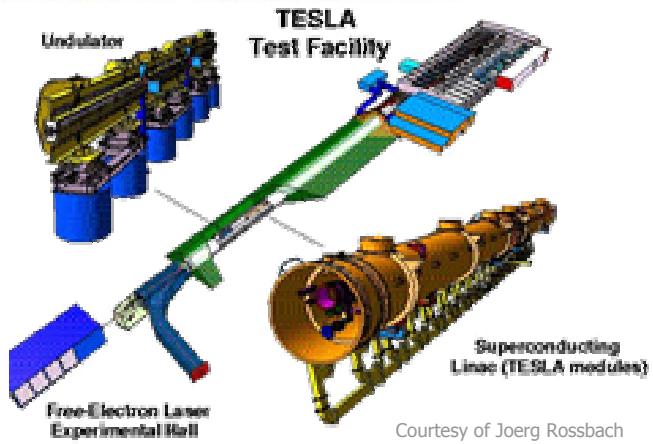
Upcoming Machines

From LCLS Website



Courtesy of Bill Graves

From TESLA TDR

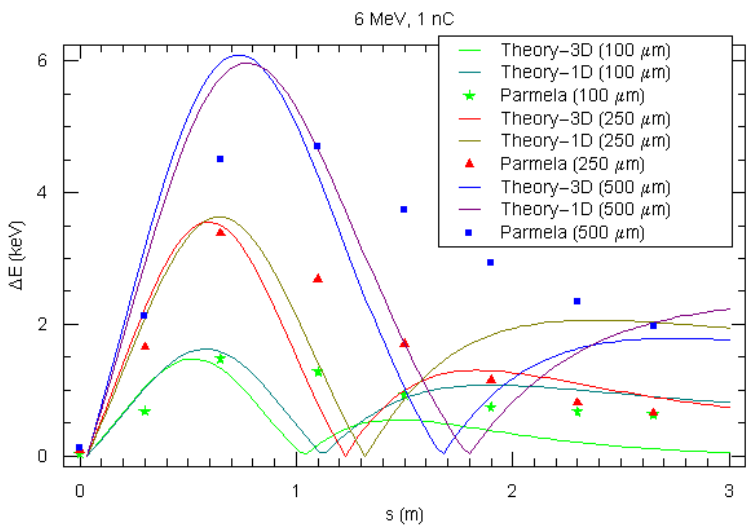


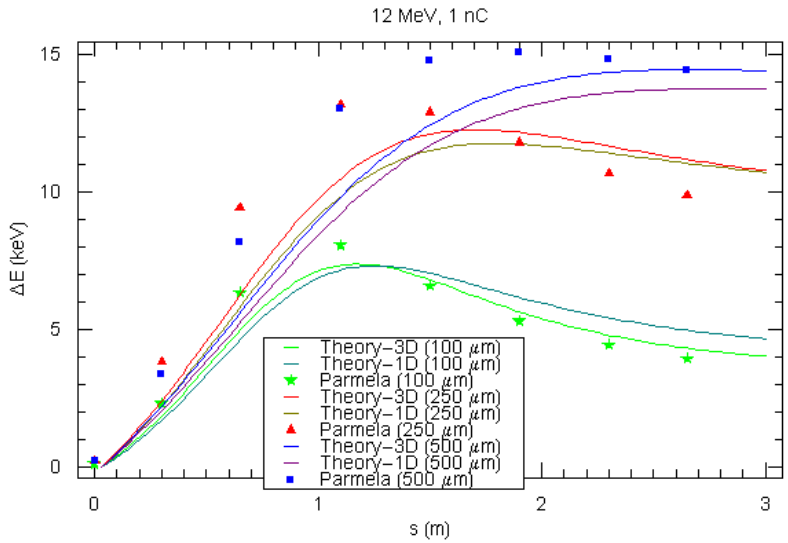
Courtesy of Joerg Rossbach

Longitudinal Space-Charge

- Density fluctuations in physical space
  - laser profiles
  - virtual-cathode effects
- Space-charge effects can smooth out the density dist. in physical space
- Resulting momentum-space density variations can interact with CSR mech.

Theory vs. PARMELA Simulation





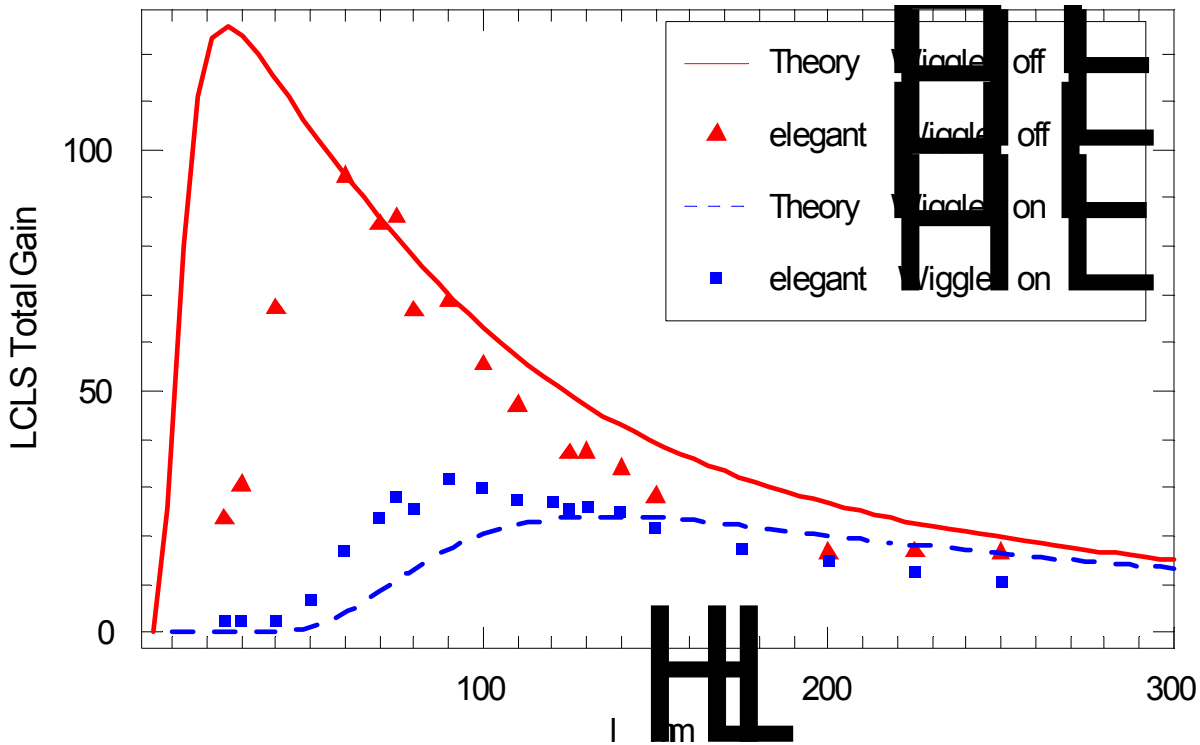
- Parmela simulations (C. Limborg) of a 3-m drift at 6 and 12 MeV (beam size changes due to optics and transverse SC)
- Theory-1D: integral equation using average LSC impedance
- Theory-3D takes into account transverse variations of LSC (J.H. Wu)

(Taken from Z. Huang's Monday talk, S2E workshop)

Coherent Synchrotron Radiation

- Well-covered in the previous workshop
- Effort devoted to longitudinal space-charge effect interaction and gain
- Discussed recent advances in the simulation codes, and wants/needs for future codes for CSR calculation

CSR in LCLS Linac



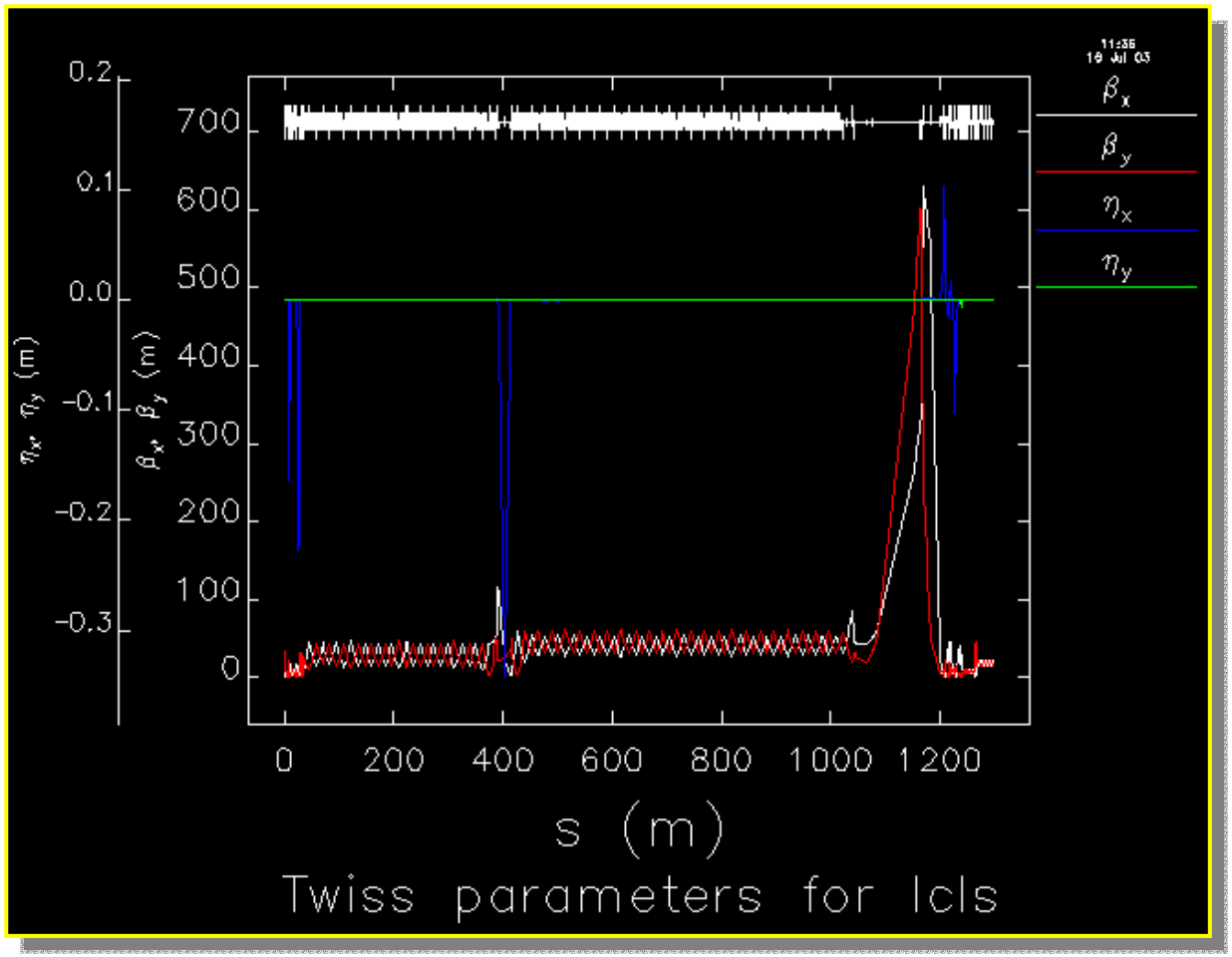
Incorporates linac wakefield, gain across multiple compressors, damping wiggler

(Taken from Z. Huang's Tuesday talk, S2E workshop)

S2E simulations

- Try to run single simulations from cathode to beam dump
- Some old problems still exist:
  - code compatibility
  - distribution scaling (up & down in N_{par})
  - physical models
- More machines being modeled

LCLS S2E with steering errors



Includes injector (PARMELA), linac (elegant) and FEL (genesis)

Includes trajectory error and steering correction algorithm simulation

Jitter tolerances tight but achievable

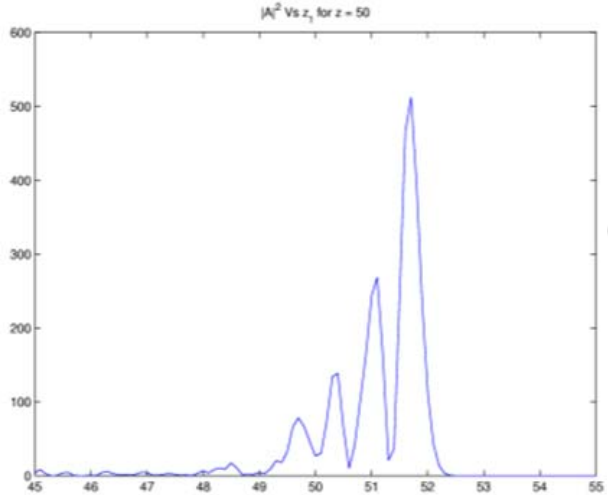
Taken from Paul Emma's Wednesday talk

FEL simulations

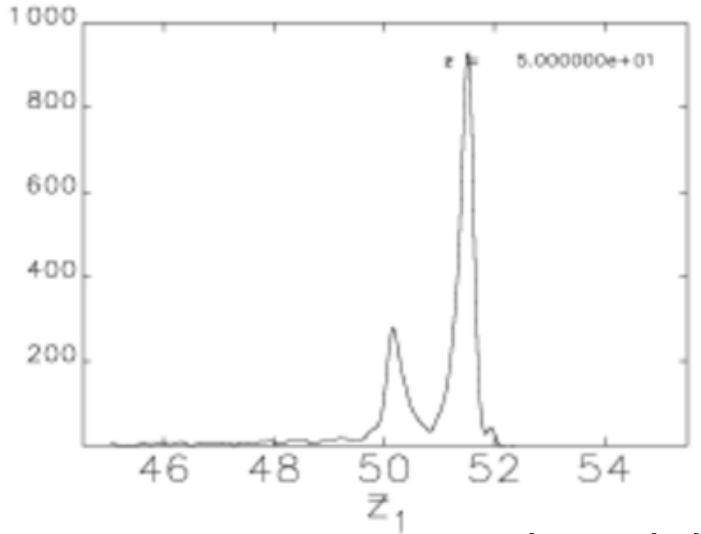
- Check of some test cases under various conditions
- Recent work in code developments
- Undulator and beam modeling issues
- Some new thoughts on how to model things like very intense radiation pulses, setting up the initial distribution, etc.

Ultra-short radiation pulse propagation

Propagation of a sub-wavelength radiation pulse
- exploration of saturation effects
- does not include diffraction yet



Averaged model



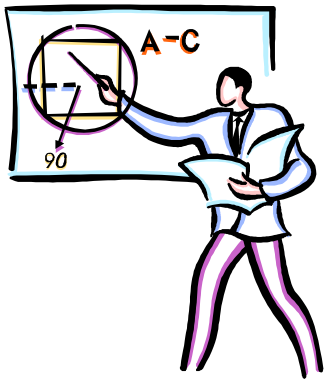
Non-averaged model

Taken from Brian McNeil's talk on Thursday

Measurements

- Presented from a number of places
  - SLAC/GTF: transverse emittance measurements
  - TTF: beams from the bunch compressor
  - DUV-FEL: longitudinal microbunching
  - SPPS: initial results, bunchlength meas.

Overall Blend



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Summary

- Overall, a good workshop
- Many interesting and inter-related topics covered
- Importance of "details" to machine performance strongly highlighted

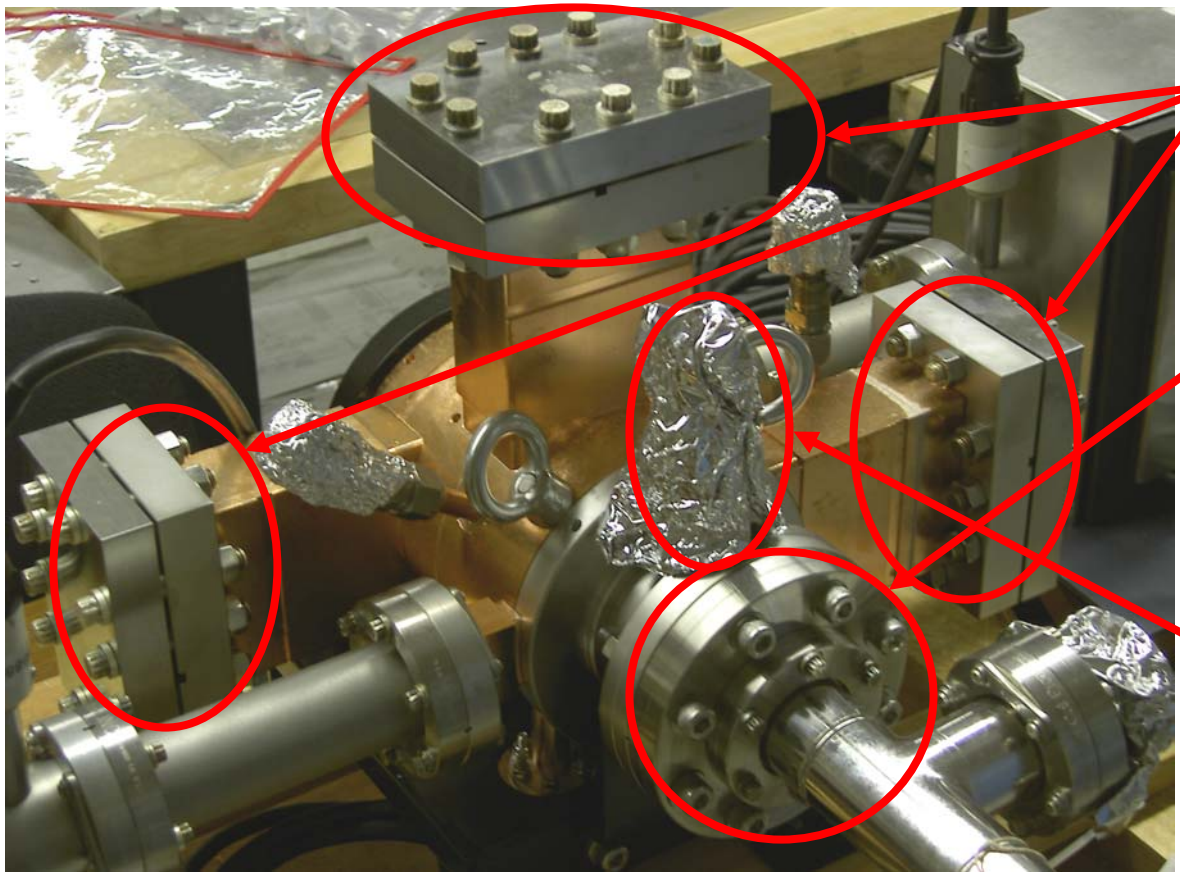

AND NOW
FOR SOMETHING
DIFFERENT

Injector Research at APS

Some highlights:

- Ballistic Bunch Compression injector
- Needle Cathodes
- Higher-Order Mode Cavity Gun

BBC Gun

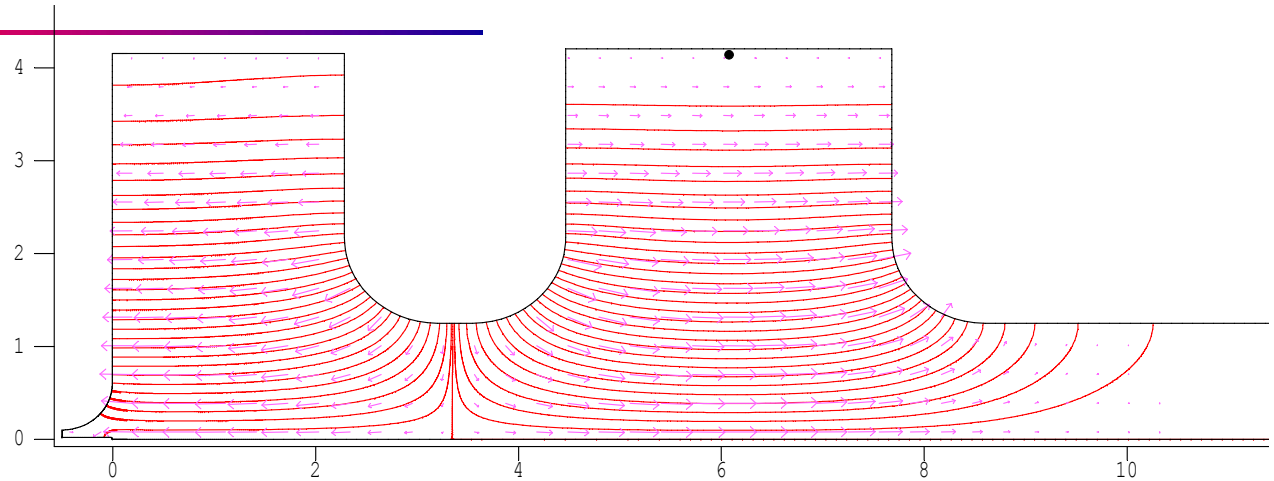


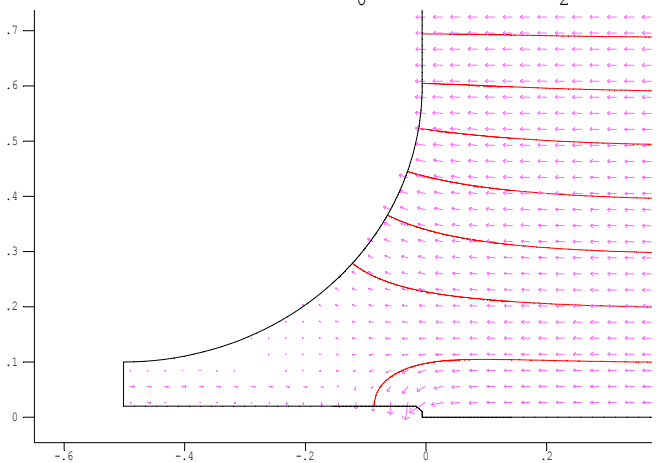
Three separate RF feeds

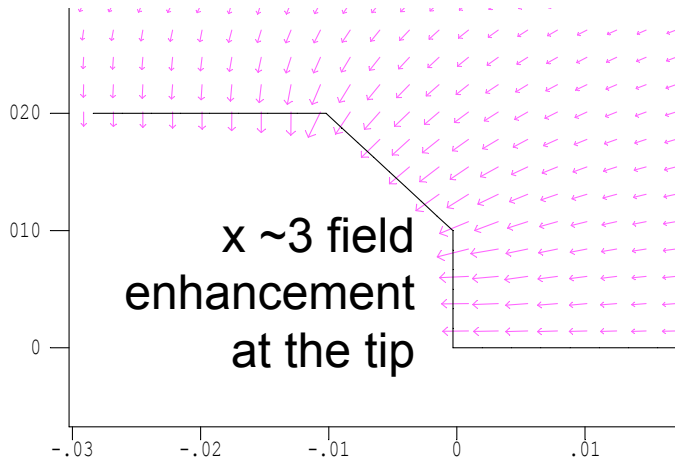
Built-in Cathode Vestibule

Thermionic or Photo Cathode

Needle Cathodes

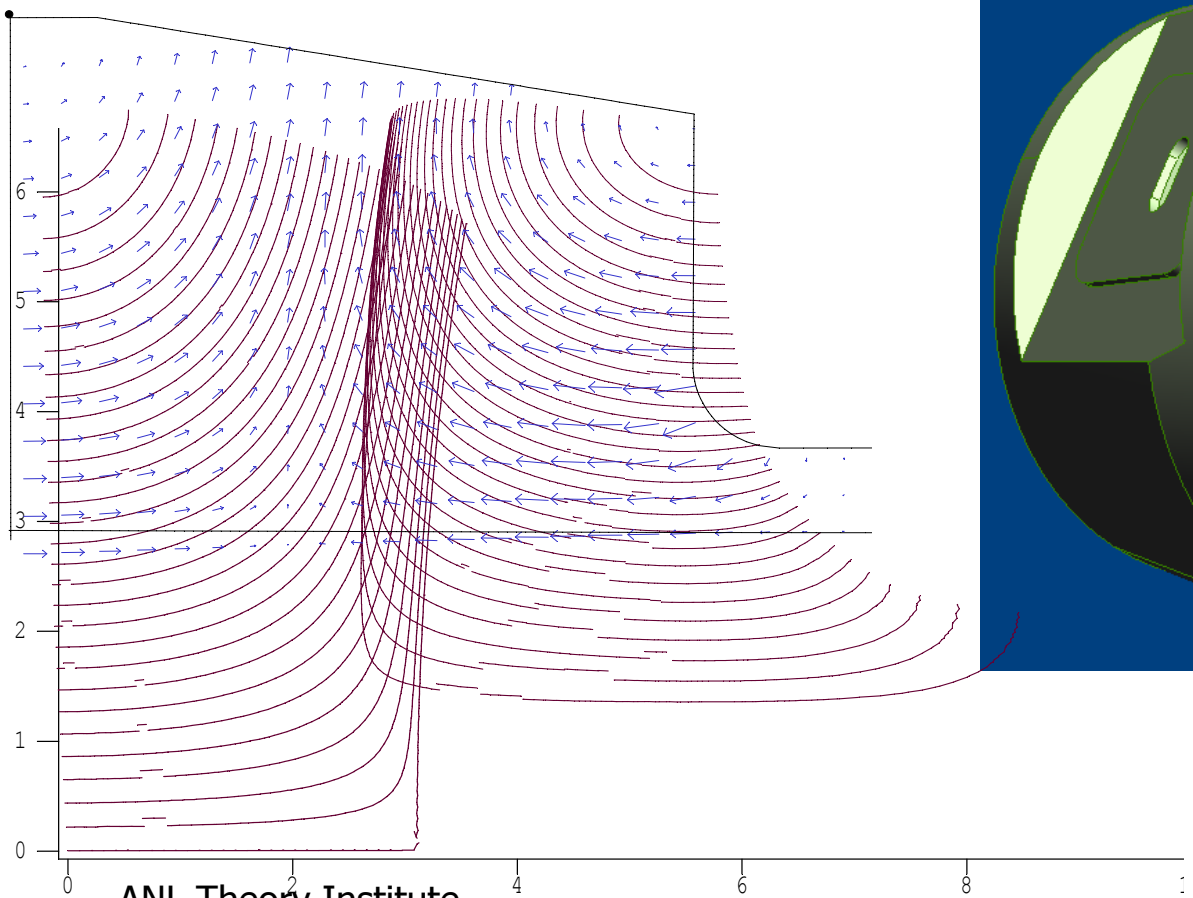


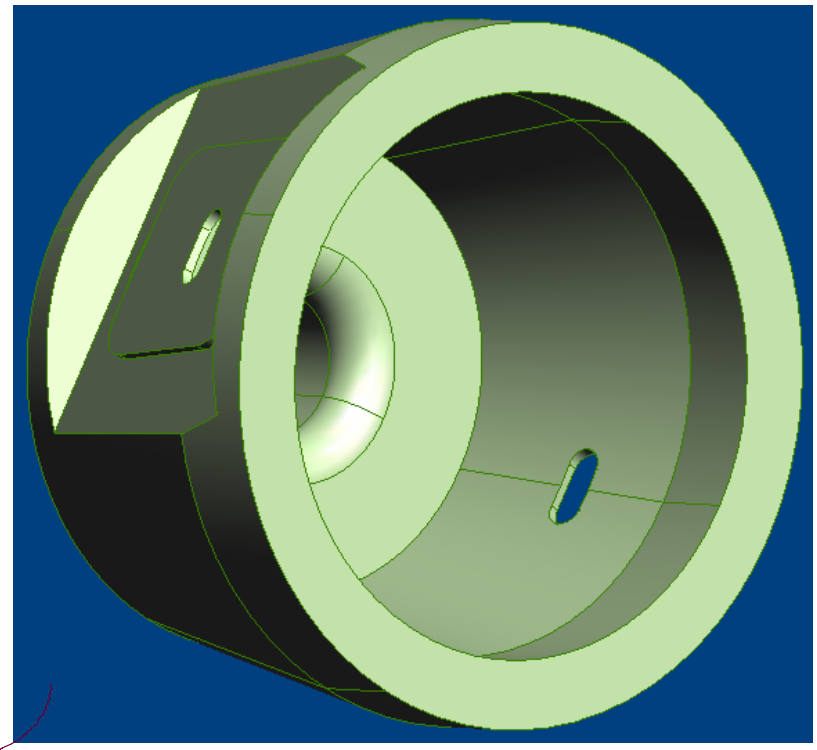




Higher-Order Mode Gun

$TM_{0,1,1}$





The End (really!)

Thanks for coming!