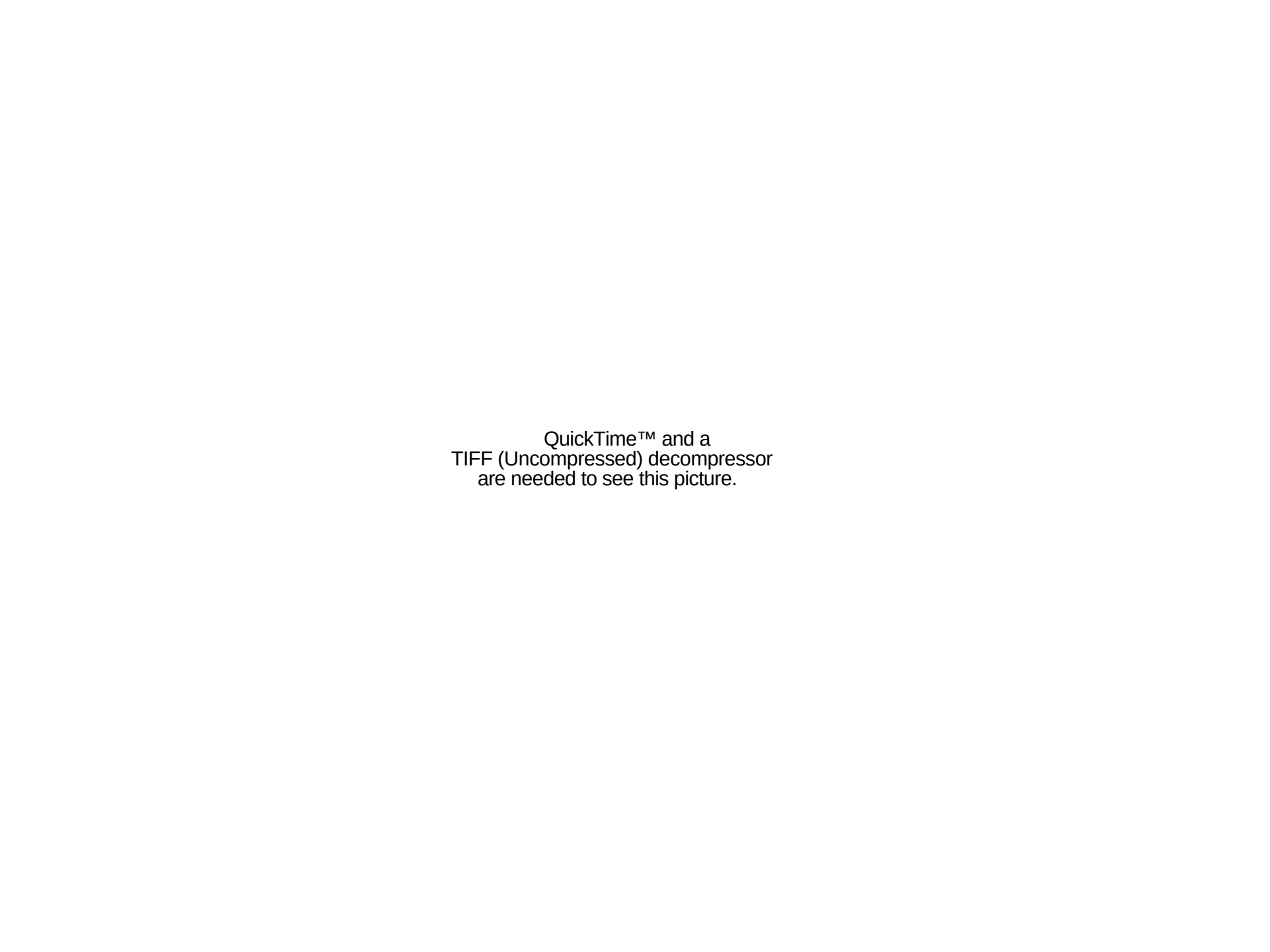
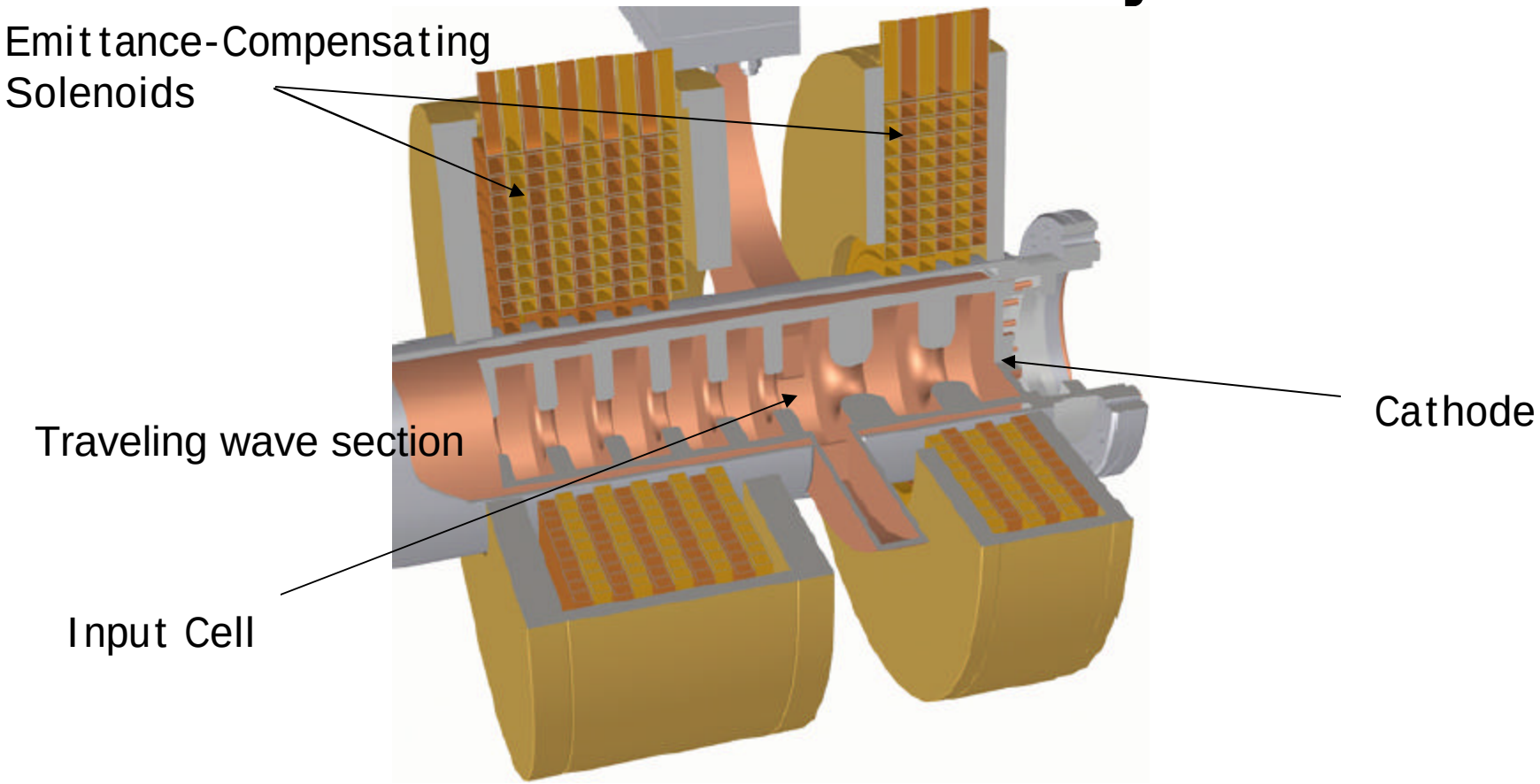
The hybrid TW-SW photoinjector

J. Rosenzweig, B. O'Shea, A. Boni, A. Fukusawa
UCLA Dept. of Physics and Astronomy
D. Alesini, A. Mostacci, L. Palumbo
Universita di Roma "La Sapienza", Dipart. di Energetica
B. Spartaro, M. Ferrario
INFN-LNF, Frascati


QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

The SWTW Photoinjector

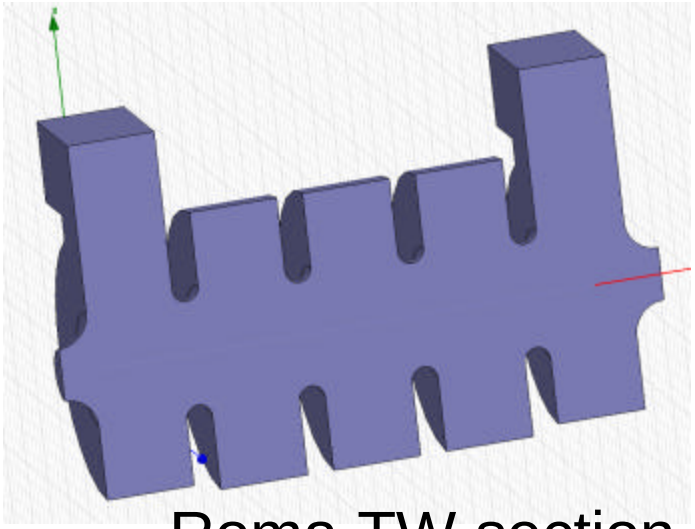


SW 1.6 Cell Gun matched to a TW structure, with common RF feed in third cell

Why?

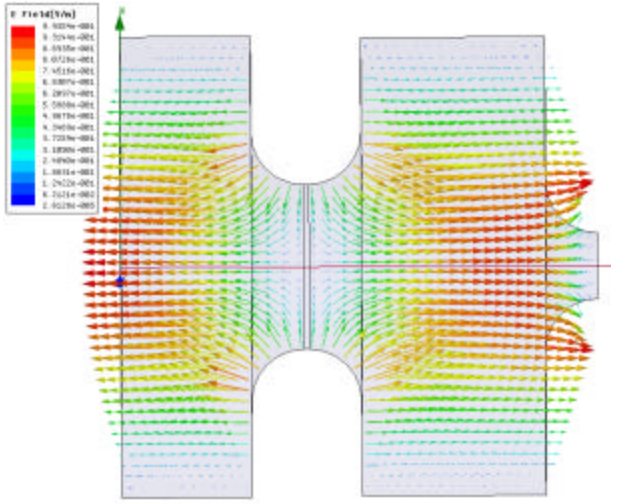
- Eliminate transient reflection associated with SW structure
  - Needed for X-band (SW sol'n has serious problems)
  - Scale to shorter wavelength (brightness ~ l_{rf}^{-2})
- Compact
  - Simple (1 RF feed!)
  - Inexpensive (RF distribution, structures)
  - Efficient (TW low gradient, low power, high energy)
- Good beam dynamics
  - Shorter pulses (no expansion after gun section)
  - Flexible energy; *velocity bunching*
- In S-band, 20-30 MeV in single structure…

Hybrid Gun RF Design Simulations (S-band)



Roma TW section

+



UCLA 1.6 cell gun

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QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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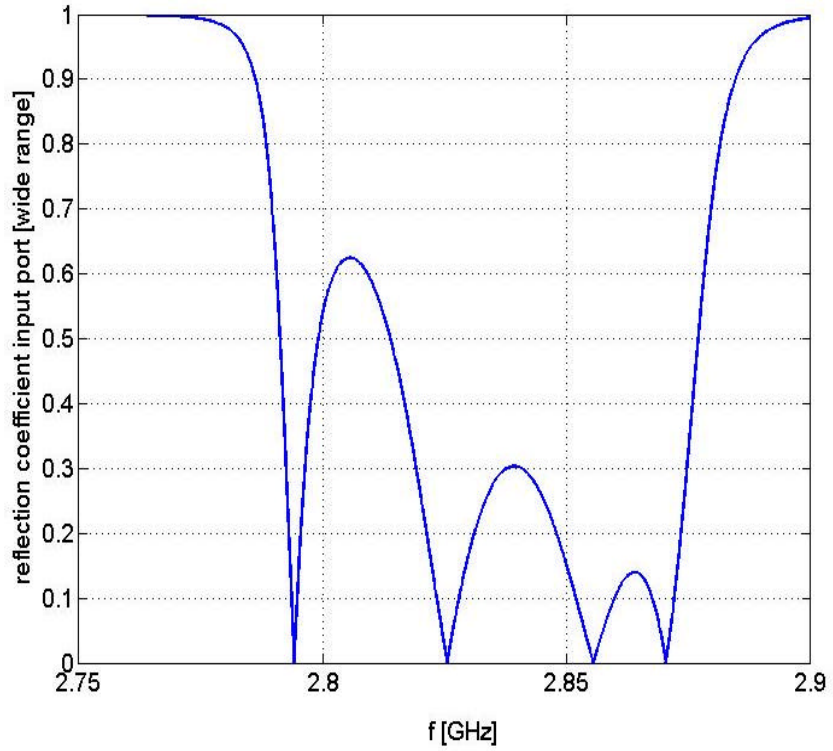
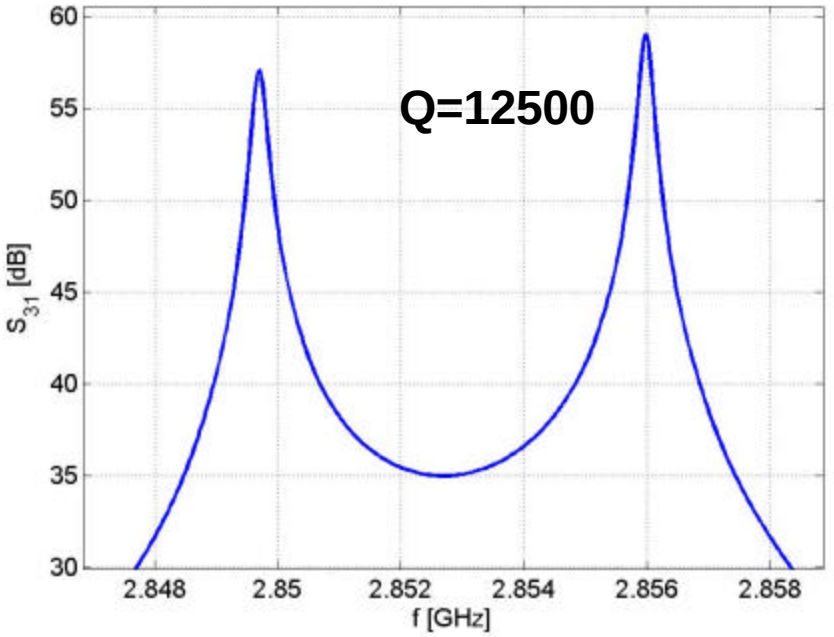
HFSS Port Parameters

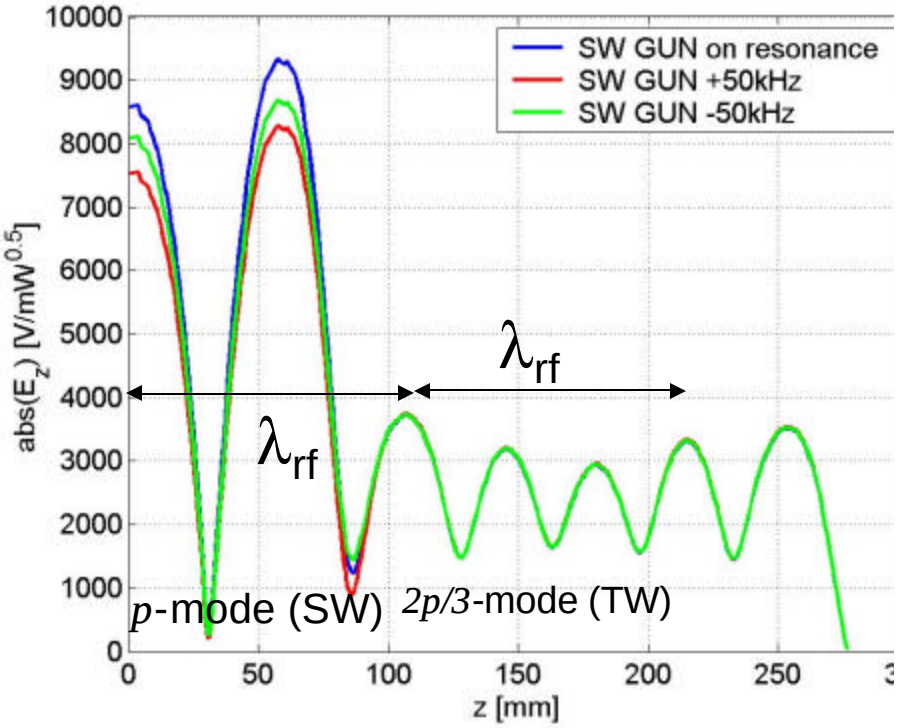


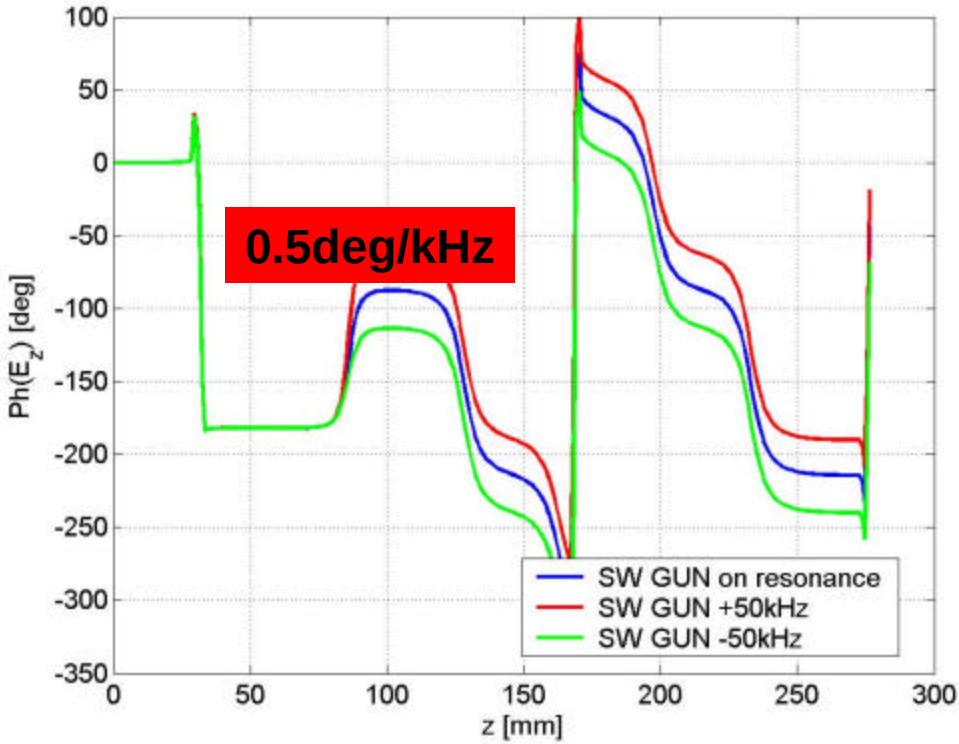
WG S_{11} (pass-band appears)



WG-Gun loop

Images courtesy of David Alesini.



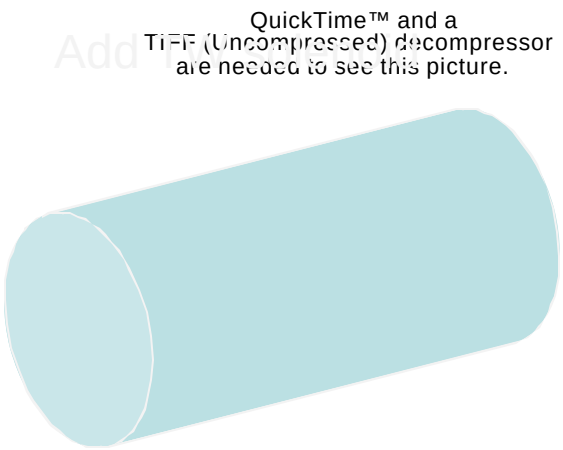


Cautions:

- +90 degrees between cells 2 and 3 (velocity bunching)
- Need tight, separate control on temperature in TW section

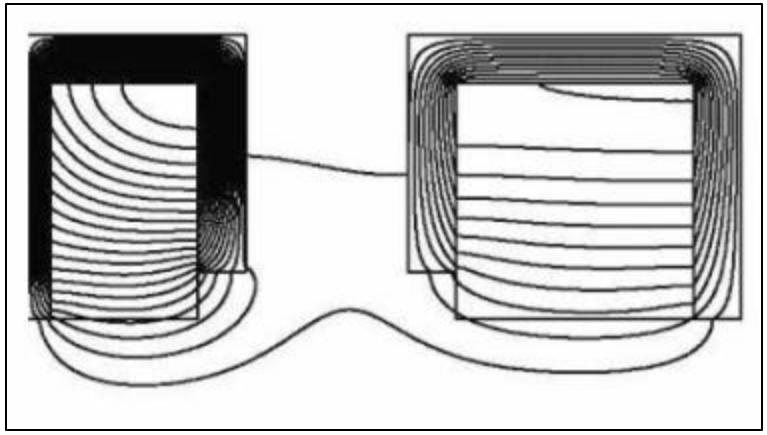
Beam Dynamics Studies: S-band Parameters

- Q=1 nC
- L_{TW}=3 m
- T_0 =10 psec
- R_b=1.57 mm
- f_0=40 deg

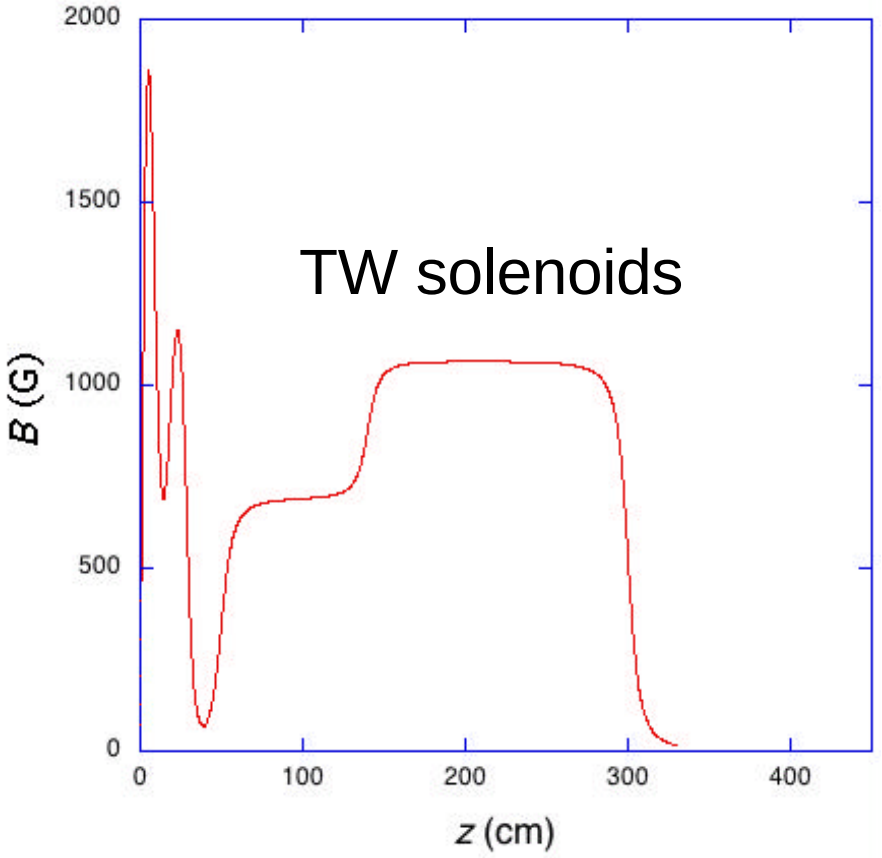


Full structure

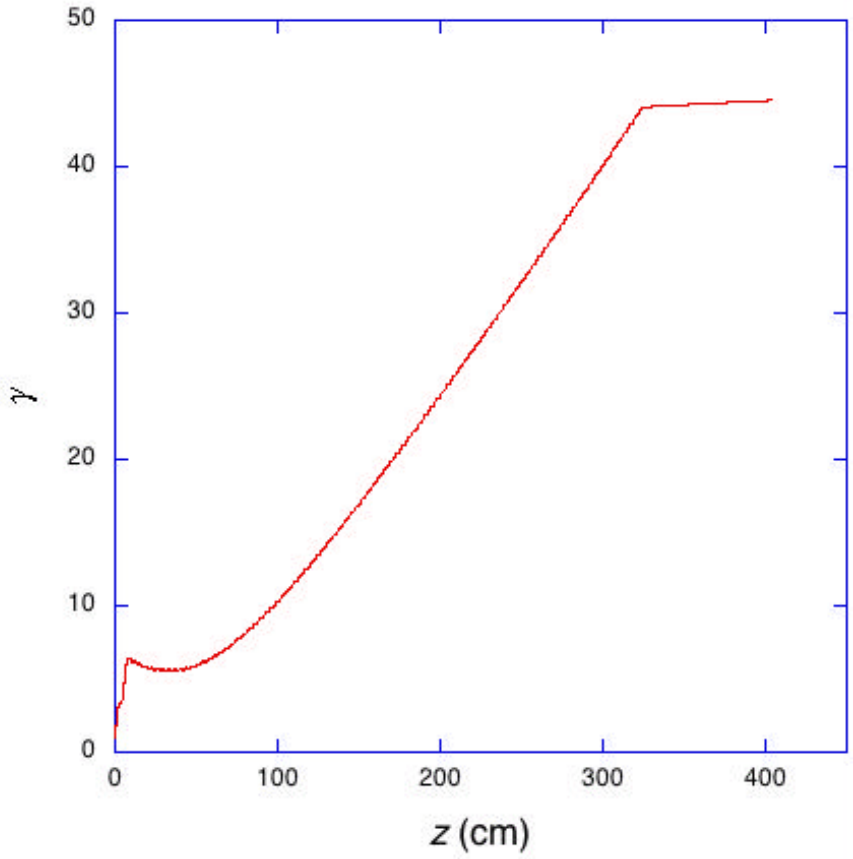
Magnetic field



Gun region solenoid

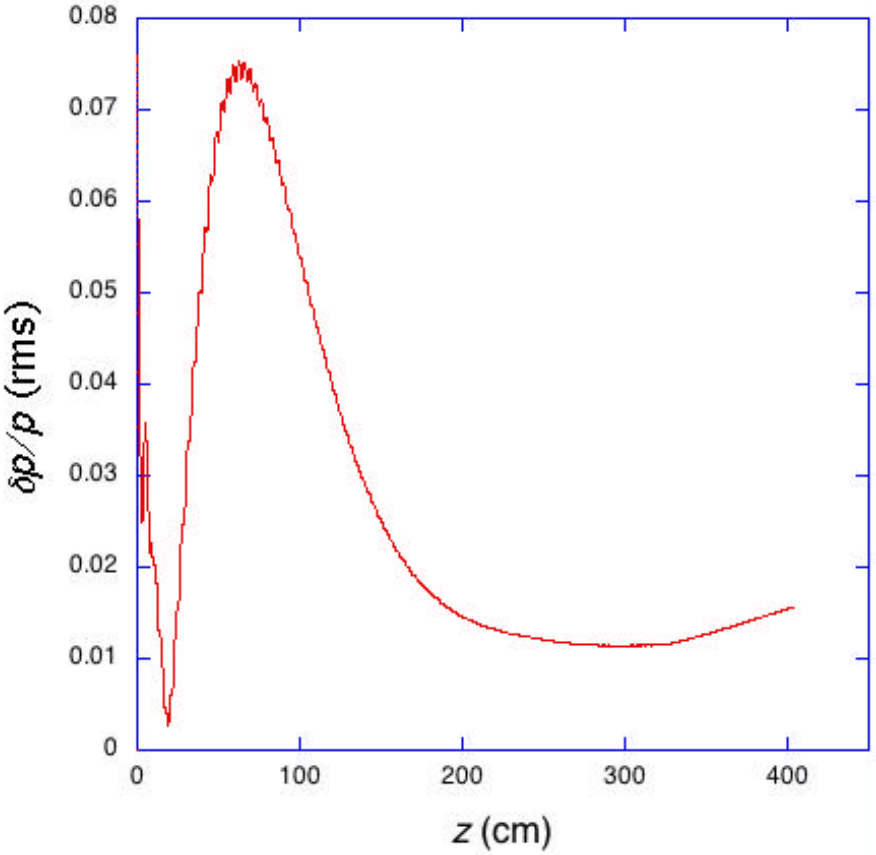


Energy



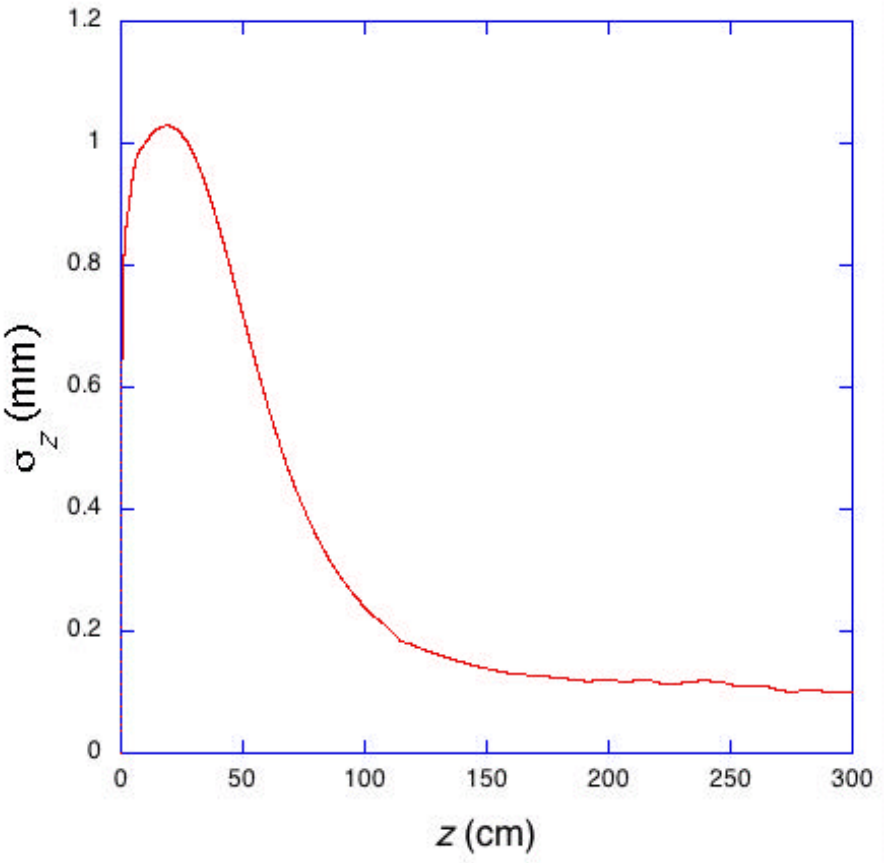
Initial deceleration for velocity bunching

Momentum spread evolution



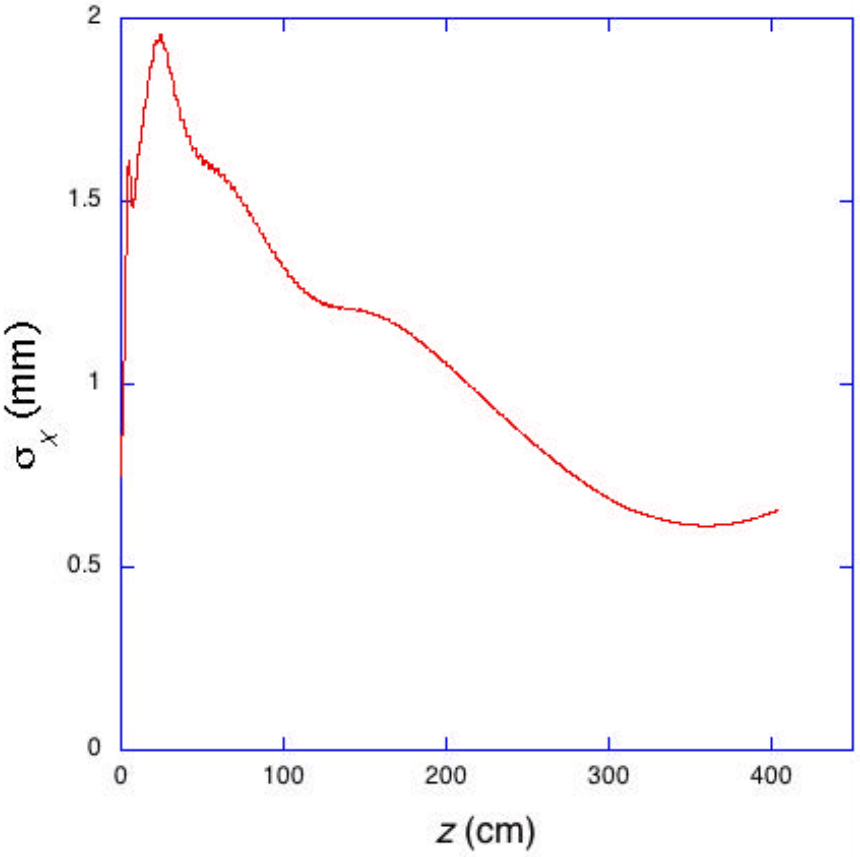
Minimum near 1.2% rms

Bunch length evolution



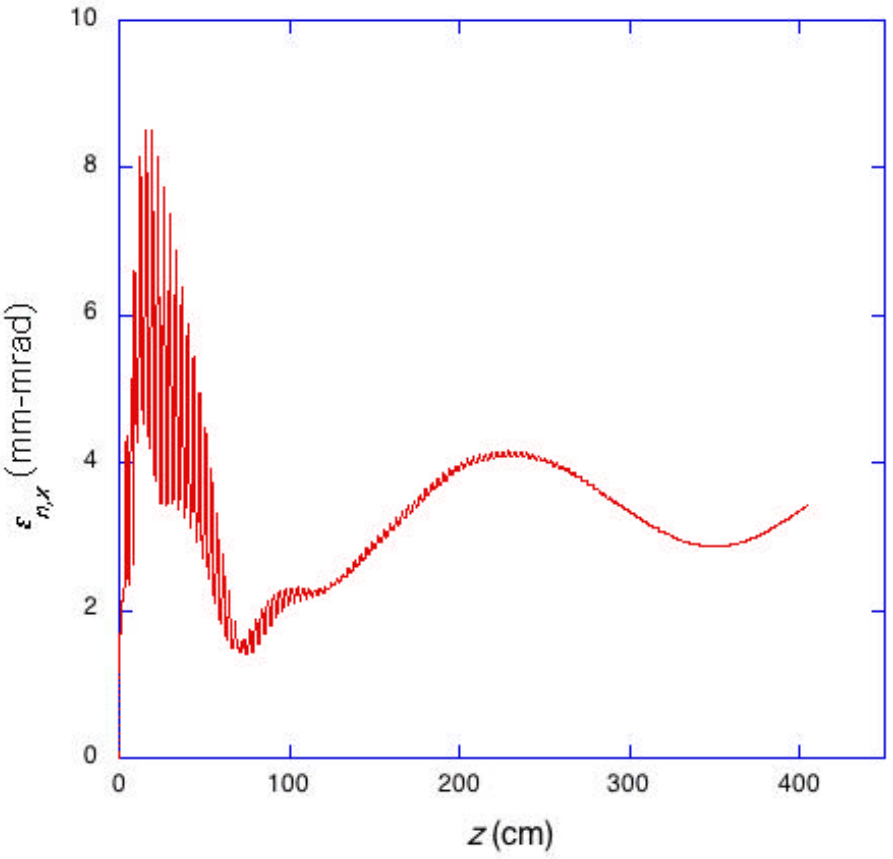
100 micron final bunch length

Transverse beam size evolution



Need secondary solenoids due to bunching

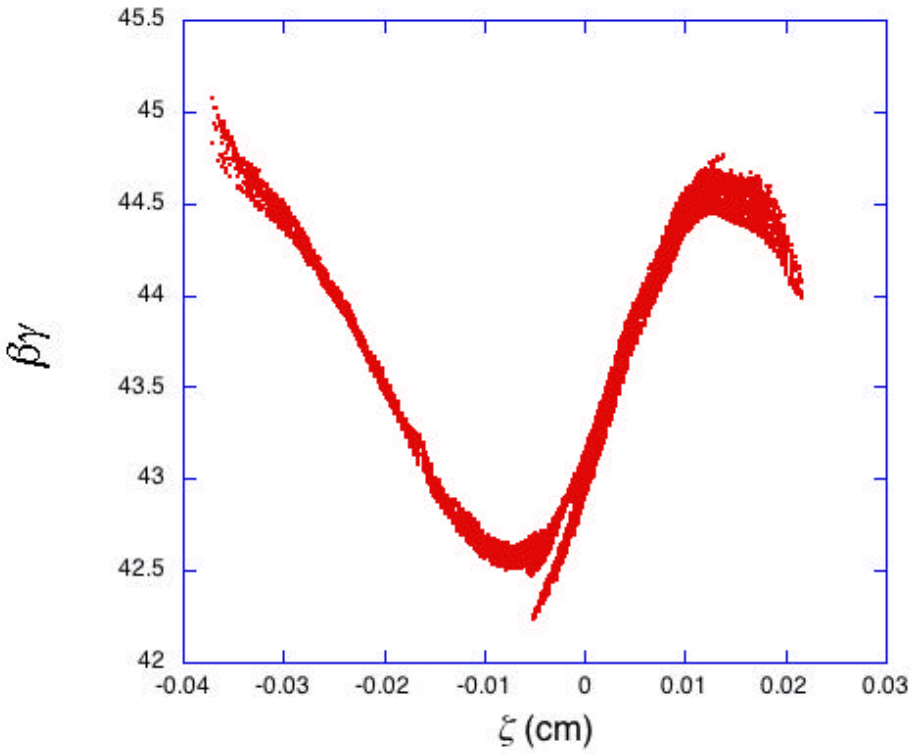
Emittance evolution

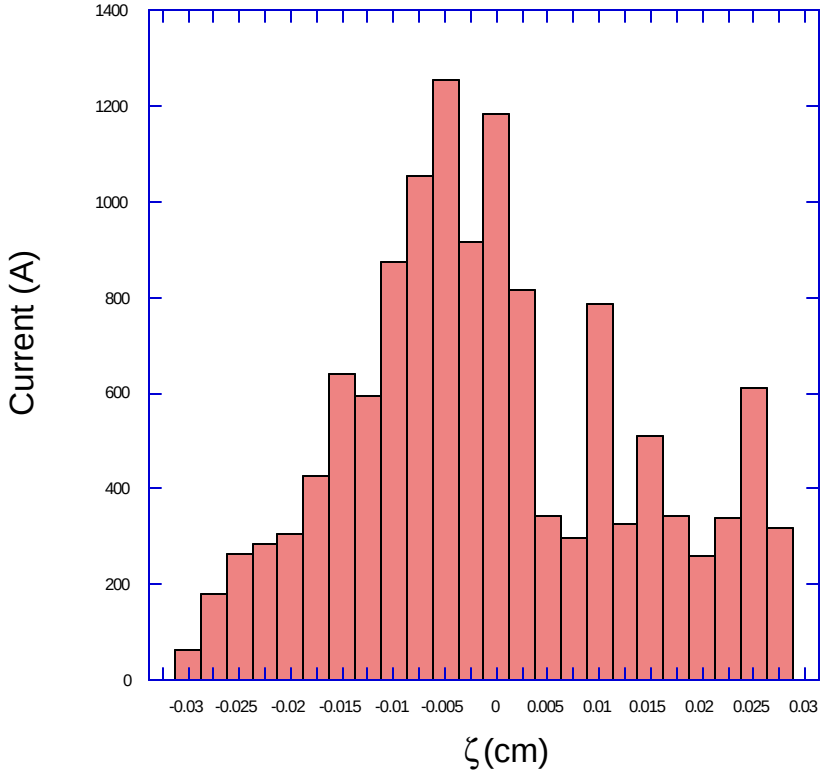


Space charge still alive at end…

Control beam after injector taking into account e oscillations

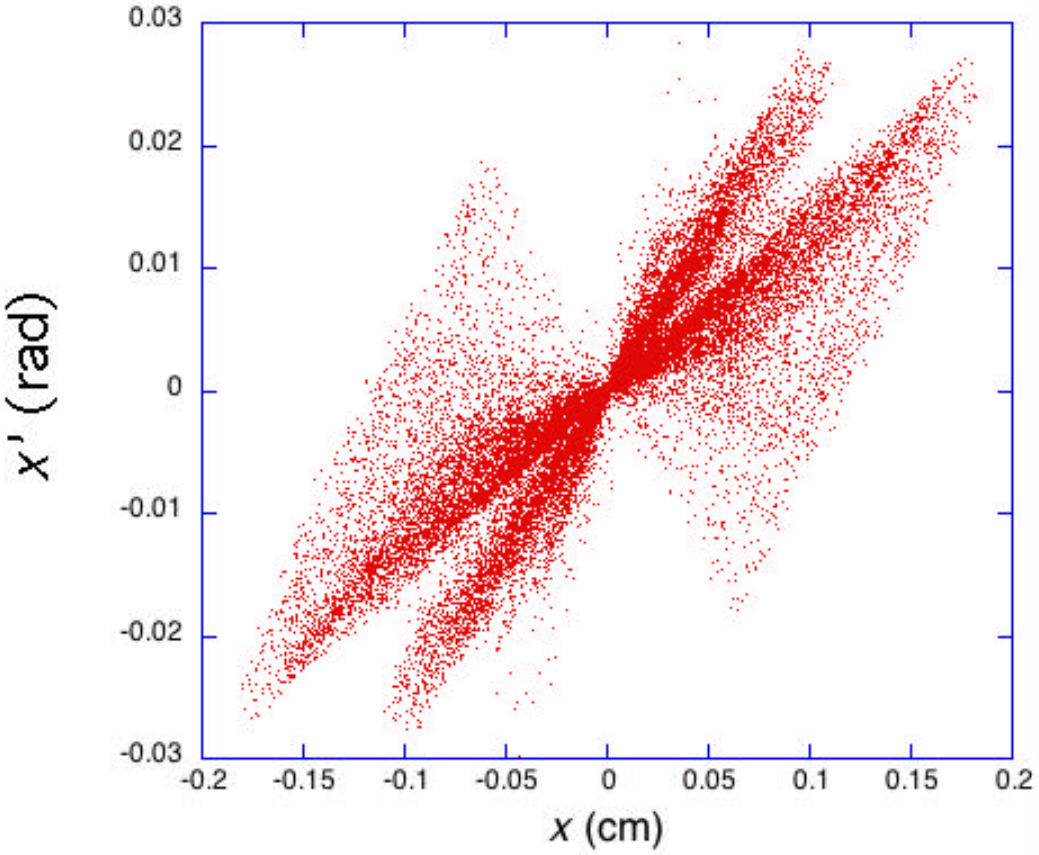
Longitudinal phase space





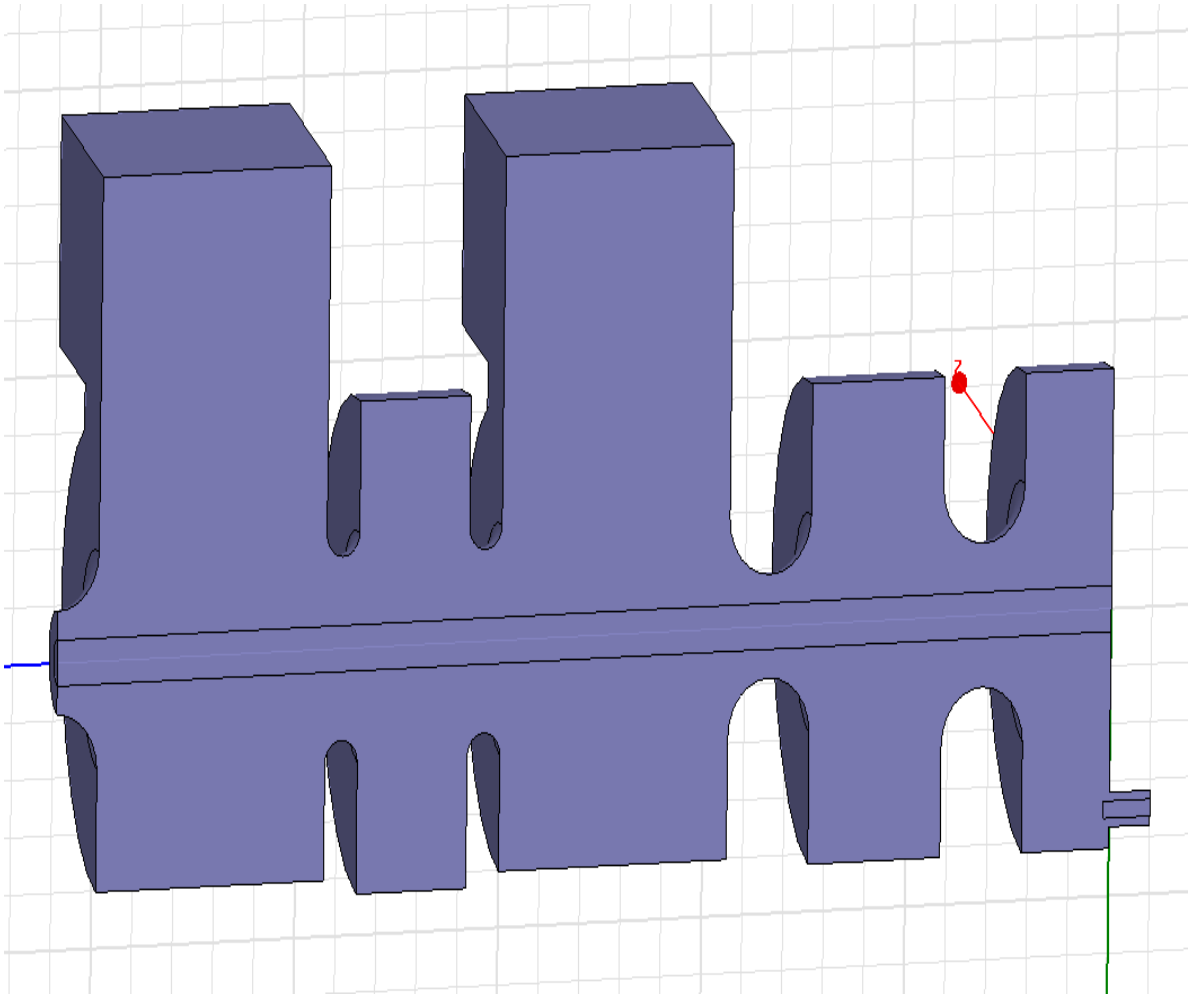
Current peaks above 1 kA

Transverse phase space

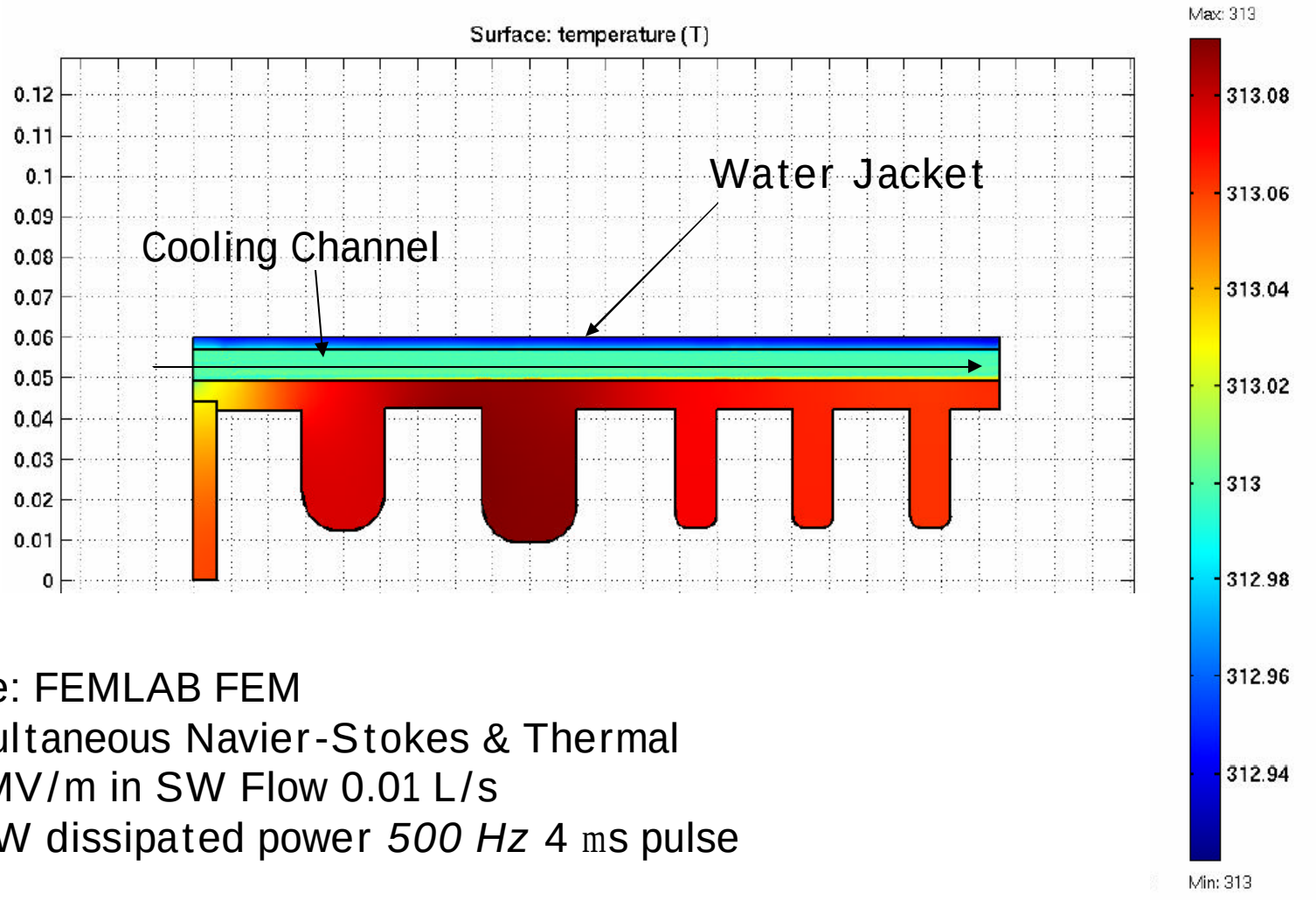


Collimation removes much emittance, few particles

Solution for rephasing (no velocity bunching)



Preliminary Thermal



Code: FEMLAB FEM
Simultaneous Navier-Stokes & Thermal
60 MV/m in SW Flow 0.01 L/s
2 MW dissipated power *500 Hz* 4 ms pulse

Current activities

- S-band cold test model, now machining at UCLA
- Interesting “hybrid” RF measurement issues
- Dual feed design studies (Roma)
- Solenoid designs
  - Coils for S-band
  - Hybrid PM/Coil for X-band
- Solve laser injection issues (65 deg, thru solenoid)
- High power testing at UCLA PEGASUS
- Examining *applications* of 22 MeV, >kA beam
  - Coherent Cerenkov THz source for Neptune (A. Cook, AAC ‘06)
  - Super-radiant THz FEL for Neptune
  - Inverse Compton scattering (LCLS-like photons)