Superconducting RF Injector Project

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Collaborators

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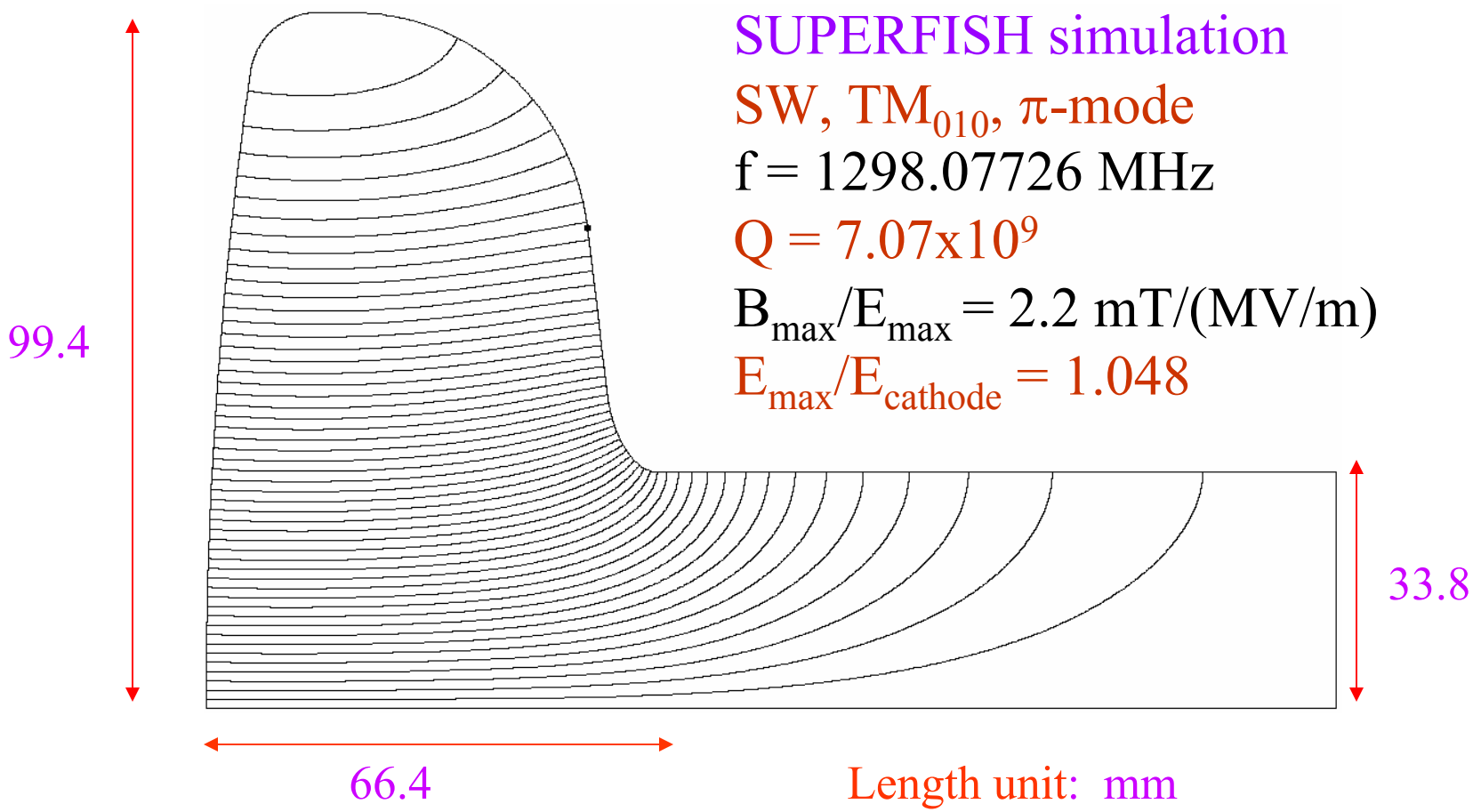
Motivation

- Development of High average current injector
  - Heat Loss→RF Requirements → Superconducting injector
  - Photocathode
    - Cesium Telluride
    - Nb
    - Secondary emitter

Cavity design (AES)



SUPERFISH simulation

SW, TM_{010}, π-mode

f = 1298.07726 MHz

$Q = 7.07 \times 10^9$

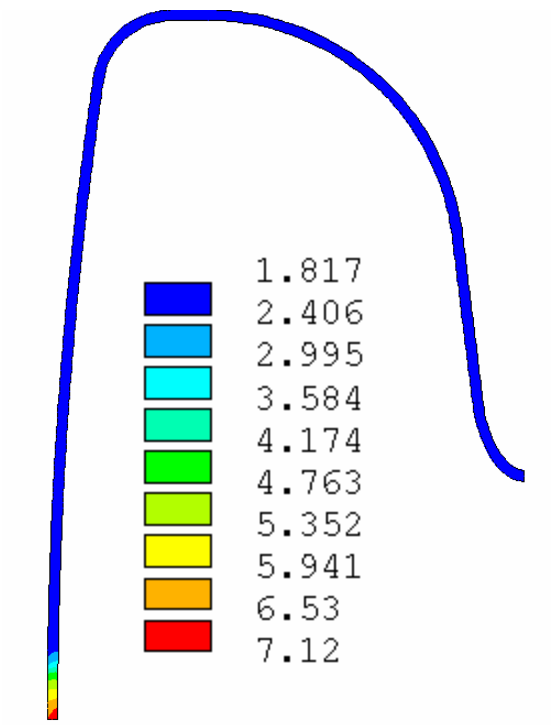
$B_{max}/E_{max} = 2.2$ mT/(MV/m)

$E_{max}/E_{cathode} = 1.048$

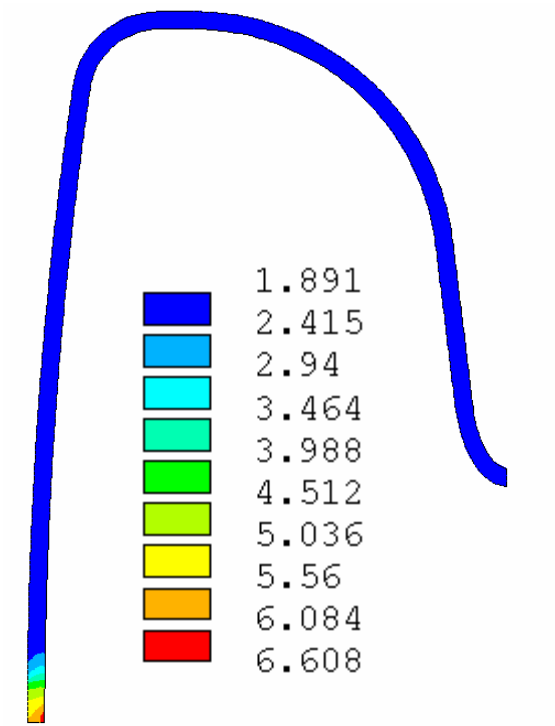
Thermal results (AES)

Wall Thickness vs. Temperature distribution

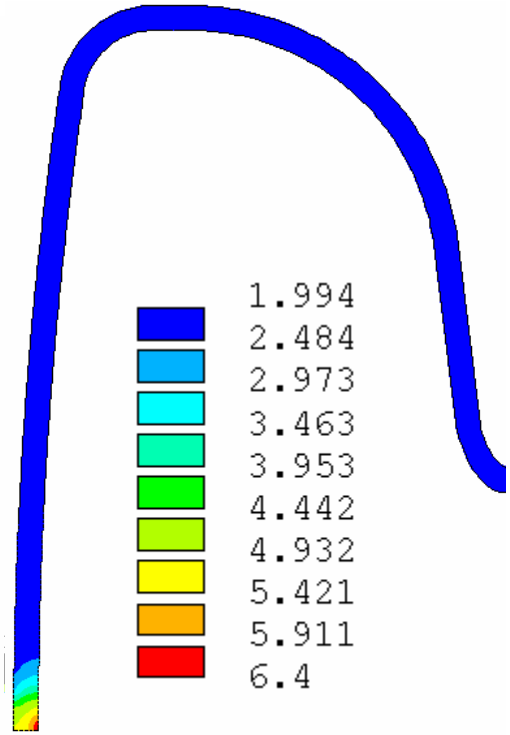
1.5 mm



2.5 mm



3.5 mm

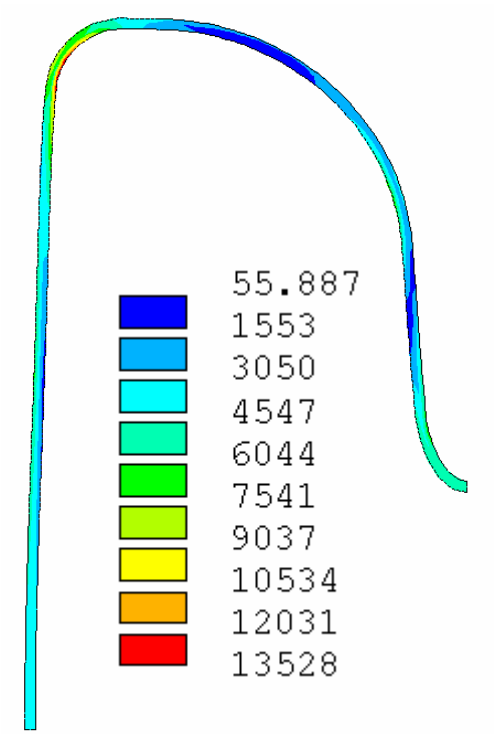


Temperature in K

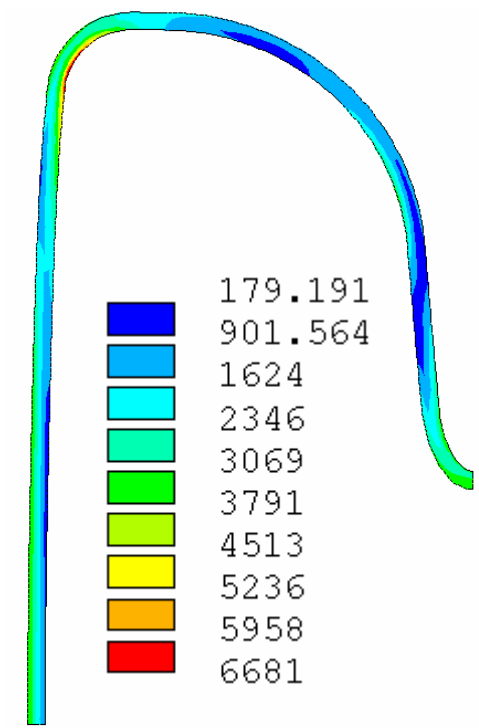
Structural results (AES)

Wall Thickness vs. stress/strain distribution

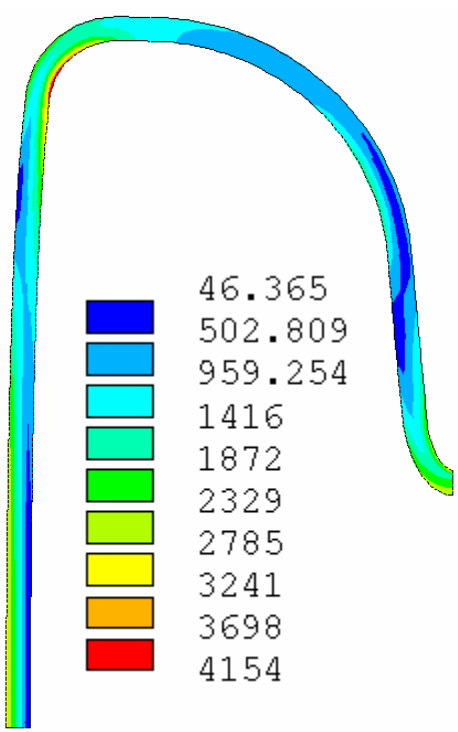
1.5 mm



2.5 mm

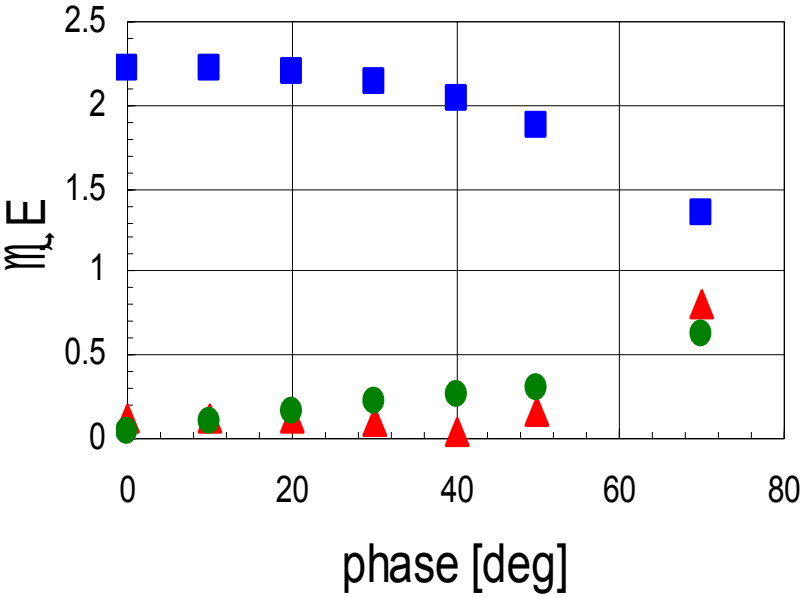


3.5 mm



Von Mises stress in PSI

Cavity Design and simulations



½ CELL, 1.3 GHz CAVITY, Domed end wall for stiffness, 3.5 mm Nb electro formed and welded. Thickness optimized for thermal loading.

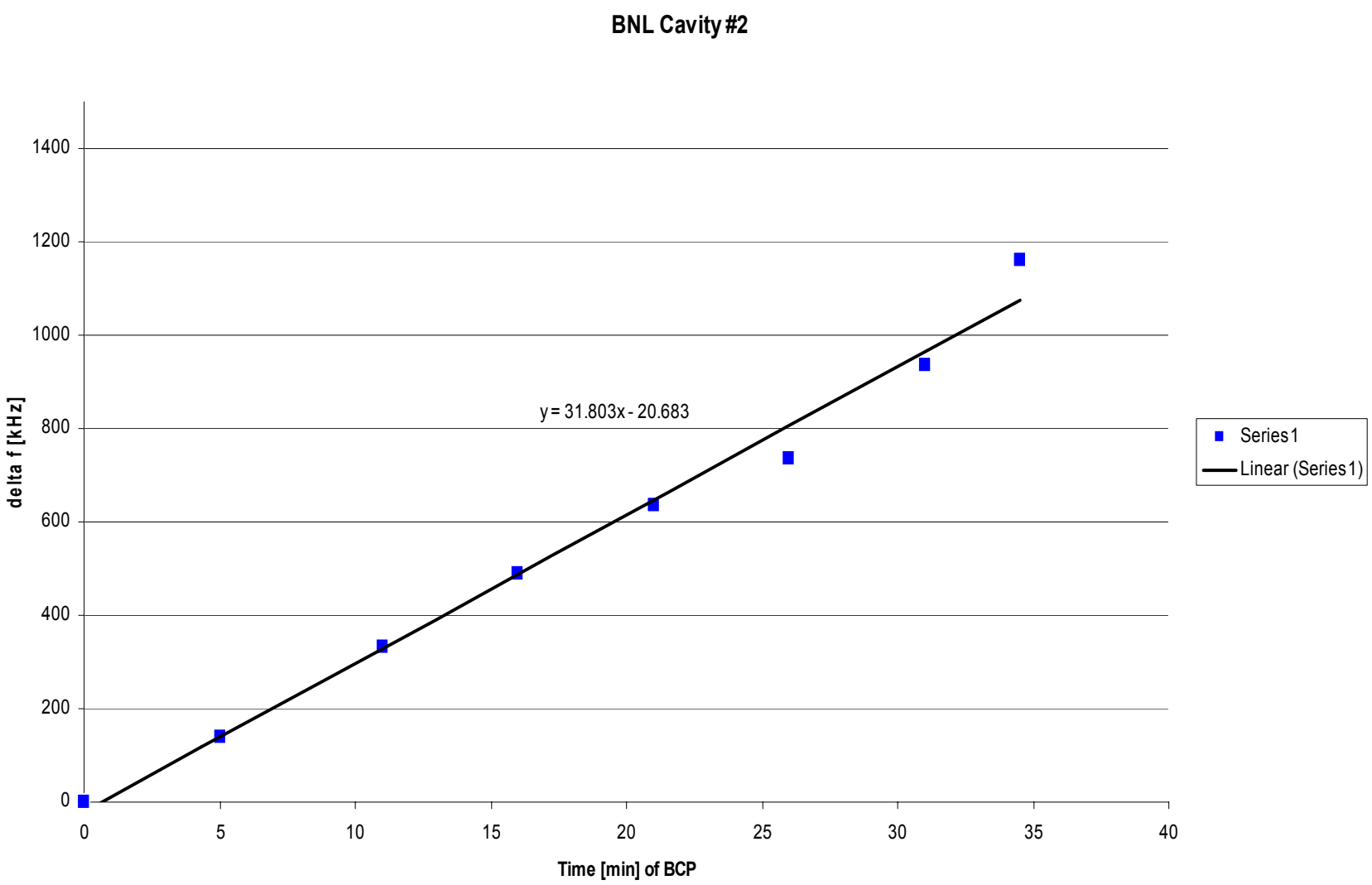
Frequency, Coupling & Cross talk measured at room temperature

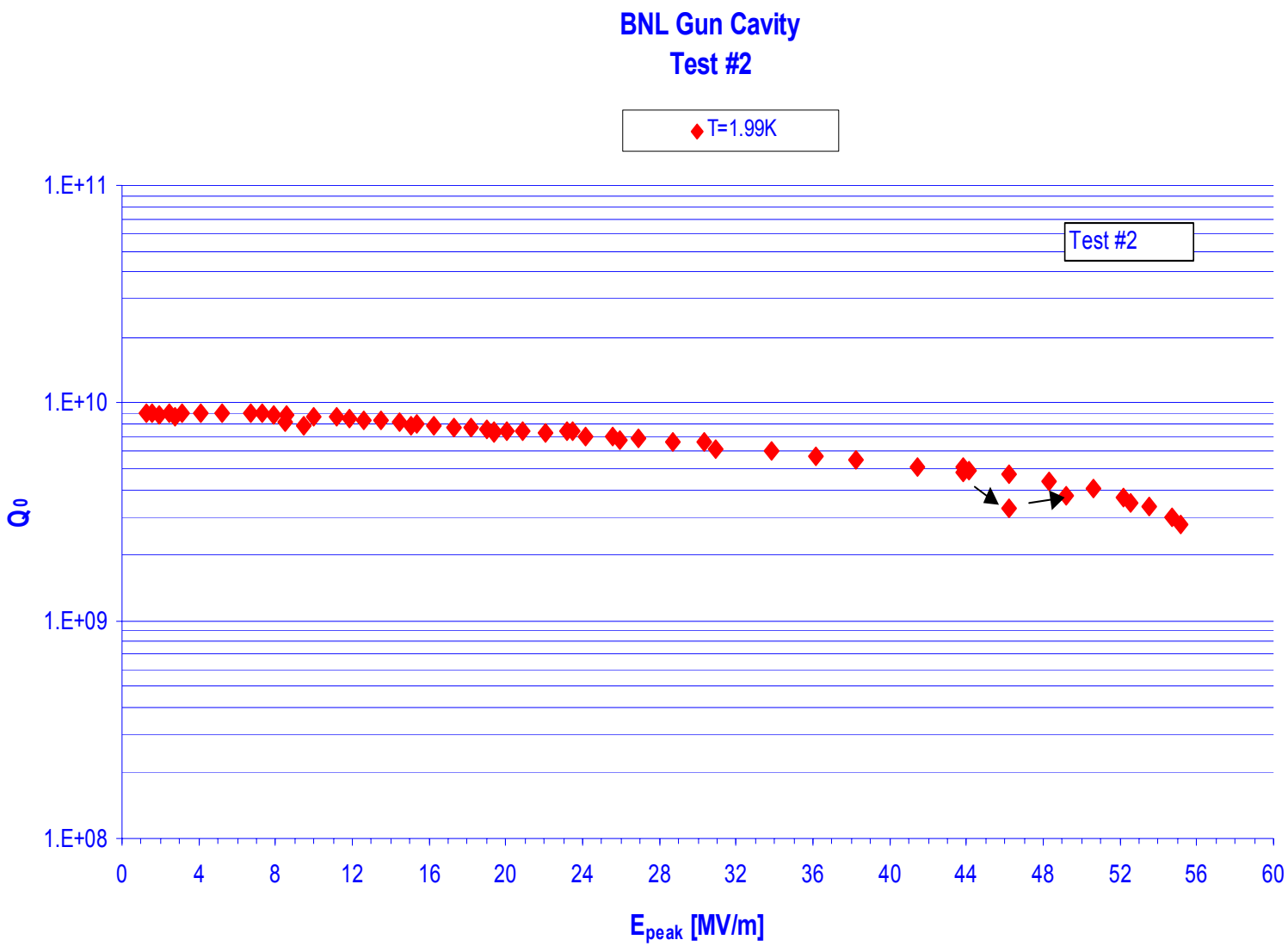
PARMELA simulation

● Longitudinal emittance in keV deg,

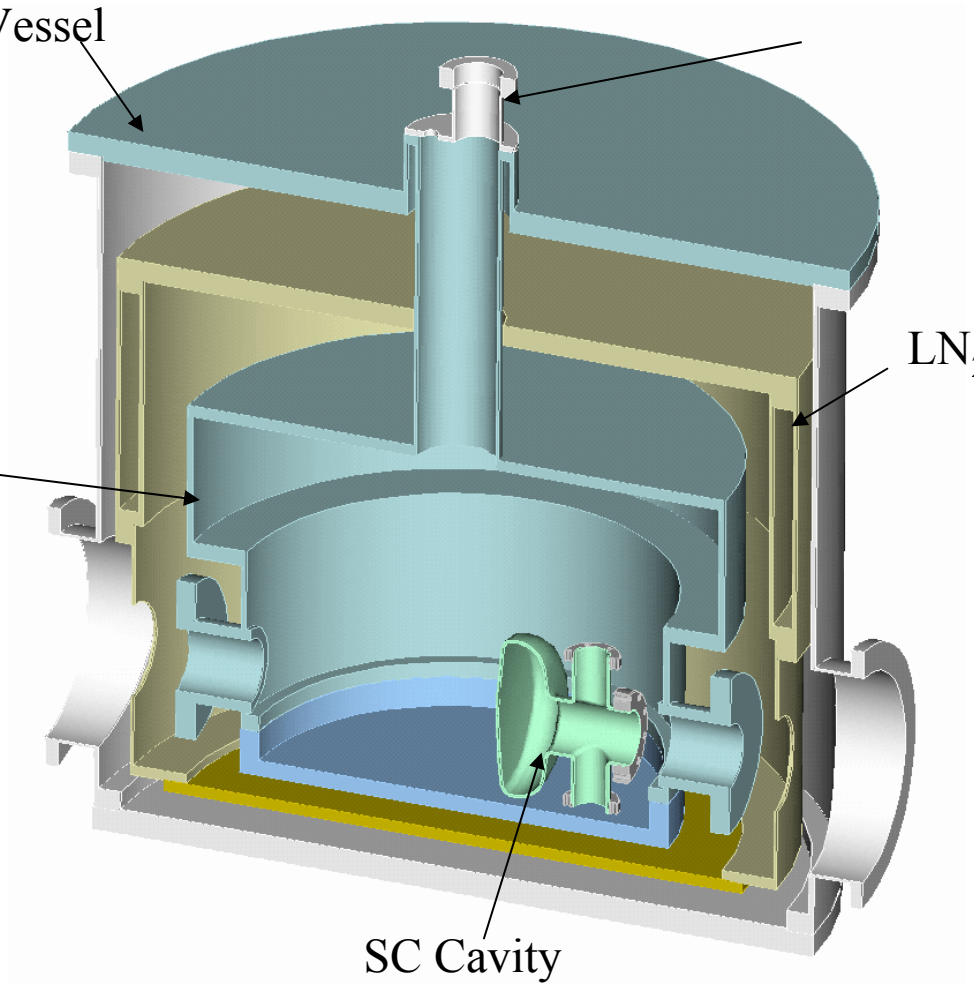
▲ Transverse emittance in mm mrad,

■ Energy in MeV


BNL Cavity #2
1400
1200
1000
800
600
400
200
0
delta f [kHz]
y = 31.803x - 20.683
0
5
10
15
20
25
30
35
40
Time [min] of BCP
Series1
Linear (Series1)


BNL Gun Cavity
Test #2
T=1.99K
Test #2
1.E+11
1.E+10
1.E+09
1.E+08
Q0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
Epeak [MV/m]

Cross Sectional View of The Cryostat



Photograph of Cryostat

Instrumentation

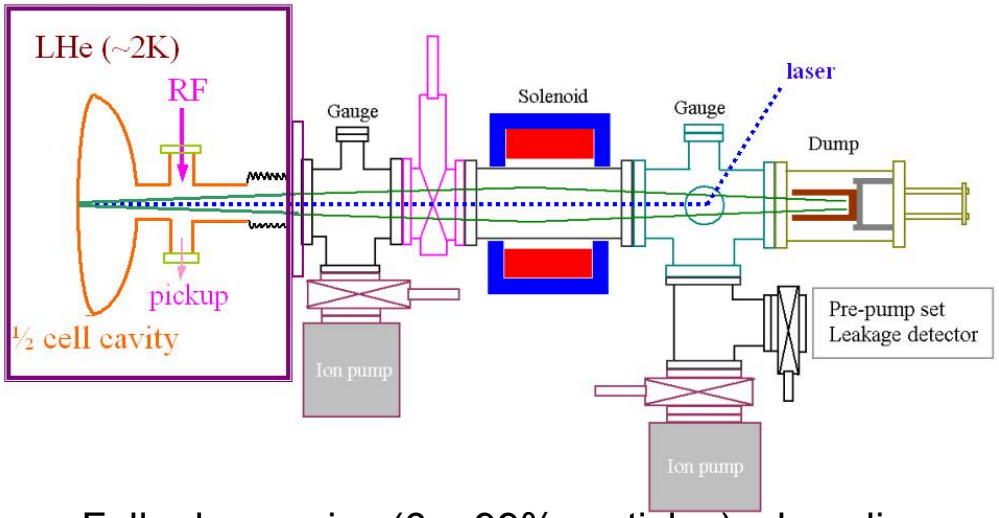
Level probes for LHe @ 2 K, 4K, and LN2

Temp. sensors for LHe, RF cavity and LN2 shield

Tested Without cavity at 70 K Measured shift of cavity during cooling is ~ 1.9 mm in downward direction

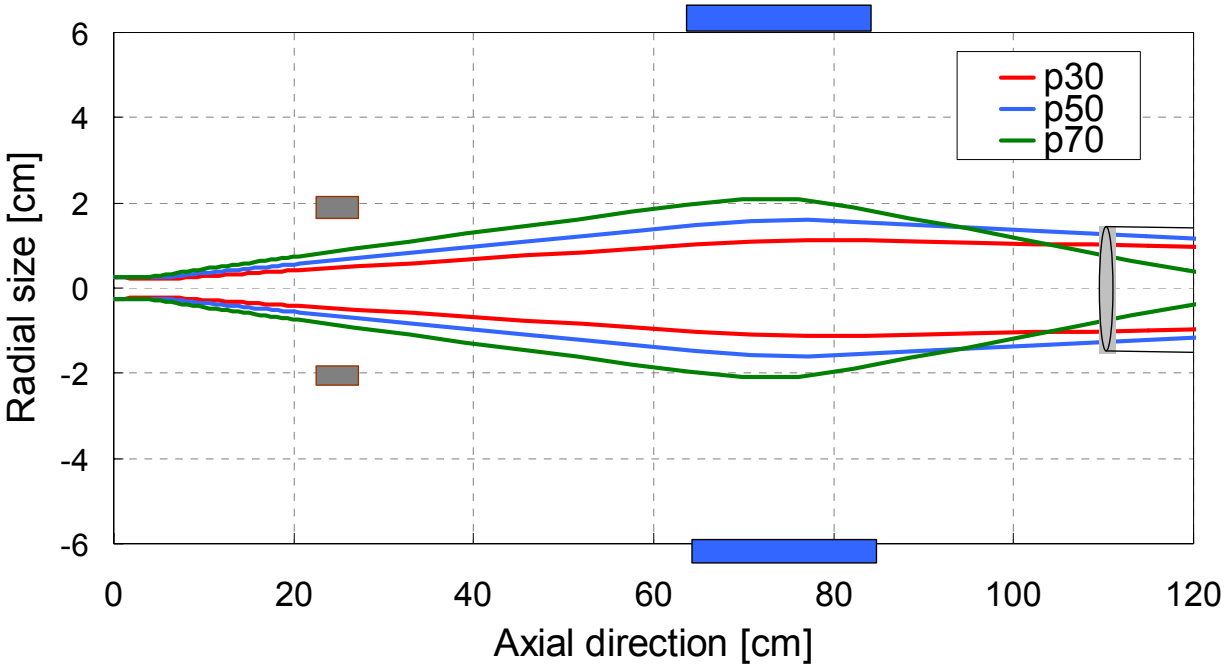
Beam Transport Line

ELECTRON BEAM TRANSPORT LINE



Full e-beam size (6σ, 99% particles) along line

Q=1pC, R=1.2mm, Ec=43MV/m, B=600Gs



Laser

Gain Medium: Nd:YVO_4

Power: 8W@1064nm,

2.3W@532nm,

150mW@ 266nm

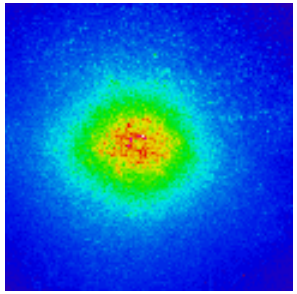
Repetition: 81.25 MHz

Pulse width: ~ 6 ps @ 266nm

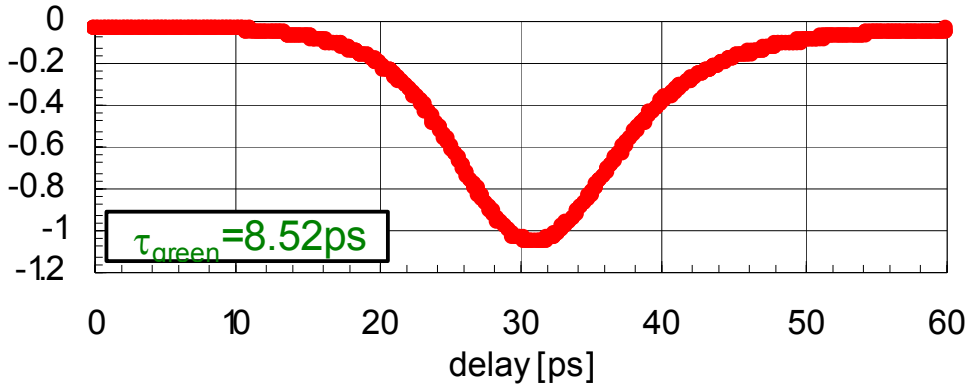
Divergence: 1.5 mrad (full angle) @ 266 nm

Pulse-to-pulse stability: 1.3% (pk-pk, rms)

Transverse Intensity profile of UV

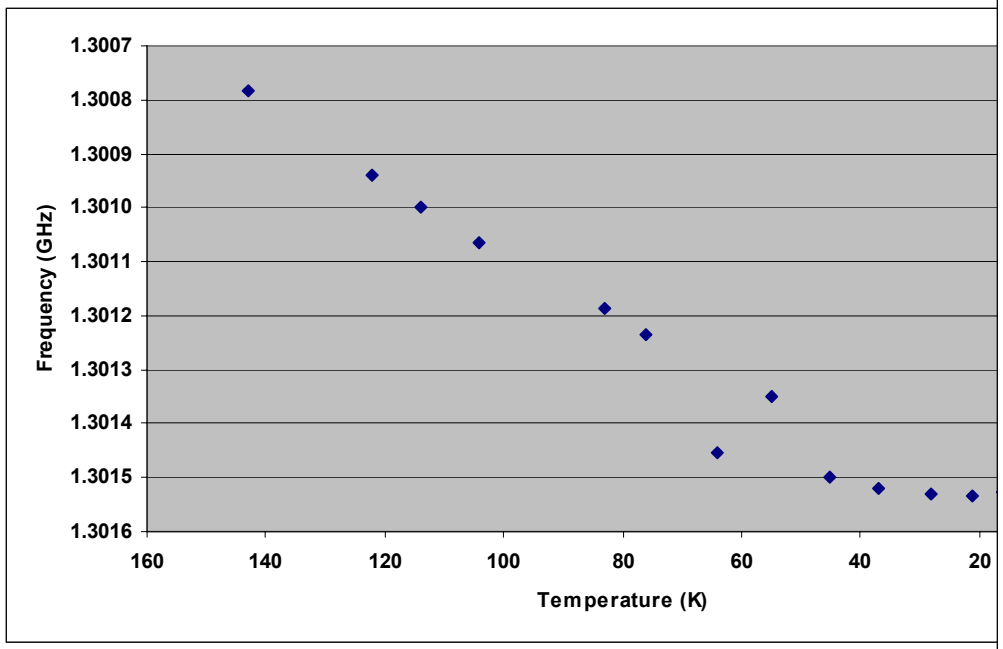


Autocorrelation of 532 nm beam

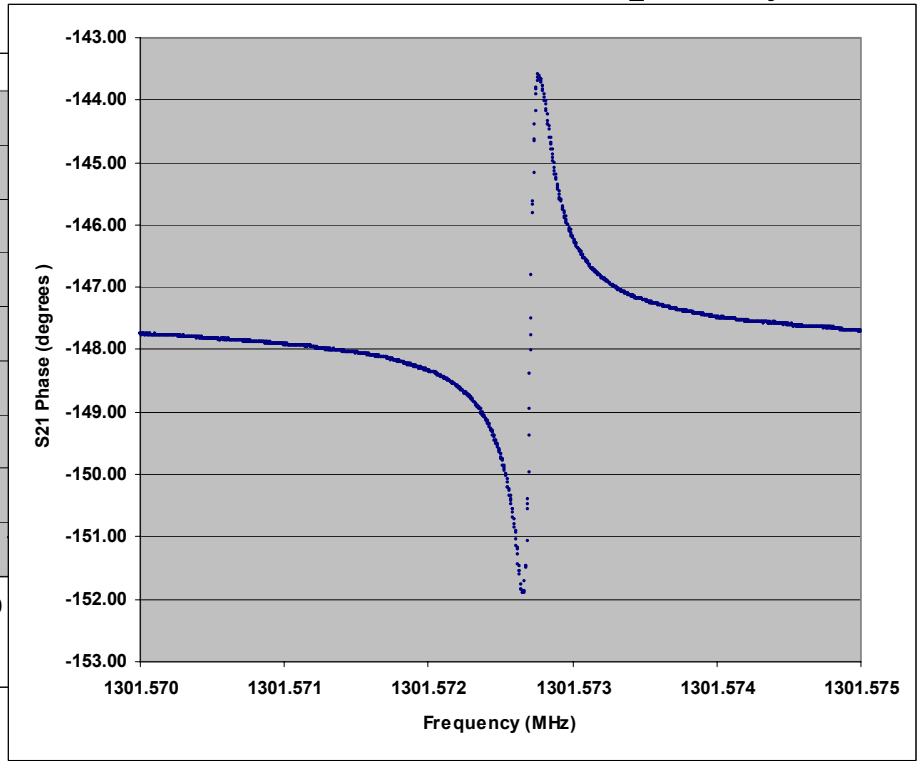


First Cool down results

Freq. Vs Temperature



RF Phase Vs Frequency



Cooled to 4 K. Undercoupled

Frequency: ~1301.5727 MHz,

Loaded Q:~1×10^7-Contaminants effect?

Future Plans

- Laser cleaning of the cavity
- Photoemission from the cavity
- High power RF into the cavity
- QE, emittance measurements

- Design and Modify to accept secondary emitter
- Secondary emission measurements