

U.S. LARP Large Hadron Collider
Accelerator
Research
Program



Gaussian TEL gun progress

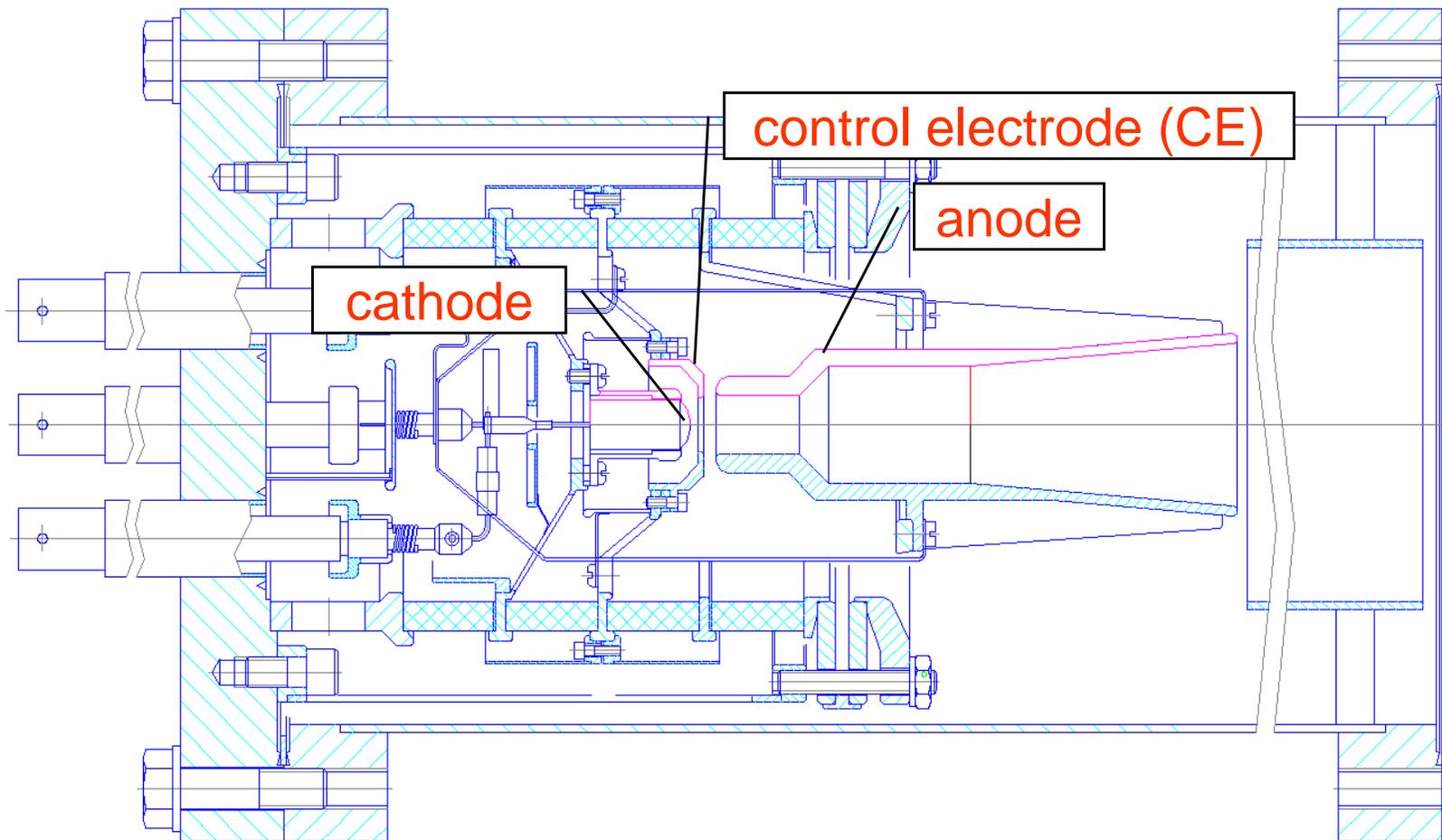
V. Kamerdzhev, G. Kuznetsov, V. Shiltsev

LARP Collaboration Meeting 10
Danfords on the Sound, Port Jefferson, NY, April 23-25, 2008



The e-gun design

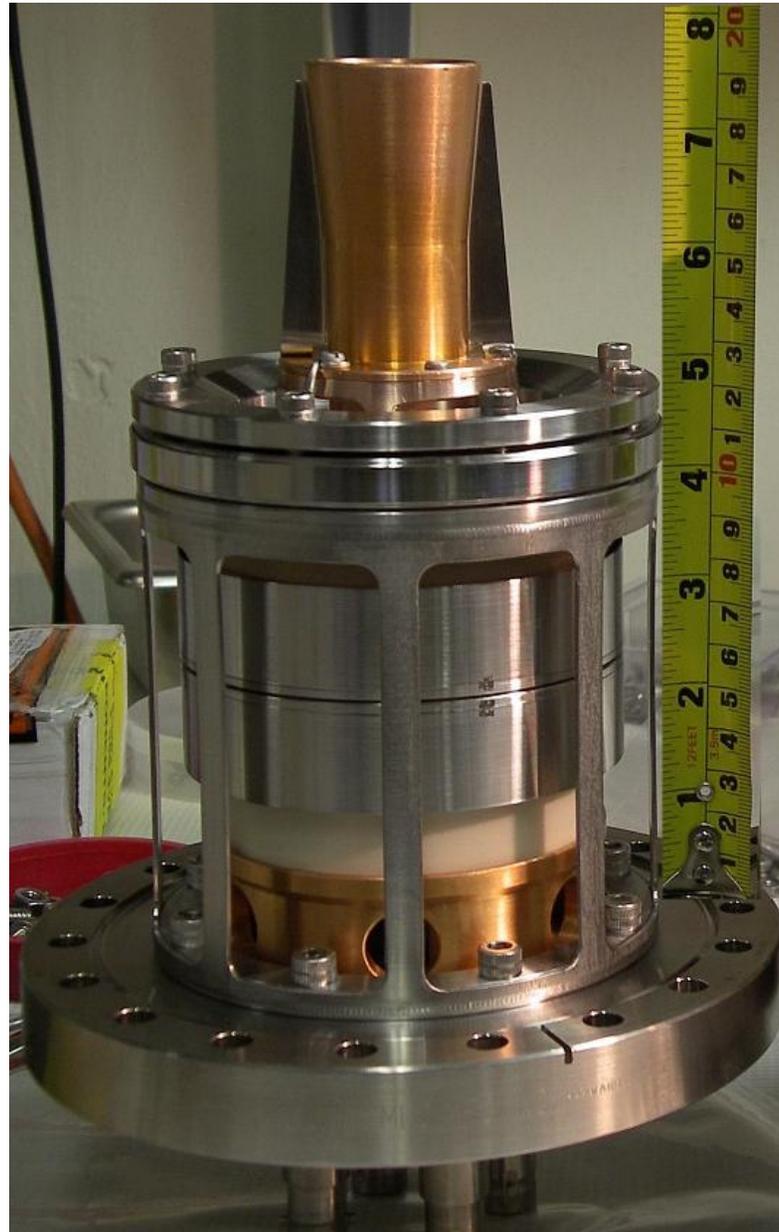
The electrode geometry is optimized for generating Gaussian-like transverse current density distributions (profiles) using SuperSam/UltraSam code*



* M. Tiunov, INP Novosibirsk, Russia



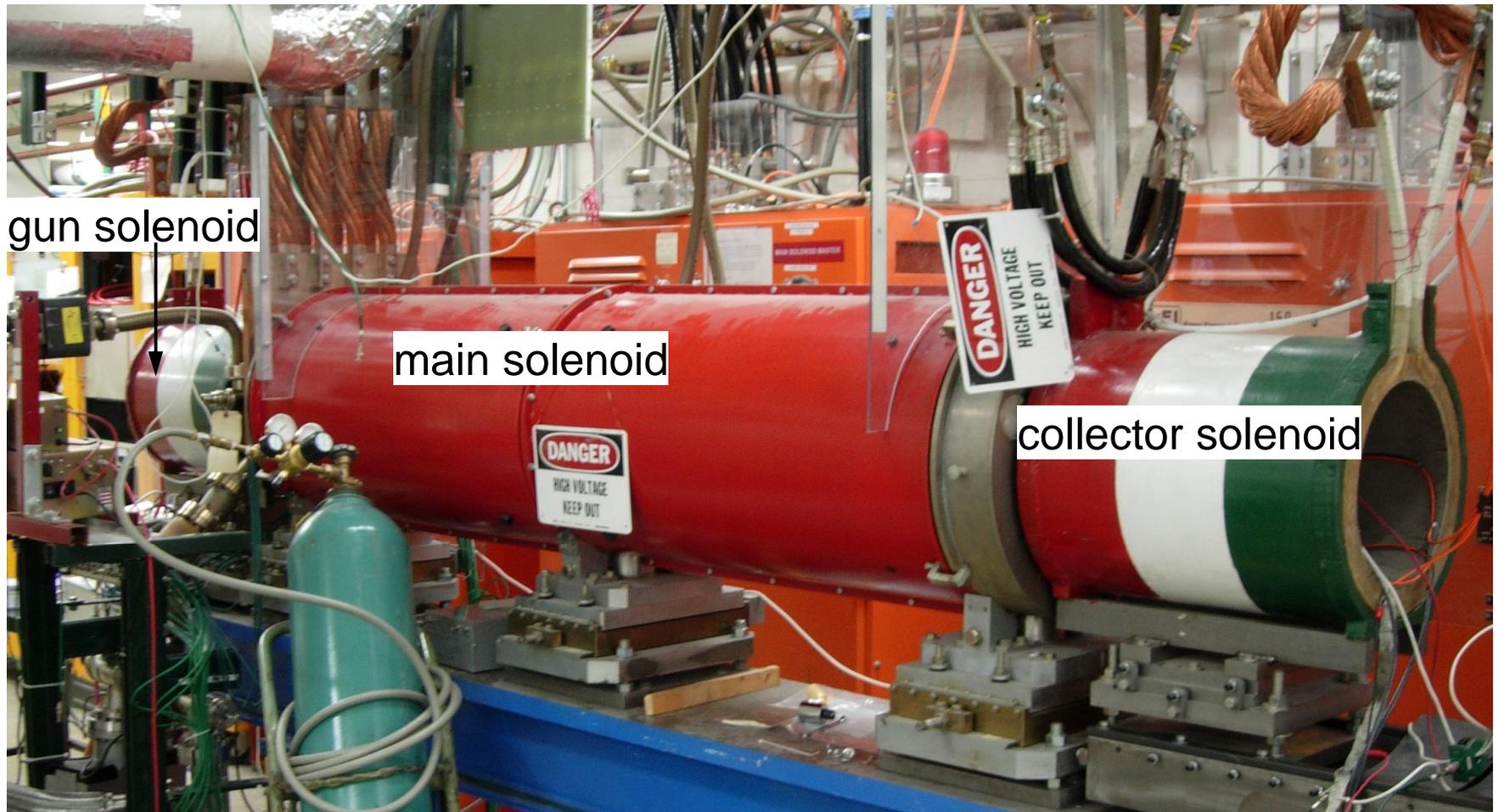
The electron gun



assembled on a
6 $\frac{3}{4}$ conflat flange

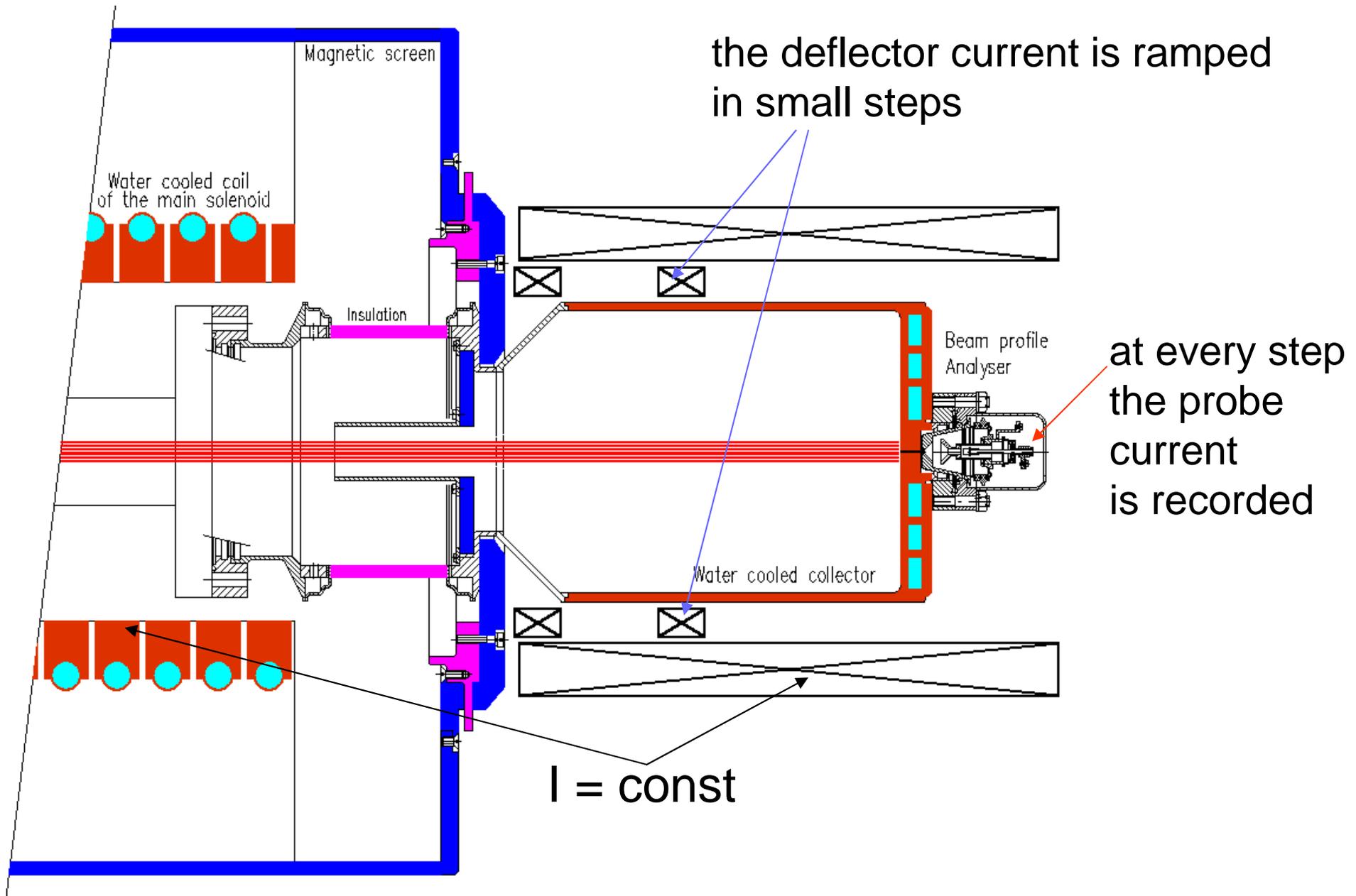


The test bench



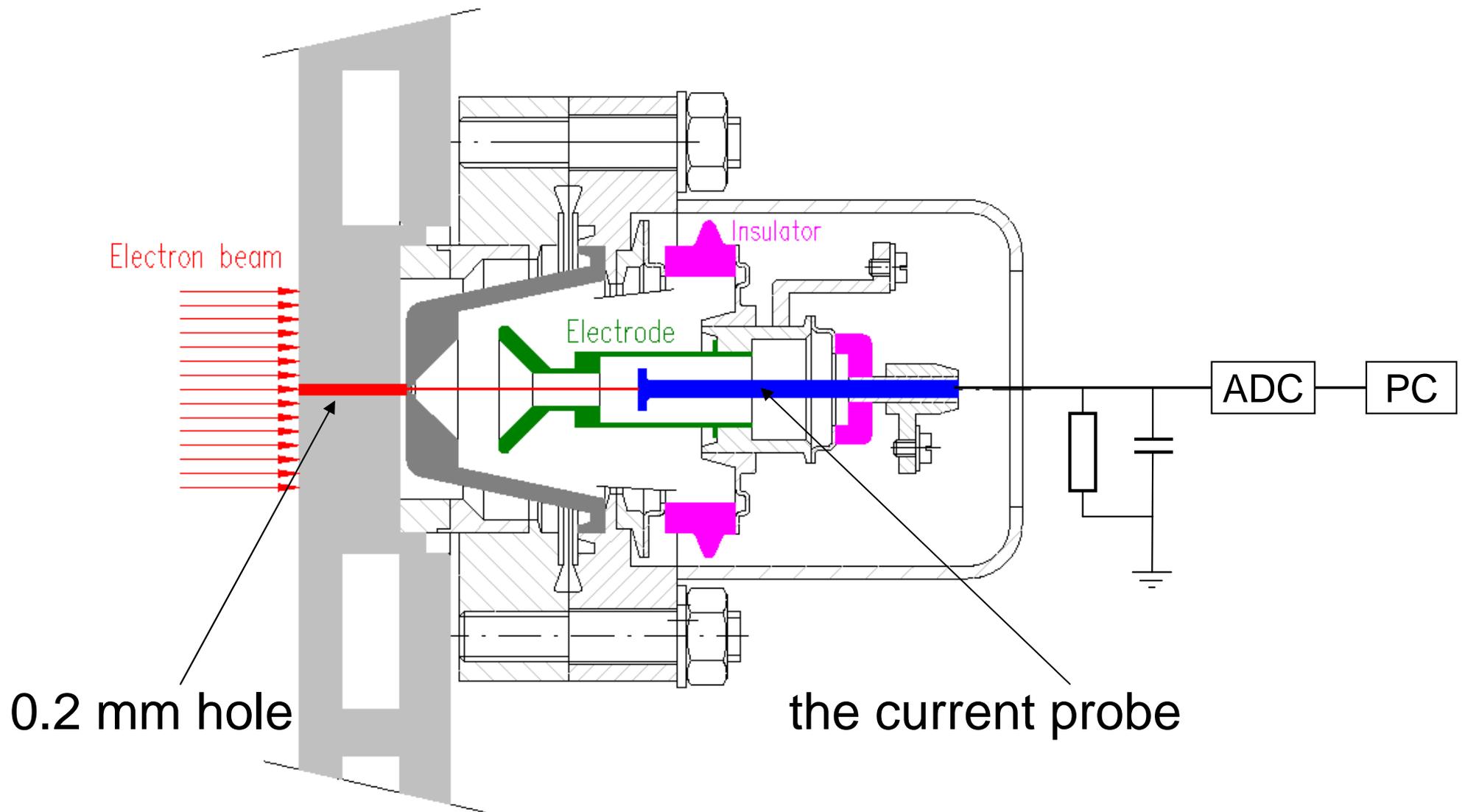


Profile measurement technique



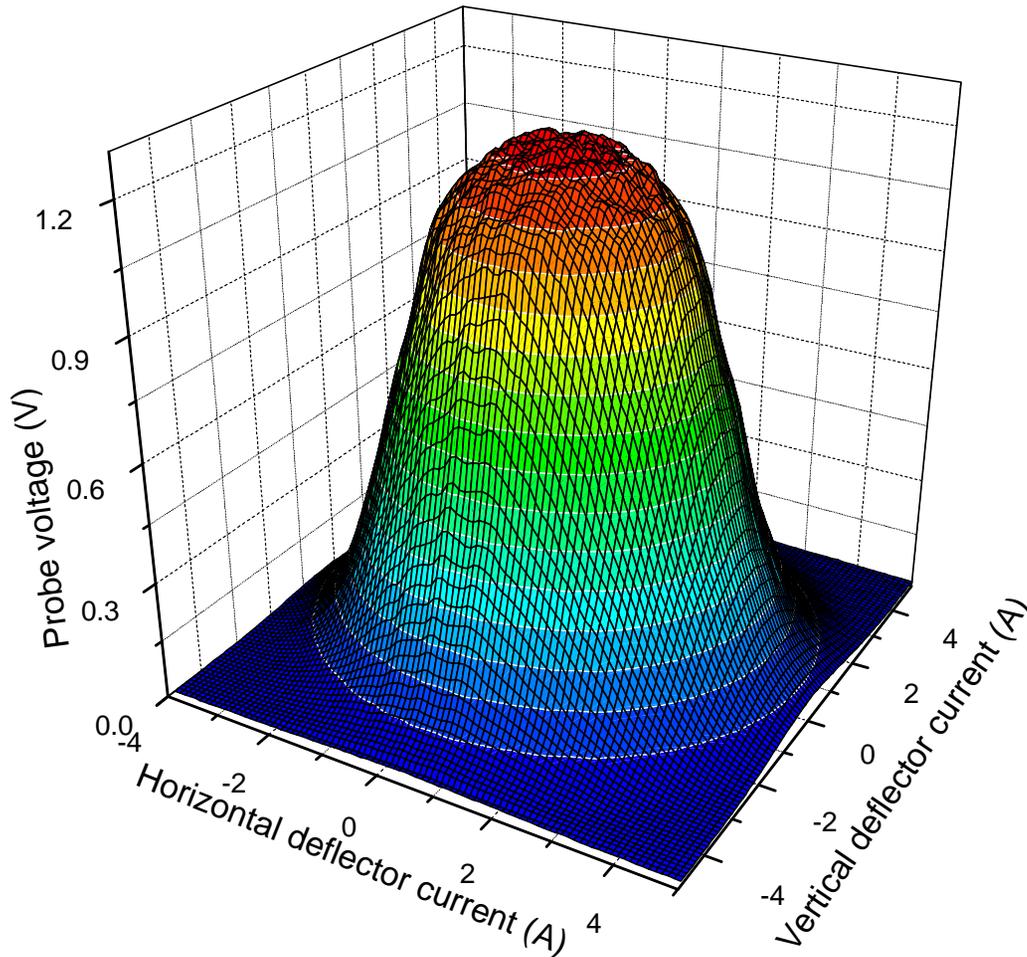


Electron beam analyzer





3D current density distribution @ 8kV



Gaussian electron gun
0.4" cathode

Current density
distribution

$$U_{\text{cath}} = -8\text{kV}$$

$$U_{\text{ce}} = -8\text{kV}$$

$$U_{\text{anode}} = -8.35\text{kV, Gnd}$$

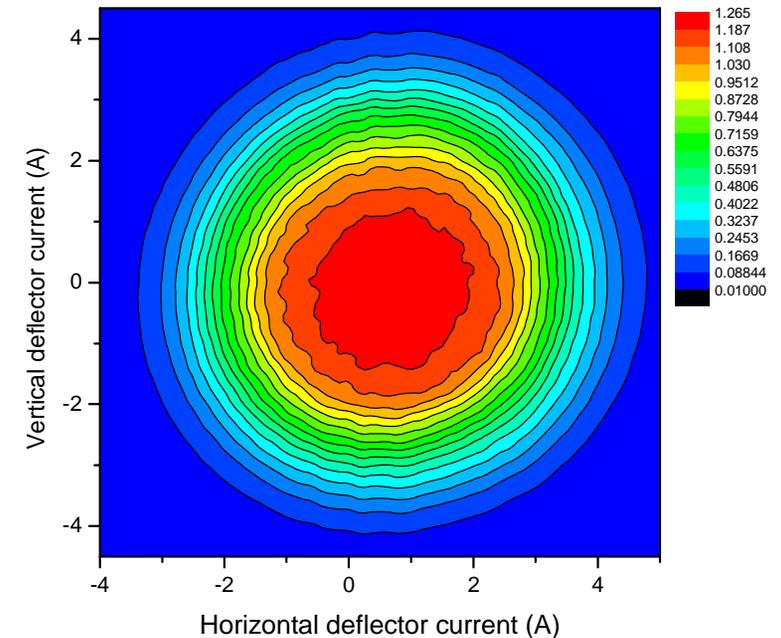
$$B_{\text{gun}} = 1.5\text{kG}$$

$$B_{\text{main}} = 2\text{kG}$$

$$B_{\text{col}} = 1.5\text{kG}$$

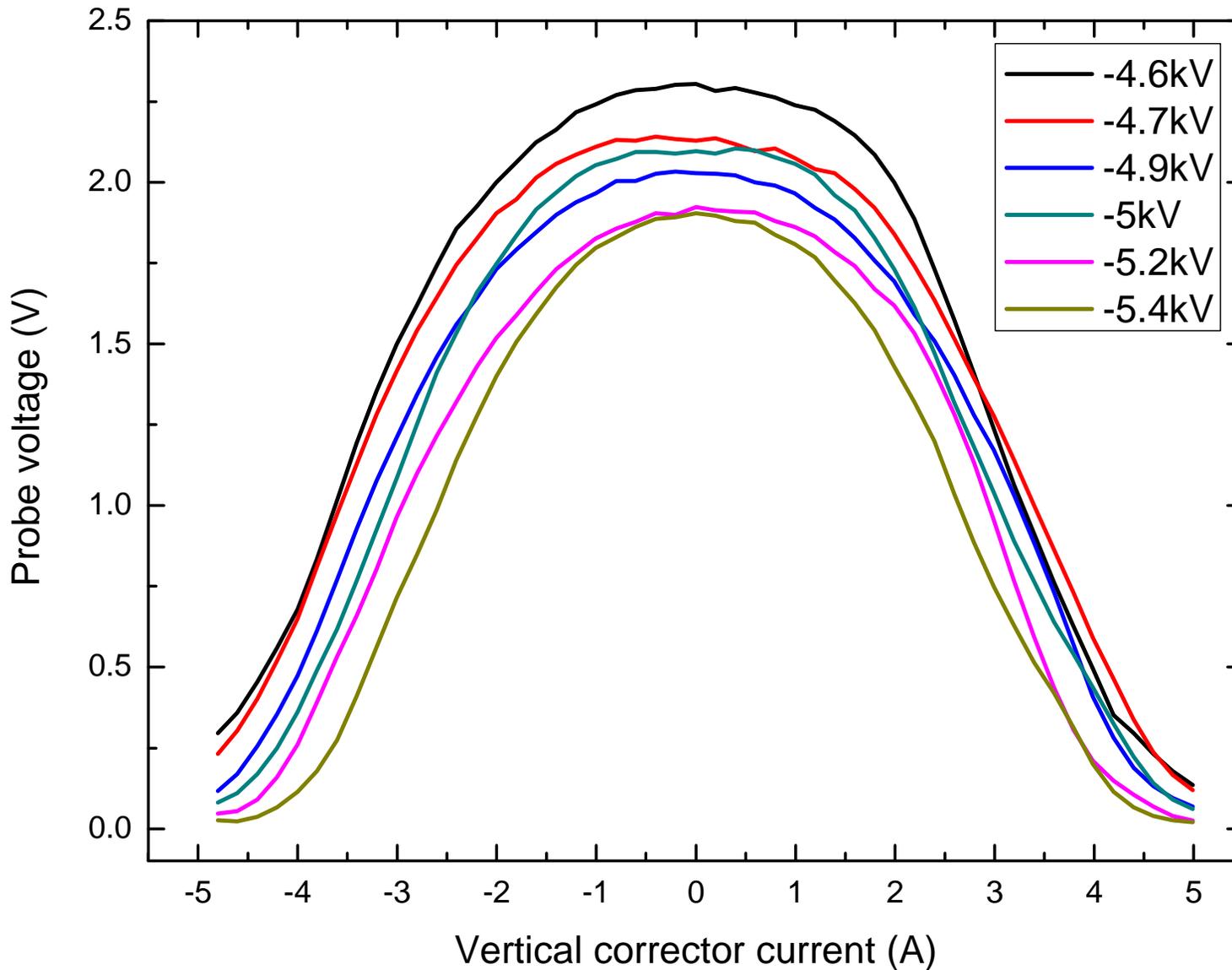
$$F = 65\text{Hz}$$

$$PW = 4\mu\text{s}$$





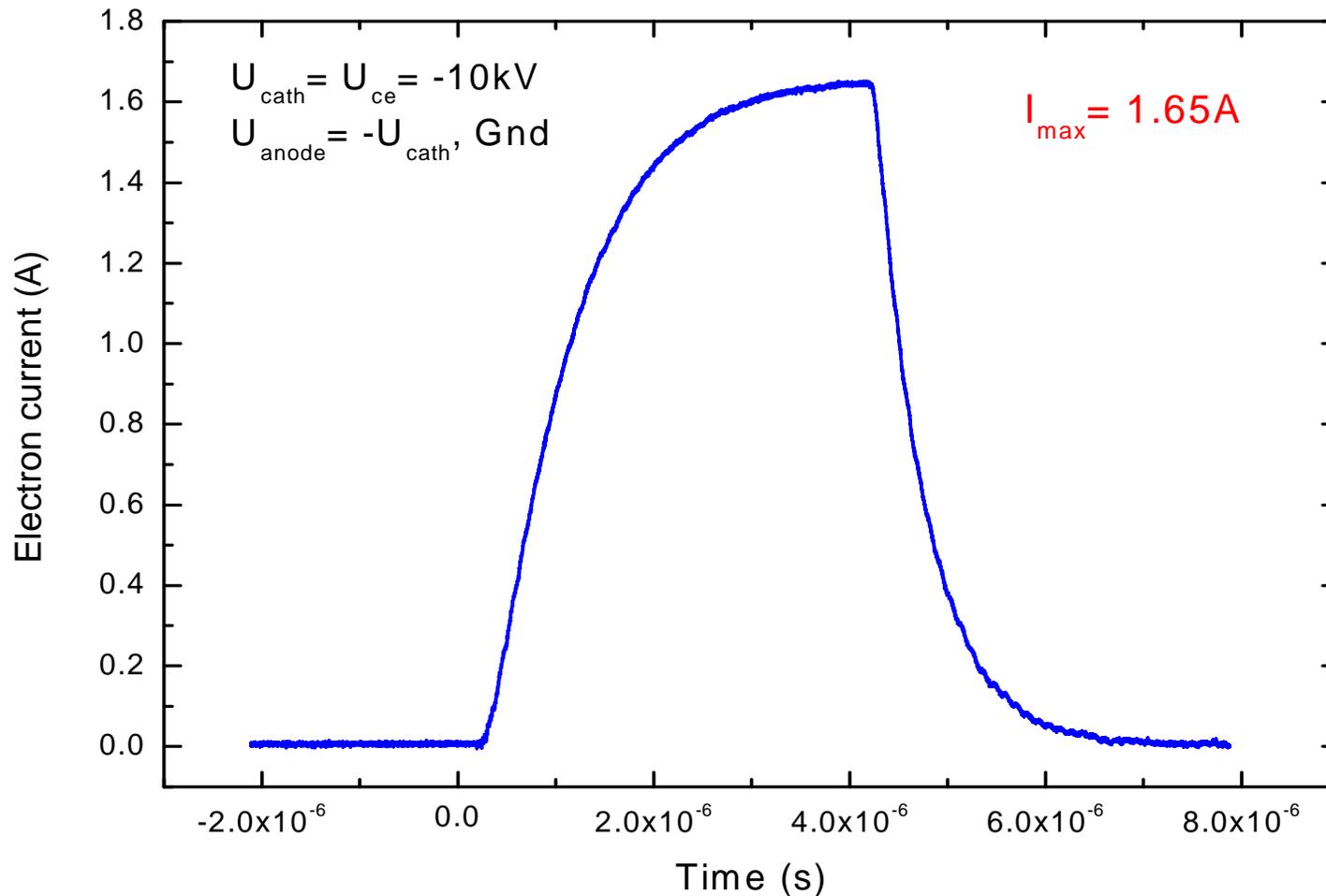
Profiles vs U_{ce} @ $U_{cath} = 5kV$





Maximum ratings

$U_{\text{cath}} = -10\text{kV}$; $U_{\text{anode}} = U_{\text{cath}}, \text{Gnd}$; $I_{\text{peak}_{\text{max}}} = 1.65\text{A}$; @ $B_{\text{gun}} = 4\text{kG}$; $5 \cdot 10^{-9} \text{Torr}$



The rise/fall time is defined by the driver circuit. Applying positive voltage to the CE in respect to the cathode will result in higher peak electron current



Summary

- The Gaussian electron gun was successfully tested on the test bench at up to 10kV
- What to do next
 - install the Gaussian e-gun in one of the TELs
 - since the e-p beam alignment is very critical we need to figure out the best way to achieve/maintain optimum e-p alignment
- the Digital Tune Monitor seems to be the best candidate capable of detecting the tune spread change (work in progress)



Backup slides

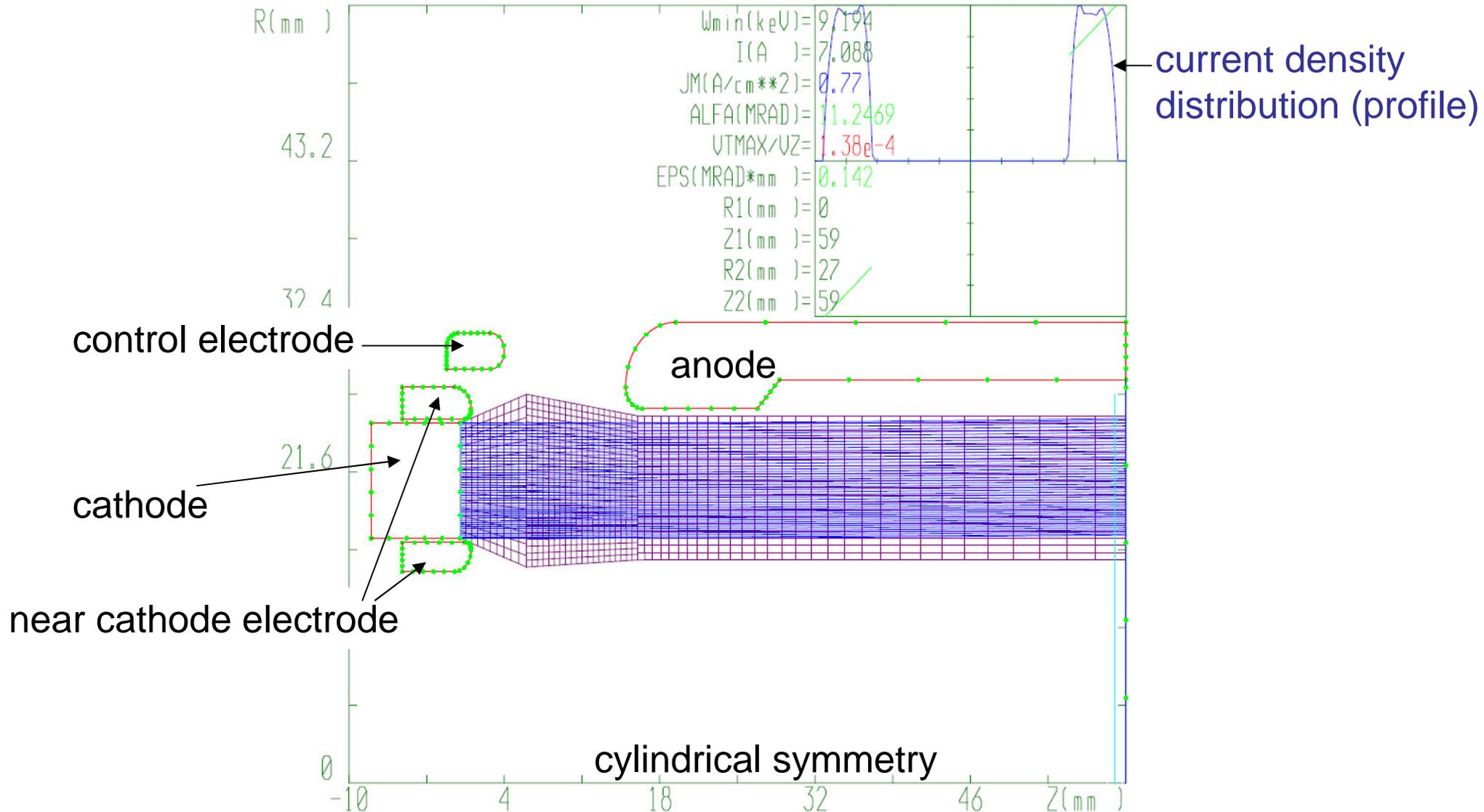
- proposed hollow electron beam for LHC collimation system
 - e-gun simulations are performed using UltraSam code
 - simulations done by L. Vorobiev
 - mechanical considerations by G. Kuznetsov
- goals
 - keep the transverse electron energy low
 - extract as much current as possible
 - simulate e-beam compression in solenoidal magnetic field



Hollow e-beam for LHC collimation system

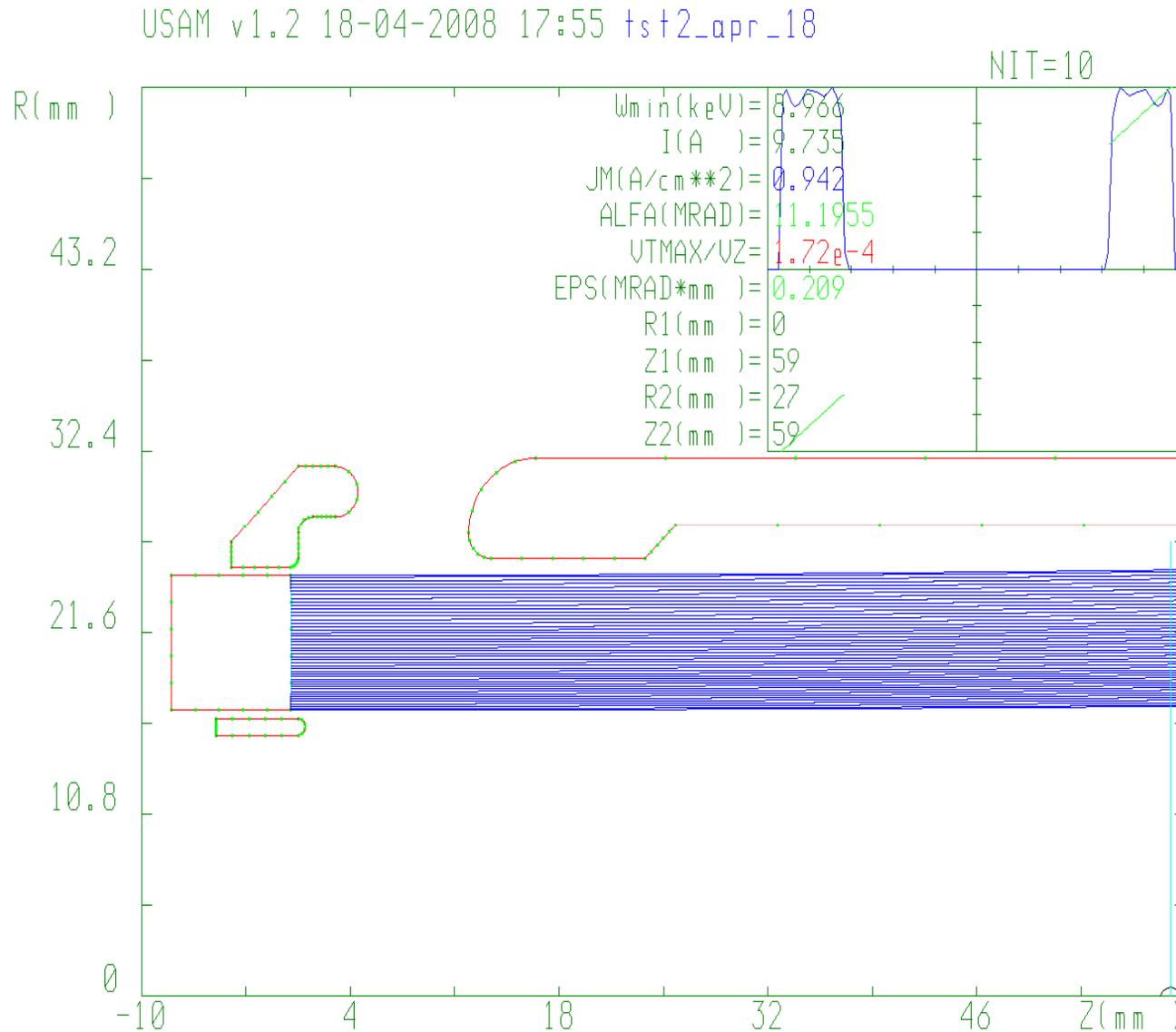
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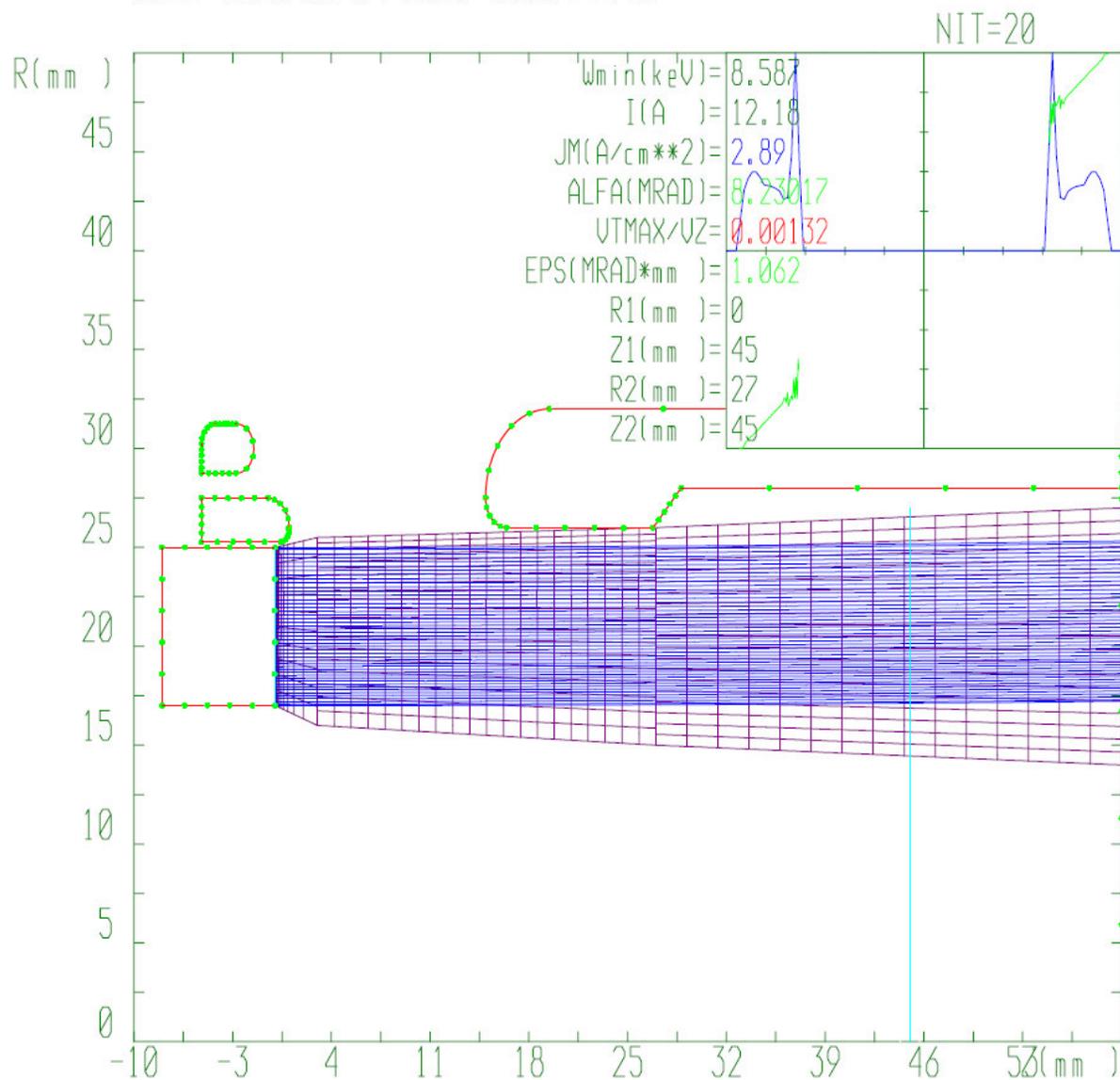
Example 2





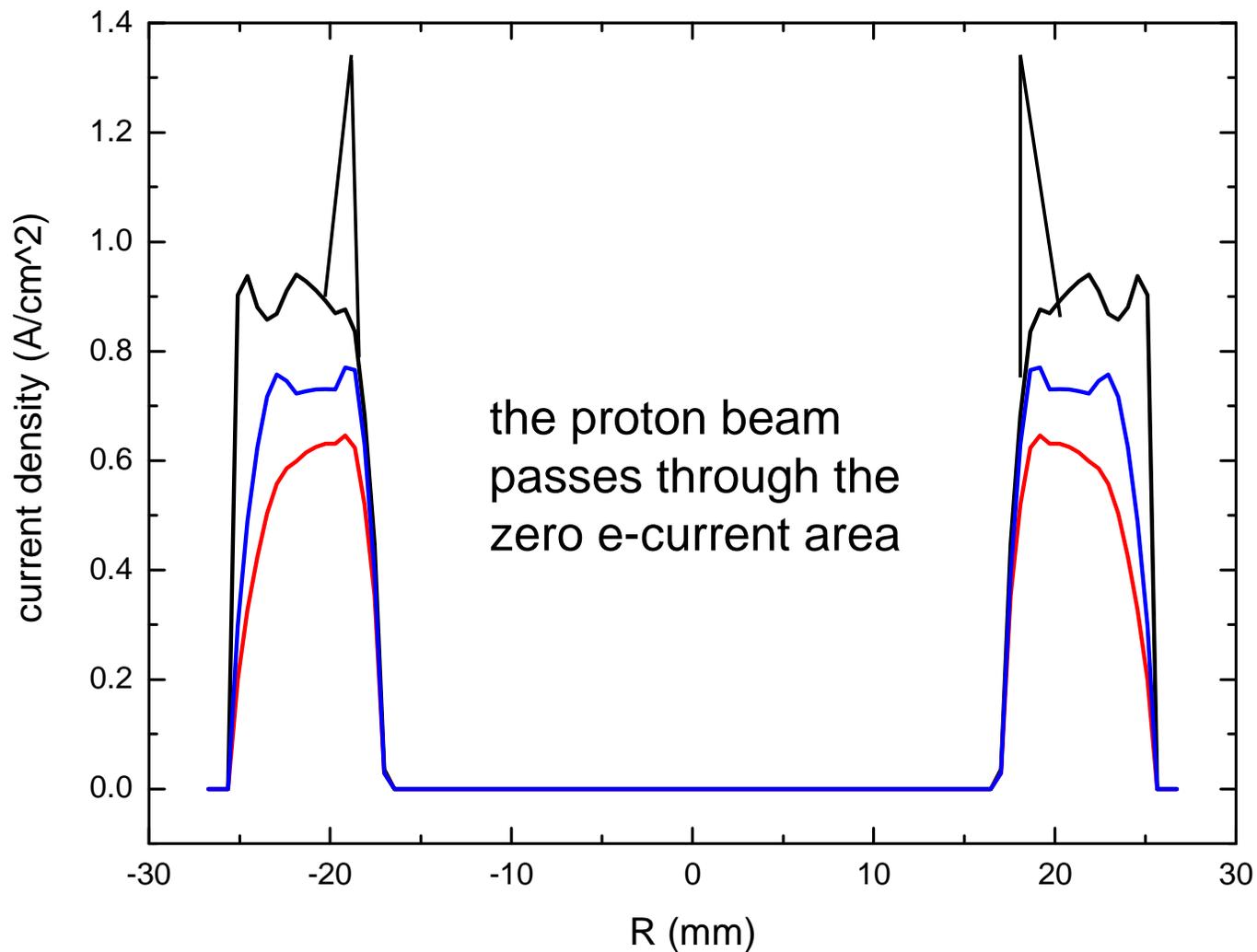
Example 3

USAM v1.2 11-04-2008 16:54 ts+2





Simulated profile comparison





Summary

- the “hollow” gun can be simulated with the tools we have (Super/Ultra SAM)
 - first look shows promising results
- mechanical design looks doable
- the infrastructure for testing the gun (once it’s been built) is available
- we plan to continue the development and demonstrate the detailed design