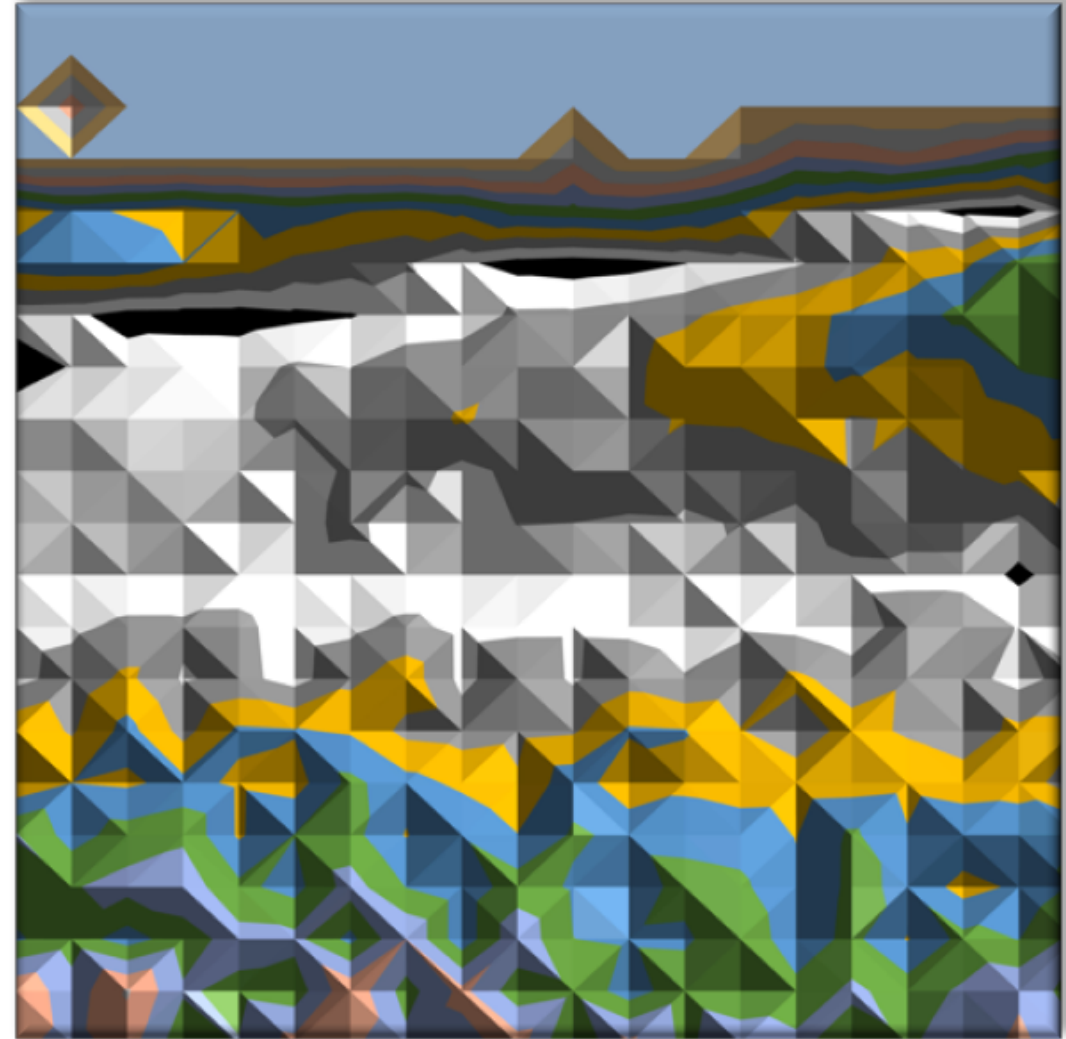


Improving Ion Transport Using Monte Carlo Optimization Methods

Jake Flowerdew
University of Calgary
TITAN Collaboration



Ion Optics

- Want to optimize emittance, transmission etc.
- Avoid dumping energy in sensitive equipment.
- Increase number of particles
Increase resolution of experiment.

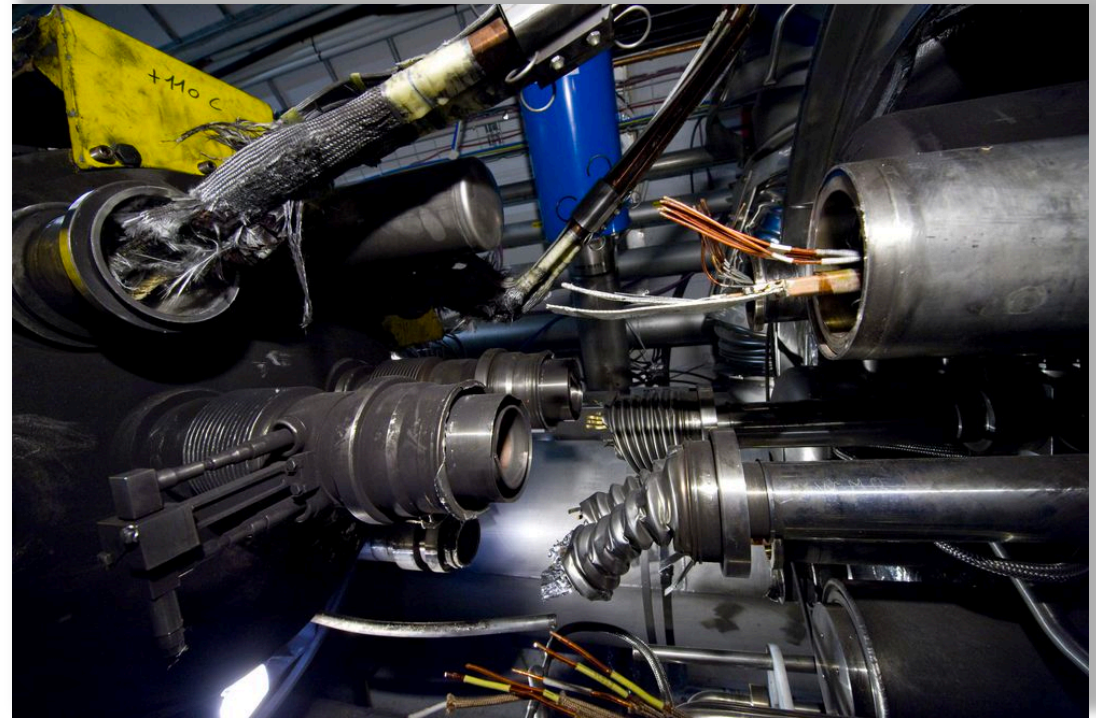


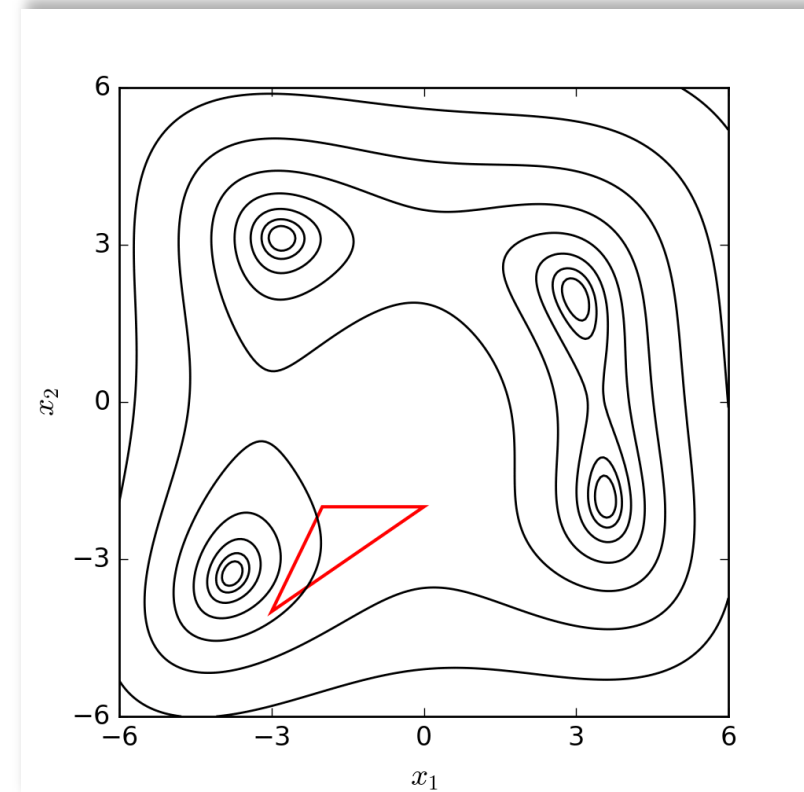
Image: LHC, CERN

Using Simulations Intelligently

- SIMION simulations can be flexibly adapted by writing user programs in lua.

Simplex Optimization Method

- Applied to non-linear optimization problems (gradient free)
- Uses reflections and stretches of a simplex to converge to a minimum
- Heuristic search – not guaranteed to find the global minimum

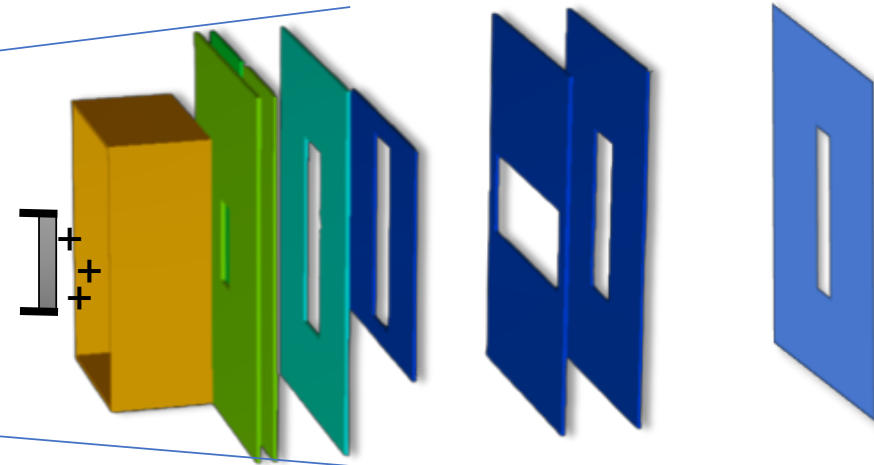
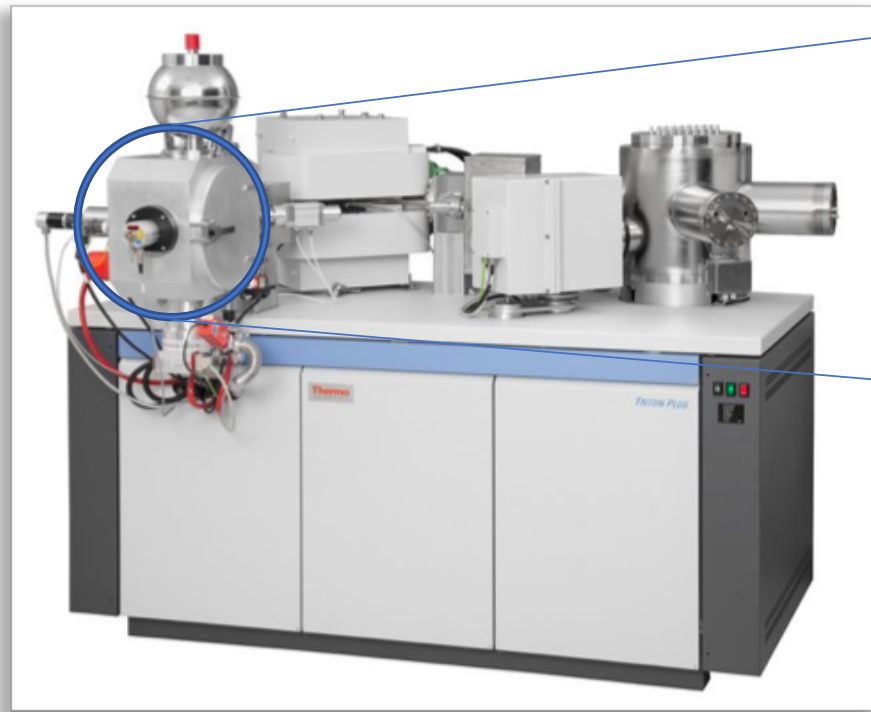


Source:

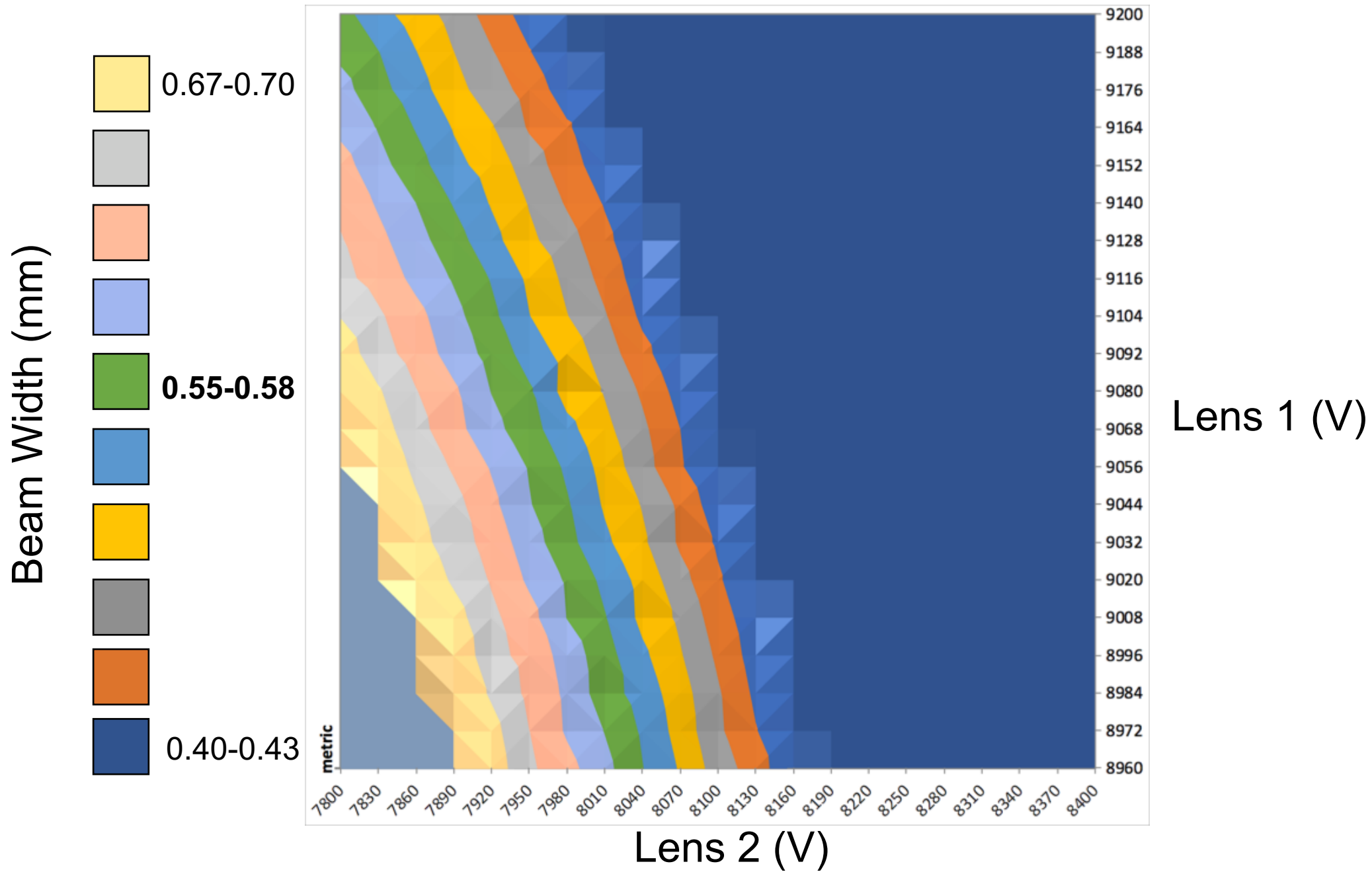
<http://creativecommons.org/licenses/by/4.0>

(nicoguaro)

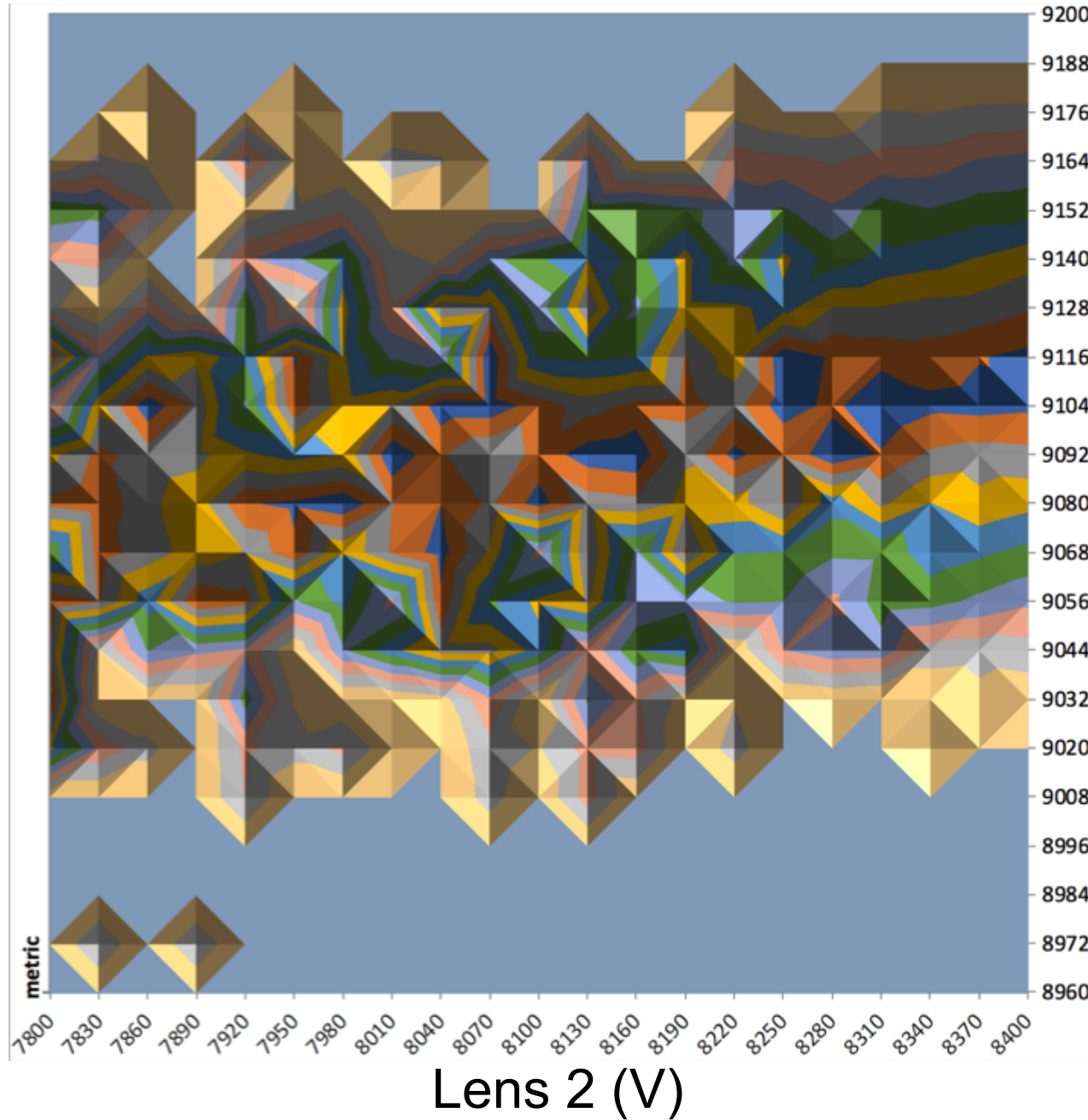
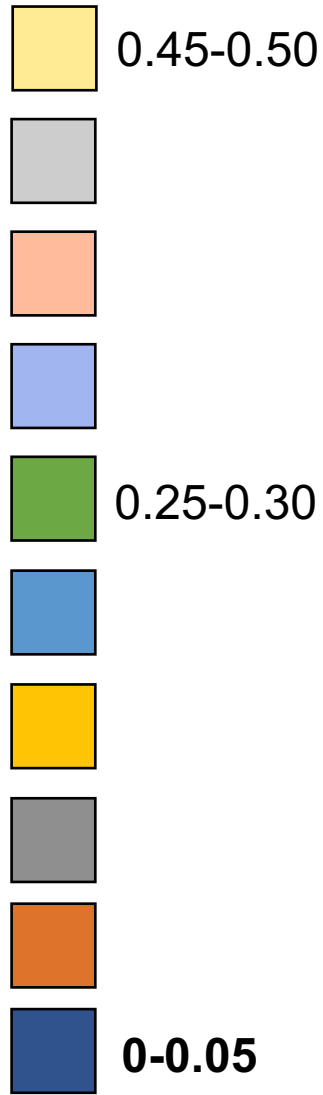
Optimizing Intensity in a Thermal Ionization Mass Spectrometer



- Voltages on three electrostatic lenses were varied to maximize illumination of exit slit & therefore intensity.



Beam Position
(off propagation axis, mm)



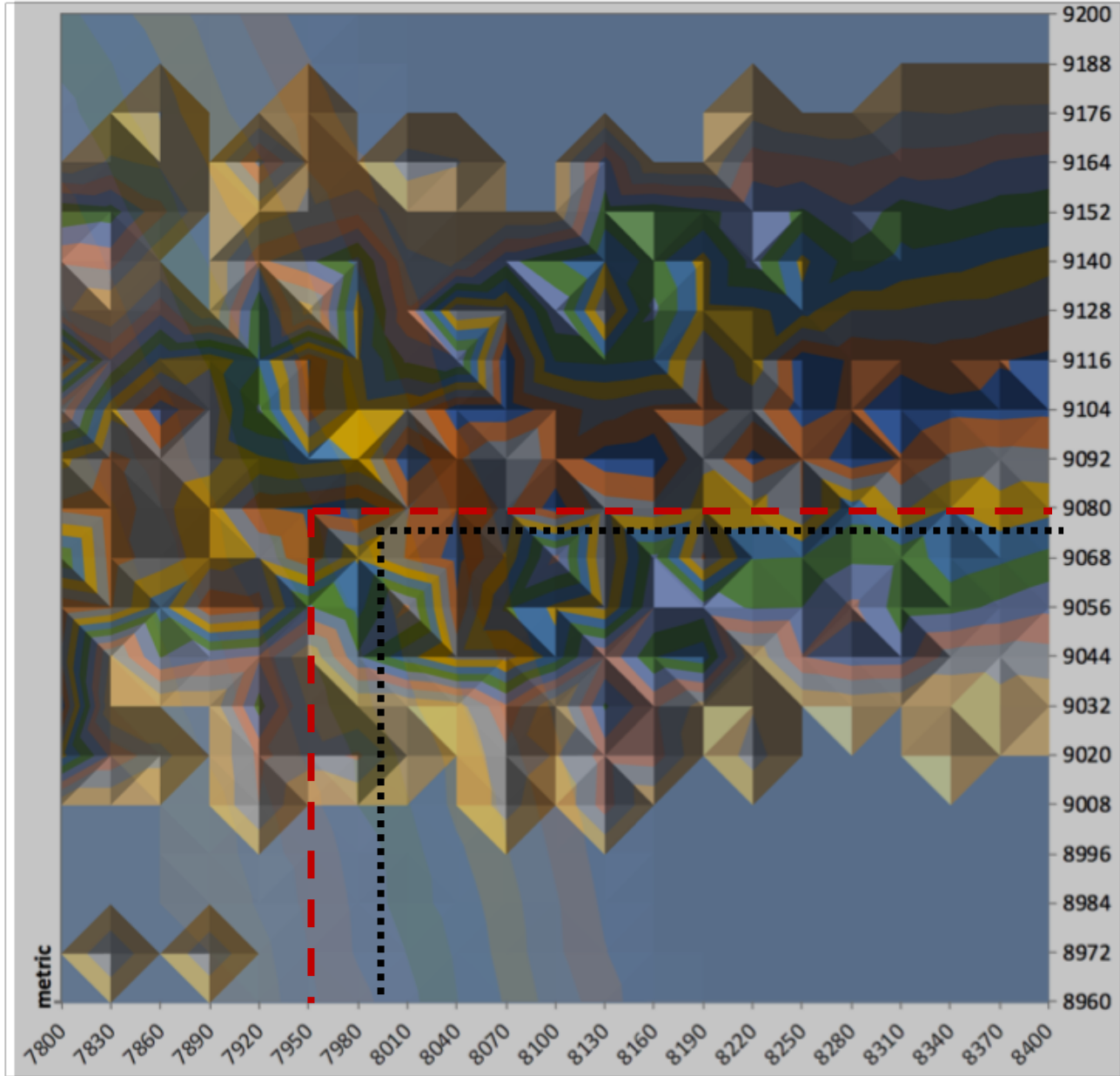
Lens 1 (V)

Lens 2 (V)

Mass Spec.
Auto Tune

Graphical
Optimum

□ 44%
improvement
in intensity
from Mass
Spec. Auto
tune!



Lens 1 (V)

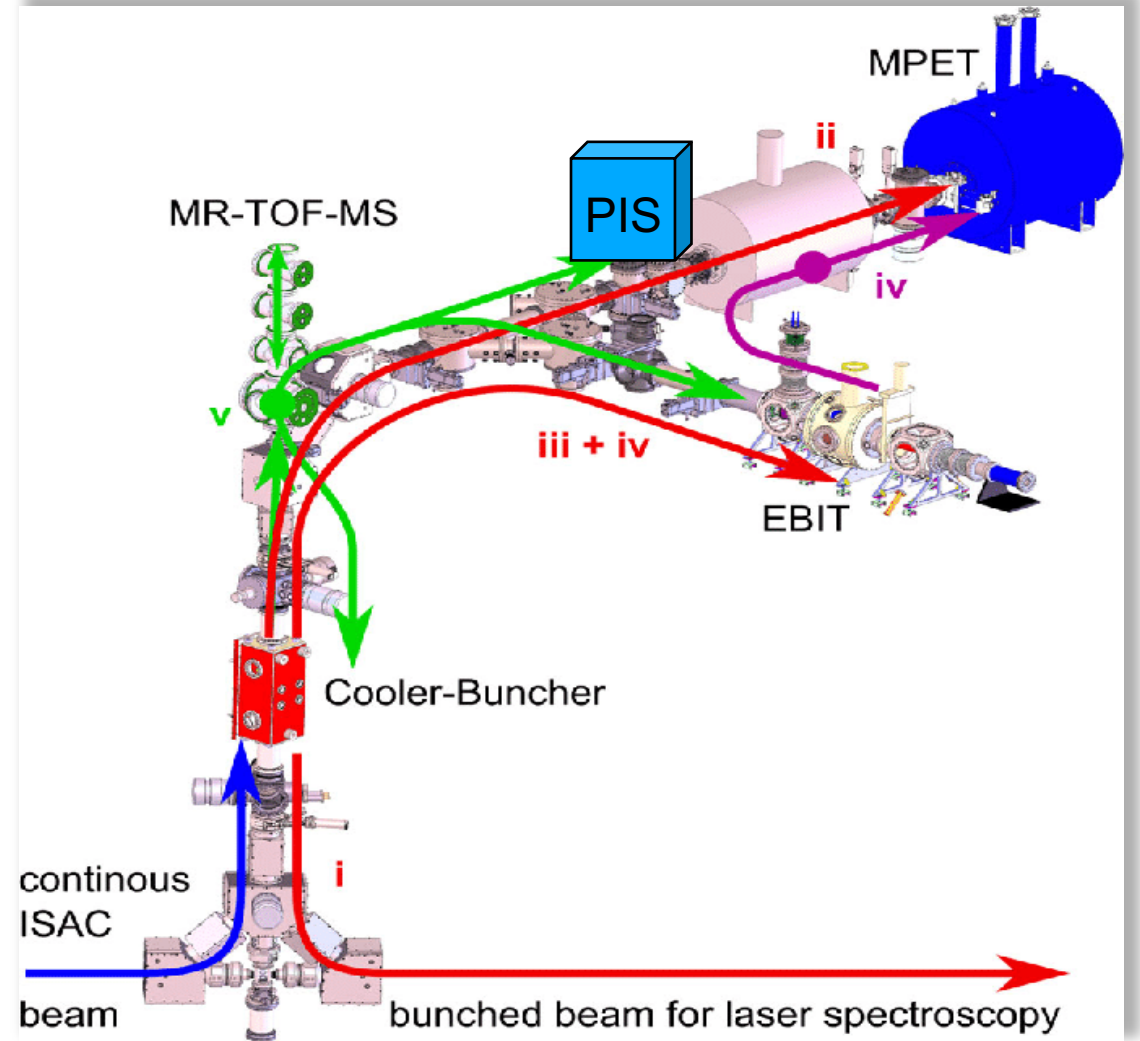
Lens 2 (V)

TITAN's Beamline

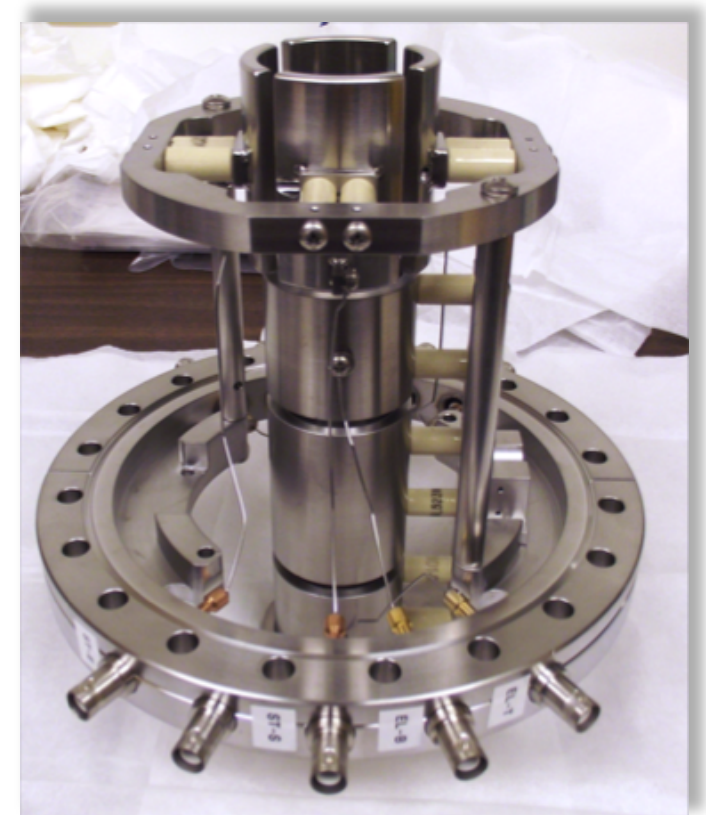
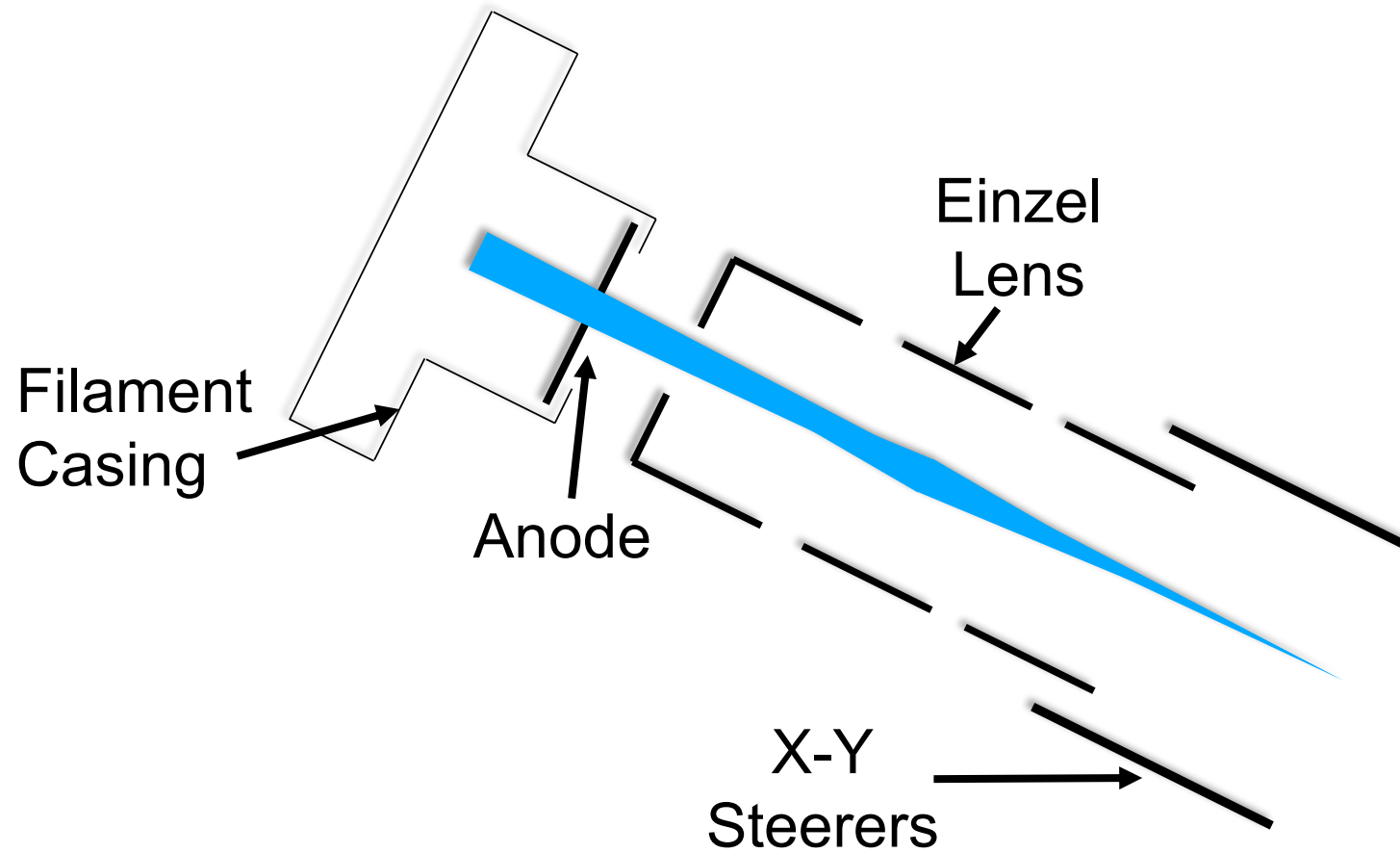
- TRIUMF's Ion Trap for **A**tomical & **N**uclear Science.
- Specialises in high precision mass measurements of short lived isotopes.

Plasma Ion Source Motivation

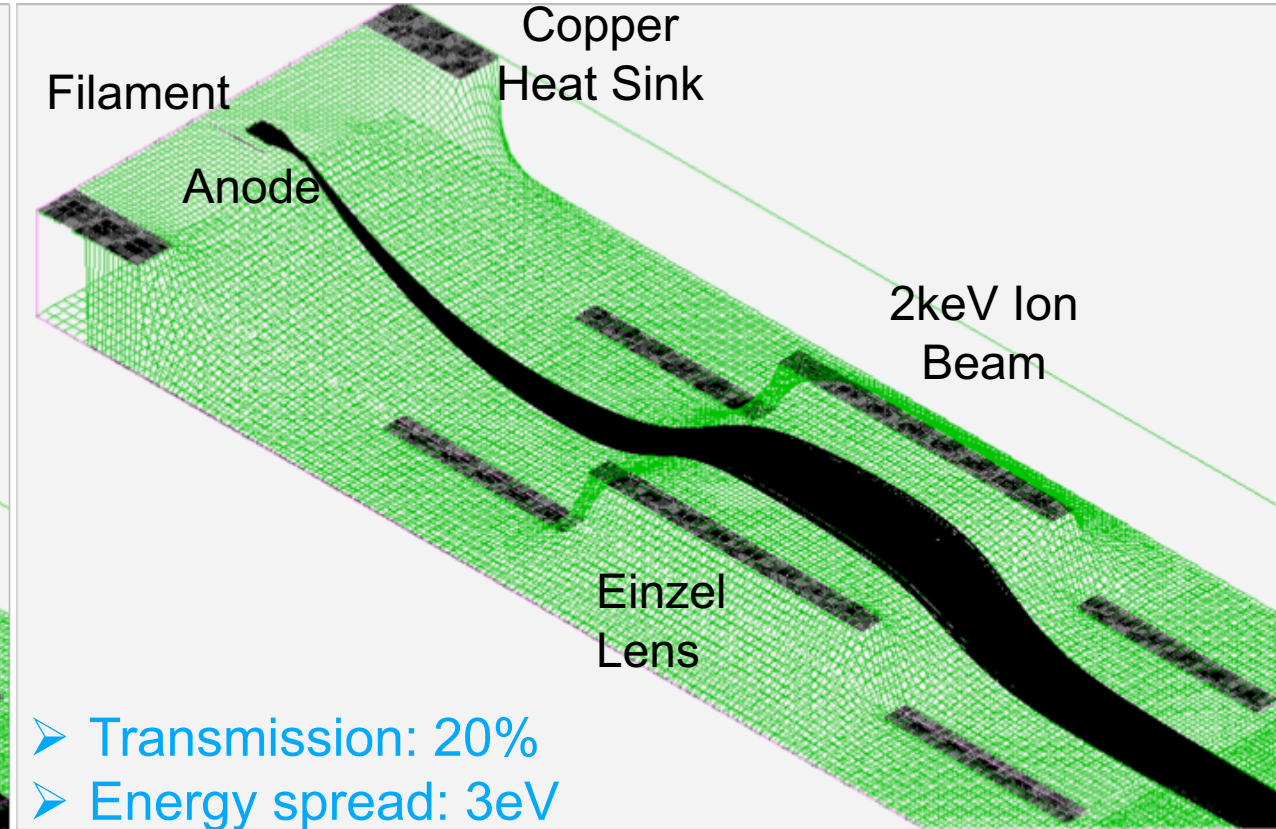
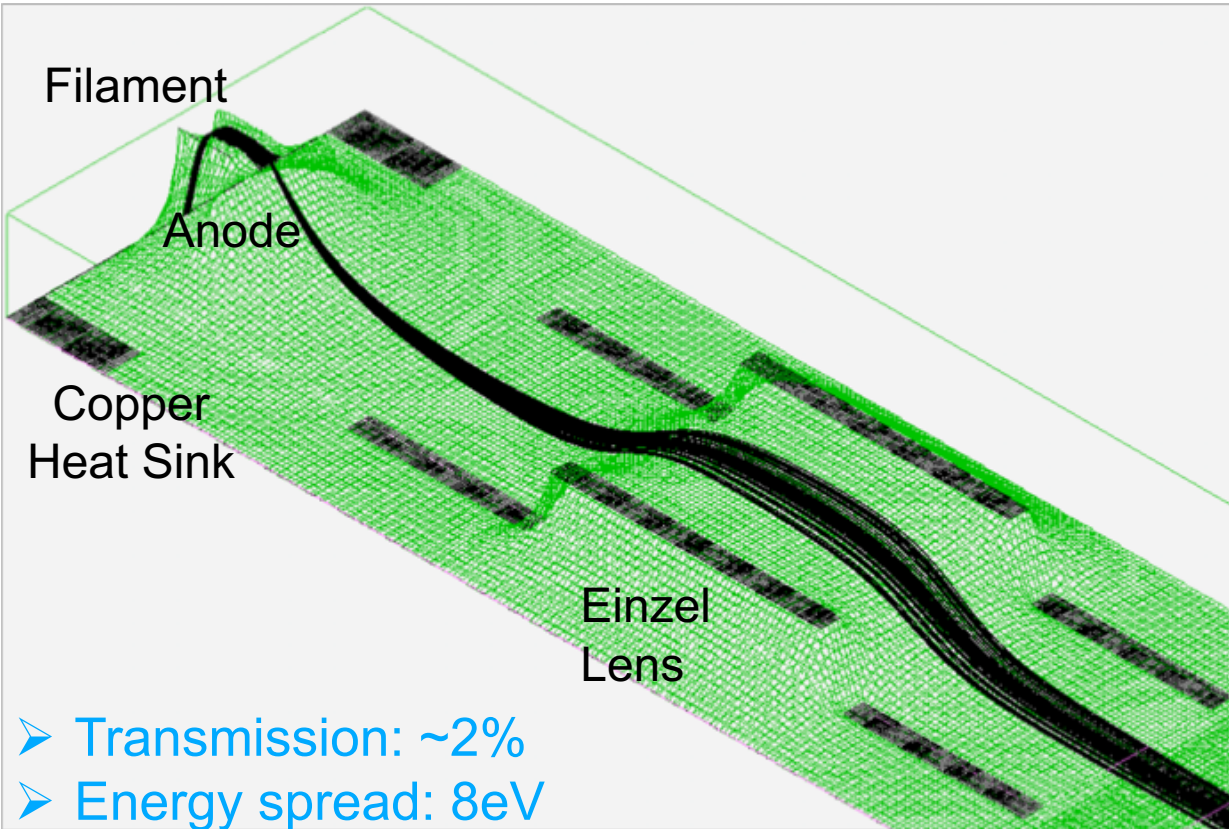
- Gives TITAN more variety in the samples it could ionize i.e. gas samples.
- Provide important stable calibrants to MPET and EBIT.



Plasma Ion Source Schematic

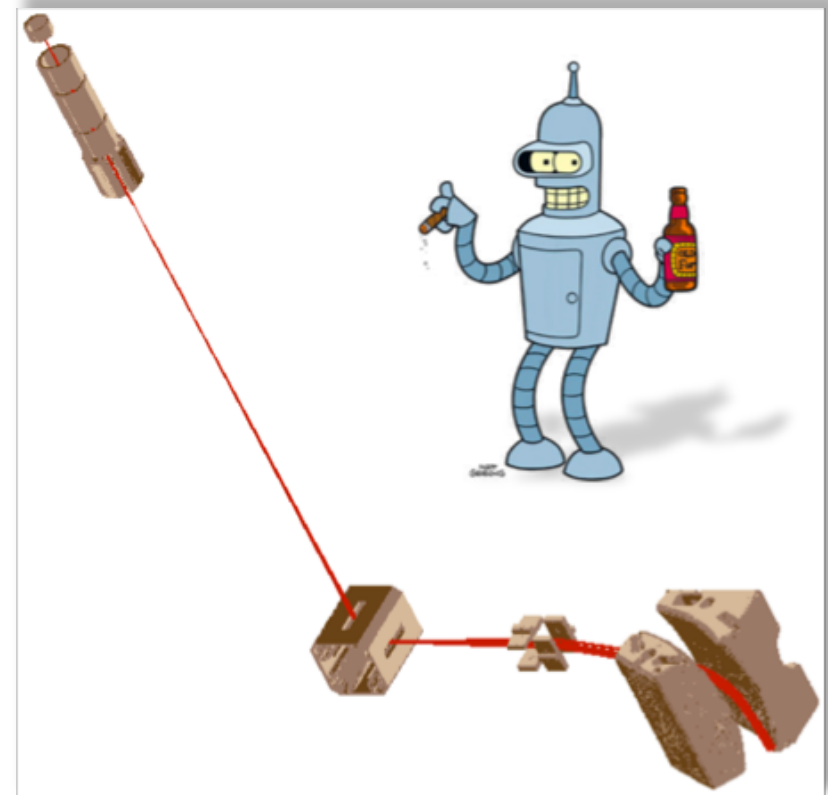


Biassing the Plasma Ion Source



The Future of the Plasma Ion Source

- Reliably send beam to each experiment.
 - Electrodeposited copper filament is being installed.
 - Introduce gas to operate in 'plasma mode'.
- New opportunities for TITAN
- Stable calibrants
 - High precision isotopic composition



Summary

- Ion optical simulations allow us to test and optimize instruments cheaply, safely and efficiently.
- Optimizing properties of the beam such as transmission & beam width determine the resolution and sensitivity of instruments.
- The commissioning of the plasma ion source at TITAN will provide versatile stable calibrants and open up new opportunities.

Thank you
Merci

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