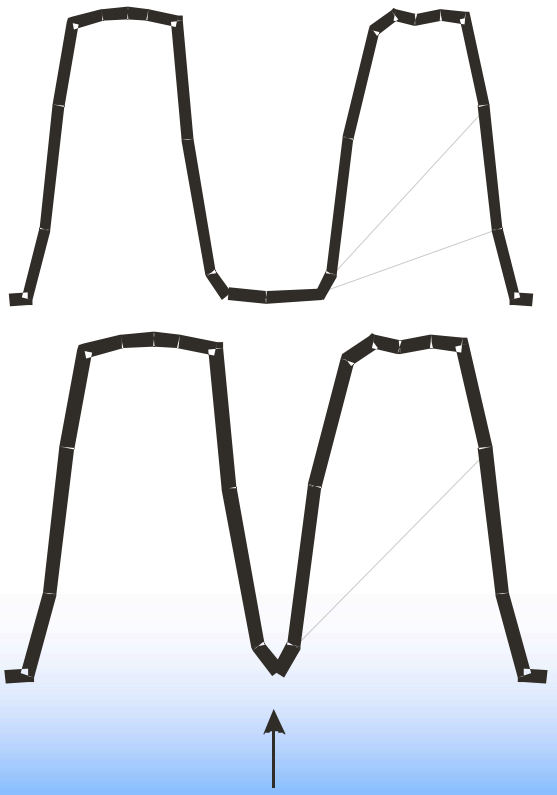
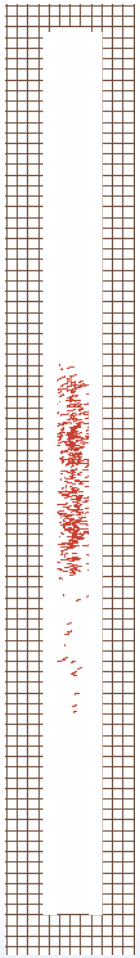
Increase the Slit Width

We only need enough resolution to discriminate 1 amu and the target mass.



Existing peak separation, VG

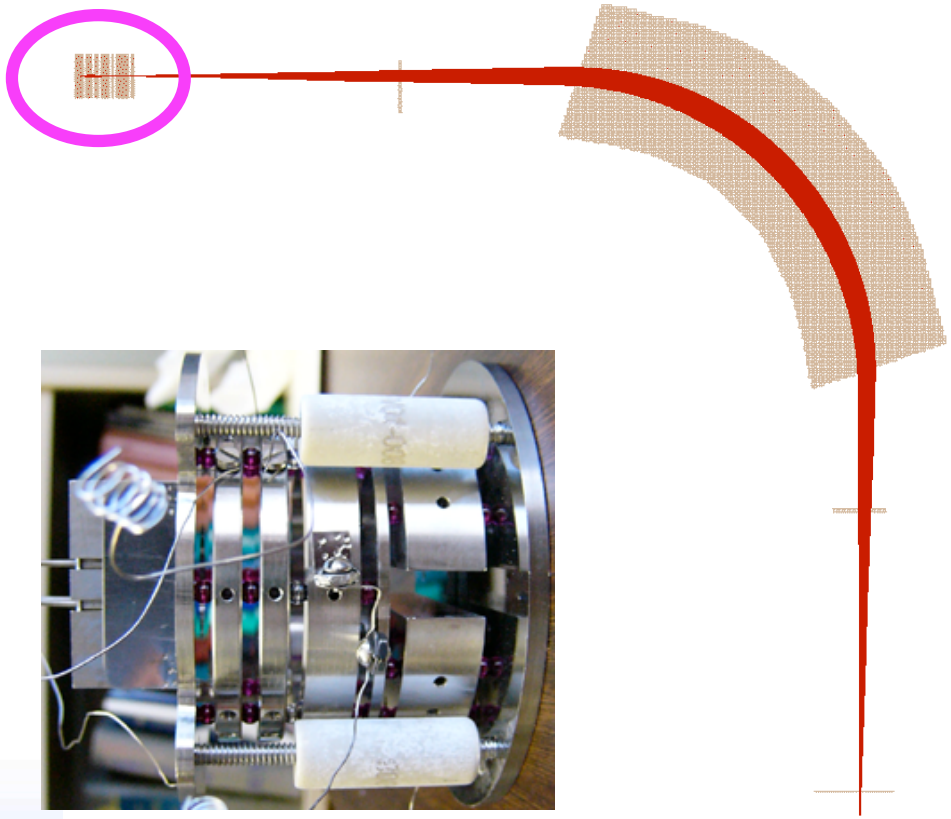
Acceptable peak separation

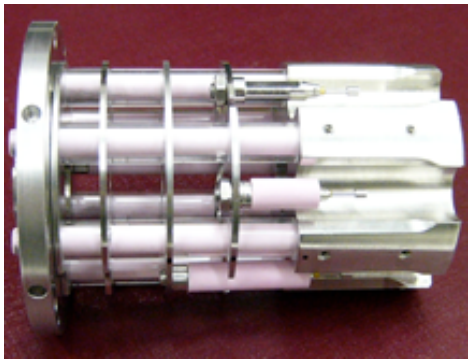


Ion Source and Lens Performance –Thermal Sources

What Matters ?

The Ion Source and Lens are the Defining Components of Beam Quality and Efficiency

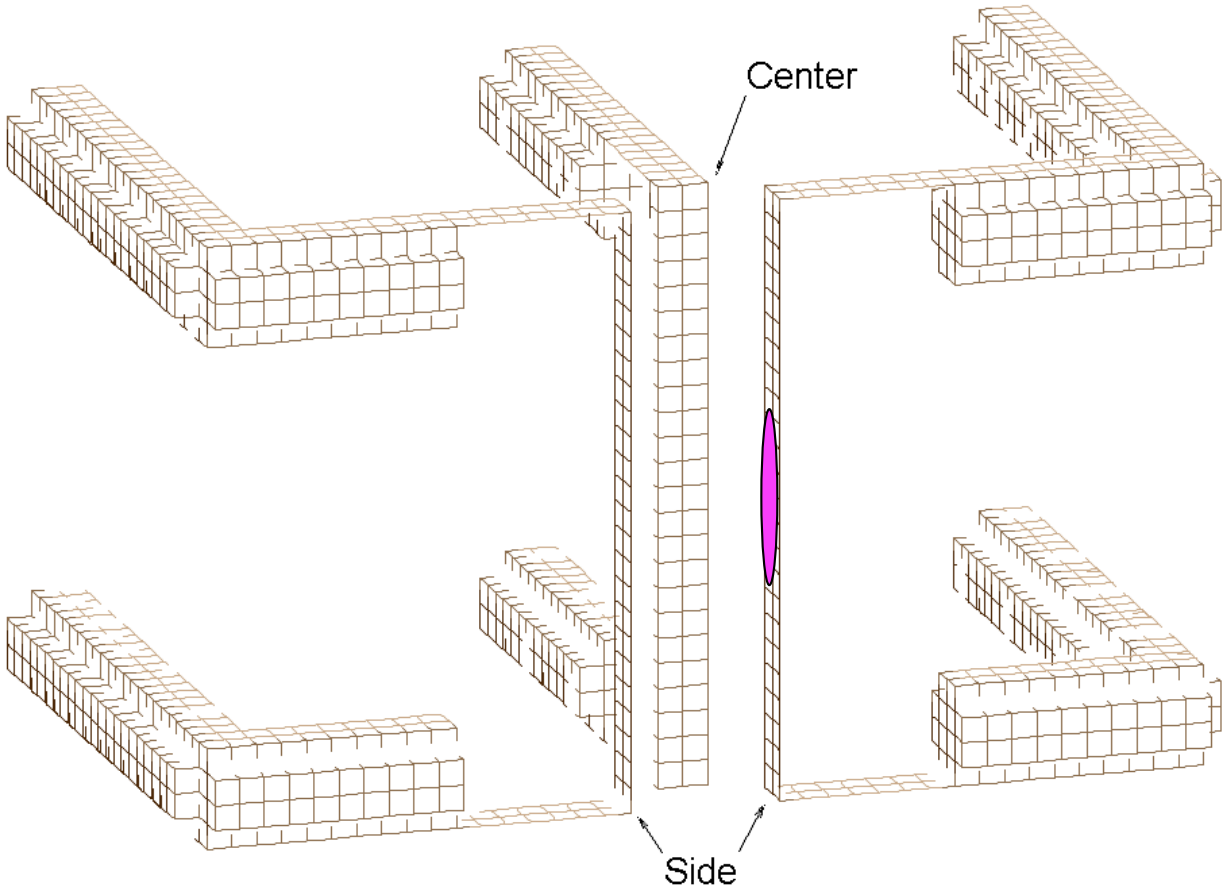


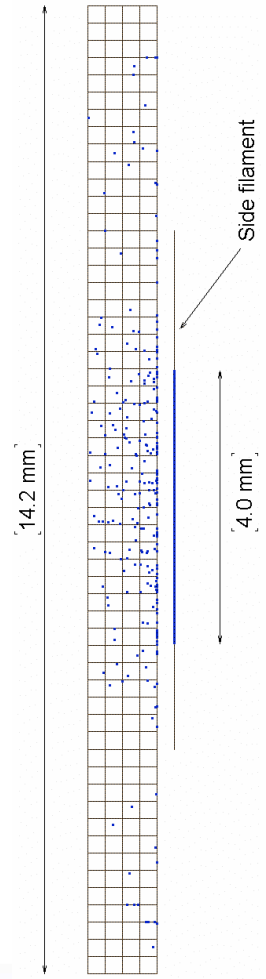


So What Matters ?

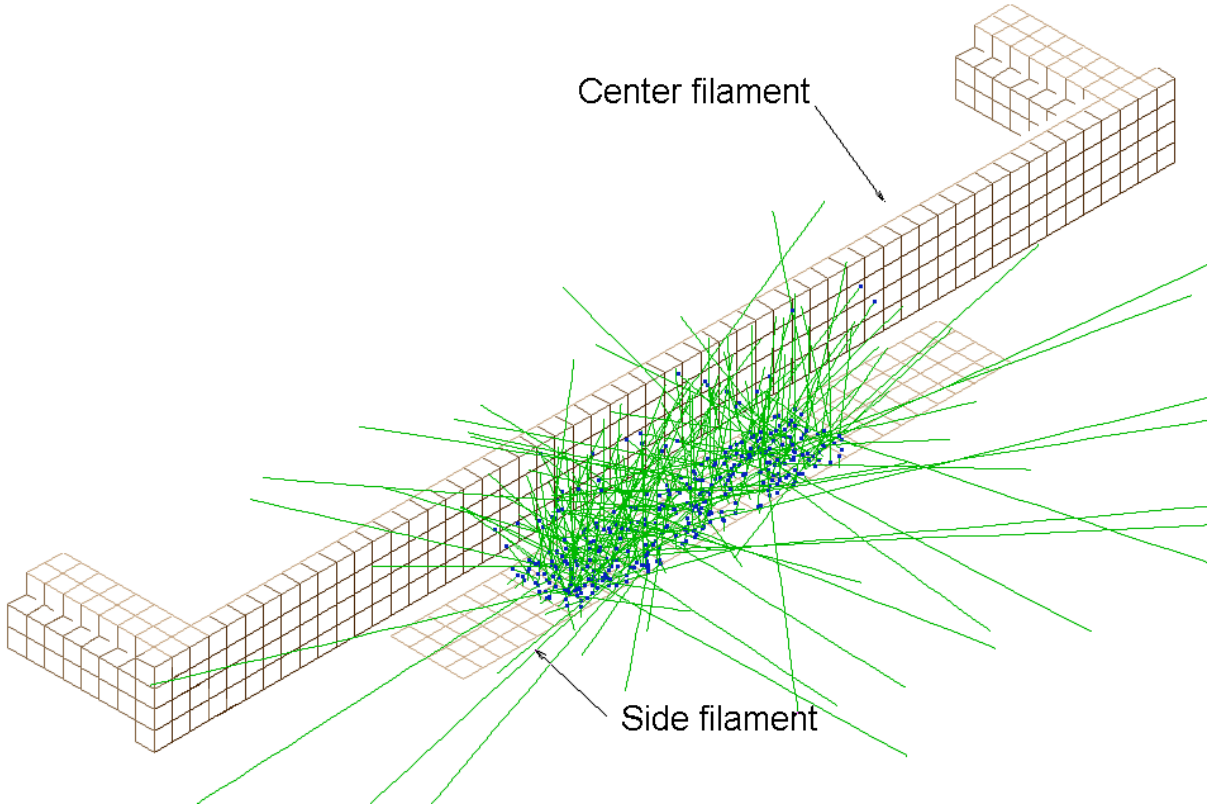
- Geometry
- Position – x, y, and z
- Size
- Lens design

Triple Filament

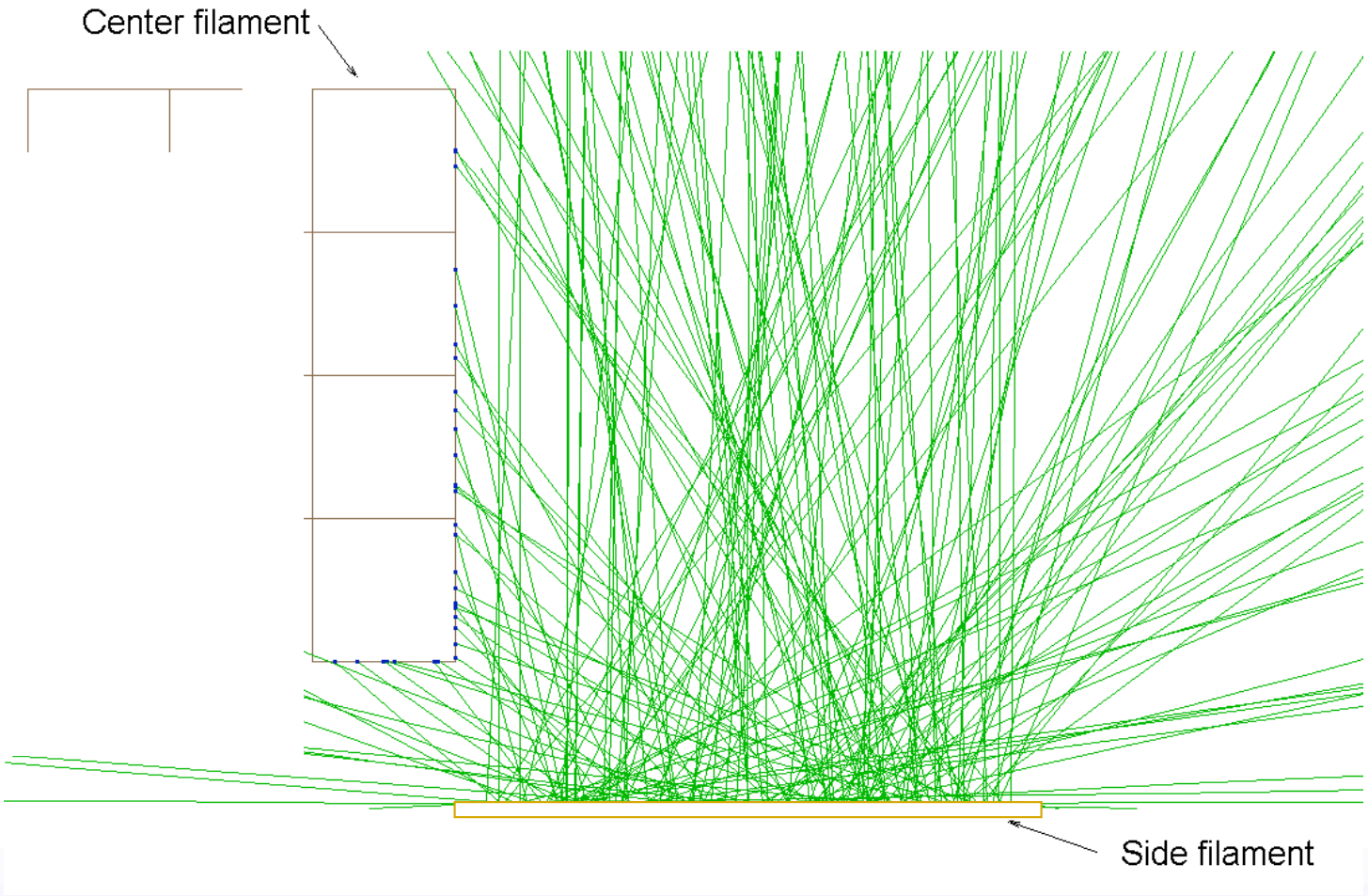




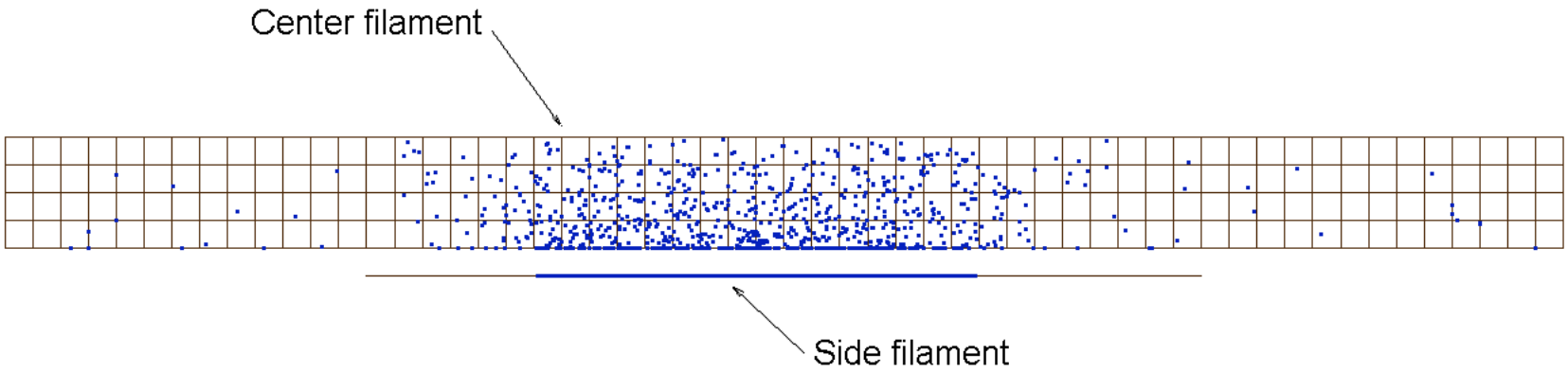
Neutral Evaporation

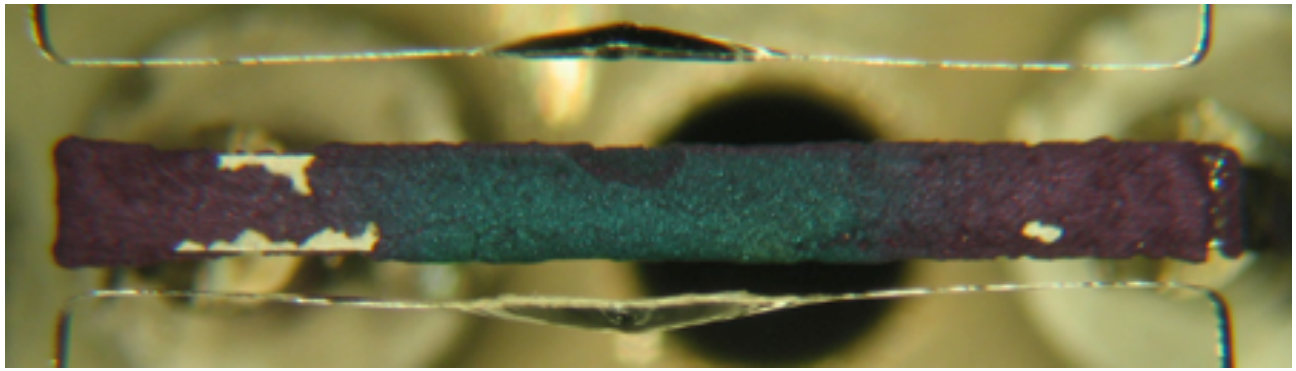


Neutral Evaporation



Neutral Evaporation Efficiency

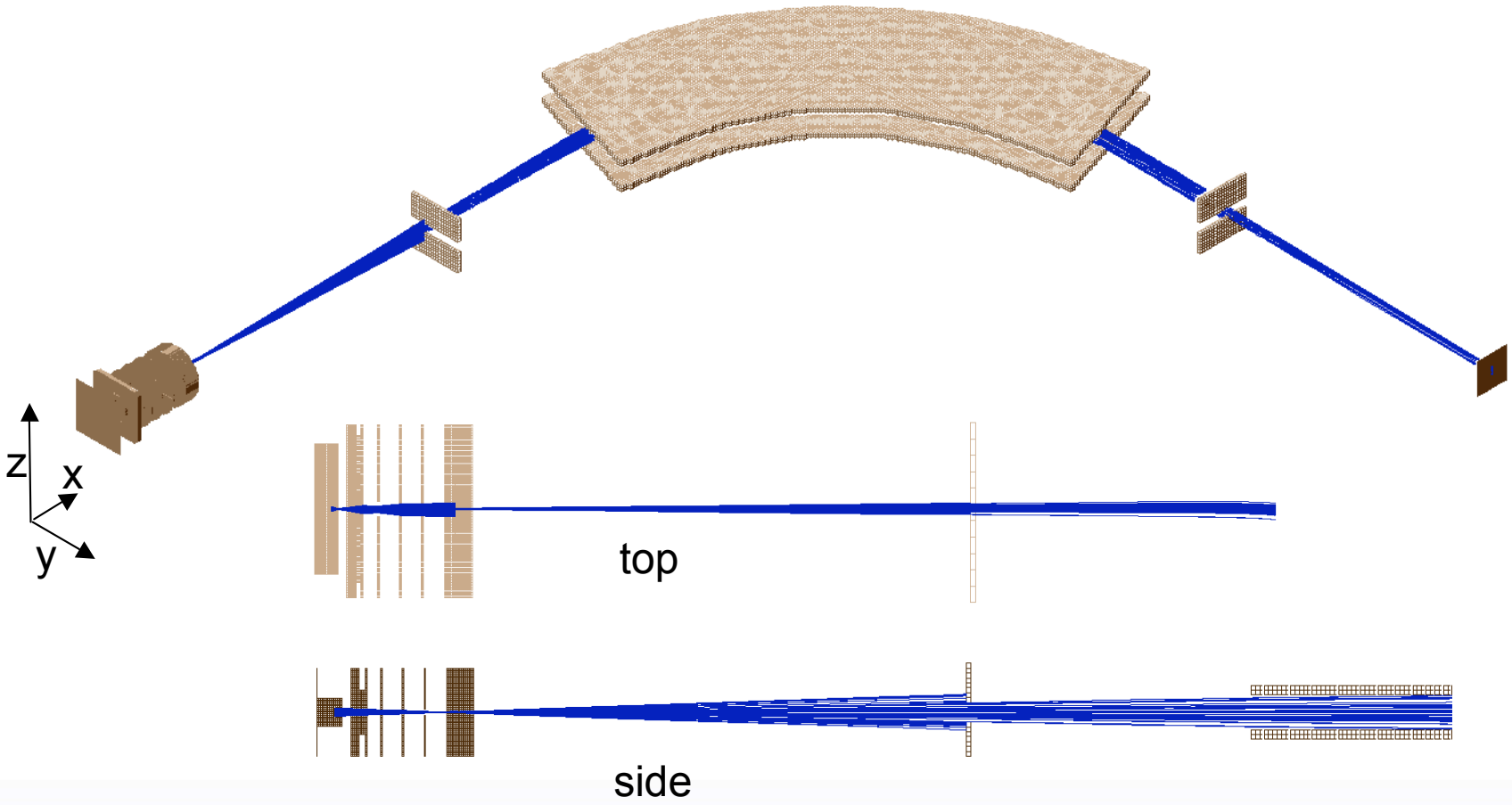




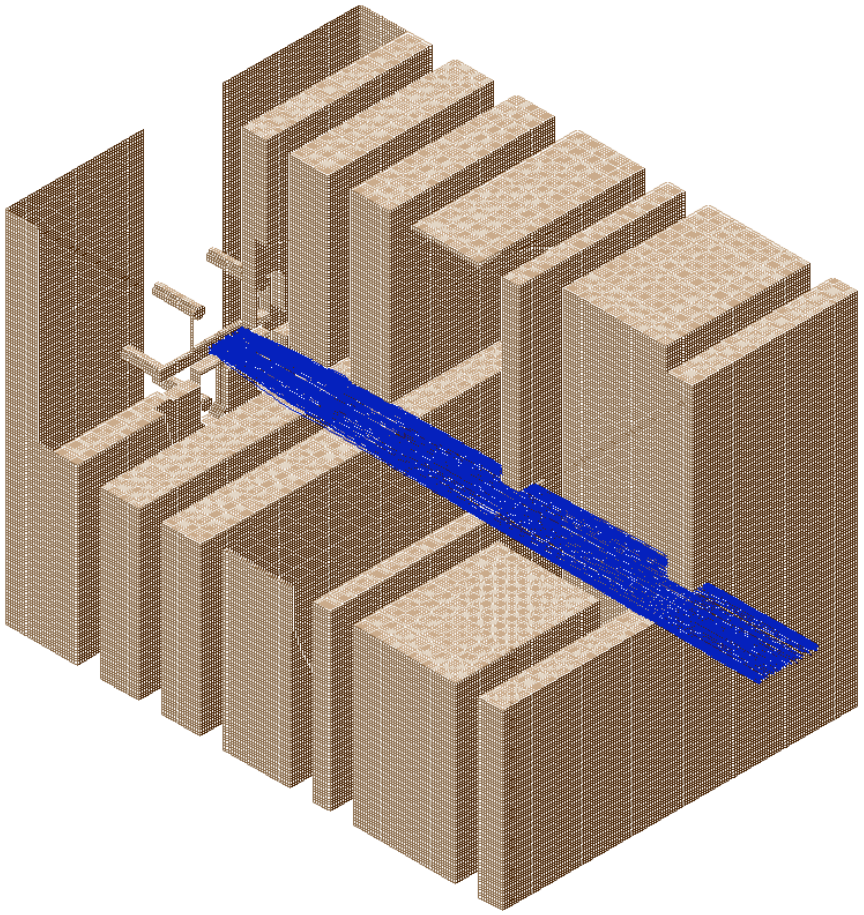
Only 1 in 5 neutrals that leave the side filament strike the center filament

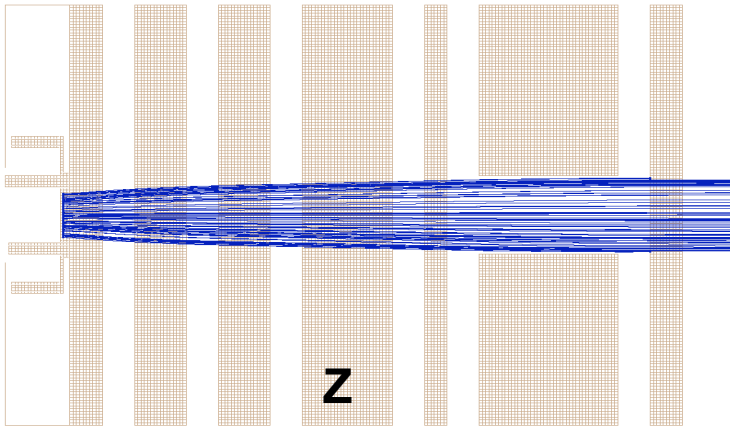
30% strike the opposite side filament

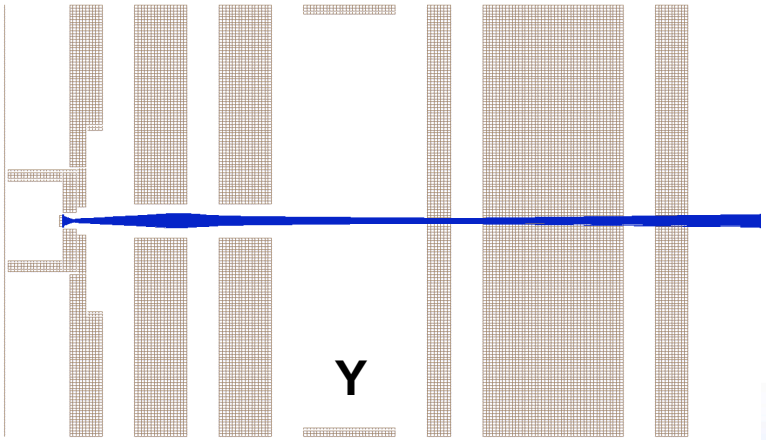
Focusing



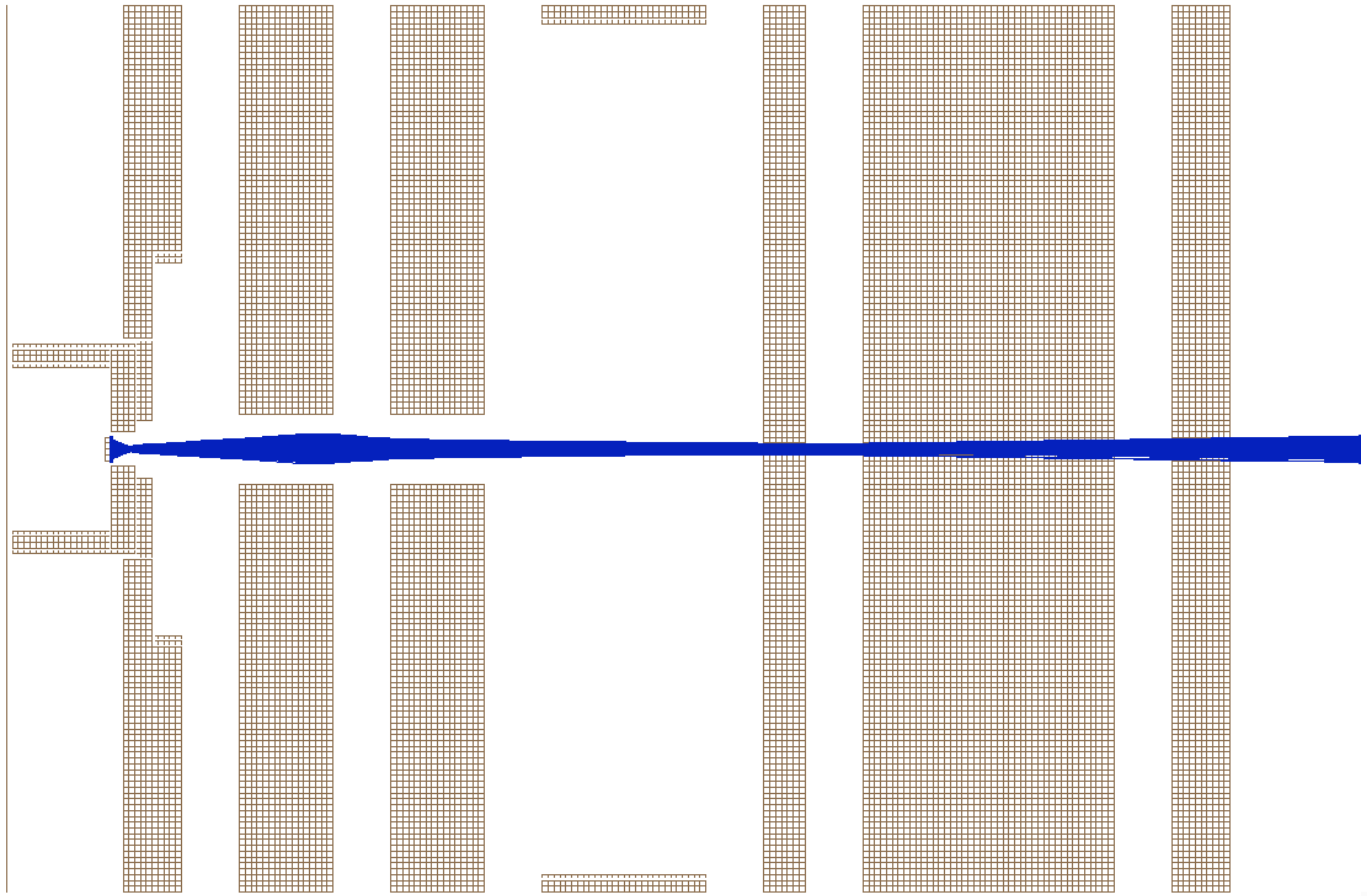
Focusing – Both Y and Z



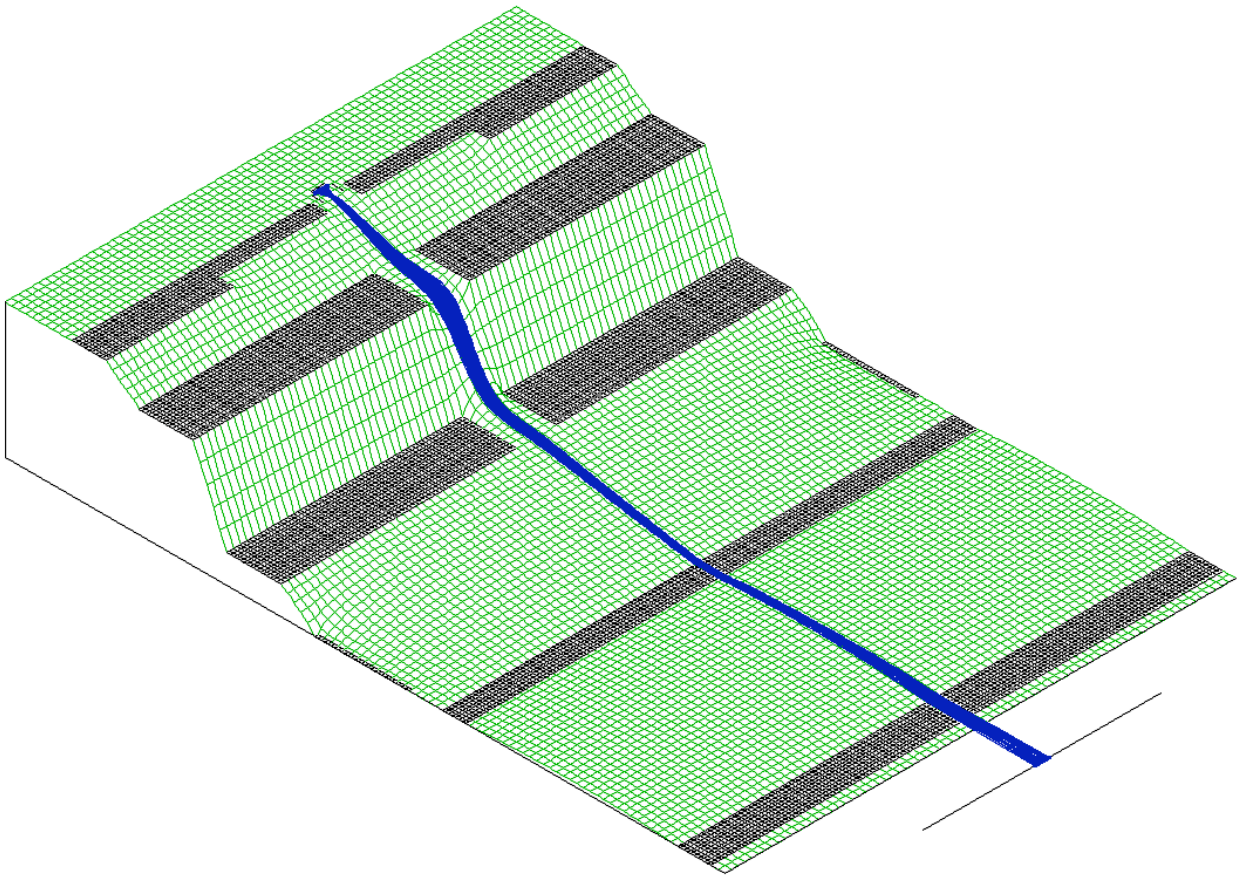




Y Focusing

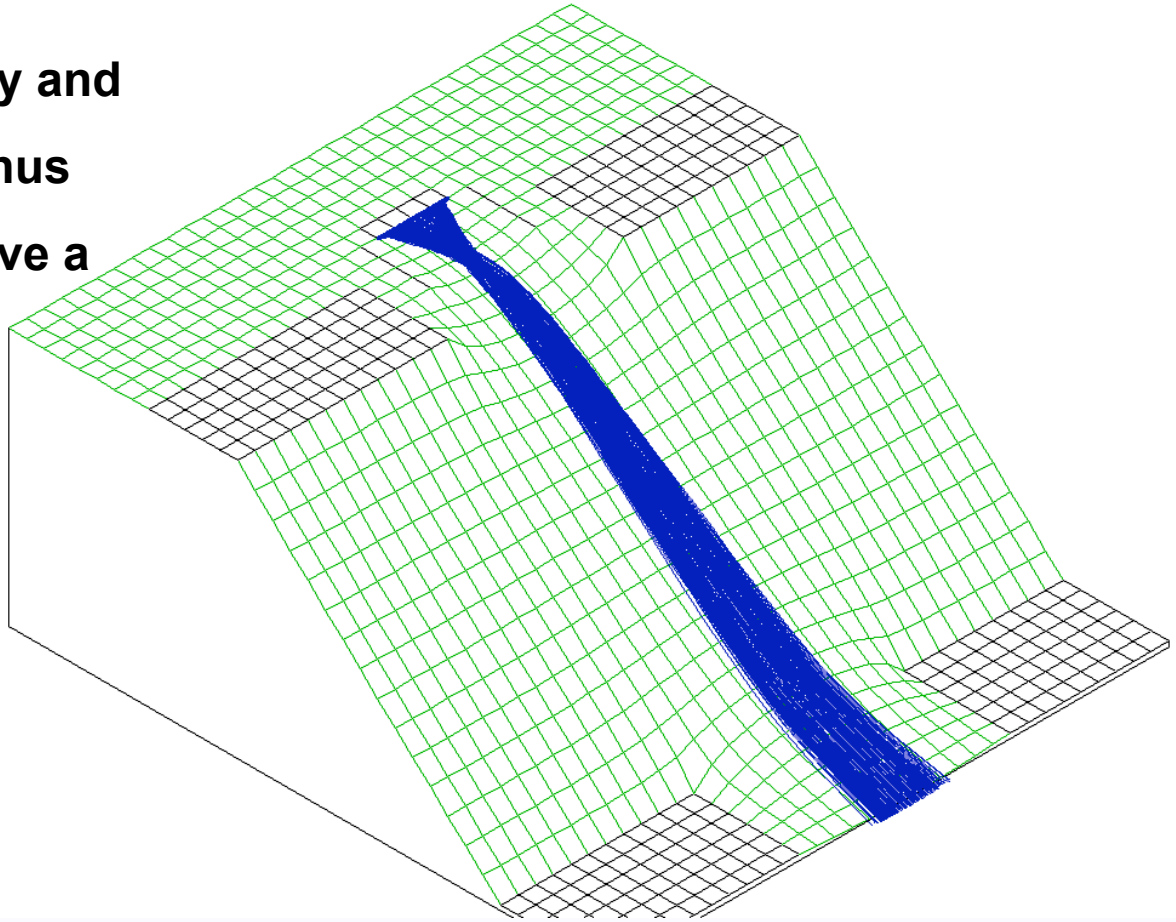


Focusing
Potential Energy Surface

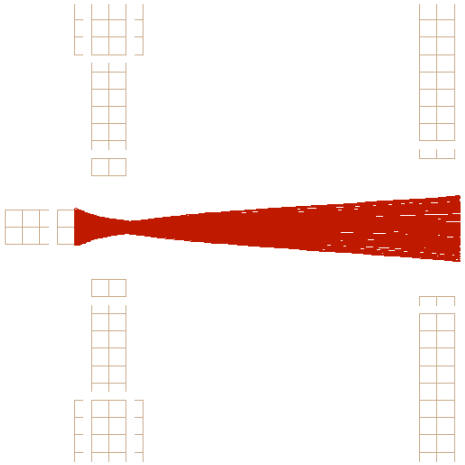


Source Region is Critical

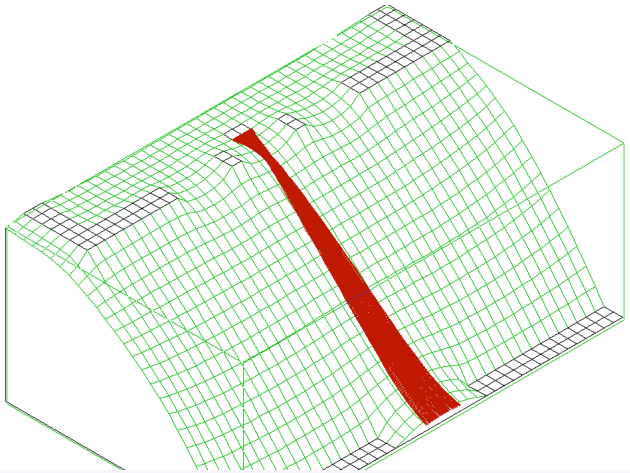
- Ions are moving slowly and
- Gradients are steep, thus
- Small changes can have a large effect.

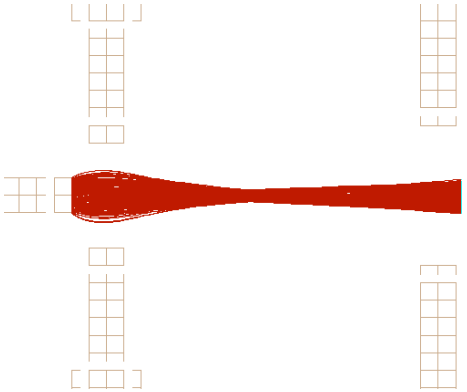


Side Filament Focusing

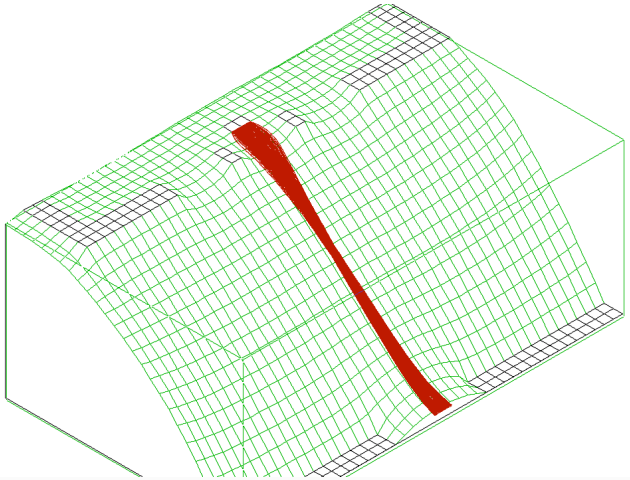


18 v bias

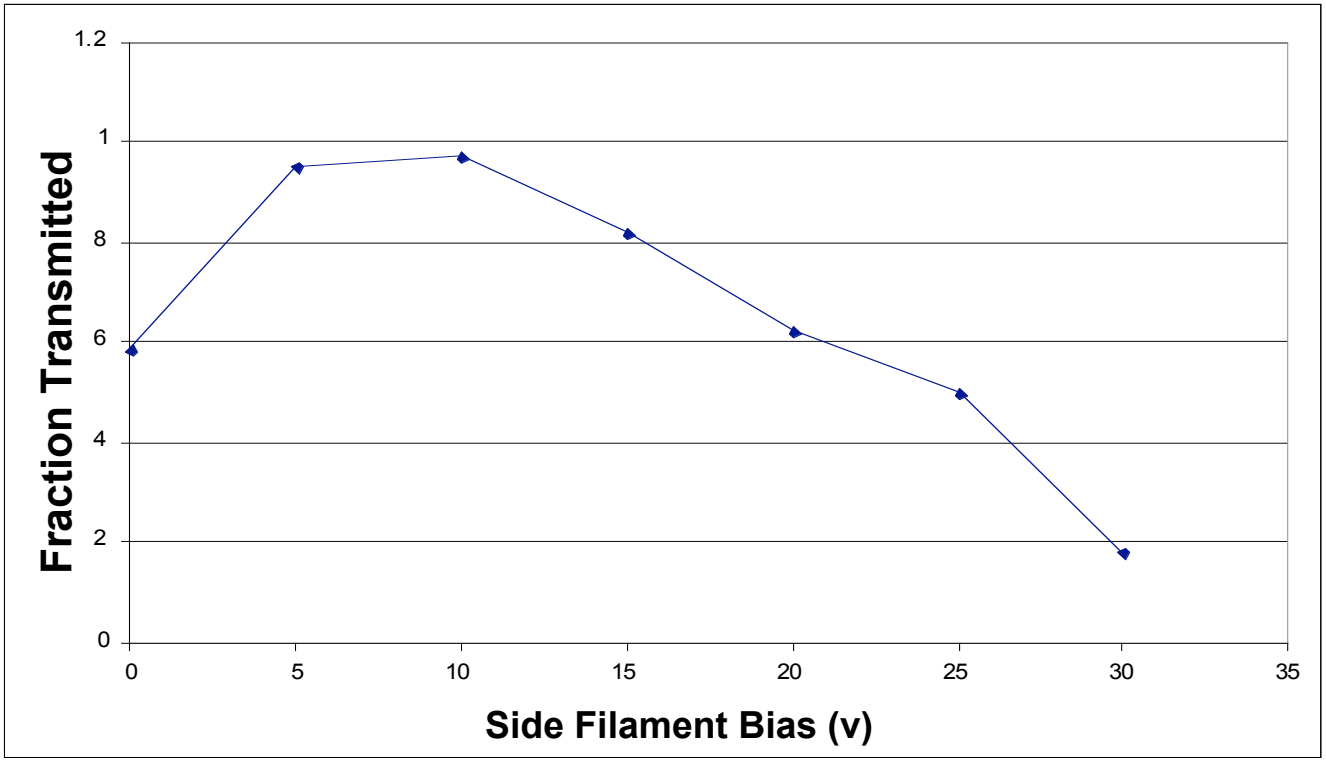




0 v bias



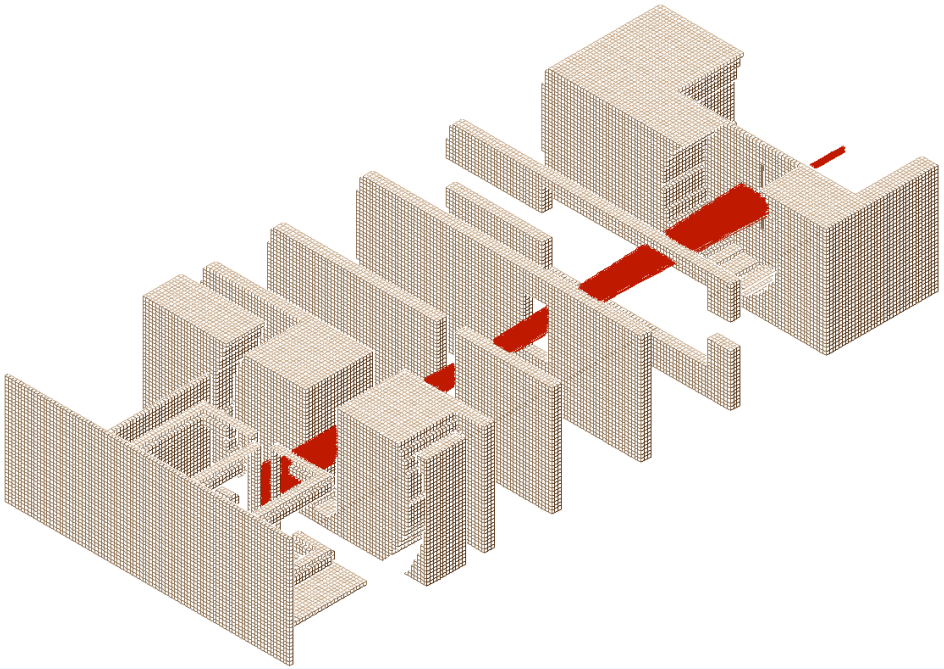
Side Filament Focusing
changes transmission through the lens



Z Focusing

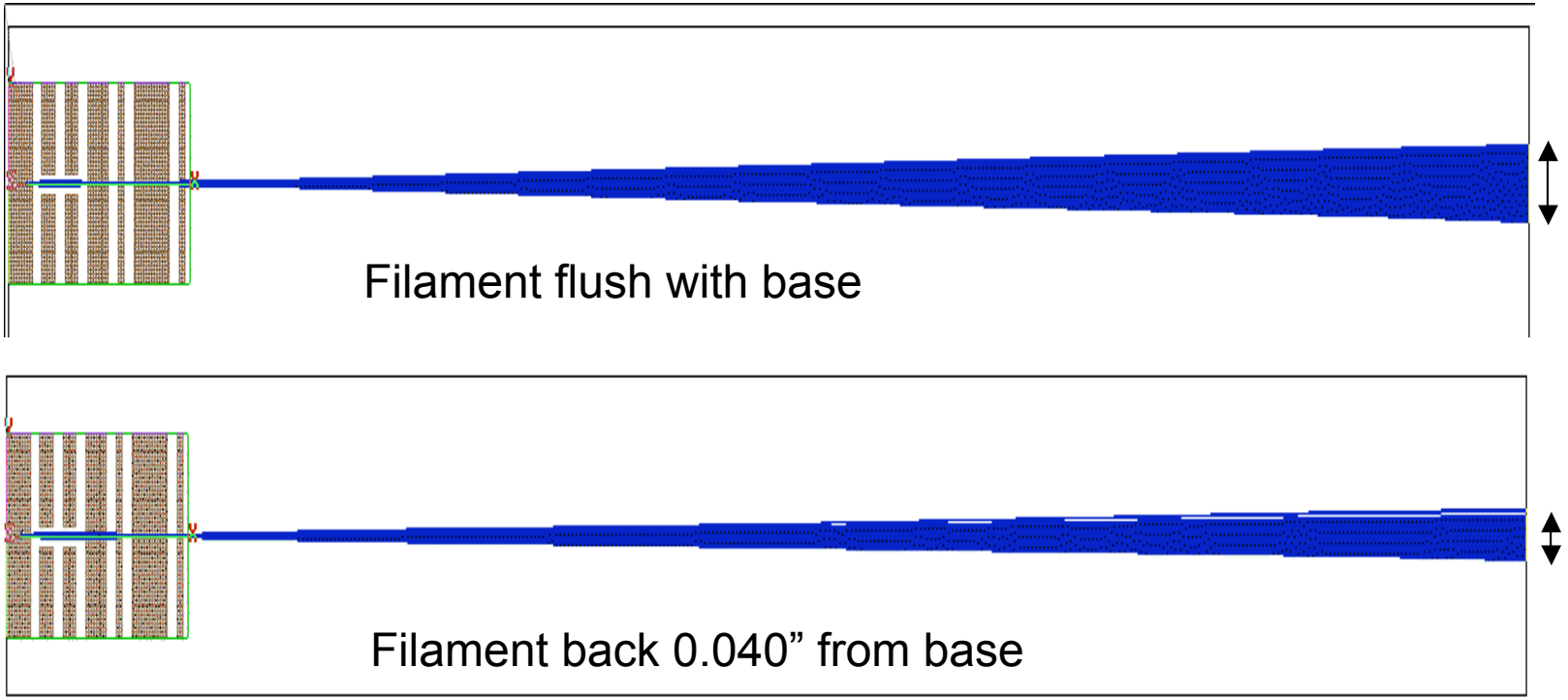
Affects the efficiency of lens and entire instrument

In the existing lens designs the Z focusing interacts with the Y focusing, complicating and limiting optimization of transmission efficiency.

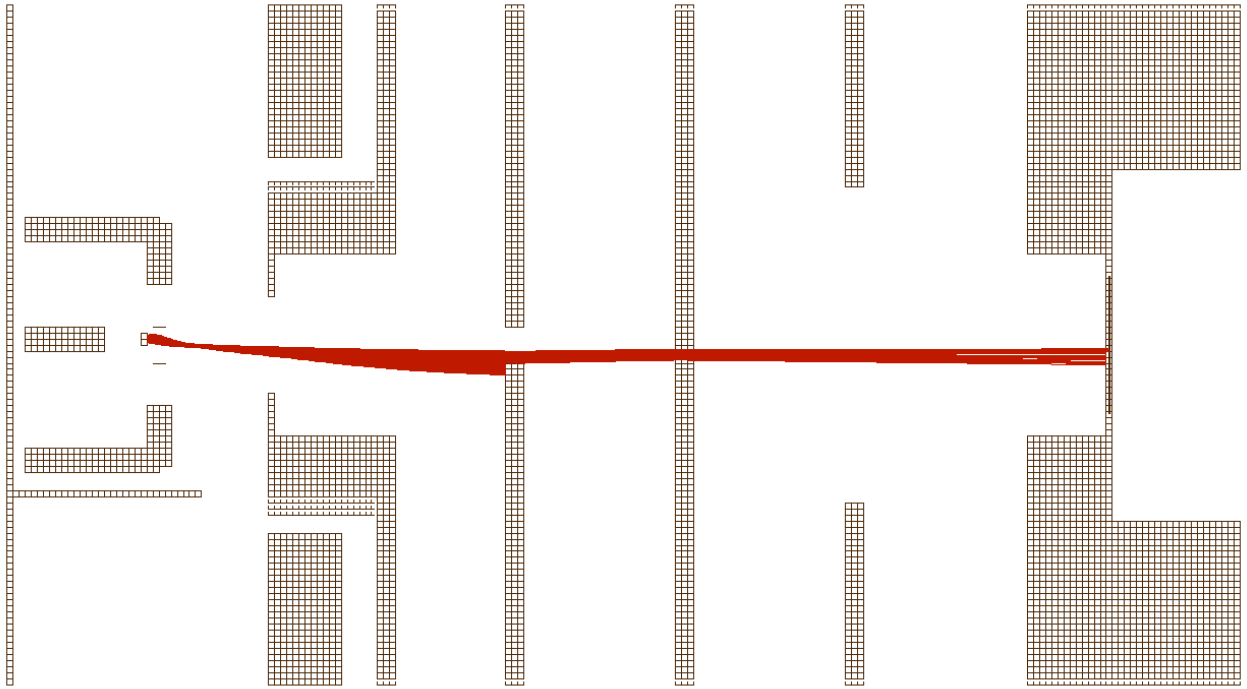


Filament Position

Anecdotal experience: setting the filament hat back 0.040” increased the signal.



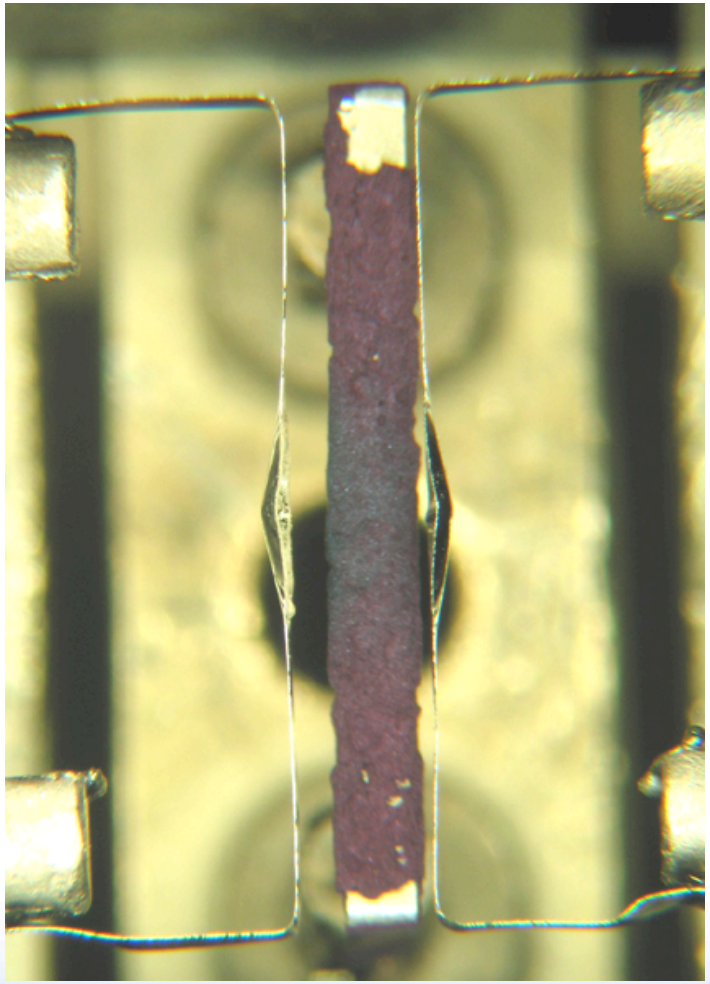
Source Positioning



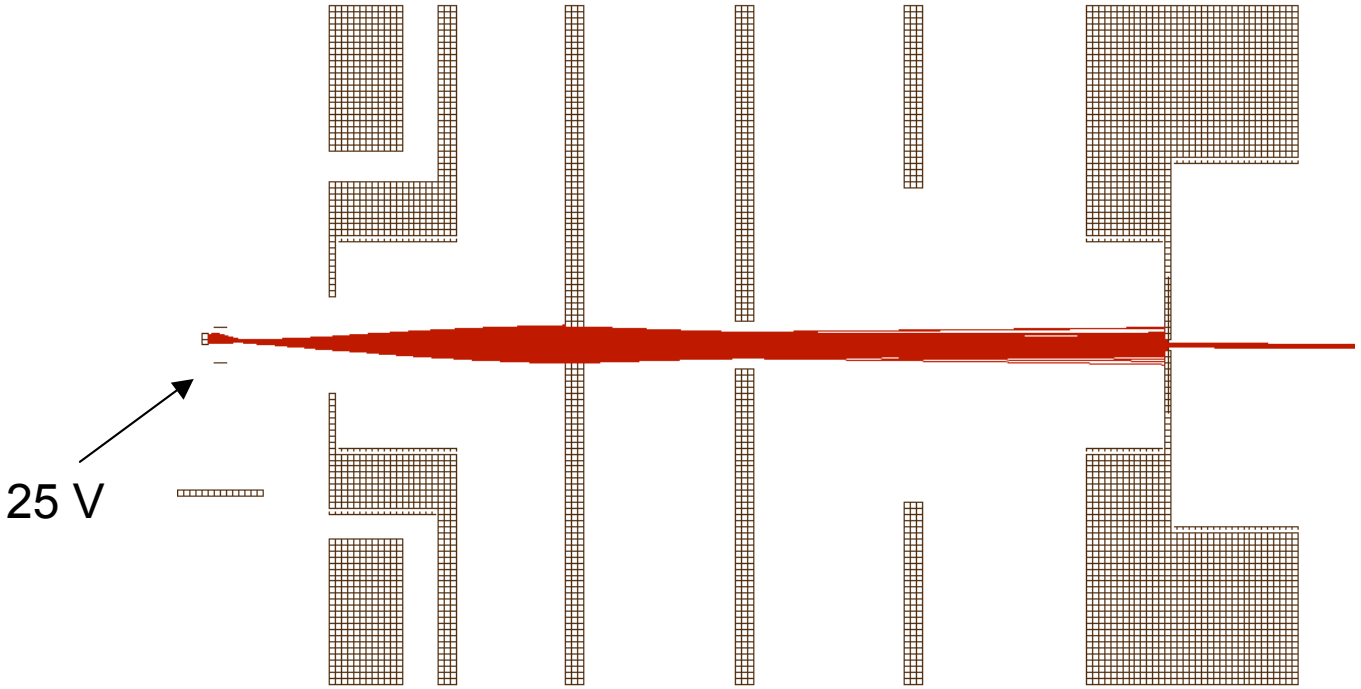
Center filament shifted 0.015” (half of a filament-width) toward side filament

Source Positioning

Center filament shifted 0.015” (half of a filament-width) toward side filament



Electrostatic Alignment



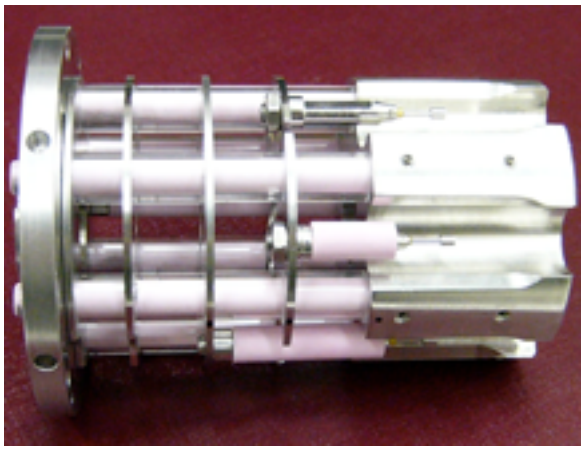
Use side filament bias to compensate for physical misalignment

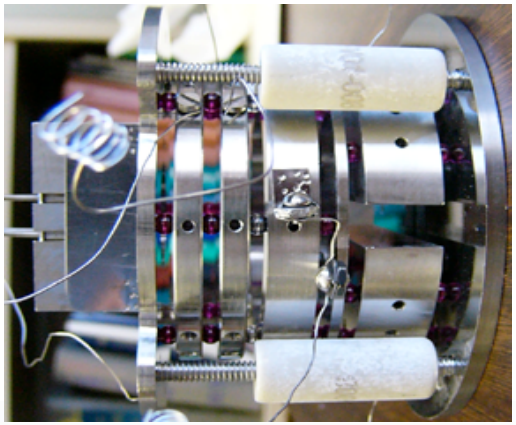
Source Positioning

- **The side filament bias can be used to compensate for misaligned center filaments, this works reasonably well.**
- **The optimum solution is to be able to reposition the source after it is in the instrument so that the center filament is at the center of the lens.**
- **Most important is side-to-side adjustment for the existing lenses.**

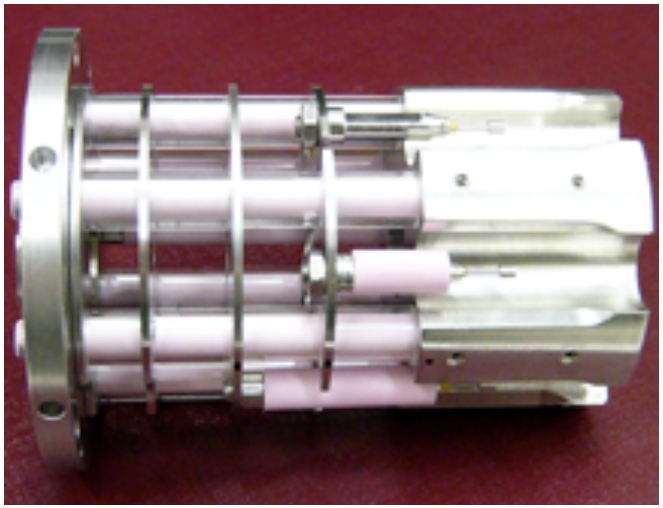
Lens Design/Operation

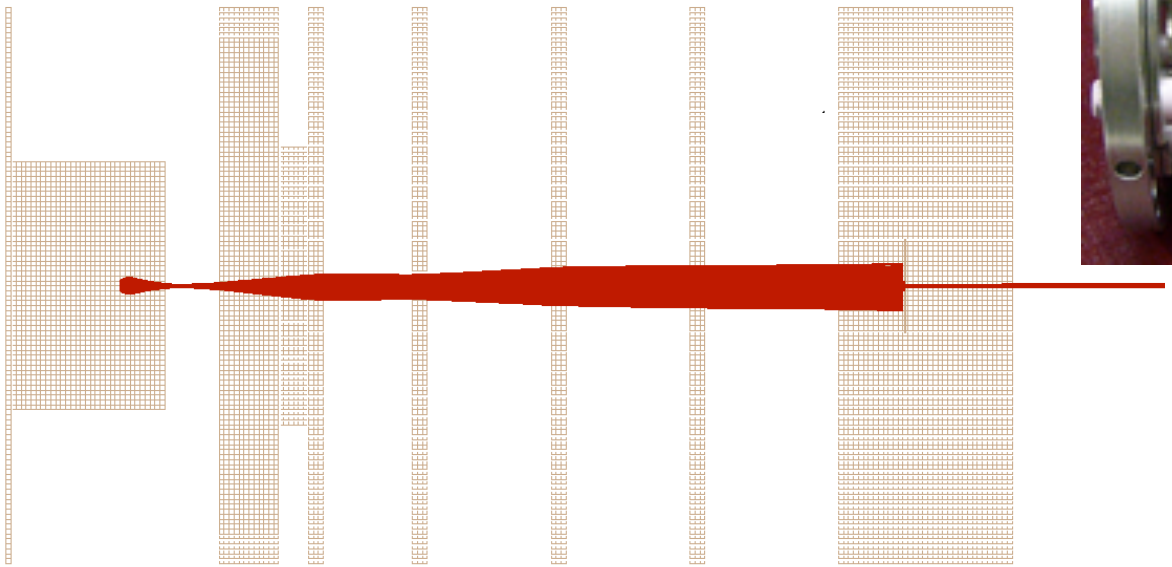
The design of the lens and how it is operated offer opportunities for improving sensitivity.





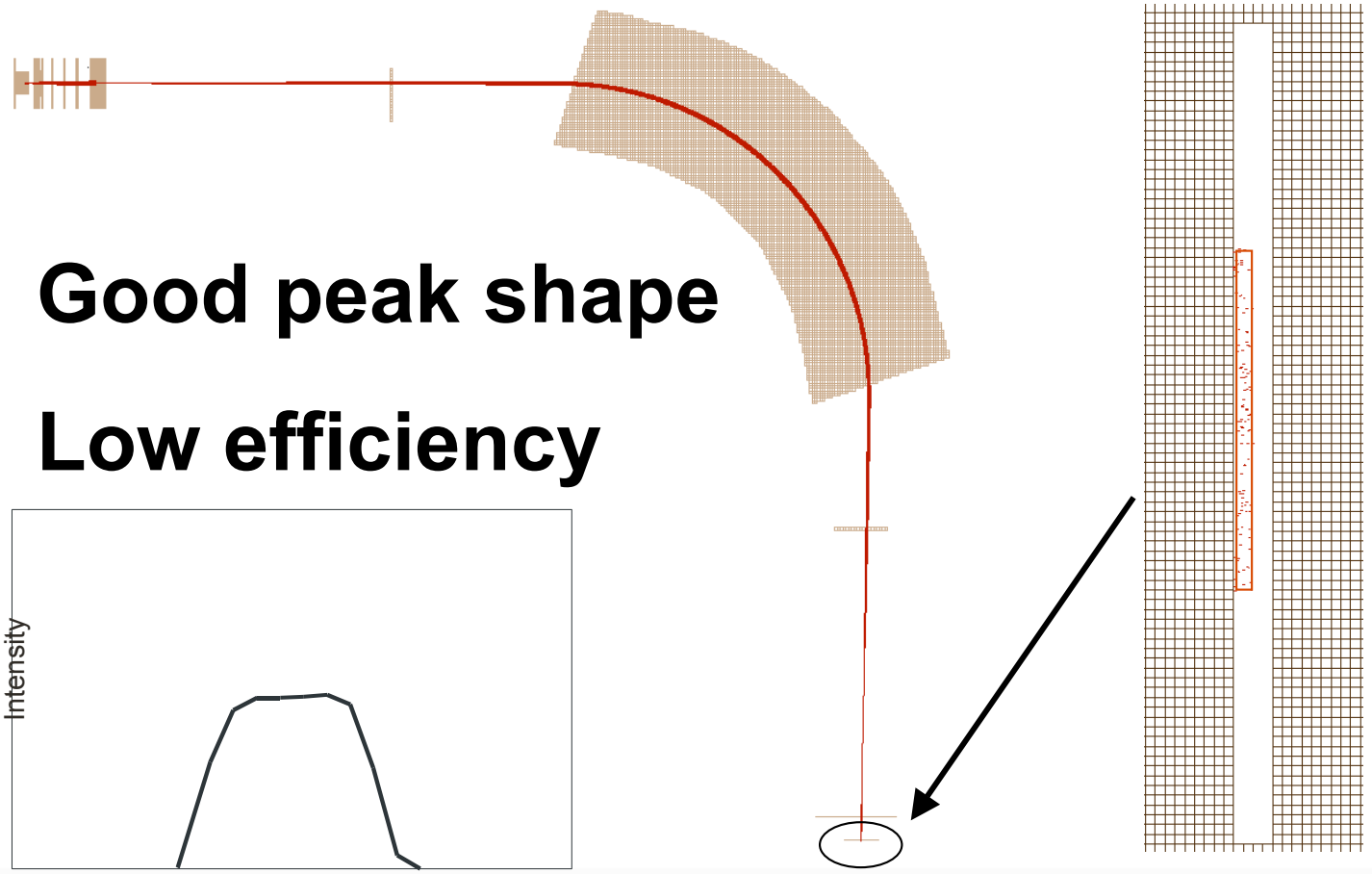
Production Setup - VG lens





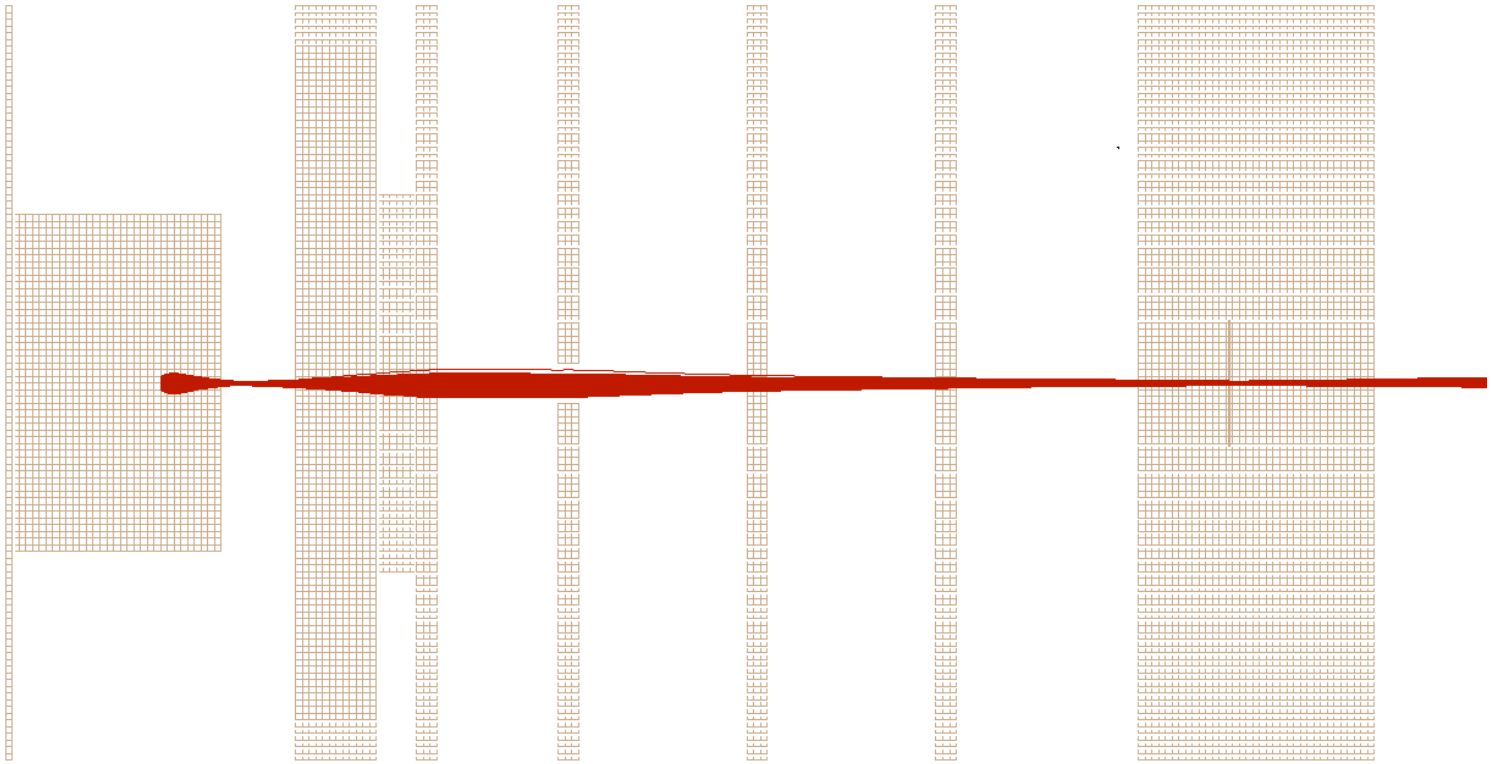
As-run voltages – good peak shape, low efficiency (2%)

Production Setup - VG



- **Good peak shape**
- **Low efficiency**

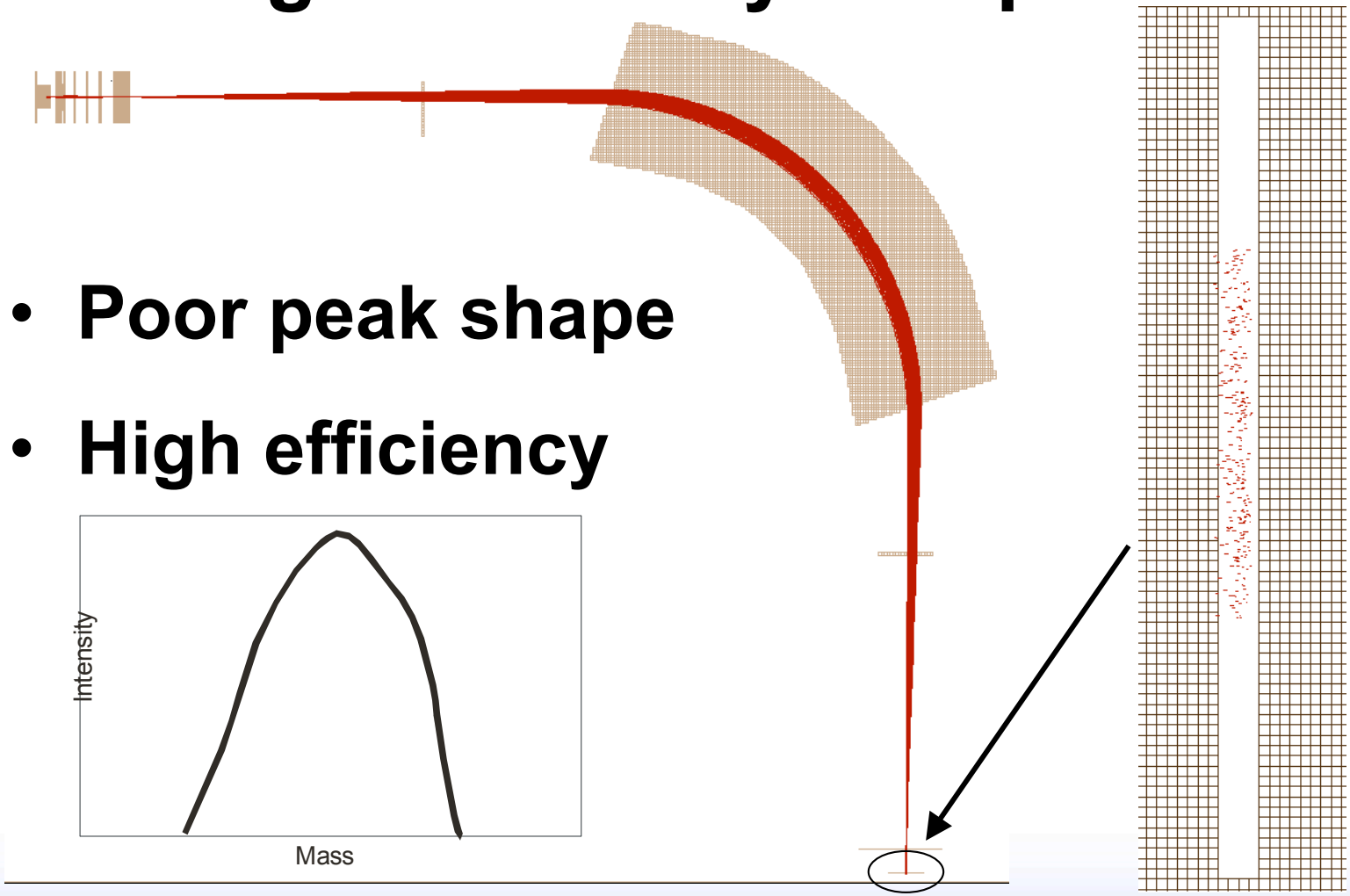
High Efficiency Setup - VG



Change voltages on selected electrodes to focus the beam through the defining slit and improve the transmission efficiency.

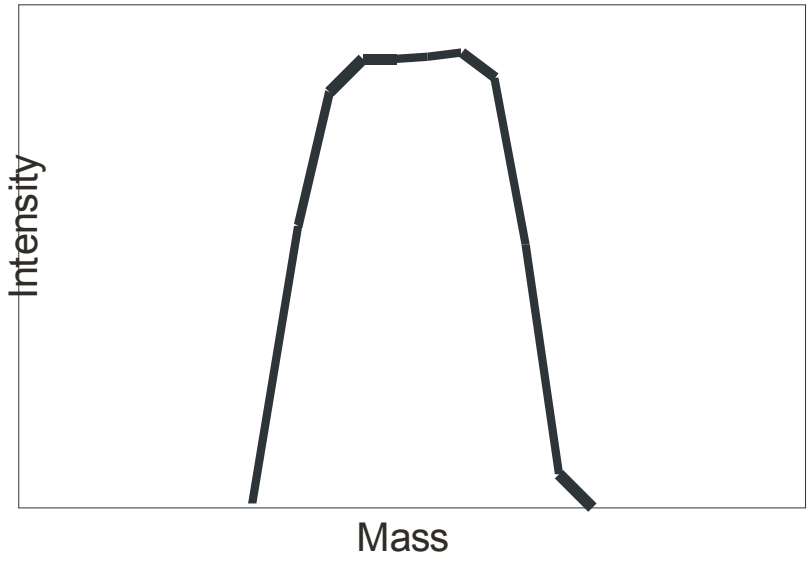
High Efficiency Setup - VG

- **Poor peak shape**
- **High efficiency**



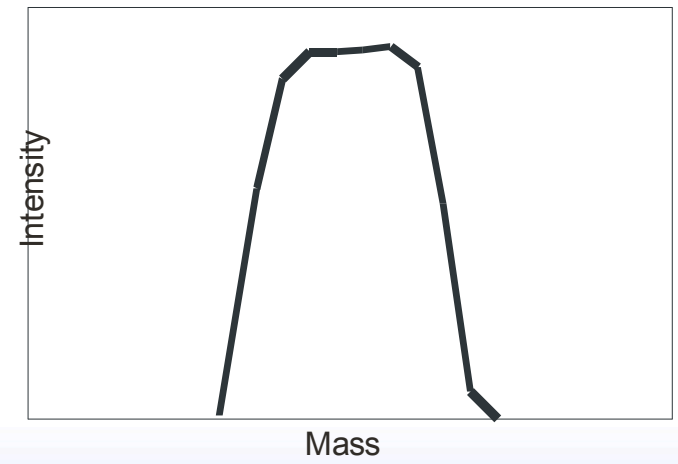
How do we get both?

- Good peak shape
- High efficiency



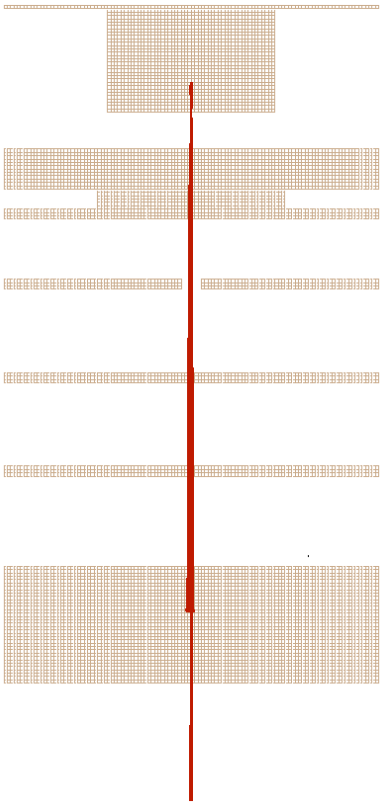
4x Narrower Source

- **Good peak shape**
- **Good efficiency**

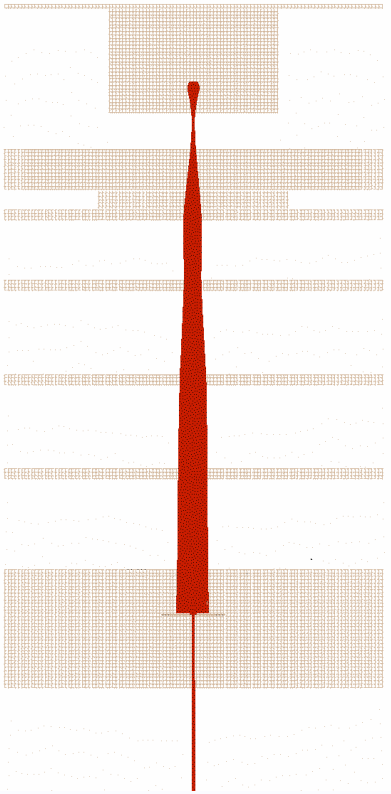


Size Matters !

0.2 mm

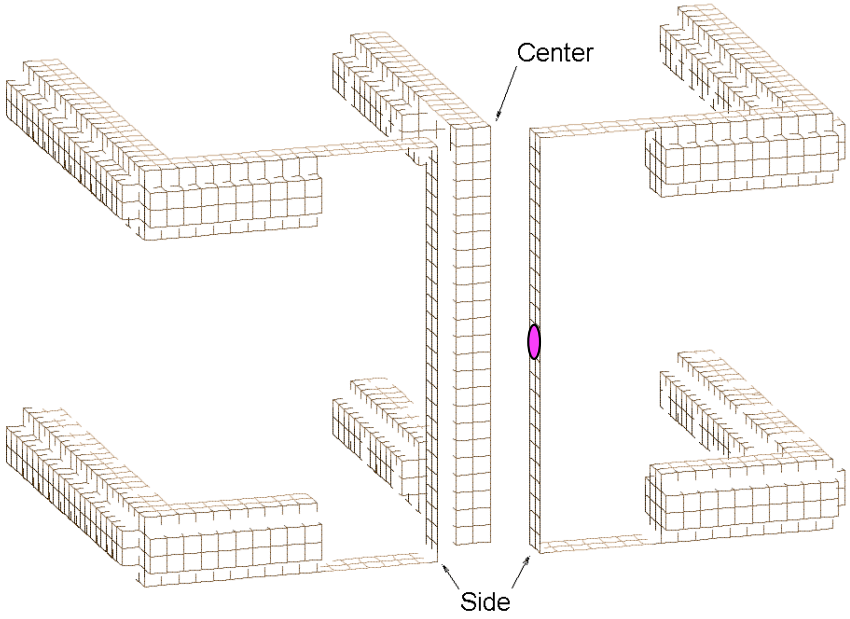


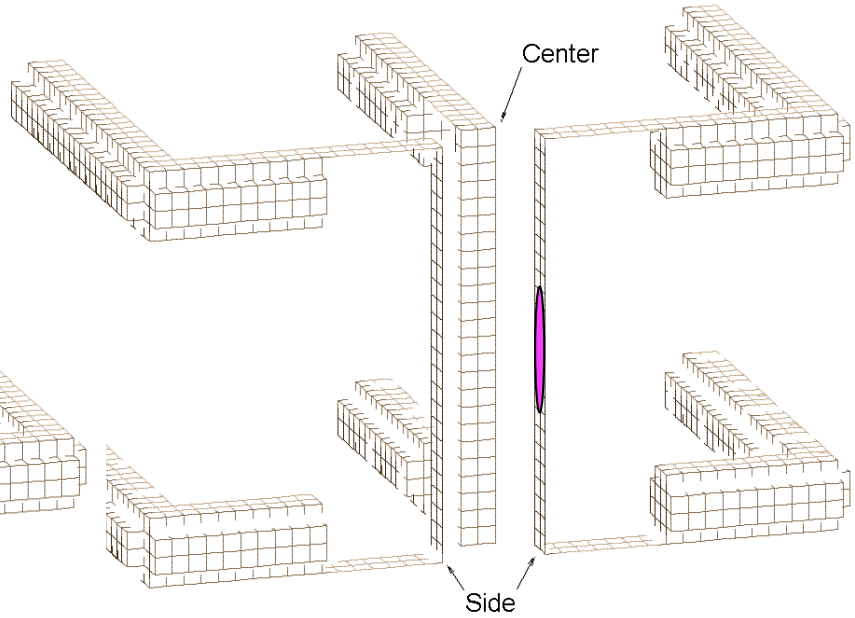
0.8 mm
(standard)



Source Height

Forming the ions along a shorter length of the filament reduces the losses in the Z direction.





Source Height

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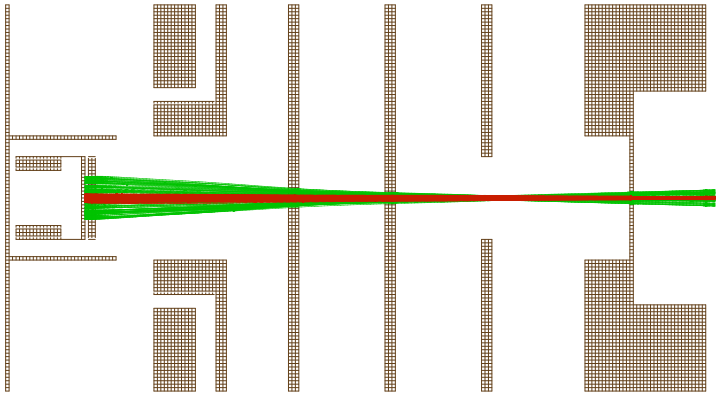

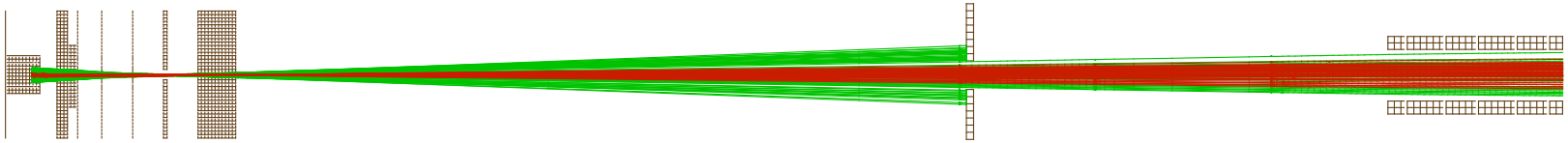

Red = 1 mm high x 0.5 mm wide

Green = 5 mm high x 0.5 mm wide

Summary

- **The ion source and lens is a primary component in the existing mass spectrometers that can limit performance.**

- **Understanding how the geometry, size, and position affect sensitivity should help us to optimize our existing instruments.**