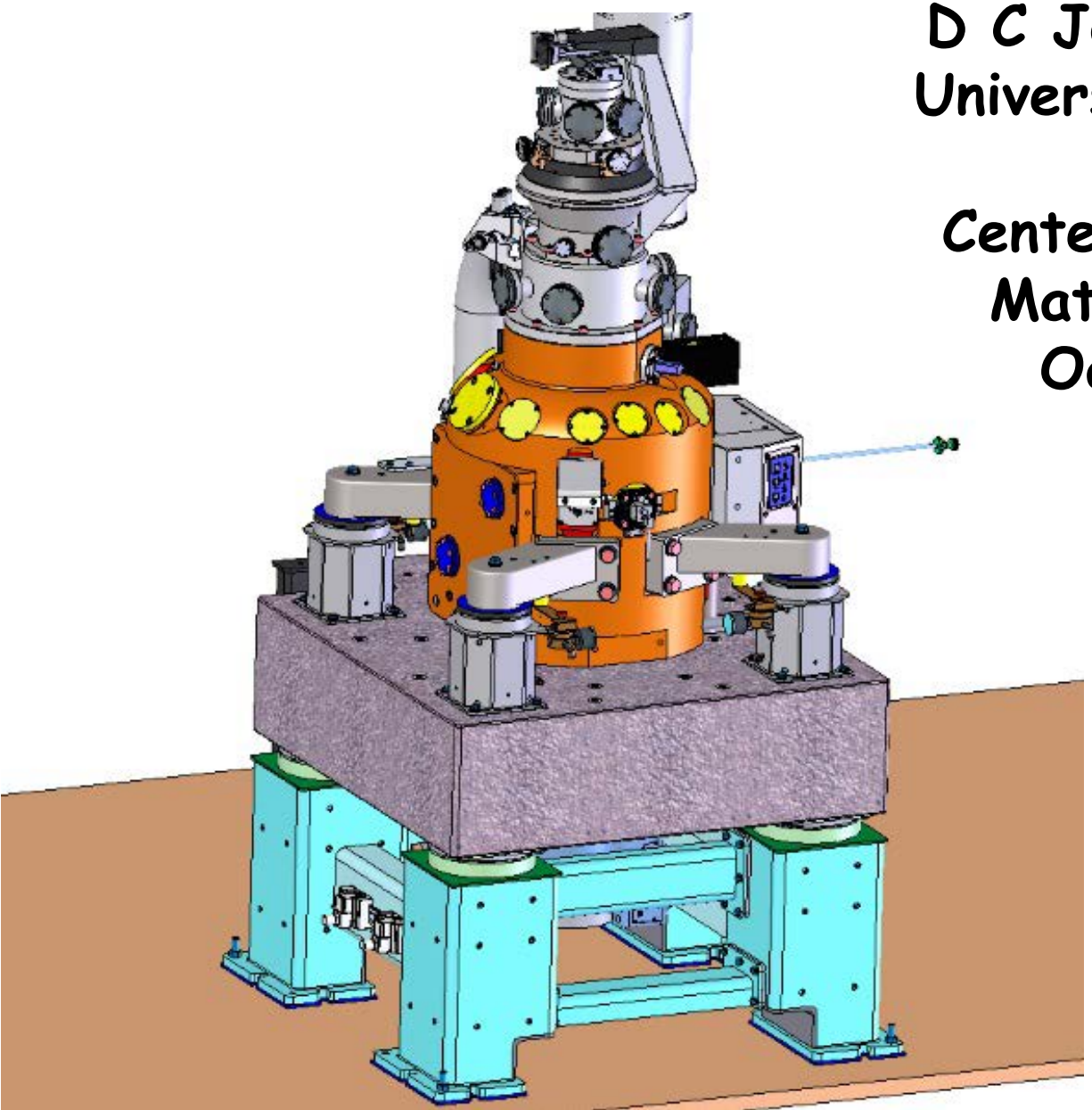
MC Simulations of He, Ne deposition

D C Joy and P D Rack
University of Tennessee
and
Center for Nanophase Materials Science,
Oak Ridge, TN



The ORION NF HIM

A new type of "Dual-Beam"

- HIM *with extras !*
- More compact
- He+ & Ne+ capable

  60 sec change-over
- 45keV beam energy
- Pattern generator
- 0.4nm resolution

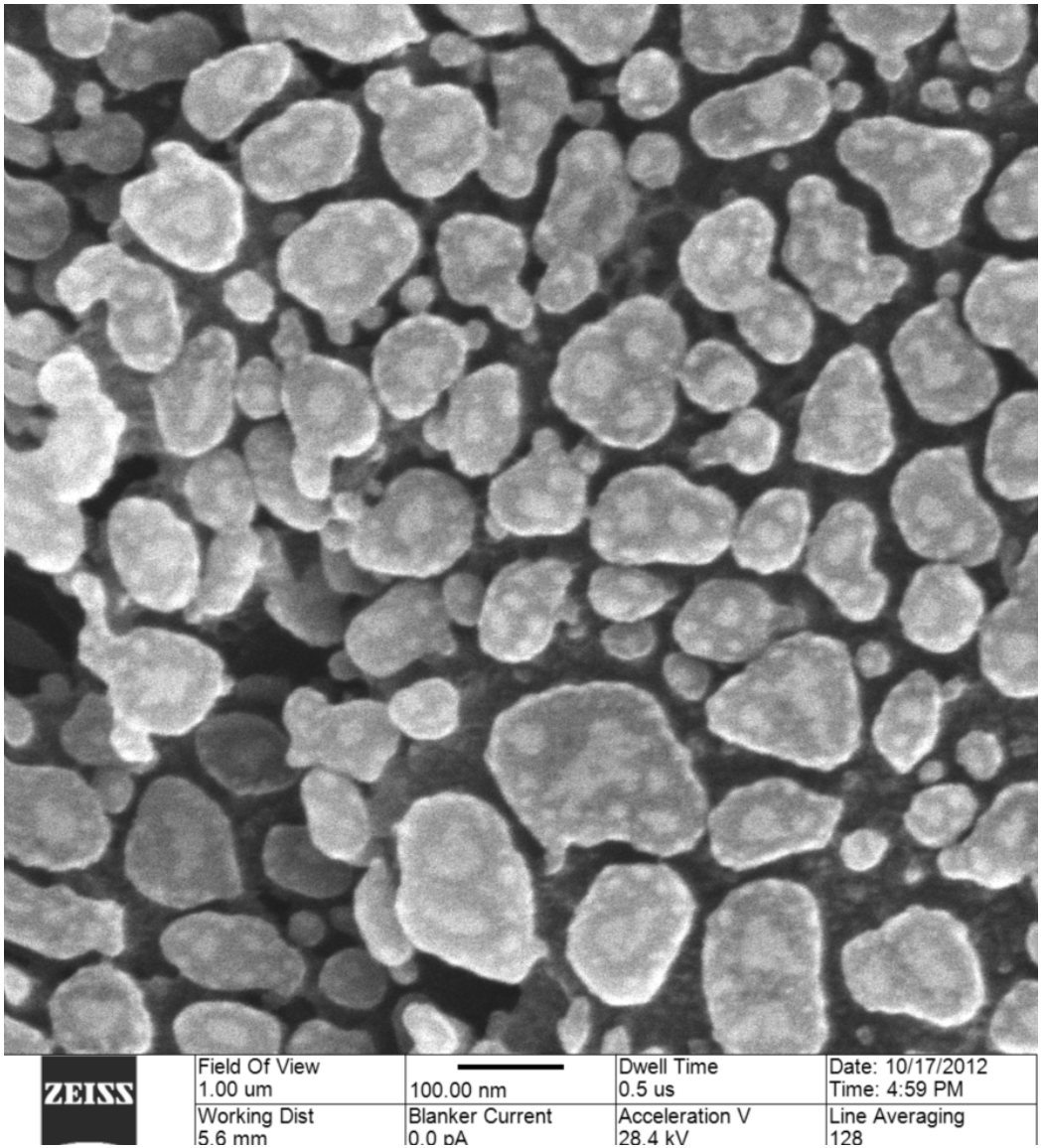
Zeiss ORION NF

iSE image of cross-sectioned Nano particles

Beam energy 28keV

1μm FoV

He+ beam

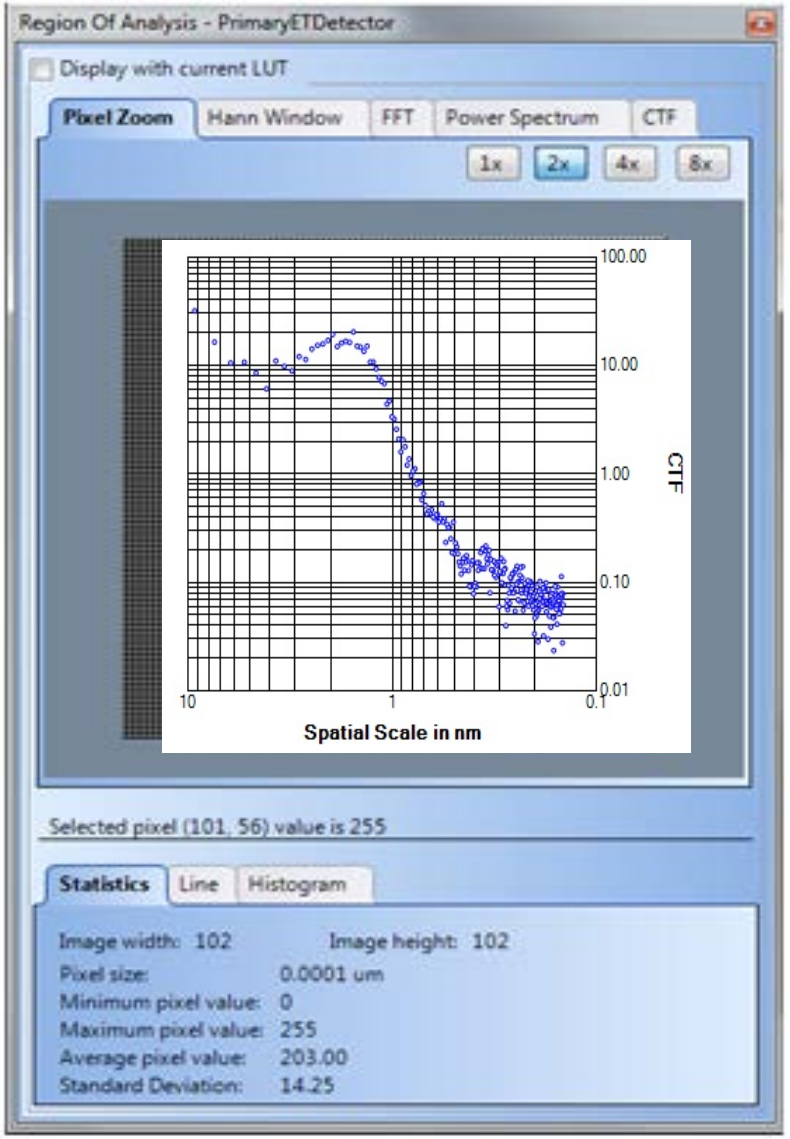


Optimizing Images

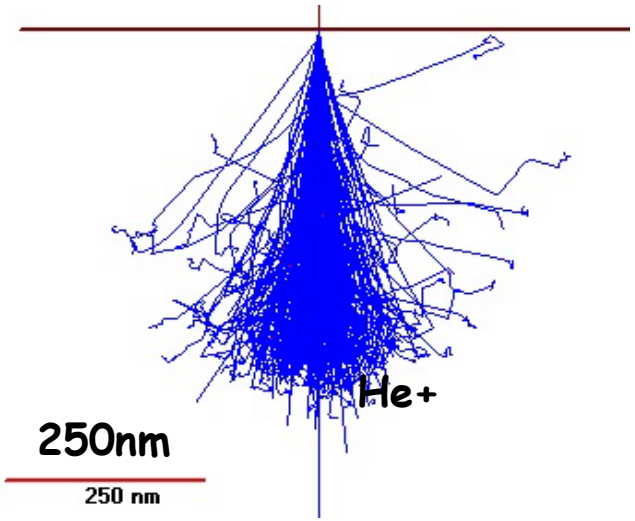
Contrast Transfer Function (CTF) tool built into software

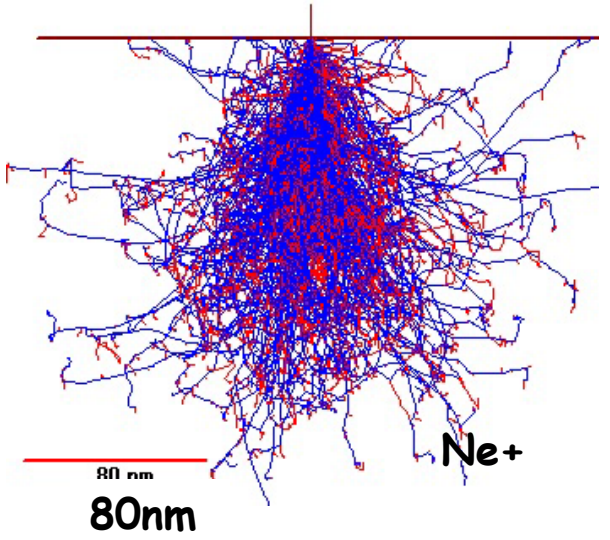
High speed analysis – less than one second/image

Monitors alignment, focus, astigmatism etc. in real time to ensure optimum performance and control



Why add a Neon Beam?



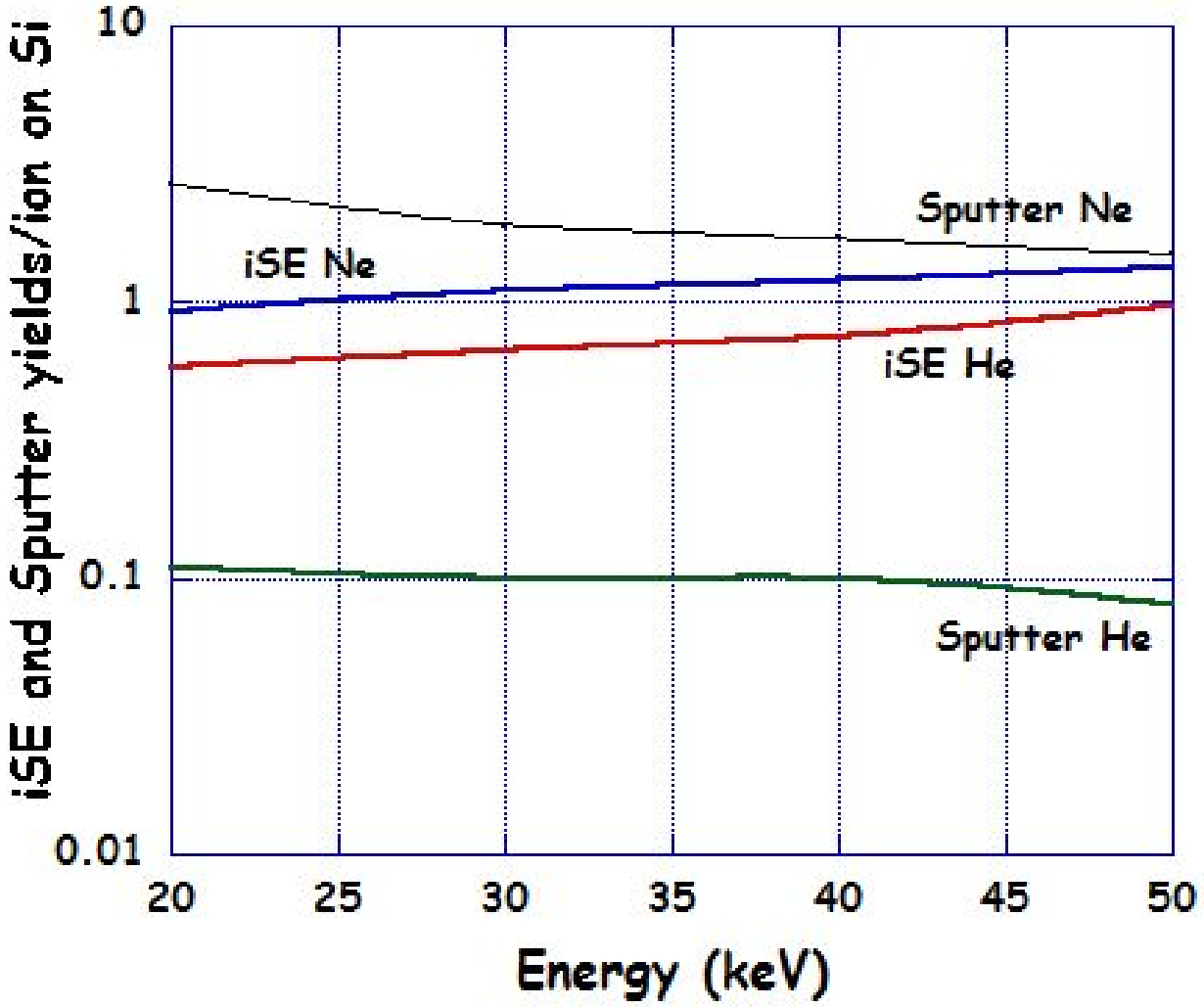


He+ is gentle beam - slow removal of material
No residual deposit
High resolution – minimum feature <2nm

Ne+ 10x faster than He+
No residual deposit
Beam range is shorter
Minimum feature size <5nm – set by chromatic error in the beam

Interaction volumes @40keV in Mo (Blue=forward, red = back)

Comparing He+ and Ne+ Properties

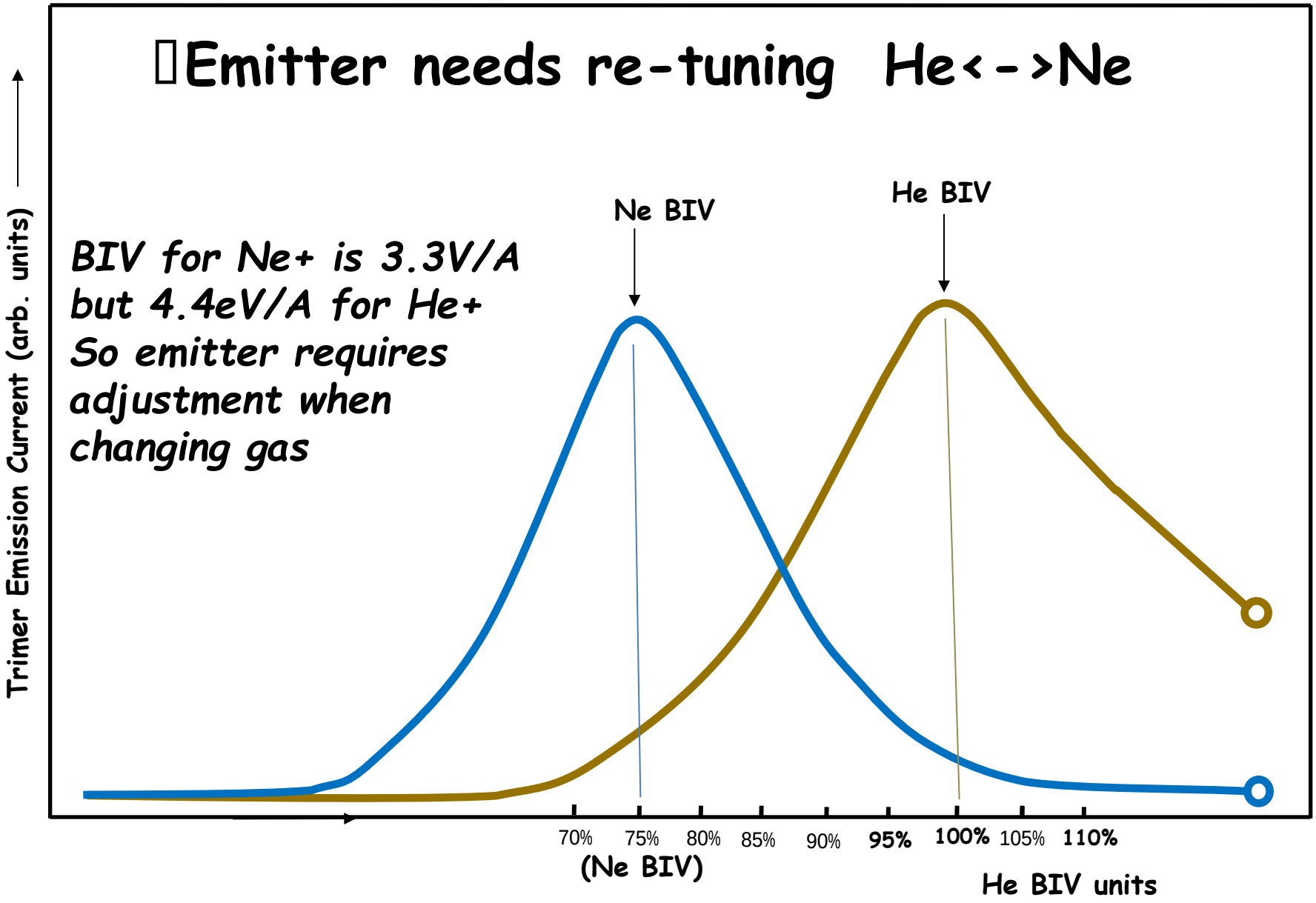


MC Models show how iSE and sputter yields compare for He+ and Ne+ beams

He+ - low sputter, and moderate iSE yield

Ne+ -50x higher sputter rate, 50% more iSE at same energy

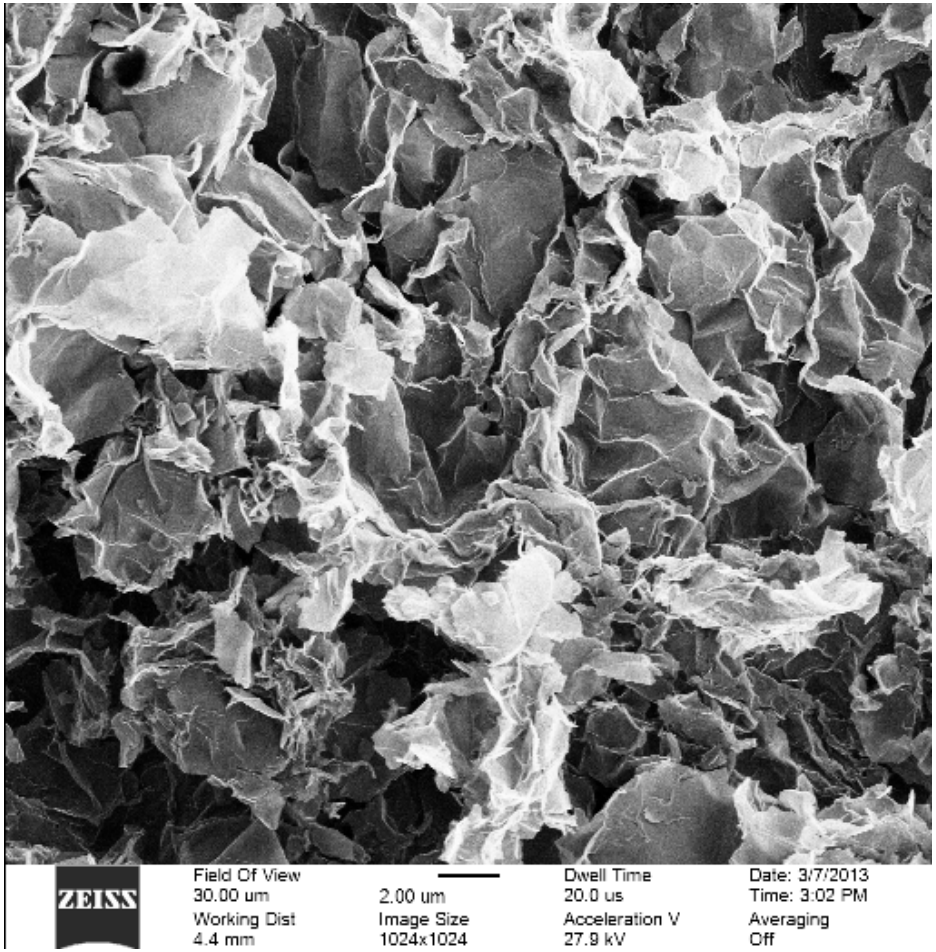
Emitter needs re-tuning He<->Ne



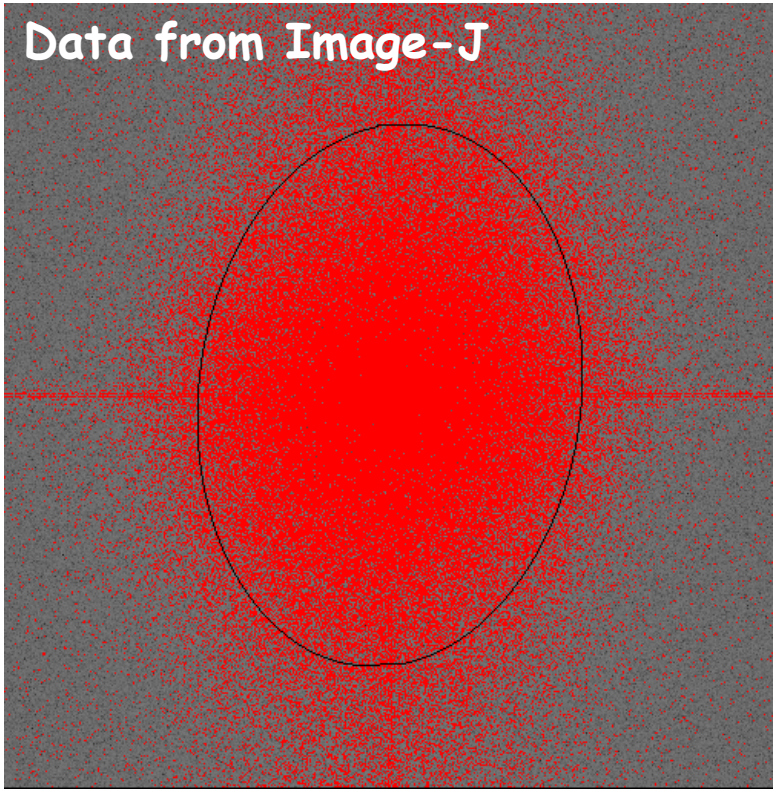
BIV=Best Imaging Voltage

Courtesy Dr. John Notte

What comes next?



Graphene catalyst 27.4 kV, He+ iSE
SNR 14.6,resolution 3.3nm =2pix



…but eccentricity ~ 0.3 – why is it so high? How can it be reduced?

CNMS User Program

The ORION NF is in the

Center for Nanophase Material Science,

Oak Ridge National Laboratory,

and is a US DOE User Facility

User time on this instrument will soon be available contact djoy@utk.edu for details