Latent tracks of swift heavy ions in Si_3N_4

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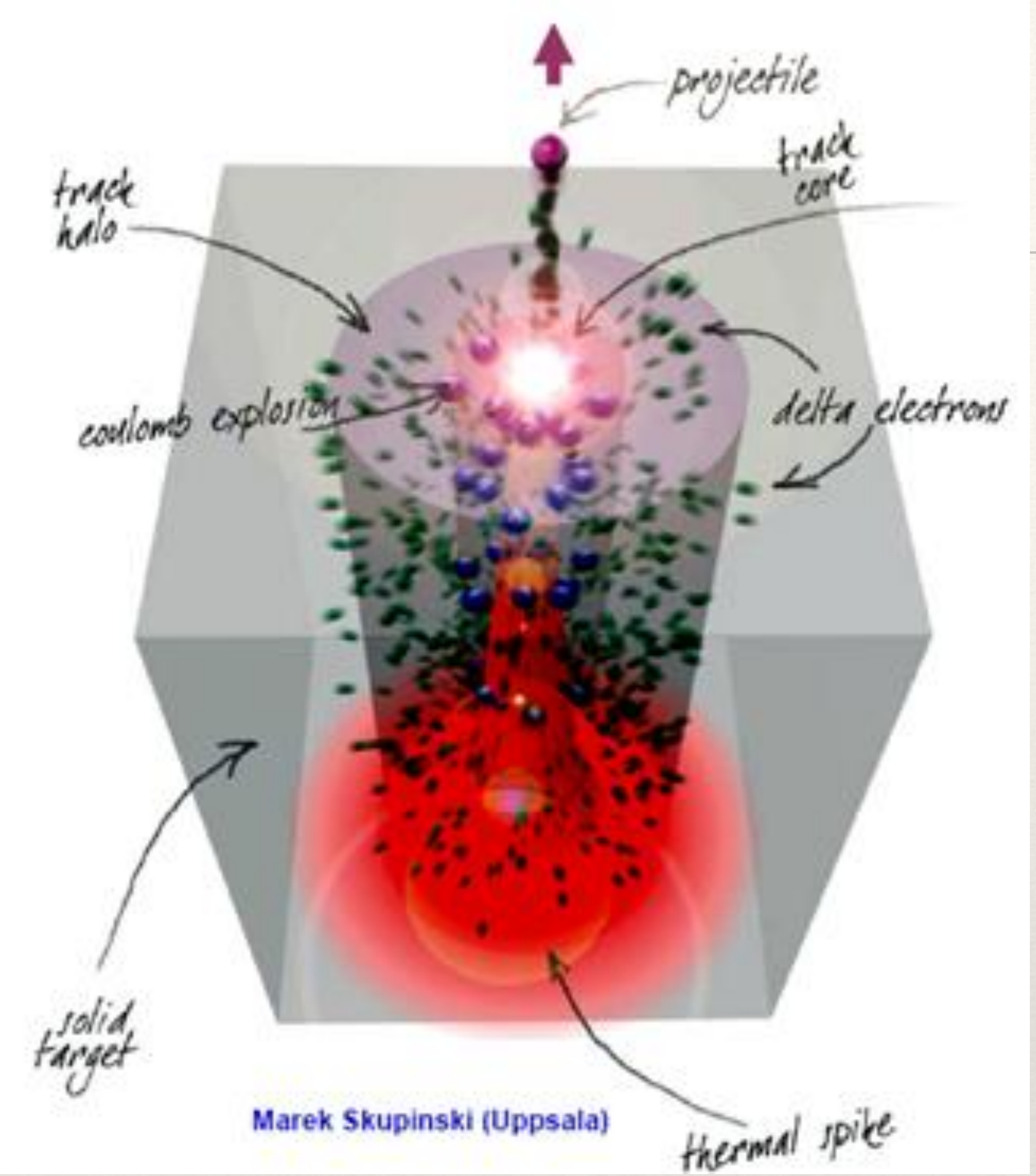
Si_3N_4 as candidate material for inert matrix fuel hosts

Inert matrices - ceramics … and with low neutron absorption cross sections … for transmutation of actinides via nuclear reacti…

Ceramics and oxides cons… nert matrix fuel hosts - $MgAl_2O_4$, MgO, Al_2O_3, Zr… $_3N_4$

- Small absorption cross s… s
- Good thermal and mecha…
- Good stability against neutron irradiation

Radiation defects induced by swift heavy ions simulating fission fragments impact still remain less studied in comparison with neutron and conventional (low energy) ion irradiation



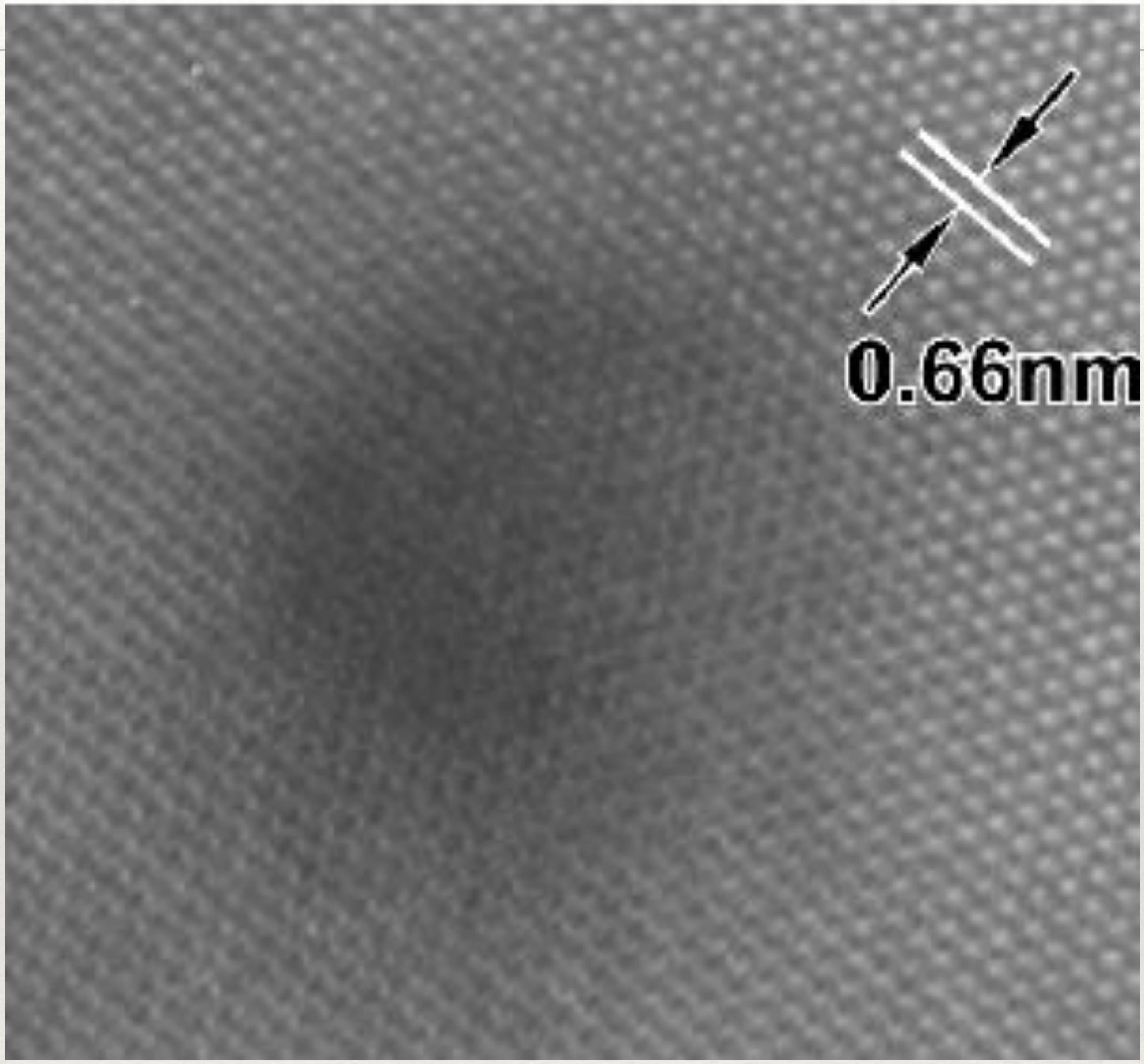
$$(-dE/dx)_t = (-dE/dx)_n + (-dE/dx)_{ion}$$

~ 1% ~ 99%

Main peculiarity of swift heavy ion interaction with solids is a high level of ionizing energy losses which may result in formation of specific radiation damage – latent tracks

Aim of this work is to evaluate latent track parameters in Si_3N_4 irradiated with swift Bi ions

Latent tracks in crystalline Si3N4

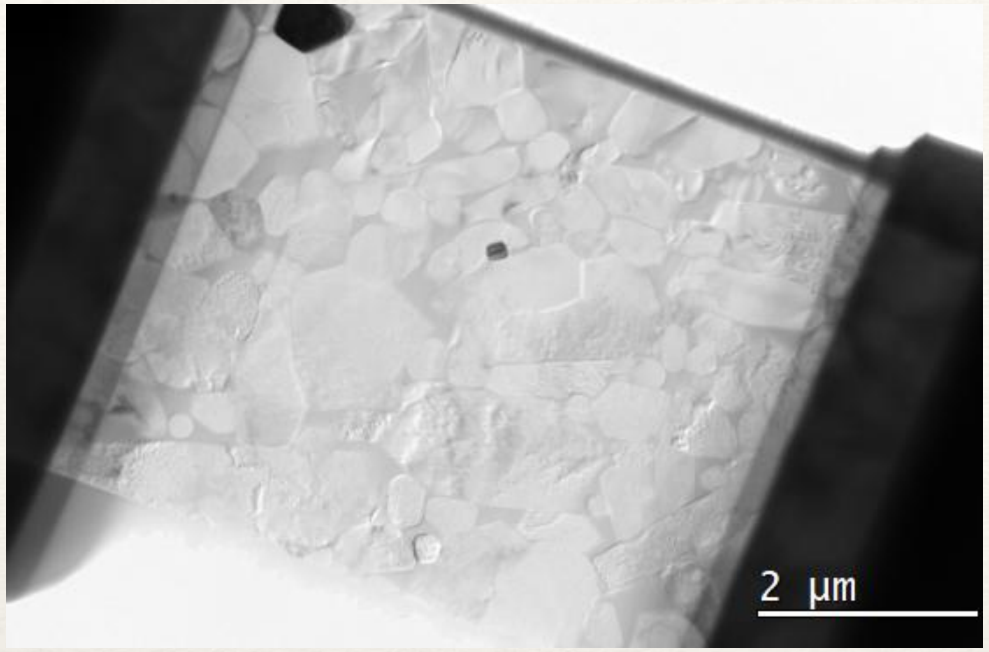


Amorphous latent track of 710 MeV Bi ion in polycrystalline Si_3N_4.

Track diameter = 3 - 4 nm

S.J. Zinkle, V.A. Skuratov and D.T. Hoelzer. Nucl. Instr. Meth. B 191 (2002),758

Materials & Methods



Polycrystalline Si_3N_4:2 at.% Al (MTI,USA)

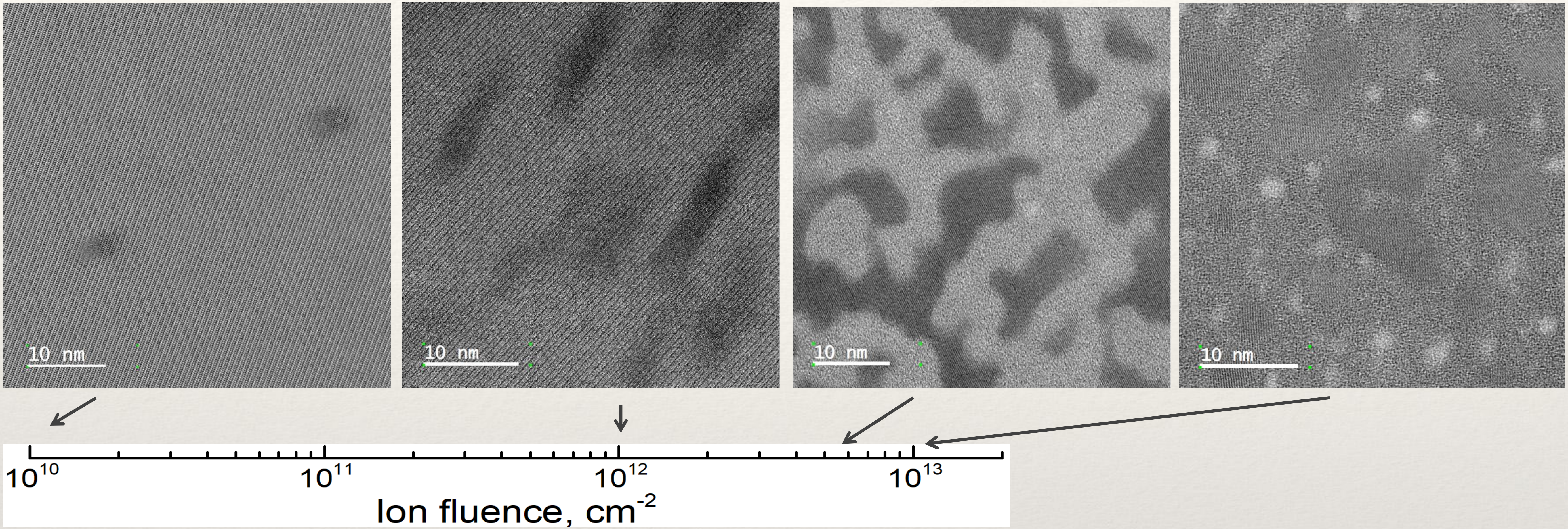
Ion irradiation parameters

Ion, energy (MeV)	Ion fluence, cm^{-2}
Bi, 700	5×10^{11}, 1×10^{12}, 5×10^{12} 1×10^{13}, 1.23×10^{13}
Bi, 1030	1×10^{10}

Facility: cyclotrons U400, U400M (JINR, Dubna)

Facility: FIB, TEM – Centre for HRTEM (NMU, Port Elizabeth)

Bi, 700 MeV



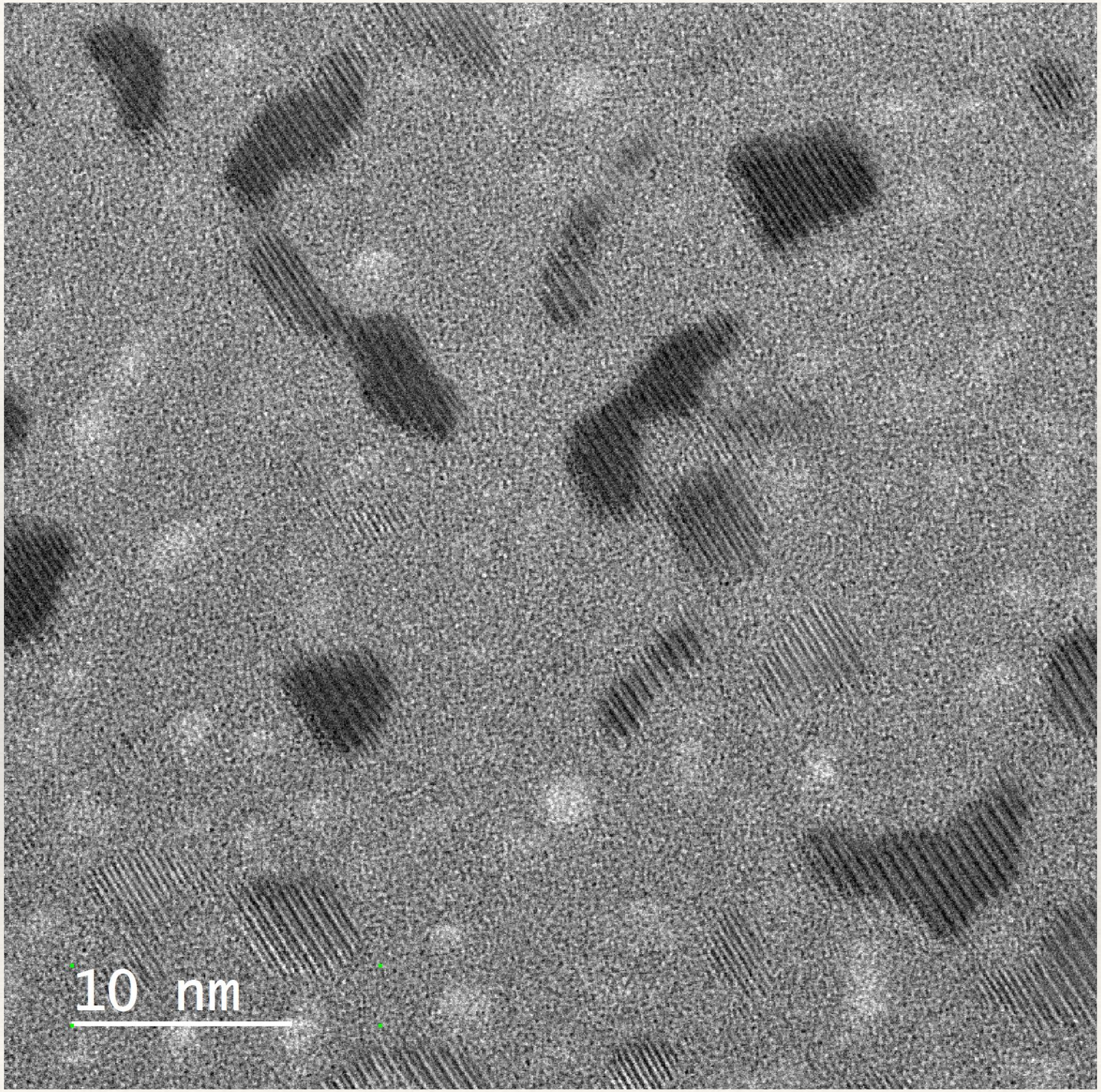
Amorphous tracks in crystalline matrix

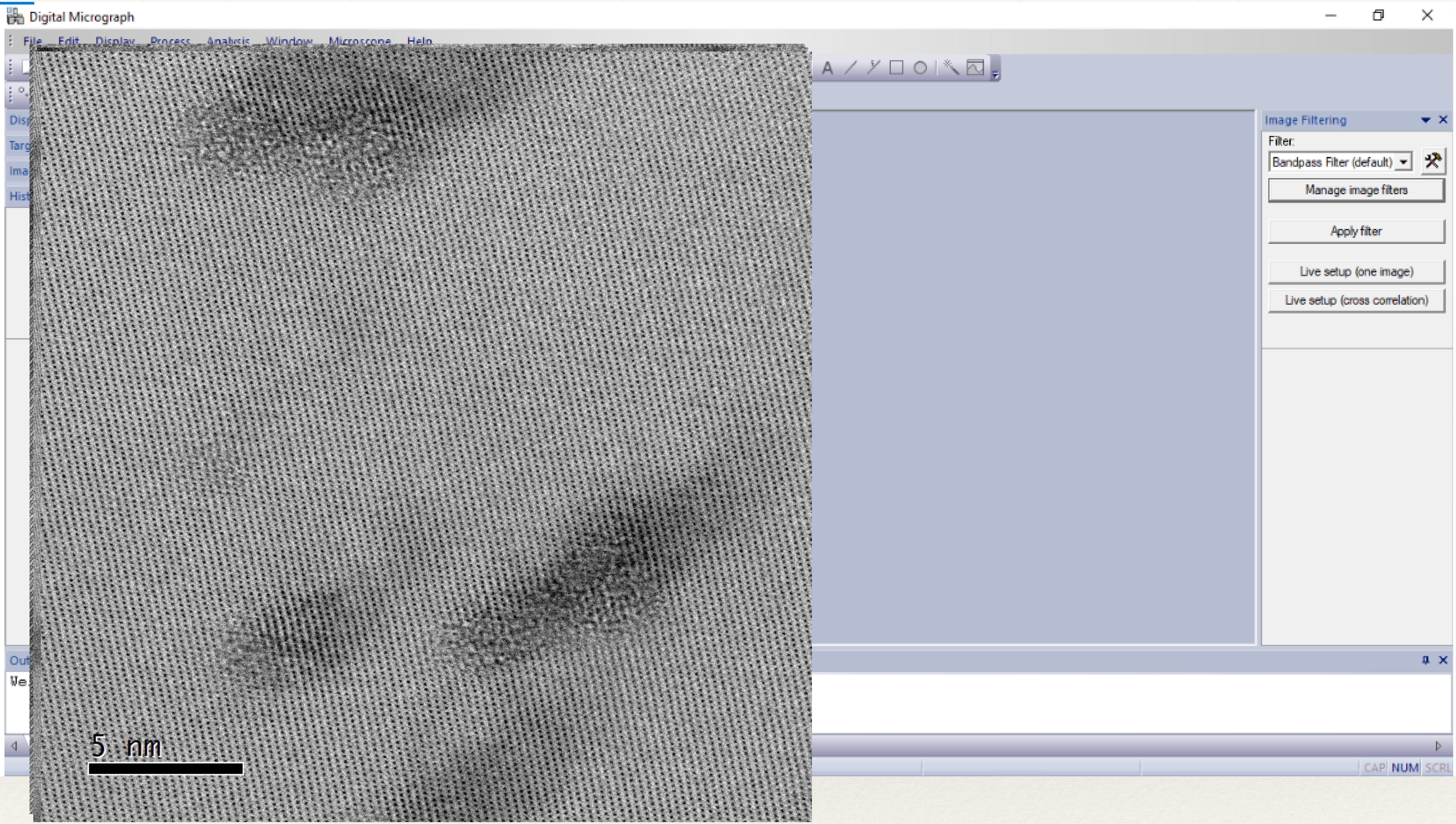
Amorphous tracks in amorphous matrix

Ion fluence for latent track overlapping $\Phi_{overlap.} \times \pi R^2 = 1 cm^2$ $R = 1.65$ nm

$$\Phi_{overlap.} = 1.2 \times 10^{13}\ cm^2$$

Bi, 700 MeV. Ion fluence $10^{13}cm^{-2}$




Digital Micrograph
File Edit Display Process Analysis Window Microscope Help
Image Filtering
Filter:
Bandpass Filter (default)
Manage image filters
Apply filter
Live setup (one image)
Live setup (cross correlation)
5 nm
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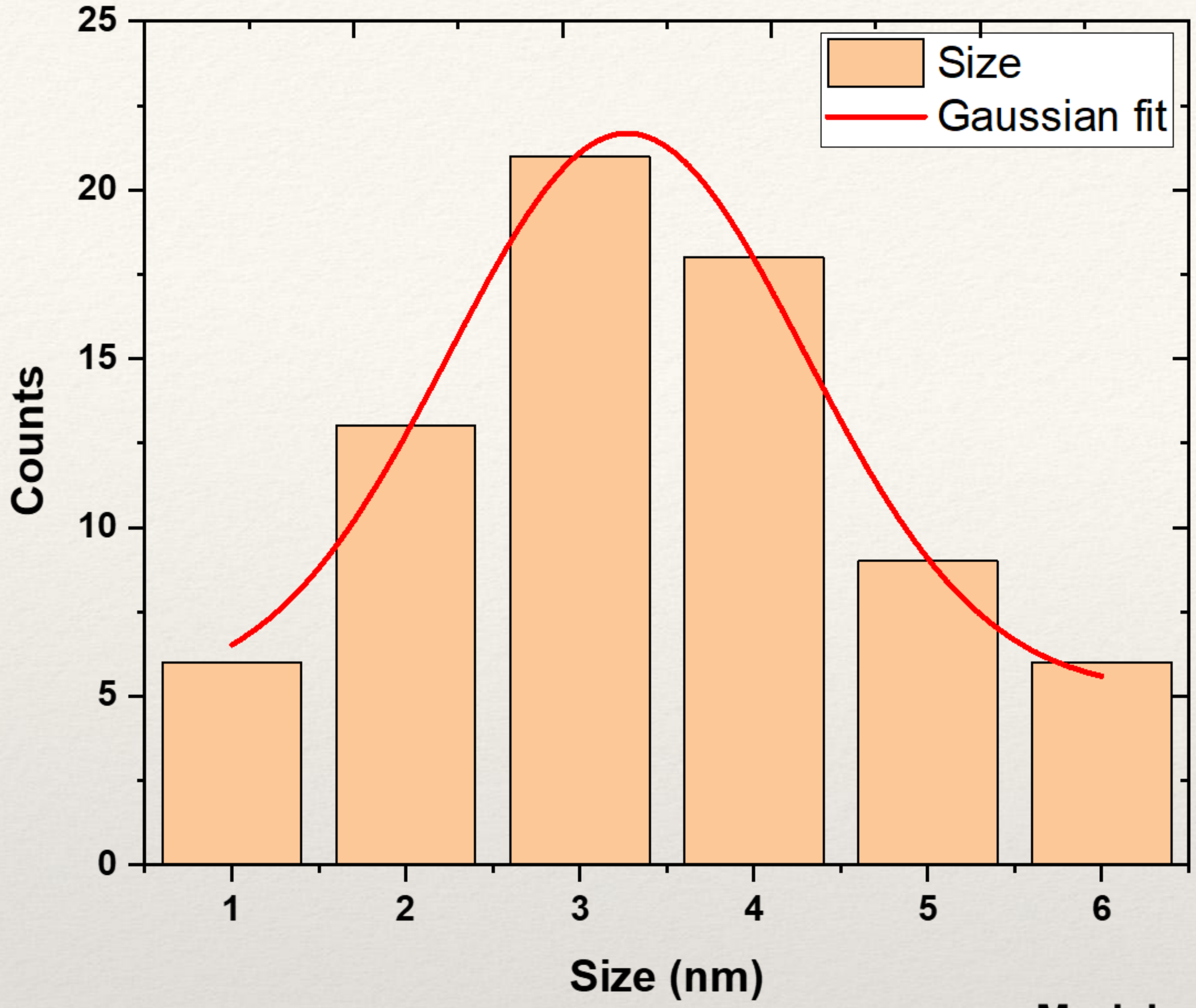

Model	Gauss
Equation	y=y0 + (A/(w*sqrt(pi/2)))*exp(- 2*((x-xc)/w)^2)
Plot	A
y0	5.12669 ± 0.57155
xc	3.2717 ± 0.03301
w	2.04247 ± 0.1152
A	42.36176 ± 3.26458
Reduced Chi-Sqr	0.2589
R-Square (COD)	0.9974
Adj. R-Square	0.99349

Thank you for your attention!

ACKNOWLEDGEMENT

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