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Affects of Single Ion Strikes into Si on the 3D Reciprocal Space

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Outline

- Motivation
- Potential Scenario
- Question to be answered
- Hypothesis
- Experimental Methods
- Experimental Conditions
- Next steps
- Acknowledgements

Motivation

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- As humanity moves out to space need to make sure out equipment won't fail during inopportune moments this will help predict that.
  - Future Mars Missions

Potential Scenario

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- Electronics currently in the Gale Crate
  - Galactic Cosmic Radiation (GCR) or Solar Energetic Particles (SEP) need to be in excess of 150 MeV to reach the martian surface
    - GCR makeup
      - 85-90% protons
      - ~10-13% helium
      - ~1% electrons
      - ~1% heavier ions
    - SEP makeup
      - Suppresses the GCR
      - ~1-% Helium
      - < 1% heavier ions
      - ~90% protons and electrons
  - Shielded by approximately 4mm of aluminum

Question

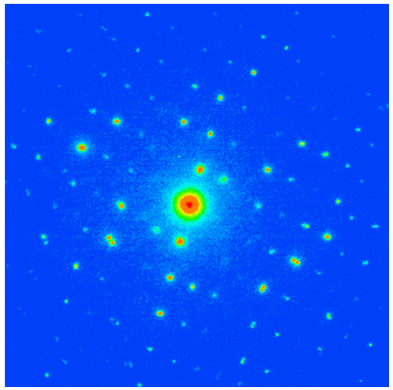
How do accumulated damage events induced by single ion strikes of H, Si, and Au from 10 Kev, 100Kev, 1Mev, and 10Mev at 90° affect the 3D diffraction pattern of single orientation Si?

Hypothesis

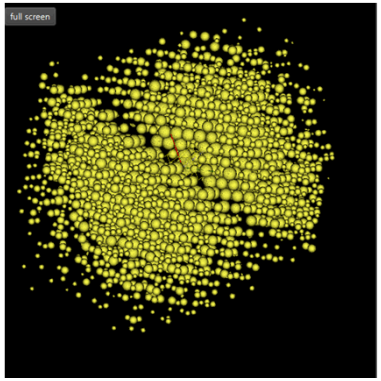
- At low energies the diffraction pattern will see little change from that of undamaged Si. Expected damage to be Frenkel pairs
- At high energies, damage dominated by cascade events with major affects to the diffraction pattern seen in experiments

Experimental Methods

- LAMMPS
  - Molecular Dynamics code
- EMsoft
  - Reconstruct TEM images from the LAMMPS model
- Nanomegas ADT3D
  - Takes diffraction patterns from TEM to create a 3D reconstruction of the crystal lattice



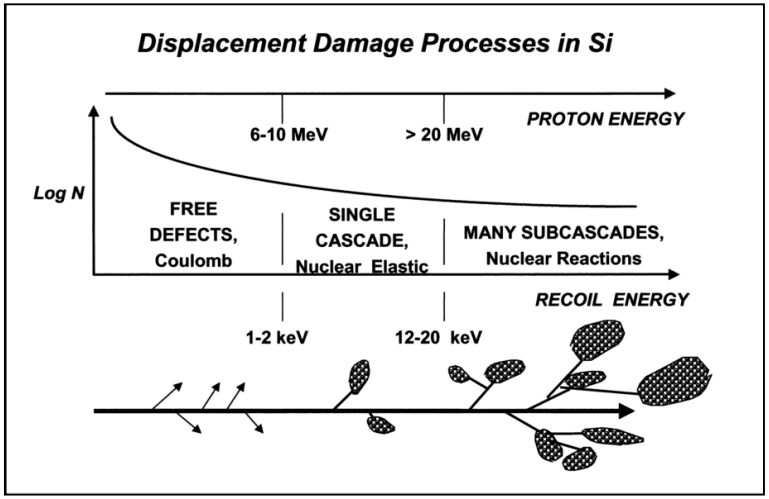
BaSO4 Diffraction Pattern



Reconstructed BaSO4 crystal lattice

Experimental Conditions

- Ions: Protons, Si, Au
- Attenuated by 4mm of Al
- Low Solar Activity Period
- 10 Kev, 100Kev, 1Mev, and 10MeV
- Azimuth angle is constant 0 degrees
- Theta angle is constant 90 degrees
- Single Orientation Si



Damage induced by Single Proton Strike

Next Steps

1. Setup software by end of September
2. Reconstruct crystal lattice for undamaged Si

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