Coherent Scattering and Imaging

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8SXNS
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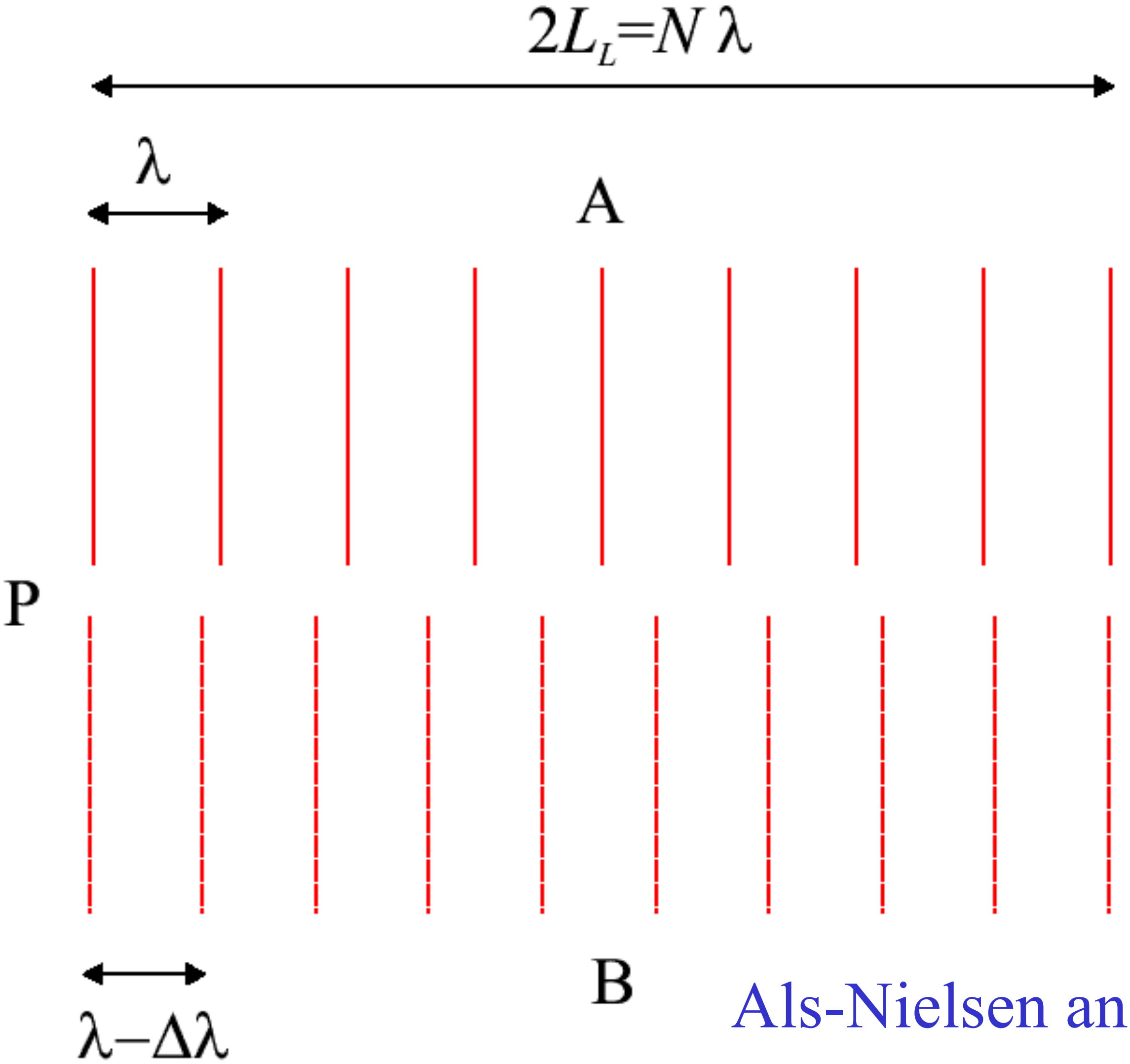
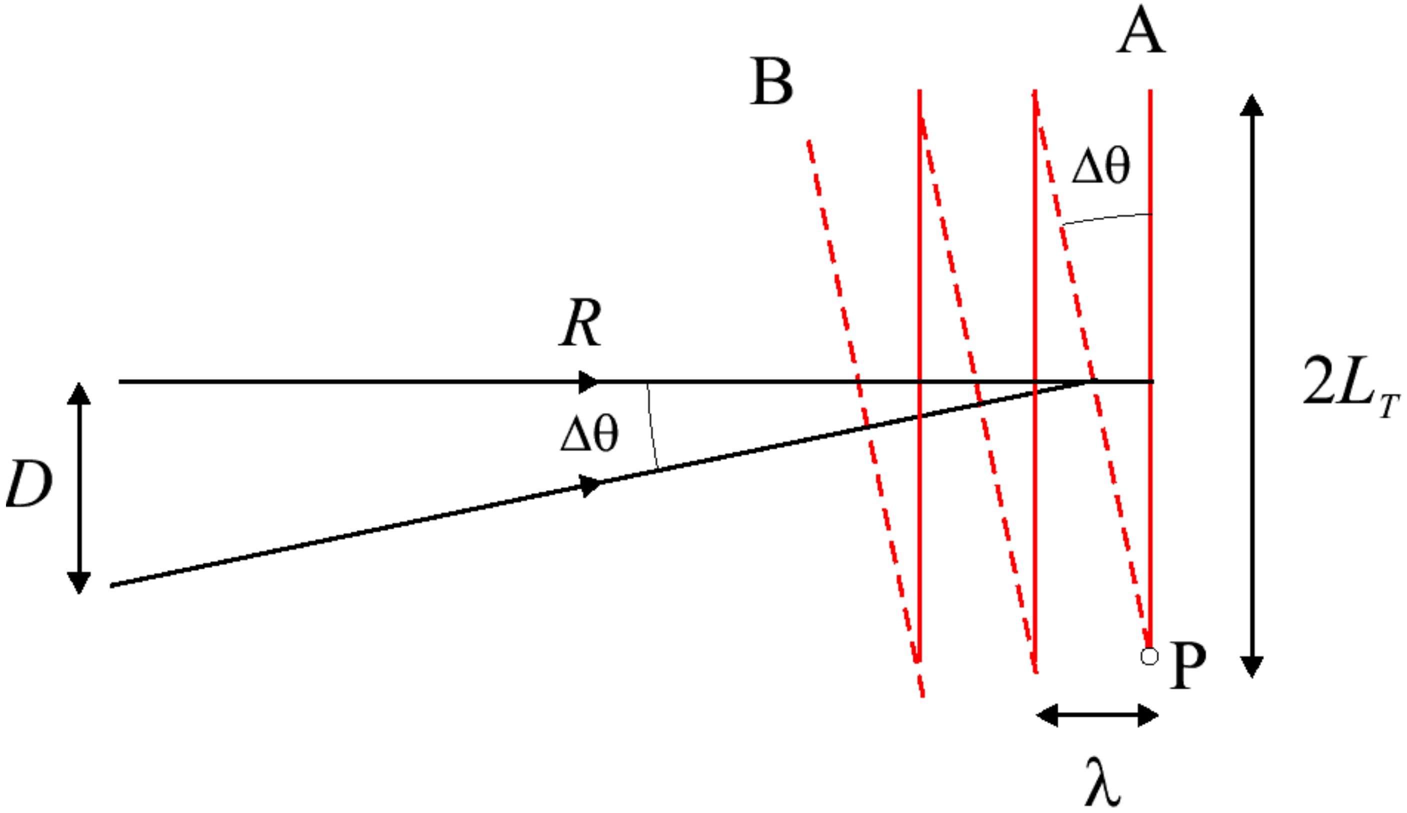
Longitudinal Coherence



$$L_L = \frac{1}{2}\frac{\lambda^2}{\Delta\lambda}$$

Als-Nielsen and McMorrow (2001)

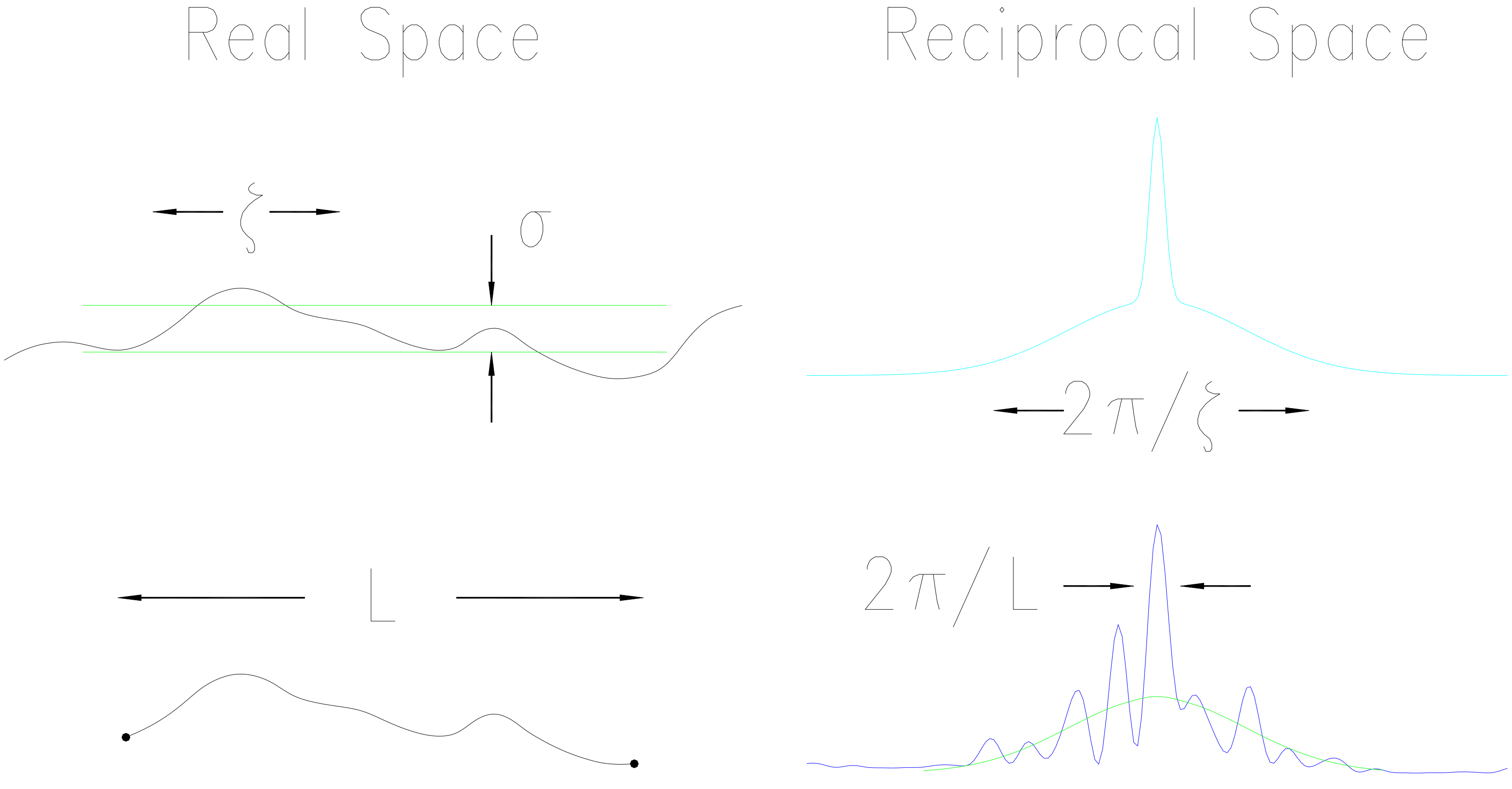
Lateral (Transverse) Coherence



$$L_T = \frac{\lambda}{2}\frac{R}{D}$$

Als-Nielsen and McMorrow (2001)

Diffuse Scattering acquires Structure using CXD



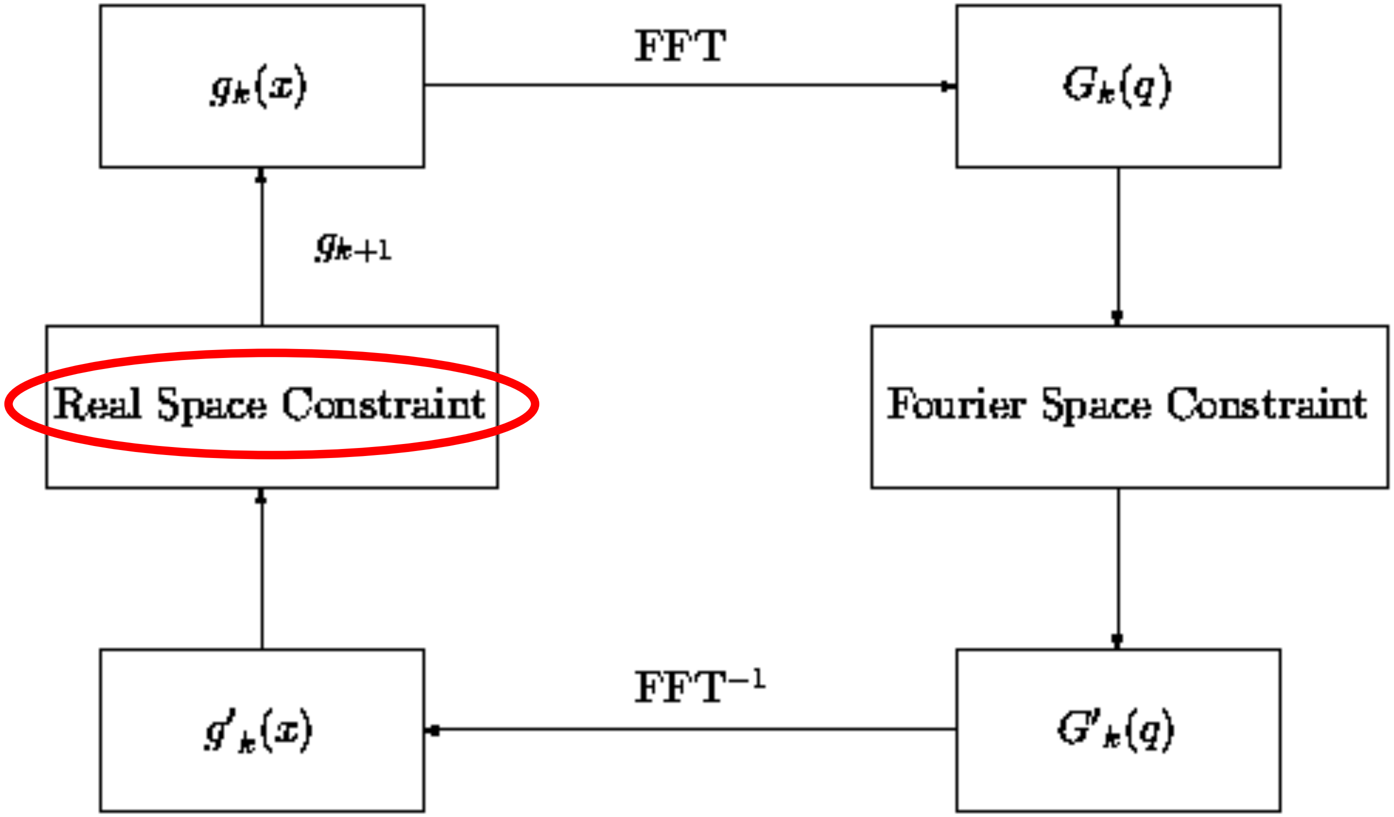
Rules of Life with Coherence

- No more diffuse scattering
- No more ensemble averaging
- Coherence is indestructible
  - everything following your (coherence-defining) entrance slit is your ‘sample’
- If something moves, the whole interference pattern changes

Applications of Coherence

- “Coherent X-ray Diffraction Microscope”
  - small objects (Pfeiffer)
  - magnetic domains (Eisebitt)
- X-ray Photon Correlation Spectroscopy
  - poymer melt dynamics (Kim)
  - liquid crystal films (de Jeu)
  - heterodyne fluctuations (Madsen)
- Phase objects ...

Iterative Phase Refinement



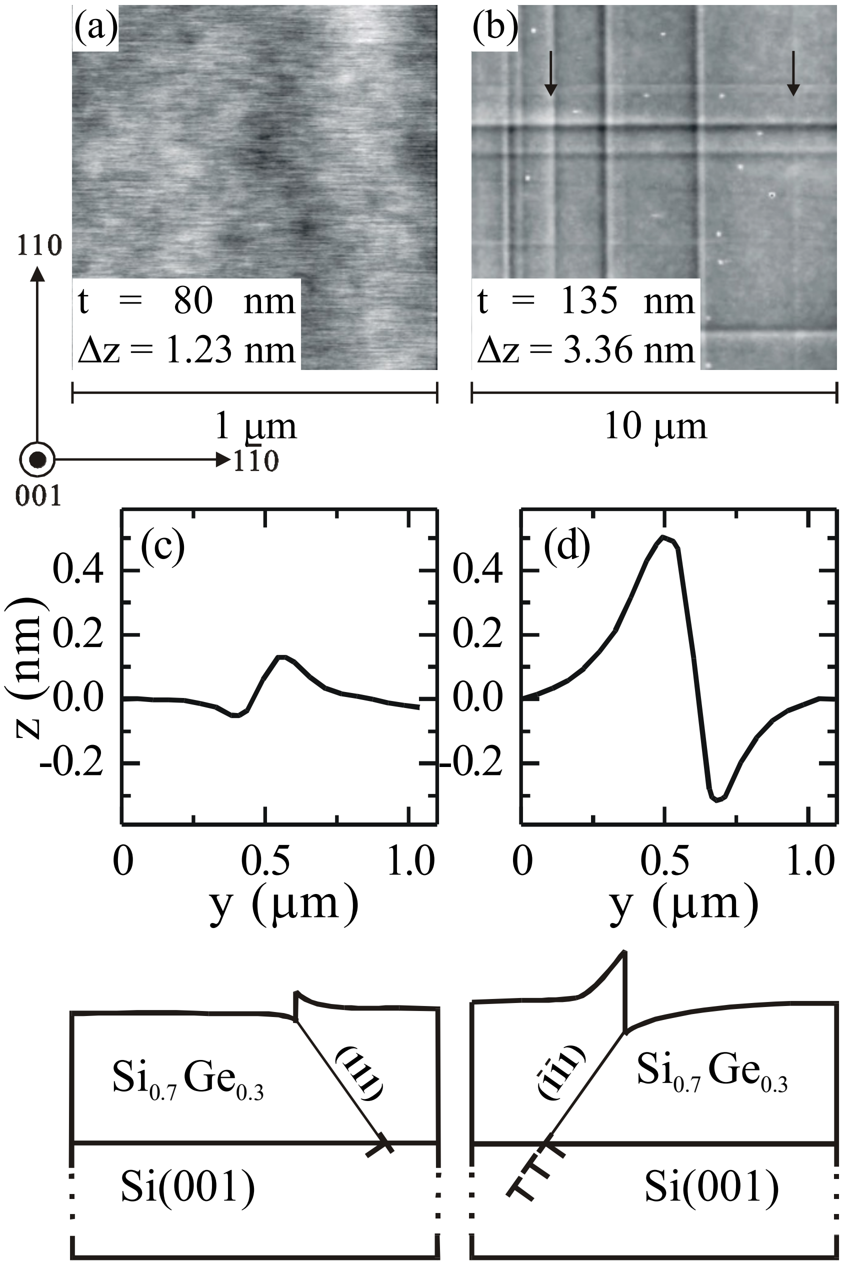
J. R. Fienup Appl. Opt. 21 2758 (1982)
R. W. Gerchberg and W. O. Saxton Optik 35 237 (1972)

Low dislocation density GeSi films

Thickness close to critical thickness

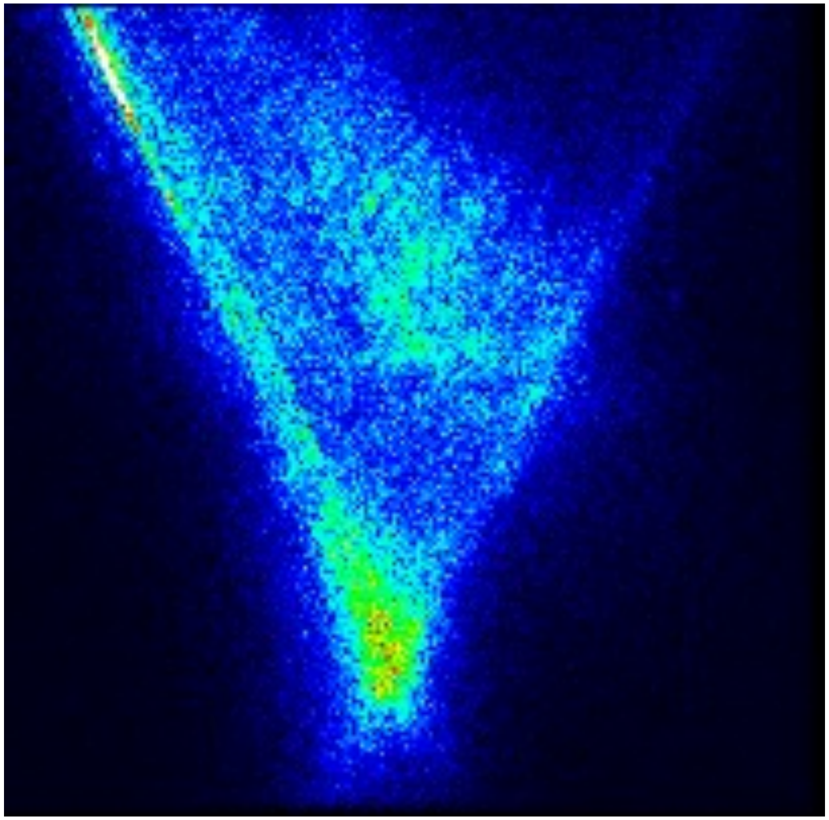
Dislocations aggregate at interface and glide to surface along {111}

T. Spila, UIUC Thesis

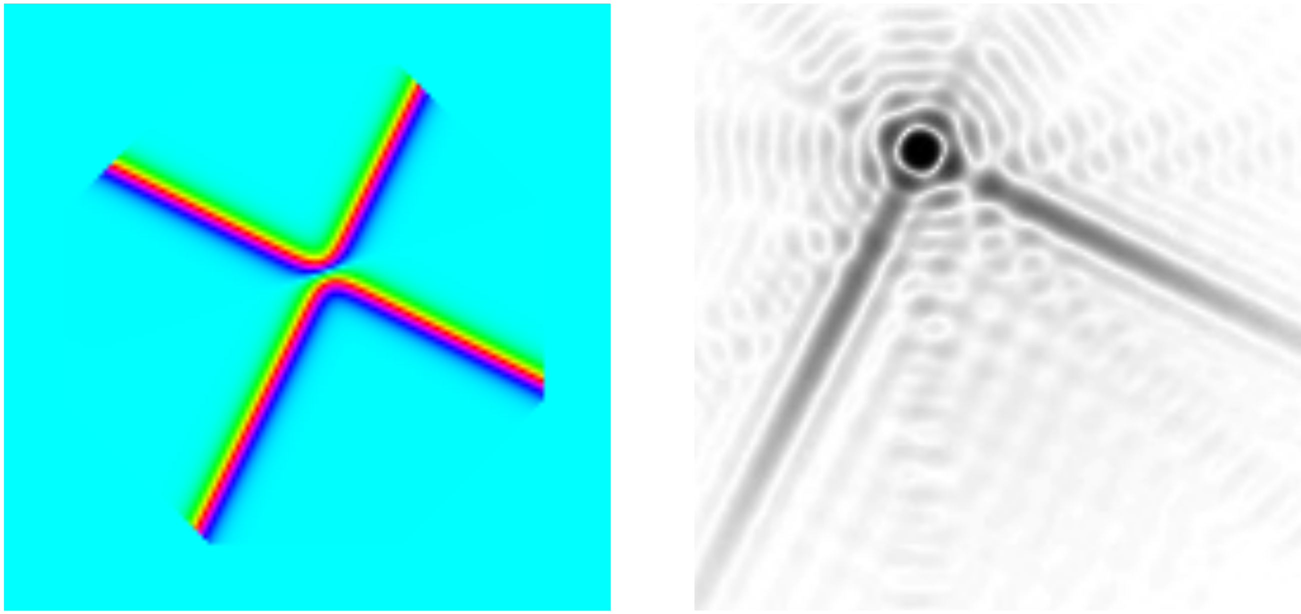


Use CCD and scan sample position

(2,0,1.92) 280nm thick $Ge_{0.3}Si_{0.7}$



Dislocation Diffraction



Multiple Dislocations