

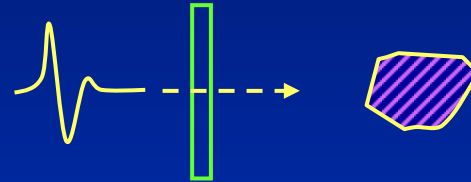
Time reversal 3-D imaging using single cycle terahertz pulses

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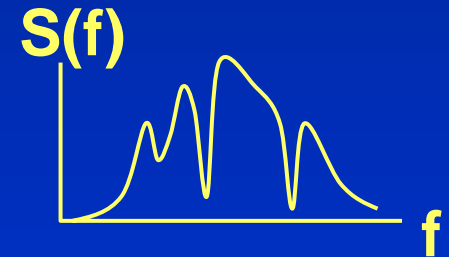
Introduction

- Goal: 3-D imaging with THz pulses
- Motivation:

1) THz can penetrate various opaque materials



2) Absorption lines in THz band



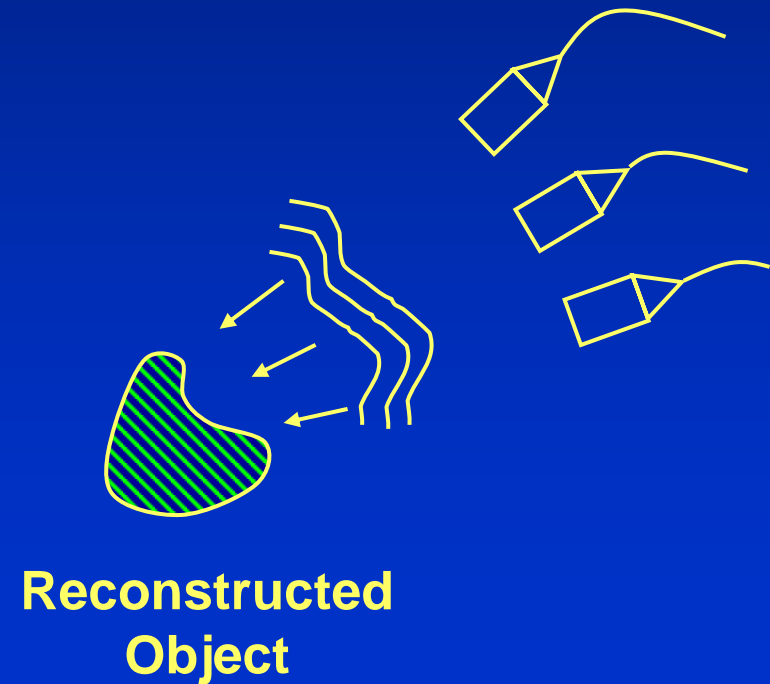
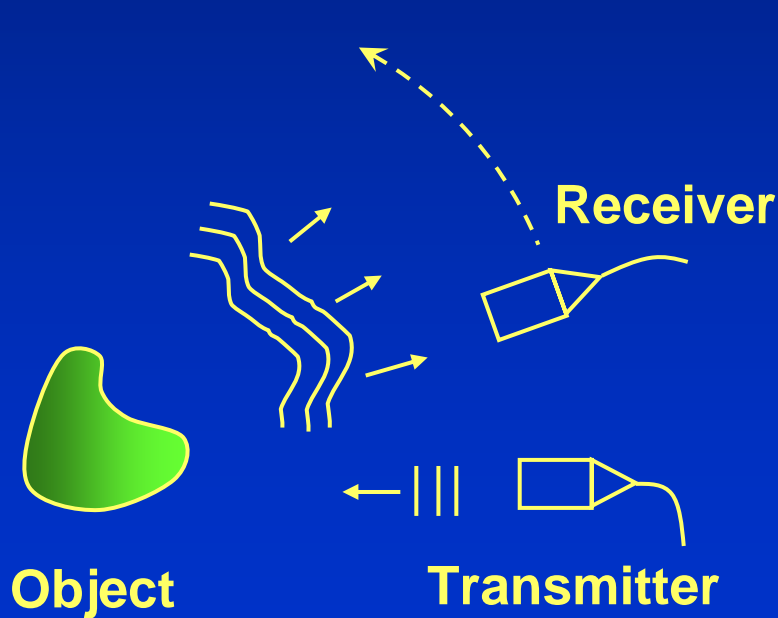
3) Sub-mm resolution



Time Reversal Imaging

1) Record scattered waves at various locations

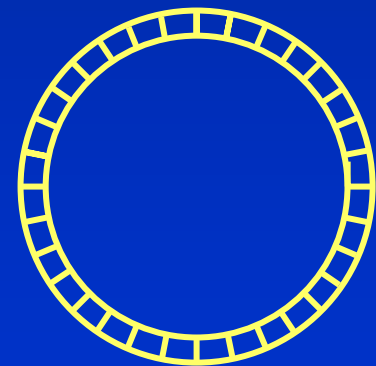
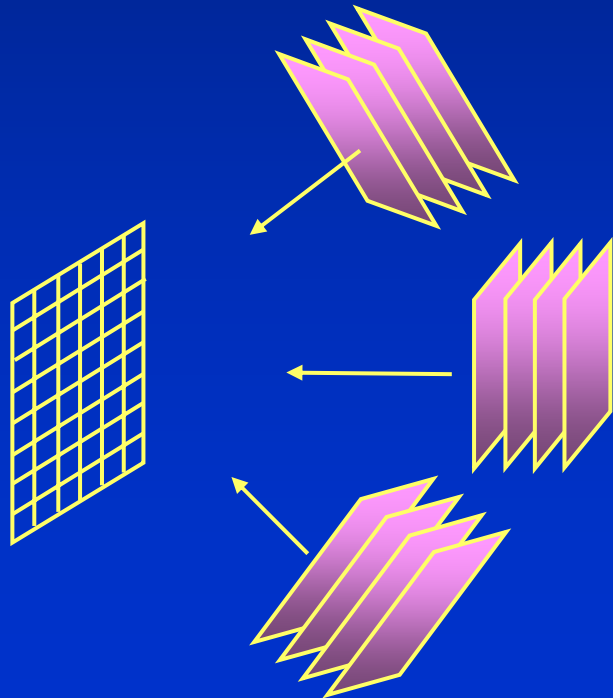
2) Backpropagate the waves to reconstruct the object



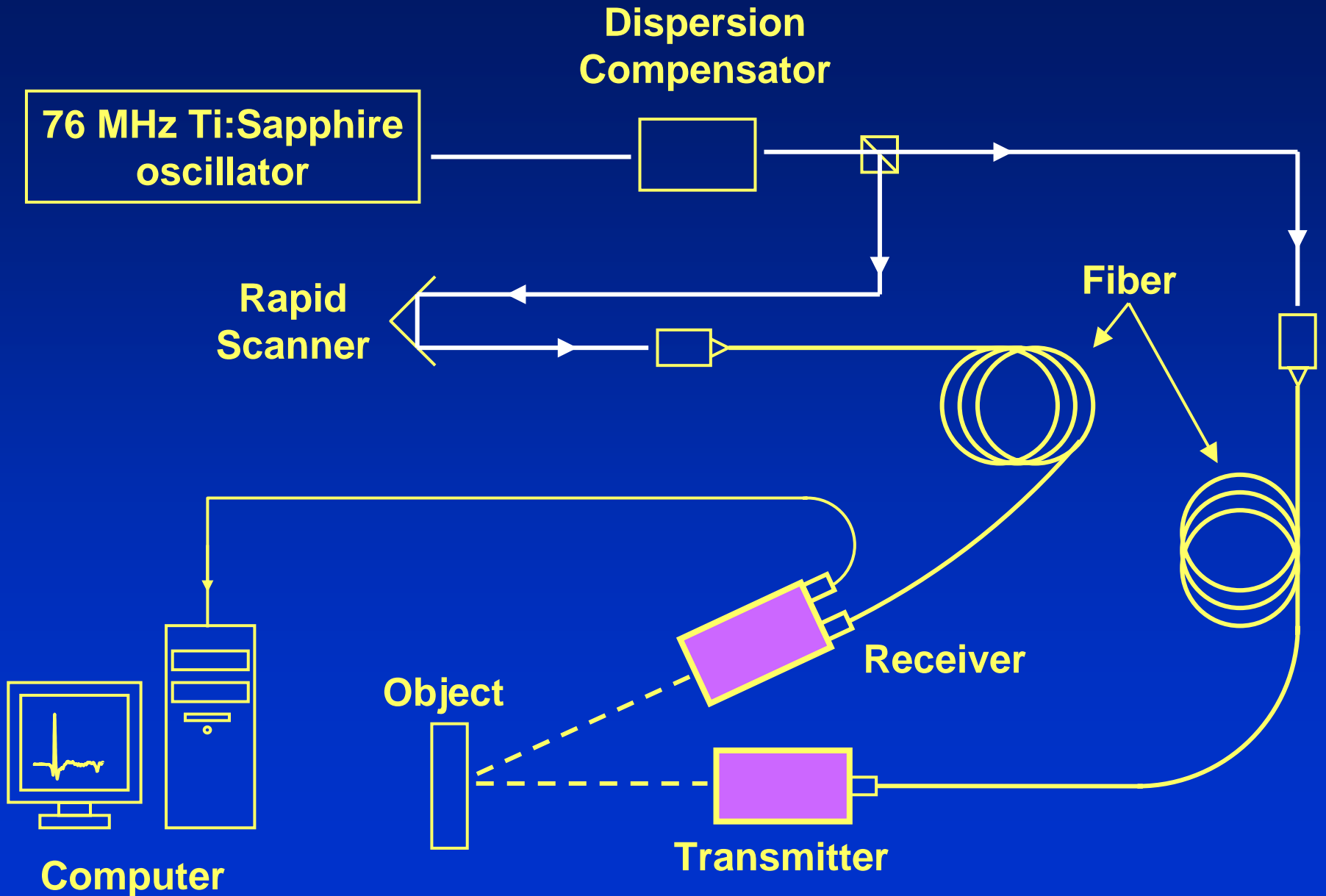
Array Geometry for 3-D Imaging

- Need 2-D array to record the angular spectrum

- 3-D imaging is still possible with a ring annular array

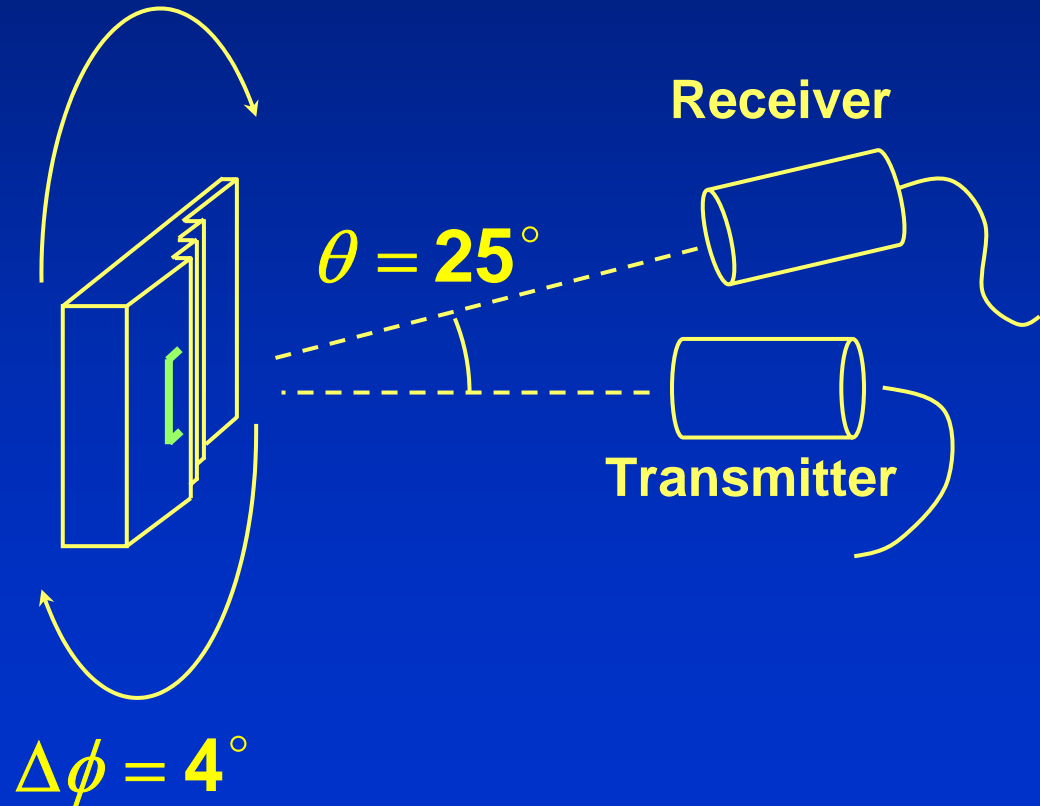
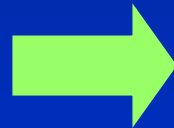
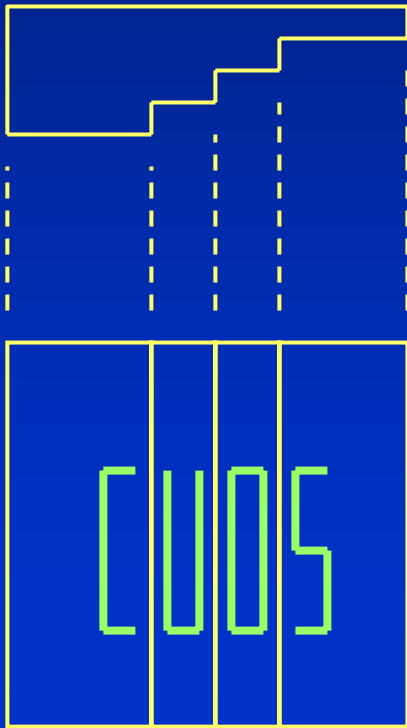


Experimental Setup



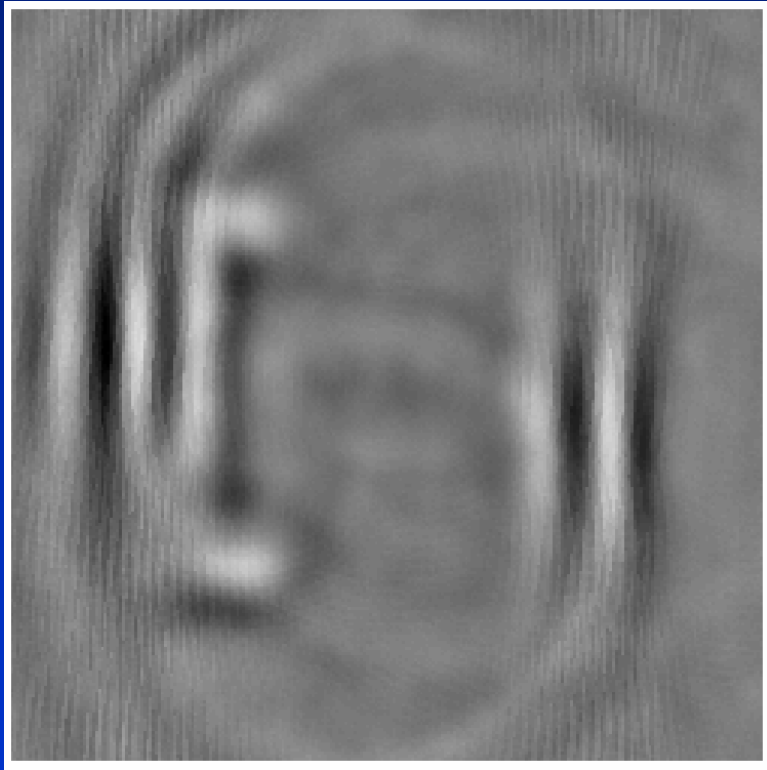
3-D Imaging Geometry

“CUOS”
3-D object



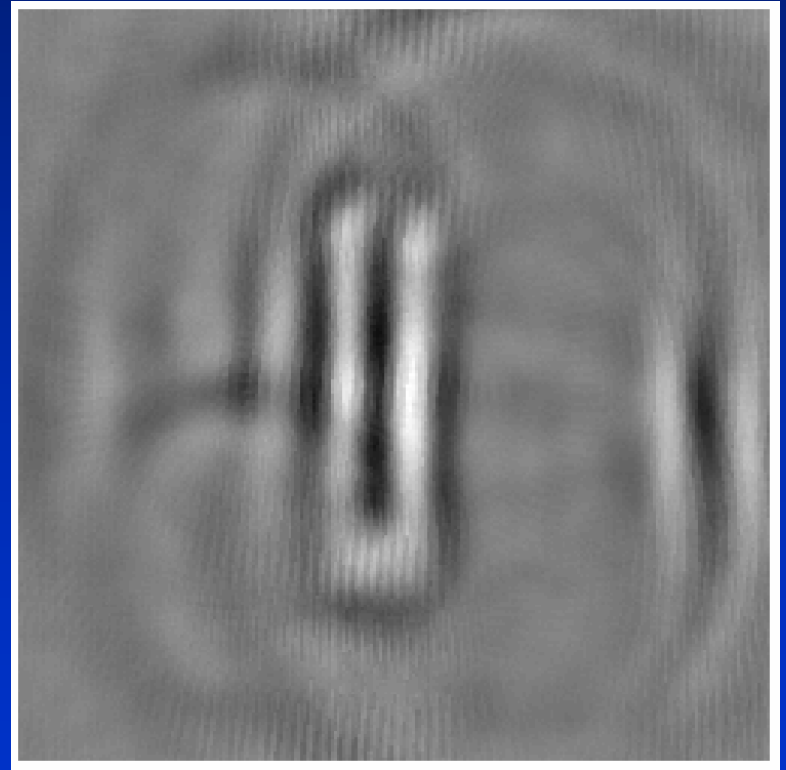
Reconstructed Images

Letter "C"



— 3 mm

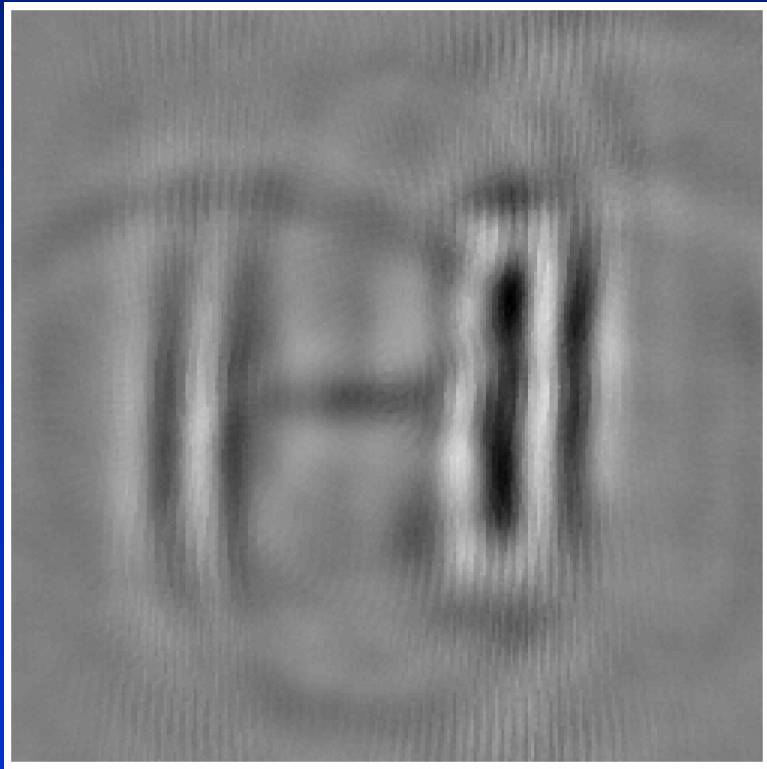
Letter "U"



— 3 mm

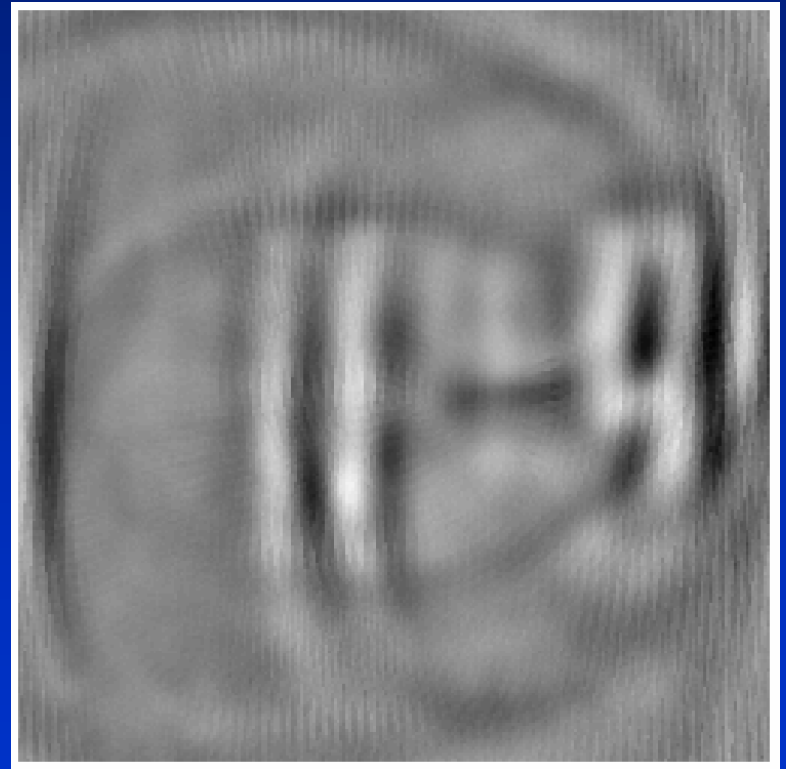
Reconstructed Images

Letter "O"



— 3 mm

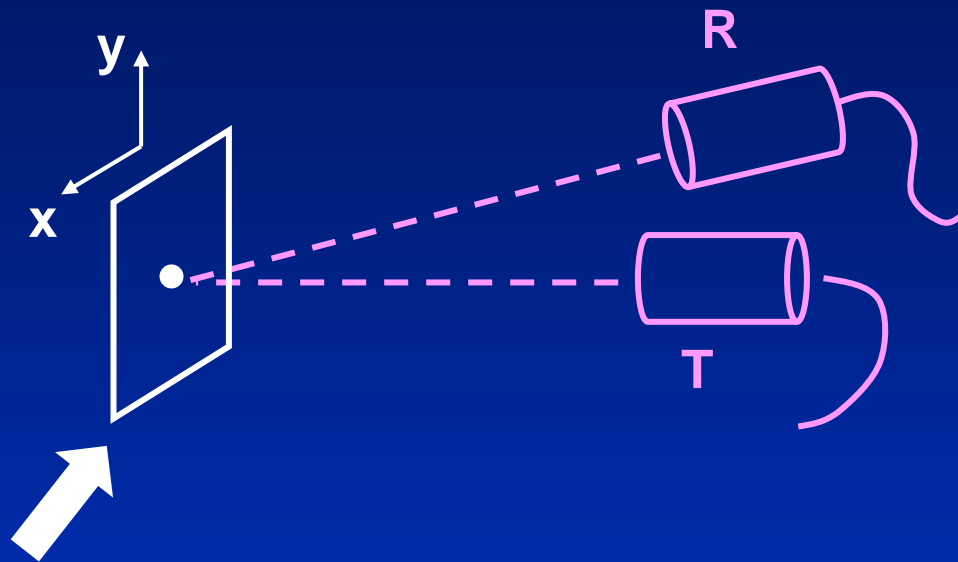
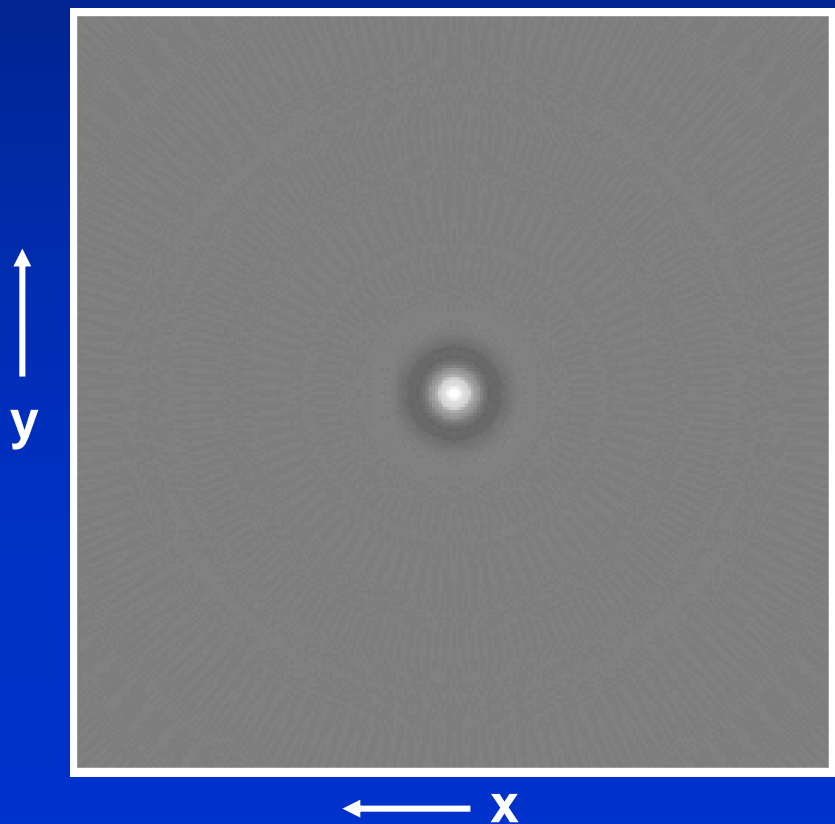
Letter "S"



— 3 mm

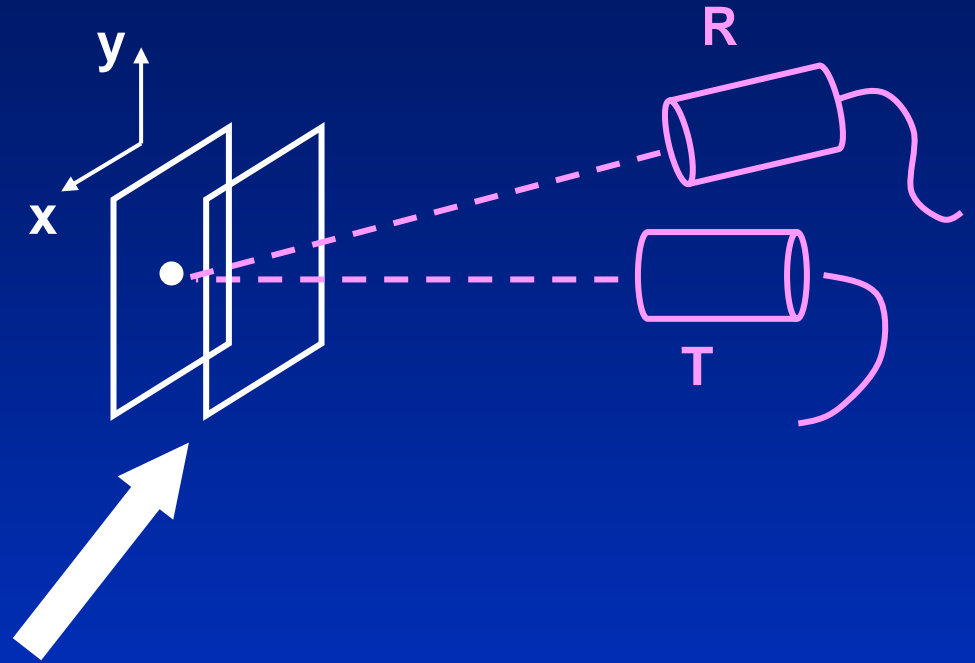
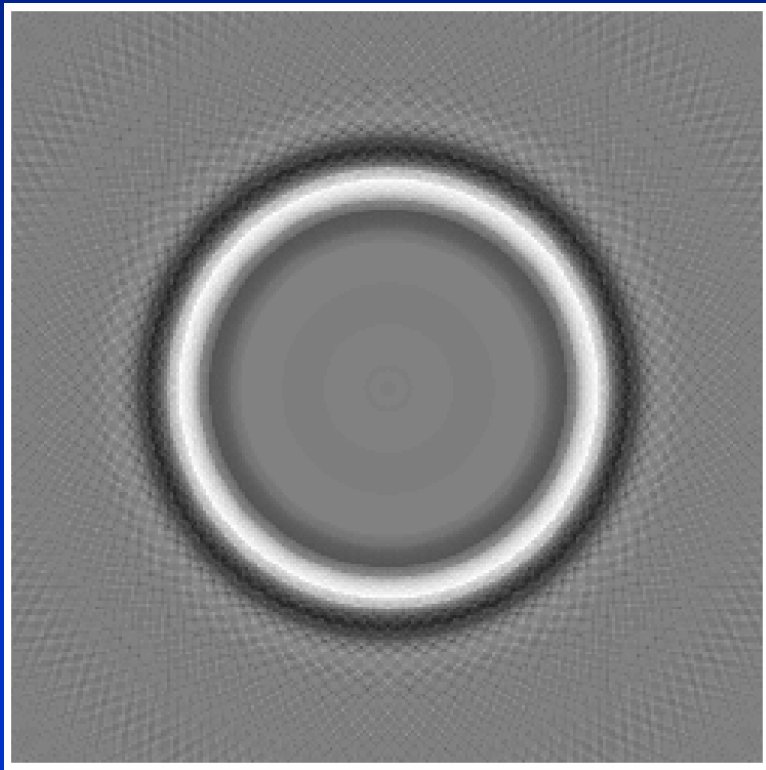
Simulated Point Spread Fn

Reconstruction



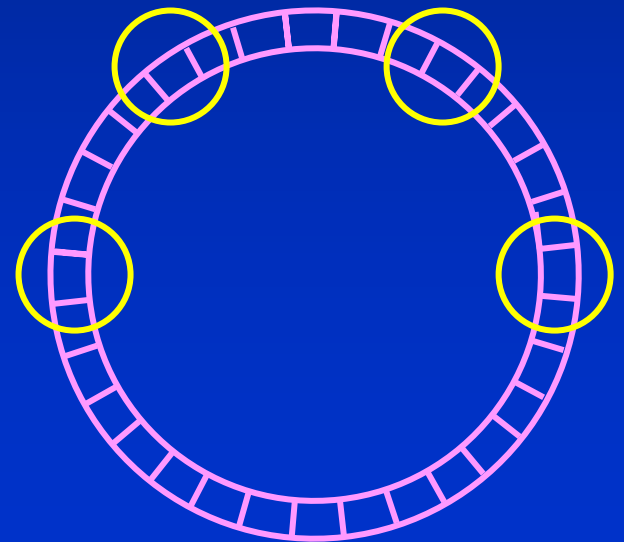
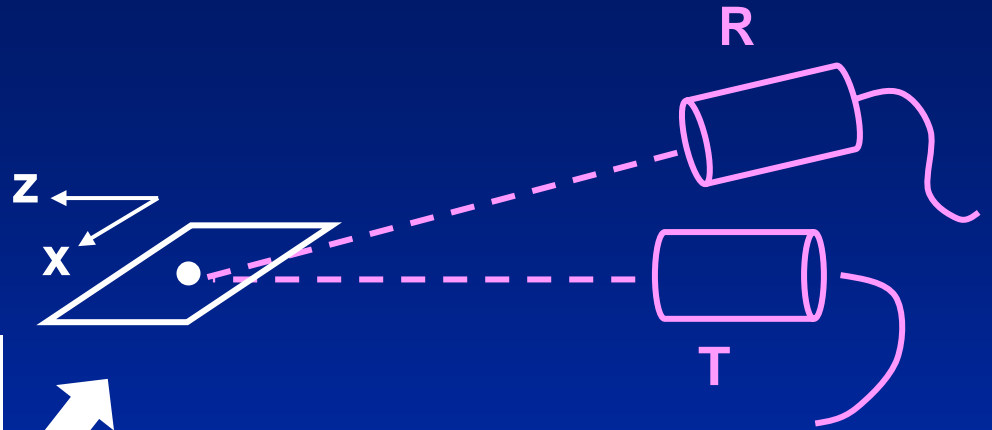
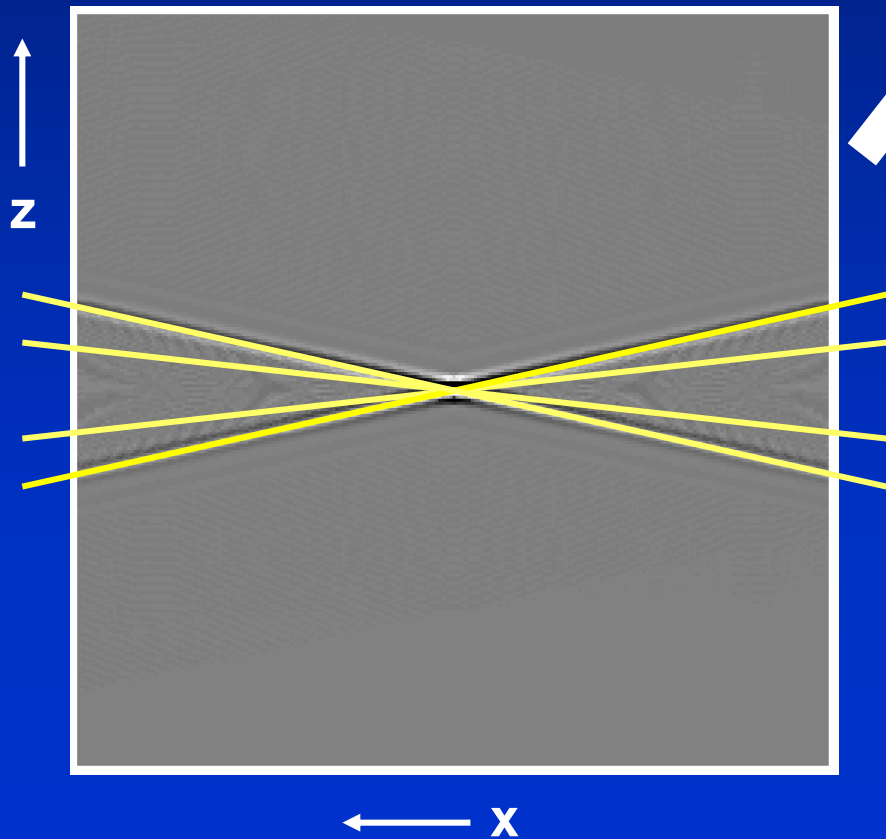
Simulated Point Spread Fn

Reconstruction



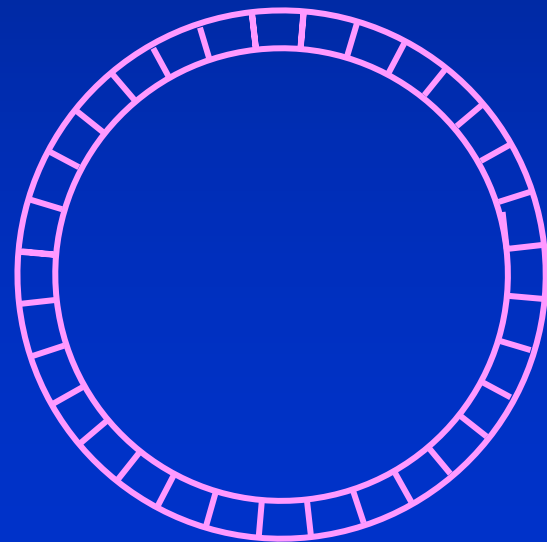
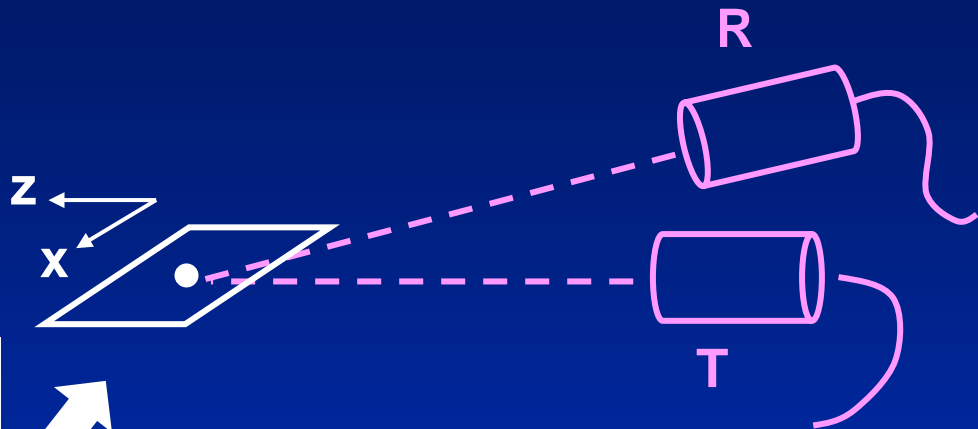
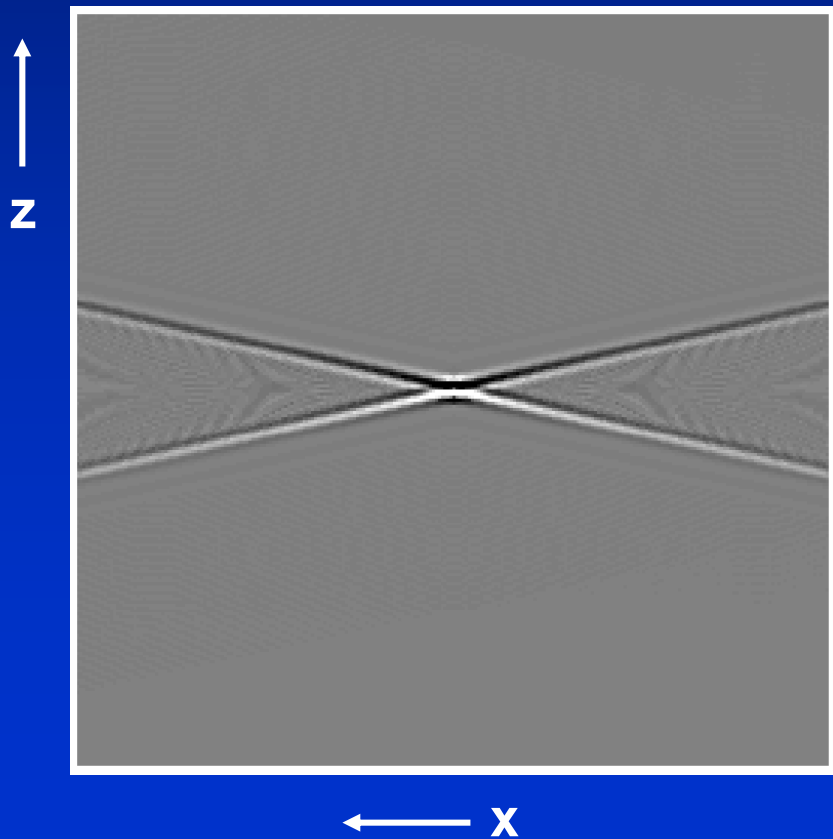
Simulated Point Spread Fn

Reconstruction

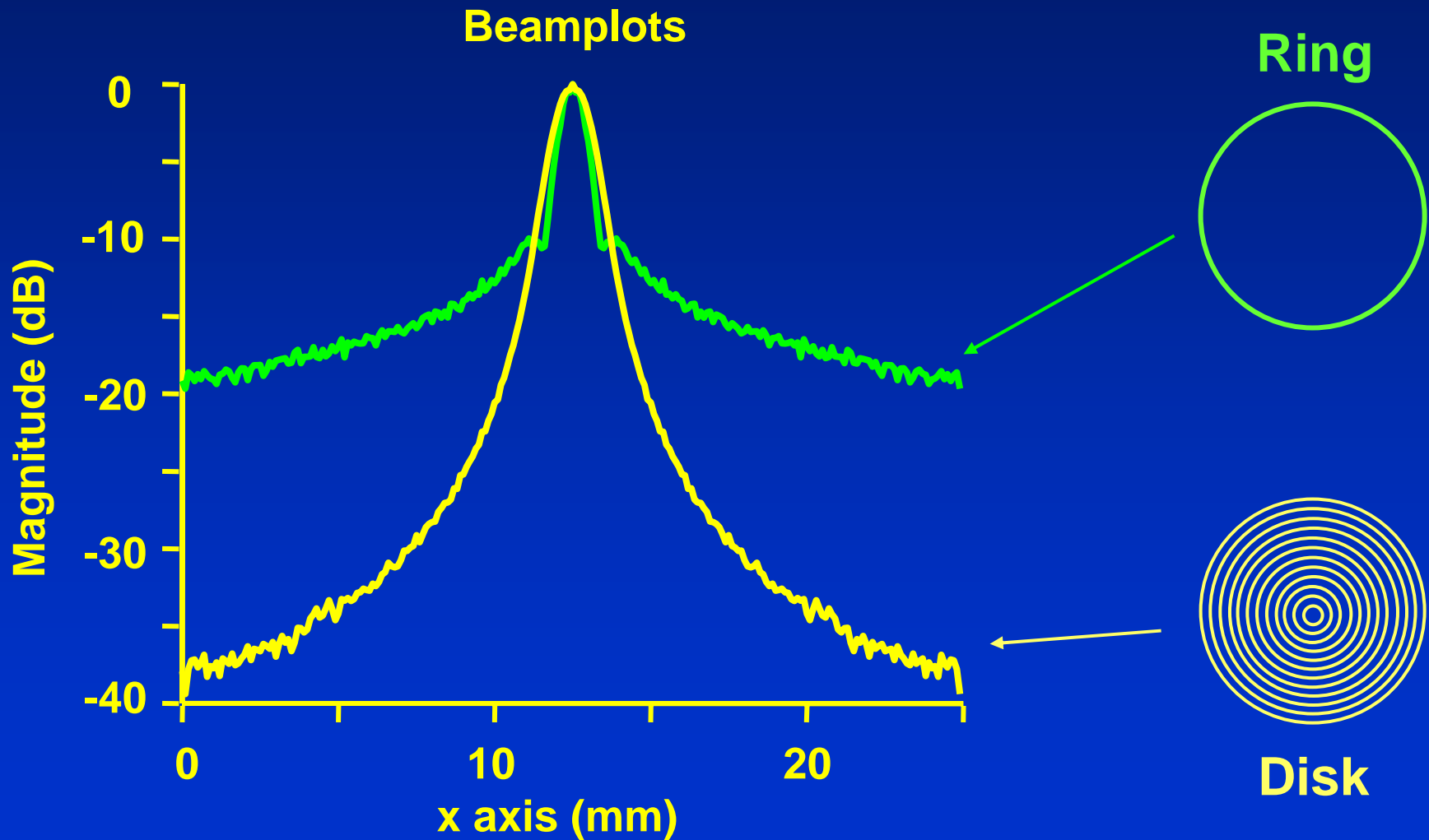


Simulated Point Spread Fn

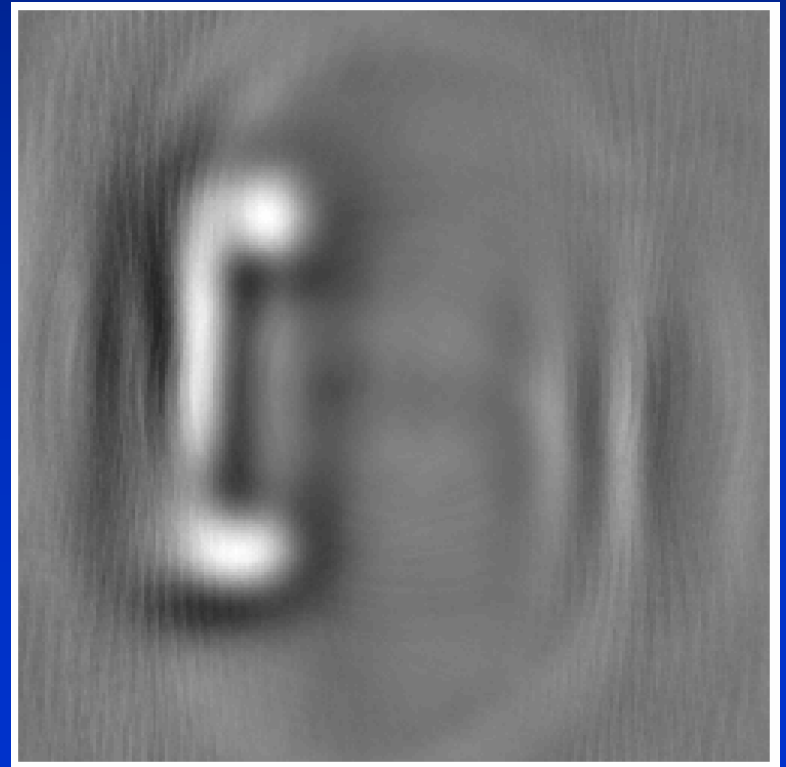
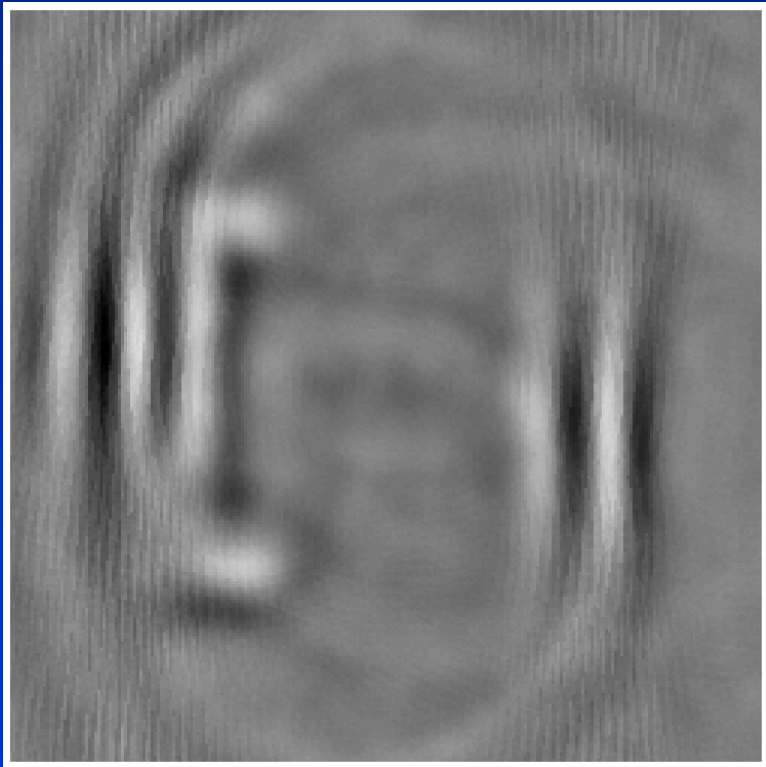
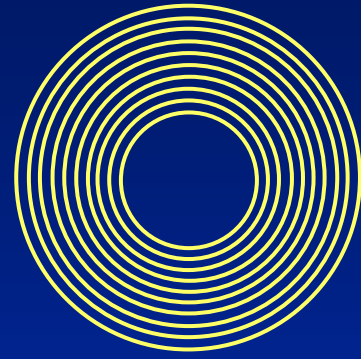
Reconstruction



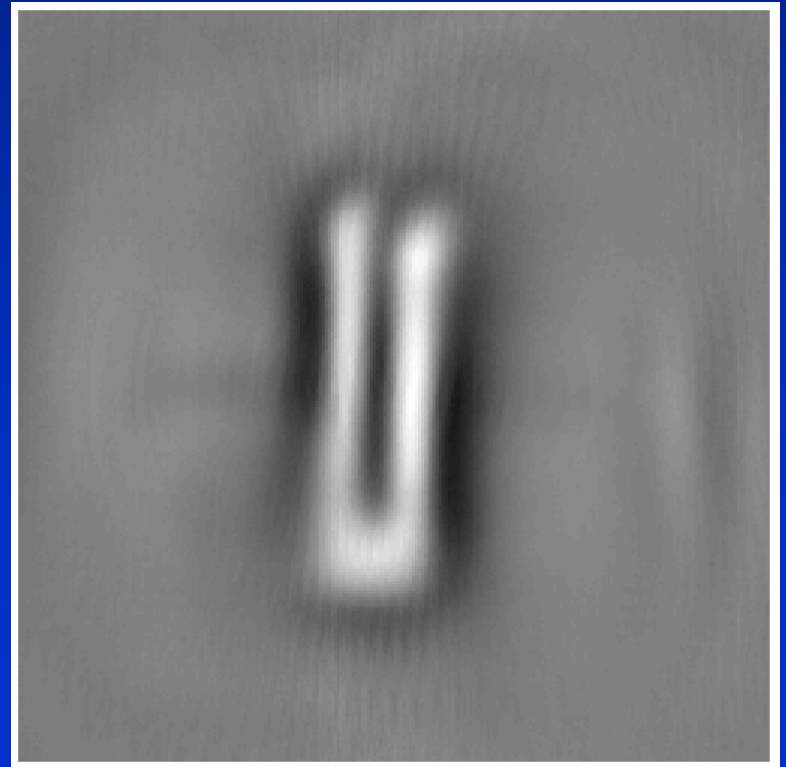
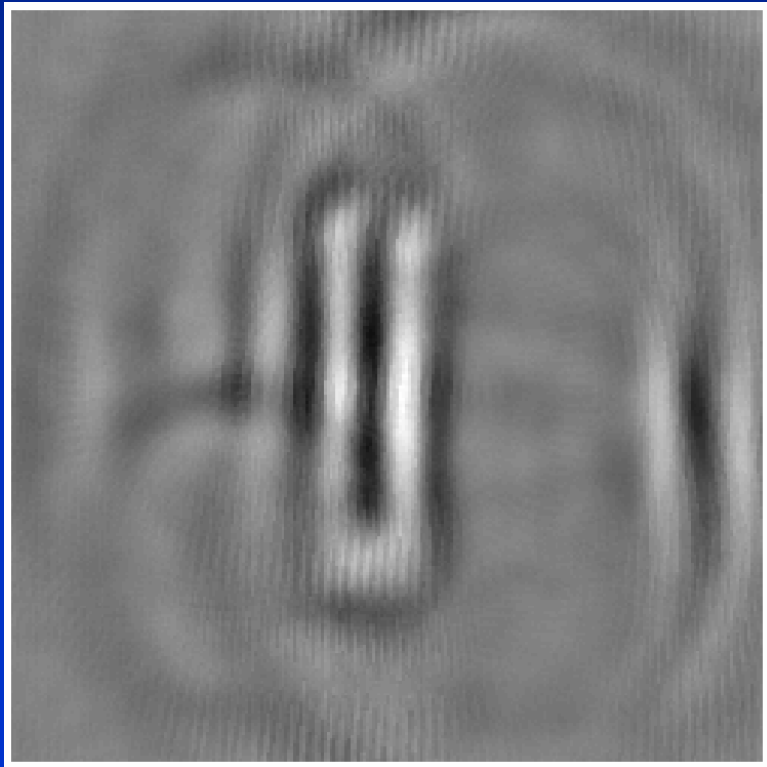
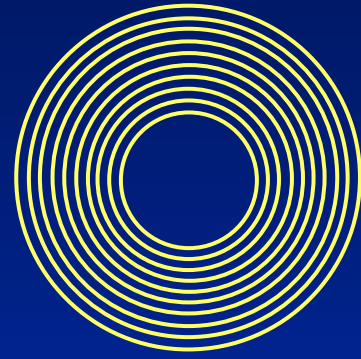
Reducing Artifacts



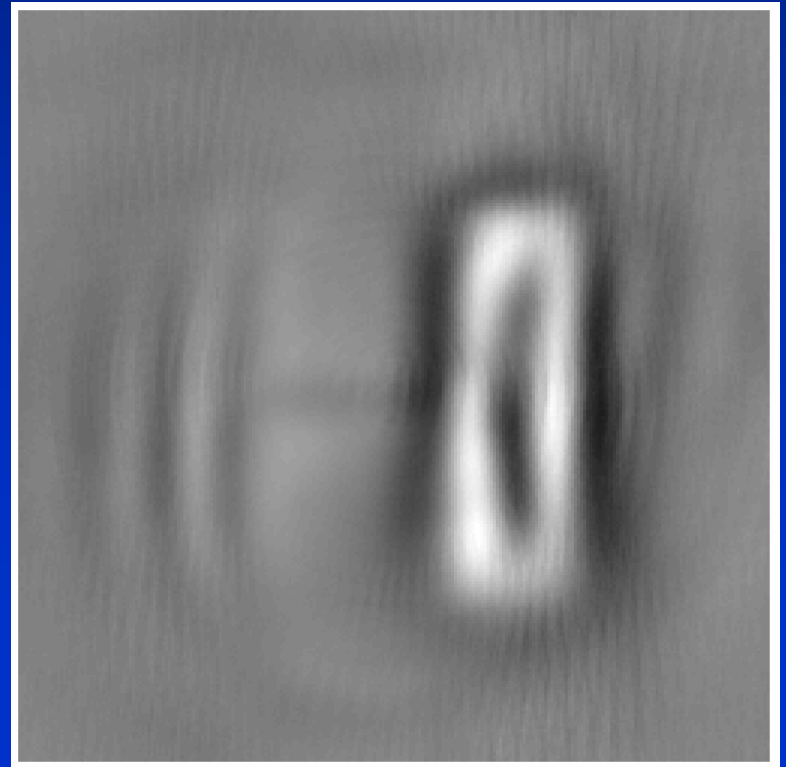
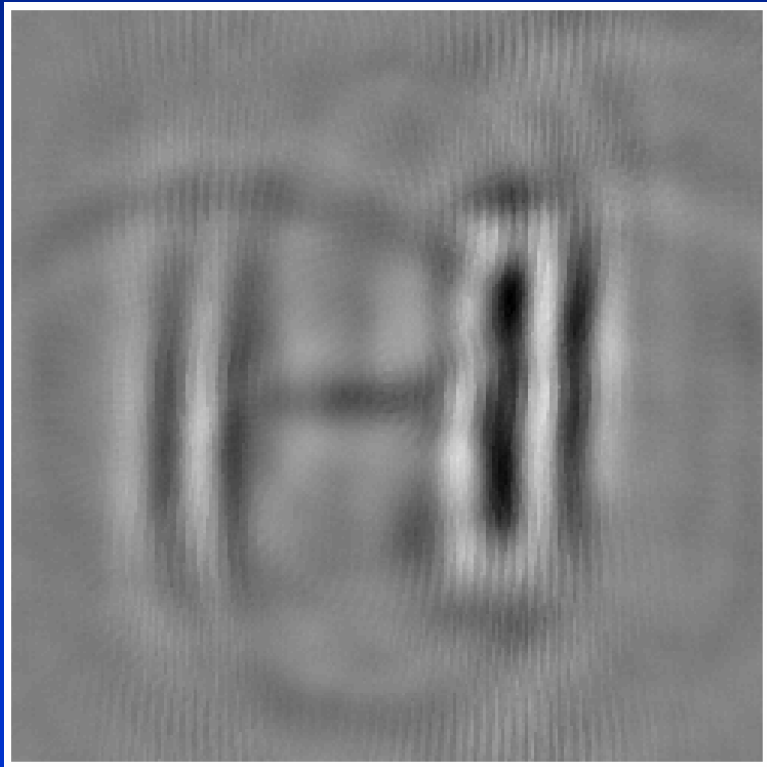
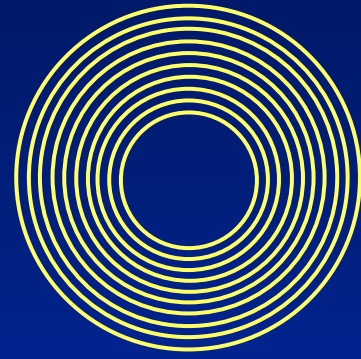
Reconstructed Images



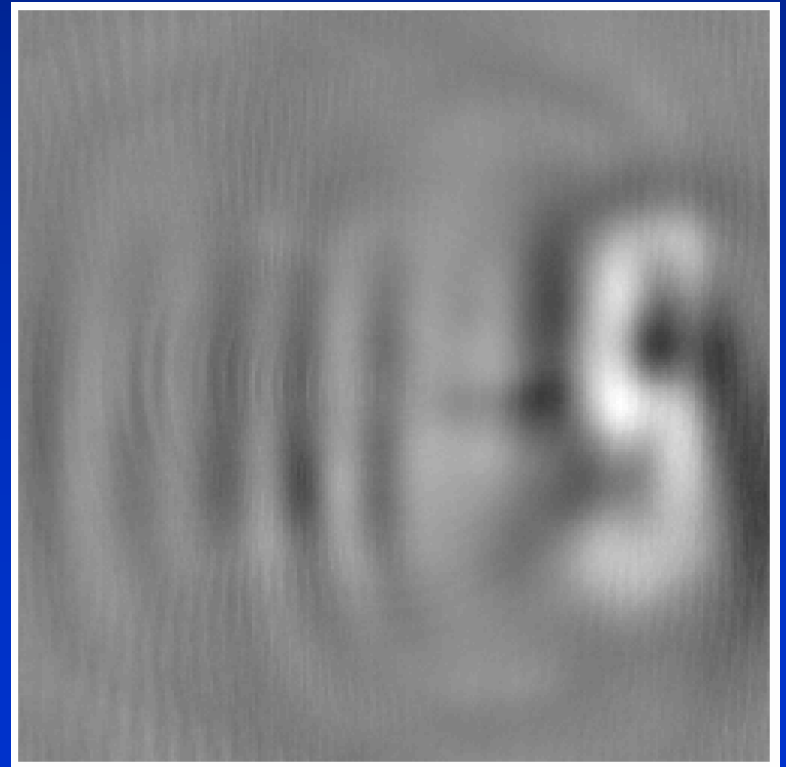
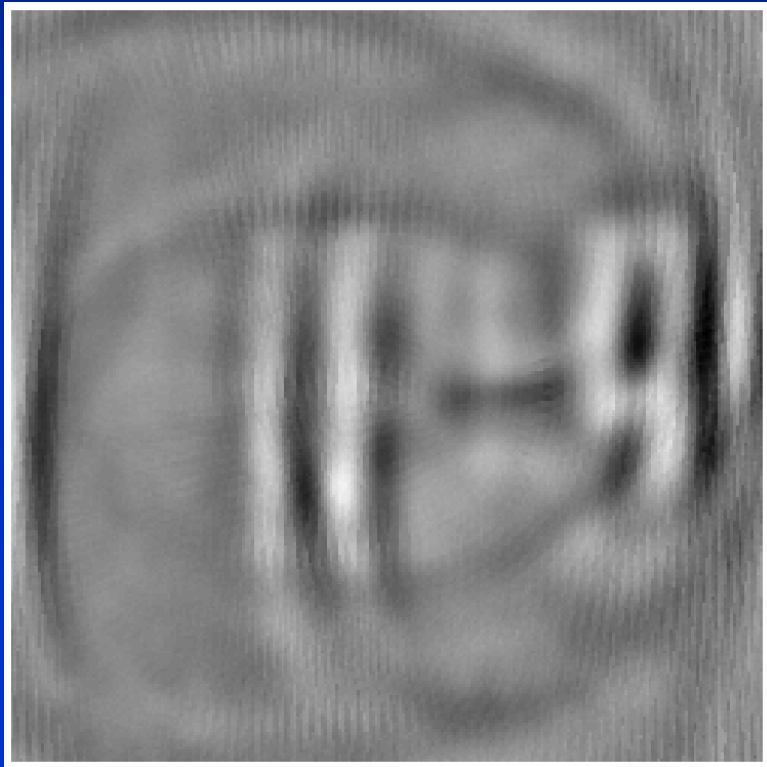
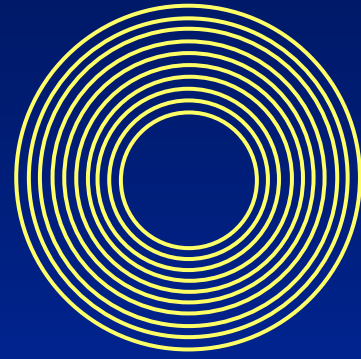
Reconstructed Images



Reconstructed Images

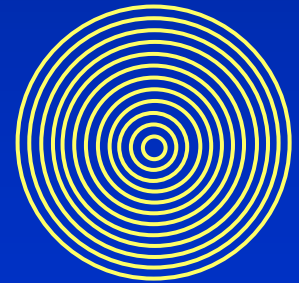


Reconstructed Images



Conclusions

- **3-D imaging is possible with a ring annular array**
- **Need to synthesize a disk aperture to suppress artifacts**



Future Work for 3-D Imaging

- Improve SNR !!!!!
- Phase aberration correction
- Strongly scattering objects
- Spectroscopic imaging

