# Time reversal 3-D imaging using single cycle terahertz pulses

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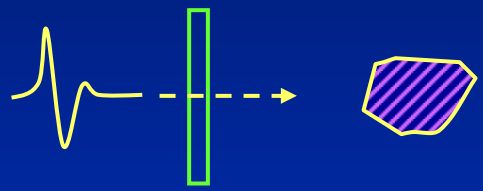
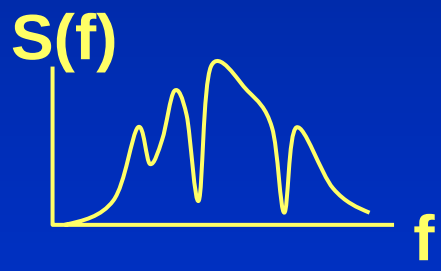
# Introduction

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

1) **THz can penetrate various opaque materials**



2) **Absorption lines in THz band**

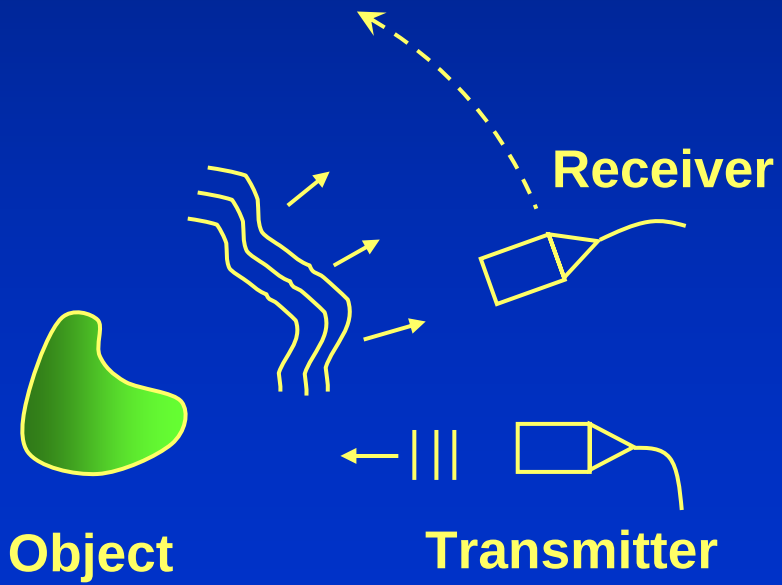


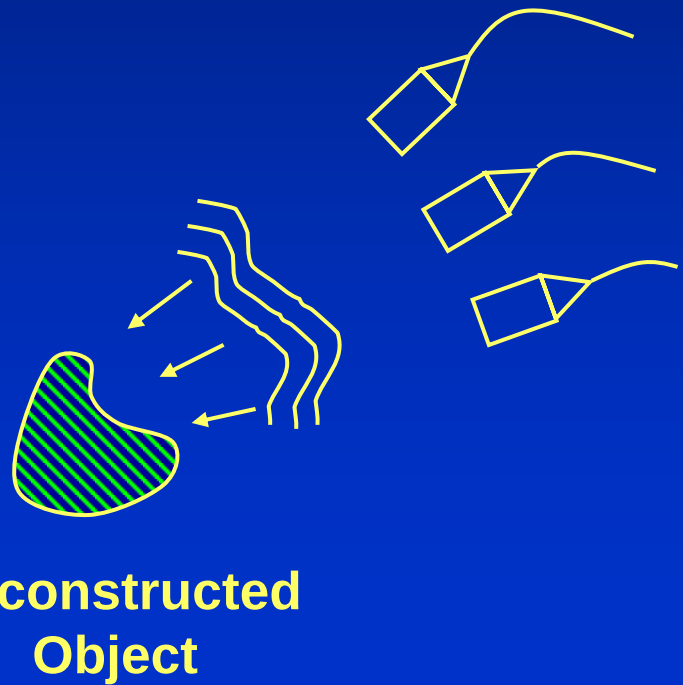

3) **Sub-mm resolution**

# Time Reversal Imaging

1) Record scattered waves at various locations

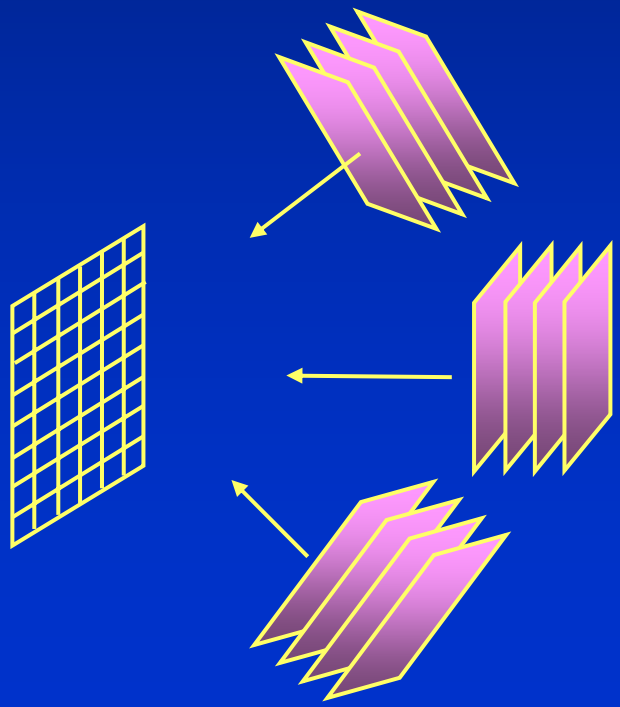
2) Backpropagate the waves to reconstruct the object



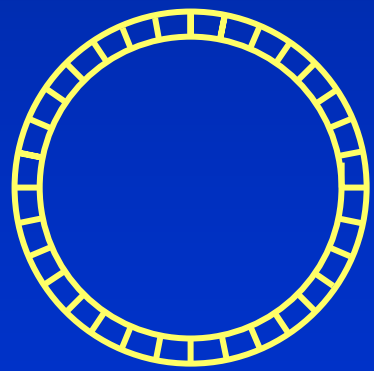



# Array Geometry for 3-D Imaging

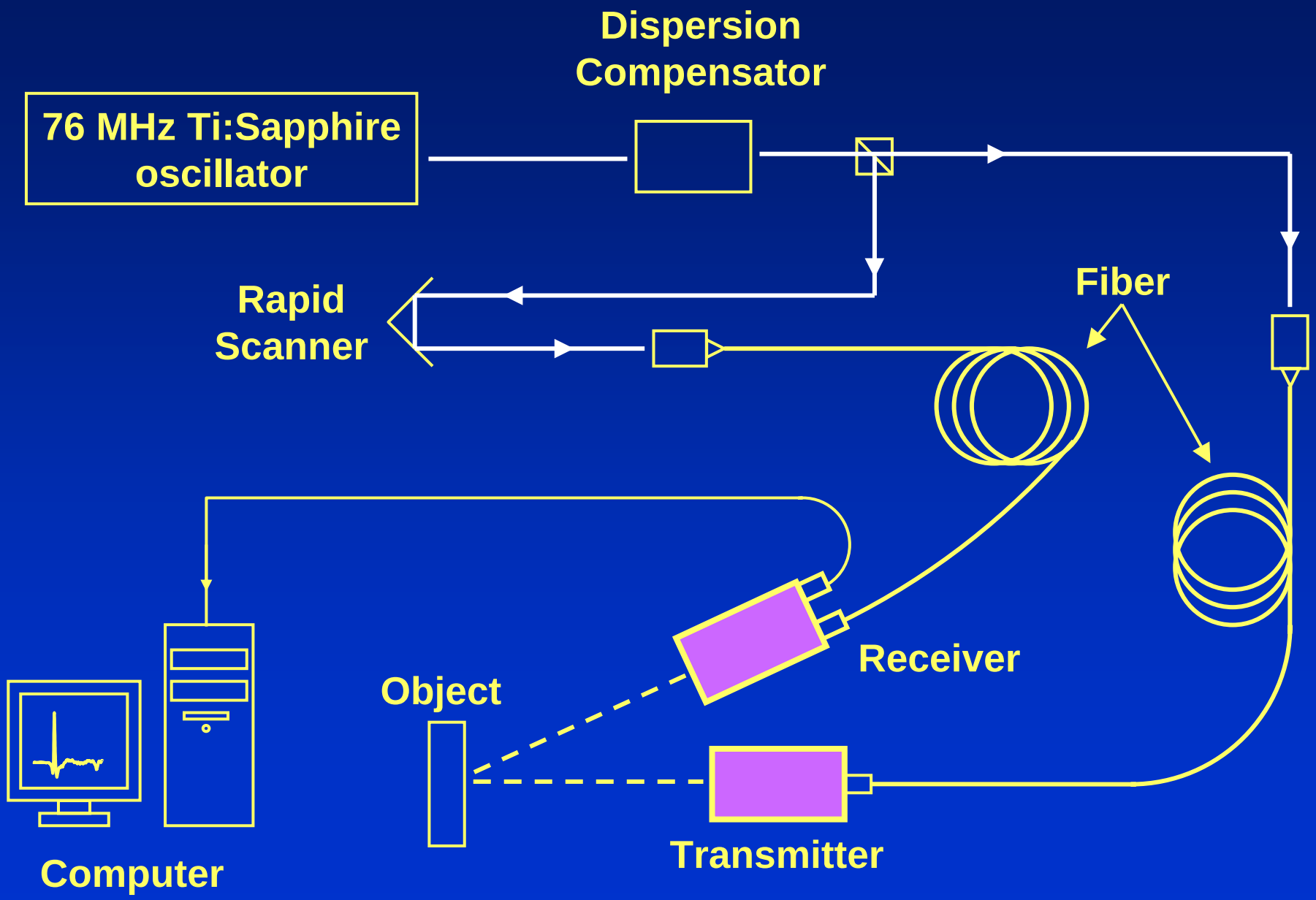
- Need 2-D array to record the angular spectrum



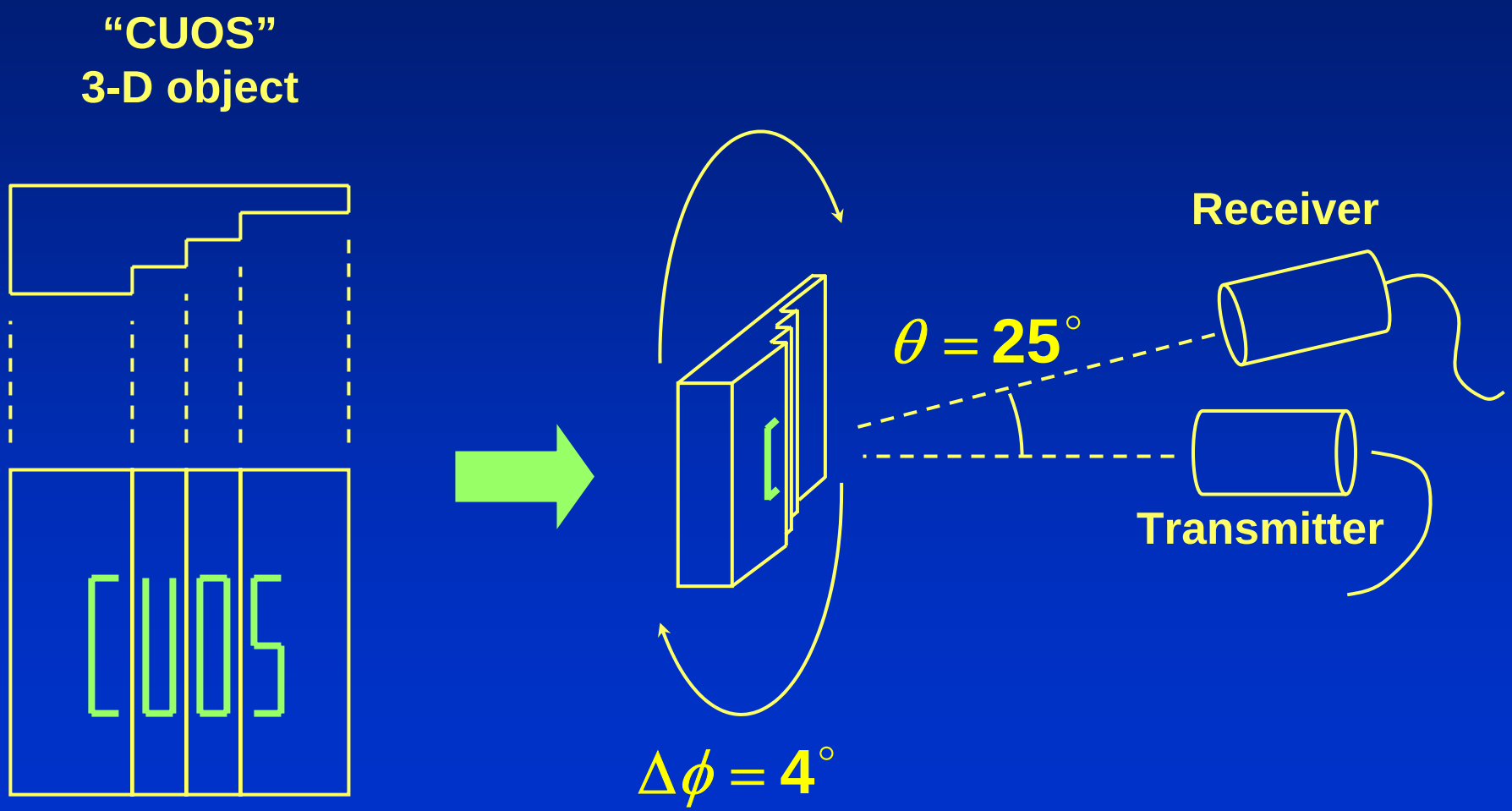
- 3-D imaging is still possible with a ring annular array



# Experimental Setup

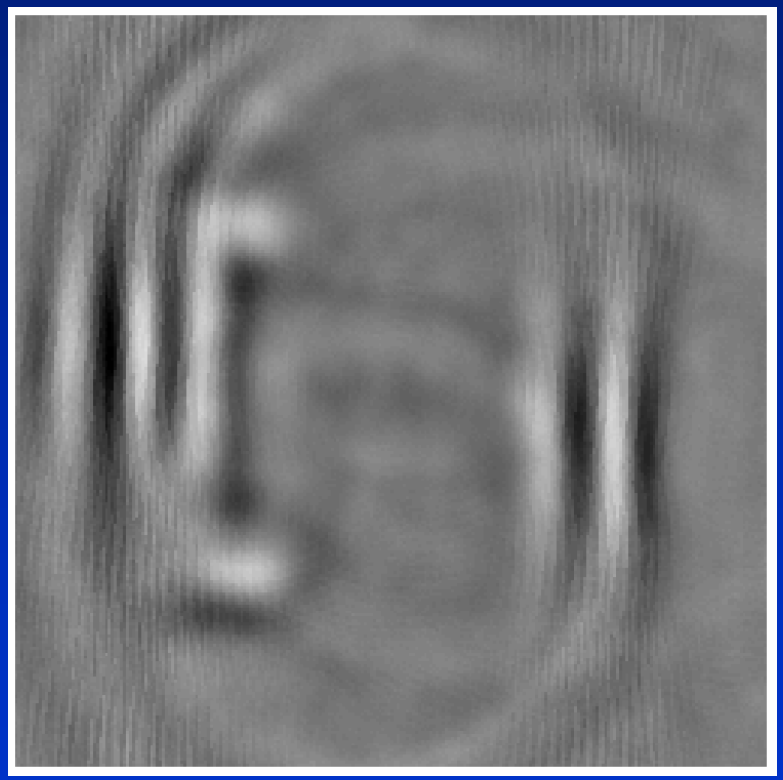


# 3-D Imaging Geometry



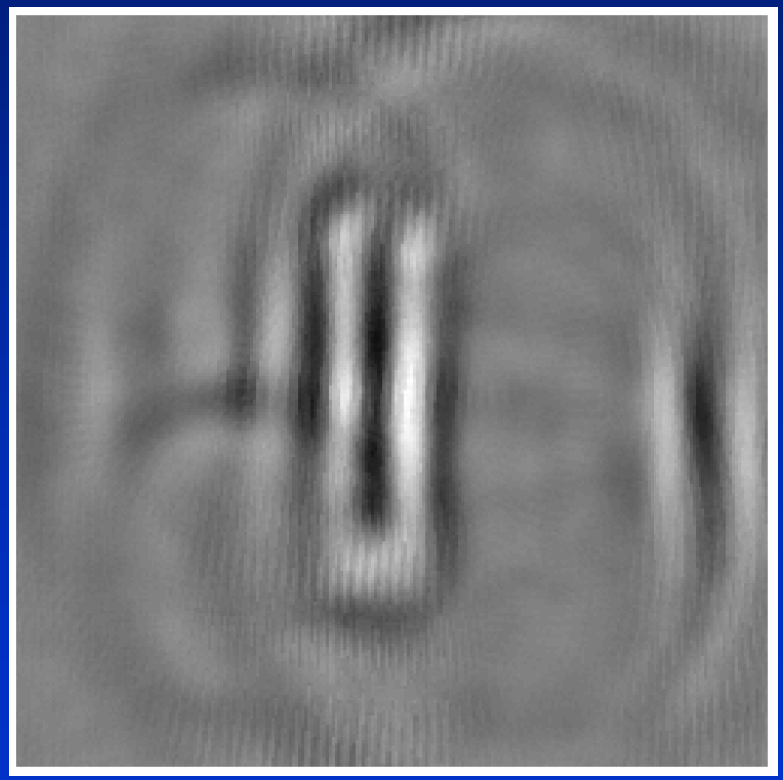
# Reconstructed Images

Letter “C”



— 3 mm

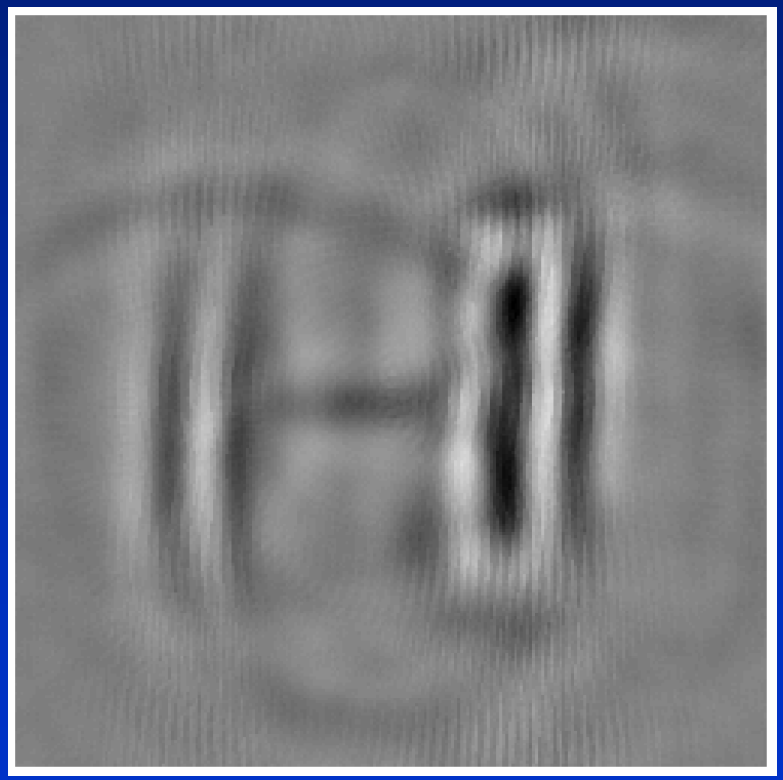
Letter “U”



— 3 mm

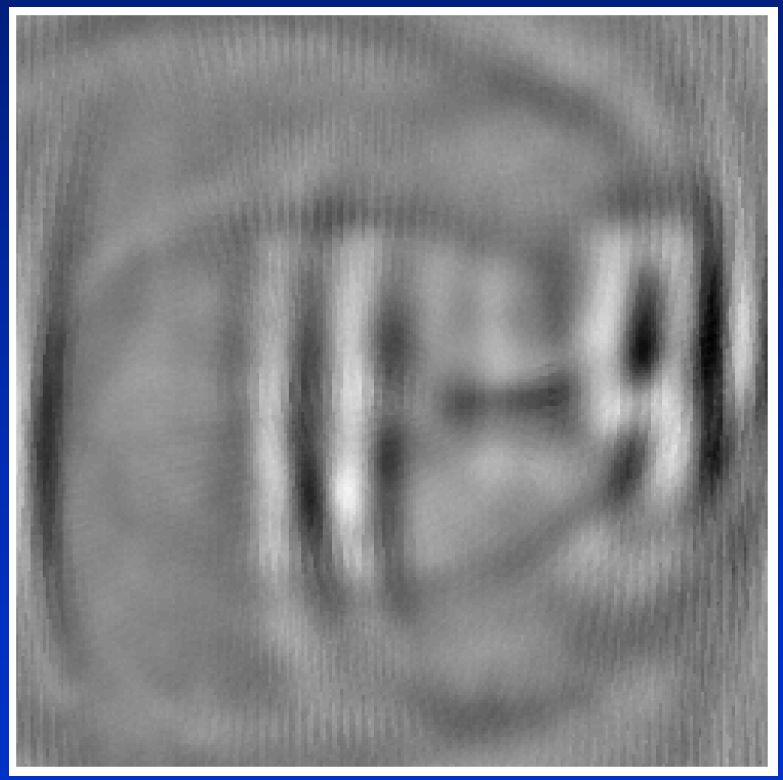
# Reconstructed Images

Letter “O”



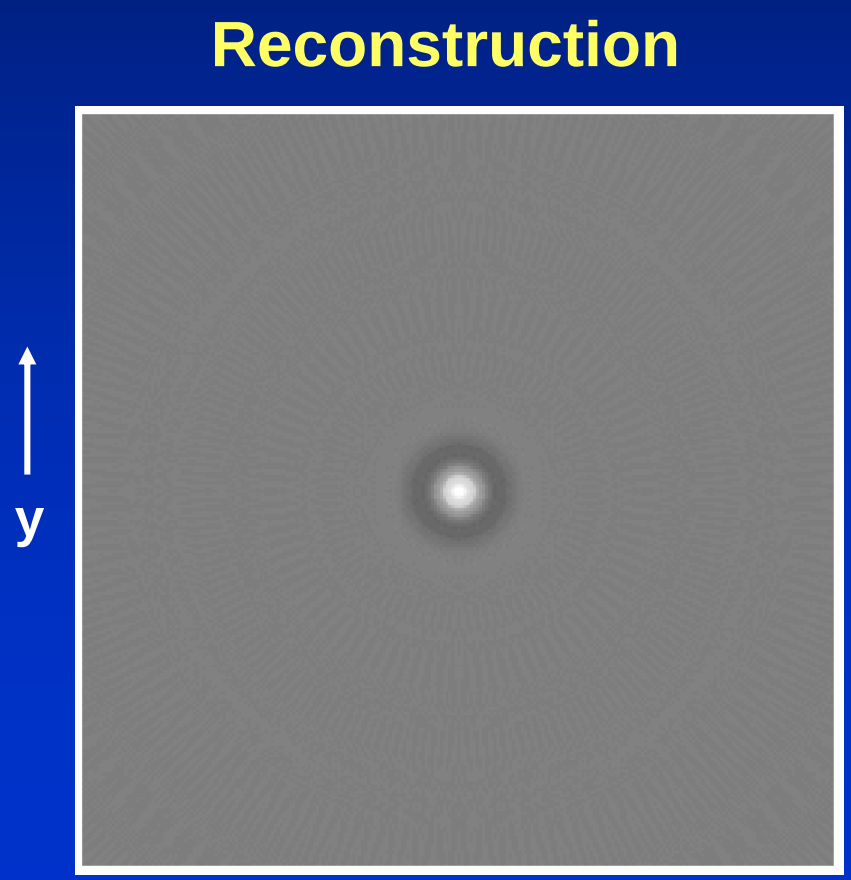
3 mm

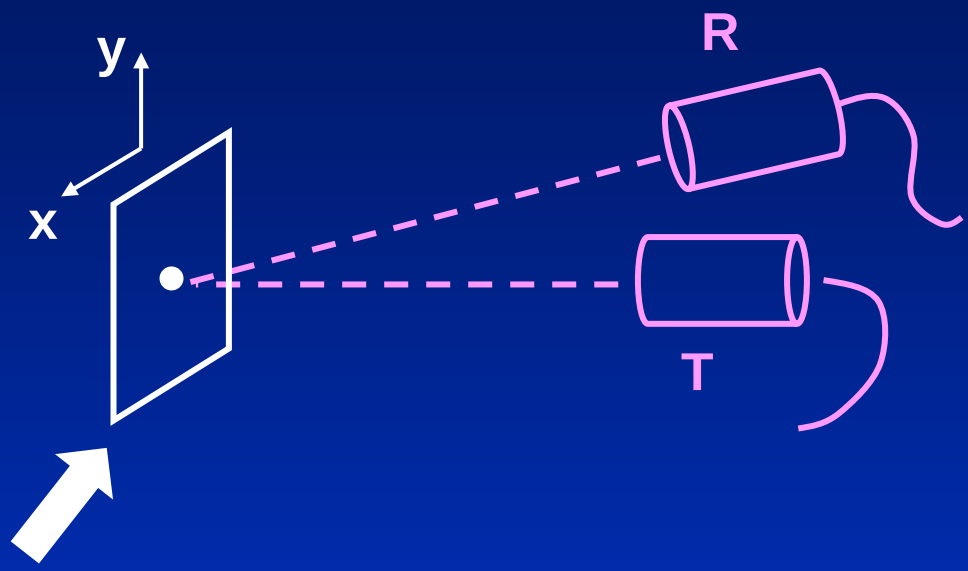
Letter “S”



3 mm

# Simulated Point Spread Fn



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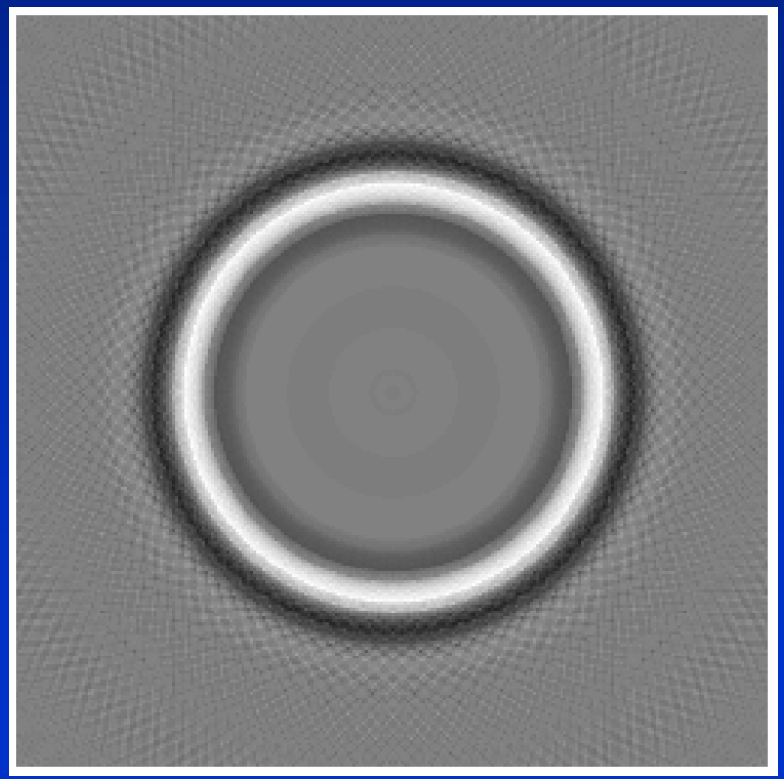


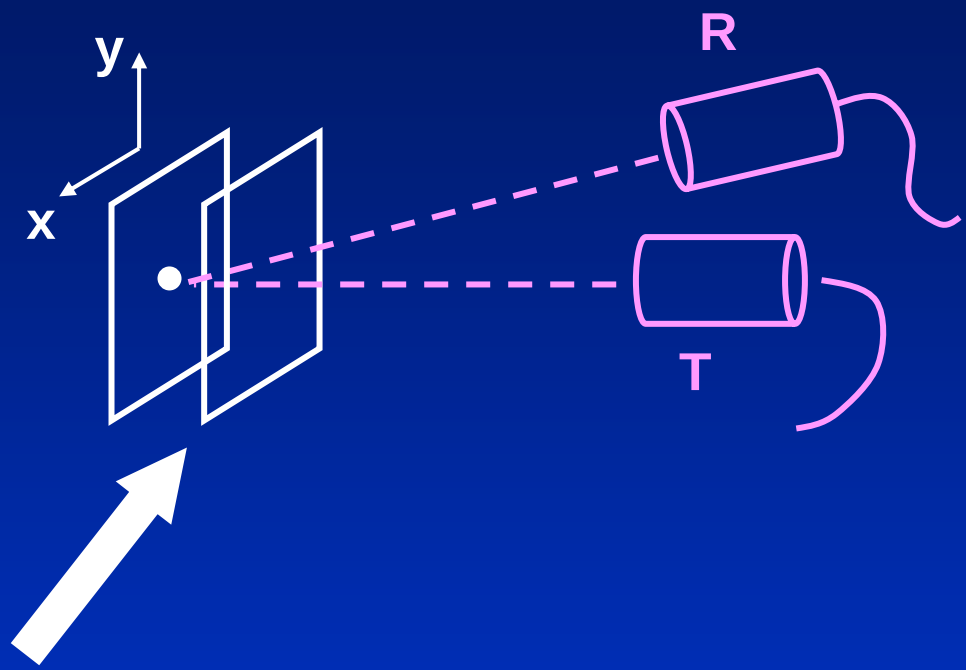

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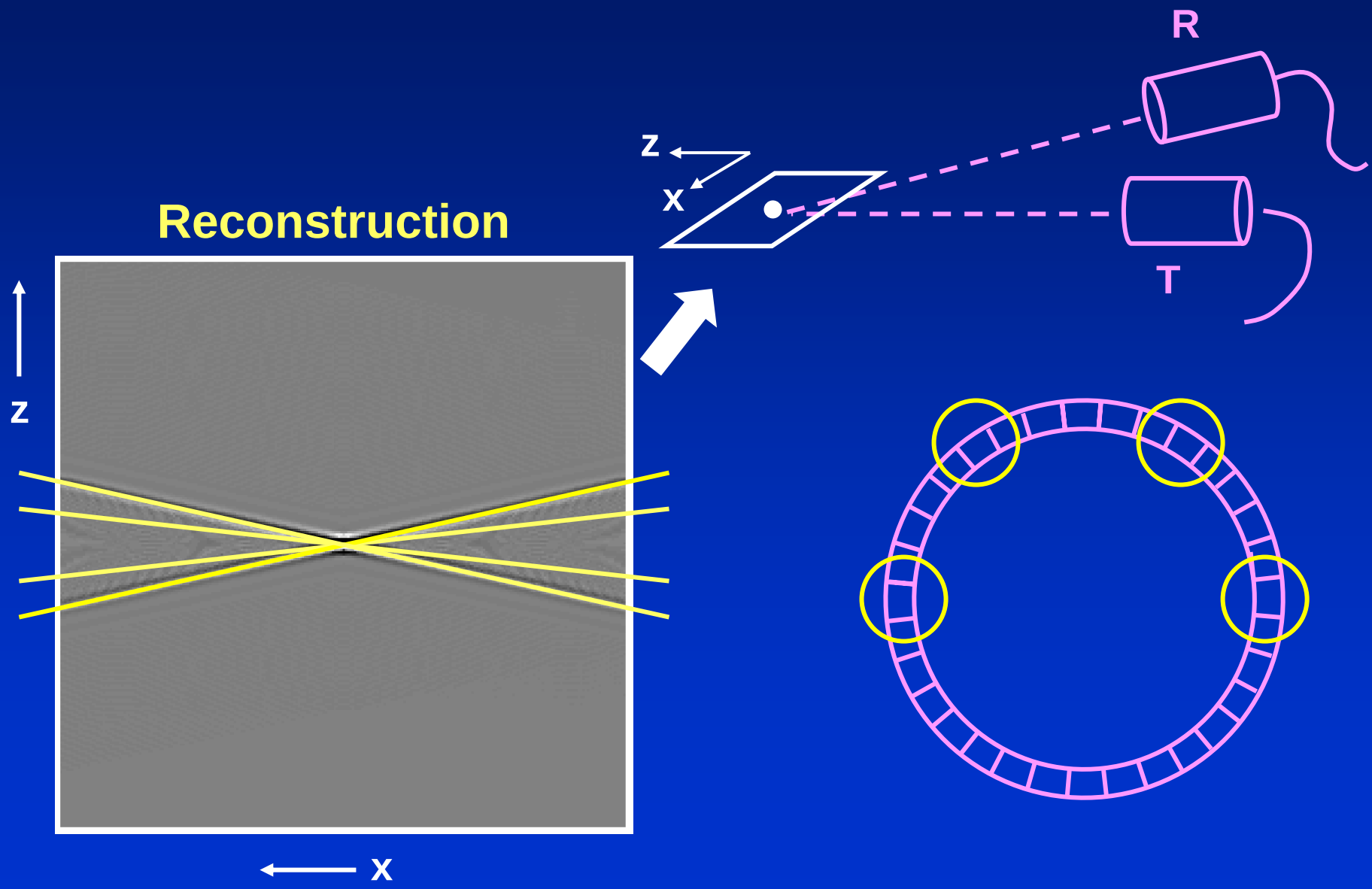
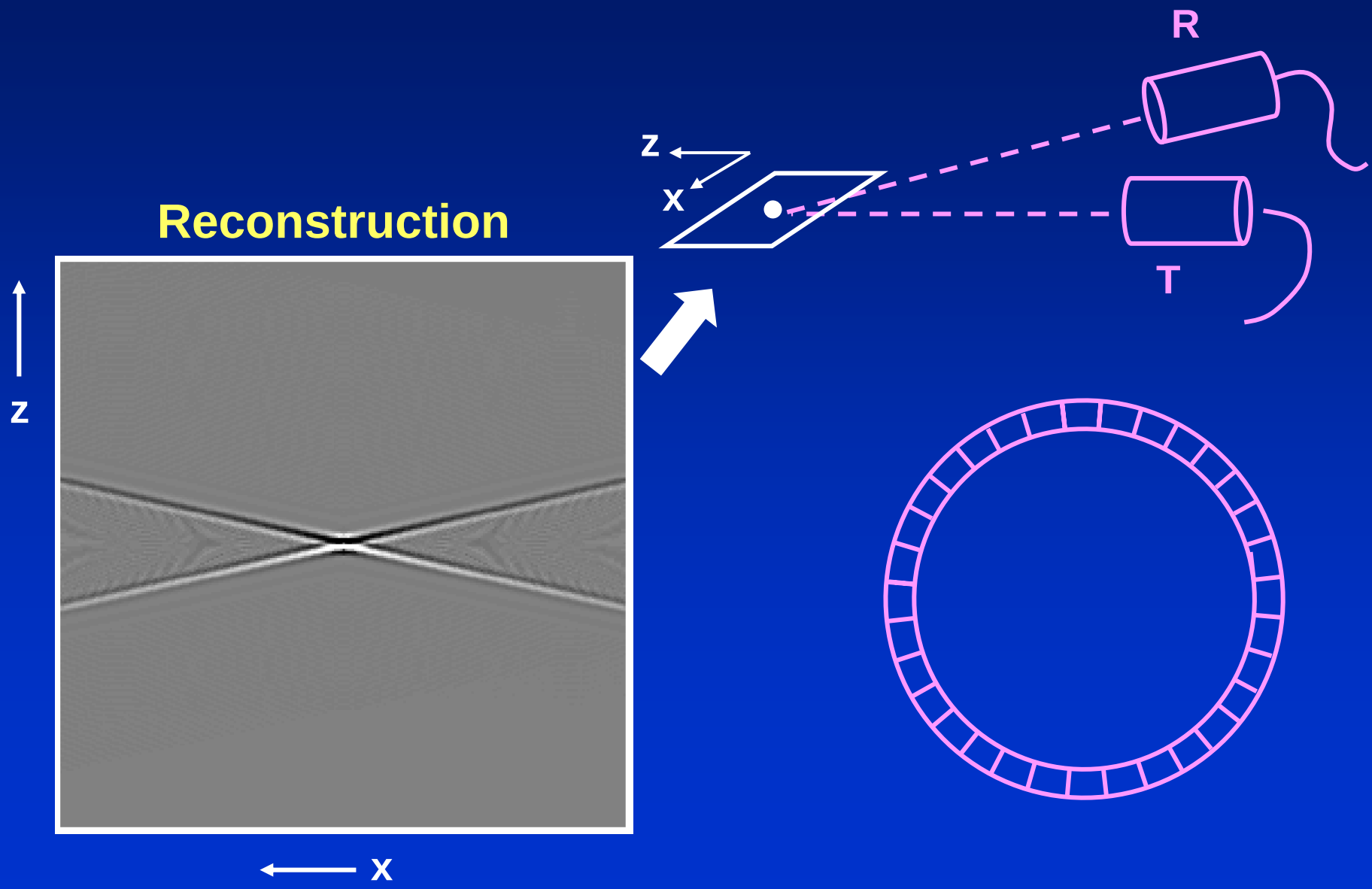
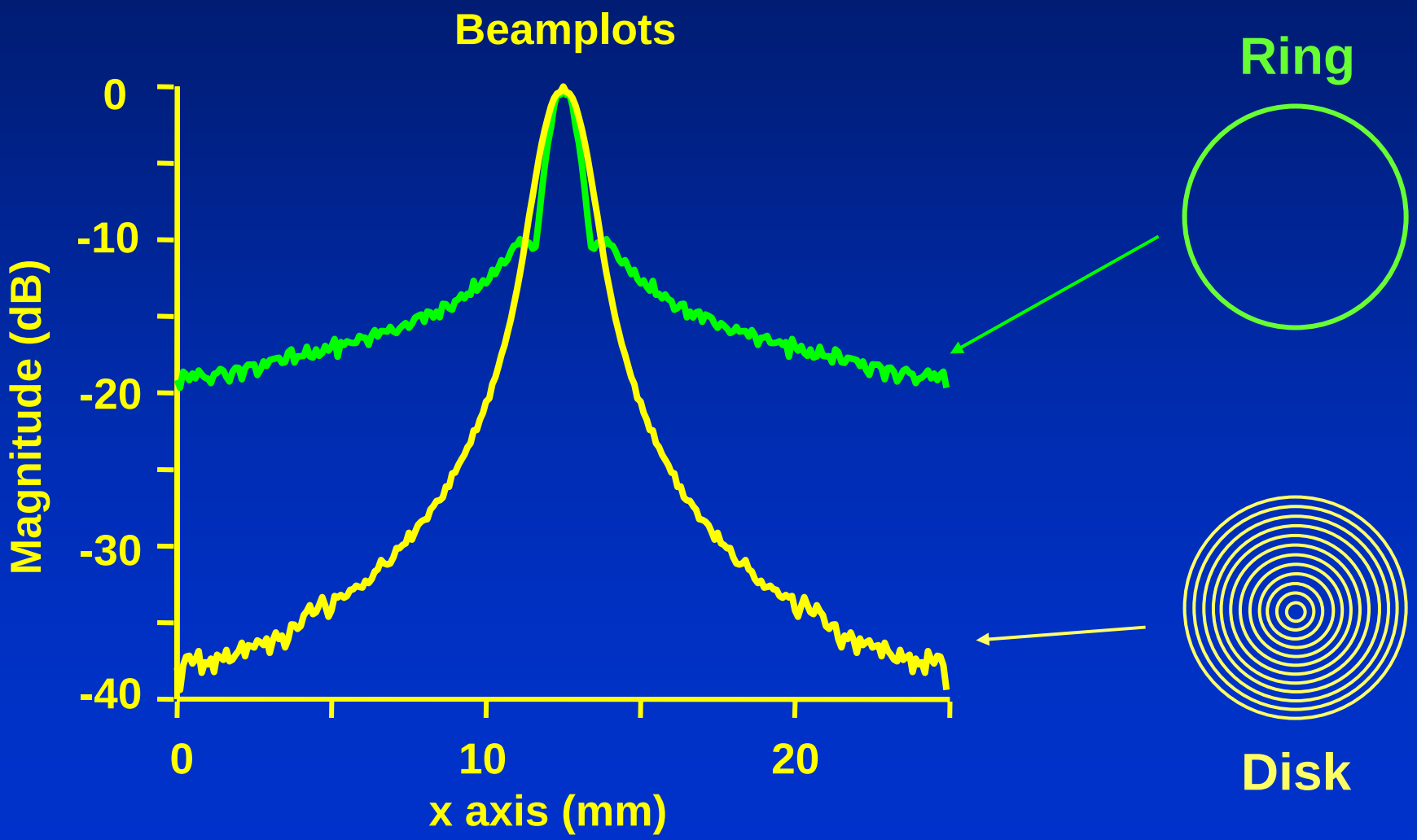


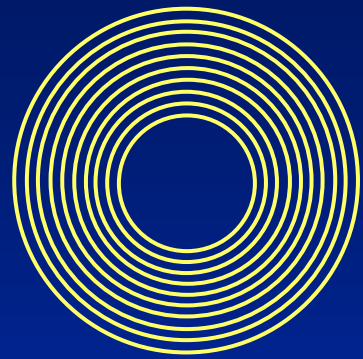
# Simulated Point Spread Fn

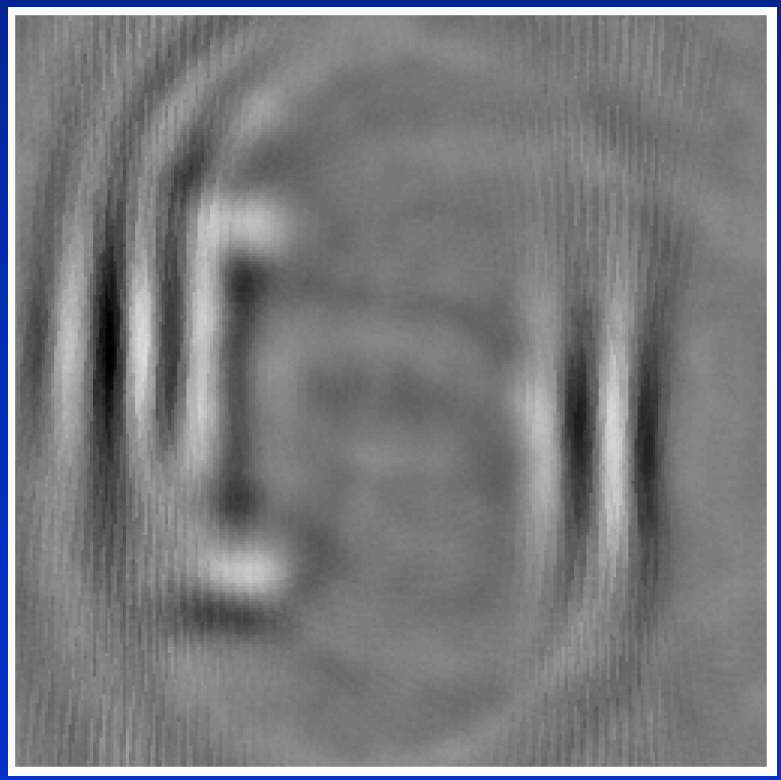


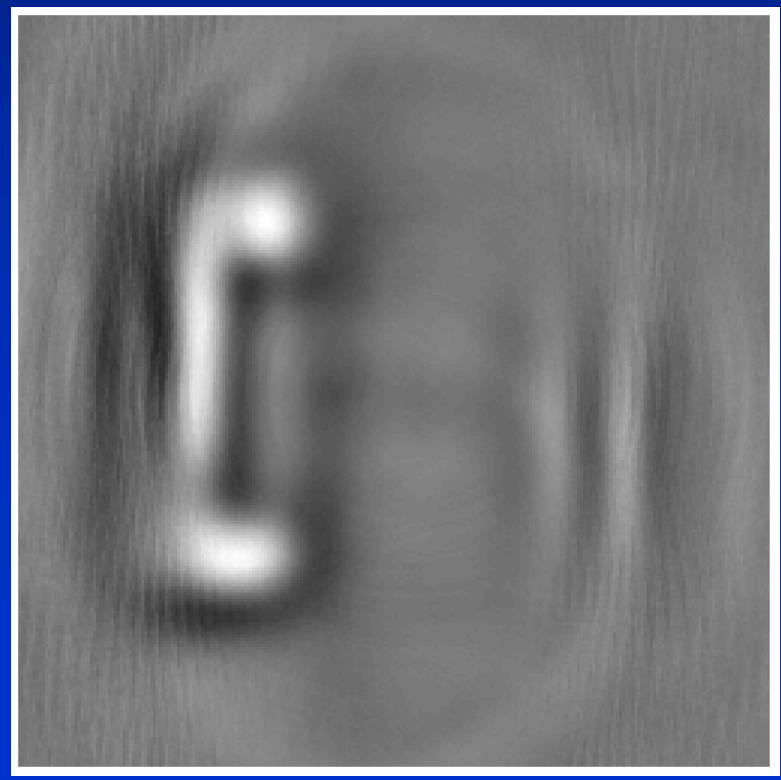
# Reducing Artifacts



# Reconstructed Images







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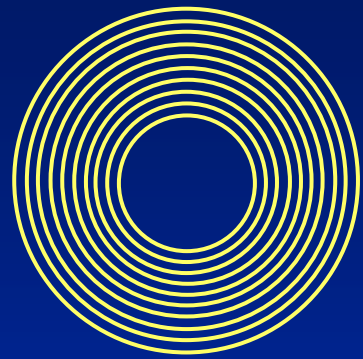

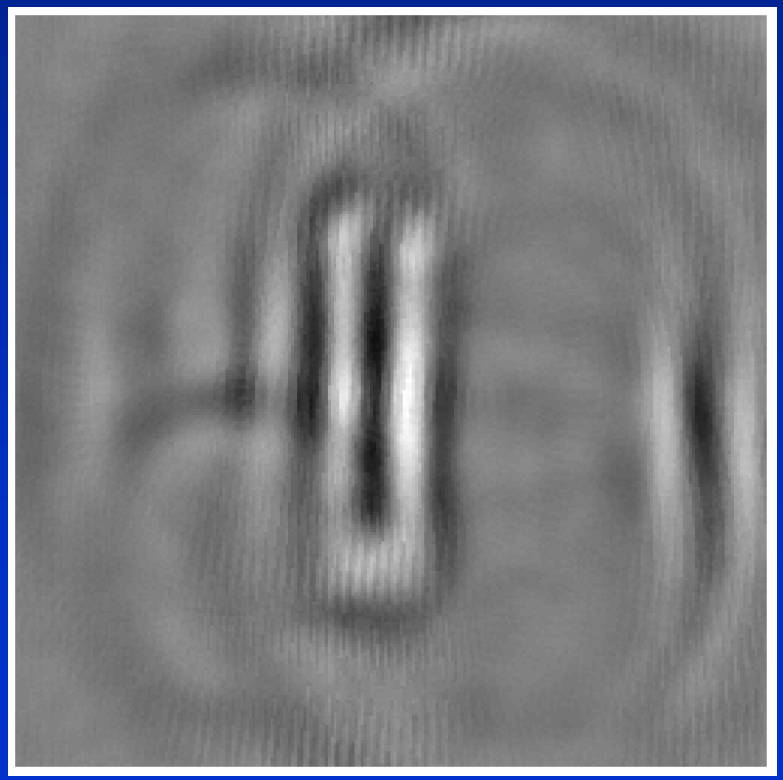

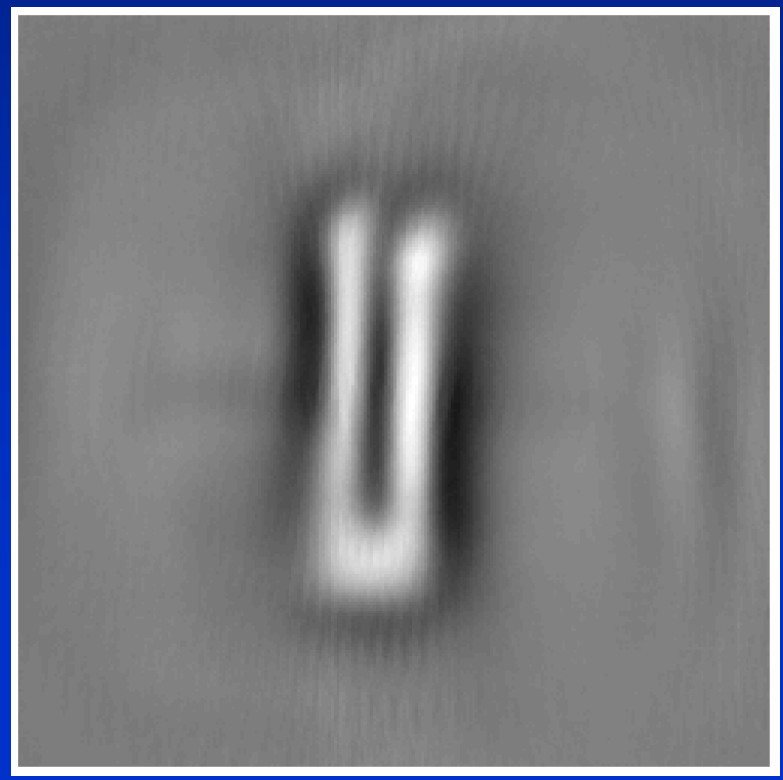

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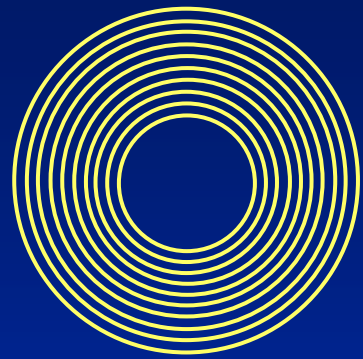

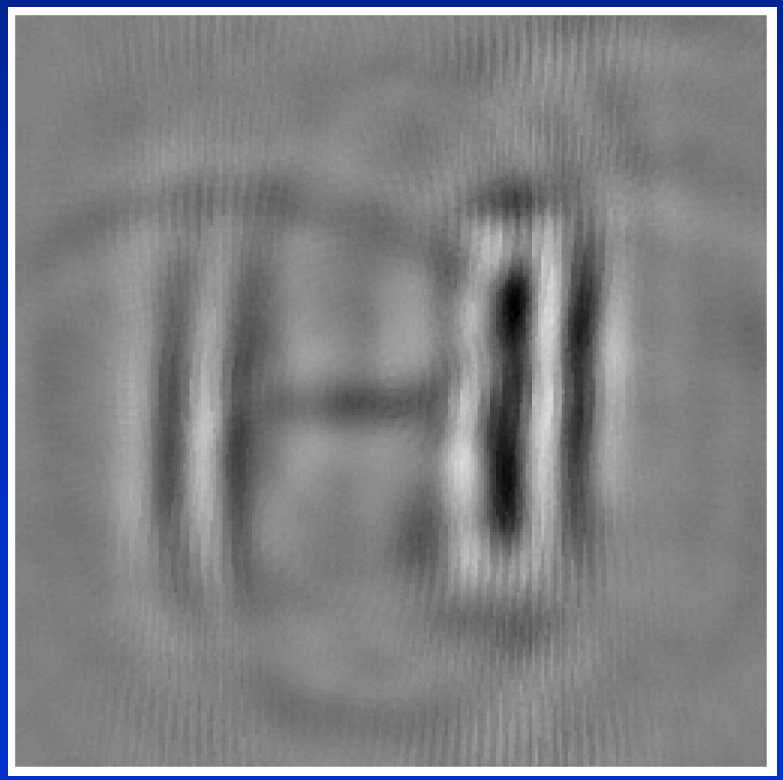

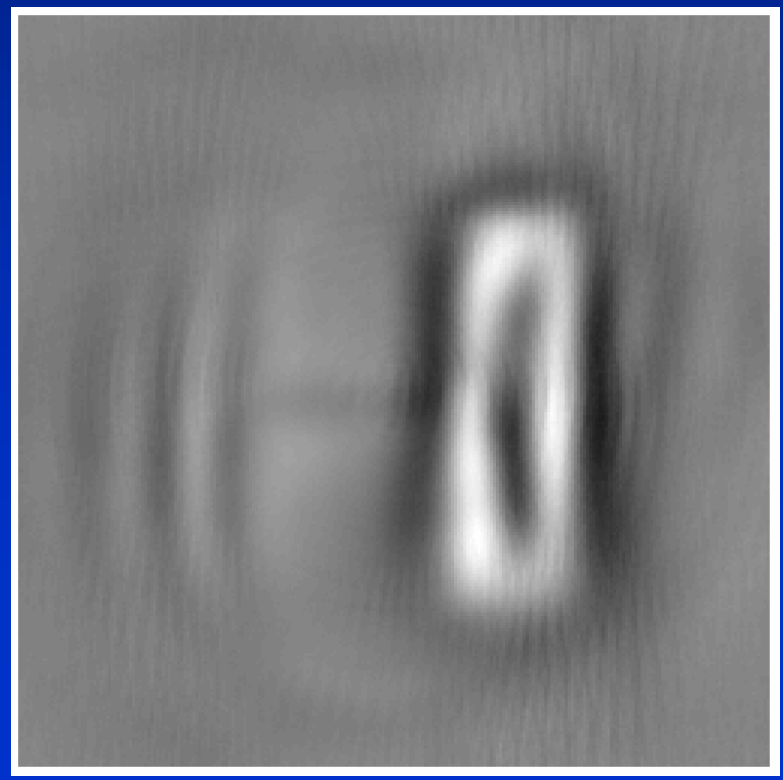

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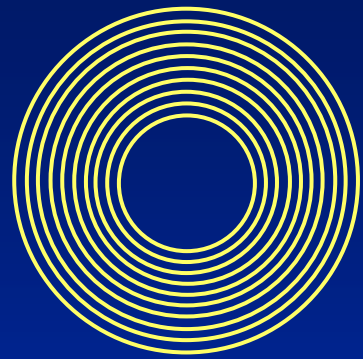
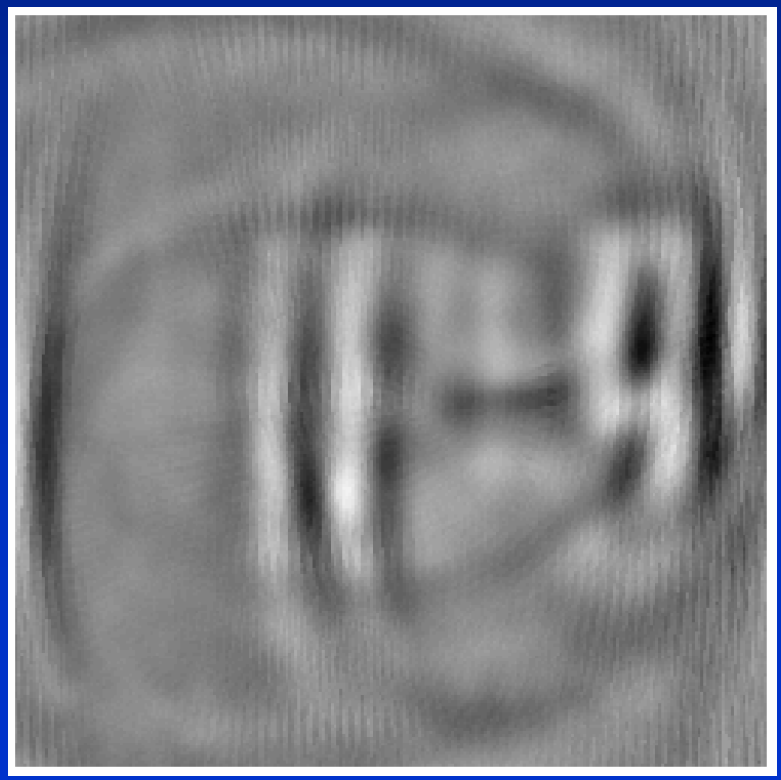
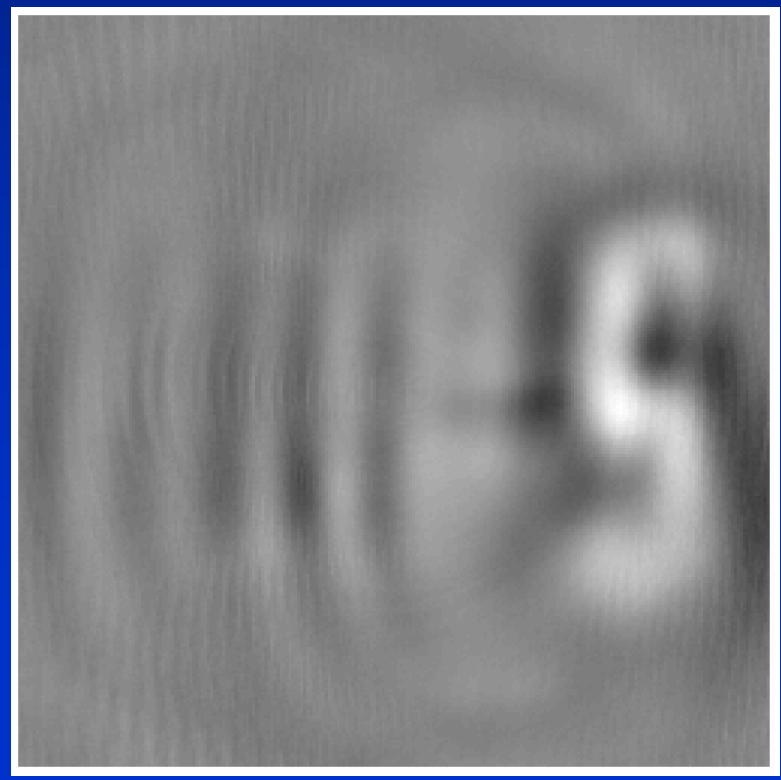
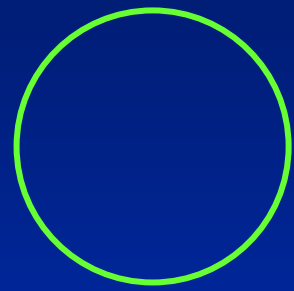




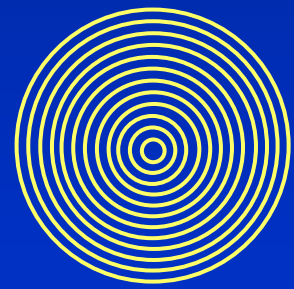


# Conclusions

- 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