3D Imaging Using Interferenceless Coded Aperture Correlation Holography (I-COACH)

Noah Plant

Metrology Lab, Department of Applied Physics and Material Sciences

Research Background

Traditional Holography:

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- Captures 3D images

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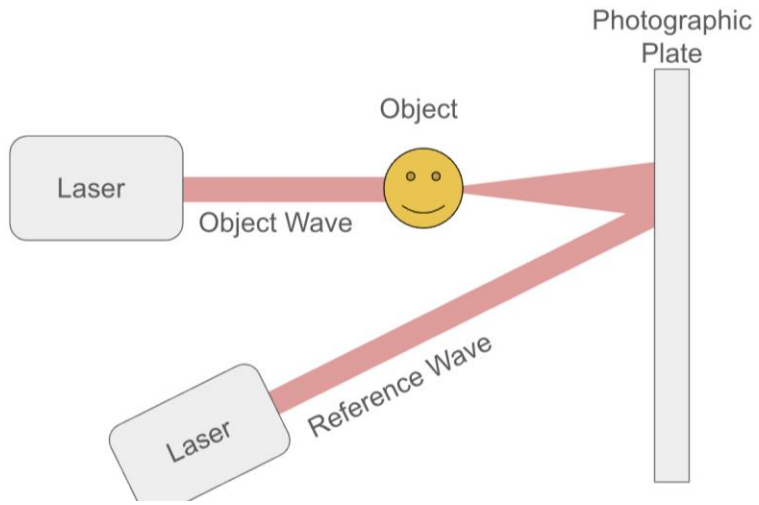

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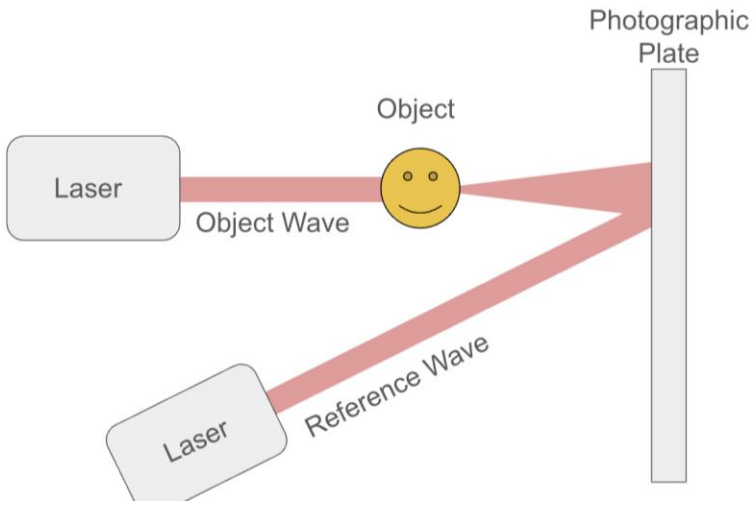

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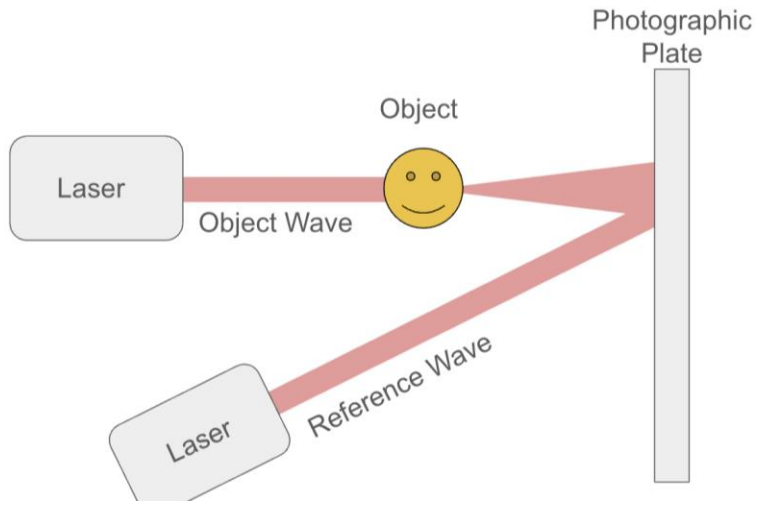

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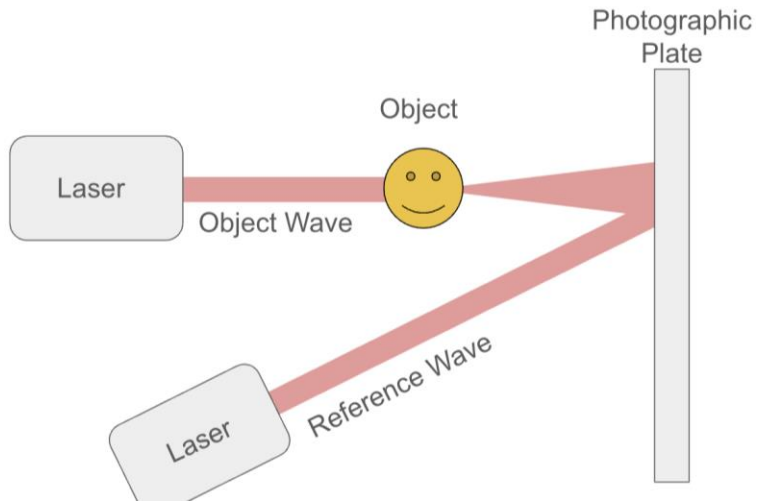

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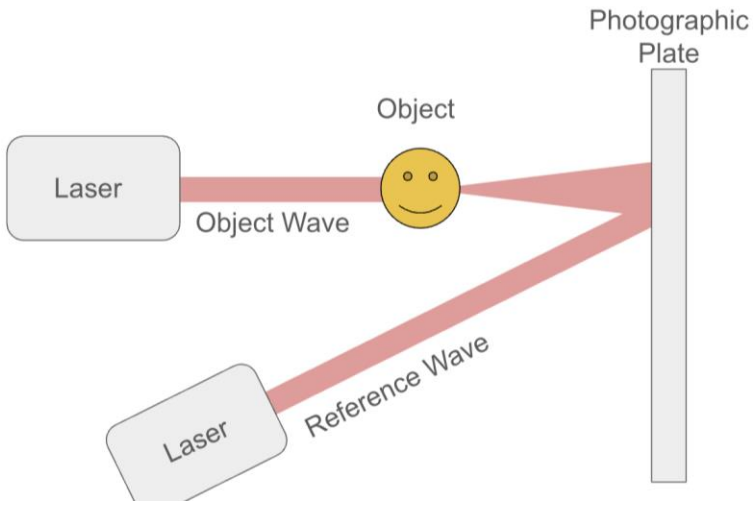

Digital Holography:

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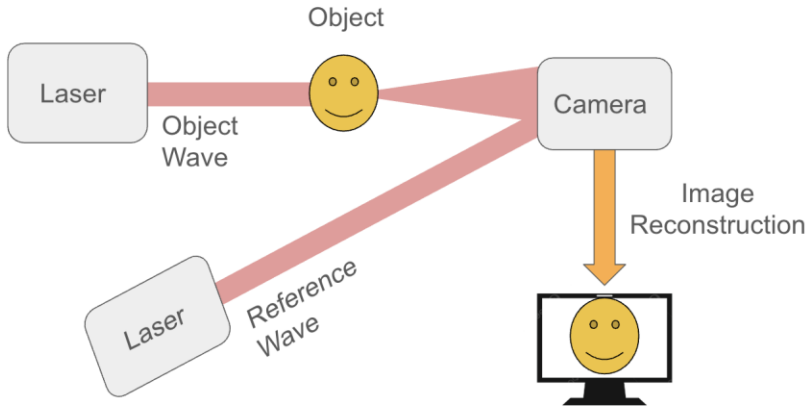

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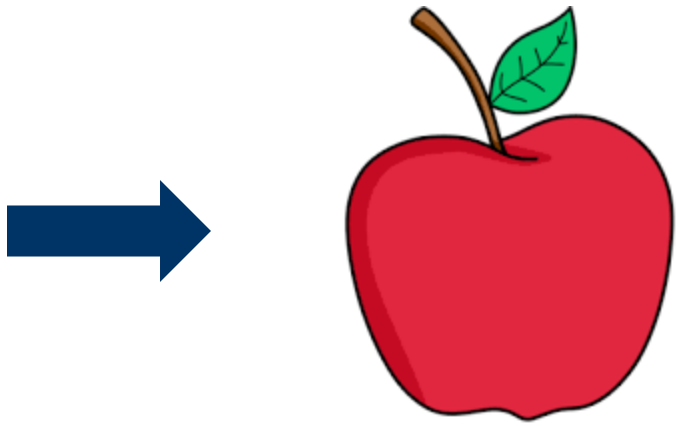

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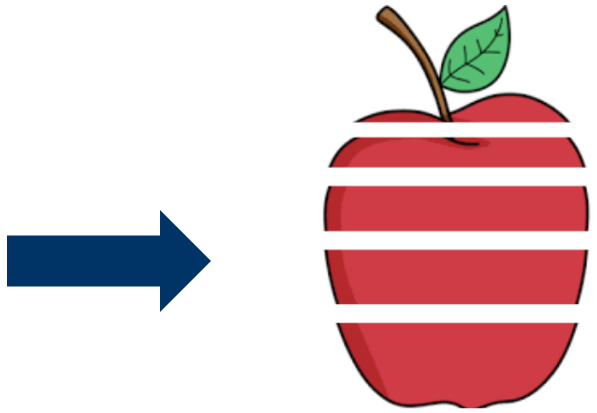

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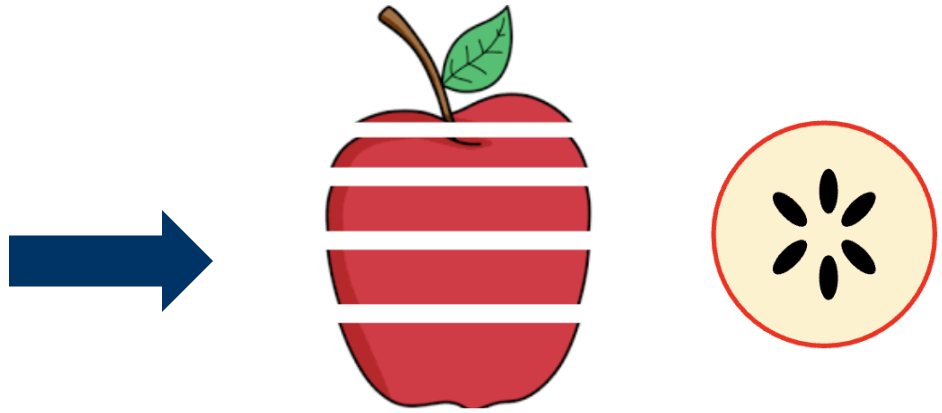

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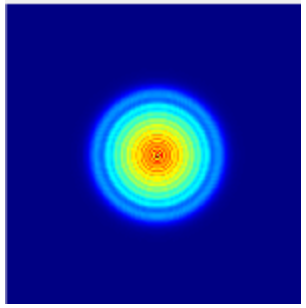

Figure 1) A simulated PSF recorded at the axial plane z=4cm

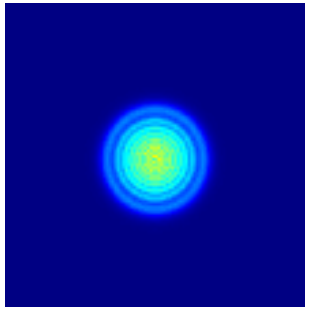

Figure 2) A simulated PSF recorded at the axial plane z=5cm

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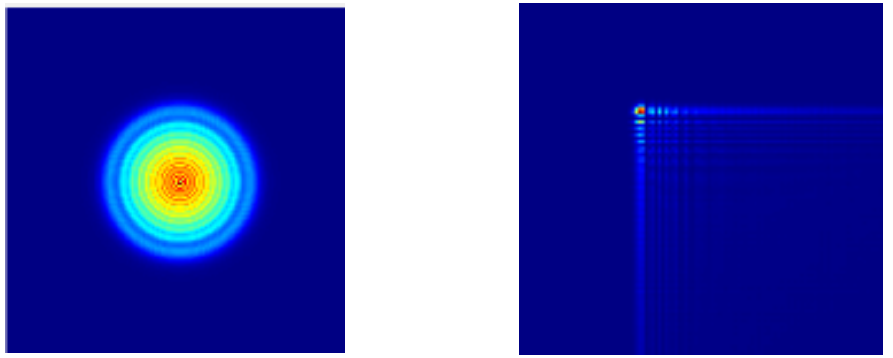

Figure 3) A simulated PSF recorded with diffractive phase mask (left) and cubic phase (right)

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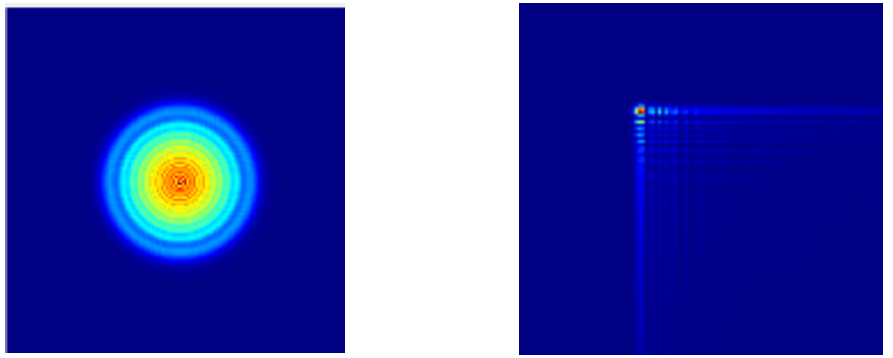

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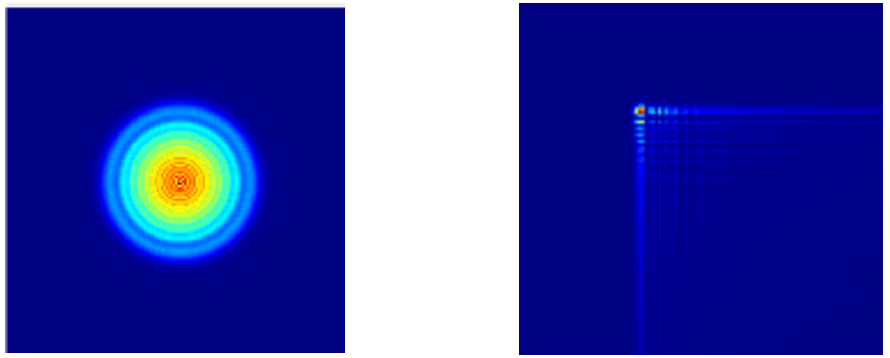

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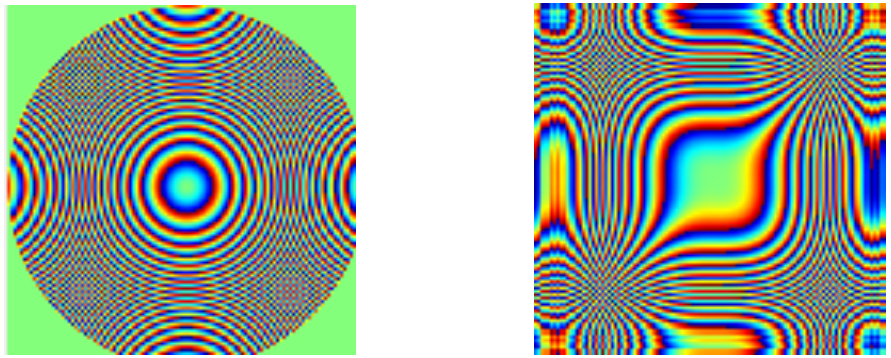

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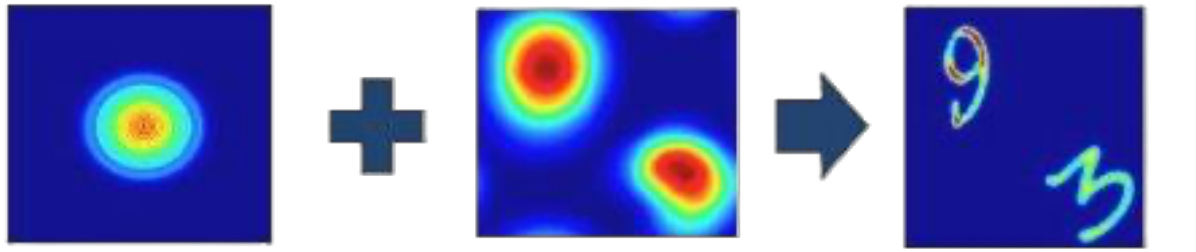

PSF | Image captured by camera | Reconstructed image

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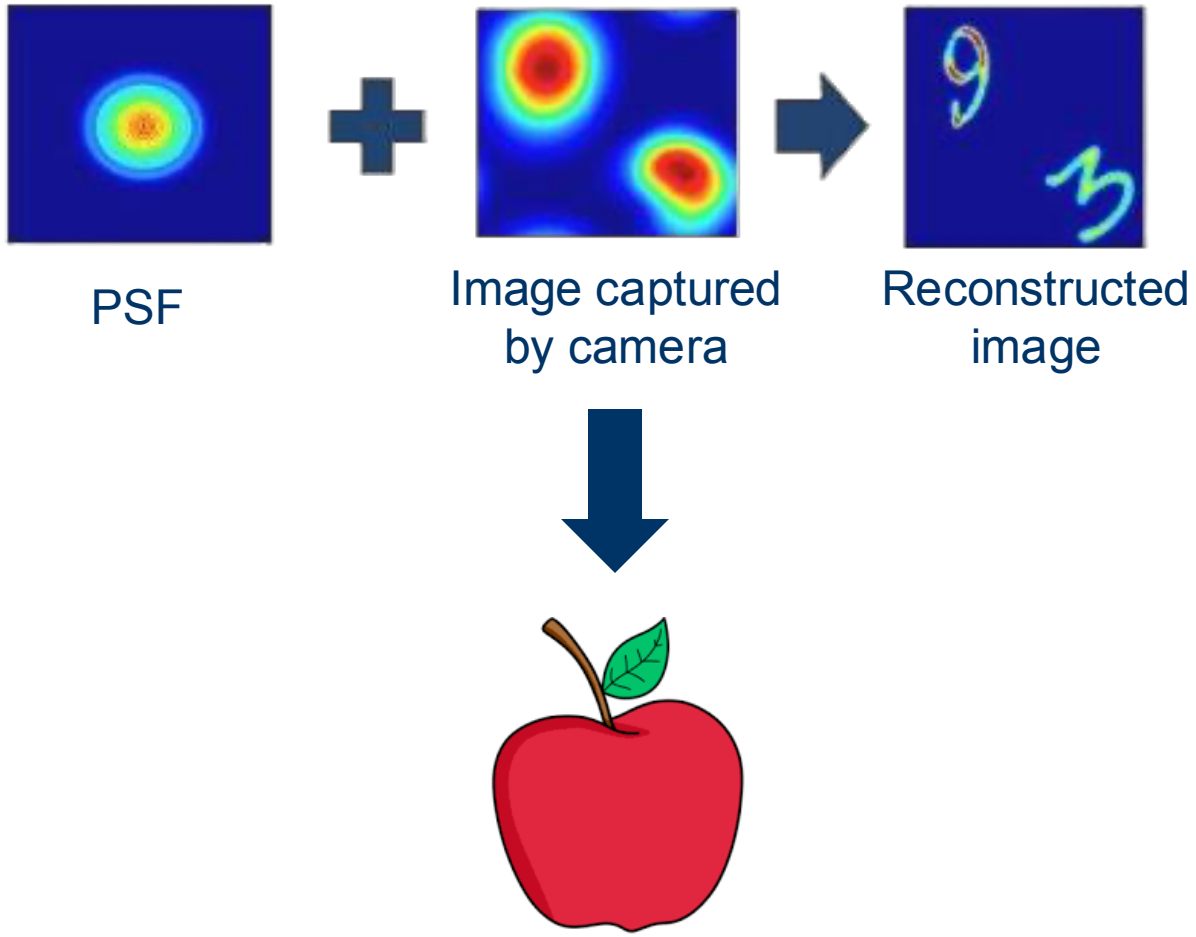

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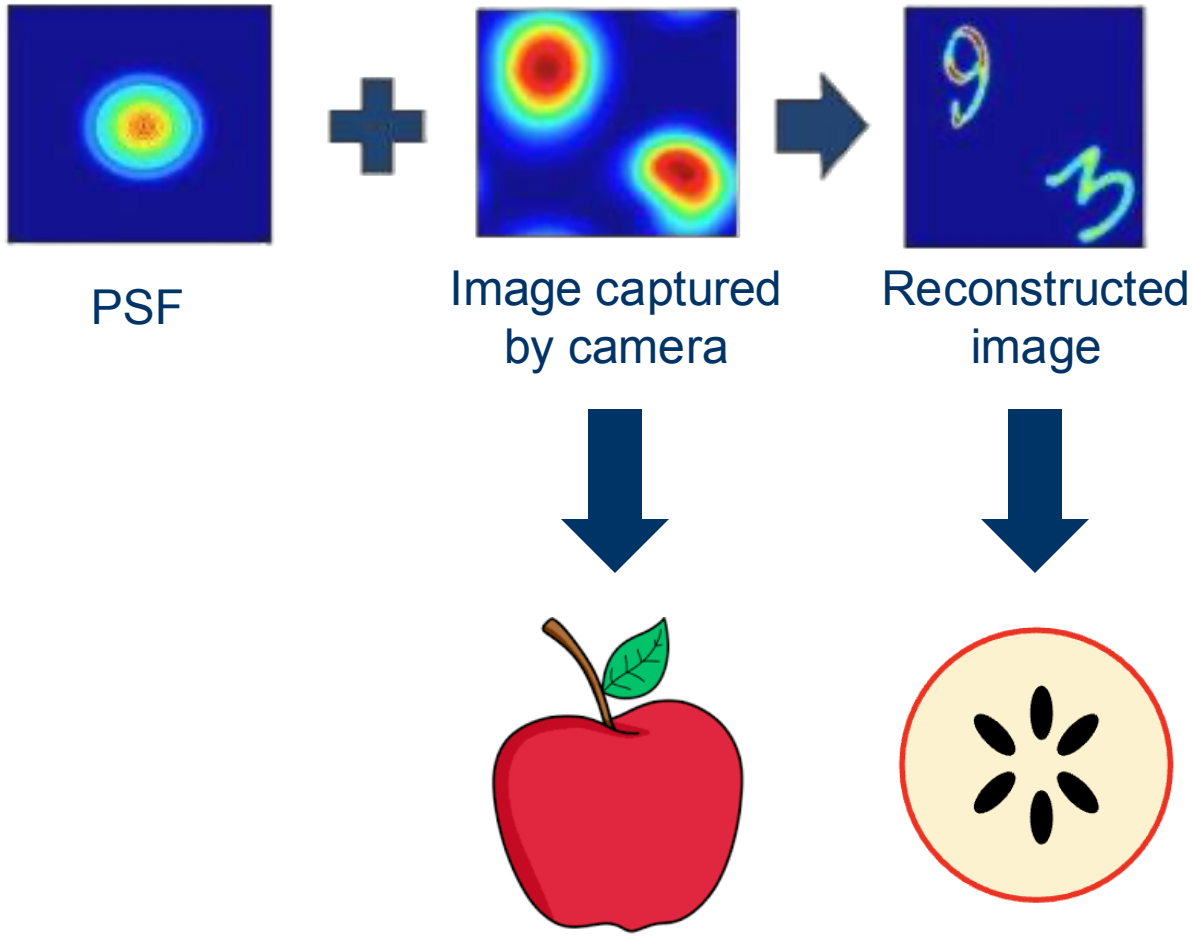

Phase Mask Design

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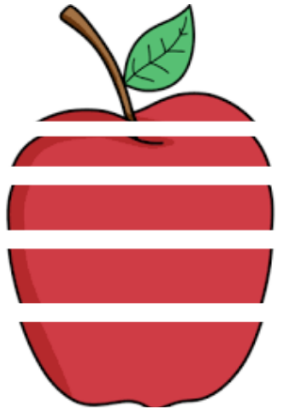

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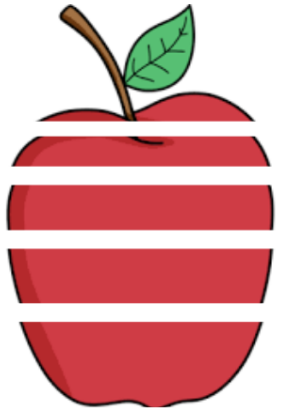

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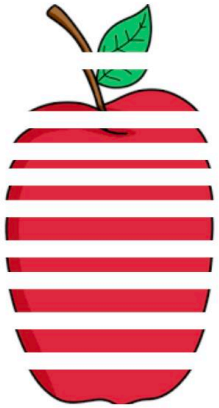

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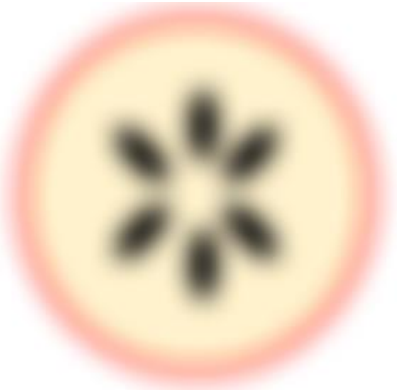

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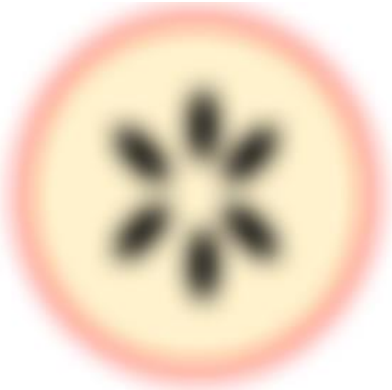

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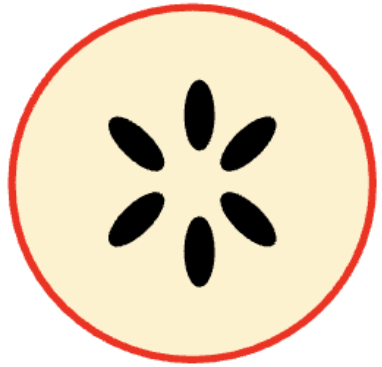

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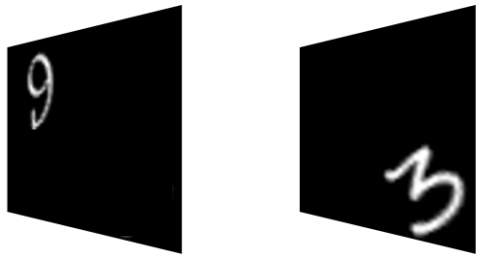
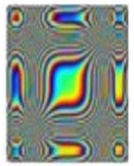
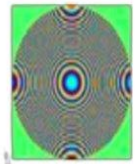
- The simulated object consisted of 2 handwritten numbers on different planes:



RESULTS

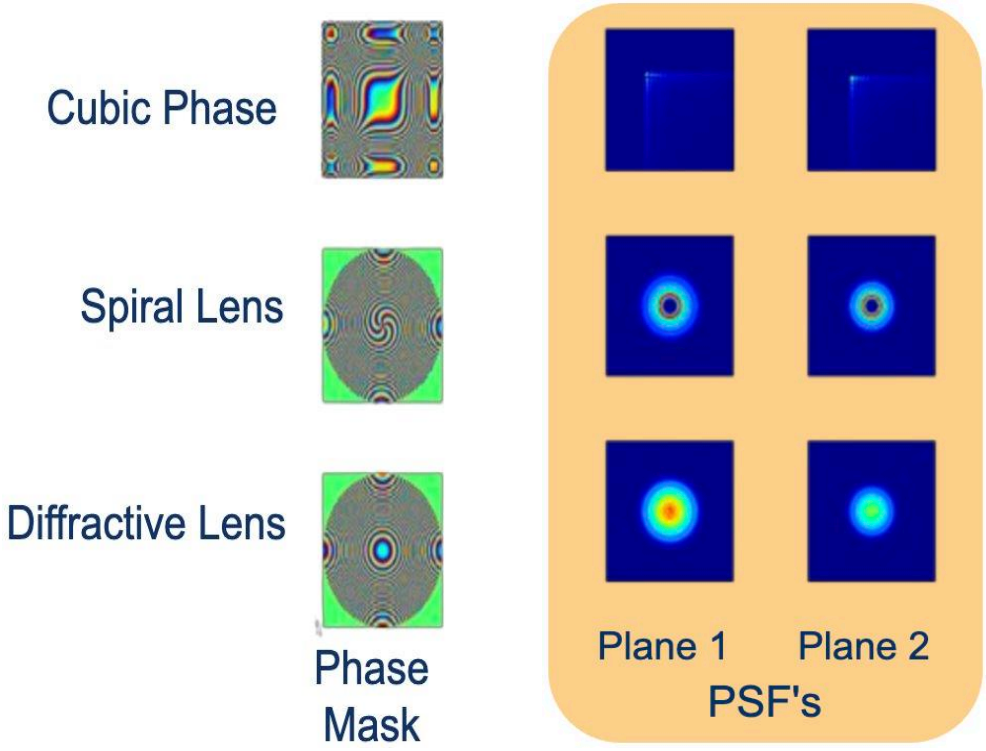
Cubic Phase 

Spiral Lens 

Diffractive Lens 

Phase Mask

Results


Cubic Phase
Spiral Lens
Diffractive Lens
Phase Mask
Plane 1
Plane 2
PSF's

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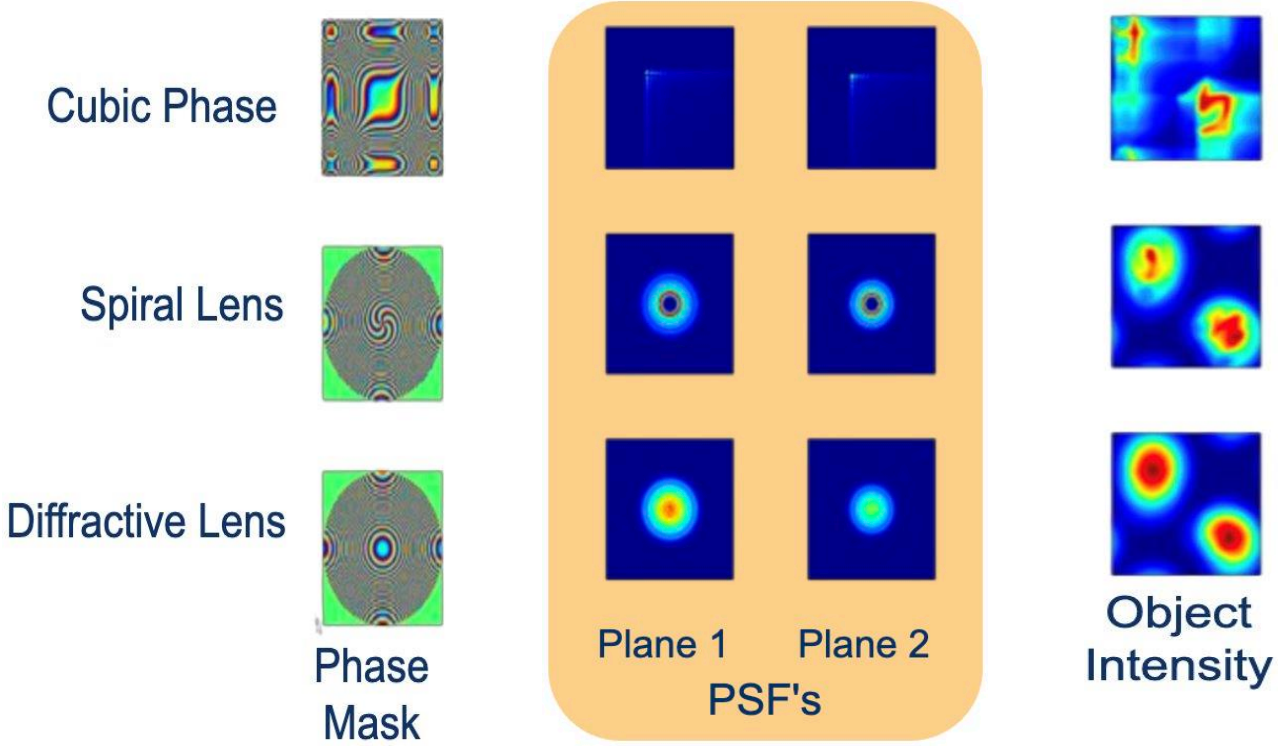
Cubic Phase
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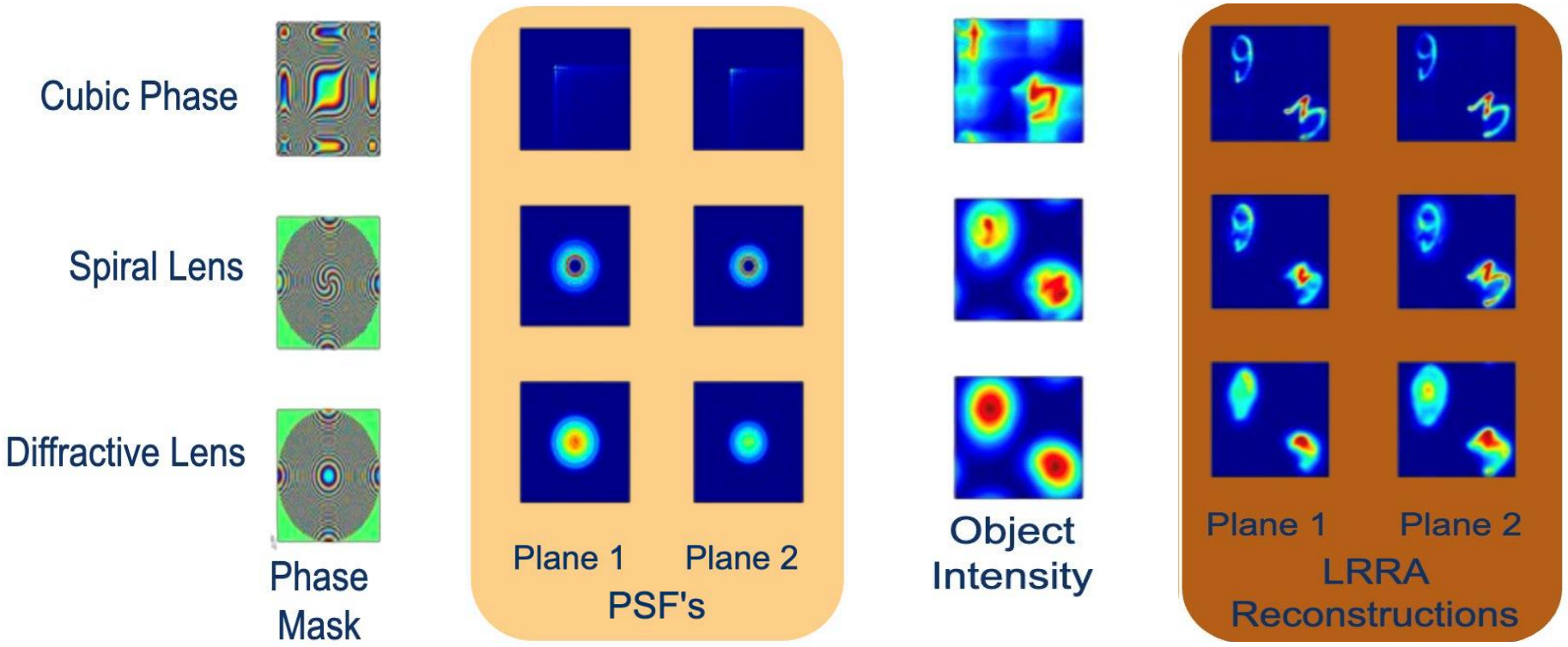
Plane 1
Plane 2
PSF's
Object Intensity

RESULTS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LRRA Reconstructions

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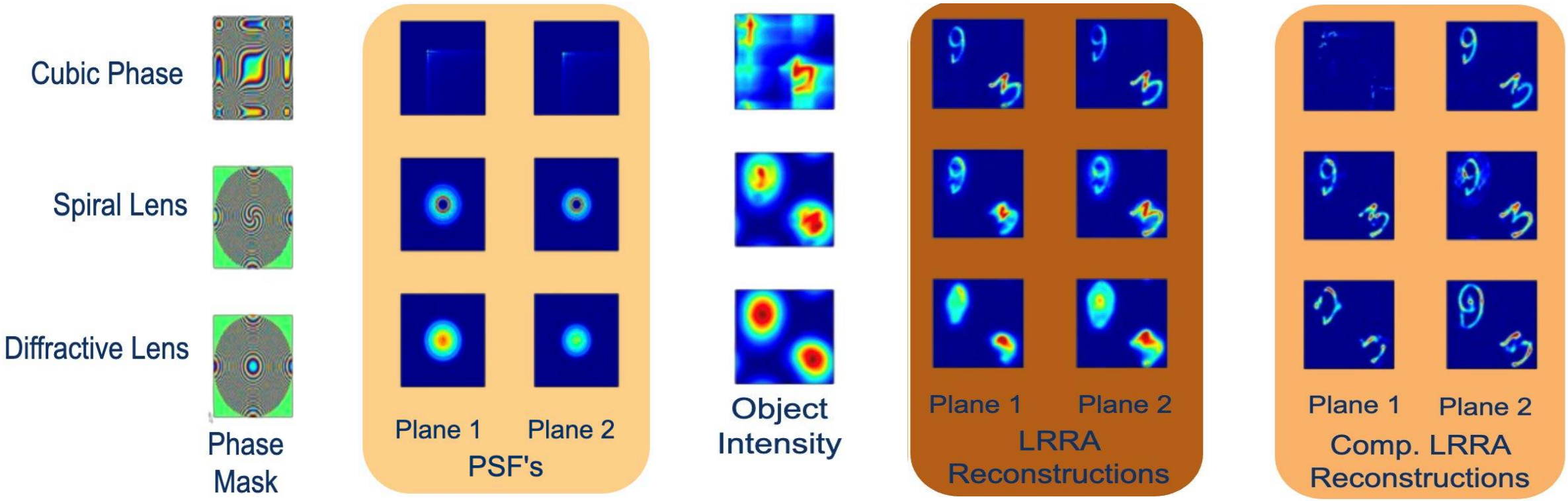
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Comp. LRRA Reconstructions

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- The use of digital phase masks, provides greater flexibility and freedom in image reconstruction.
- The compressive Lucy Richardson Rosen Algorithm (Comp. LRRA) is an effective algorithm for image reconstruction.

Future Work

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- Design unique phase masks to offer new perspectives on objects.