Preparation work for reflection-mode CDI

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Contents

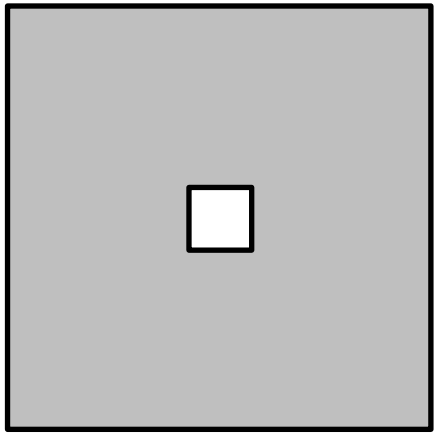
- CDI and Ptychography
- Visible Light Setup
- Progress in Southampton
- Reflection Design
- Tilted Images
- Work Plan

CDI and Ptychography

Abbe formula: $d = \frac{\lambda}{2 \cdot NA}$

Resolution limit for visible light is ≈200nm

Diffraction pattern can break resolution limit



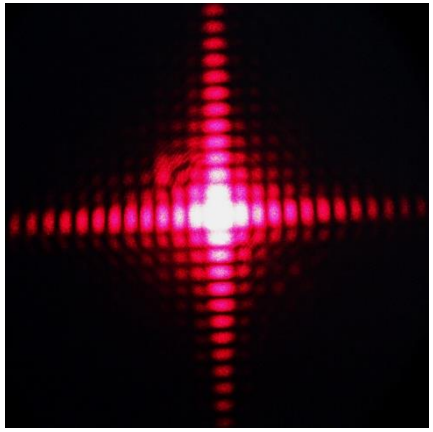
Aperture

$\mathcal{F}$

Fourier Transform

Reverse Fourier Transform

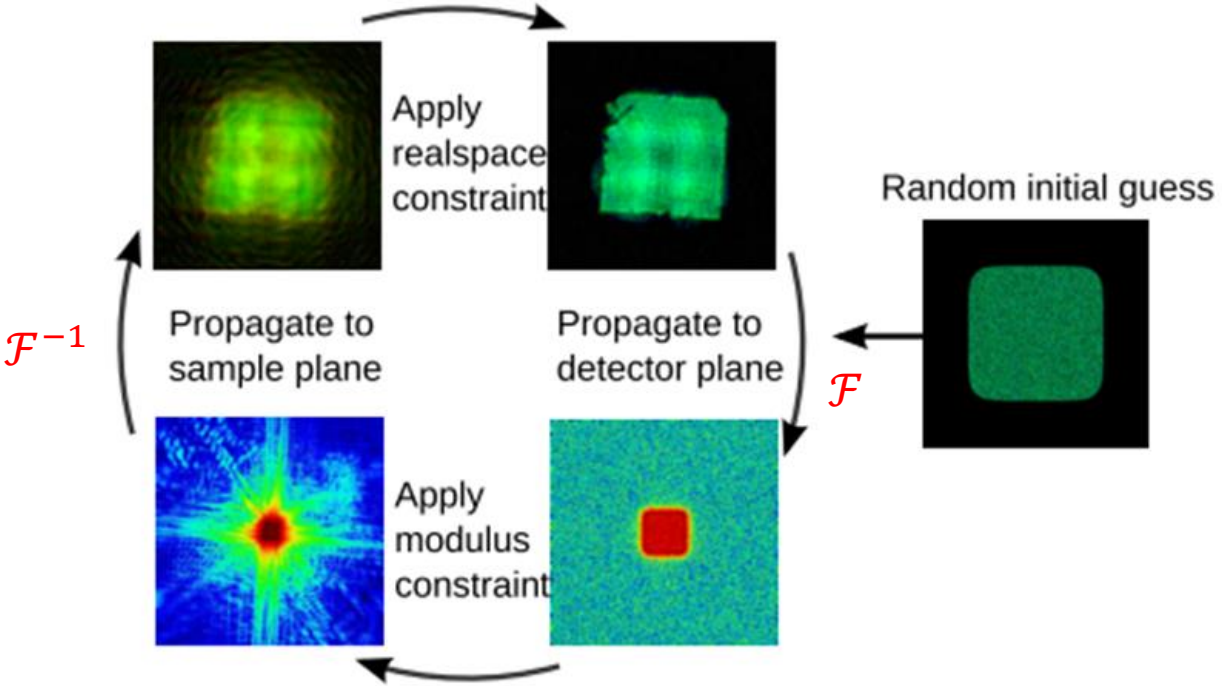
$\mathcal{F}^{-1}$



Diffraction pattern

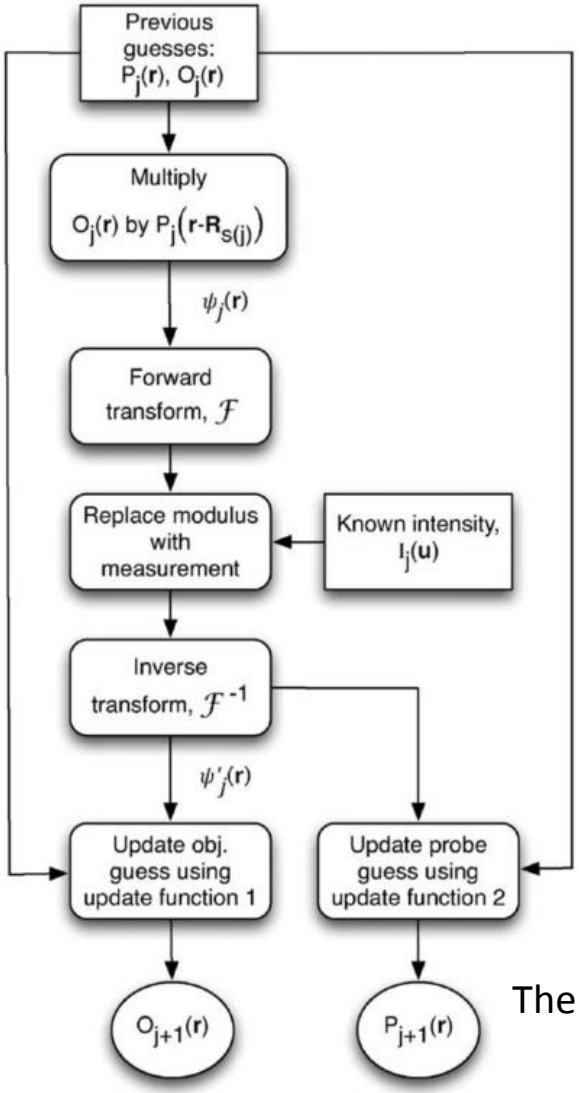
CDI and Ptychography

CDI - Coherent Diffraction Imaging



The process of CDI reconstruction [1]

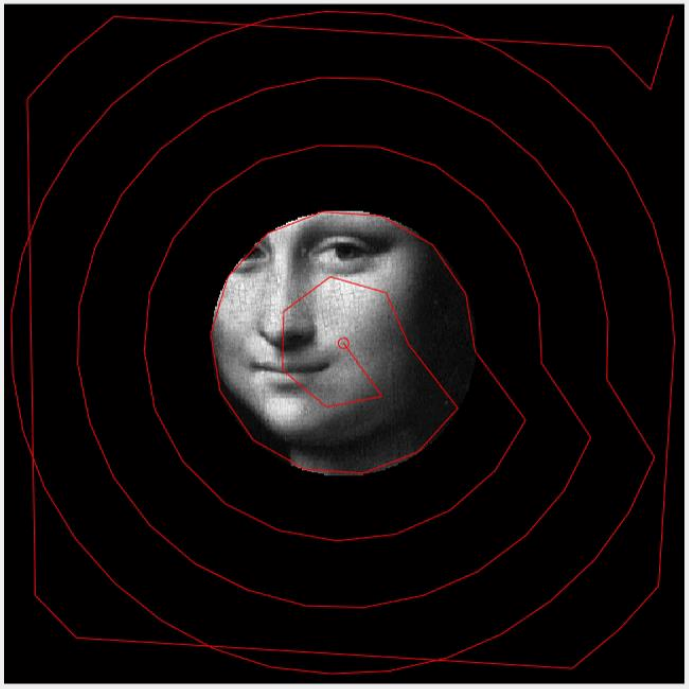
CDI and Ptychography



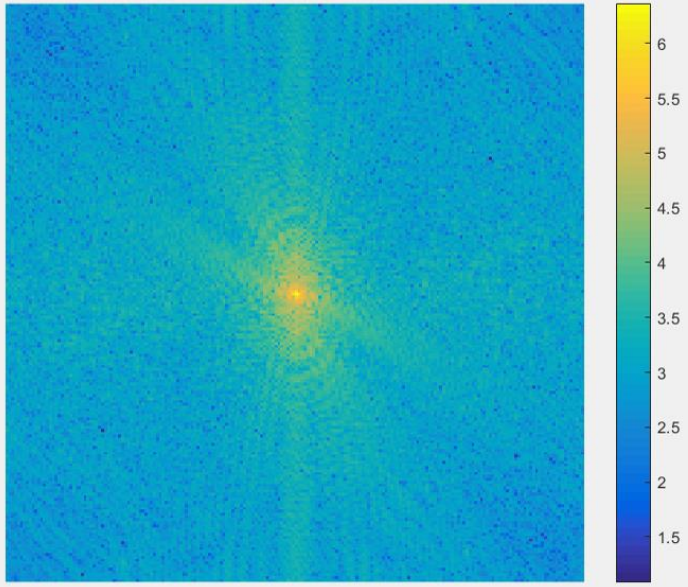
Ptychography – Scanning CDI

The flow chart for ePIE algorithm which solves the ptychography problem [2]

CDI and Ptychography



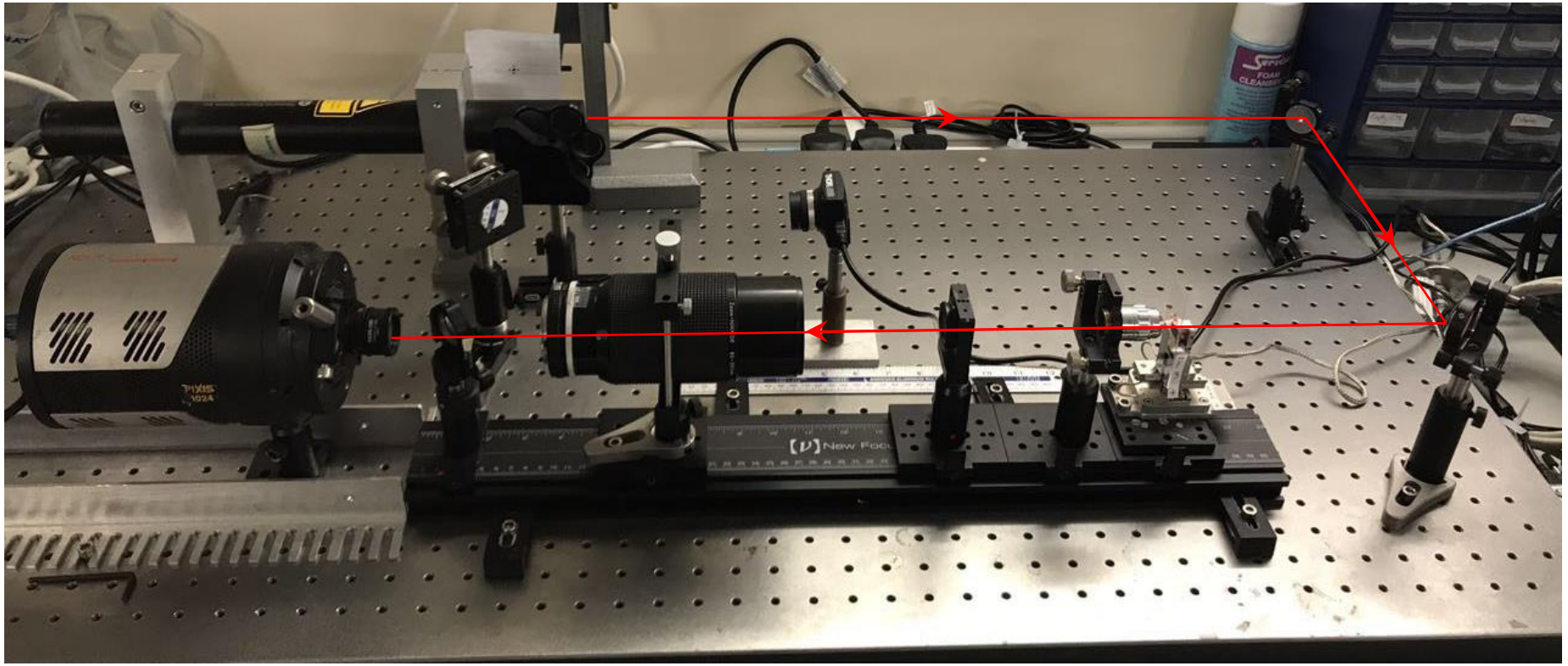
Object scanned



Diffraction pattern collected

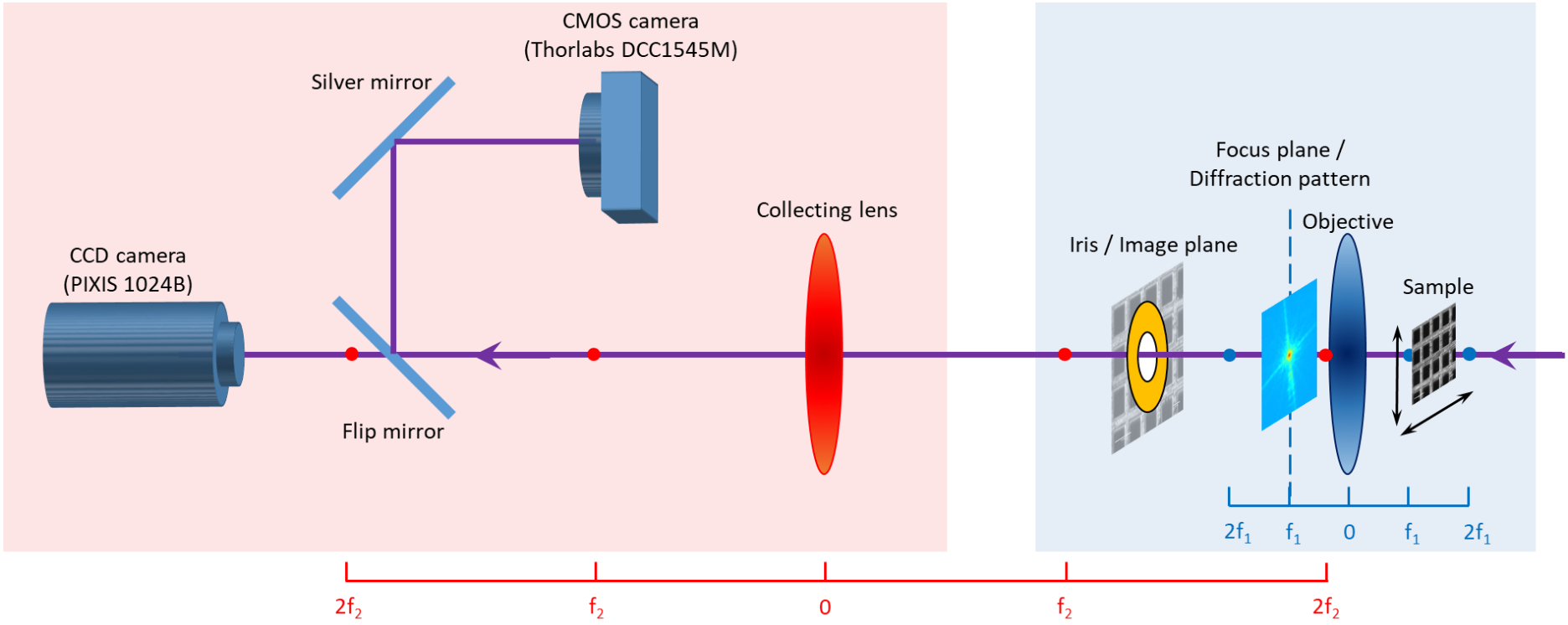
Scan process for ptychography

Visible Light Setup



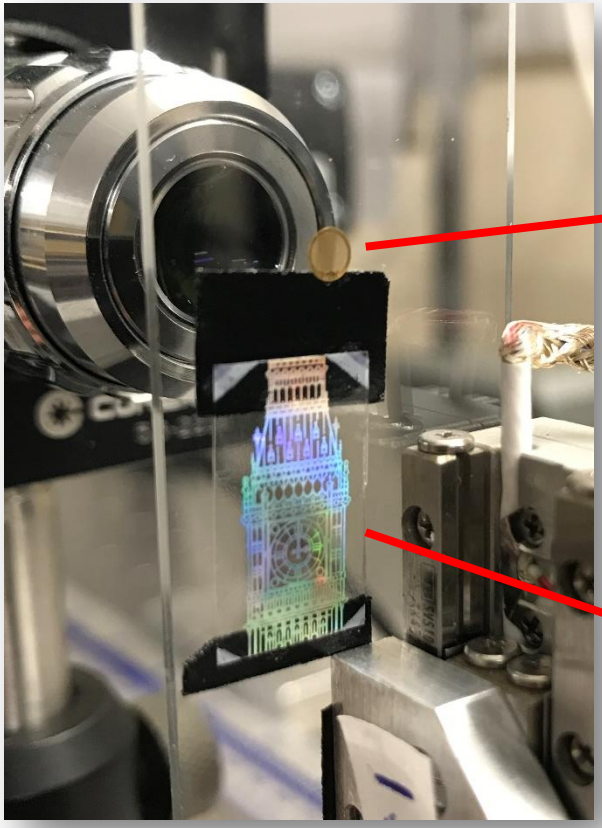
Picture of visible light setup using HeNe laser

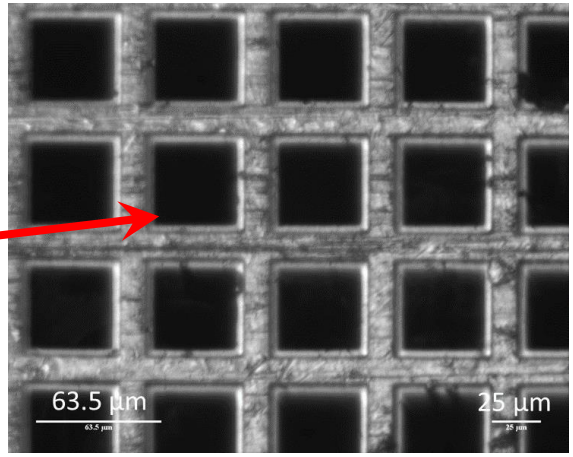
Visible Light Setup



Schematic of visible light setup using HeNe laser

Visible Light Setup

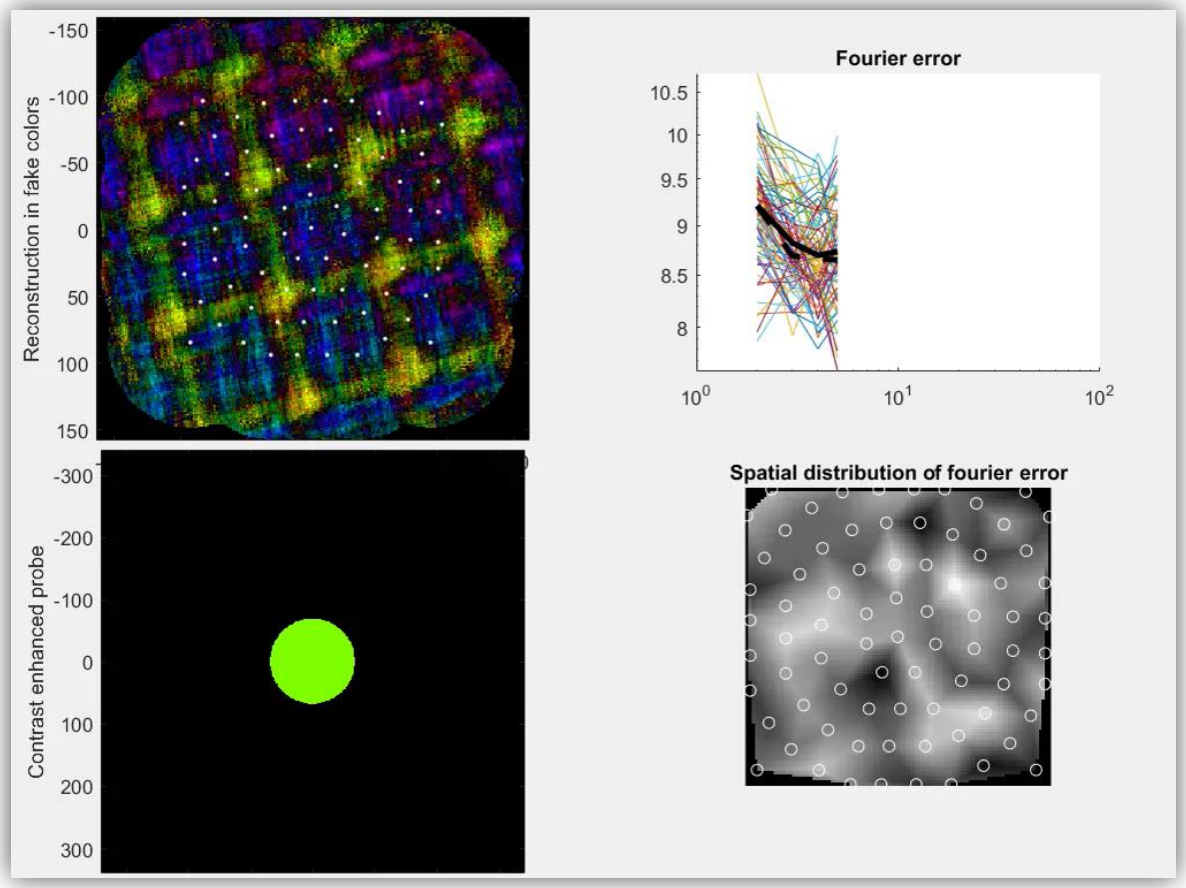




400 mesh golden grid
(taken by optic microscopy)

5 pound note

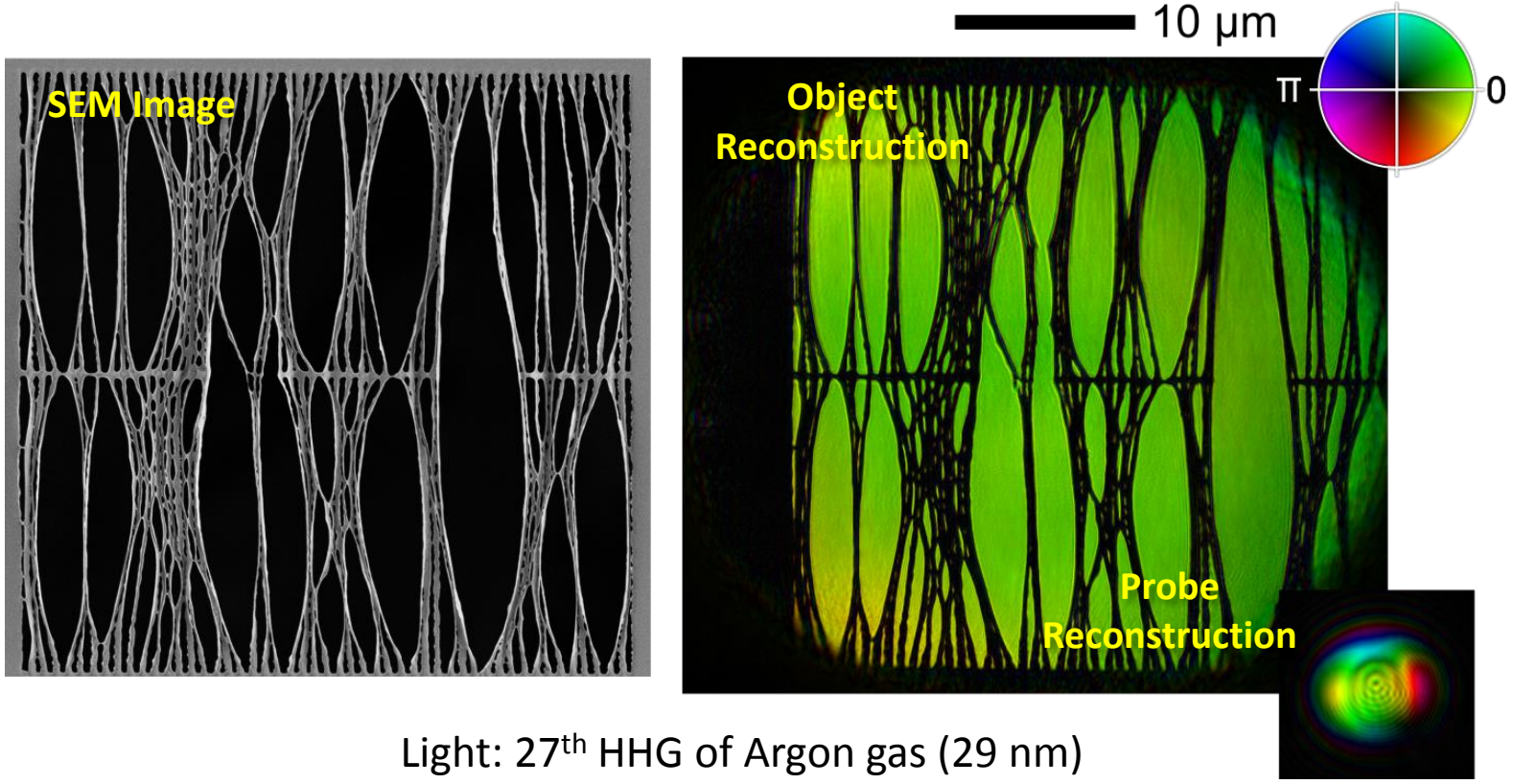
Visible Light Setup



Reconstruction process of **100** iterations

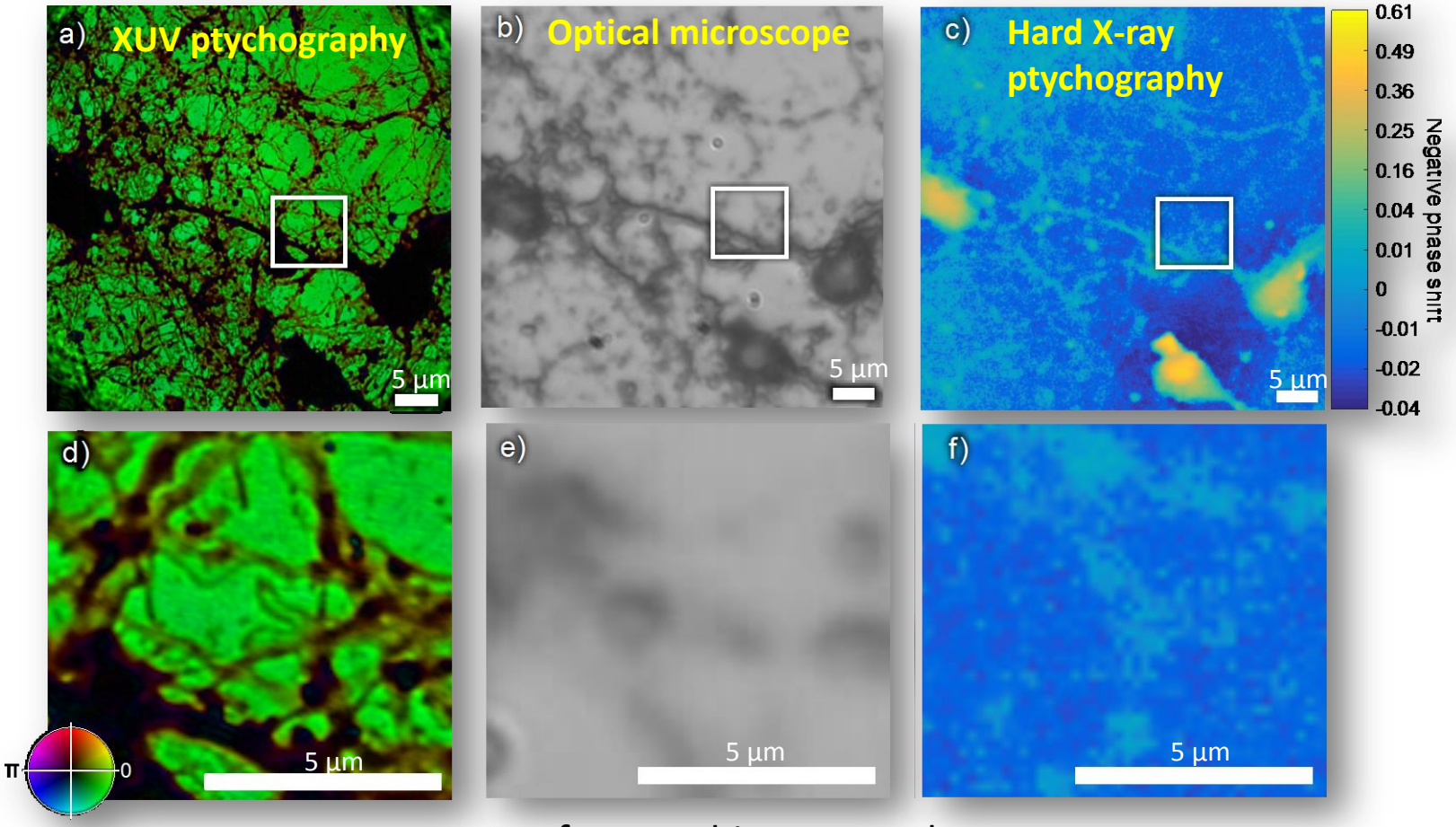
Number of scan: 79

Progress in Southampton



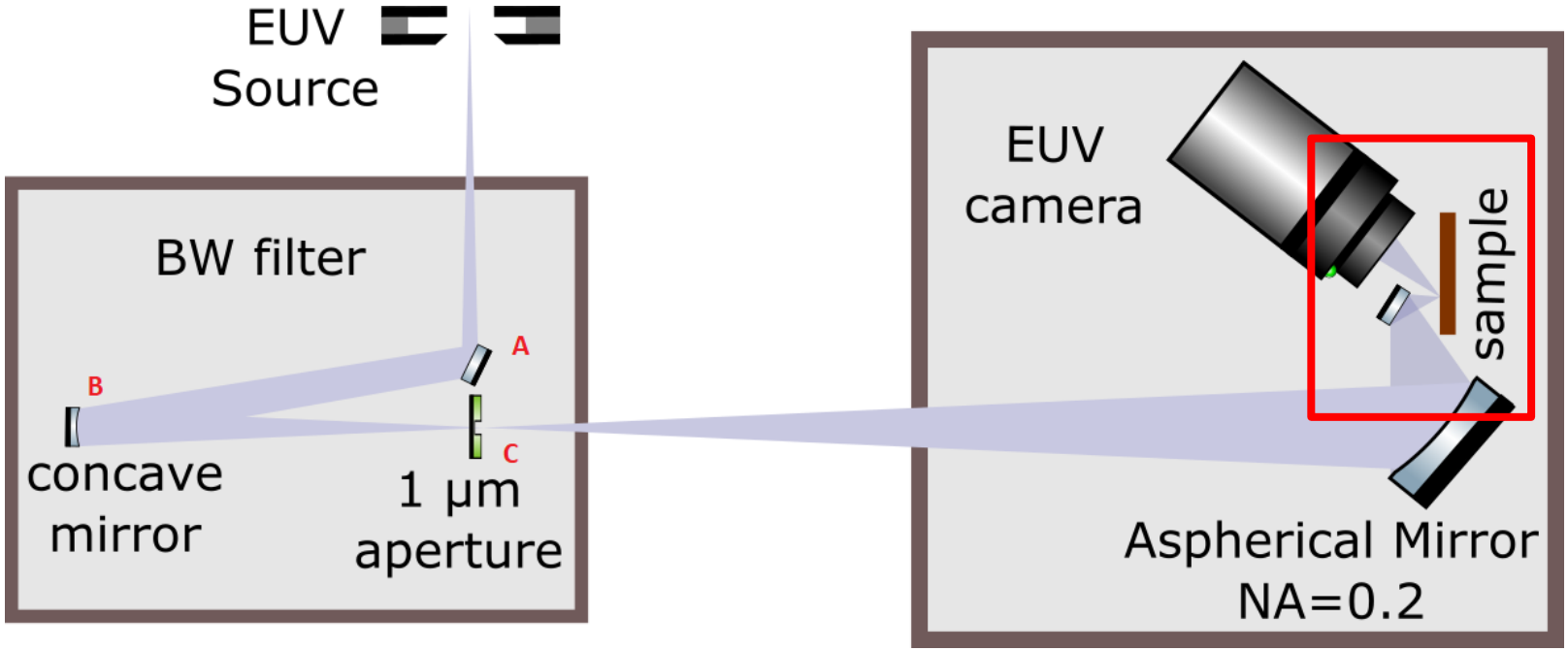
Light: 27th HHG of Argon gas (29 nm)
Sample: FIB-written mask on SiN
Number of scan: 400

Progress in Southampton



Images of Mouse hippocampal neurons

Reflection Design



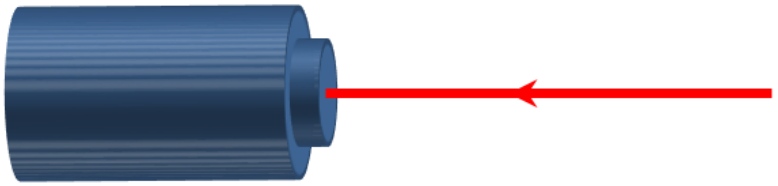
Schematic of reflection CDI setup

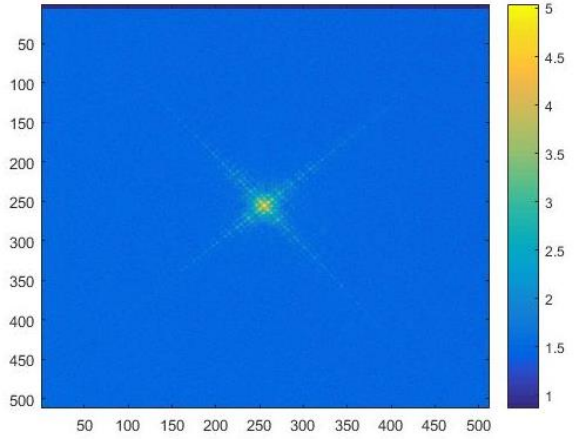
Tilt[illegible] Images

The Ambassadors, oil on oak, by Hans Holbein the Younger

Tilted Images

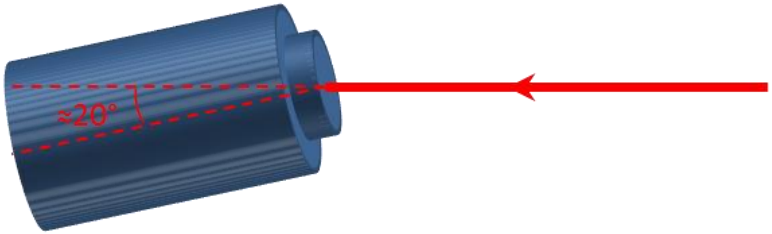
CCD camera
(PIXIS 1024B)

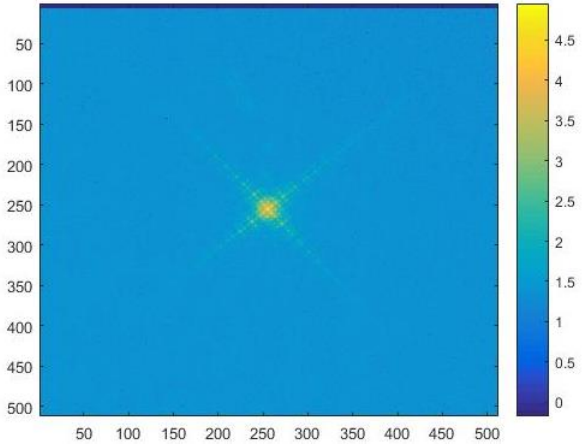




Photons counts
(in $\log_{10}$)

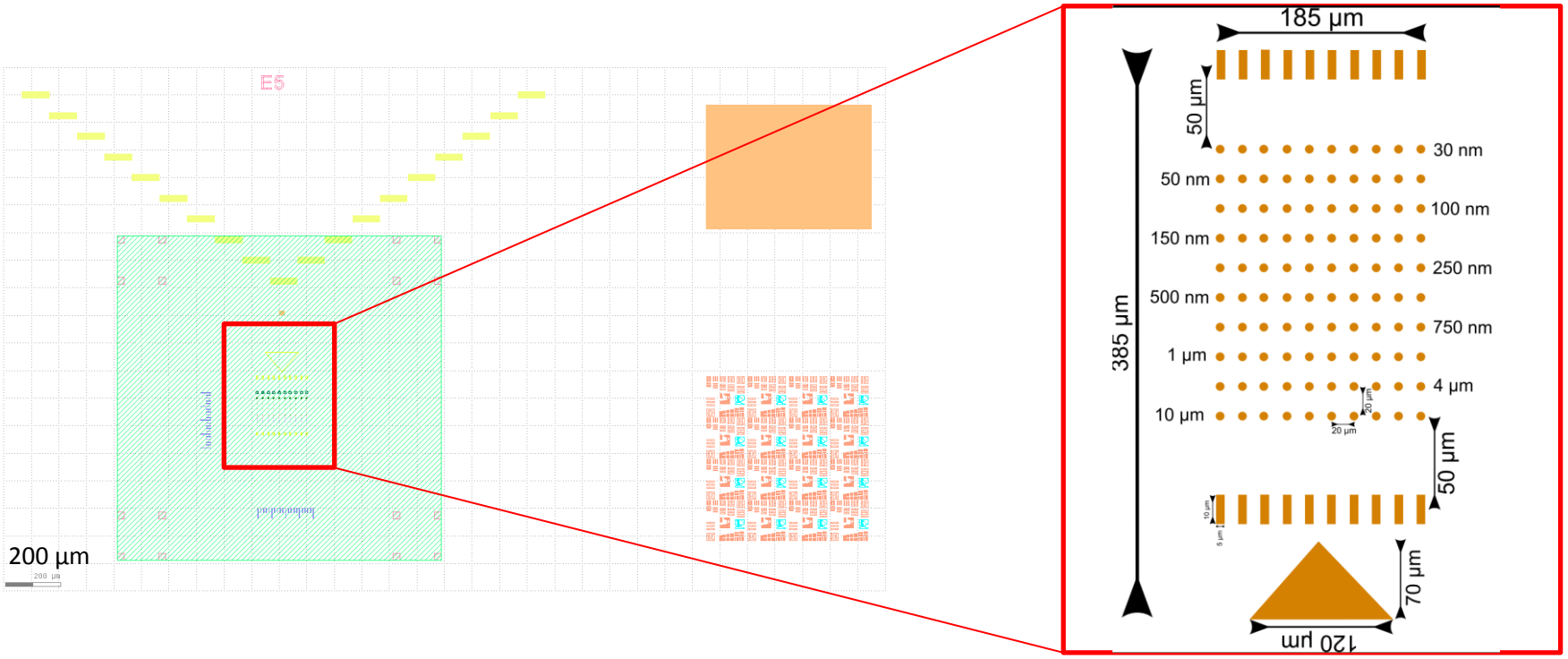
CCD camera
(PIXIS 1024B)





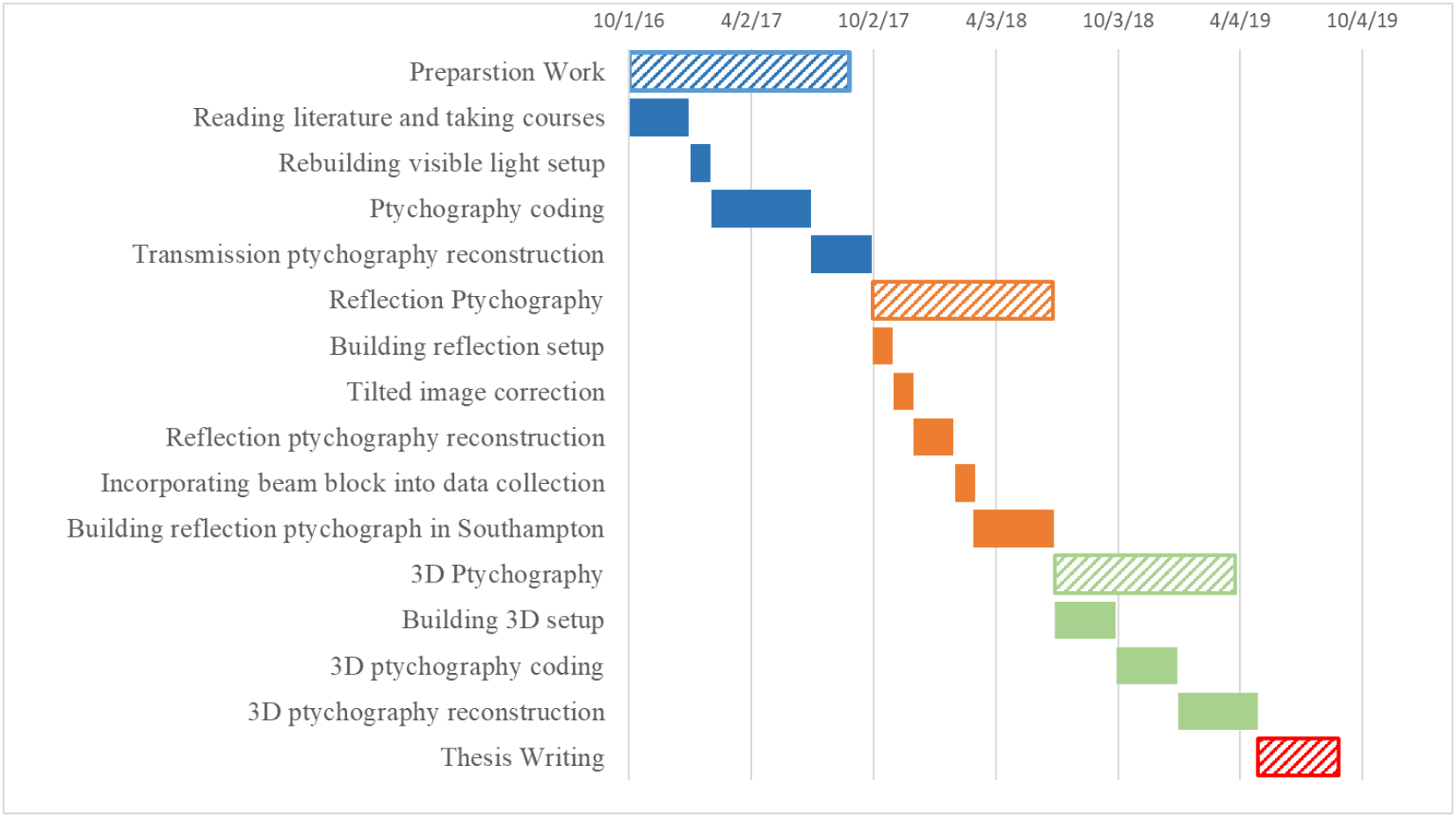
Photons counts
(in $\log_{10}$)

Reflection Design



Design of programmed defects

Work Plan



Work Plan

Reference

- [1] M. Odstrcil, “Coherent Diffractive Imaging Using Table-top Sources”, Ph.D. thesis in University of Southampton and RWTH Aachen University, October 2016.
- [2] A. M. Maiden, J. M. Rodenburg, “An improved ptychographical phase retrieval algorithm for diffractive imaging”, Ultramicroscopy, 109, 256–1262 (2009).

Acknowledgement

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Thank you

CDI and Ptychography

1) Circular path is used instead of scanning line by line to avoid regular artifacts

2) Step is controlled to ensure overlapping of neighbouring is 60% - 70%