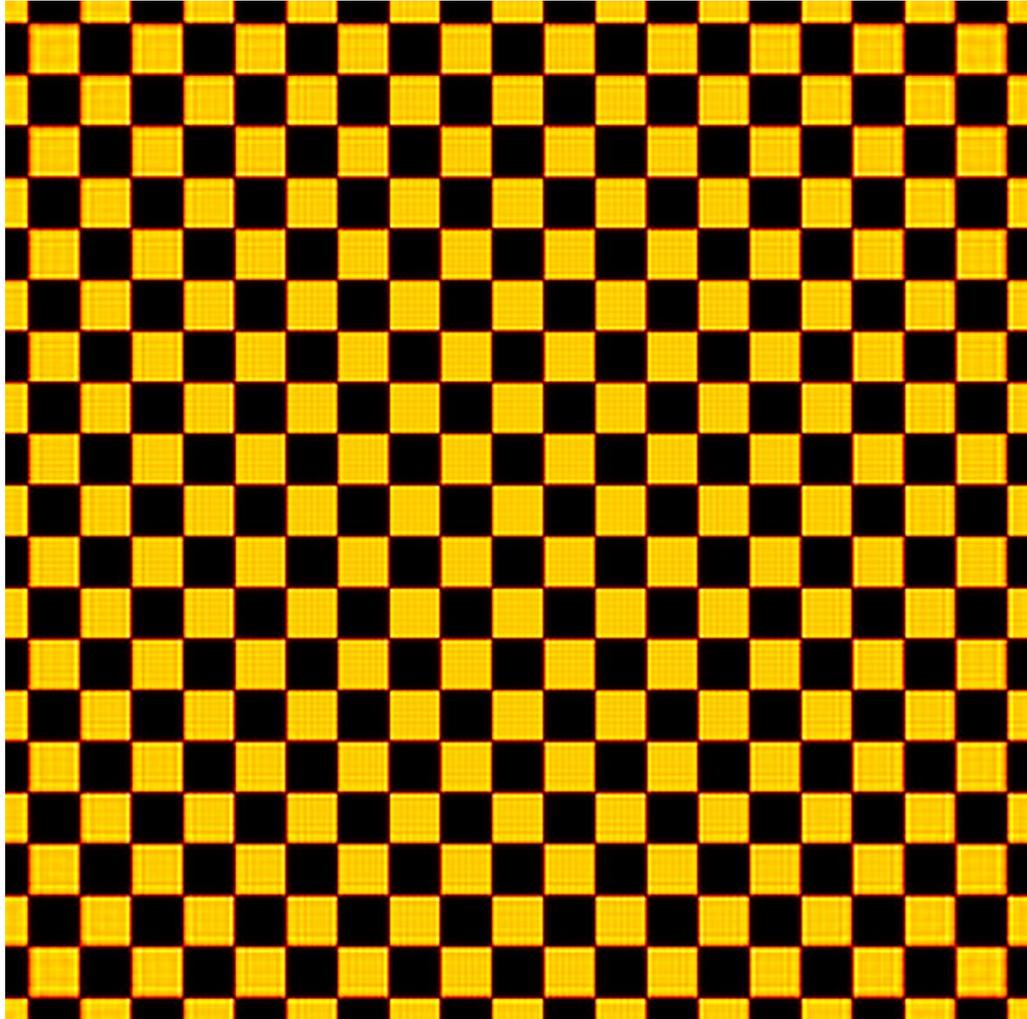


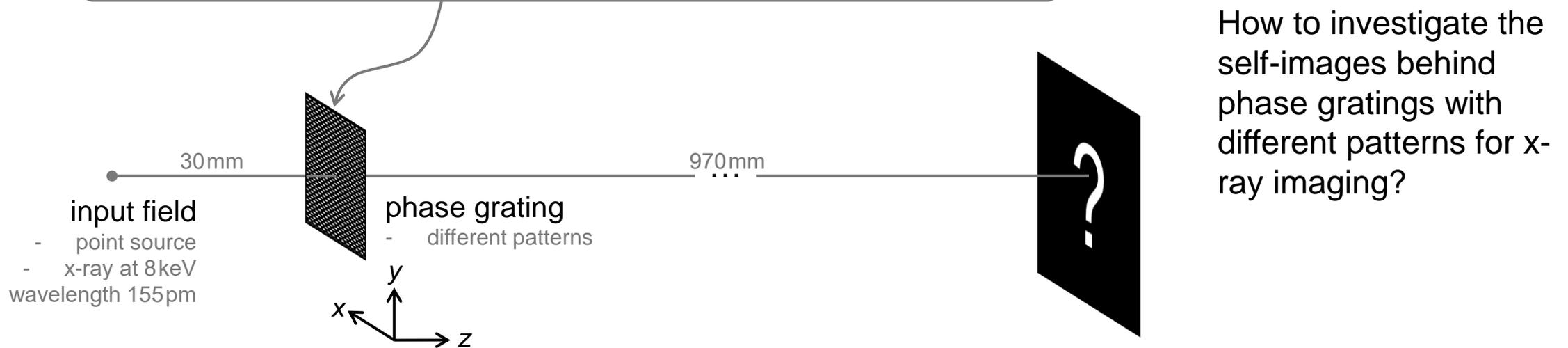
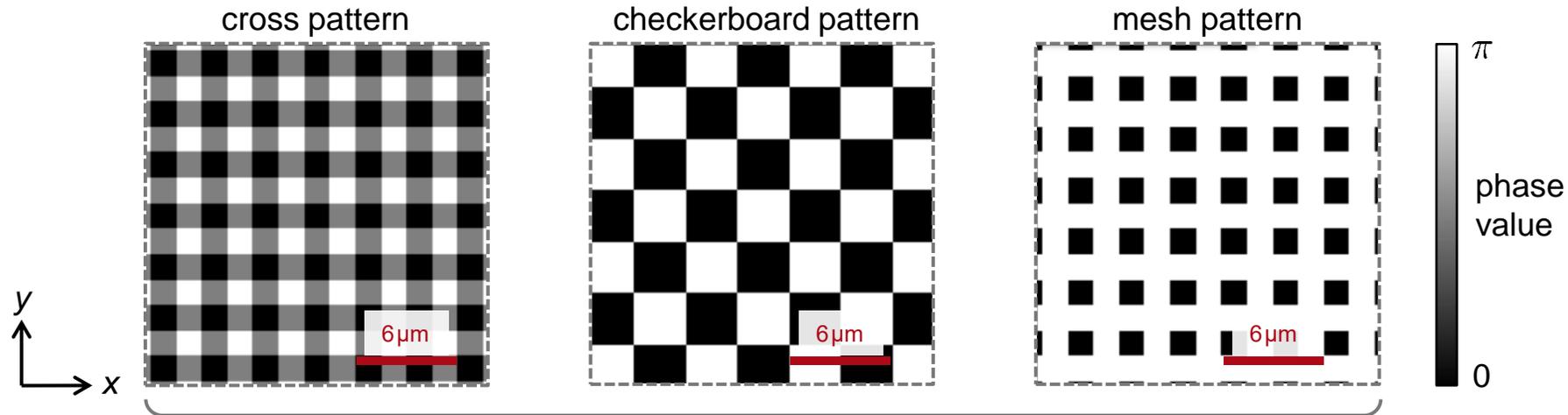
# Single Grating Interferometer for X-Ray Imaging

# Abstract



X-ray imaging is often based on the Talbot effect and the self-image of gratings. Following the work of N. Morimoto *et al.*, we selected three types of phase gratings, with cross, checkerboard, and mesh patterns. The gratings are employed in a single grating interferometer, modeled as phase-only transmission functions (because the x-ray wavelength is much smaller than the grating period), and their self-images are examined in VirtualLab Fusion.

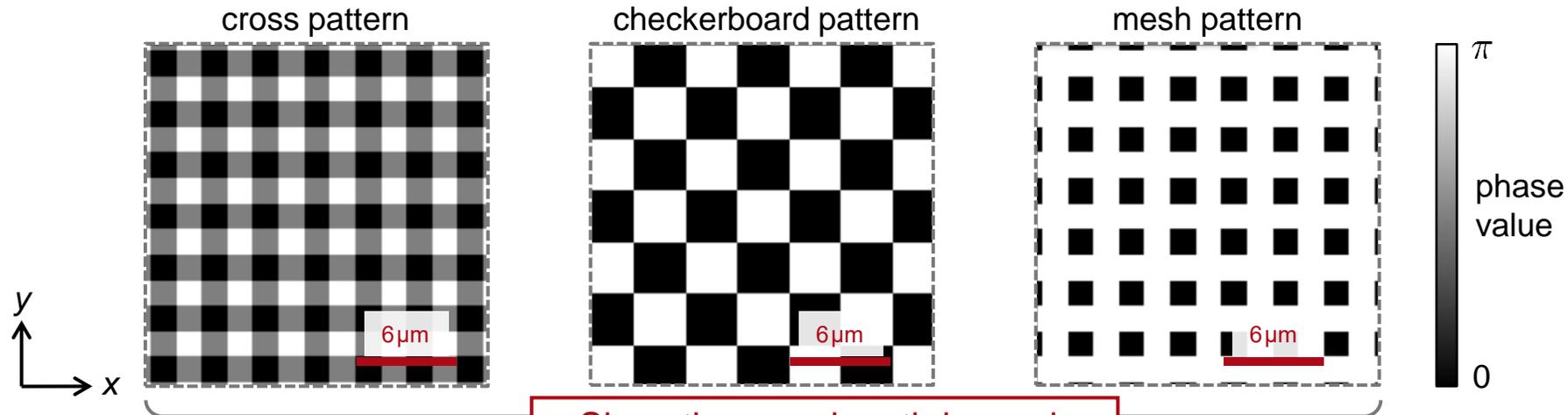
# Modeling Task



How to investigate the self-images behind phase gratings with different patterns for x-ray imaging?

system parameters from N. Morimoto, *et al.*, Opt. Express 23, 29399-29412 (2015)

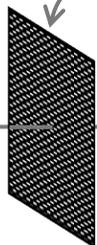
# Modeling Task



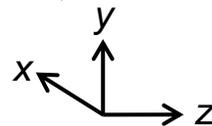
Since the wavelength is much smaller comparing to the period, the gratings can be modeled by transmission functions.

input field  
- point source  
- x-ray at 8keV  
wavelength 155pm

30mm



phase grating  
- different patterns



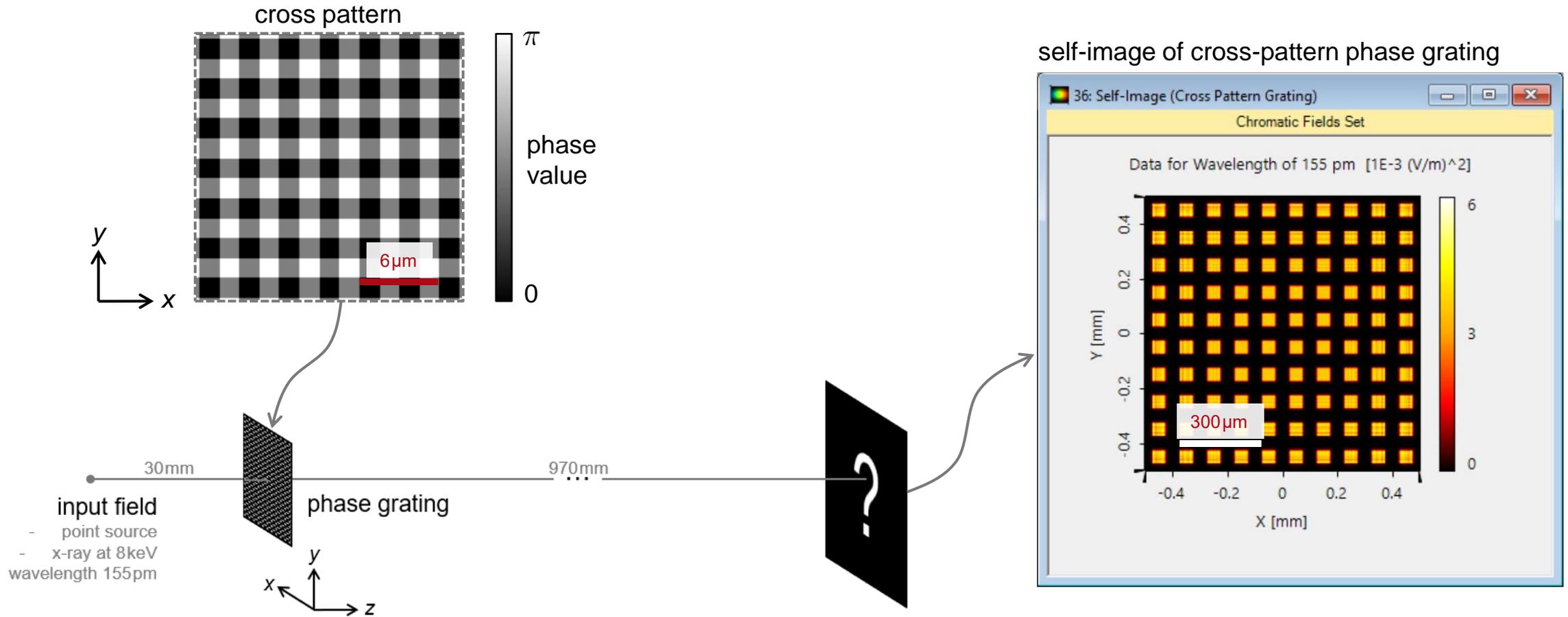
970mm



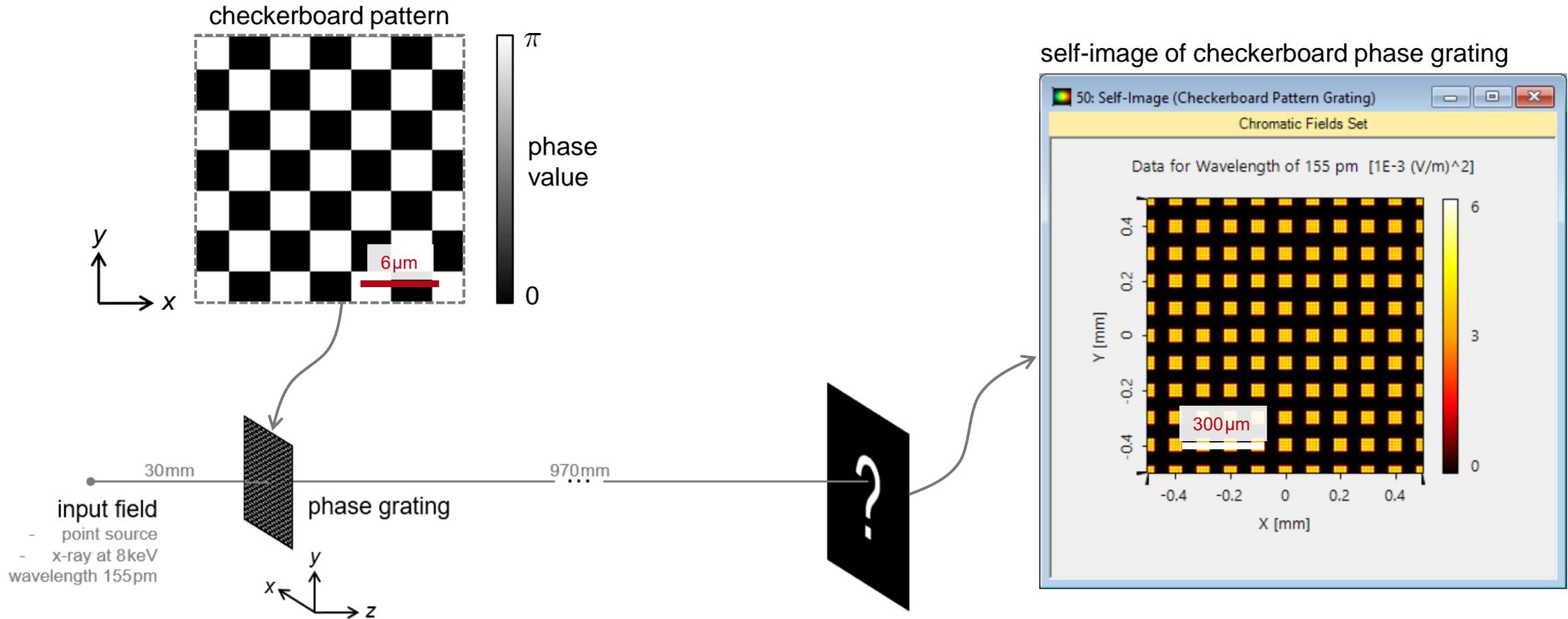
How to investigate the self-images behind phase gratings with different patterns for x-ray imaging?

system parameters from N. Morimoto, *et al.*, Opt. Express 23, 29399-29412 (2015)

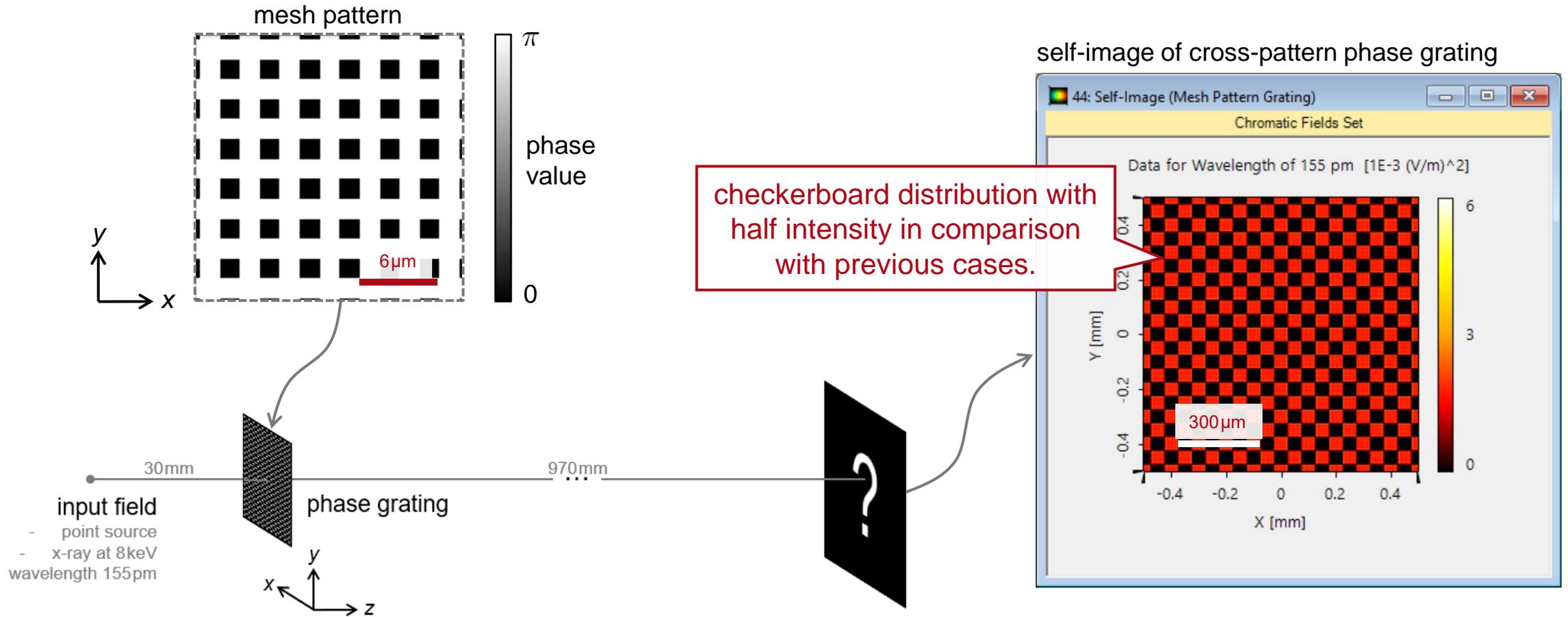
# Cross-Pattern Phase Grating



# Checkerboard-Pattern Phase Grating

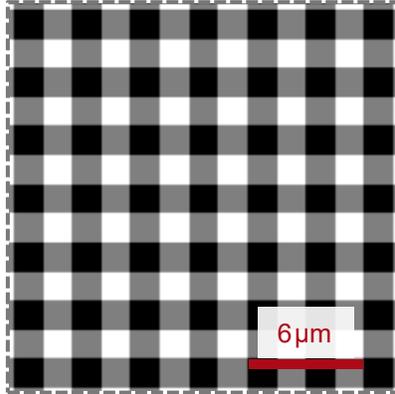


# Mesh-Pattern Phase Grating

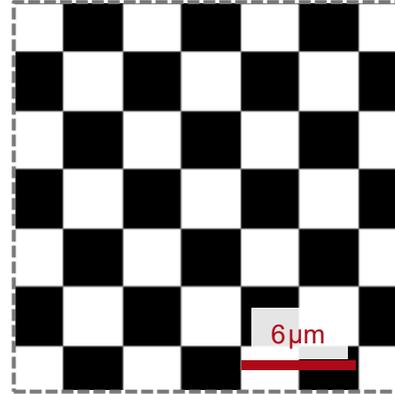


# Comparison of Different Cases

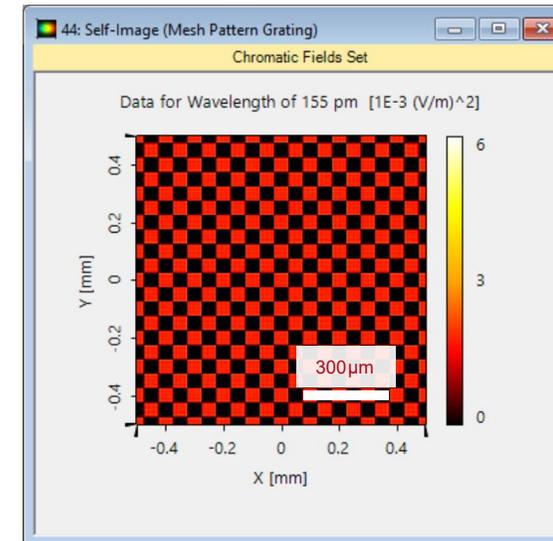
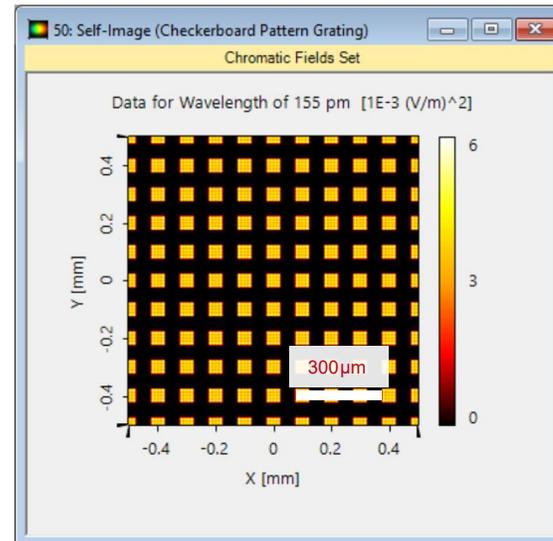
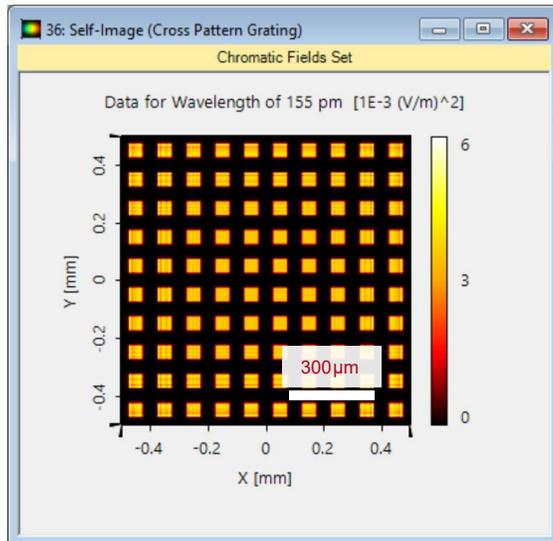
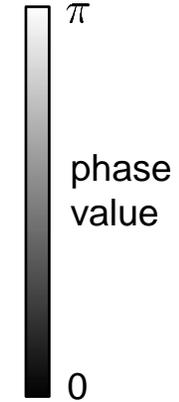
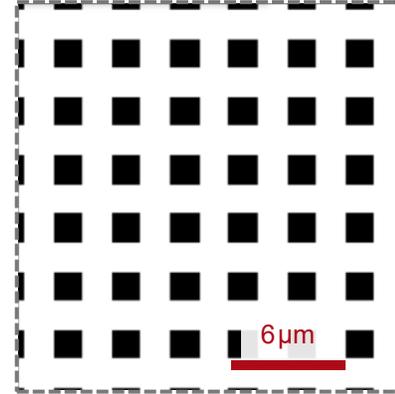
cross pattern



checkerboard pattern

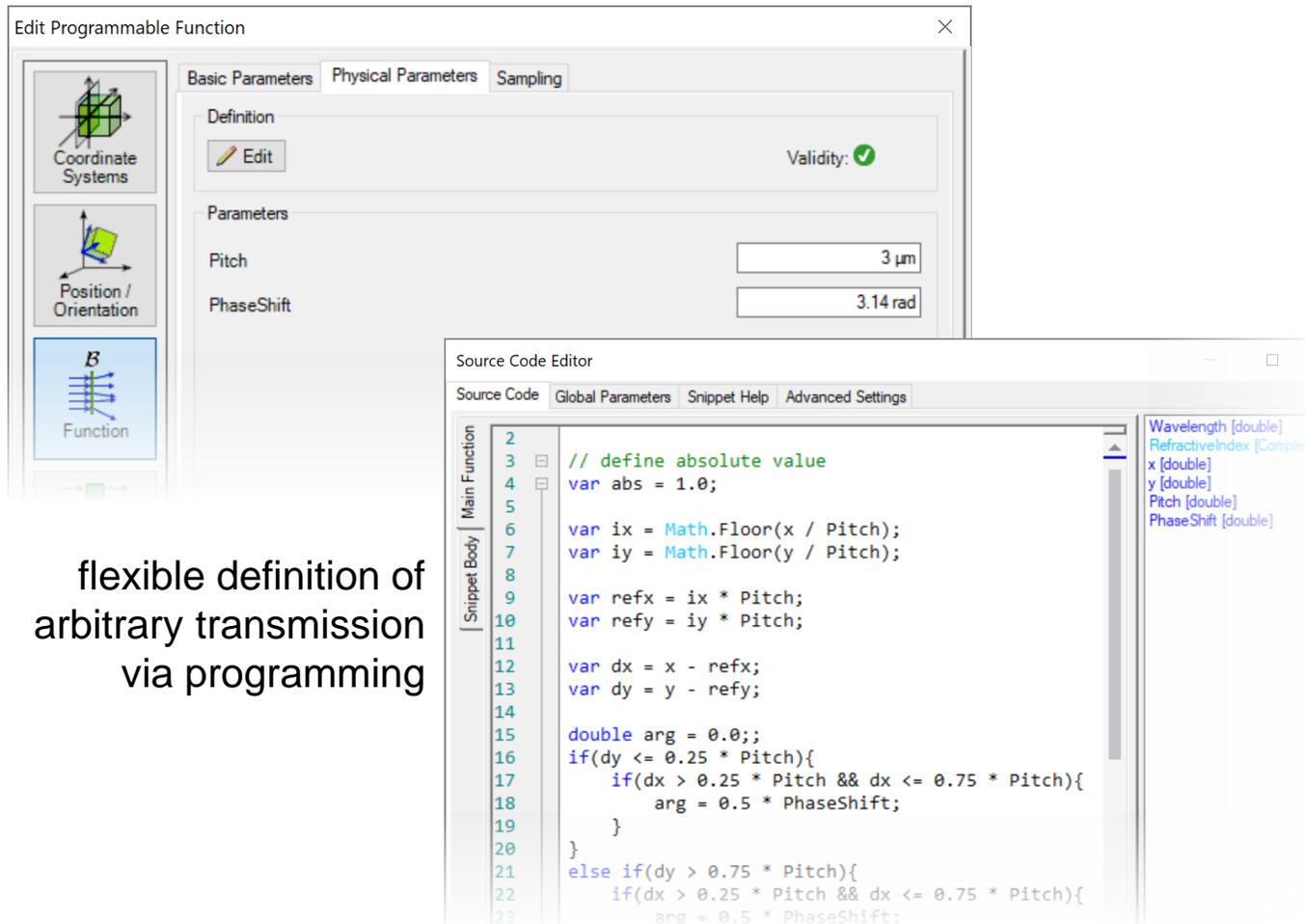


mesh pattern



self-image

# Peek into VirtualLab Fusion

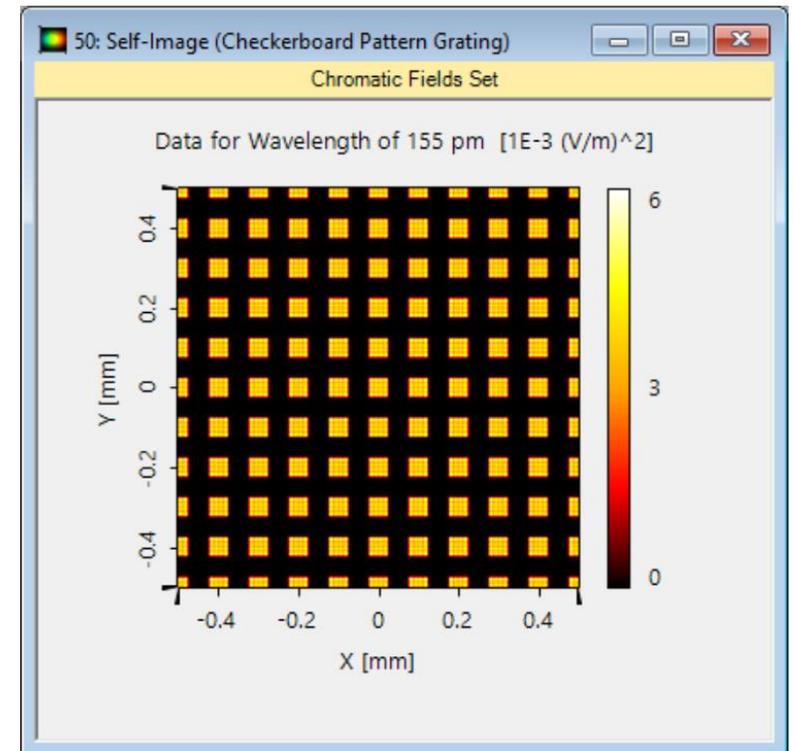


The screenshot displays the 'Edit Programmable Function' dialog box with tabs for 'Basic Parameters', 'Physical Parameters', and 'Sampling'. The 'Definition' section shows a validity checkmark and an 'Edit' button. The 'Parameters' section includes input fields for 'Pitch' (3  $\mu\text{m}$ ) and 'PhaseShift' (3.14 rad). Below the dialog is a 'Source Code Editor' window with the following code:

```
2 // define absolute value
3
4 var abs = 1.0;
5
6 var ix = Math.Floor(x / Pitch);
7 var iy = Math.Floor(y / Pitch);
8
9 var refx = ix * Pitch;
10 var refy = iy * Pitch;
11
12 var dx = x - refx;
13 var dy = y - refy;
14
15 double arg = 0.0;
16 if(dy <= 0.25 * Pitch){
17     if(dx > 0.25 * Pitch && dx <= 0.75 * Pitch){
18         arg = 0.5 * PhaseShift;
19     }
20 }
21 else if(dy > 0.75 * Pitch){
22     if(dx > 0.25 * Pitch && dx <= 0.75 * Pitch){
23         arg = 0.5 * PhaseShift;
```

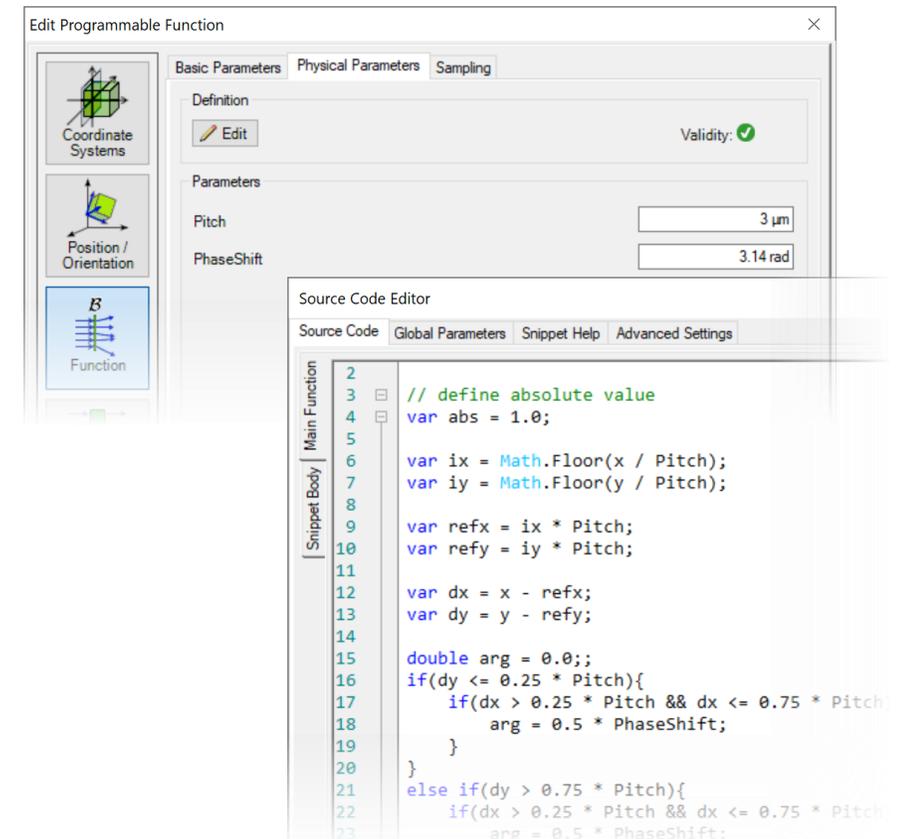
flexible definition of arbitrary transmission via programming

diffraction-included calculation and convenient result visualization

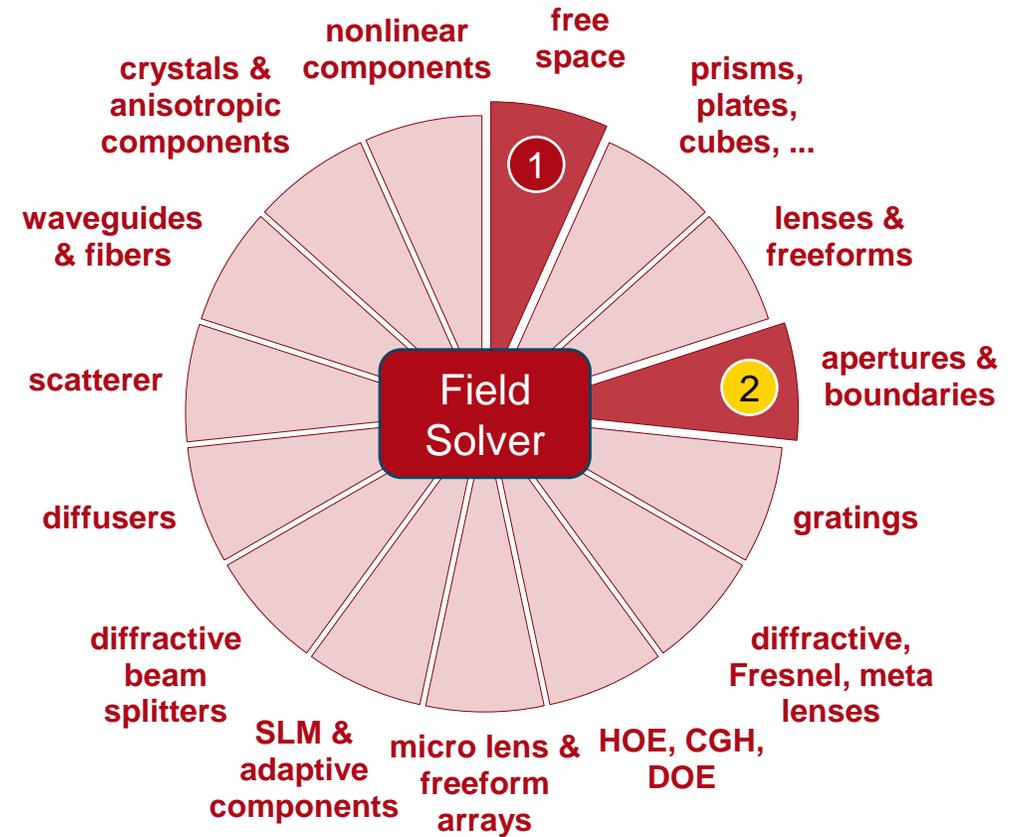
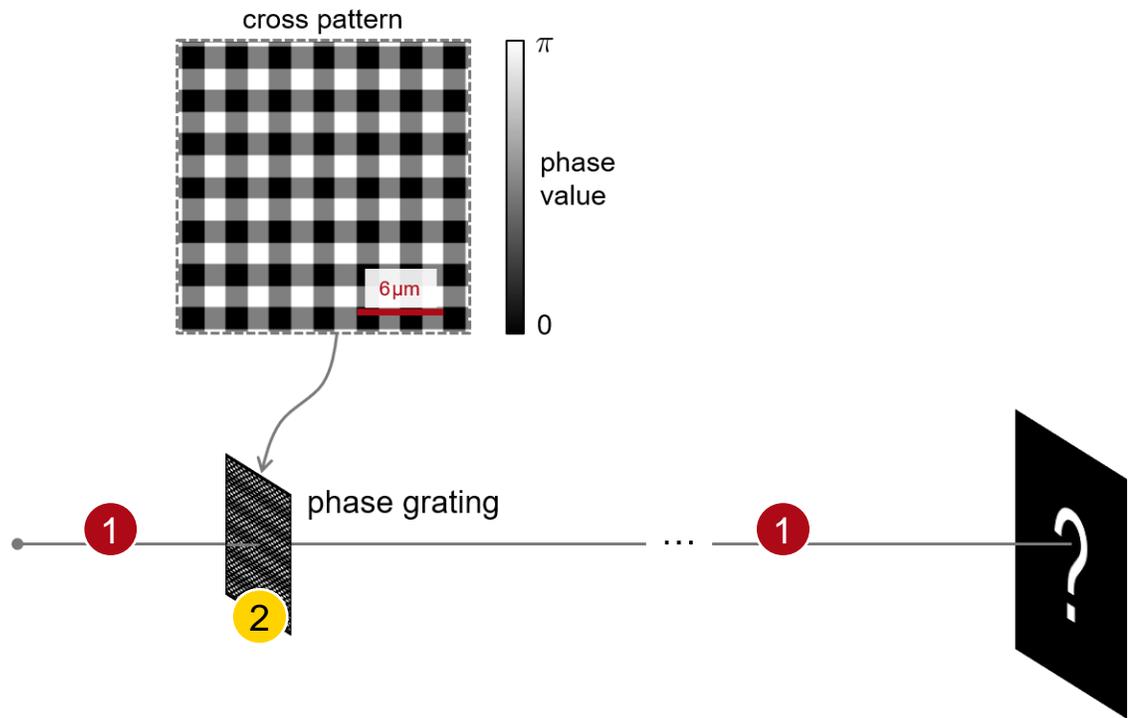


# Workflow in VirtualLab Fusion

- Specify or customize transmission functions
  - [How to Work with the Programmable Function & Example \(Cylindrical Lens\)](#) [Use Case]
- Select proper detector for field visualization
  - [Electromagnetic Field Detector](#) [Use Case]
- Set the Fourier transforms properly
  - [Fourier Transform Settings – Discussion at Examples](#) [Use Case]



# VirtualLab Fusion Technologies



# idealized component

# Document Information

title	Single Grating Interferometer for X-Ray Imaging
document code	MISC.0079
version	2.0
edition	VirtualLab Fusion Basic
software version	2020.2 (Build 1.116)
category	Application Use Case
further reading	<ul style="list-style-type: none"><li>- <a href="#"><u>Modeling of the Talbot Effect</u></a></li><li>- <a href="#"><u>Fourier Transform Settings – Discussion at Examples</u></a></li><li>- <a href="#"><u>Diffraction Patterns behind Different Apertures</u></a></li></ul>