

# RESCAN: An actinic lensless microscope for defect inspection of EUV reticles

Iacopo Mochi<sup>\*a</sup>, Patrick Helfenstein<sup>a</sup>, Istvan Mohacsi<sup>a</sup>, Rajeev Rajendran<sup>a</sup>, Yoshitake Shusuke<sup>b</sup>, Yasin Ekinci<sup>a</sup>

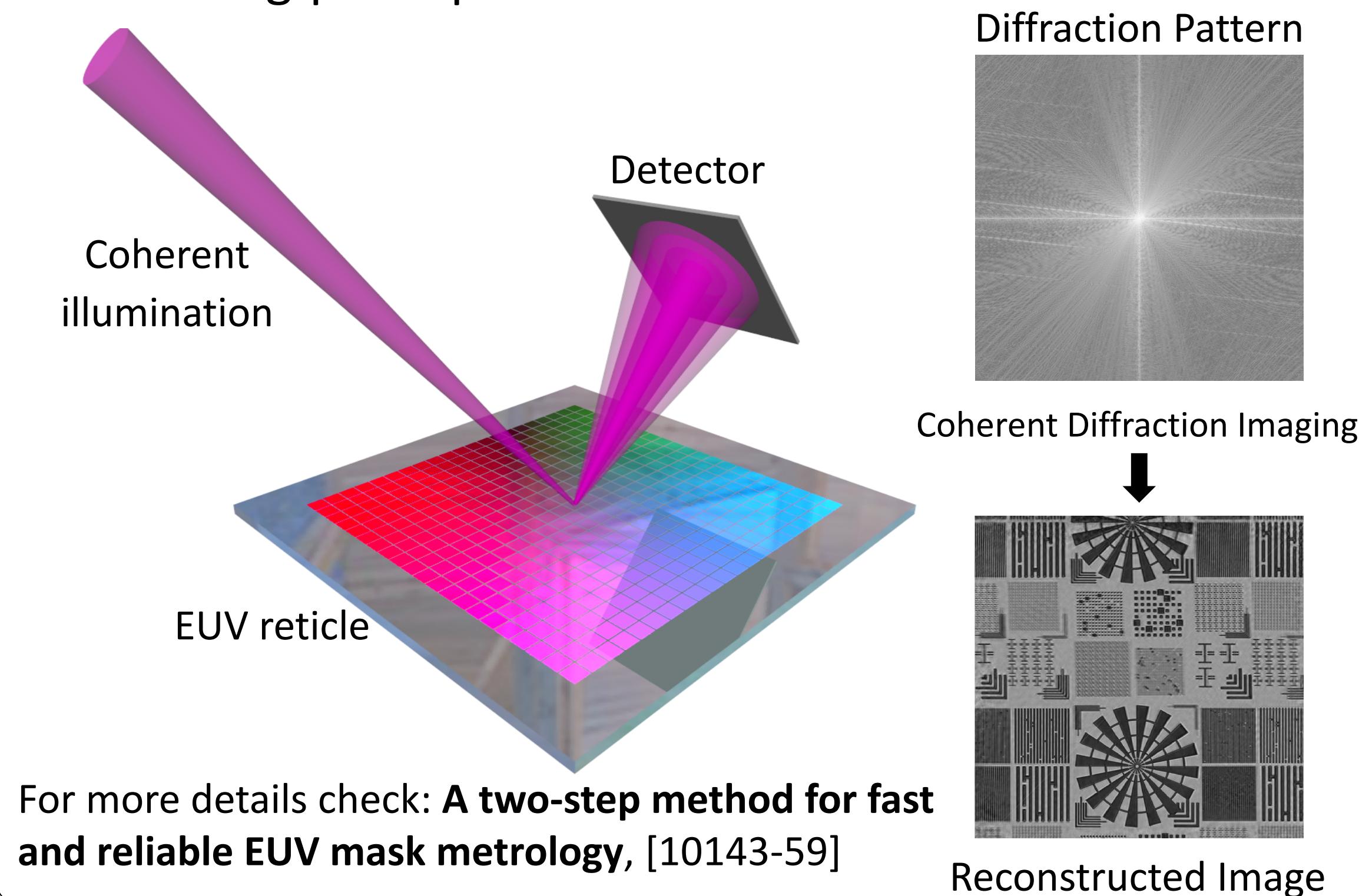
<sup>a</sup>Paul Scherrer Institute, Villigen PSI, Villigen, CH-5232, Switzerland. <sup>b</sup>NuFlare Technology, Inc., 8-1 Shinsugita-cho, Isogo-ku, Yokohama 235-8522, Japan.

## What is RESCAN

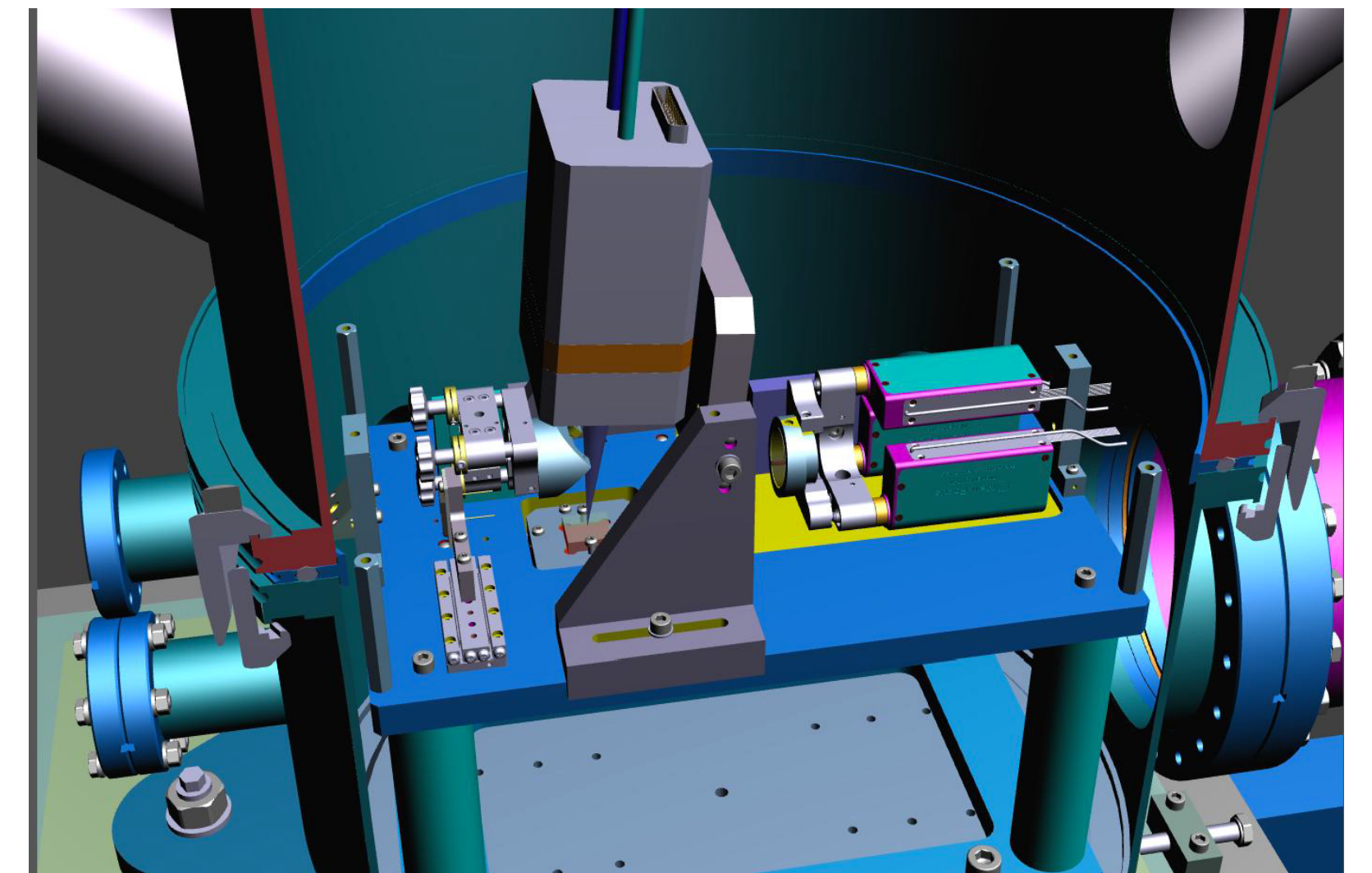
The reflective-mode EUV mask scanning lensless imaging microscope (RESCAN) has been developed to provide actinic mask inspection capabilities for defects and patterns with high resolution and high throughput, for node 7 and beyond.

For more details about RESCAN check: **Toward a stand-alone high-throughput EUV actinic photomask metrology tool**, [10145-22]

## Working principle



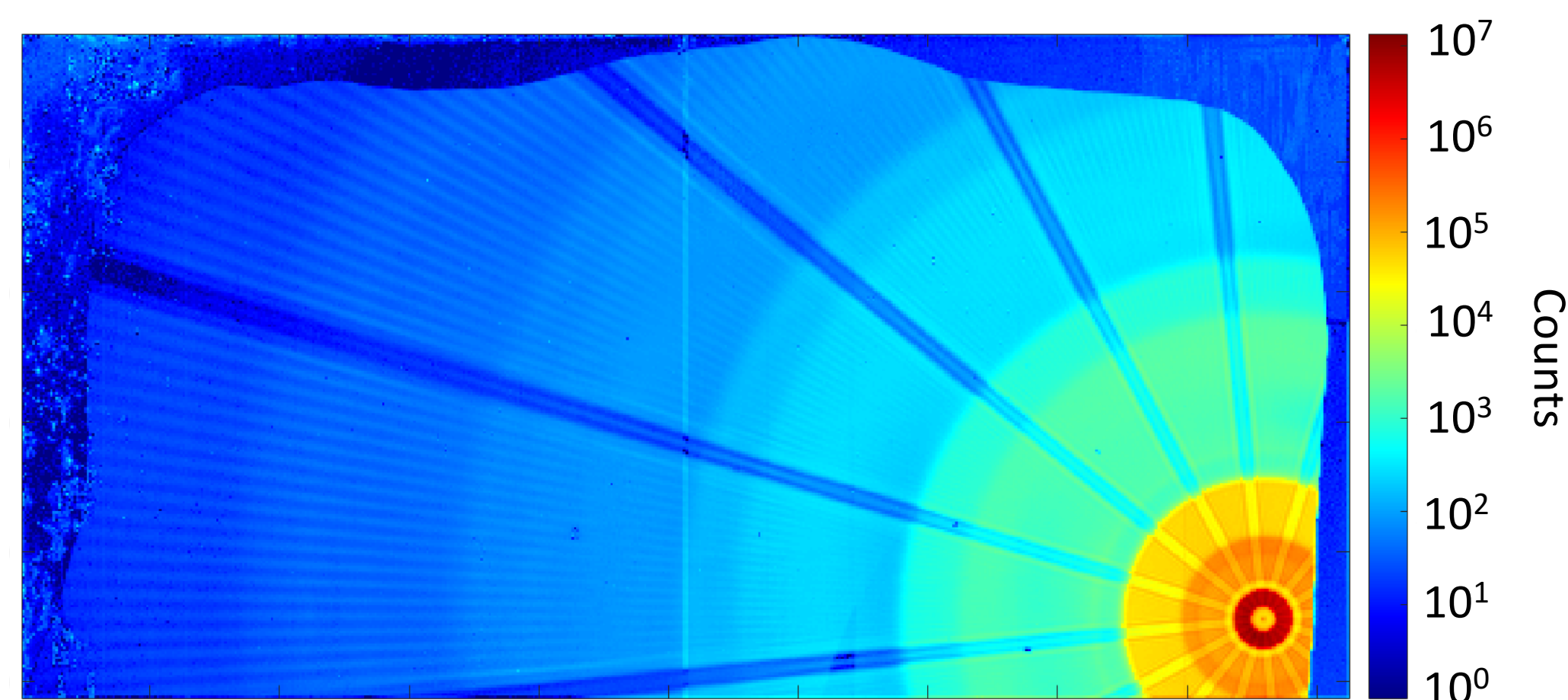
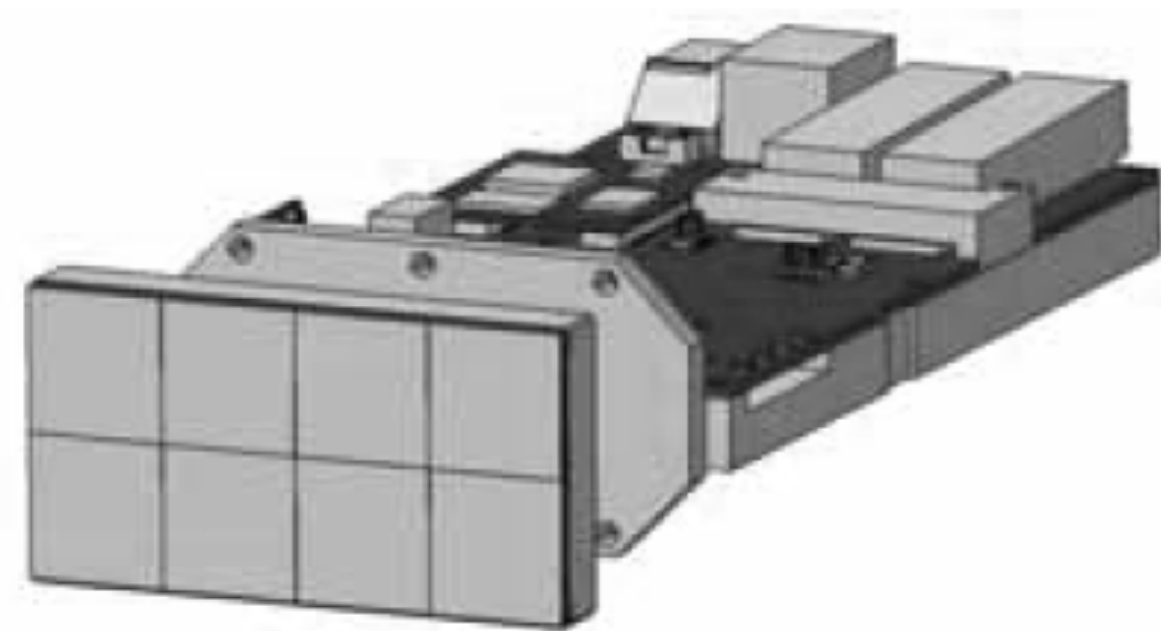
## RESCAN prototype



The current prototype of the RESCAN detector is operating at the Swiss Light Source synchrotron.

## Fast inspection

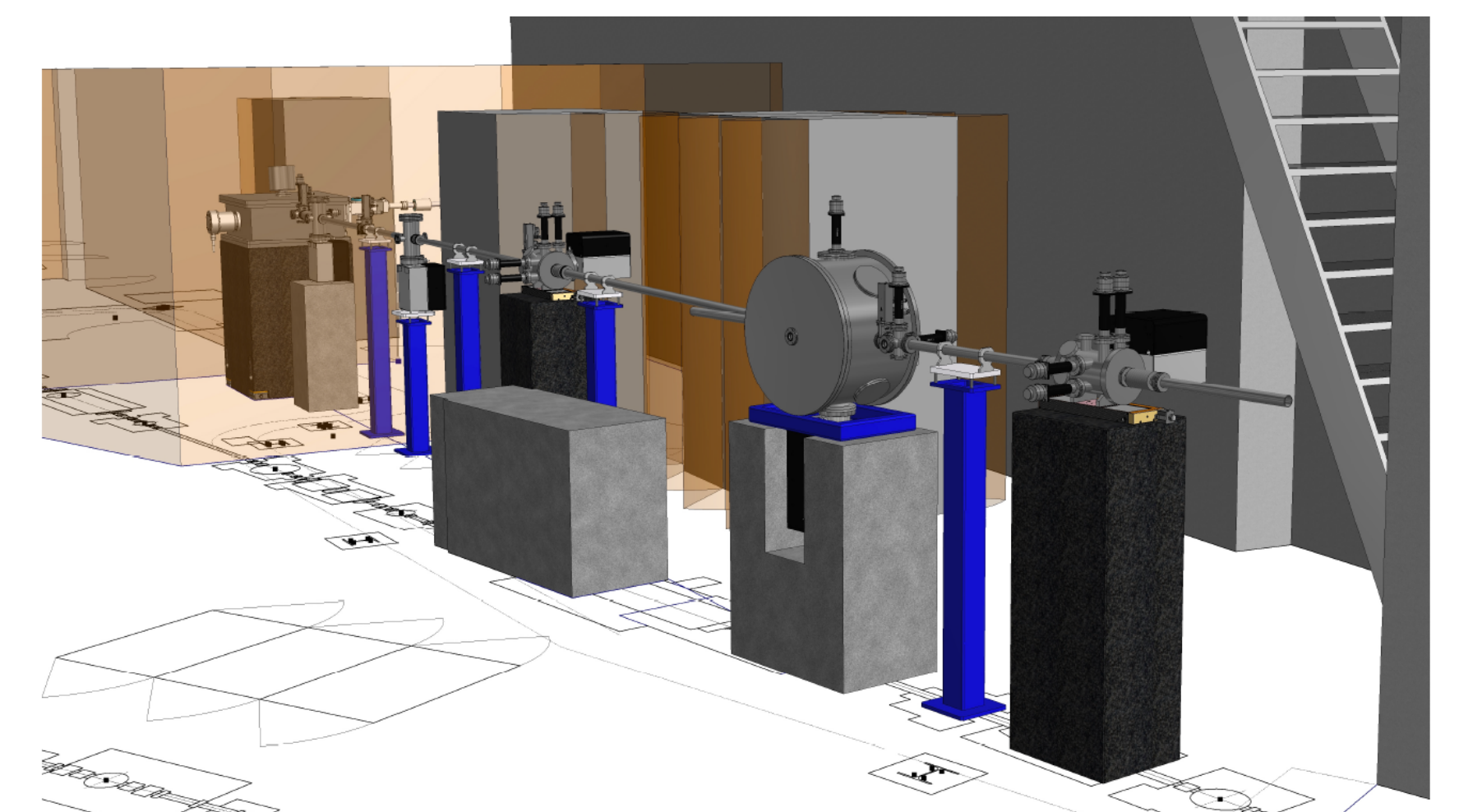
### JUNGFRAU: CMOS sensor for RESCAN



- Designed and developed in house at PSI
- Originally designed as a large dynamic range, high frame rate, charge integrating sensor solution for Free Electron Laser applications at (10 keV)
- Adapted for EUV and soft x-ray applications. Optimized for 13.5 nm.
- Large dynamic range (20 bit) achieved by intensity dependent gain switching.
- Fast frame rate (up to 2000 Hz) accomplished by massive parallelization in read out at pixel level.
- Modular design.

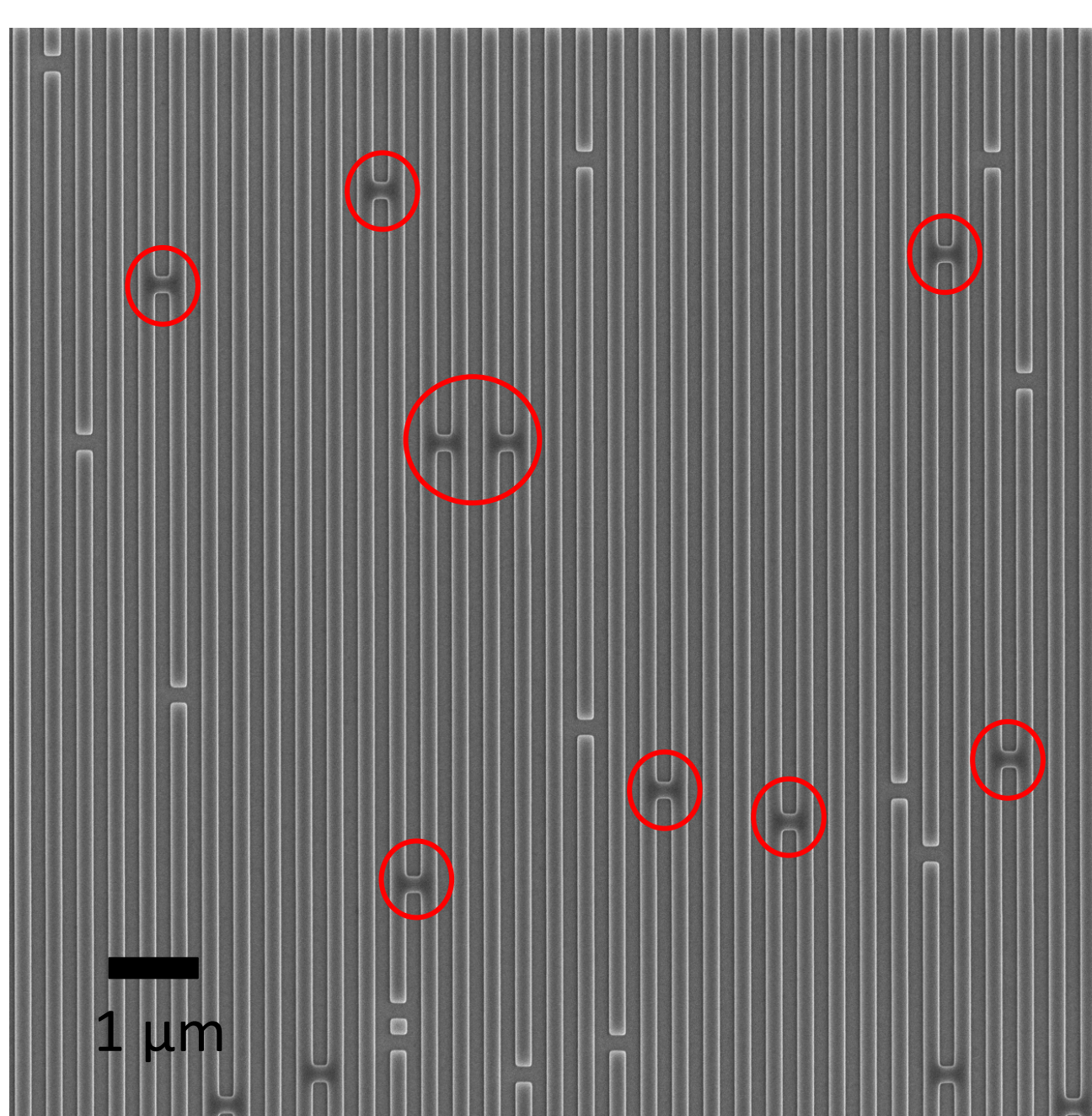
## High-intensity coherent illumination

### Dedicated beamline at the SLS

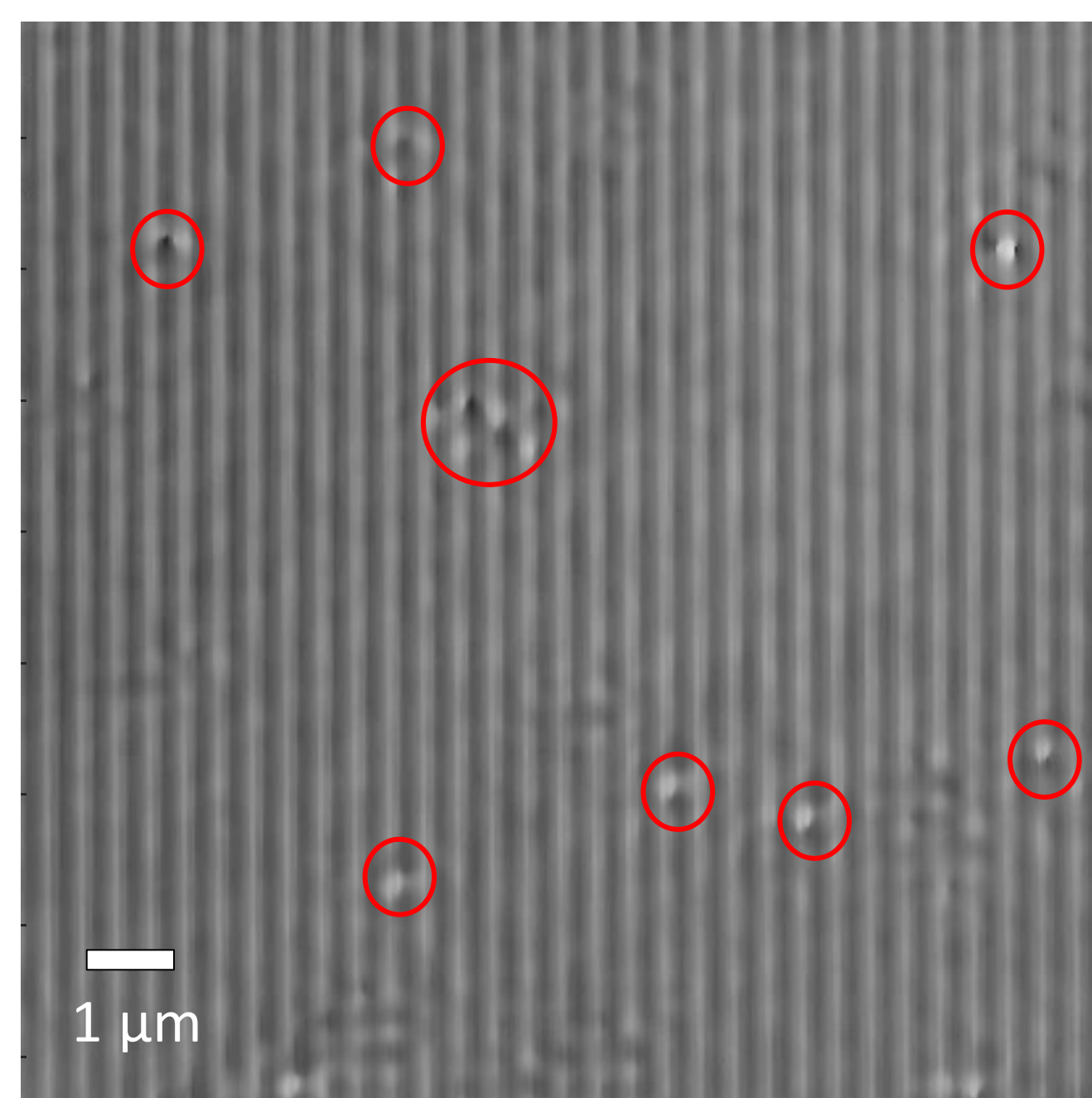


- Wavelength: 4 -14 nm
- Photon rate:  $10^{11}$  -  $10^{12}$  Ph/s (Coherent flux on sample at 13.5 nm)
- Monochromaticity: 1600

## Defect inspection and localization



SEM image



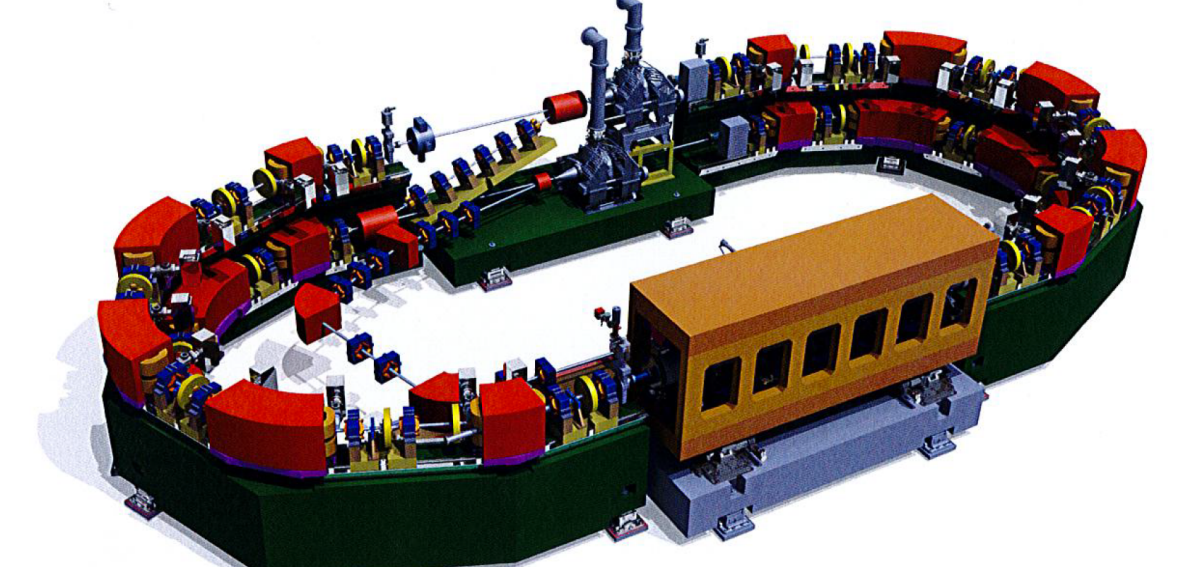
Reconstructed phase map

## Current and future upgrades

Complete redesign of optics and end station to include:

- Full mask area scan.
- 2k×2k pixel sensor.
- Improved vibration isolation.
- Improved detection algorithm.

COSAMI: a standalone coherent EUV source



|            |                                    |
|------------|------------------------------------|
| $\lambda$  | 13.5 nm                            |
| Flux       | >100 mW                            |
| Brilliance | > $10^6$ W/(mm <sup>2</sup> ·strd) |
| Footprint  | 5m × 12m                           |