
A micro-channel plate detector for extreme ultraviolet imaging with high temporal resolution

Johannes Hauck

18. November 2011, Paris



EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

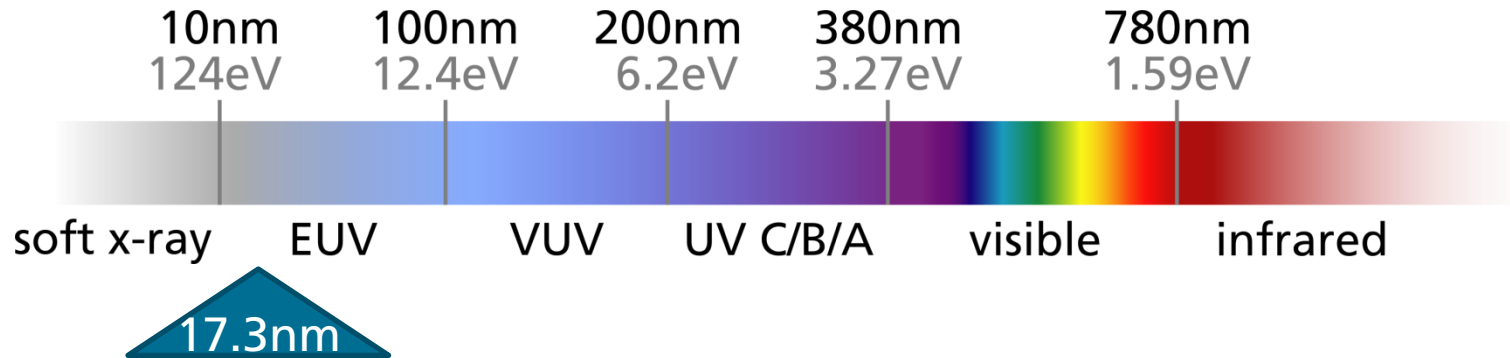
Joint Final Conference of COST Actions IE0601 and MP0601

- Introduction
 - Time resolved XUV-microscopy
- Functionality of the detector
- Measuring the performance:
 - spectral
 - spatial
 - temporal
- Summary
- Outlook

Why extreme ultraviolet?

3

▶ See small structures!



Abbe resolution limit:

Strong interaction with matter:

$$d_{min} = \frac{\lambda}{2 n \sin \alpha} \geq \frac{\lambda}{2}$$

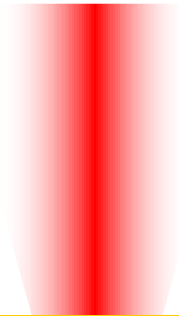
Absorption length
~ 10nm–100nm

Why time resolved?

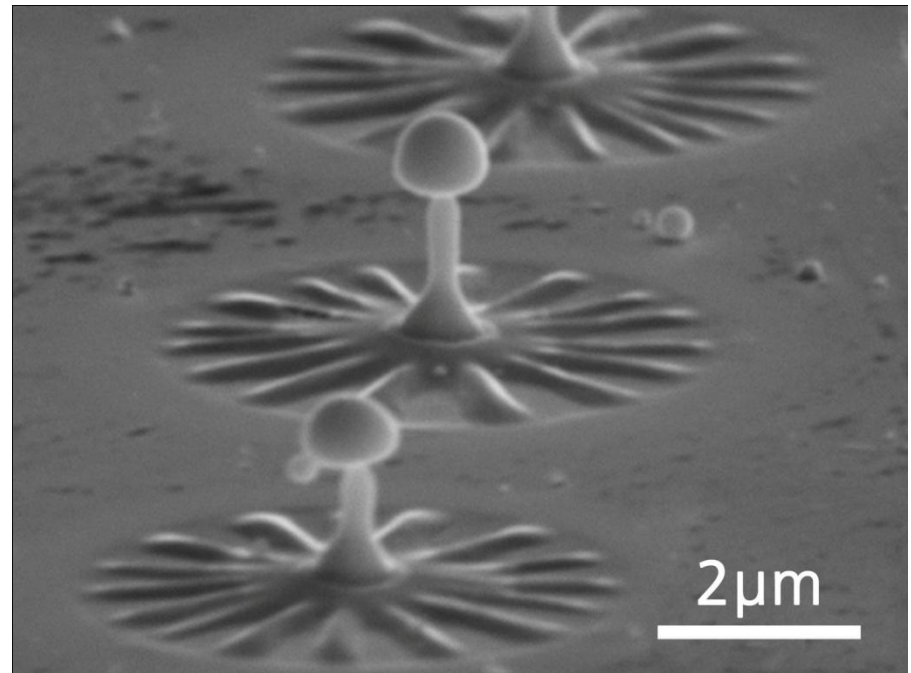
4

- ▶ See generation dynamics of nanostructures!

fs-Laser

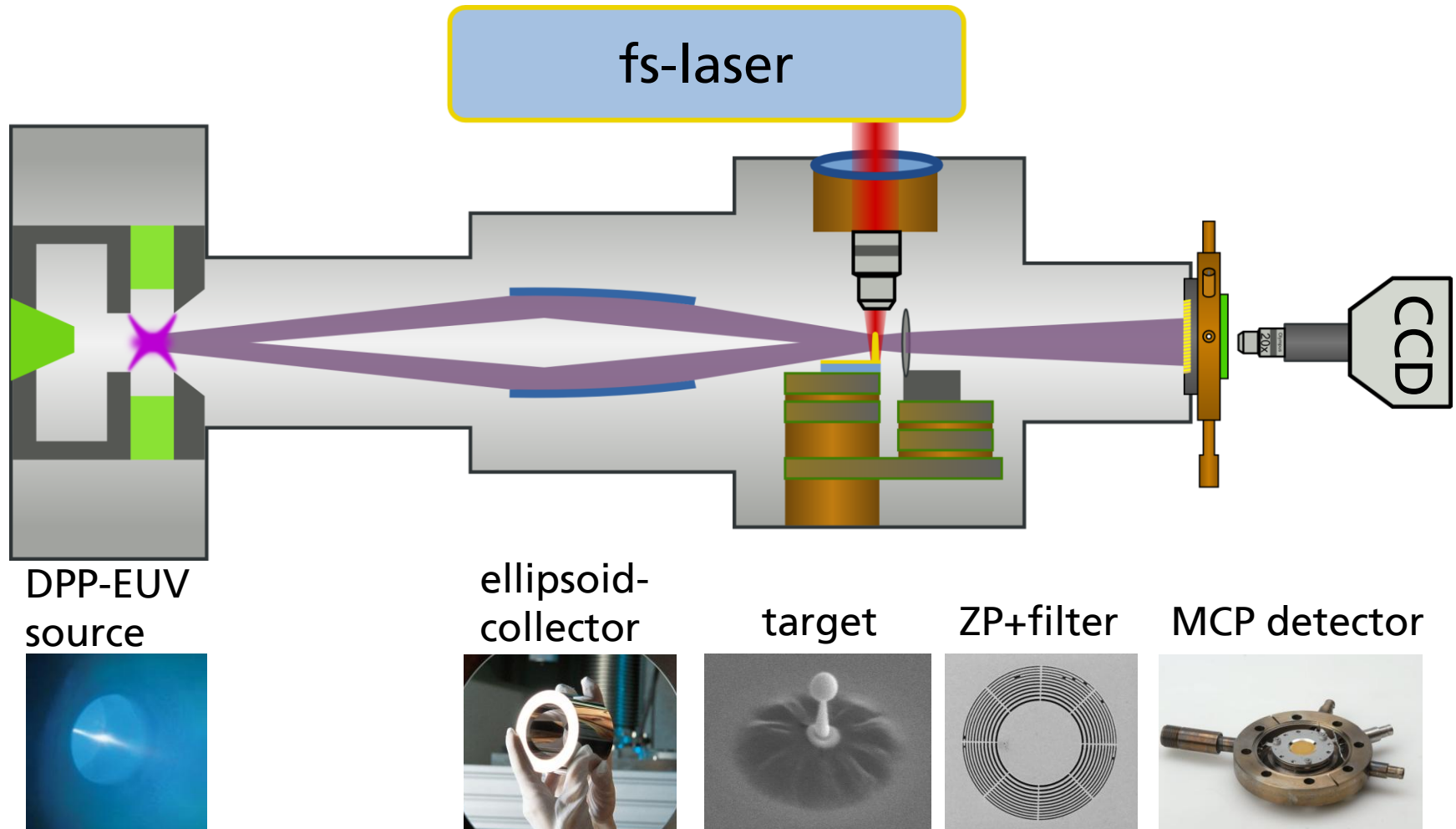


30nm Gold on
Si substrate

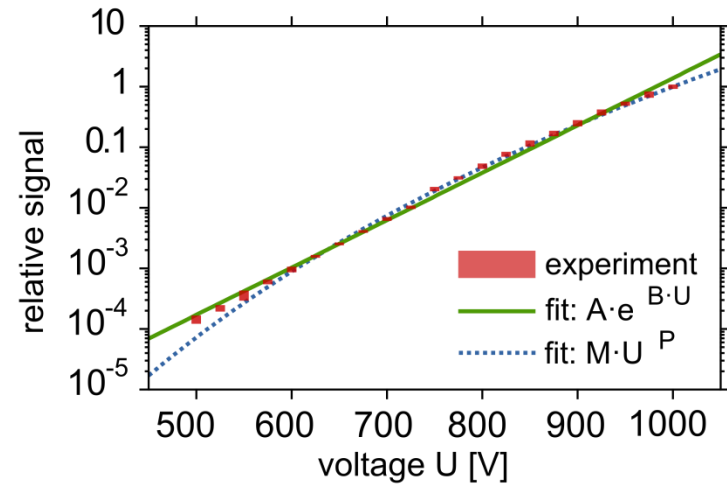
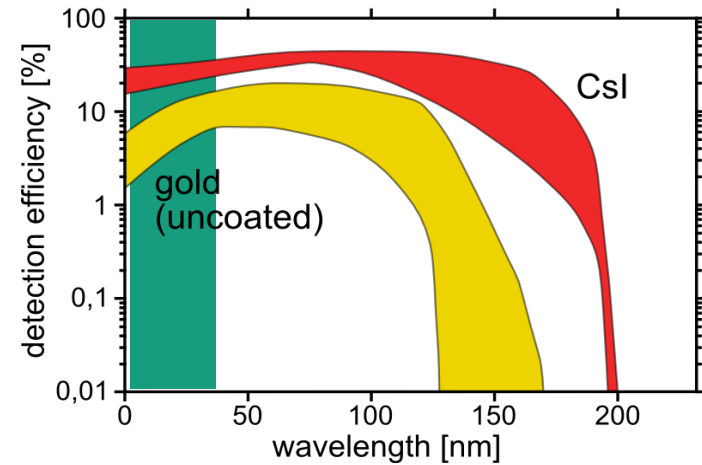
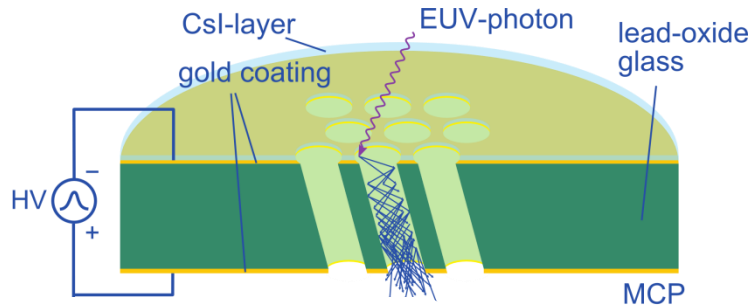


Time resolved XUV microscopy

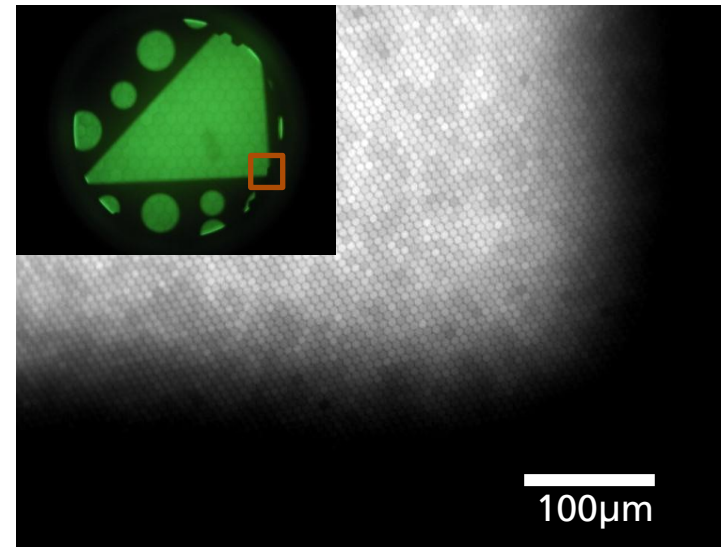
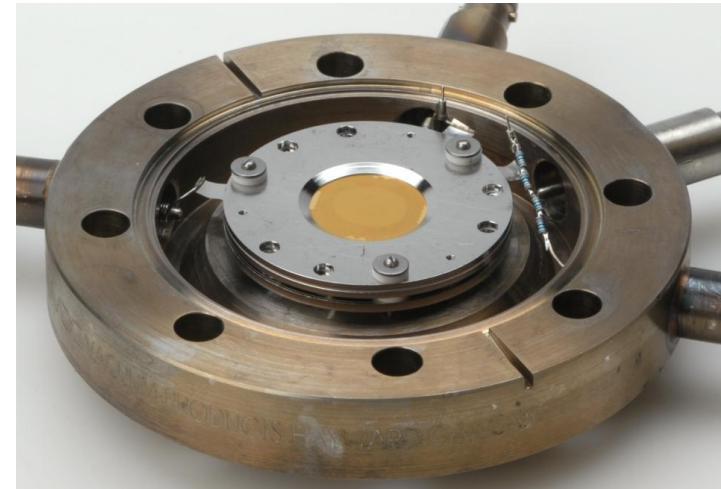
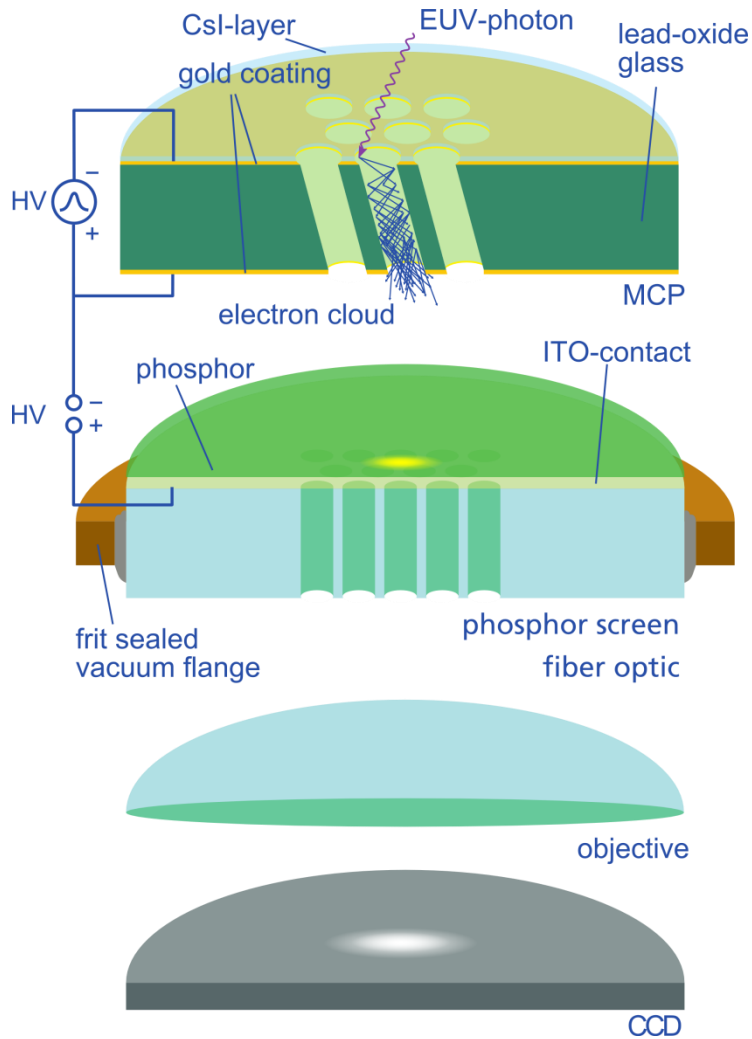
5



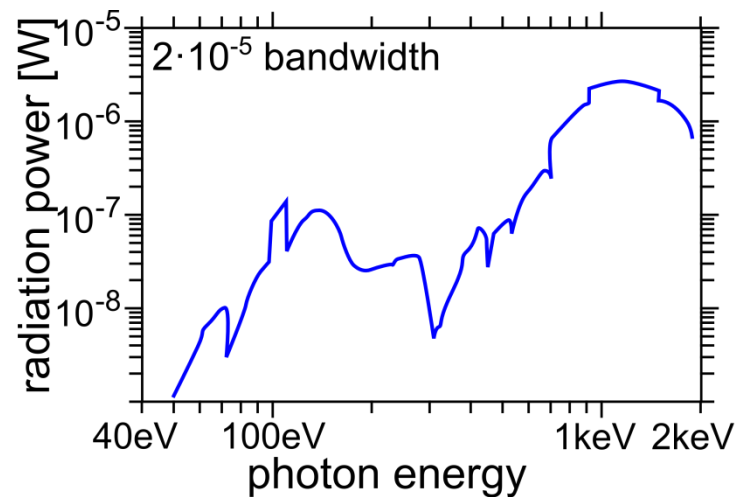
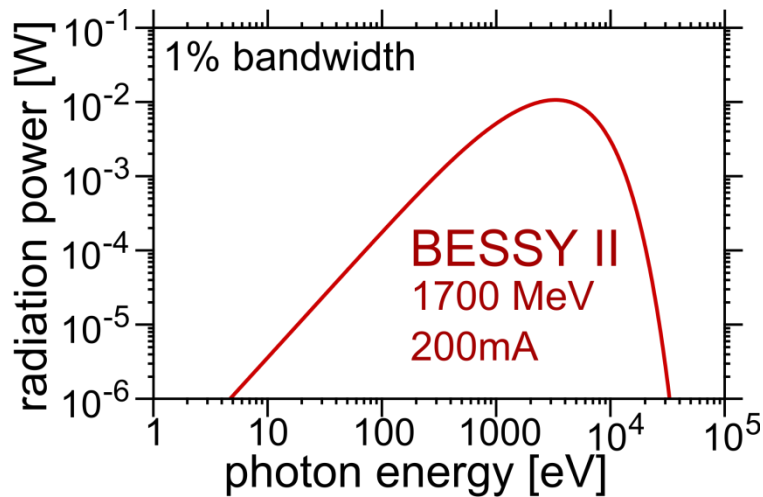
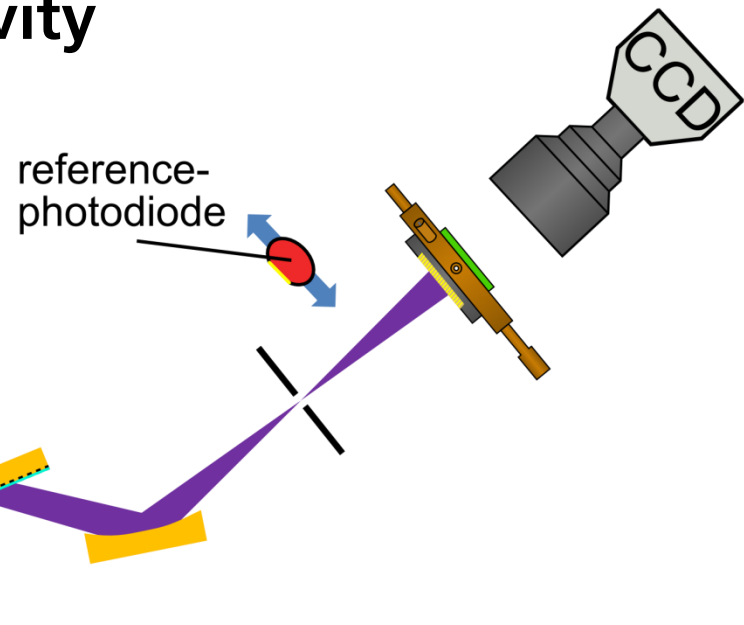
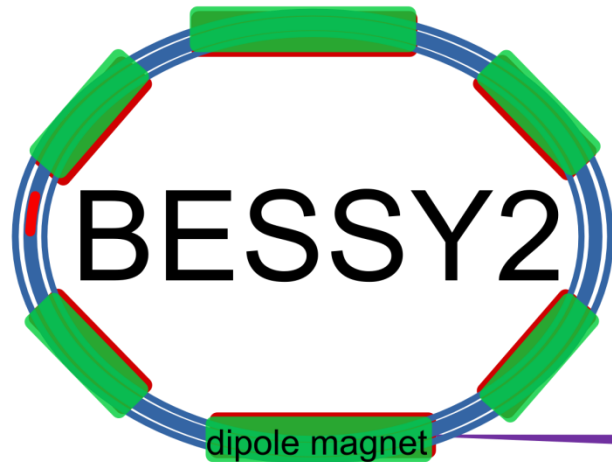
Functionality of the detector



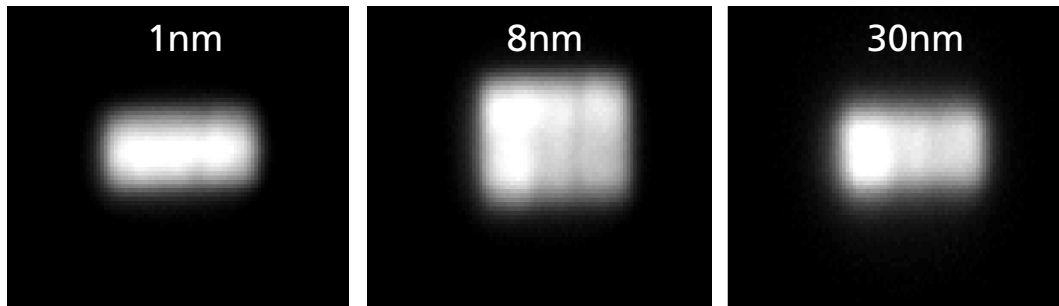
Functionality of the detector



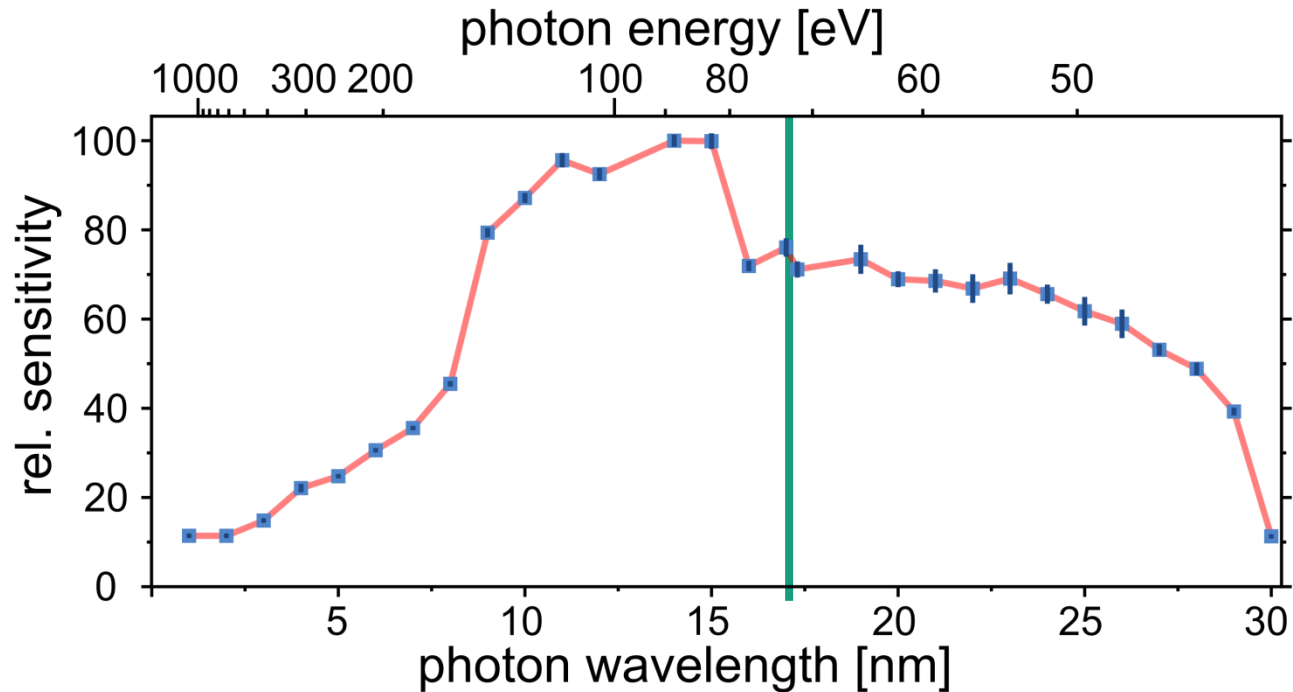
Measuring the spectral sensitivity



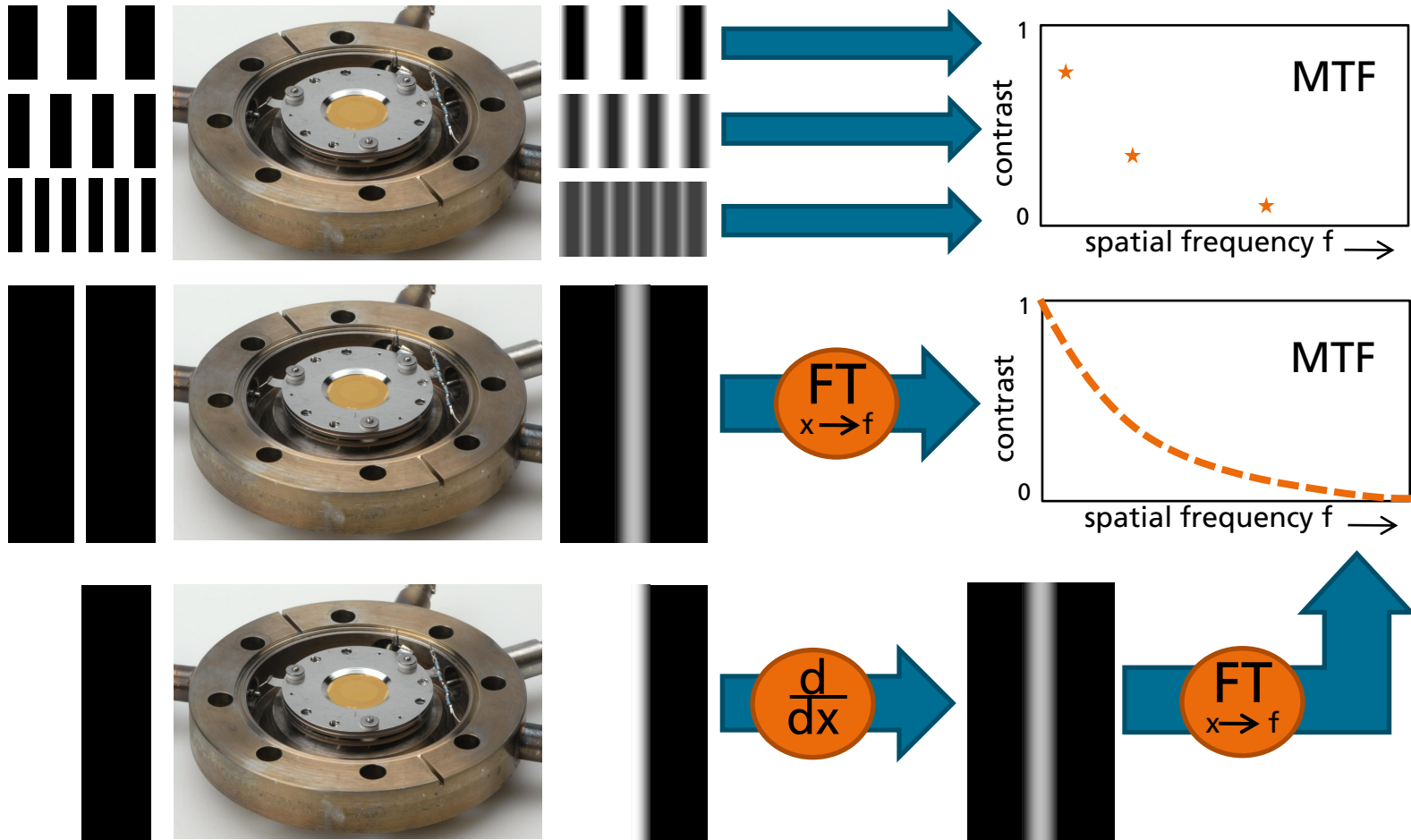
Measuring the spectral sensitivity



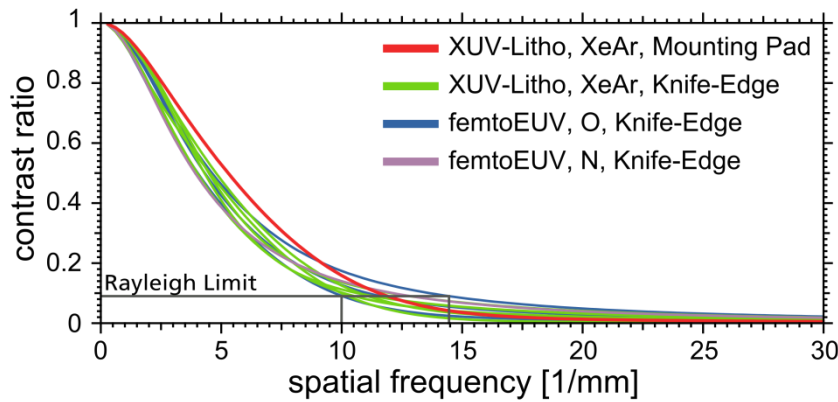
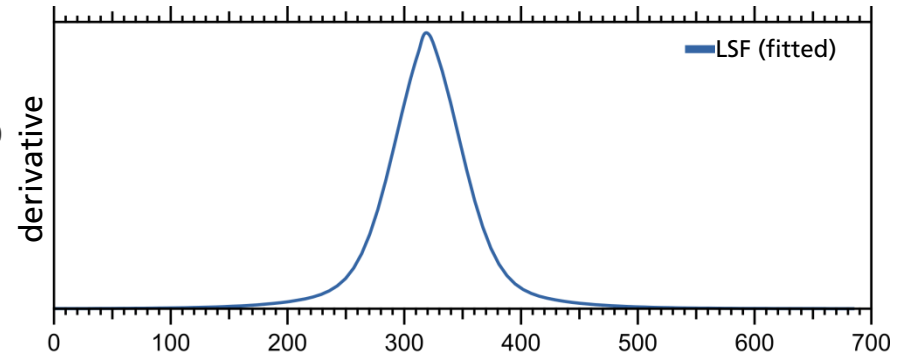
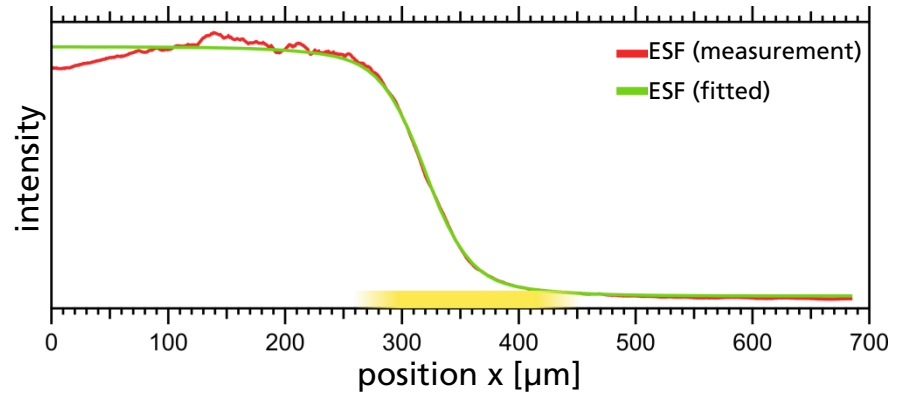
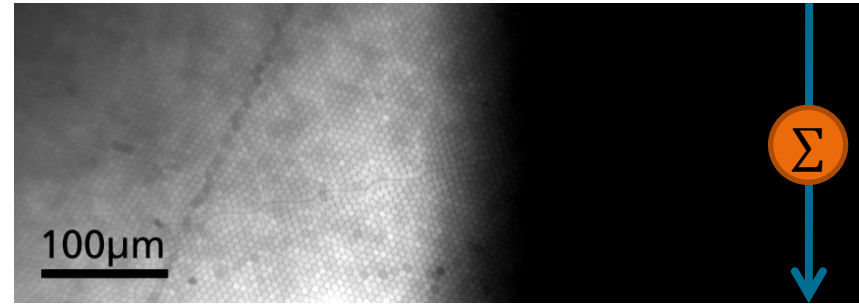
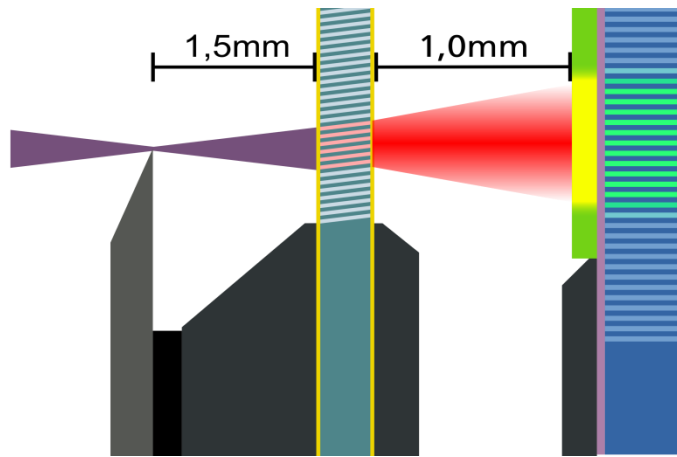
EUV
Radiation
power
(reference diode)



Measuring the spatial resolution



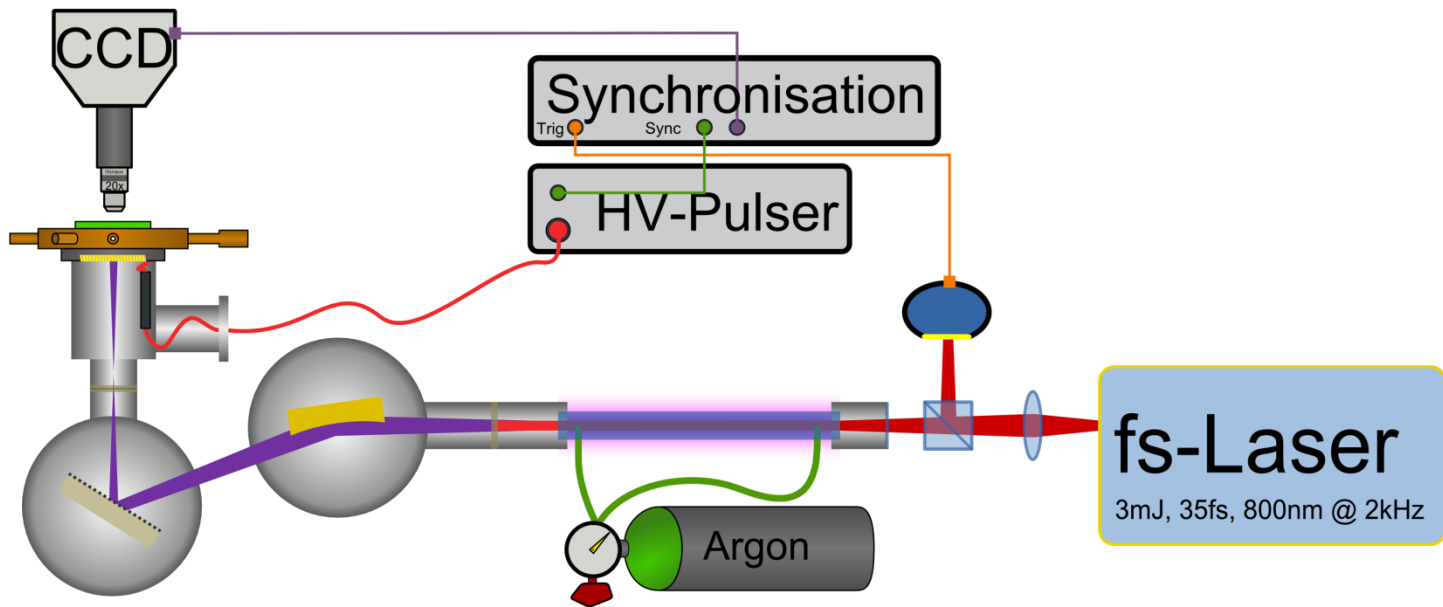
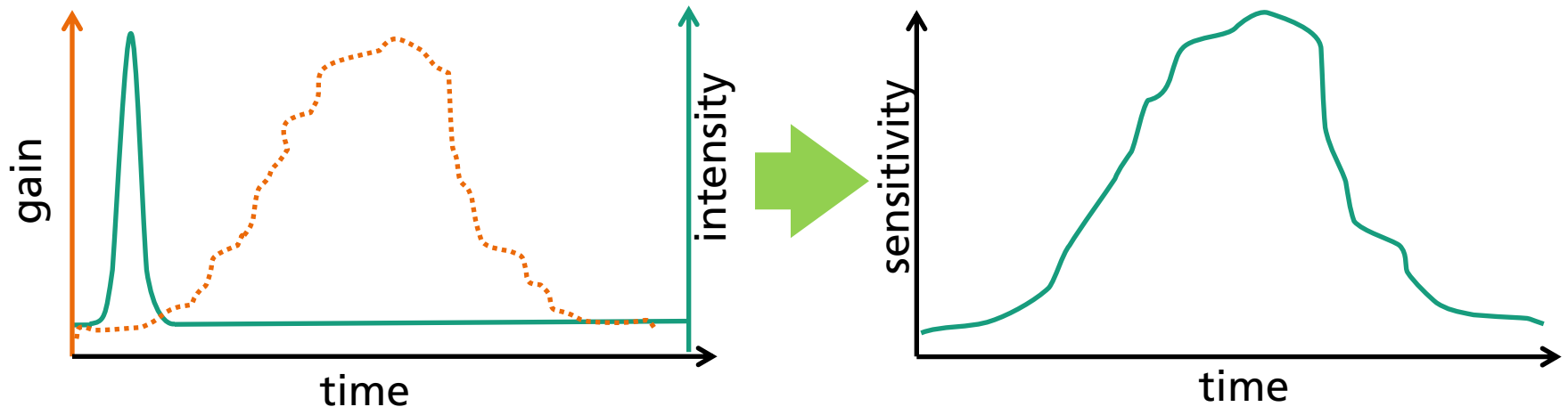
Measuring the spatial resolution



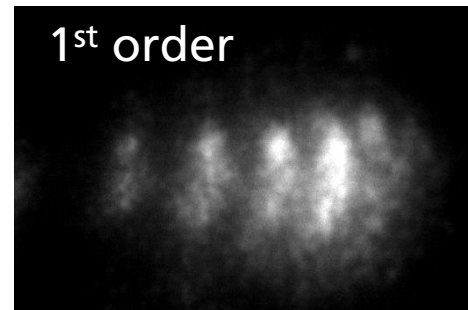
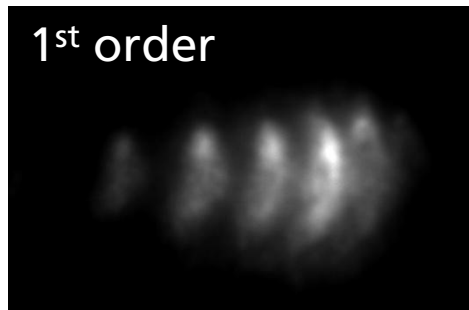
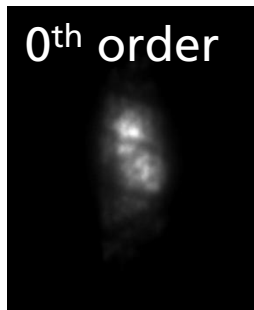
► Resolution: $12\text{lp/mm} \cong 83\mu\text{m}$

Measuring the shutter time

12

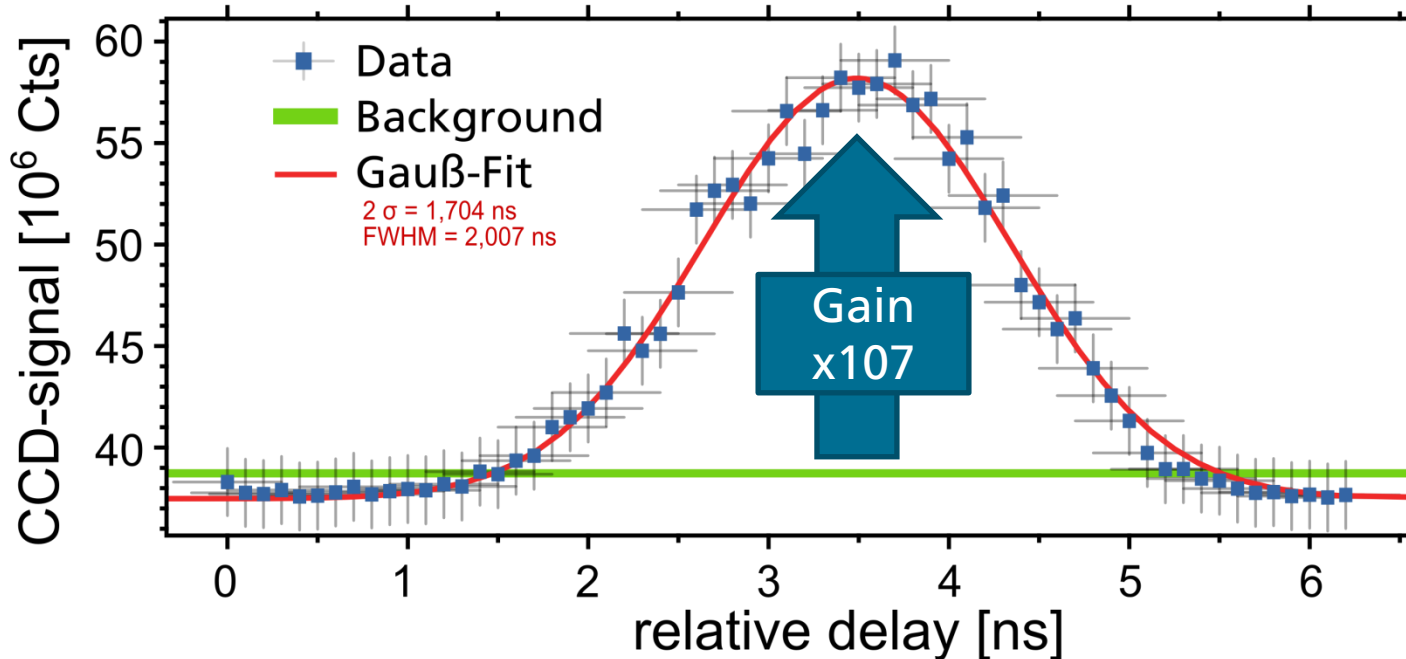


Measuring the shutter time



gated pulse: 20 pulses
background: 3980 pulses

single shot
14 pulses



■ Spectral Sensitivity:

- Best sensitivity at 9–15nm
- Good sensitivity at 17.3nm (microscopy wavelength)
- Detects single photons

■ Temporal properties:

- 2ns shutter time
- ~40ns trigger delay

■ Spatial resolution:

- 2.8 μ m channel pitch
- 12lp/mm \cong 83 μ m resolution
- Zone plate optics:
needs magnification of 1000x

Microscope will provide:

- ~83nm spatial resolution
- 2ns shutter time

- Improvement of spatial resolution:
 - Increase phosphor screen voltage
 - Decrease spacing between MCP and phosphor screen
 - Channel end coating gives electron lensing effect
- Shorting the shutter time:
 - Use low-inductance contacts
 - Lower MCP capacitance
 - Gold coating on smaller area
 - Coarse MCP
 - Pulsing electronics on HF-PCB close to detector

Thank you for your kind attention!

