NewLambda Technologies

TUNABLE, HIGH BRIGHTNESS LAB-SCALE SOFT X-RAY PHOTONS

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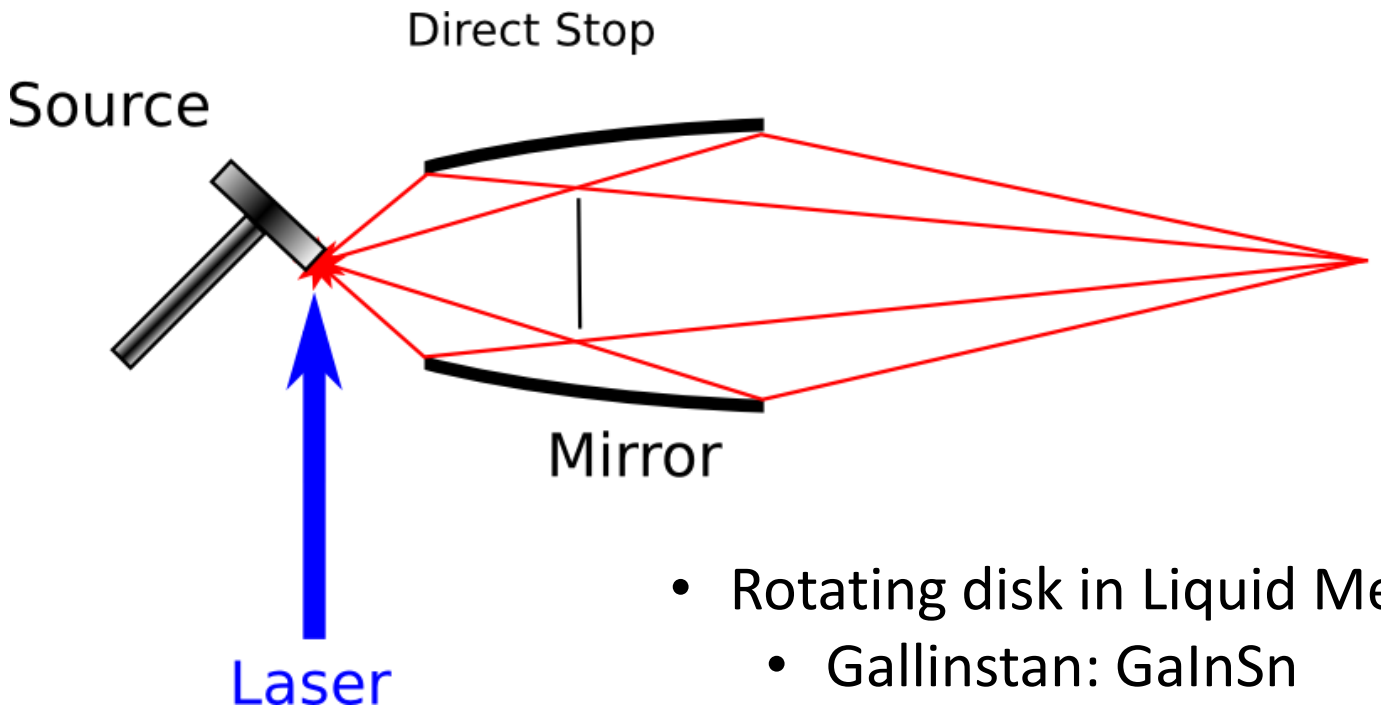
STAN™

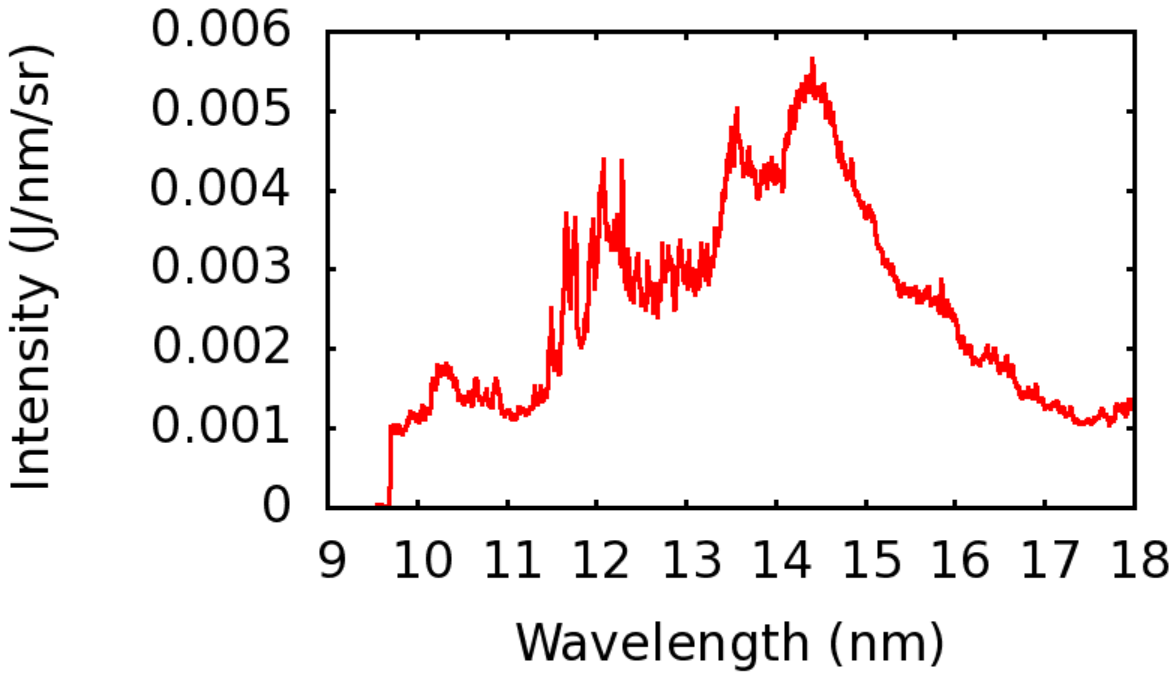
- Source Concept



- Rotating disk in Liquid Metal
  - Gallinstan: GaInSn
- Mirror also rotating in Liquid Metal

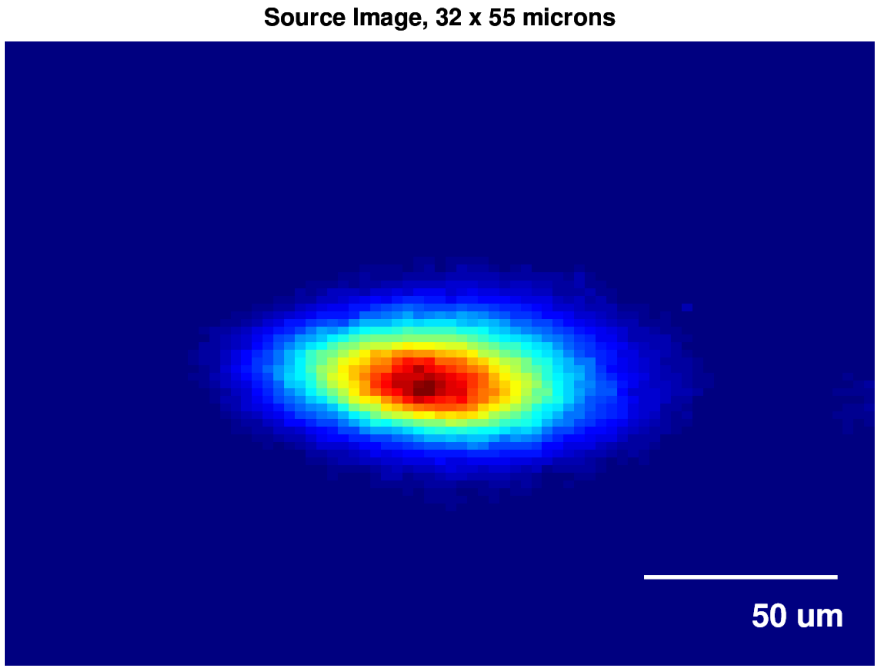
Characterisation

- Spectroscopy, ¼ m absolutely calibrated



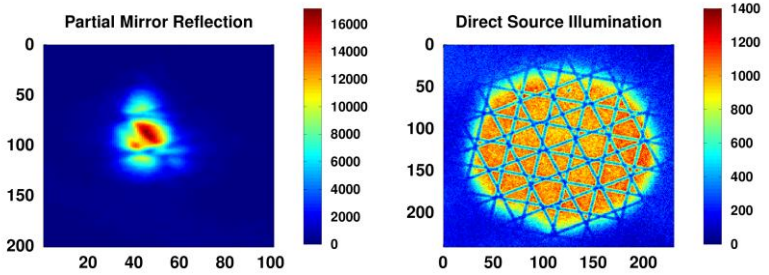
Characterisation

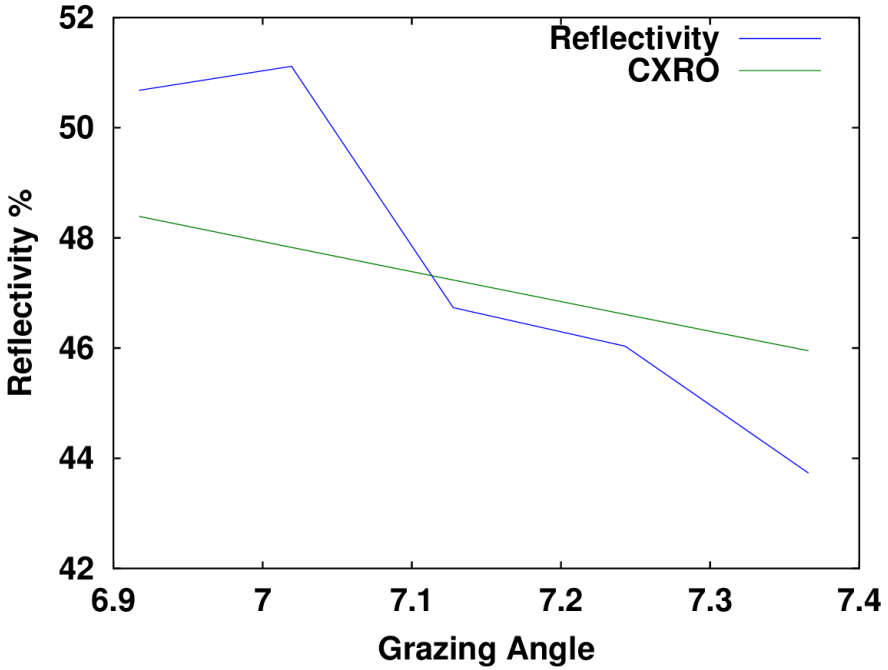
- Multilayer (Mo/Si) mirrors
  - Concave
  - Flat
- Zirconium filter
- Imaged at 45 degrees



Characterisation

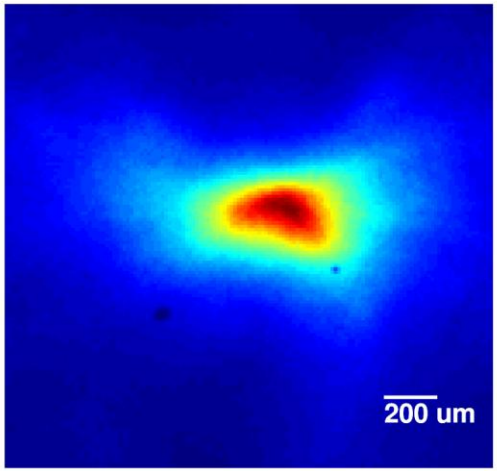
- Mirror Reflectivity
- Measured in-situ



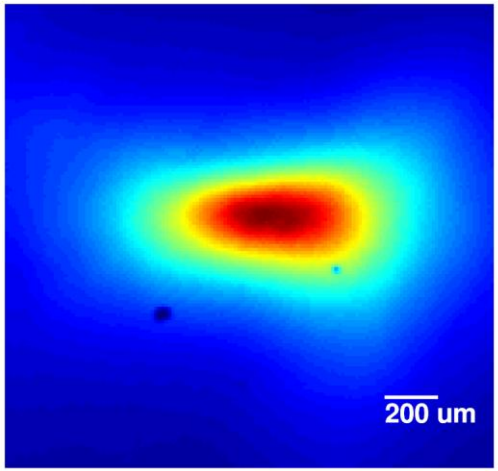


Intermediate Focus

IF: Single frame, single shot, 300 x 600 microns FWHM



IF: Avearged 100 frames, 400 x 850 microns FWHM

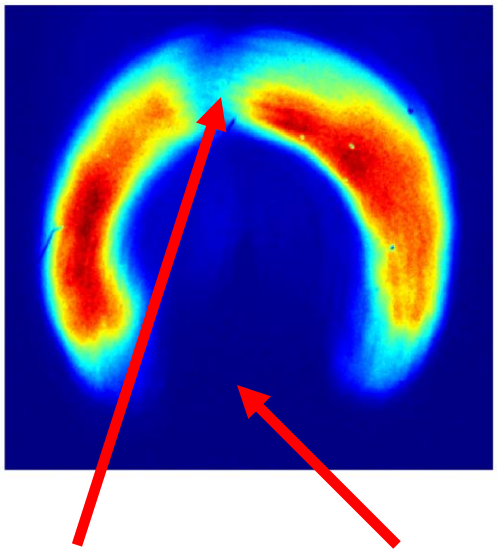


Collector Mirror has a 10x magnification

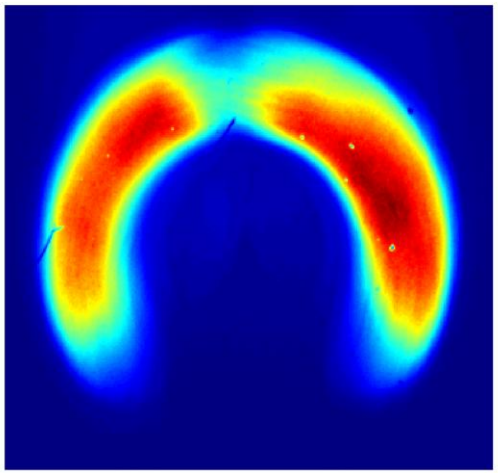
Extra Focal Ring

- Camera 60 mm extra focal

STAN, Extrafocal Ring, Single Frame, 200 Shots/Frame



STAN, Extrafocal Ring, Averaged 50 Frames

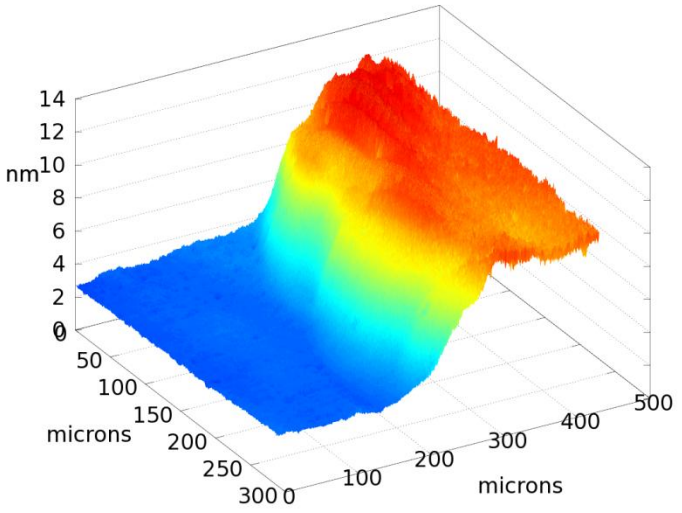


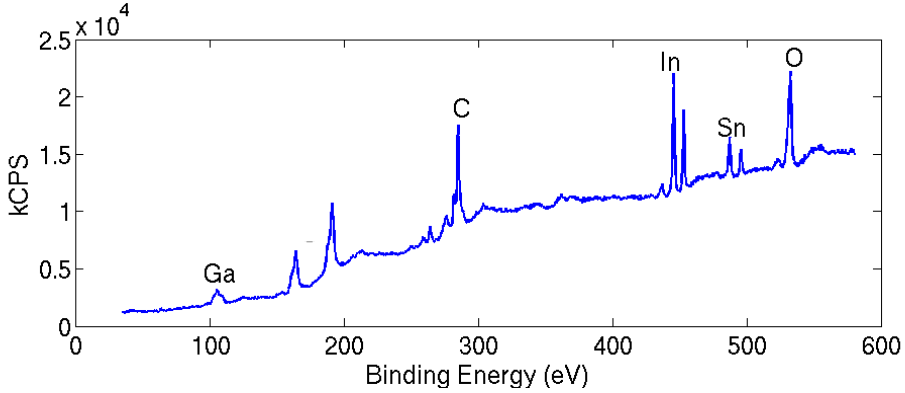
Direct Stop Mount

Collector partially submerged in liquid bath.

IF Debris Results

- Slide before IF capillary
- <2 nm of metal/hour
- No particulates
- XPS compositional analysis
  - 60% C
  - 26% O
  - 14% Liquid Metal





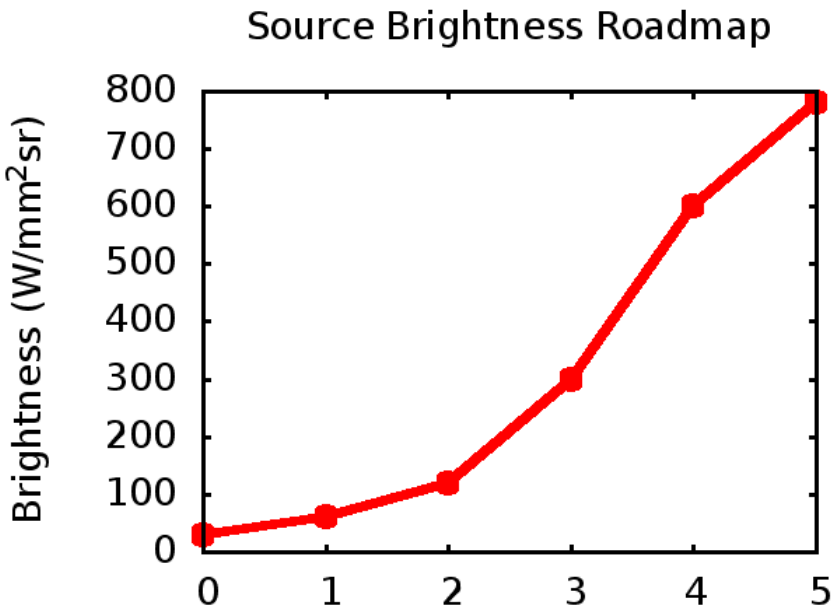
Improvements:

- Increase vacuum level, currently 1e-6 mbar
- Use gas backflow at IF capillary

Brightness

- Current Brightness: 30 W/mm^{2}sr
- Clear path to 780 W/mm^{2}sr

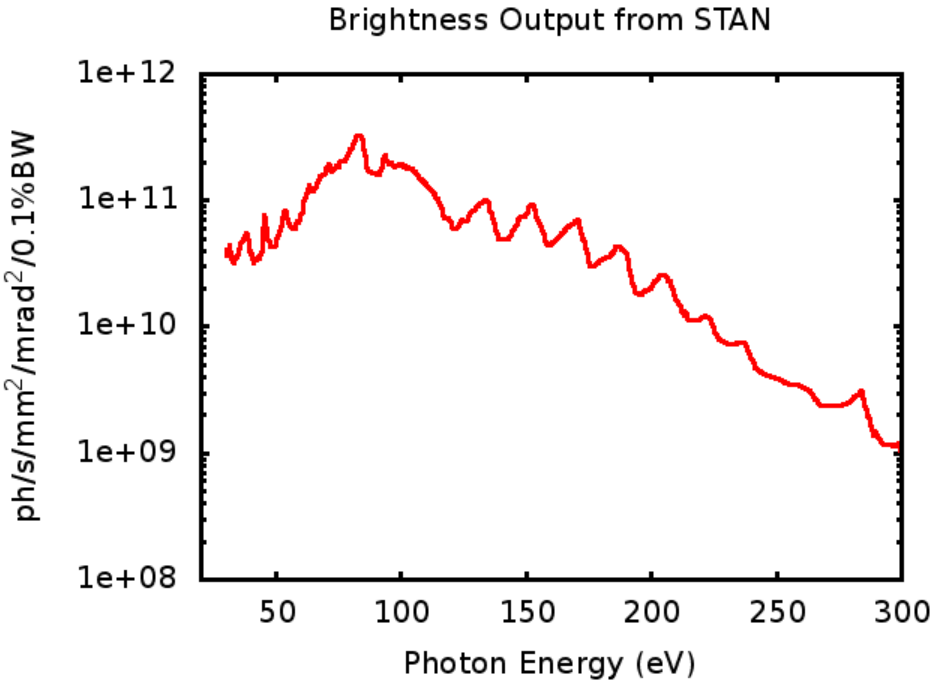
- Total laser input
  - required 200 W
  - current 55 W



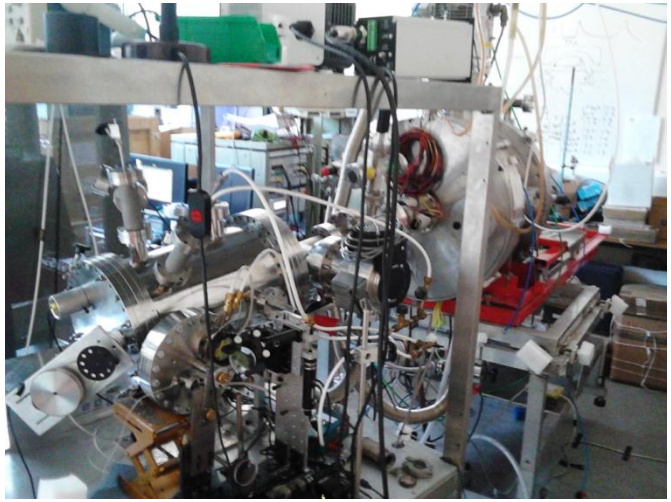
Applications

STAN

- Broadband output
- Ideal for photoelectron spectroscopy
- In-house PES chamber

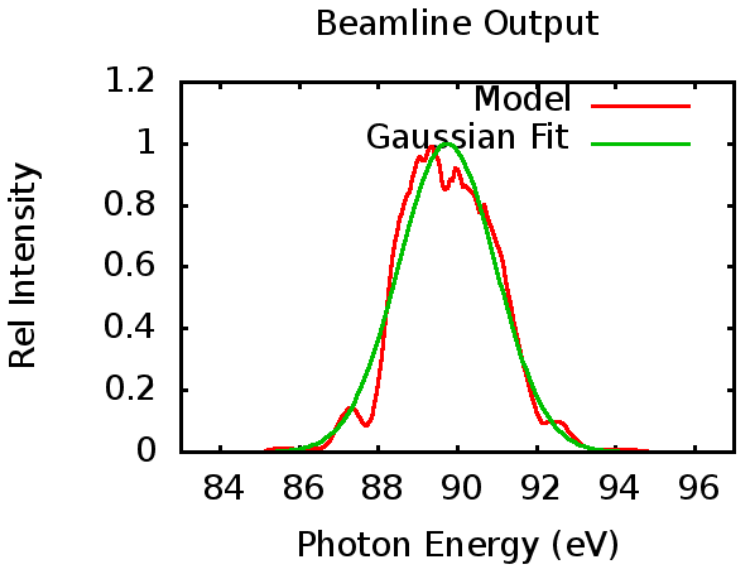


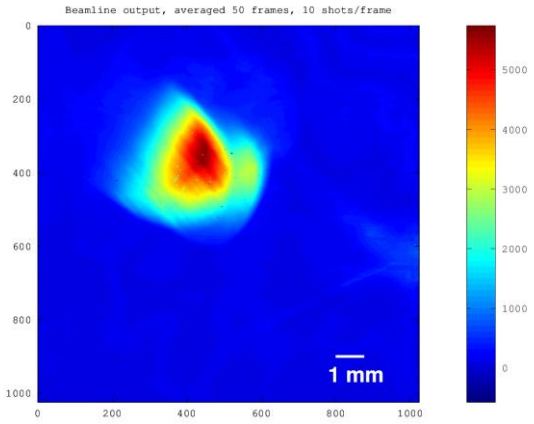
PhotoElectron Spectroscopy



PES Beamline

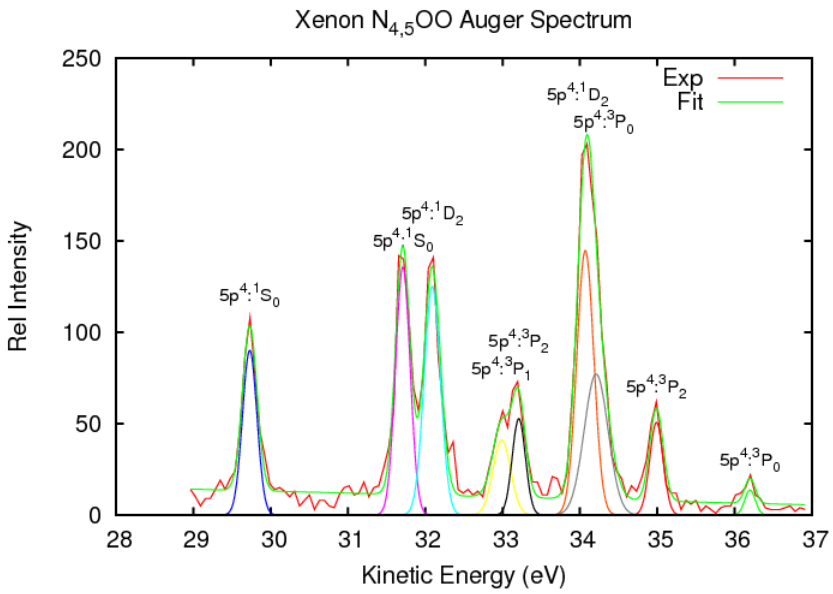
- Multilayer mirrors
  - 1 Concave (f=125mm)
  - 1 flat
- Spectral Narrowing
- 89 eV
- 3 eV FWHM
- Focused to < 3 x 3 mm^2





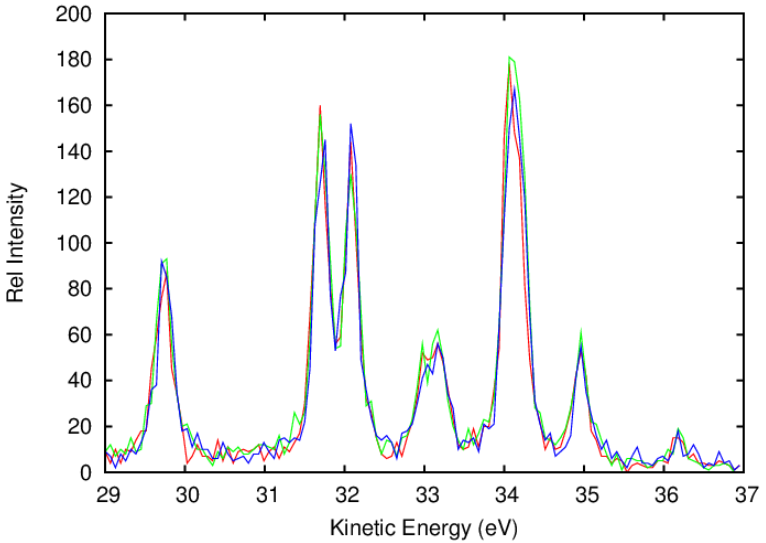
PES Experiment

- Xenon $N_{4,5}OO$ Auger Decay
- Acquisition time 23 minutes



PES Experiment

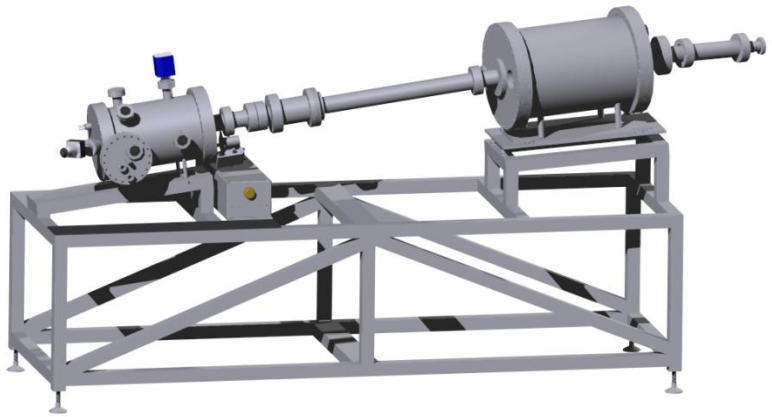
- Xenon $N_{4,5}OO$ Auger Decay
- Acquisition time 23 minutes
- High Stability
  - Repeated 3 times over 4 hours.
  - No variation



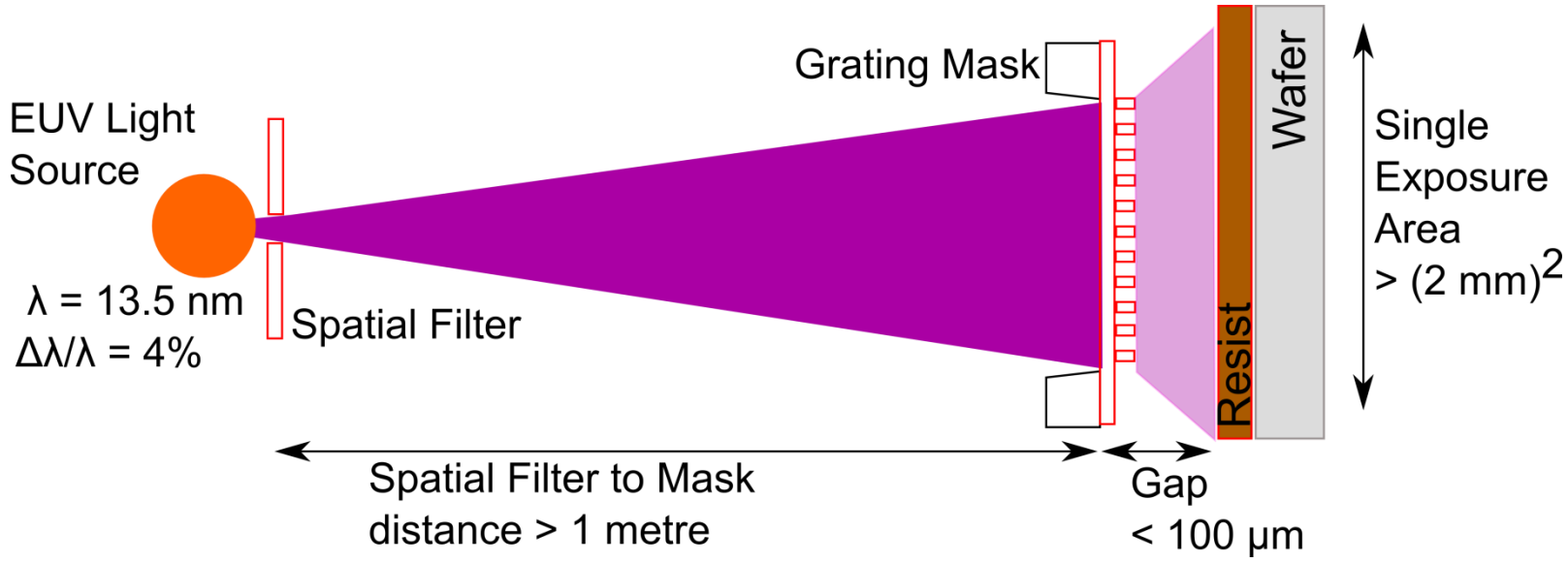
Ongoing Work

- Building Custom Monochromator
  - PGM Design
  - 10 – 100 eV
  - Resolving Power: >300 to >1200
  - Designed for STAN
- Different designs

for broader energy range



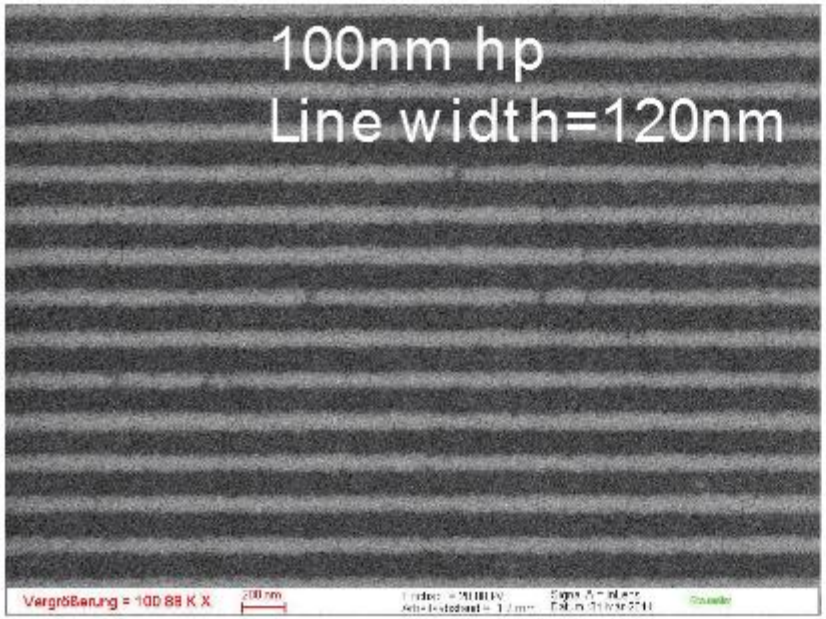
EUV Interference Lithography



Talbot Self Imaging

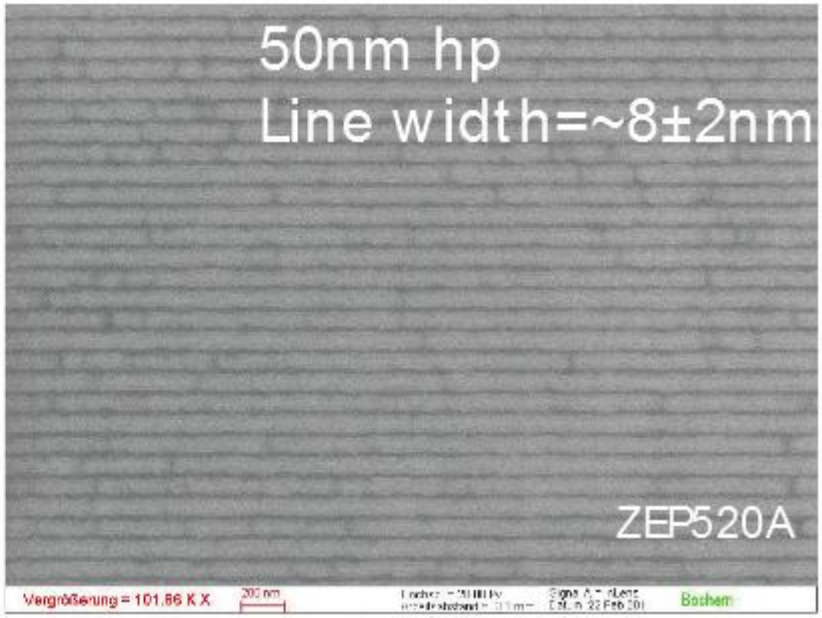
- Periodic Arrays
- HP equal to half the grating period

EUV Interference Lithography



Distance to mask z few µm

Proximity printing



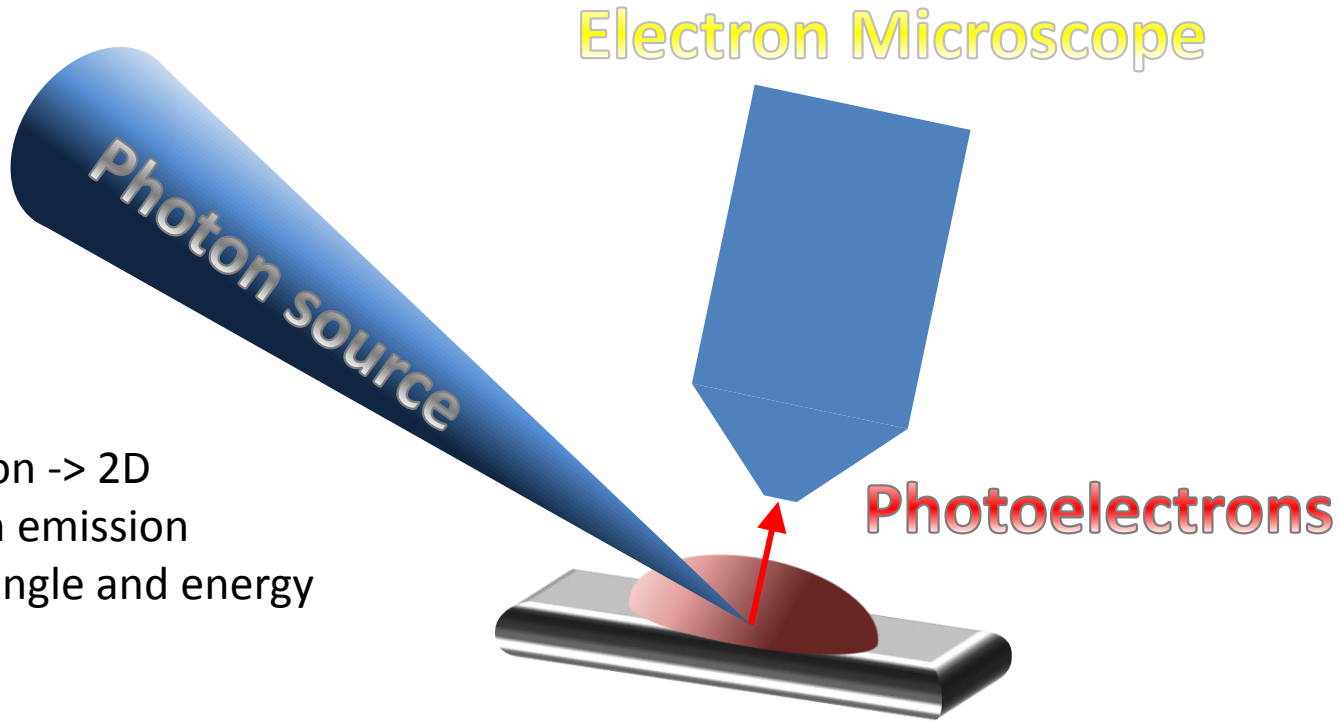
Distance to mask z= 50 µm

achromatic Talbot (with the same transmission mask!)

Serhiy Danylyuk - COST Action MP0601 Talk 2012

Other STAN Applications

Photo Emission Electron Microscopy (PEEM)



- Extracted information -> 2D mapping of electron emission retaining emission angle and energy

Image: Elmitec 2013

PEEM

Cu Layer on Mo(110)surface

Field of view 50 µm

Field of view 20µm

Field of view 10µm

Field of view 5µm

Light sources currently used

- UV Lamps
- Synchrotrons

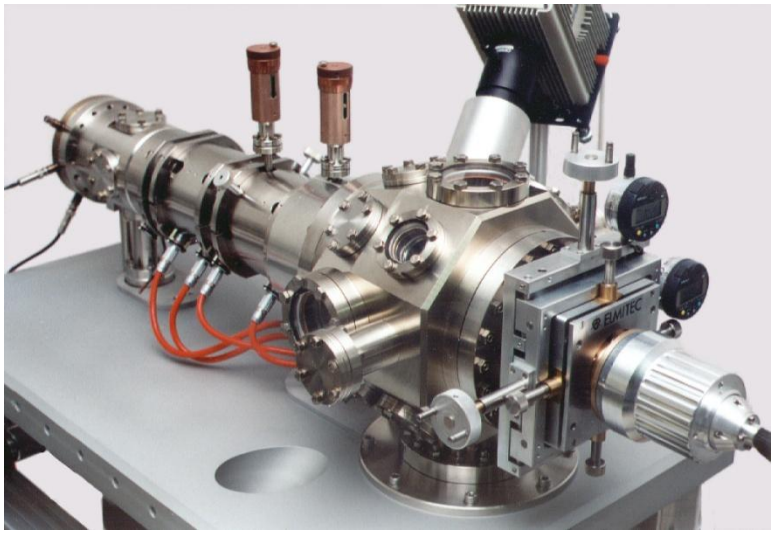


Image: Elmitec 2013

Conclusions

- The STAN light source is a simple and elegant high brightness EUV source
- Well characterised
- Running routinely in the lab
- Can be applied to multiple applictions
  - PES, XPS
  - PEEM
  - Interference Lithography
  - …….

Acknowledgements

We would like to acknowledge the kind support of
Regina Soufli, Lawrence Livermore National Laboratory,
Larissa Juschkin, RWTH Aachen,
All in the Spec Group, UCD
and the technical workshop, UCD School of Physics

Thank you for listening