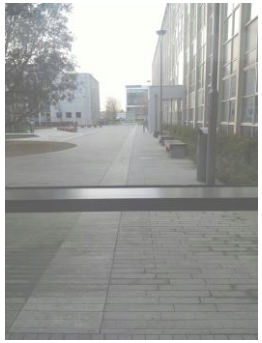
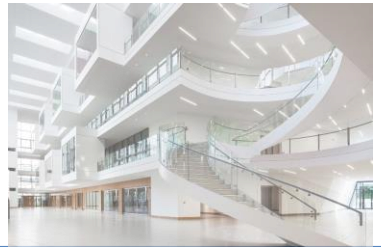
Smallest Sun: Generating the hardest soft X-rays from the hottest smallest laser plasma



[1]*University College Dublin, Belfield, Dublin 4, Ireland*
[2]*University of Padova, Padova, Italy*



Soft X-Ray Plasma Imaging

Aim:

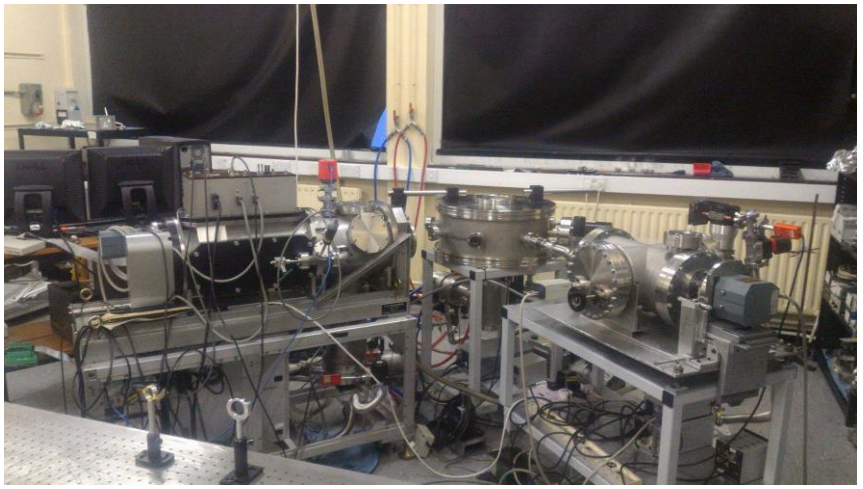
High resolution imaging and spectroscopic study of Soft X-Ray laser plasma.

Objective:

- Explore the size and shape of the Soft X-Ray plasmas with different target materials
- Understand the Soft X-Ray emission volume from different materials at different condition

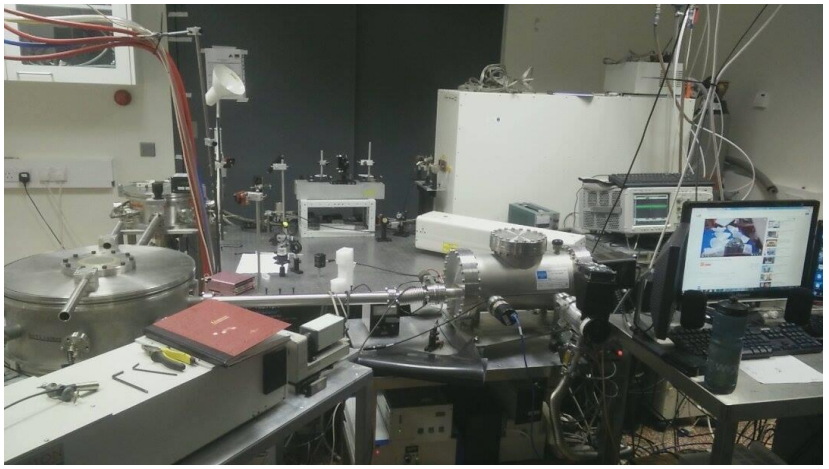
Facilities at UCD SPEC Lab

Lasers



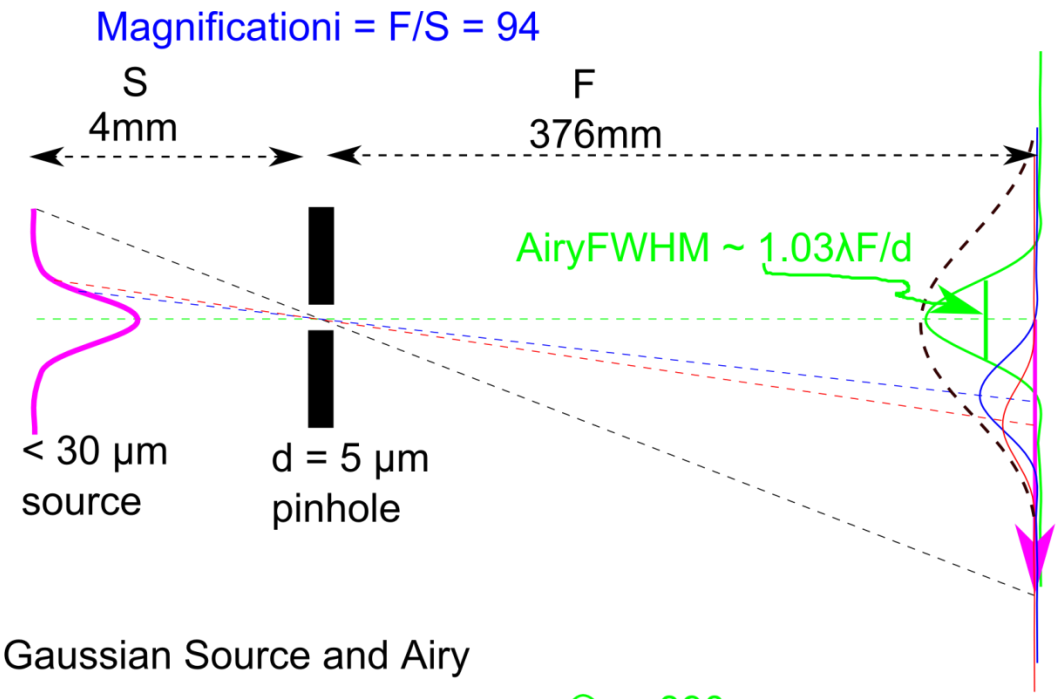
Main chamber and Spectrometers

DPP Chamber

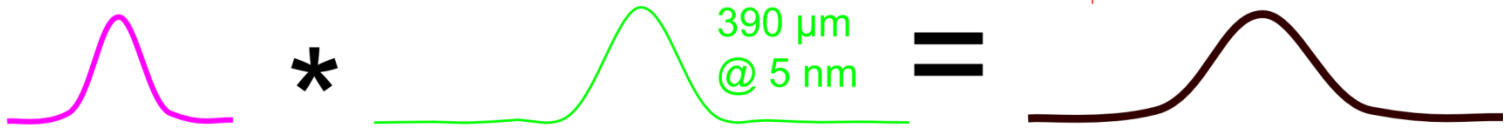


Co2 Lab

Experiment

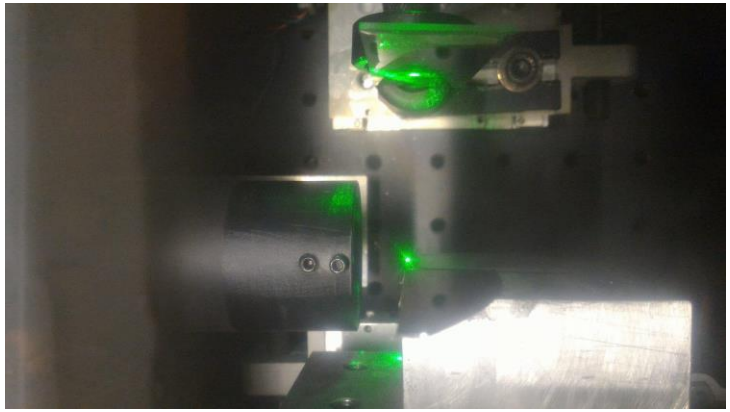


Convolve Gaussian Source and Airy

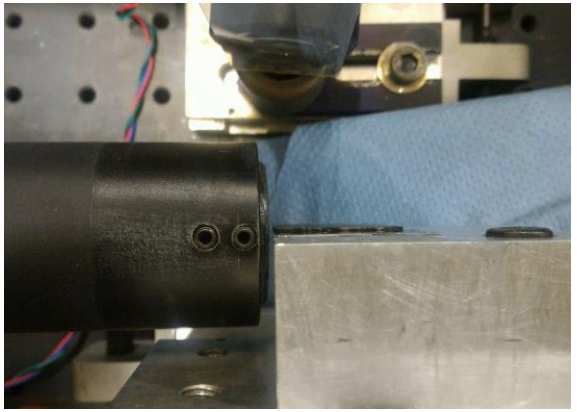


$(\text{Magnification} * \text{Source FWHM})^2 + \text{Airy FWHM}^2 = \text{Image FWHM}^2$

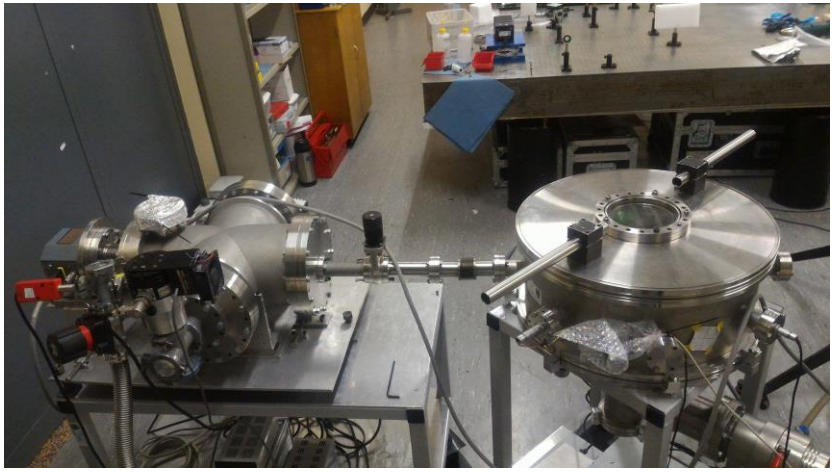
Experiment Setup



Pinhole at Lower Magnification

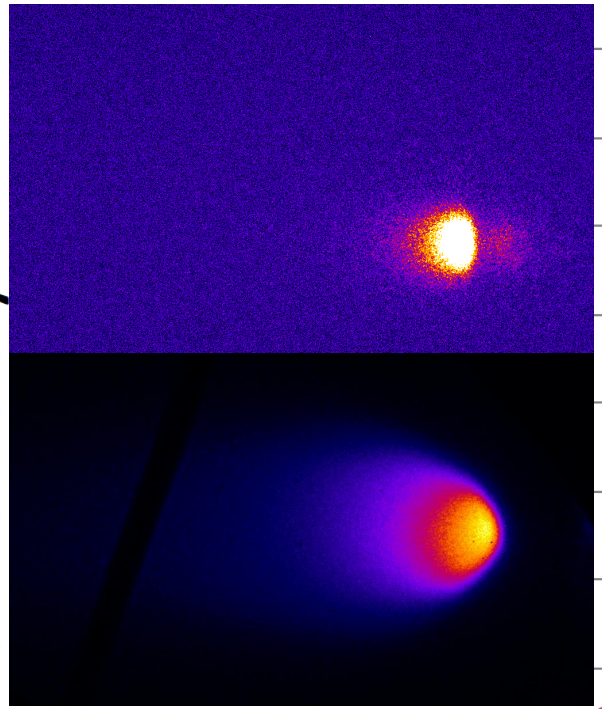


Pinhole at Higher Magnification



Spectroscopy Setup

Plasma Side View - Mo



Relative Intensity

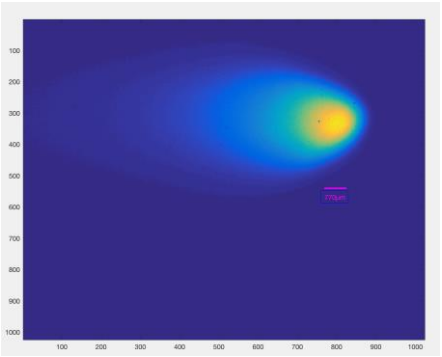
-100 -80 -60 -40 -20 0 20

Distance From Target (um)

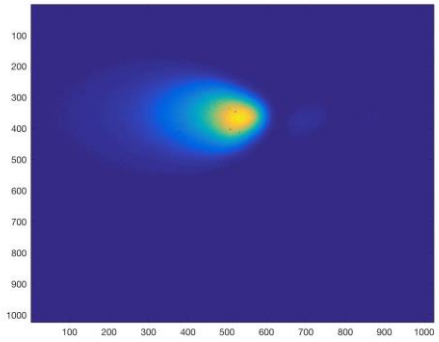
25 mJ

800 mJ

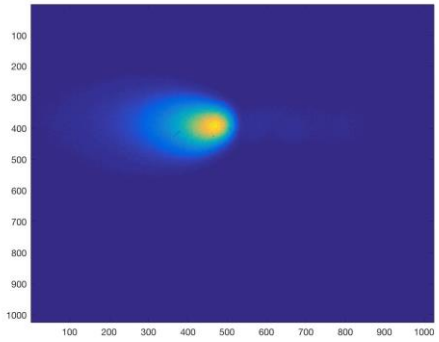
Molybdenum



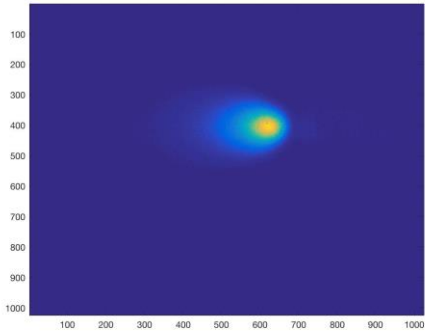
800mj



200mj

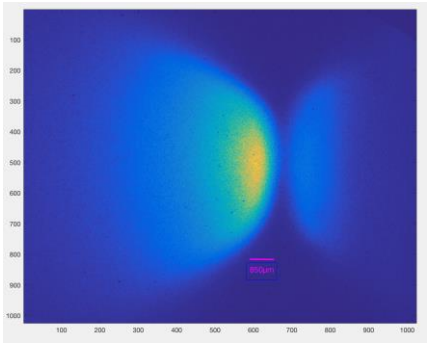


100mj

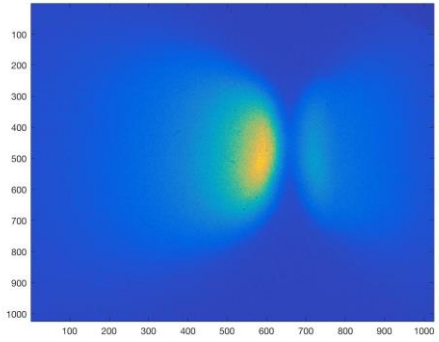


50mj

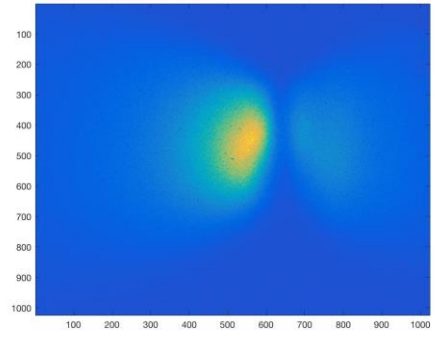
Silicon



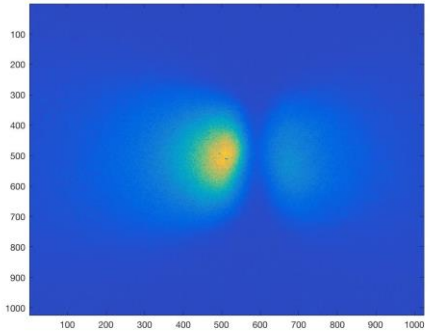
800mj



200mj



100mj

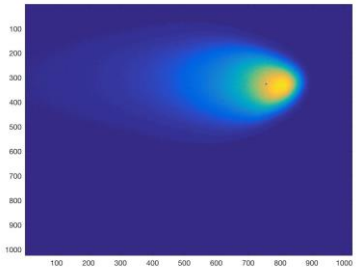
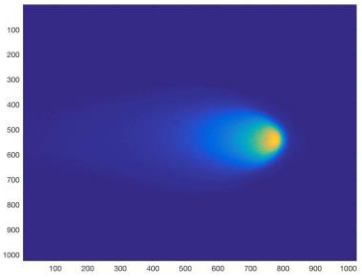
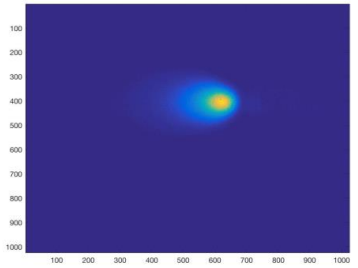
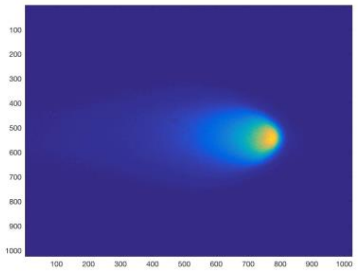
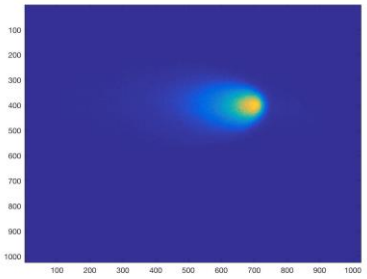
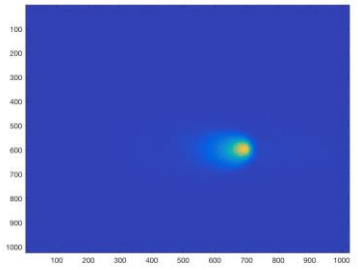
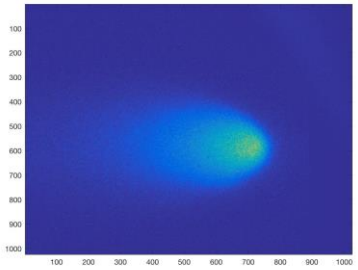
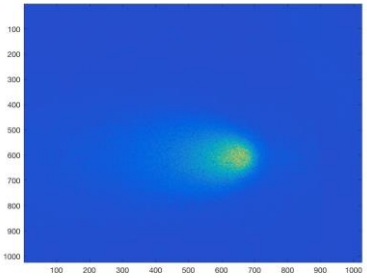
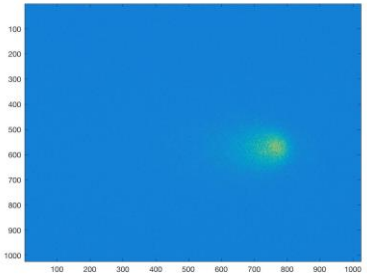


50mj

Magnification = 94.

Filter =Si3N4 and Ag

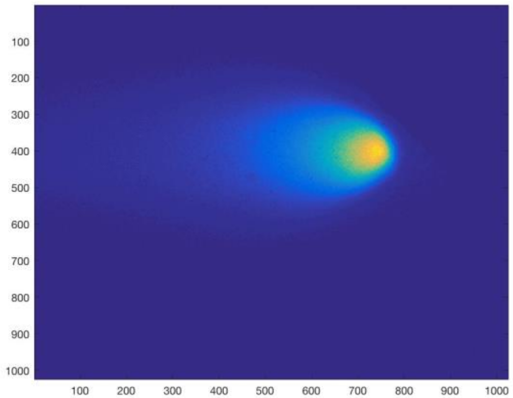
Pinhole Comparison with molybdenum plasma

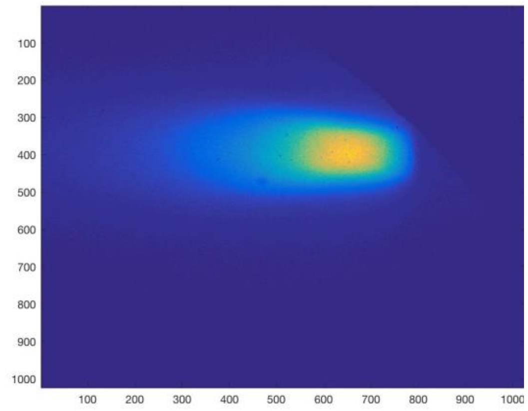
	800mj	200mj	50mj
10µm			
5µm			
2µm			

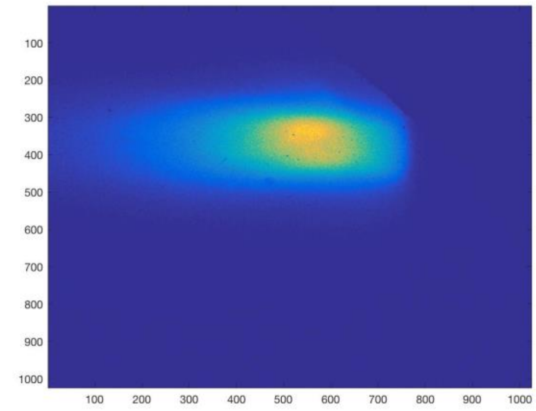
Magnification =94

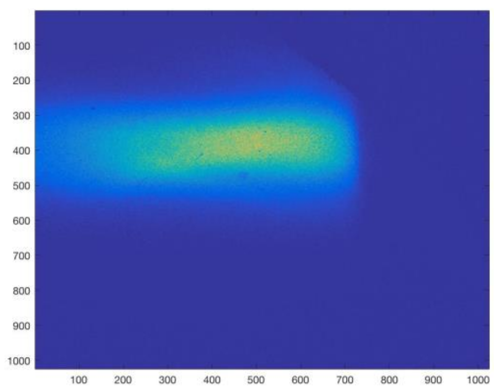
EXTATIC

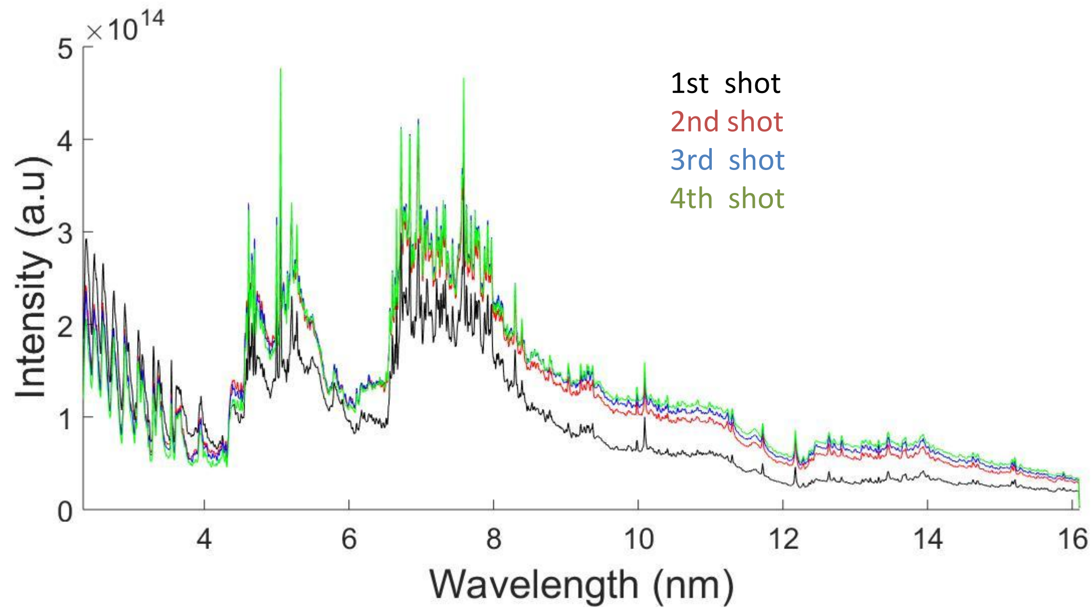
Erasmus Mundus











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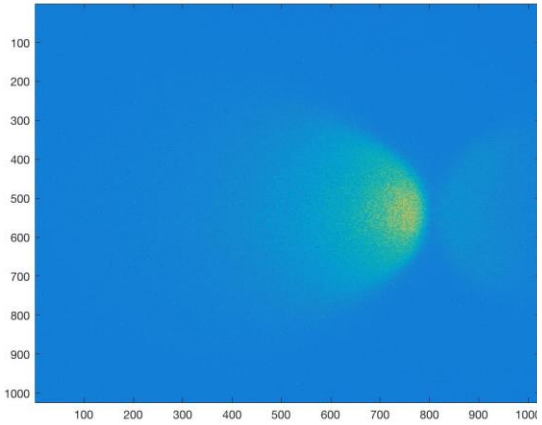
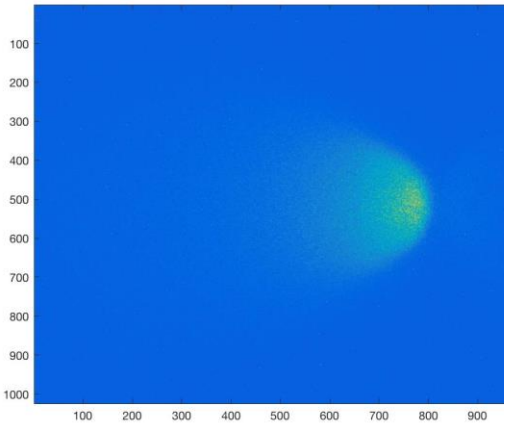
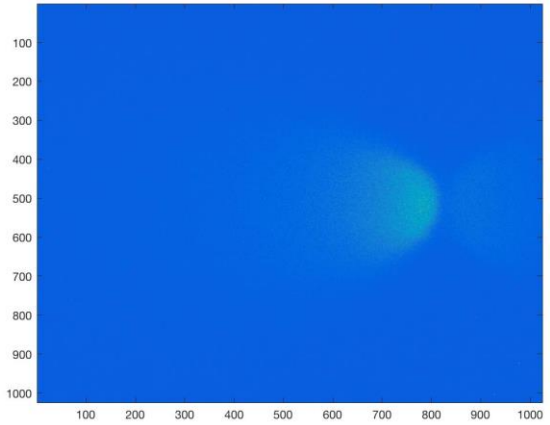
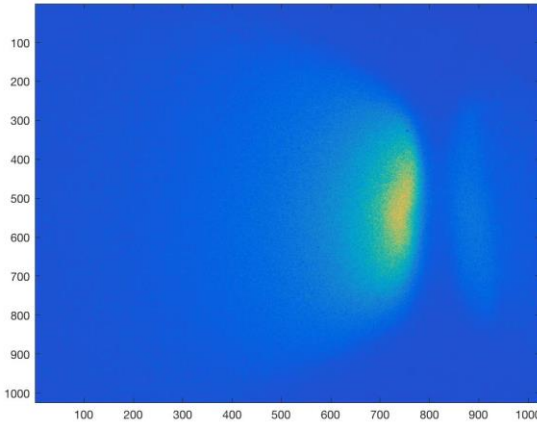
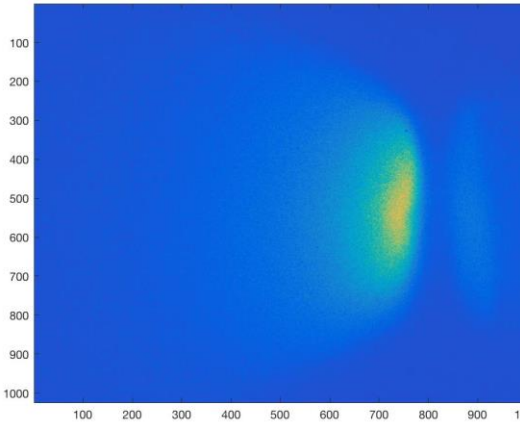
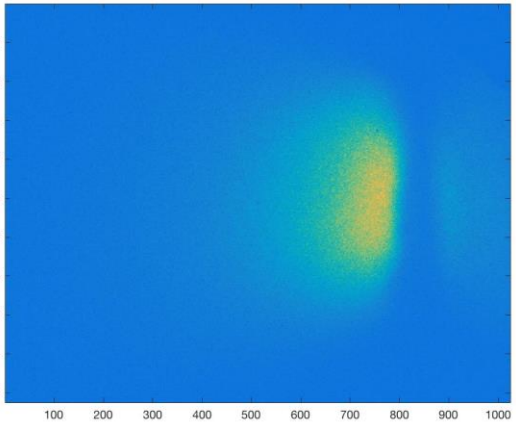
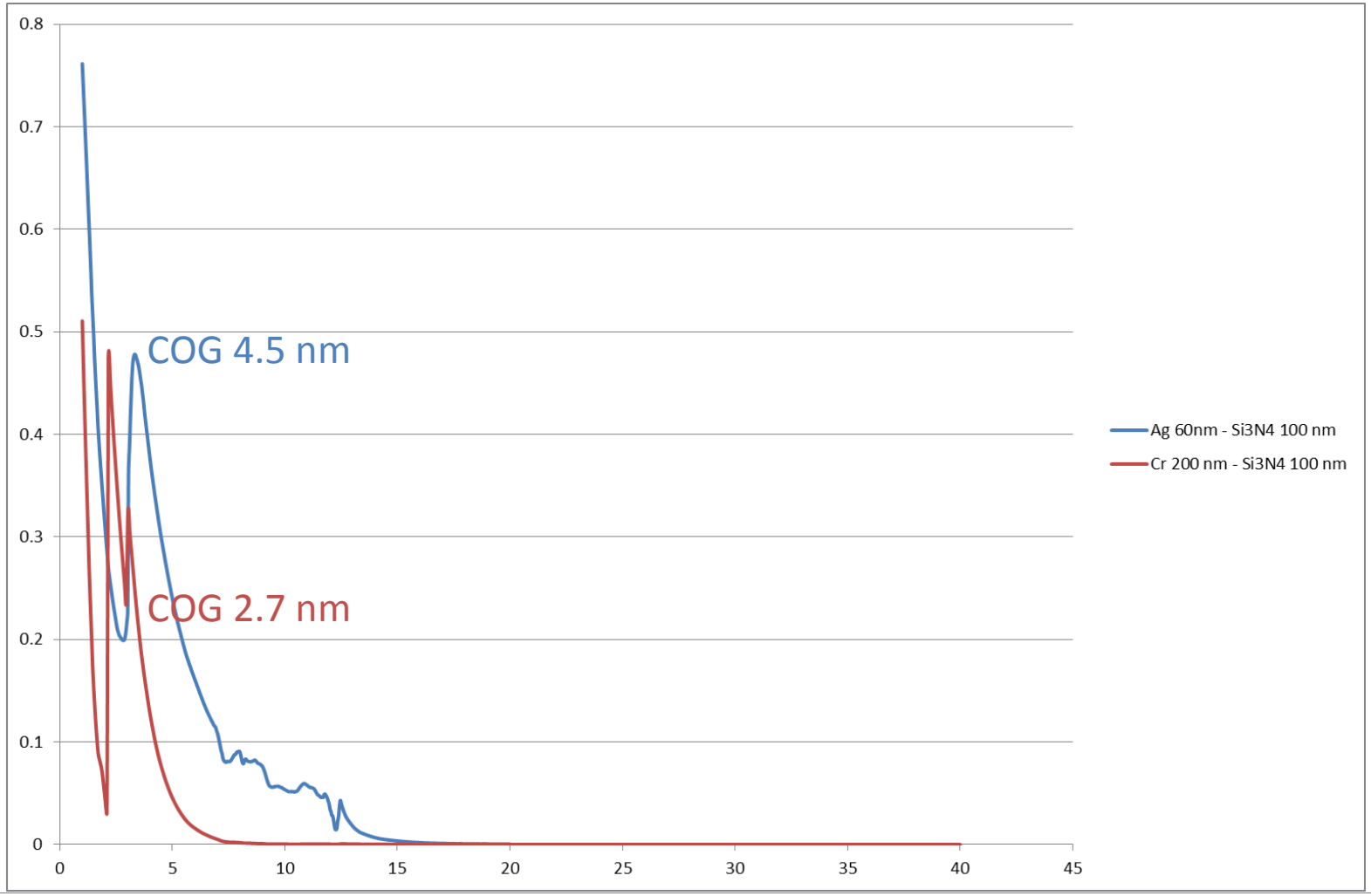
Silicon at Focus and Out OF Focus

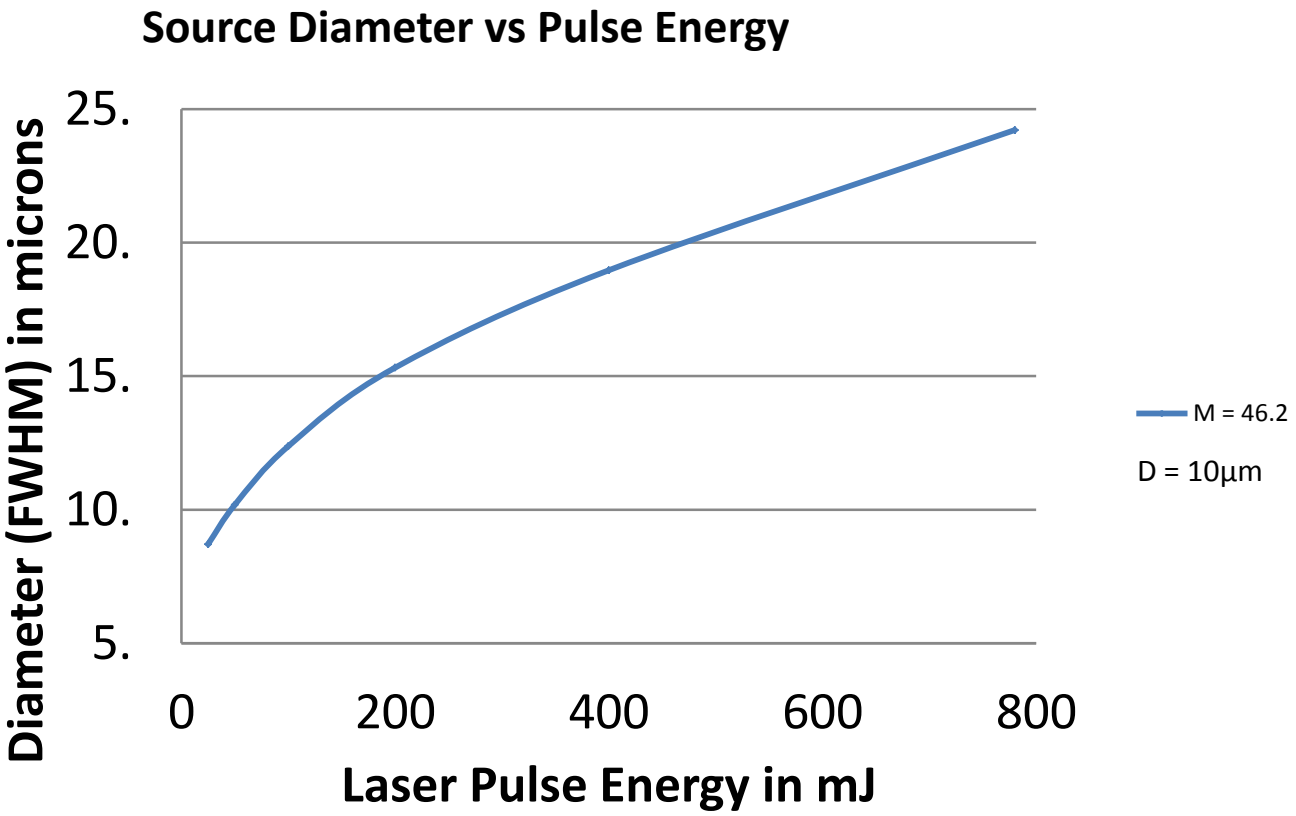
	800mj	400mj	200mj
Focus			
Out of Focus			

5um pinhole at Magnification =46.2

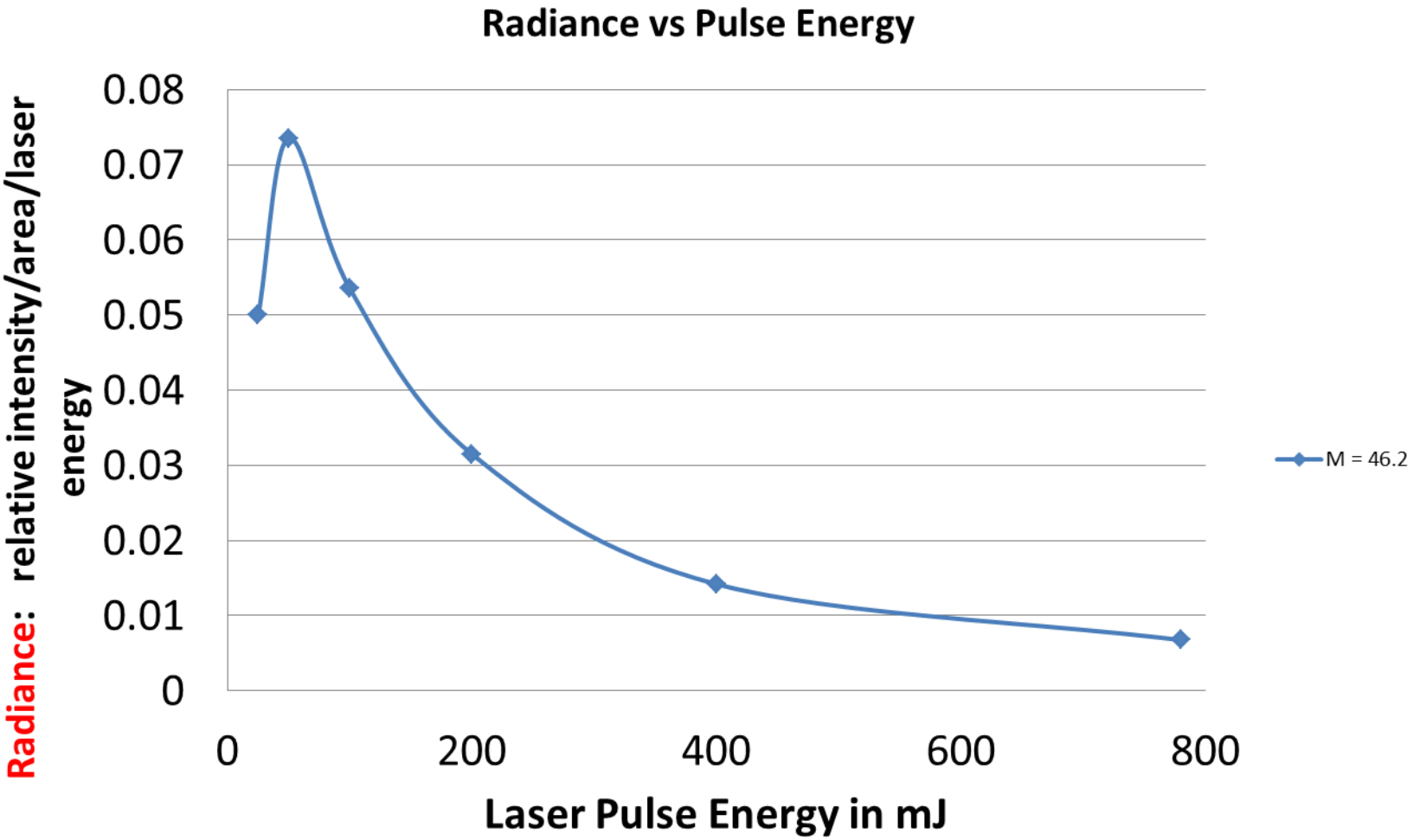
Filters


0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
35
40
45
COG 4.5 nm
COG 2.7 nm
Ag 60nm - Si3N4 100 nm
Cr 200 nm - Si3N4 100 nm

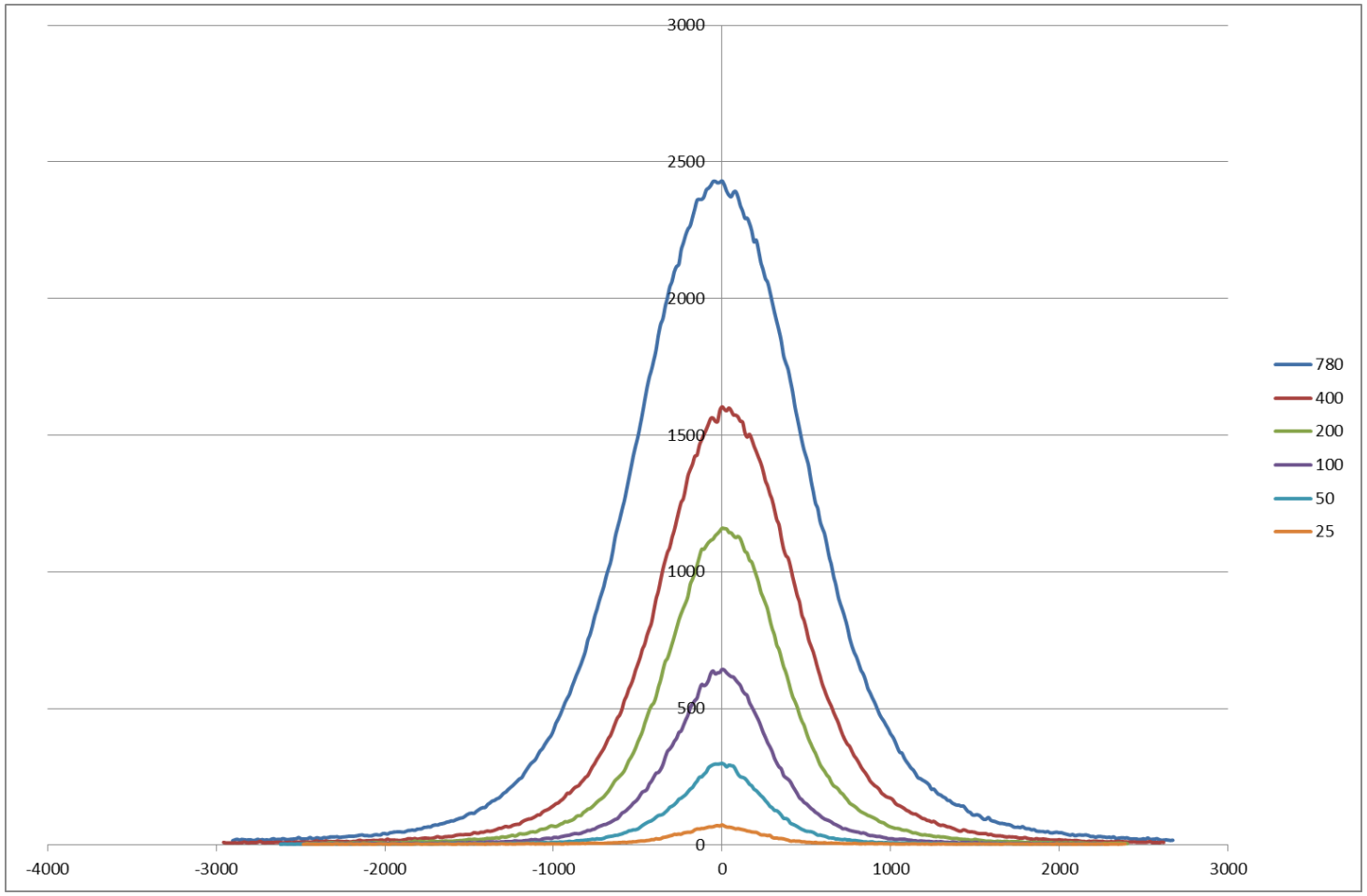
Less Energy = Smaller Plasma



Smaller Not Always Better

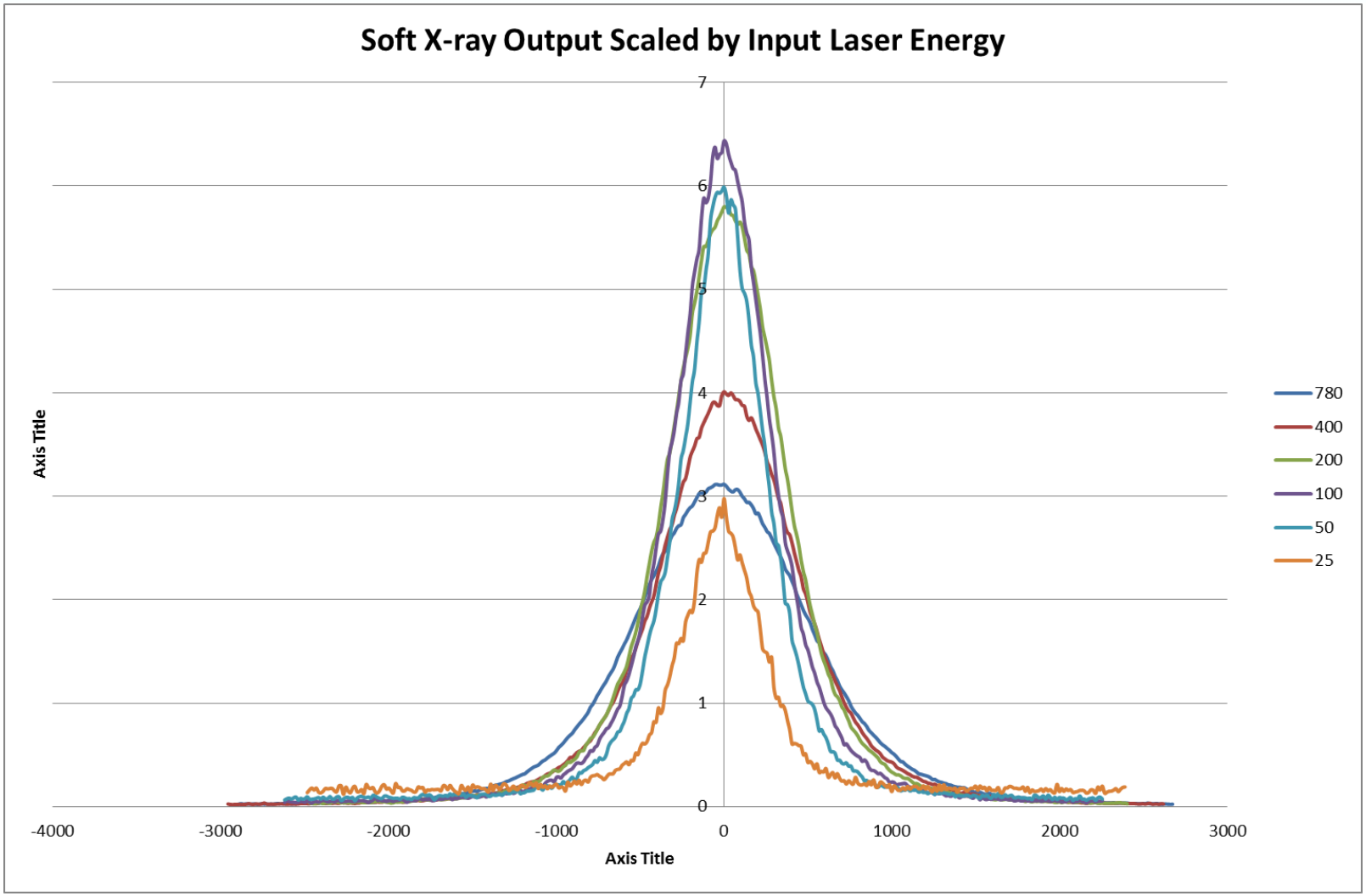


Plasma Front View - Mo



Distance from the centre in (µm)

5um pinhole at Magnification =46.2


Soft X-ray Output Scaled by Input Laser Energy
Axis Title
Axis Title
7
6
5
4
3
2
1
0
-4000
-3000
-2000
-1000
0
1000
2000
3000
780
400
200
100
50
25

Future work

- Need to analyse the data.
- Need to make a new setup for high resolution imaging using soft X-Ray mirrors.
- If possible, will make some new mix material targets for higher soft X-Ray emission.

Mobility work plan

- One physics module.
- To make a wavelength selector mirror for Soft X-Ray plasma imaging at shorter wavelength between 2 to 6nm with maximum reflectivity.
    - Planer mirrors or spherical mirrors
        - Simulation
        - Understanding possibilities and difficulties
        - Making final mirrors

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Erasmus Mundus

Thank You

धन्यवाद

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Grazie

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