

Investigation on OoB for DPP EUV sources

Spectral Purity:

130-400[nm] (DUV/UV)	$\leq 3-7\%$ ***
≥ 400 [nm] (IR Vis) at Wafer	TBD***

*** Design dependent

From Joint Requirement 2005 Feb.27

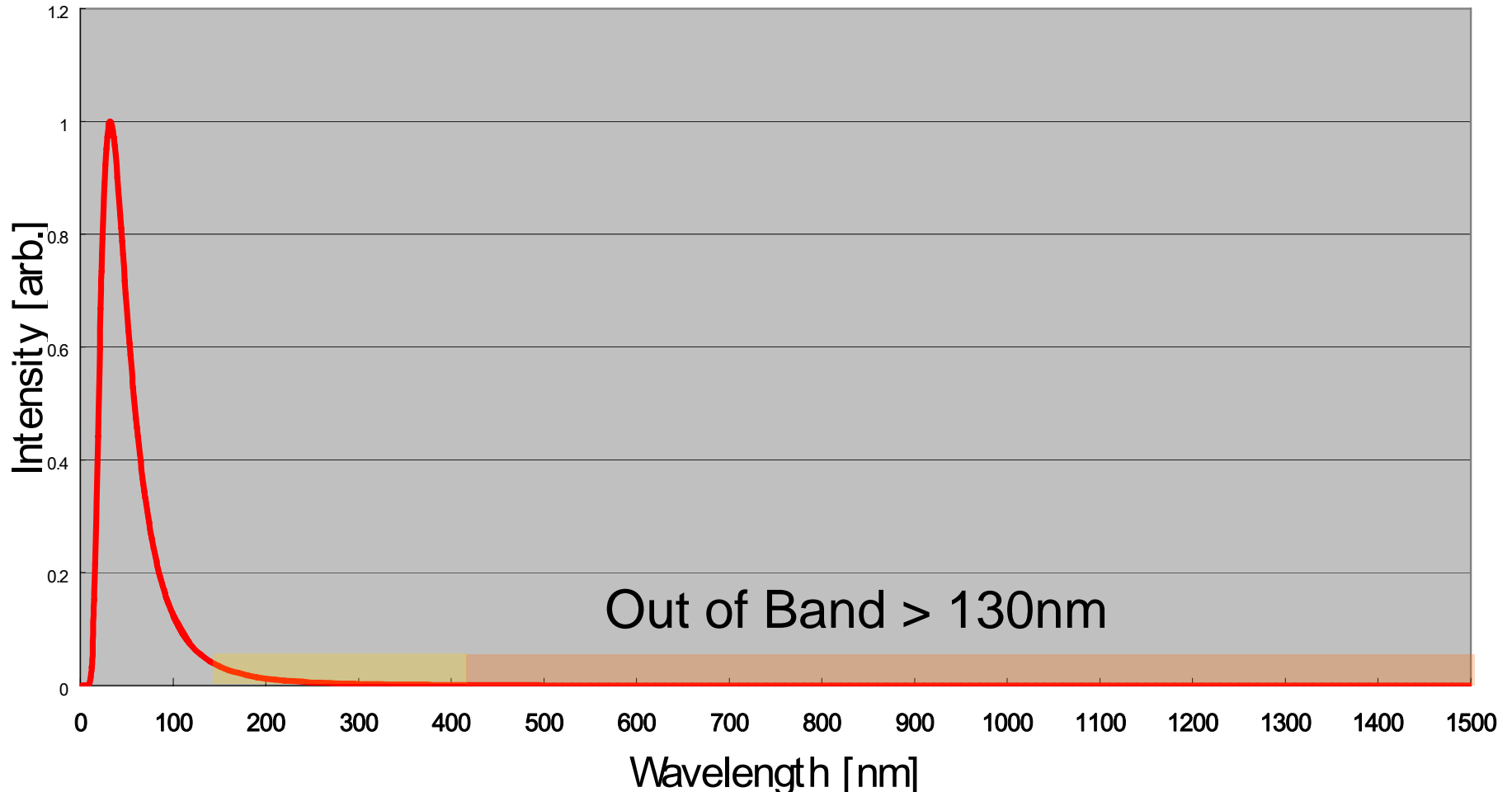
Nov. 10 2005

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EUVA

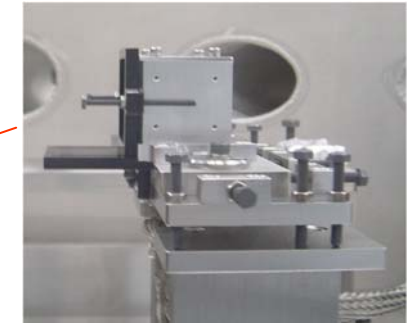
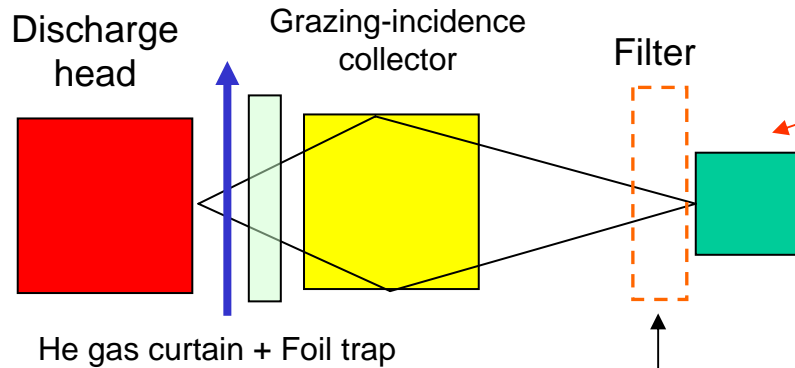
1. Rough estimation from Blackbody Radiation (BR)

Average Plasma Temp.=100000K



Almost 99% of total radiation from DPP is expected to be less than 130nm.

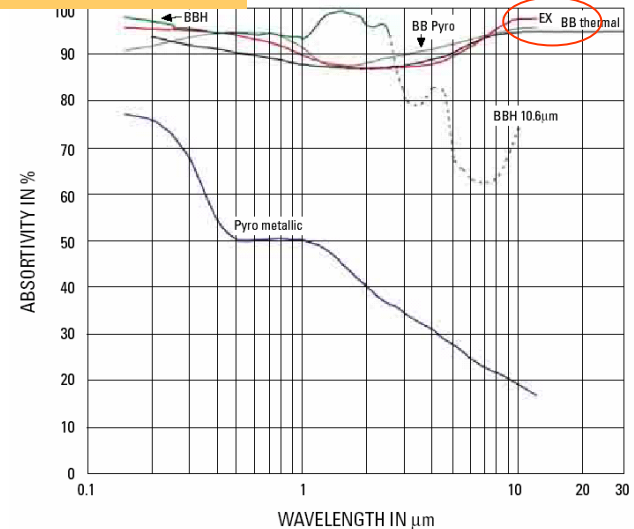
2. Evaluation method for OoB



OPHIR Peltier Sensor

Etendue of the system
 $\Omega S = 26 \text{ mm}^2 \text{ sr}$,
 Angle of emergence 13.1°
 Detection area $\Phi 14$

- (1) No Filter
- (2) MgF2: >120nm
- (3) BK7+SCF-39L: >400nm
- (4) BK7+SCF-72R: >750nm



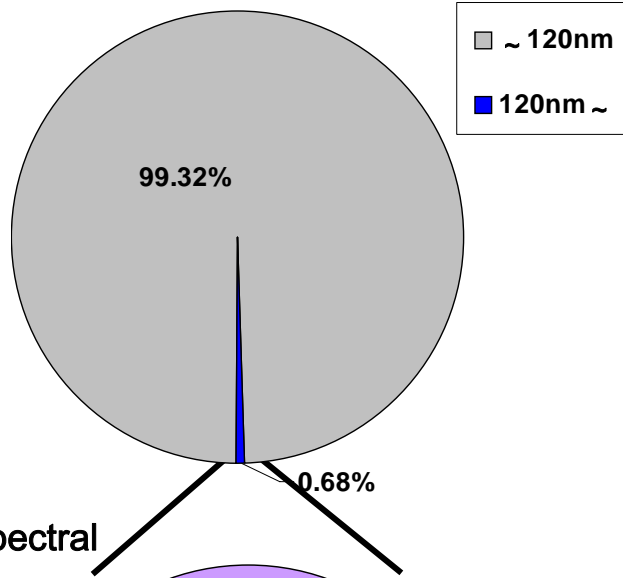
From Data sheet of OPHIR

The influence of temperature rise of filters could be avoided by forced cooling or inserting BK7 glass which absorbs shorter wavelength radiation than specific spectral regions of the color glass filters.

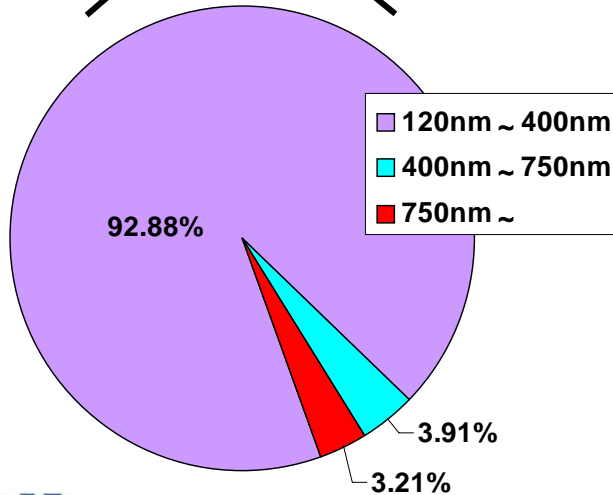
3. Experimental Results

The ratio of each spectral region

To whole spectral region

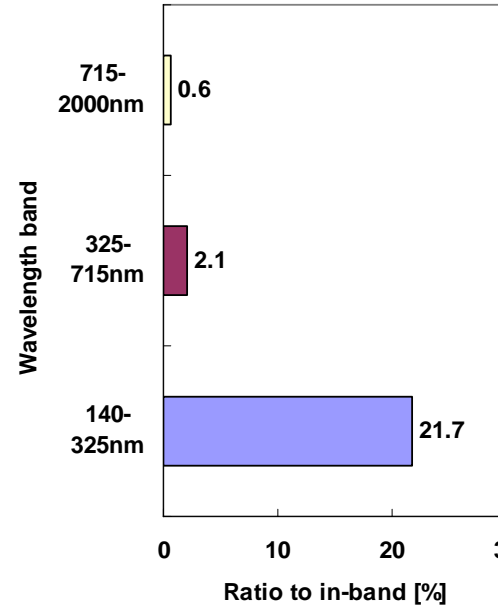


To the spectral region > 120nm

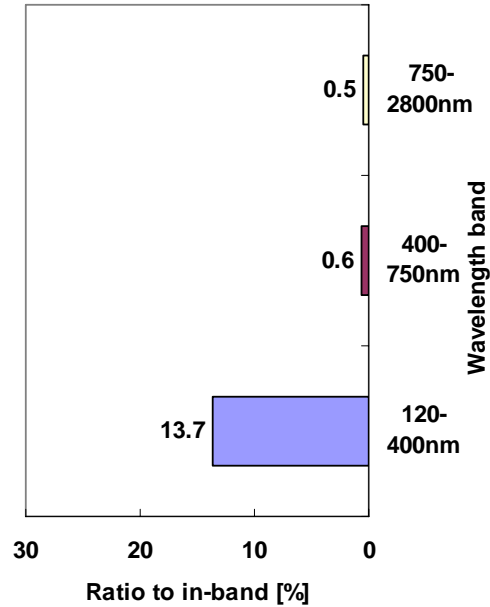


The ratio to inband radiation

At source
measured by FC2



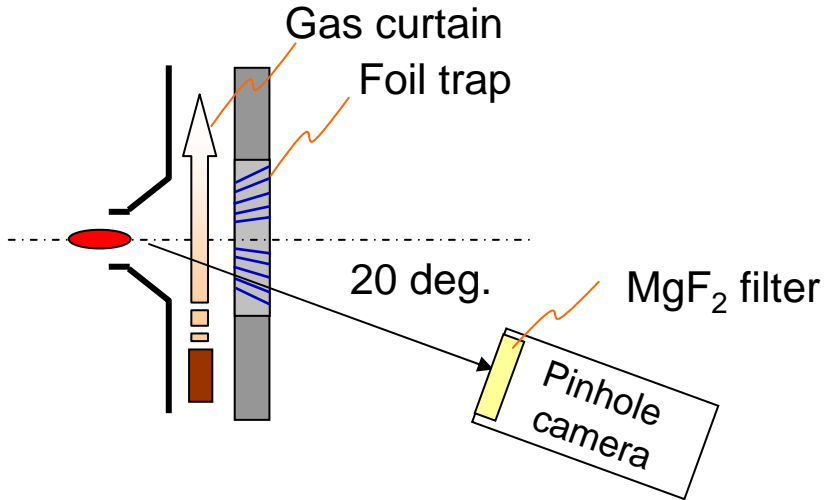
At I.F.
This study



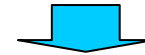
In some degree, the collector might reduce the ratio of OoB to inband.

Is it possible of the reduction of OoB by Etendue limitation ?

4. Out-of-band plasma image

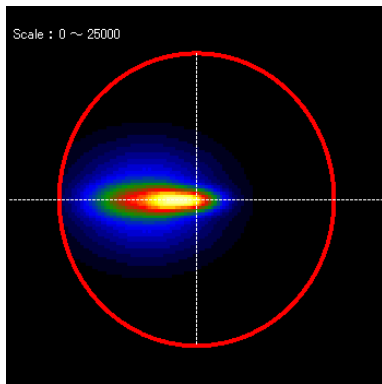


MgF₂ filter + pinhole camera

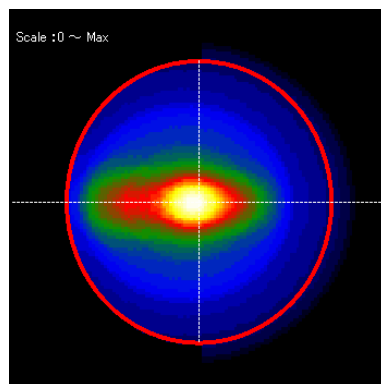


Plasma image of >120nm wavelength

“non-EUV” plasma
is larger than
EUV plasma



EUV



> 120 nm

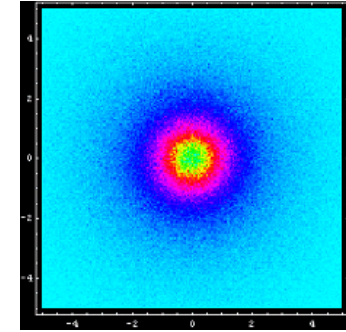
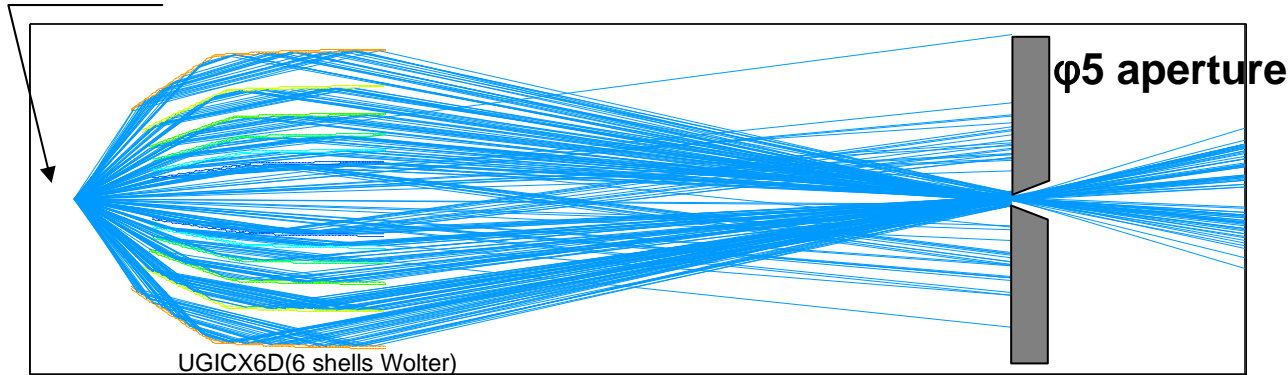
Plasma image (20 deg.)

Etendue limitation could
reduce OoB radiation to
inband radiation

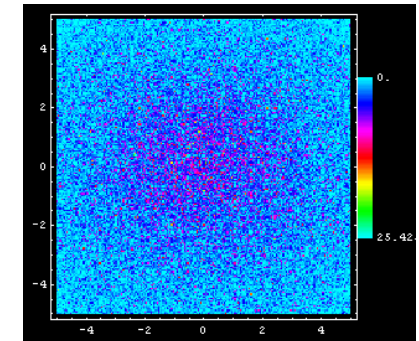
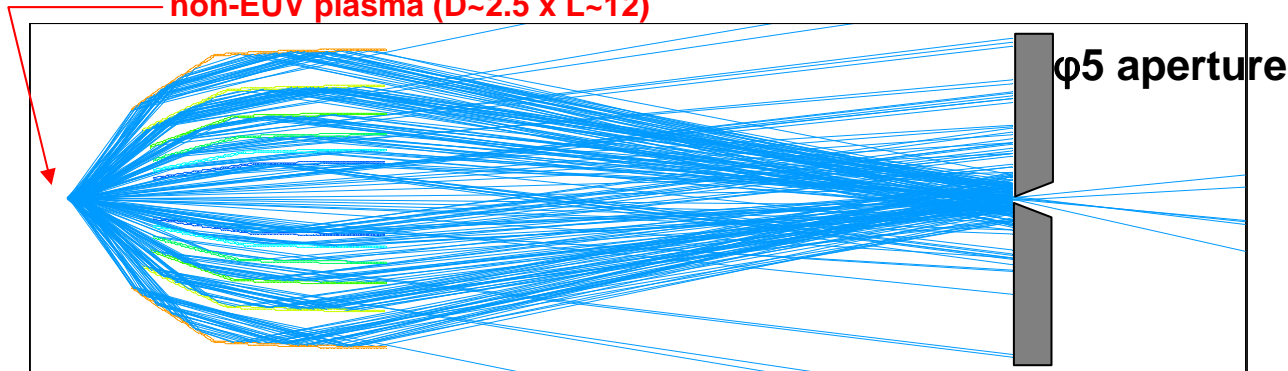
5. Etendue miss matching (EMM)

- Estimation

EUV plasma (D0.85 x L5.7) * not the one in previous page



non-EUV plasma (D~2.5 x L~12)



Energy distributions at focal plane

In case of $\Omega S = 3.3 \text{ mm}^2 \text{ sr}$

Etendue acceptance factor for EUV = 0.46

for non-EUV = 0.06



EMM technique will be able to reduce the ratio of 130-400nm to inband radiation.

6. Summary

1. In case of evaluating OoB, spectral profile of DPP may roughly compare to BR
2. 99% of DPP radiation was from <120nm spectral region
3. The ratio of 120-400nm to inband was 13.7% at IF and does not meet the requirement so far
4. It is possible to reduce the ratio of 130-400nm to inband by EMM technique

Acknowledgements

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