Joint Requirements

ASML, Canon, Nikon

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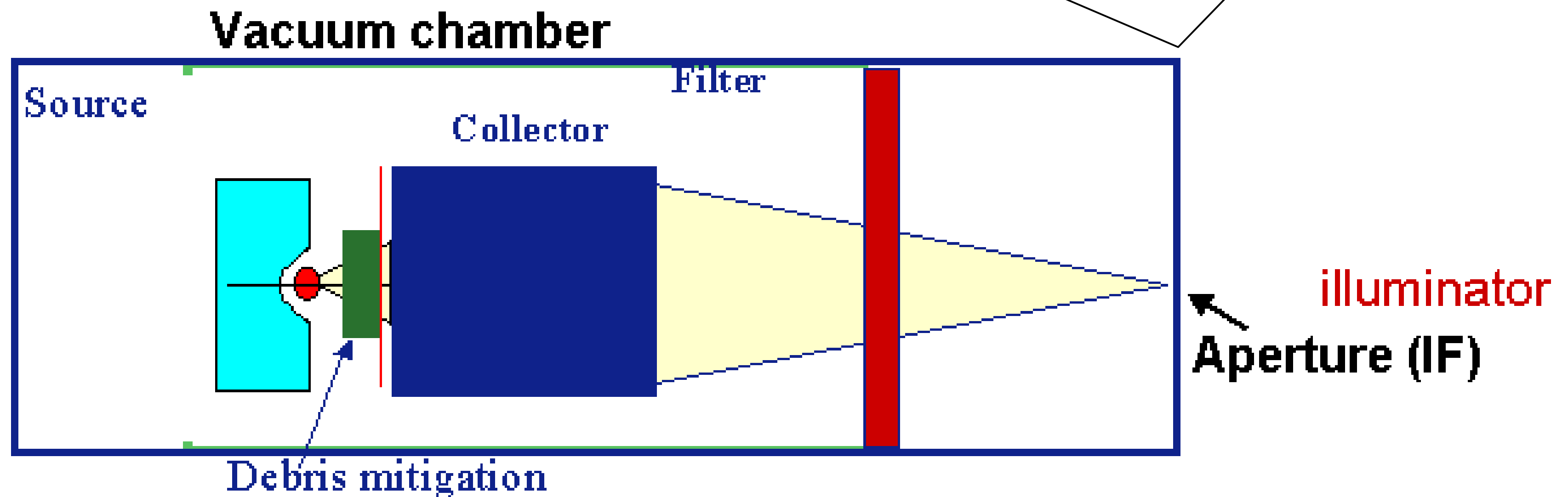
Definition of clean photon spot at intermediate focus (IF)

Source specifications are defined at intermediate focus (IF) which is illuminator entrance



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Nikon ASML Canon

Joint Requirements for EUV Source

SOURCE CHARACTERISTIC	REQUIREMENT
•Wavelength	13.5 [nm]
•EUV Power (in-band)	115 [W] *
•Repetition Frequency	> 7-10 kHz ***
•Integrated Energy Stability	±0.3%, 3σ over 50 pulses
•Source Cleanliness	≥ 30,000 hours **
•Etendue of Source Output	max 3.3 mm^2sr ***
•Max. solid angle input to illuminator	0.03 - 0.2 [sr] ***
•Spectral Purity:	
130-400 [nm] (DUV/UV)	≤ 3 - 7% ***
≥ 400 [nm] (IRVis) at Wafer	TBD ***

*** At IF**
**** After IF**
***** Design dependent**

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A wafer throughput model

Throughput	**[wfr/hr]**	**100**	
Time per item			
total time wfr	[sec]	36	
stage overhead, wafer exchange, wafer alignment, etc.	[sec]	27.0	
exposure time	[sec]	9.0	
Field-wafer parameters			
wafer diameter	[mm]	300	
% wfr exposed	%	78.7%	1)
penalty for not using full field height	%	96.2%	
Resist sensitivity	**[mJ/cm^2]**	**5.0**	
Intermidiate derivatives at wafer			
total energy/wfr	[J]	2.9	
power at wfr	[Watt]	0.321	

1) 89 25x25-mm^2 shots/wafer

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A wafer throughput model, cont.

PO-box			
reflectivity mirror	[%]	67.5%	
nb near normal mirrors		6	
bandwidth mismatch loss	[%]	5.0%	
polarization loss	[%]	5.0%	
gas absorption PO	[%]	5.0%	
Total transmission PO		8.1%	
Reticle			
reflectivity reticle	[%]	65.0%	
power at reticle	[Watt]	6.1	
Illuminator			
total transmission Ill		8.4%	
General			
overall component degradation		37%	
Power captured clean inband photons	**[W]**	**115**	

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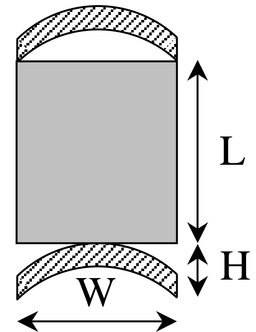
Source Power Requirement

- A wafer throughput model is introduced.

$$T = T_{scan} * N + T_{oh} = N\,(\,t_{acc} + t_{settle} + t_{exp} + t_{settle} + t_{dec}\,) + T_{oh}$$

$$= N\left(\frac{2P}{a_w * W * R} + 2t_{settle} + \frac{(L+H) * W * R}{P}\right) + T_{oh}$$



T_{scan}: scanning time per field, N: field number per wafer,

T_{oh}: overhead time (wafer exchange, wafer alignment, ...),

t_{acc}: acceleration time, t_{dec}: deceleration time, t_{exp}: field exposure time

t_{settle}: stage settling time (after accelerating and before decelerating)

P: EUV intensity on wafer, a_w: acceleration of wafer stage,

W: field width, L: field height, H: arc height + slit, R: photoresist sensitivity

- Relationship between the wafer throughput and reticle stage acceleration is considered.

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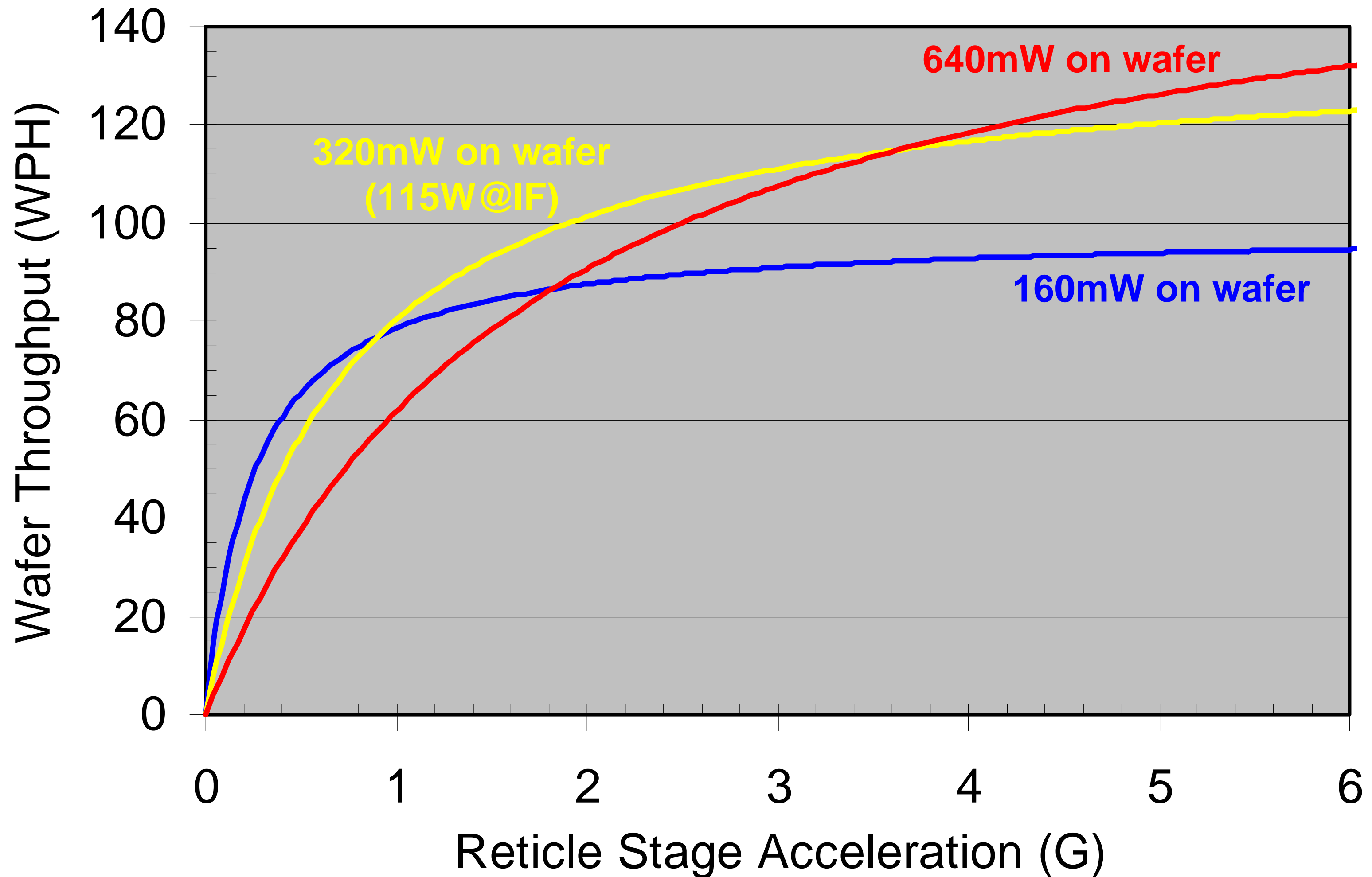
Source Power Requirement, cont.



Resist sensitivity: 5mJ/cm²

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Summary

- Joint requirements have been stable since last workshop.
- Exposure tool makers agree the throughput model has to be reconsidered on the basis of the recent advances in EUVL development.
- We will propose updated joint requirements in the next source workshop.

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