AIMS™ EUV

Status of Concept and Feasibility Study

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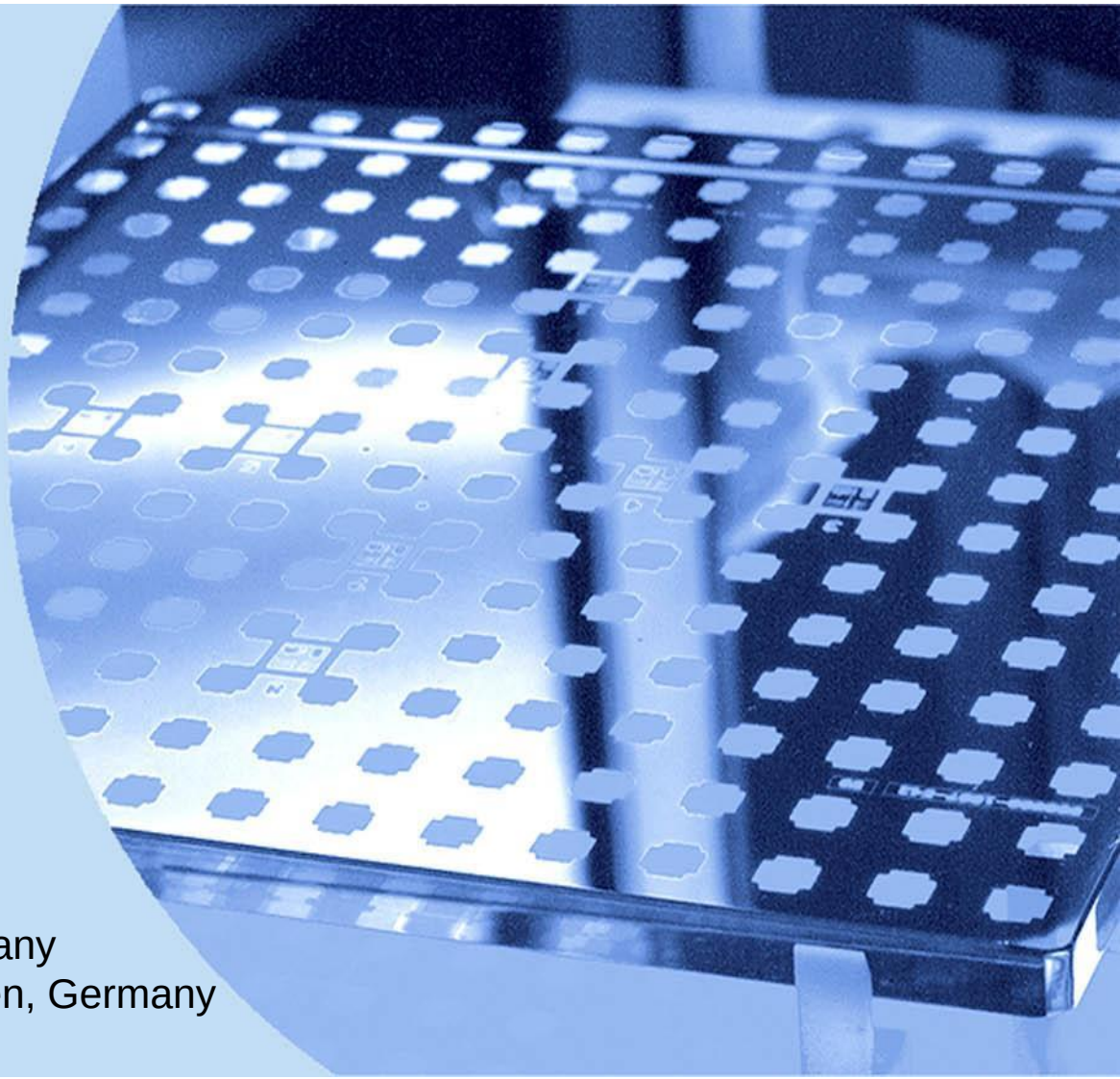
Ulrich Stroessner*
Heiko Feldmann**
Wolfgang Harnisch*
Dirk Hellweg**
Sascha Perlitz*

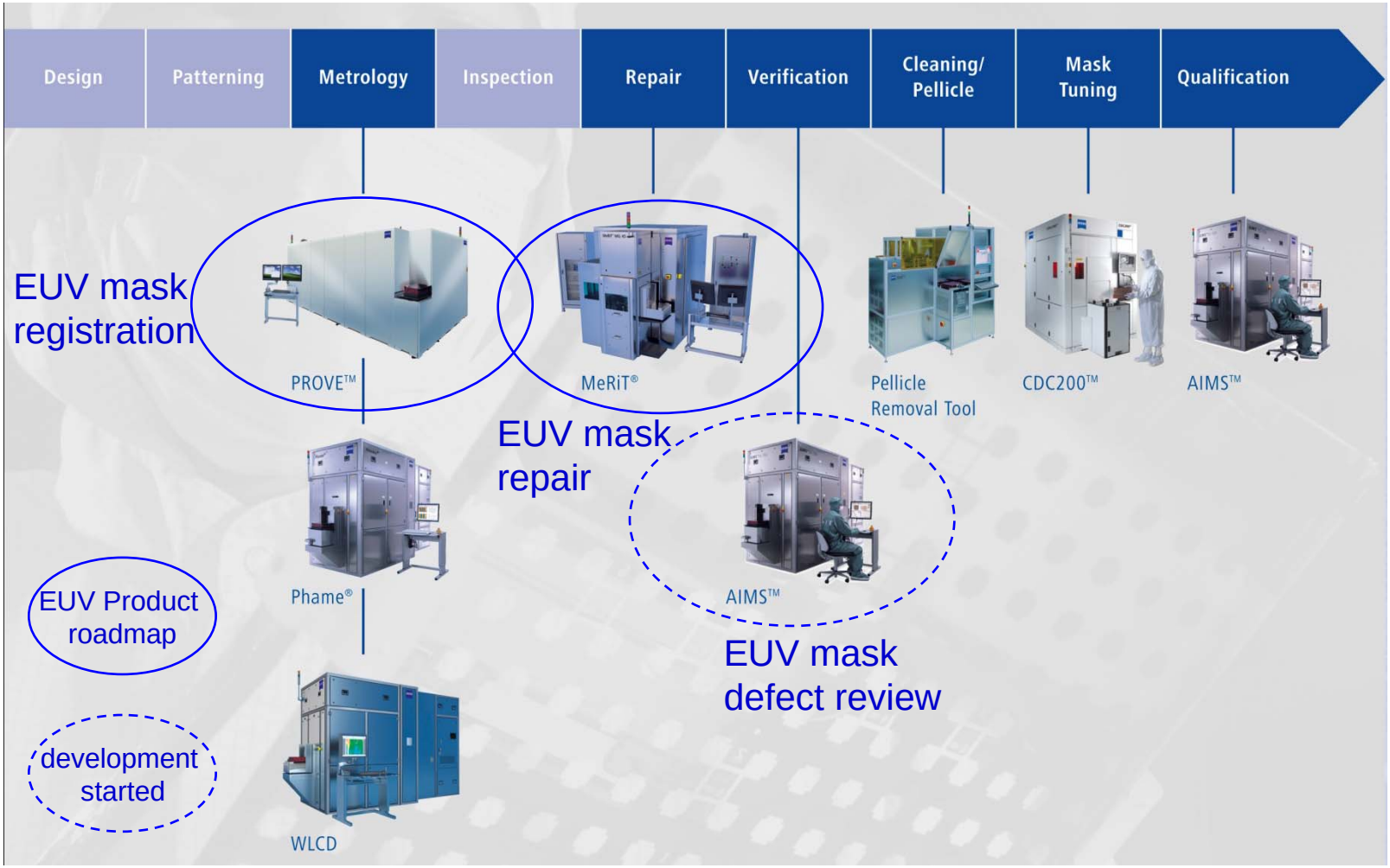
*Carl Zeiss SMS GmbH, Jena,Germany
**Carl Zeiss SMT GmbH, Oberkochen, Germany



Agenda

1. Carl Zeiss SMS products for EUV mask technology
2. AIMS™ EUV project status
3. AIMS™ EUV technical status
4. Summary

ZEISS Perfect Mask
Enabling Technologies for Manufacturing Zero-defect Masks



MeRiT® HR 32
Repair Solutions for EUV

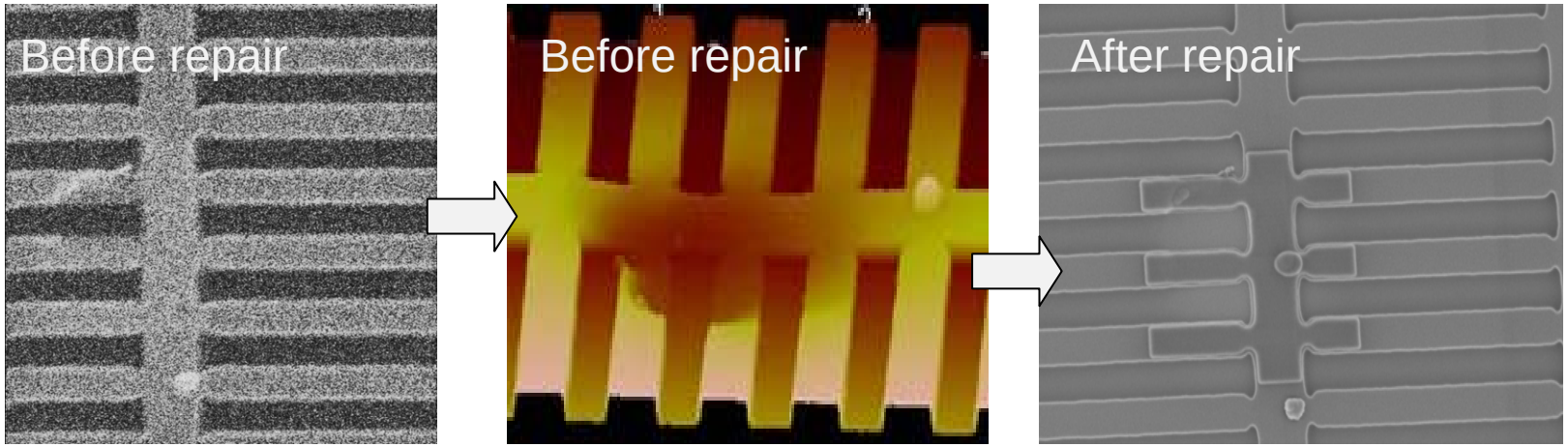
Lastest Generation of e-beam based mask repair:

MeRiT® HR 32 ready for EUV

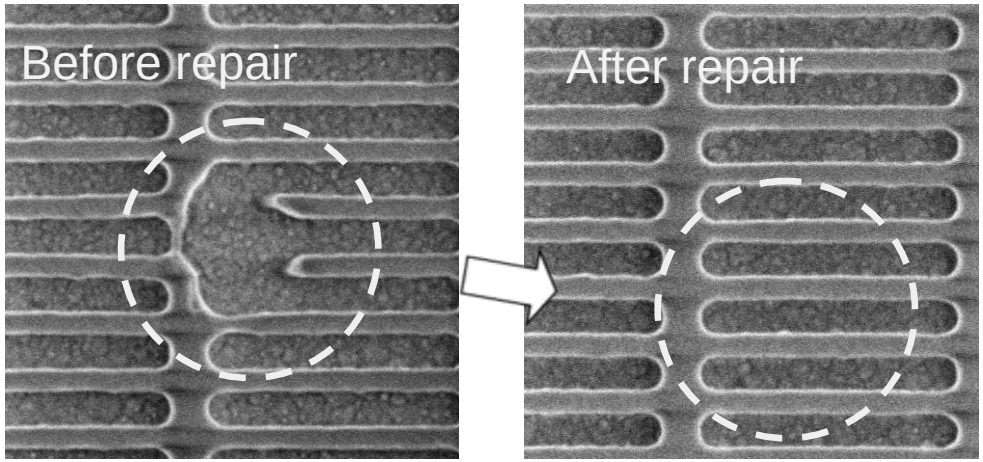
- New processes for EUV absorber depo and etch processes
- New gas chemistries → better selectivity and stability for EUV repairs
- More gases → high flexibilty regarding new EUV mask stack

Ebeam Based Mask Repair on Real Defects

SEM image EUV Mask:



SEM image Wafer print:



- No surface damage
- No change in edge placement
- No further degradation was observed

→ **Defect was repaired successfully**

PMJ 2010

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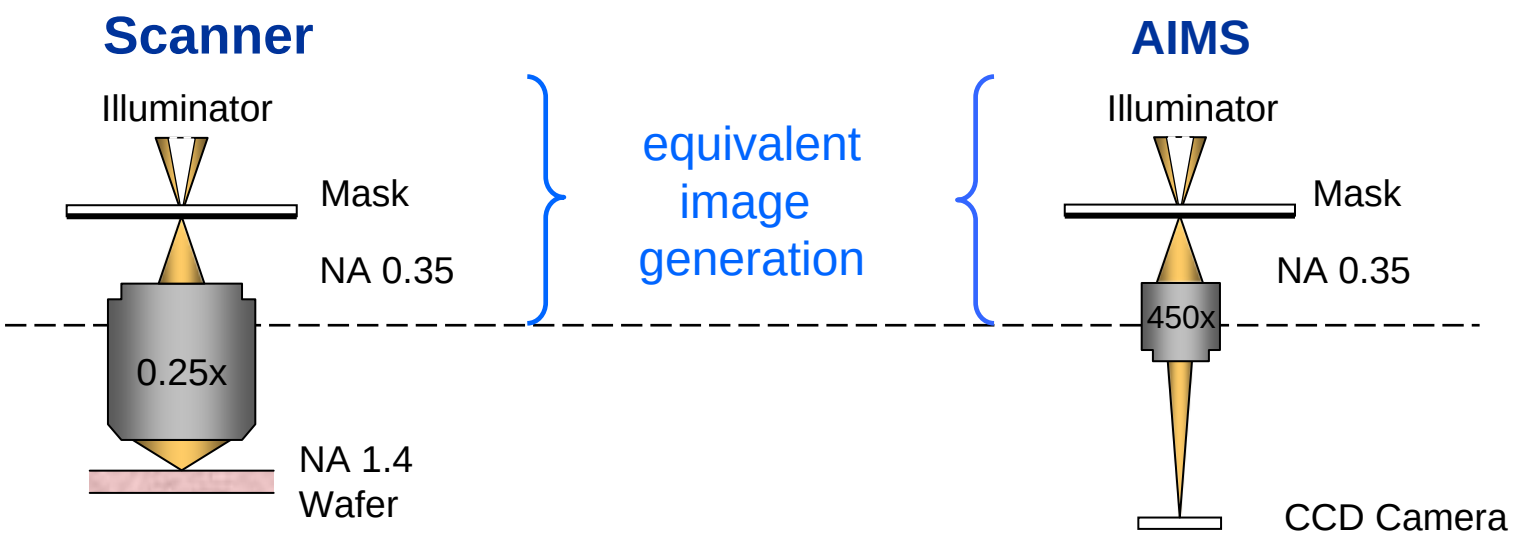
AIMS™ Principle



- AIMS™: actinic mask review
  - same wavelength
  - same mask side NA
  - same illumination setting

Capture real world mask effects!

- images the mask as the scanner will see it

AIMS™ EUV Project

Sematech EMI (EUV mask infrastructure) consortium

Need: Clear vote from all IDMs/mask manufactures for the need on an AIMS™ EUV

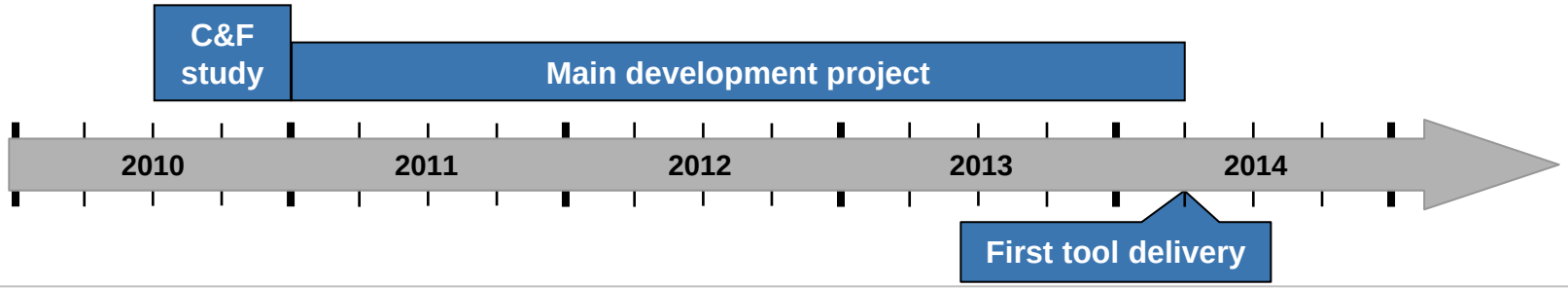
Phase 1: AIMS™ concept & feasibility (C&F) study

Structure: contract for C&F study between Sematech and Zeiss in place

Objective:
- define specification, timeline and project cost
- decide on technical concept
- finalize development contract for main project starting Jan 2011

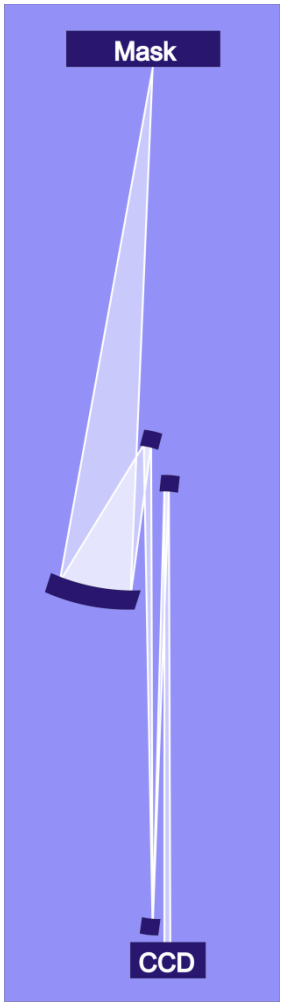
Phase 2: Main development project

Prerequisite: - development contract signed by Dec 2010



Top Level Target Specs

Topic	Specs
NA	NA 0.25 … 0.32 extendible to 0.50
CRA (illumination angle)	6° ... 9° adjustable
Illumination	Sigma and illumination shapes to match scanner optics
Aberrations	comparable to EUV scanner
CD repeatability (wafer level)	< 0.3 nm



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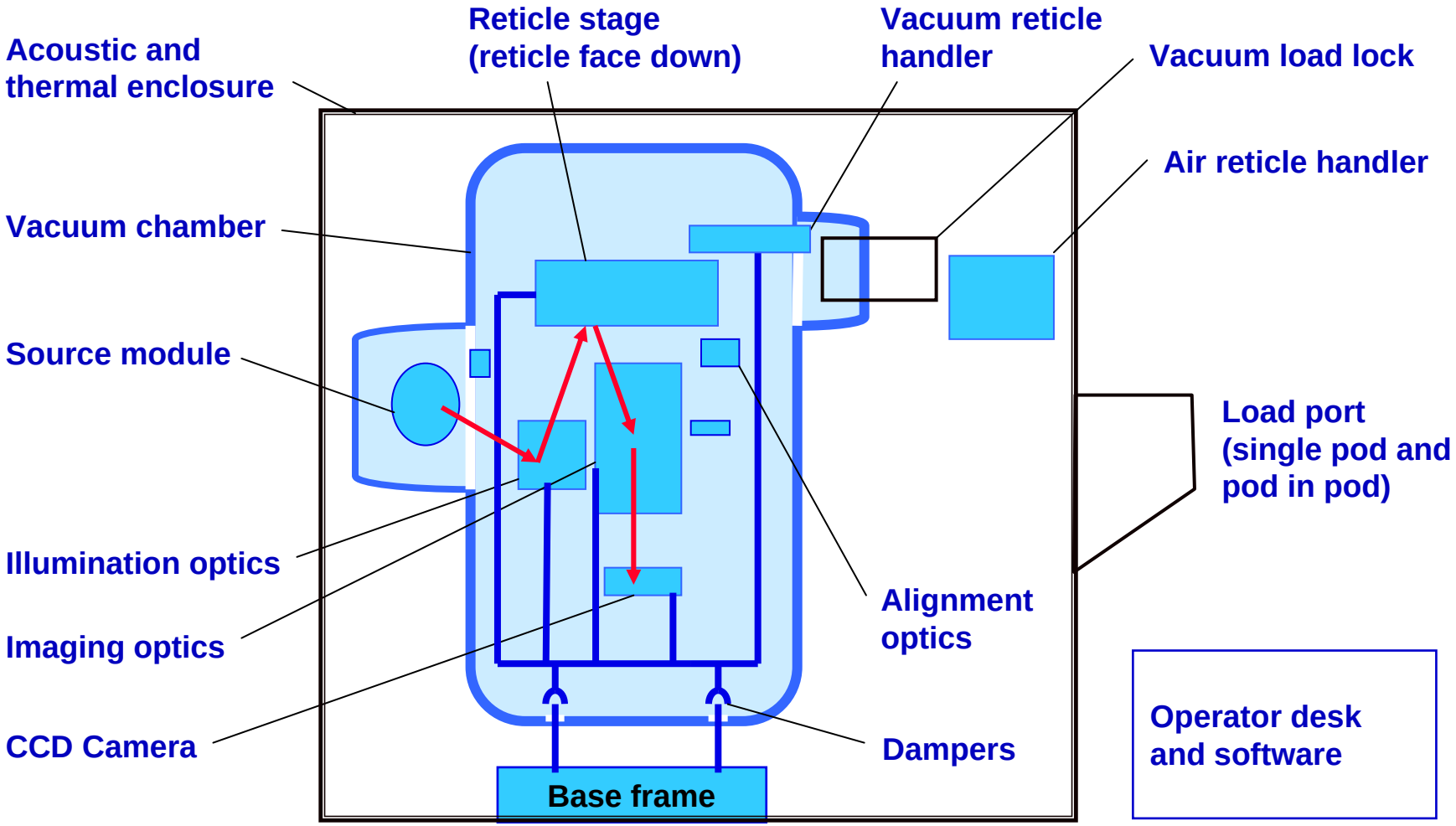
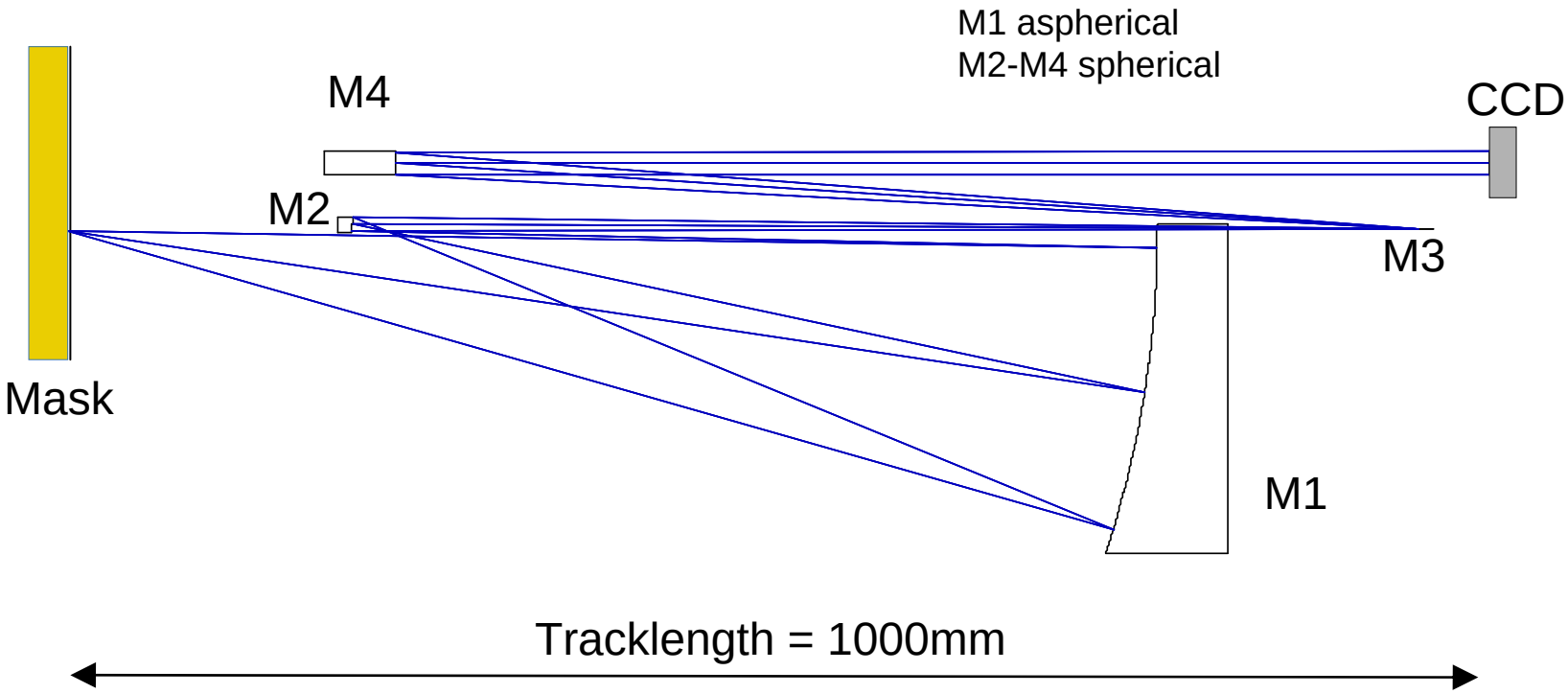
EUV Metrology Core - Main Components

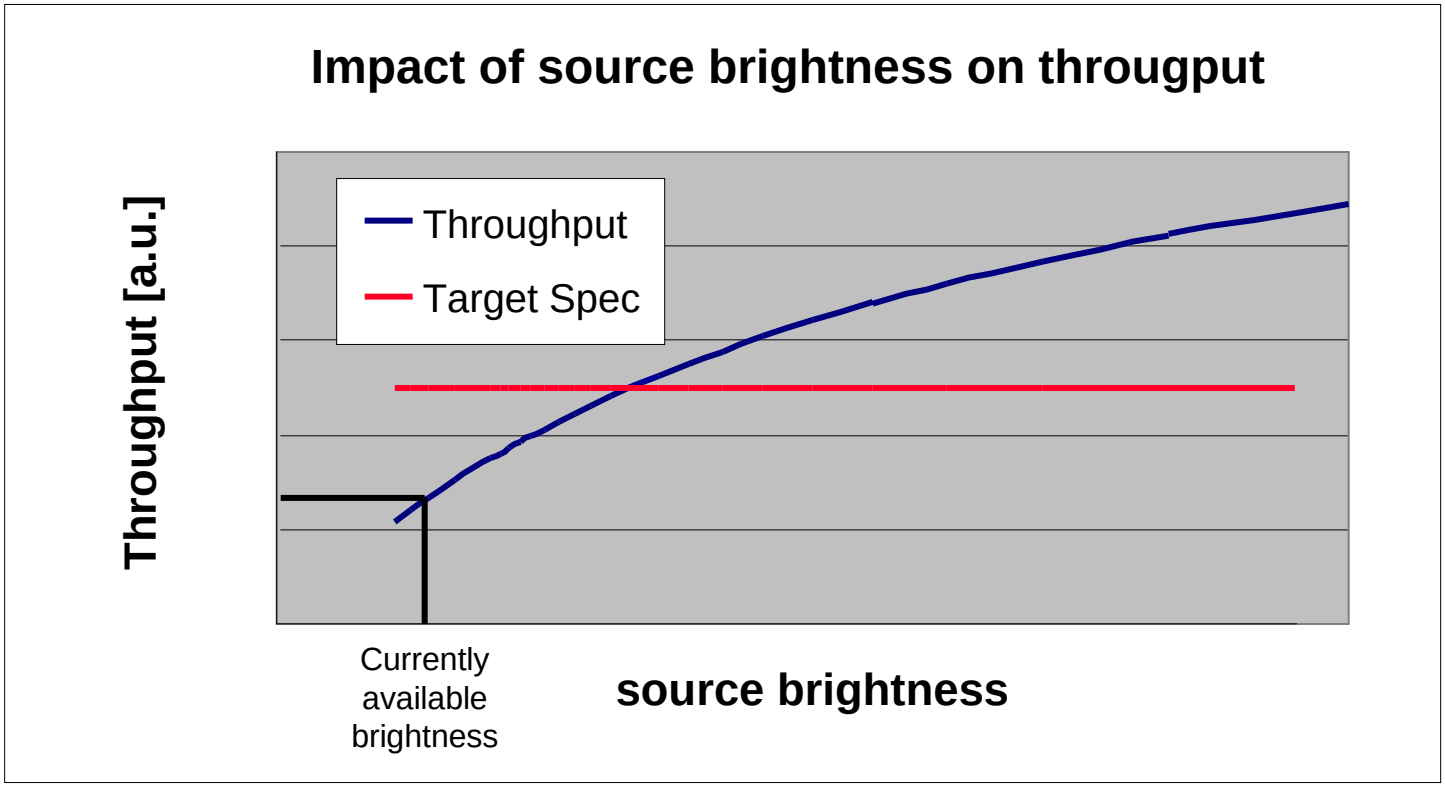


Optical Design – AIMS™ EUV

- All EUV optical design under development.
- Several designs under consideration.



EUVL High Brightness Source Status



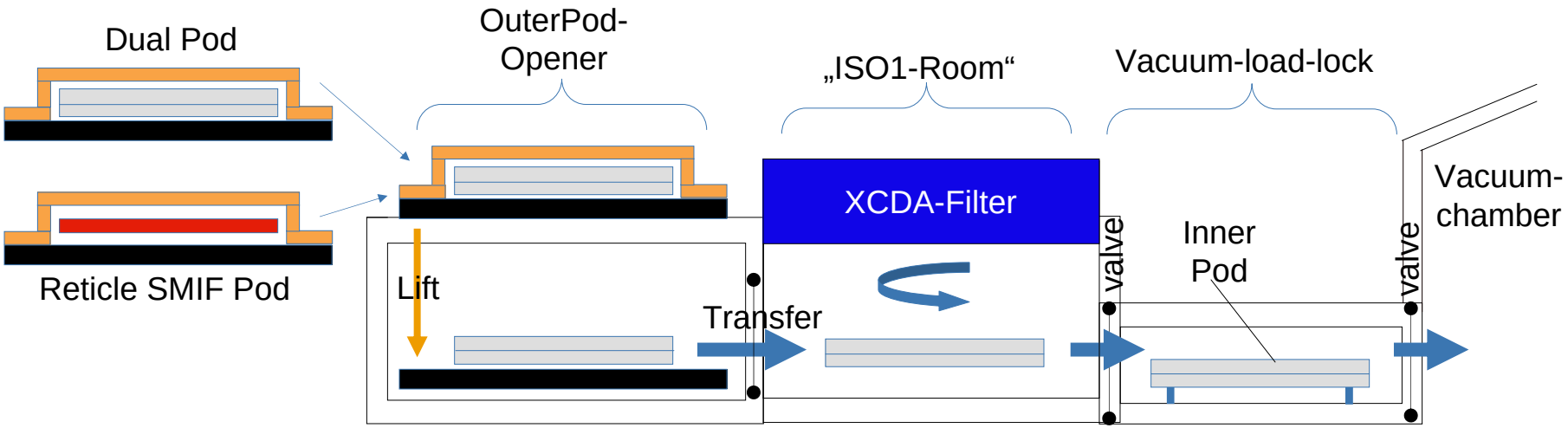
Current EUV sources deliver approximately 50% of required brightness.

=> Extension roadmap needed.

=> Trade off between throughput and CD repeatability.

AIMS-EUV Handling

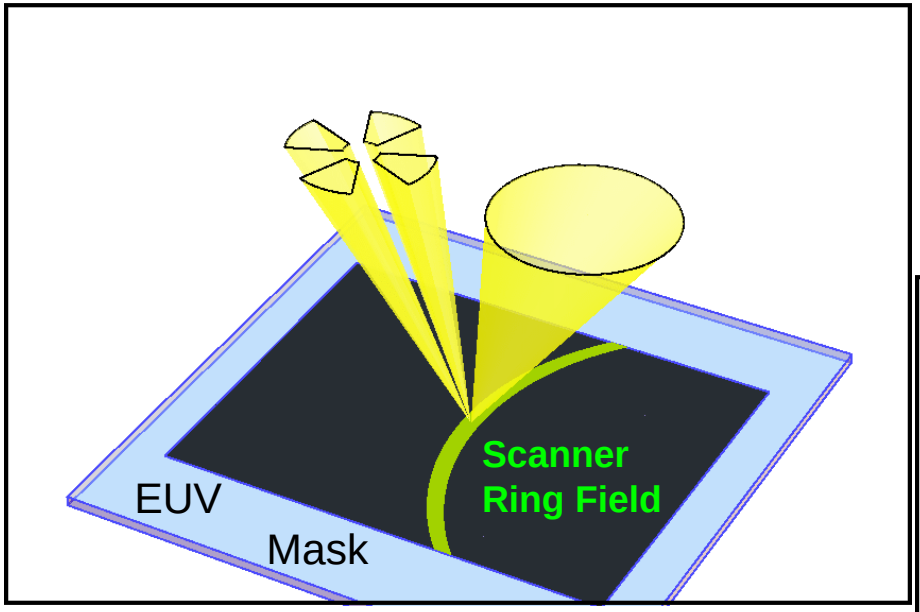
AIMS EUV: Zero contamination requirement (molecular and particle)



Four step transfer concept for particle and molecular contamination prevention

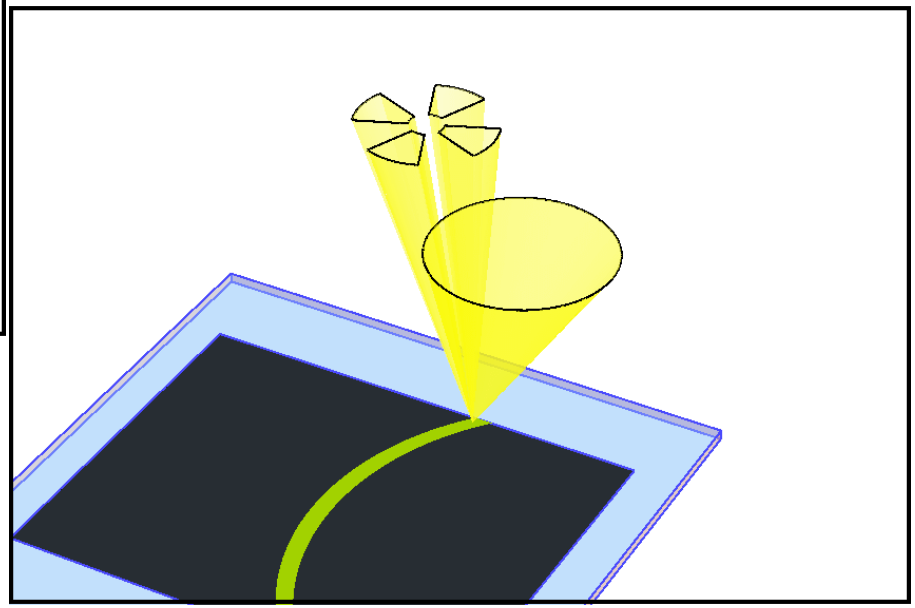
Main Challenge: ▶ Infrastructure for ISO1 and contamination testing

New Requirement:
EUV Scanner Ring Field

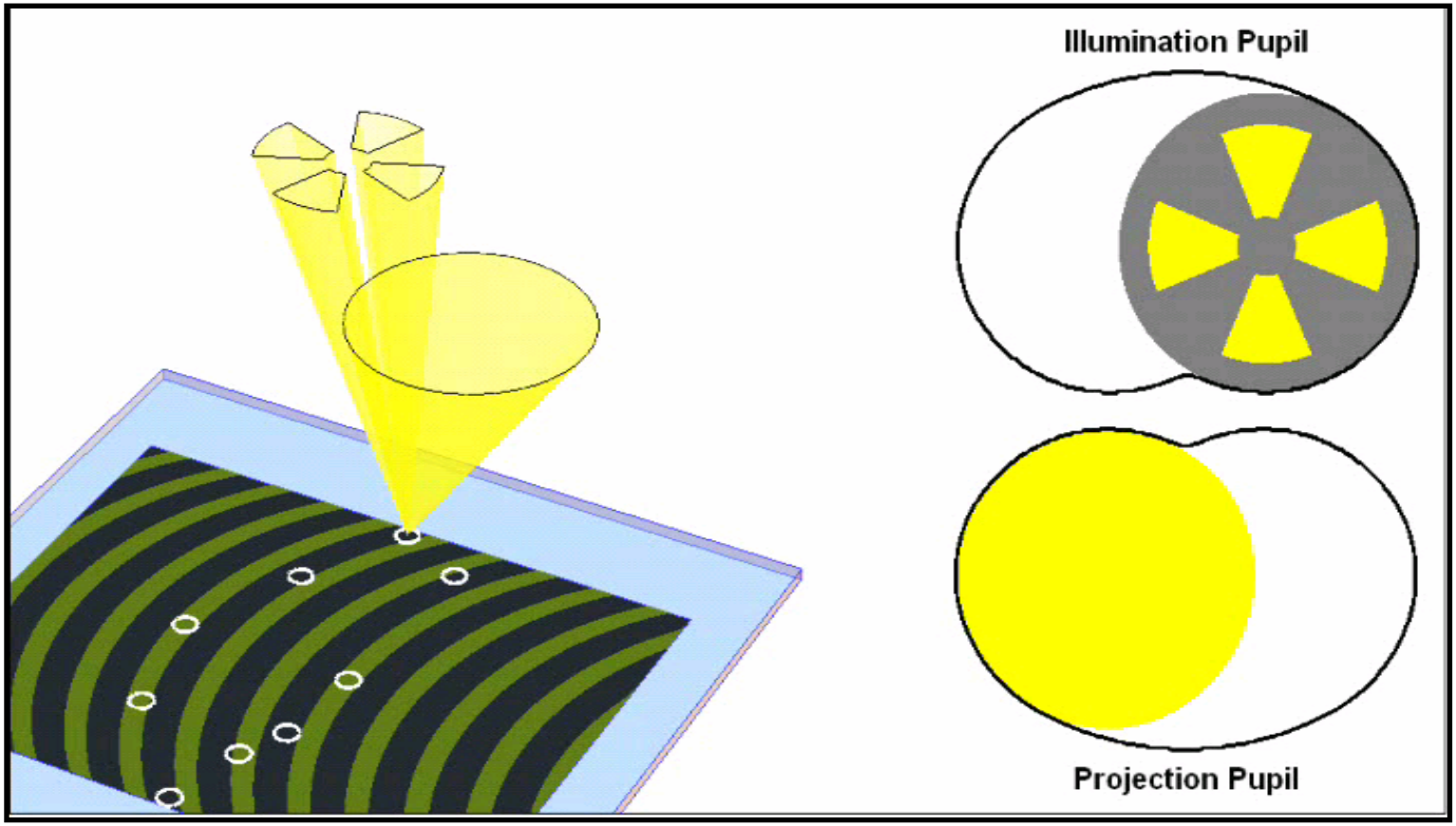


Illumination & projection light cones at the center of the mask

Light cones at the edge of the mask



Emulation of EUV Scanner Ring Field by AIMS™ EUV



Illumination angle variation leads to

- **Lateral motion of illumination and projection pupil blades**
- **Larger optics**

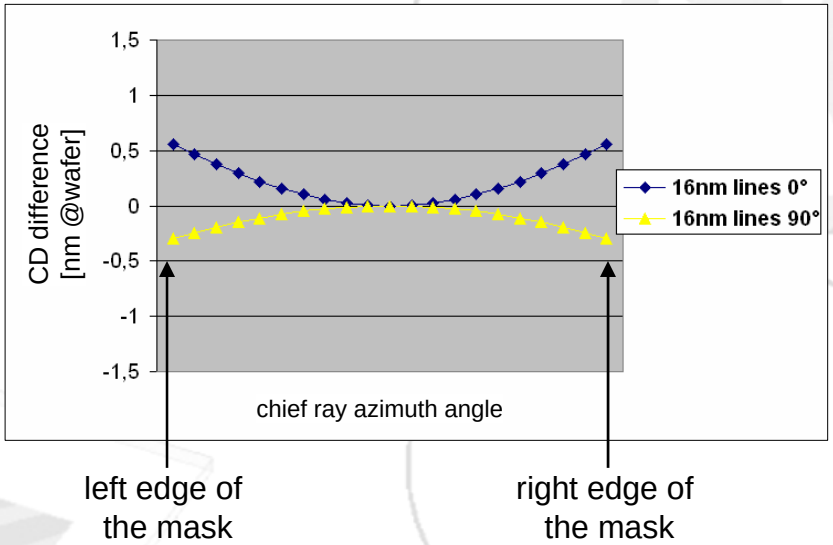
What does this matter for AIMS™ EUV?

=> On EUV masks the OPC needs to be position dependent

- But: the effort for precise mechanics to move the pupil blades in vacuum will increase tool price
- Can we ignore the optical effect?

- Simulation: CD error over mask position for 16 nm H and V lines

- CD change up to 0.55 nm = 3%



- Matters when comparing equal structures at different mask positions
- Is 0.55 nm acceptable?

What does this matter for AIMS™ EUV?

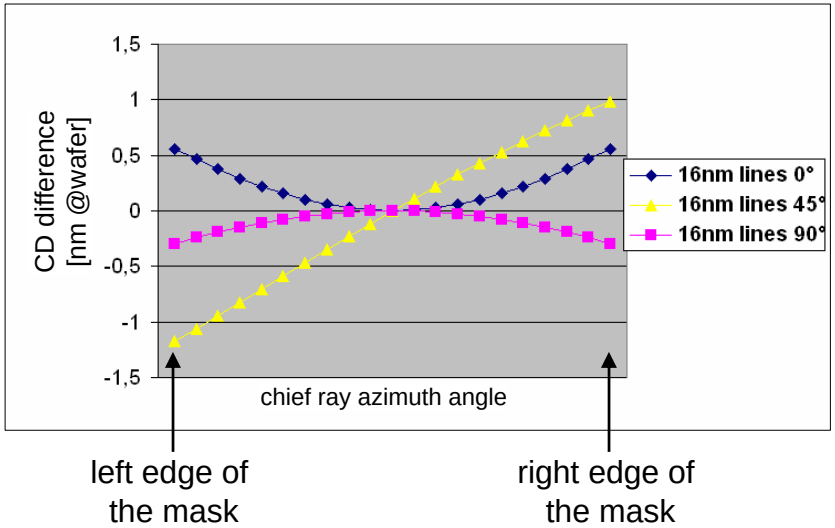
- Effect increases quadratically with increasing angle between illumination direction and structure orientation

=> H- and V-lines are least sensitive

- So what about 45° lines (relevant for brickwalls)?

- Simulation for 45° lines:

- Delta CD up to 6 %
- Delta MEEF up to 20%



=> This can not be accepted

=> We have to and will do the effort
The AIMS will emulate the varying illumination angle

Summary

Zeiss is about to close the mask infrastructure gaps with dedicated EUV solutions

- PROVE (registration tool) capable and extendable for EUV masks
- Merit HR32: EUV mask repair successfully demonstrated

- AIMS™ EUV concept and feasibility study running June-Dec 2010
  - study on track
- Zeiss is committed to AIMS™ EUV main project
  - start envisaged: Jan 2011

Acknowledgement:
C&F study funded by Sematech

ZEISS

We make it visible.