



NIKON PRECISION INC.

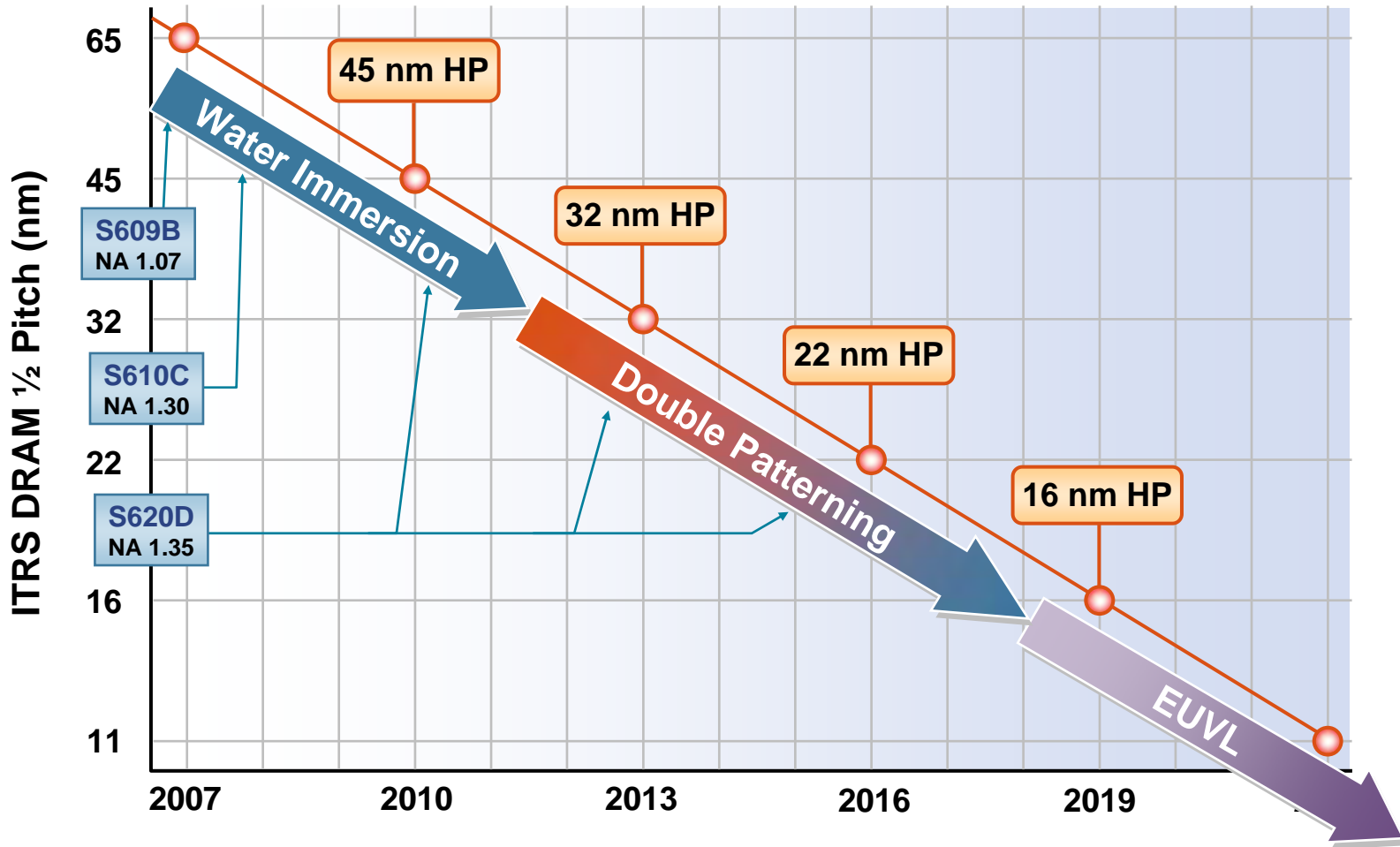
Extension of 193 Immersion Lithography

Steve Renwick

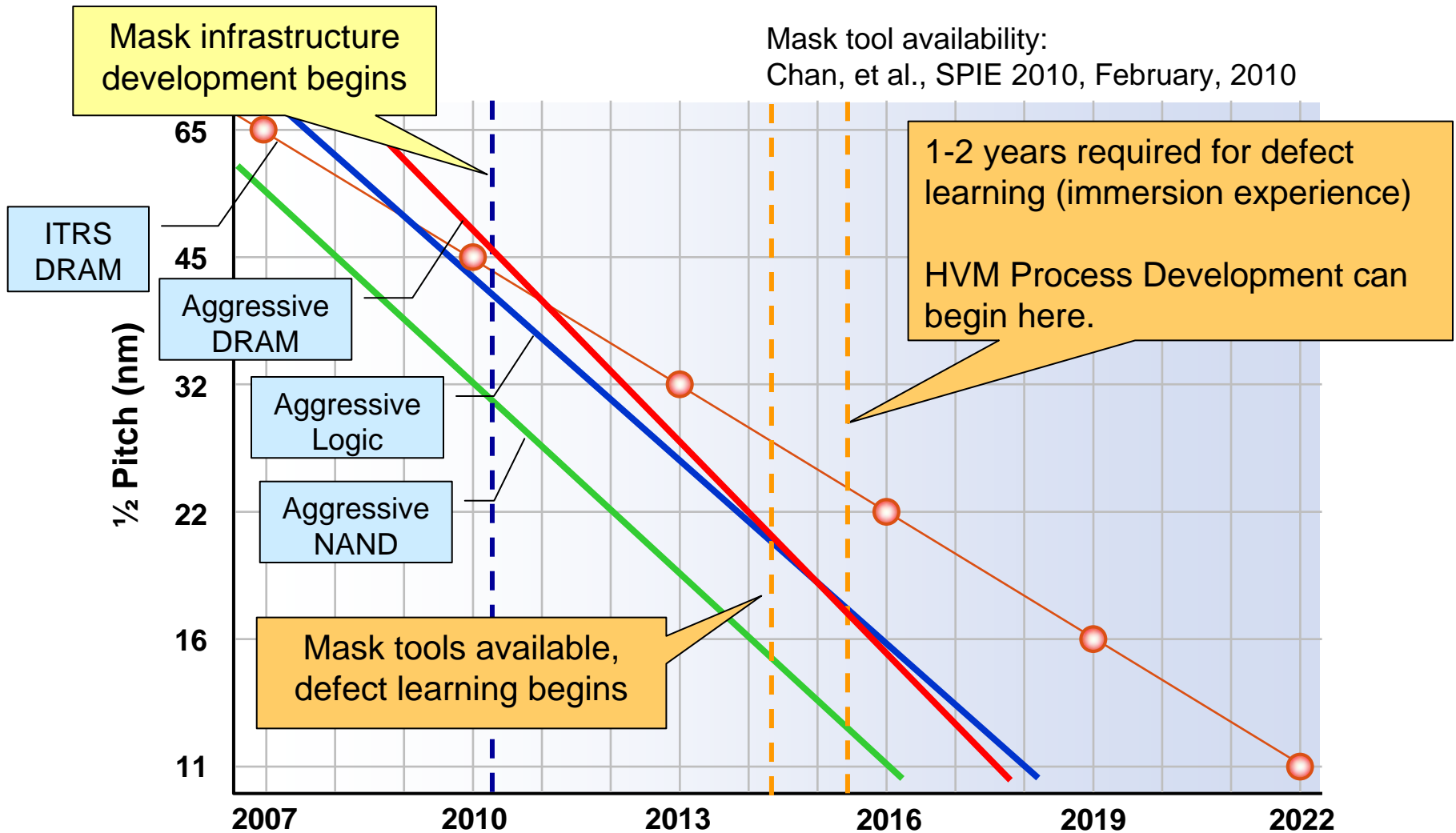
Senior Principal Engineer, NPI

- EUV Status
- Bridging to EUV
- Scanner Requirements for DP
- NSR-S620D Performance

Lithography Technology Roadmap



EUV Infrastructure Schedule

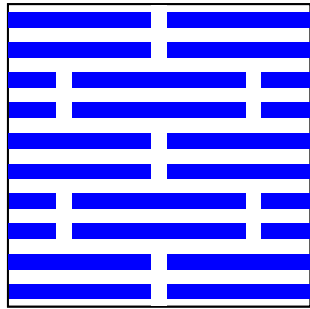


**Delays in infrastructure continue to push out adoption of EUV
→ increased cost and longer ROI for equipment makers**

- Extend single patterning:
 - Source mask optimization and custom illumination
- Enable 32 nm half pitch and beyond
 - Spacer double patterning
 - Pitch splitting double patterning (LELE, LFLE, etc.)
 - Line cutting lithography

Tool makers need to support these schemes

Line Cutting Litho Concept

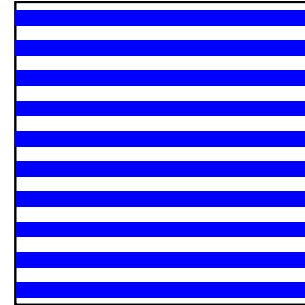


Target
22 nm SRAM
Gate Cell

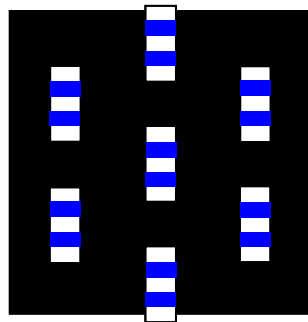
44 nm HP
Patterning



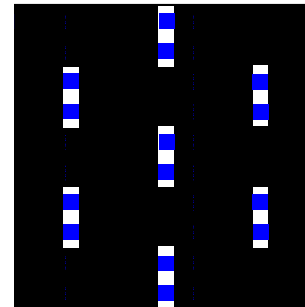
Spacer
Pitch Doubling



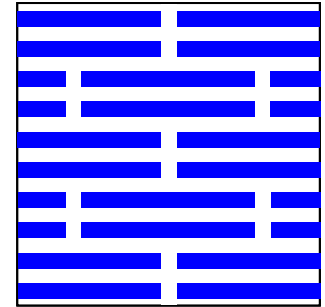
Cut Hole
Patterning



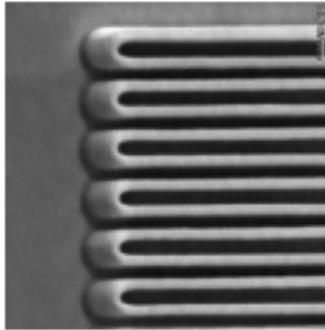
Hole Chemical
Shrink



After Etch

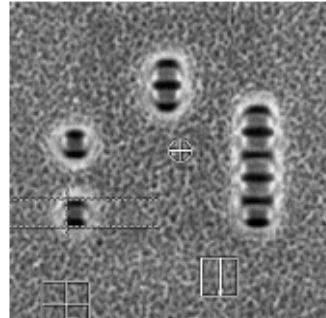


Line Cutting Lithography Concept

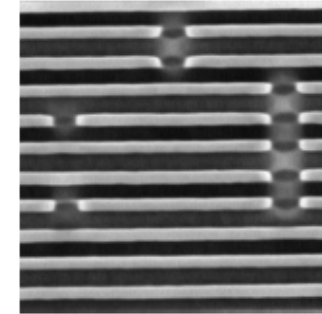


**1st patterning
(LS formation)**

+



**2nd patterning
(Cut)**



Result

C. Bencher, et al., SPIE 72740G (2009)

Down to 19 nm half pitch can be achieved

- Enabling Superior Yield:
 - Overlay accuracy to enable DP
 - CD uniformity
- Enabling Affordable Lithography:
 - Reduced wafer overhead time
 - Maximum throughput
 - Low CoO via multi-generational use of the tool
- Enabling Rapid Production Ramps:
 - Faster installation
 - Optimal uptime
 - Platform to enable reuse

The NSR-S620D Challenge



Streamalign Platform

NA 1.35
Projection
Lens

for **2** nm
self overlay

*Bird's Eye
Control*

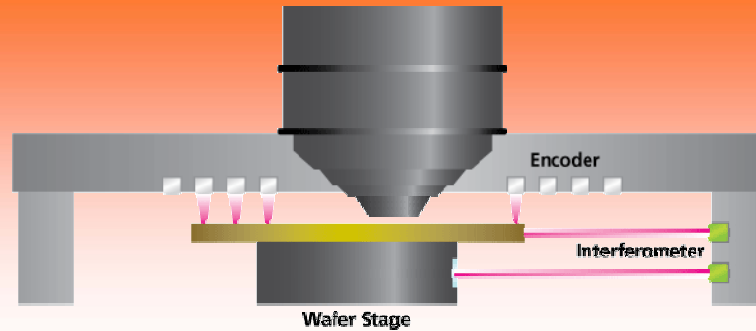
for **200** wph
throughput

*Stream
Alignment*

for **20** day
installation

*Modular²
Structure*

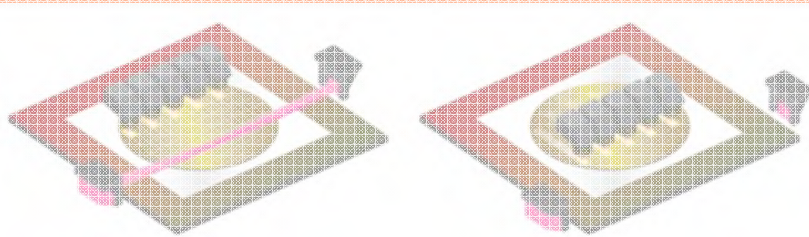
Enabling Superior Yield



Bird's Eye Control

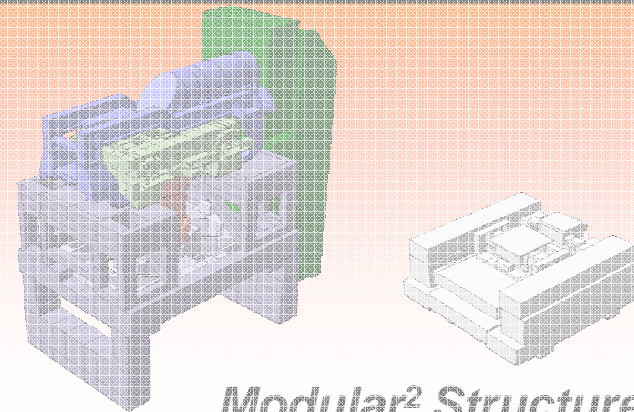
- Hybrid system uses laser encoders w/interferometers
- Dramatically improves accuracy and stability
- Targeting 2 nm overlay capabilities
- Superior focus control

Enabling Affordable Lithography



Stream Alignment

Enabling Rapid Production Ramps



Modular² Structure

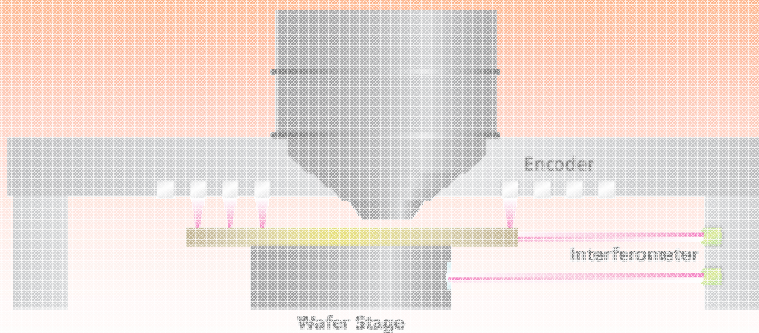
Enabling Affordable Lithography



Stream Alignment

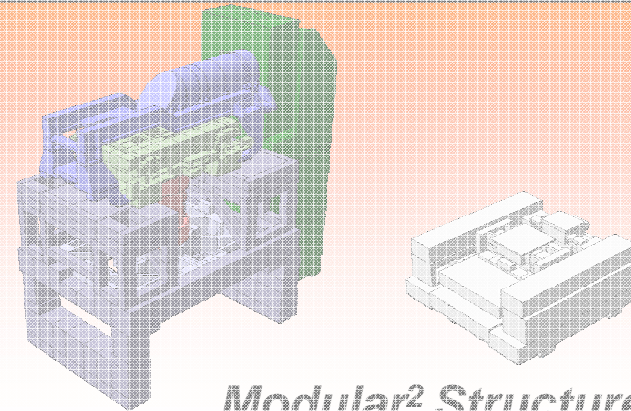
- Five-Eye FIA
- Straight Line Autofocus
- Greatly reduced wafer overhead time
- Targeting throughput up to 200 wph

Enabling Superior Yield



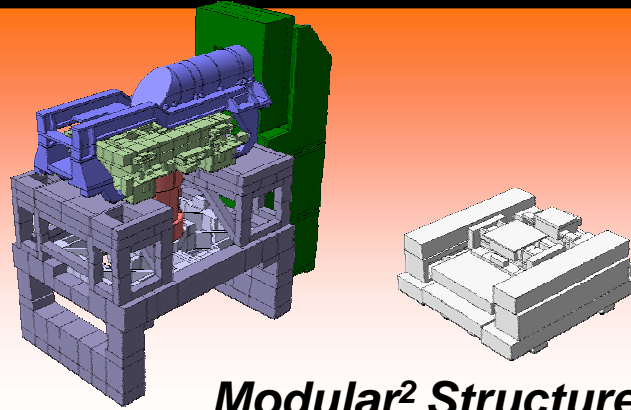
Bird's Eye Control

Enabling Rapid Production Ramps



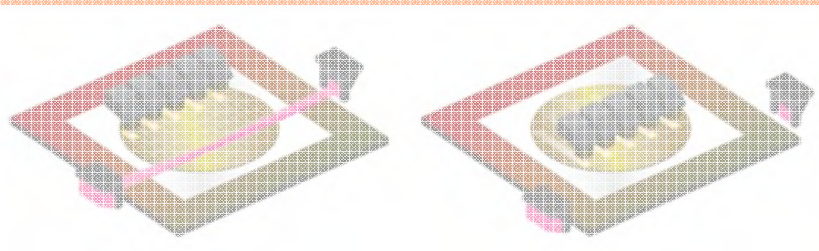
Modular² Structure

Enabling Rapid Production Ramps



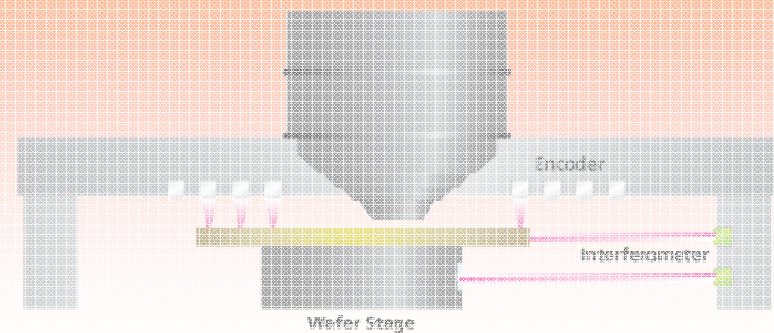
- Faster installation - 20 day target
- Simplified maintenance
- Optimal uptime
- Extendible platform to enable reuse

Enabling Affordable Lithography



Stream Alignment

Enabling Superior Yield



Bird's Eye Control

Scanner Requirements for DP



32 nm hp DP Budget

	Budget Spec	Line CDU	Space CDU
$\overline{L_1} - \overline{L_2}$	1.0 nm	2.9 nm	3.3 nm
CDU (3σ)	2.4		
OL $\overline{m_1} - \overline{m_2}$	0.5		
OL (3σ)	2.4		

CD control and overlay are critical for DP

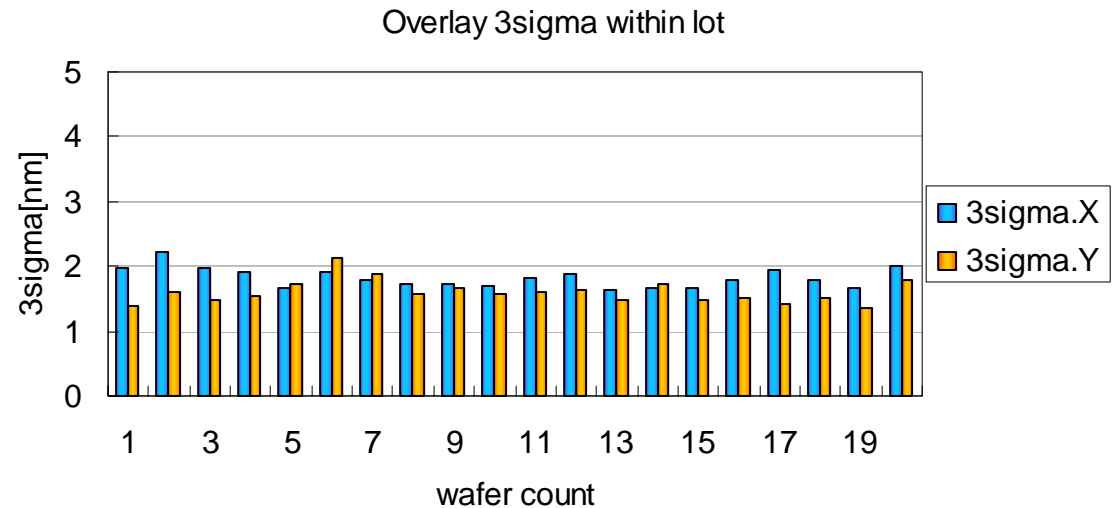
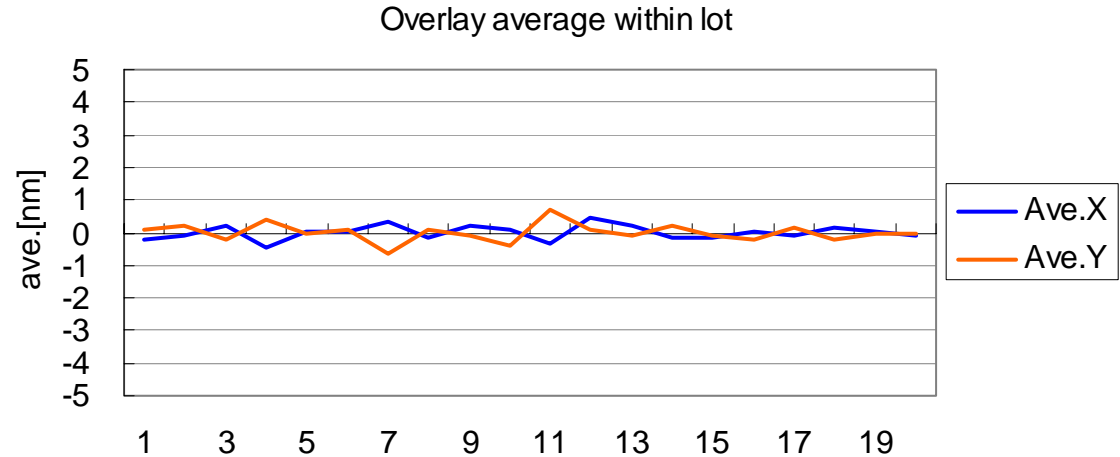
S620D Overlay Stability



	$3\sigma X$	$3\sigma Y$
Total 3σ	1.94	1.80

[nm]

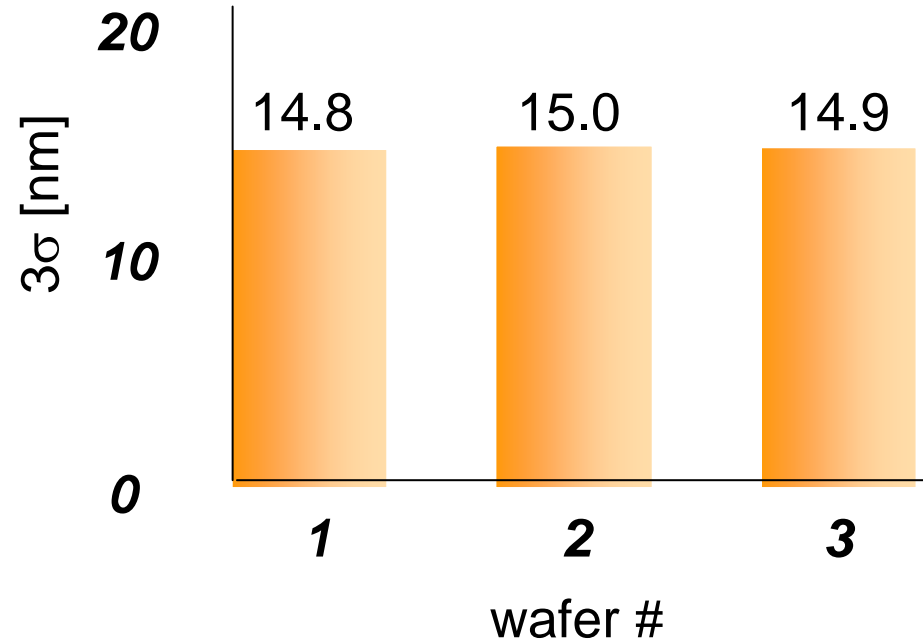
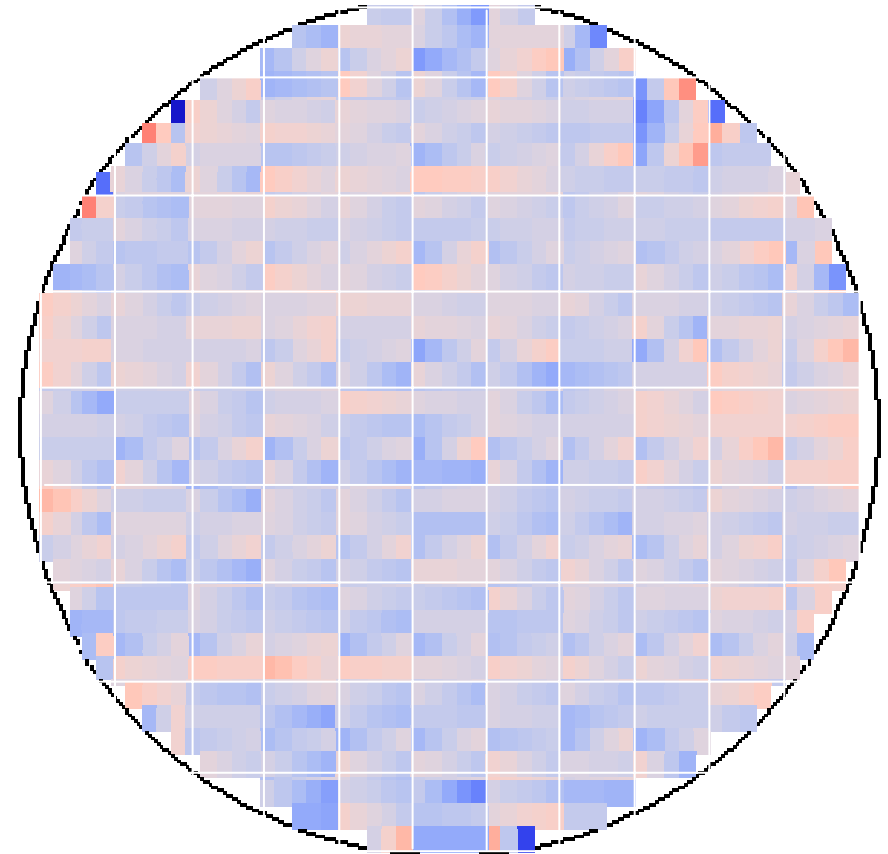
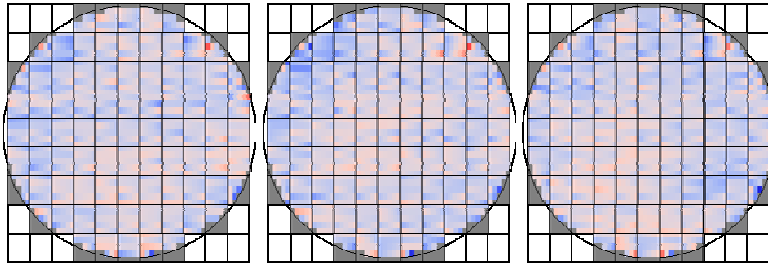
- 20 wafers continuous exp.
- Common linear terms removed



S620D meets overlay requirements for 32 nm hp DP

Focus Uniformity

14.3 nm, including edge die



Budget vs. S620D Data



32 nm hp DP Budget and Actual Data

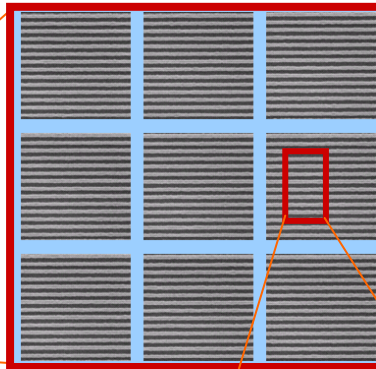
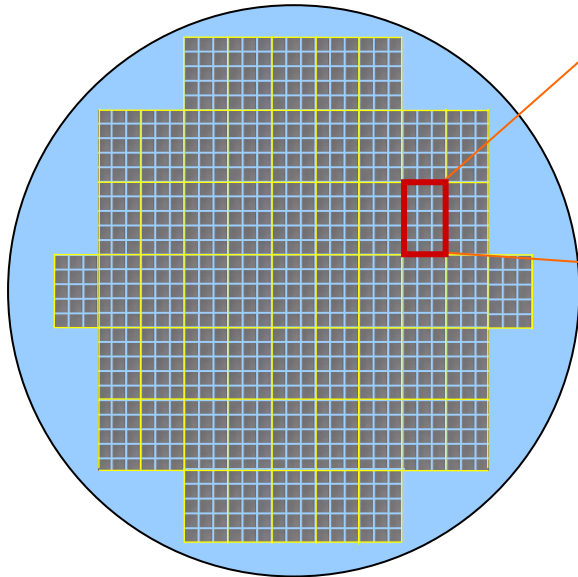
	Budget Spec	Line CDU	Space CDU
$\overline{L_1} - \overline{L_2}$	1.0 nm 1.1	2.9 nm	
ΔCD	2.4 2.1	2.5	
$\overline{m_1} - \overline{m_2}$	0.5 0.7		3.3 nm
ΔOL	2.4 1.9		3.3

S620D data meet the budget requirement

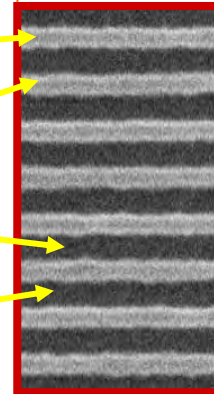
S620D Overall Performance



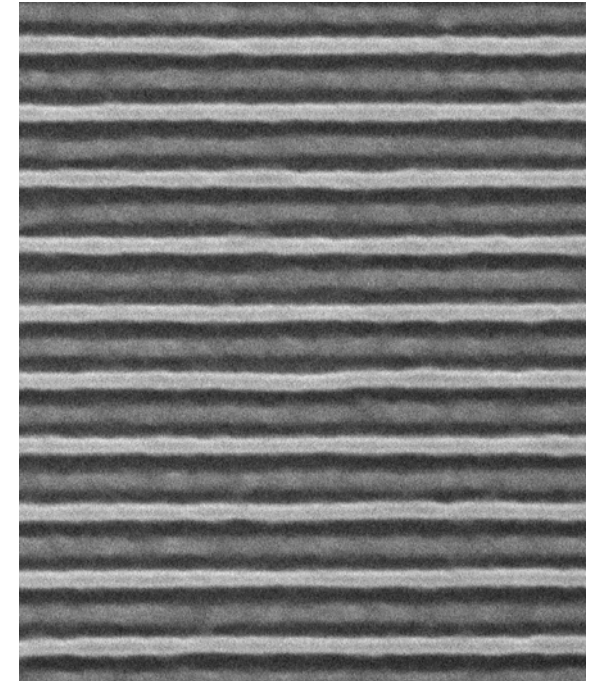
Line CDU (3σ)	2.5 nm
Space CDU (3σ)	3.3 nm



- Line 1
- Line 2
- Space 1
- Space 2

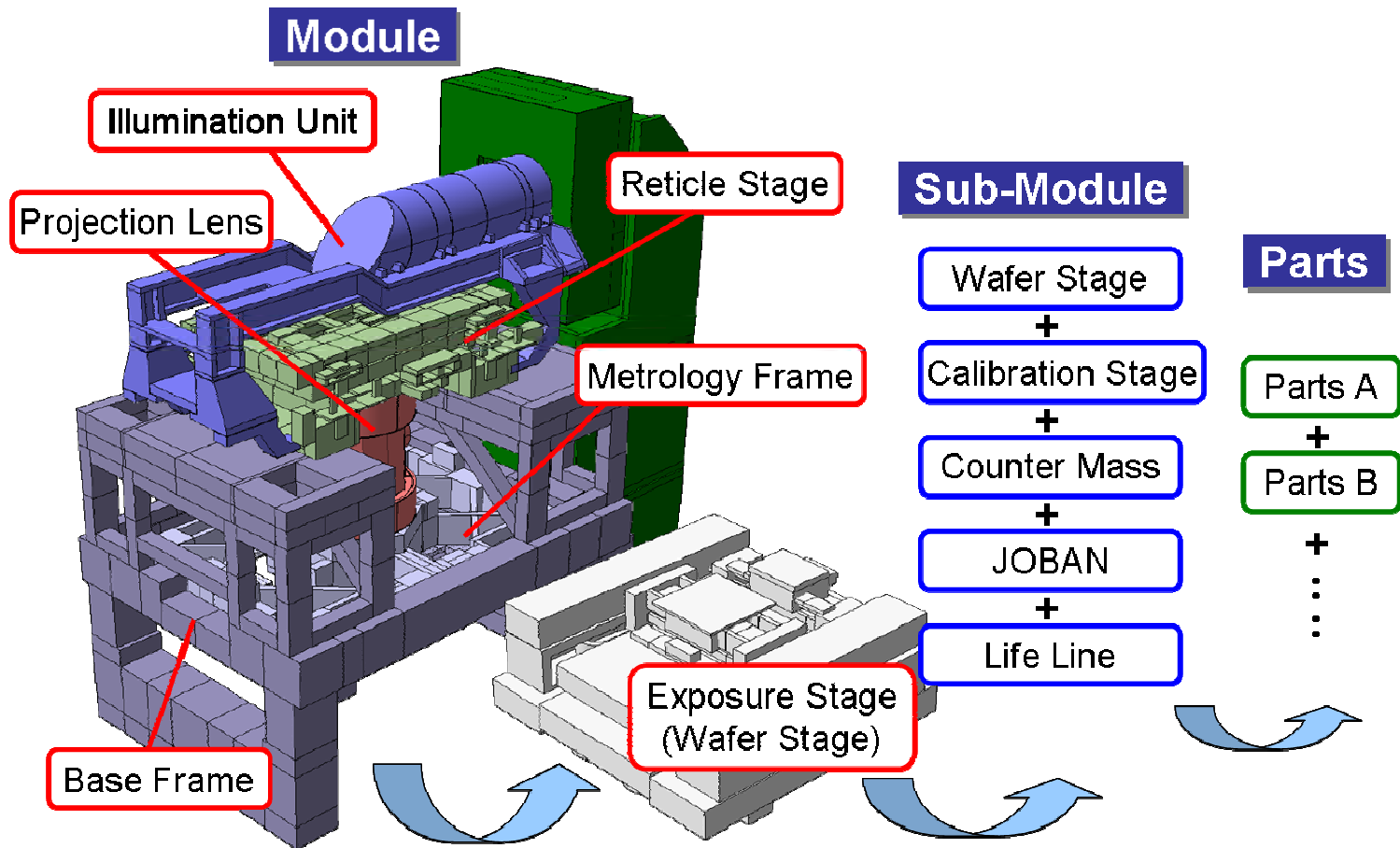


22 nm L/S



S620D enables pitch splitting DP

Extendible Platform for ArF Immersion



Modular² Structure allows multigenerational use

- The industry needs an interim solution for the 32 nm and 22 nm nodes, prior to the HVM development of EUV
- 193 immersion lithography will be extended by:
 - Source optimization and computational lithography
 - Double patterning
 - Multiple patterning and cutting lithography
- This places severe new requirements on a scanner for overlay and CD uniformity
- The Nikon S620D enables superior yield, affordable lithography, and rapid production ramps for 32 nm - with extendibility to 22 nm



NSR-S620D

ENABLING THE NEXT GENERATION