Scanning Beam Interference Lithography

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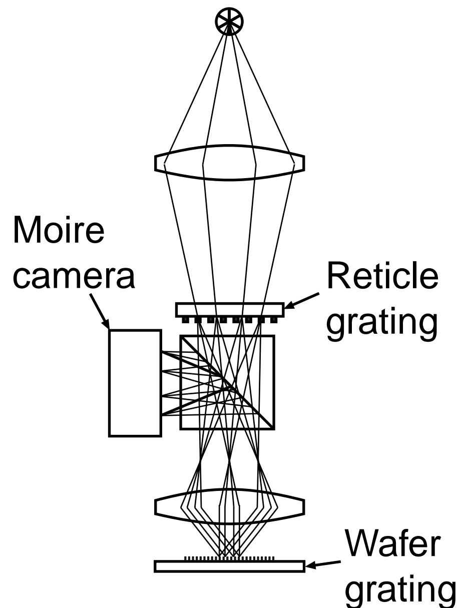
Research Objective

To develop interference lithography and fiducial grids as metrological tools.

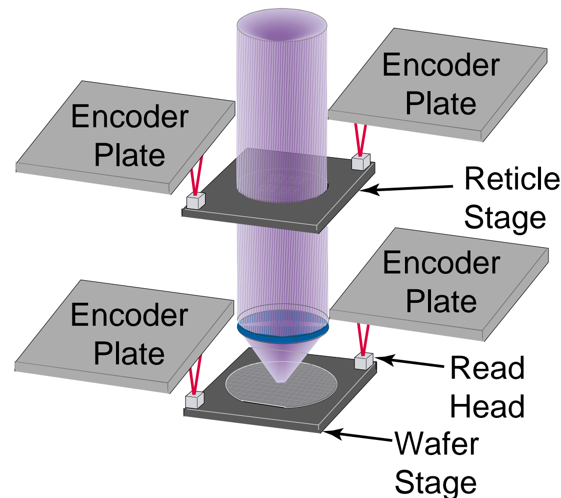
Short term goal: To pattern and measure gratings with repeatibility of 5 nm over 300 mm diameter areas.

Application of Fiducial Grids to Metrology

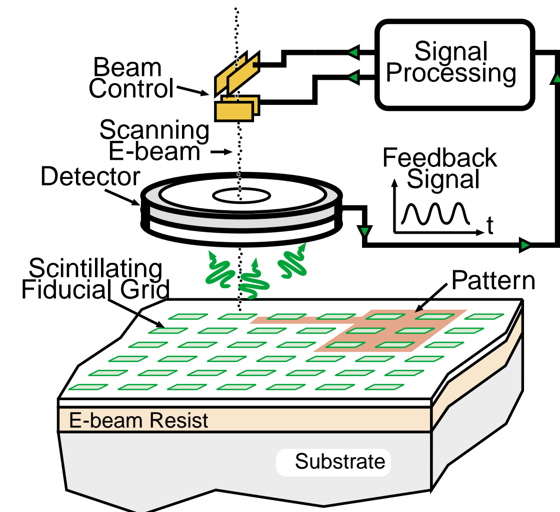
Lithography metrology.



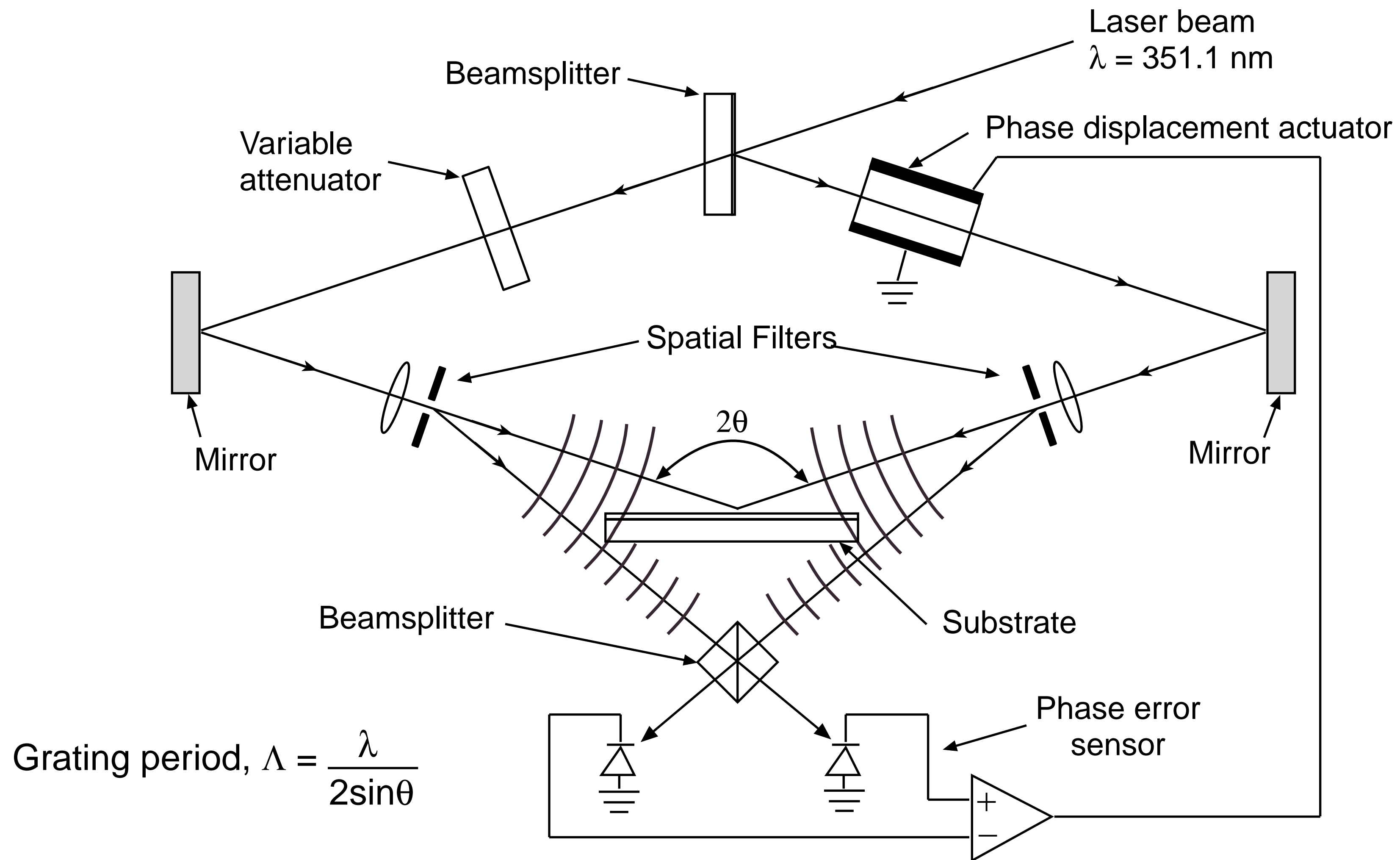
Stage encoders.



Reference for electron beam lithography

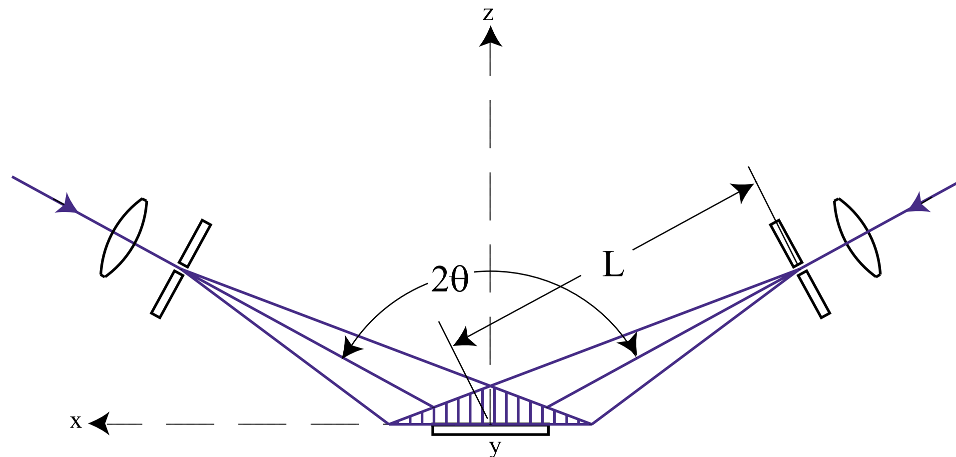


Traditional Interference Lithography

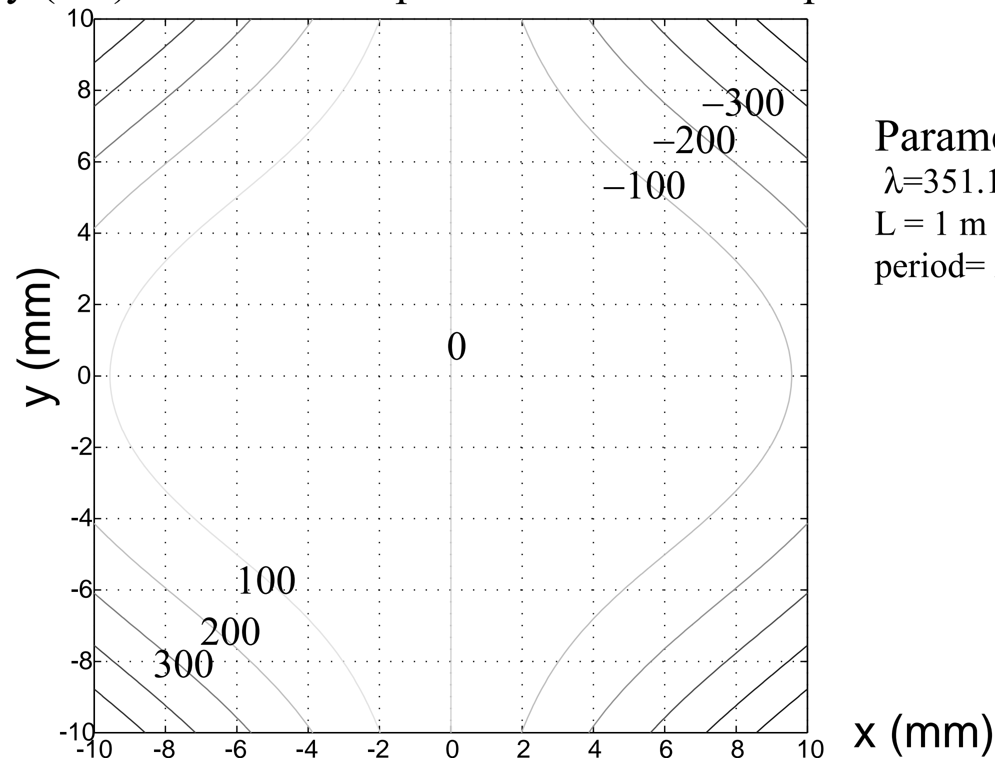


Grating period, $\Lambda = \frac{\lambda}{2\sin\theta}$

Phase Distortion of Interfered Spherical Waves



Discrepancy (nm) of interfered spherical waves with a perfect linear grating.



Parameters:
λ=351.1 nm
L = 1 m
period= 200 nm

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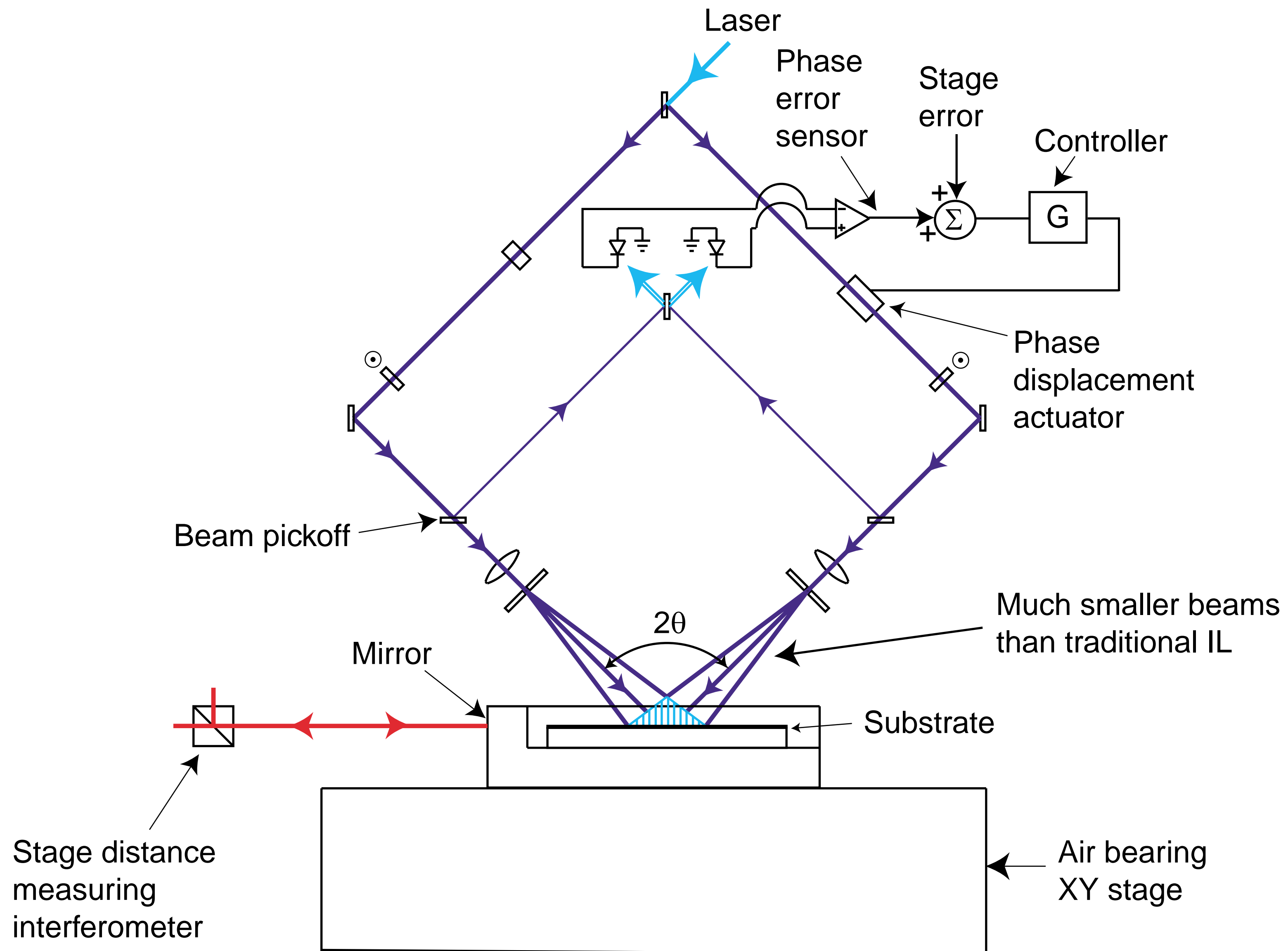
SBIL System Concept



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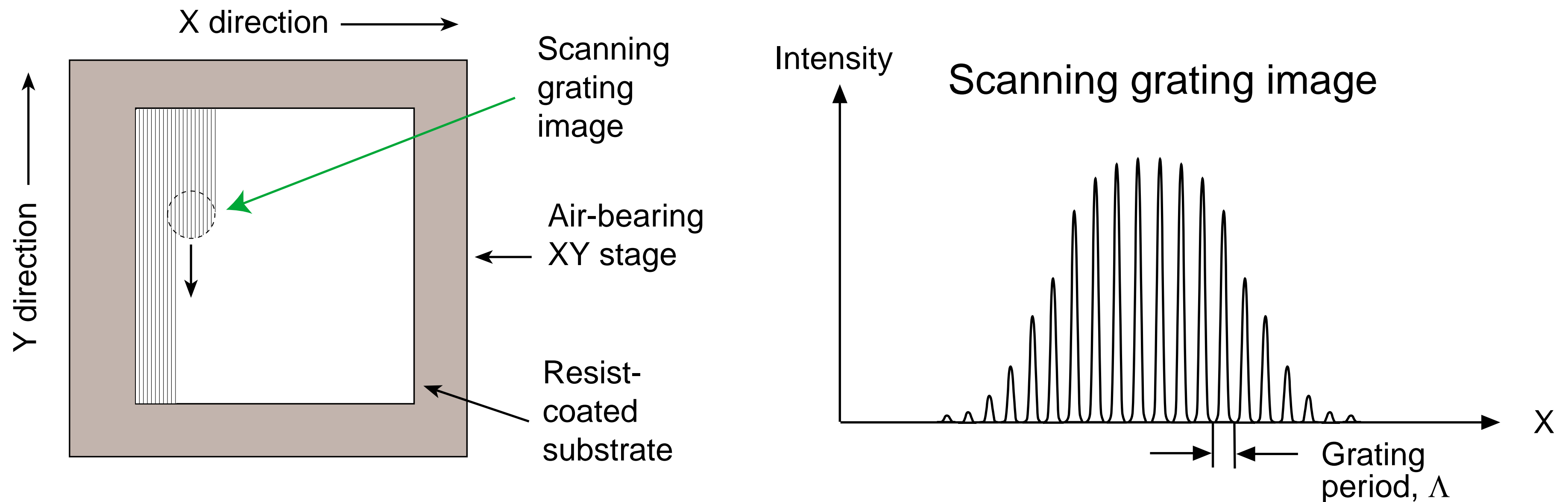
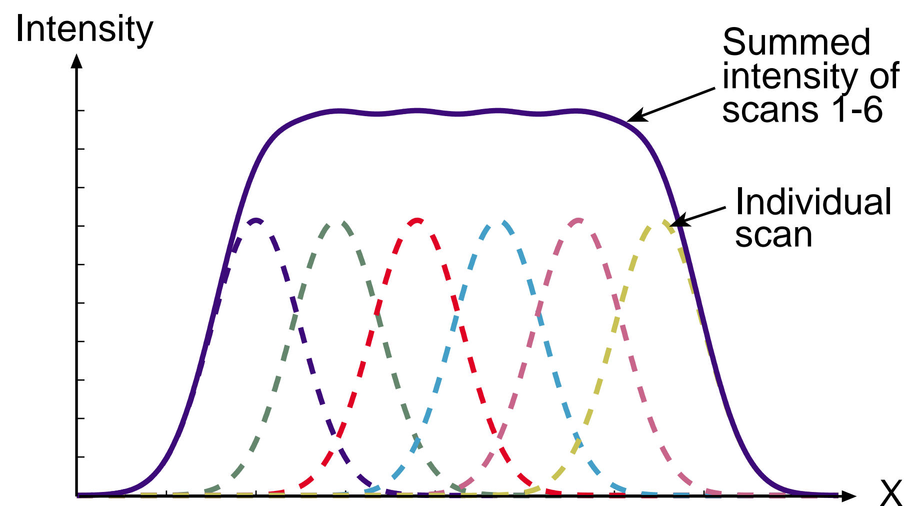
Grating Scanning Method



Overlapping scans closely approximate a uniform intensity distribution



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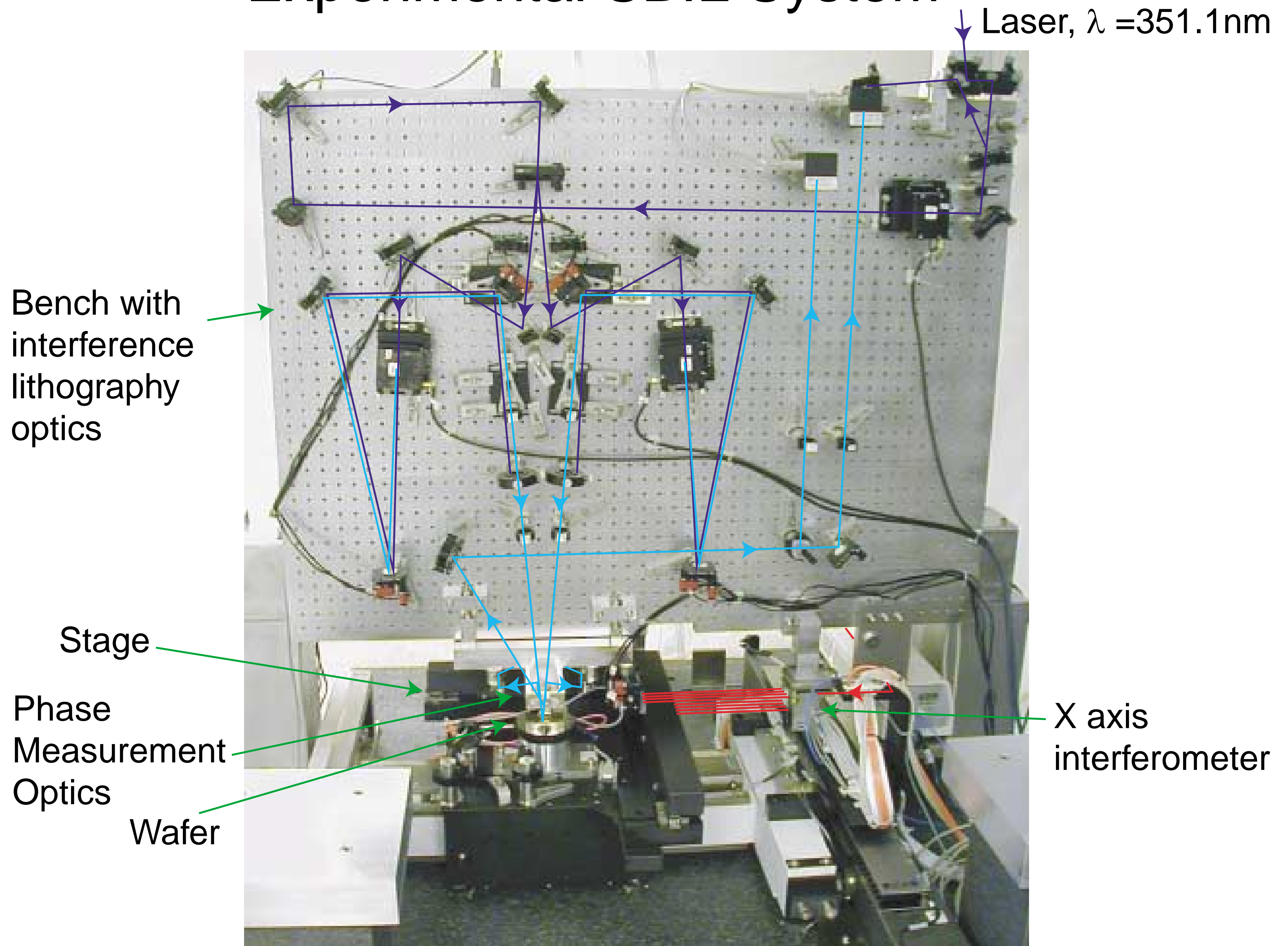
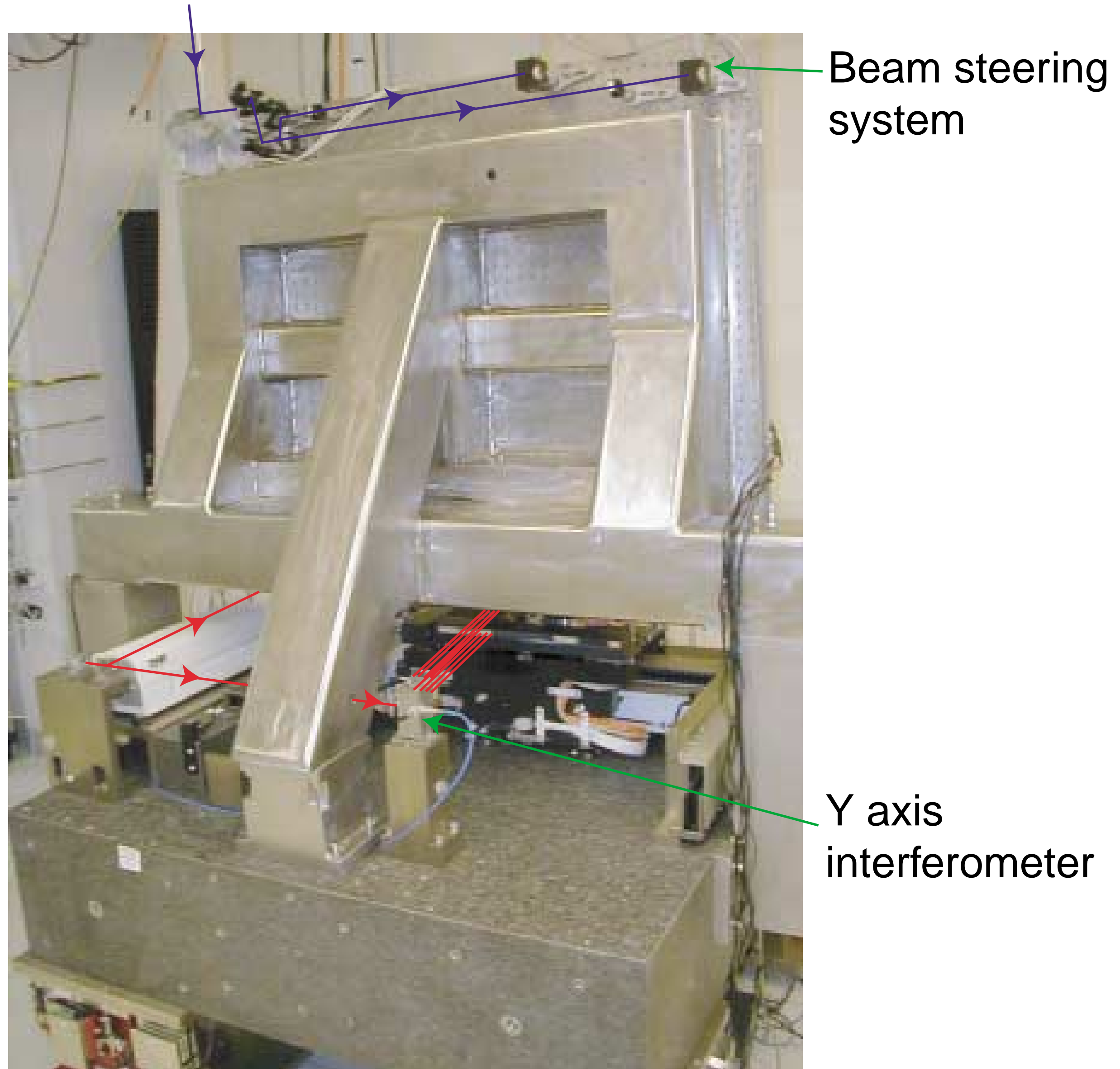
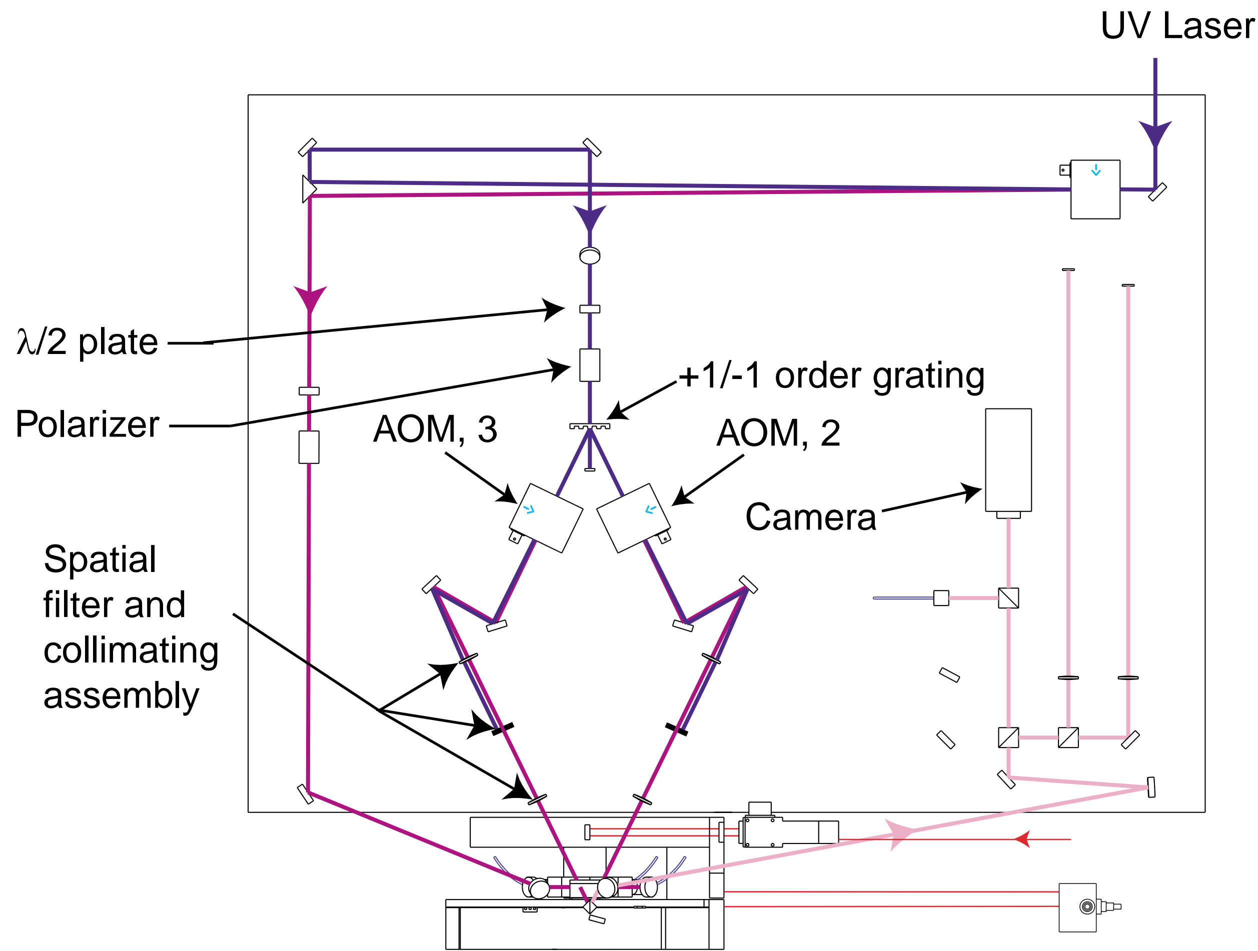
Experimental SBIL System



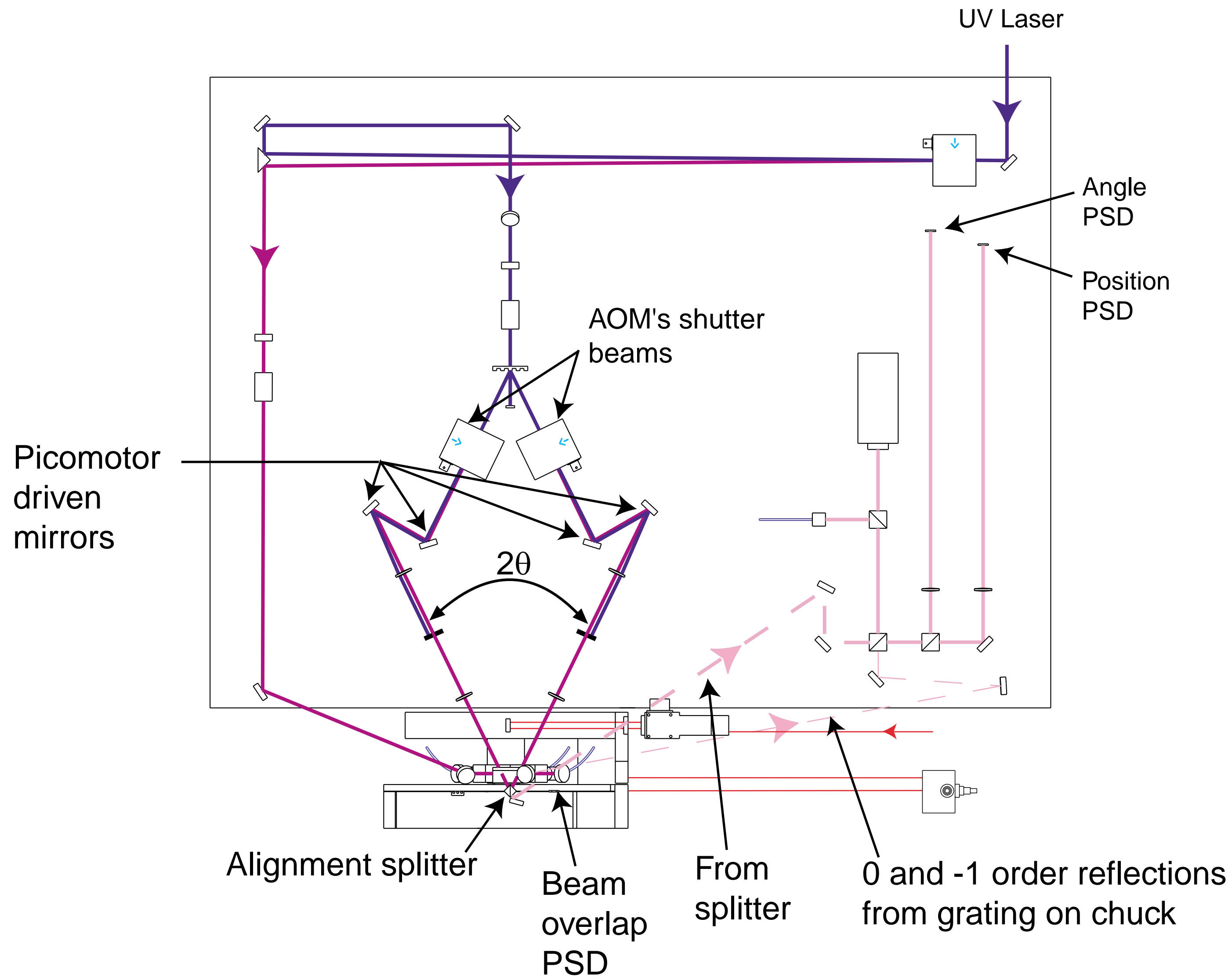
Experimental System, Rear View



SBIL Beam Conditioning Optics



SBIL Alignment Optics



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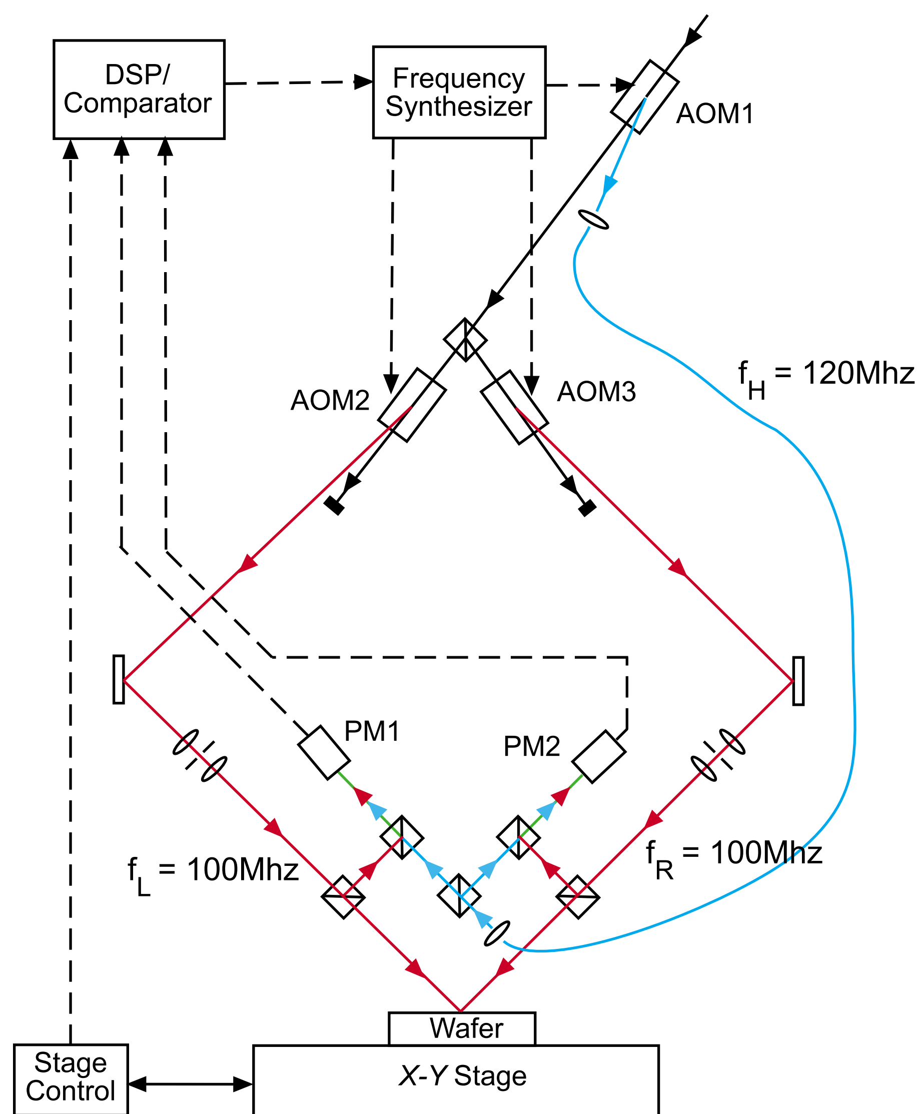
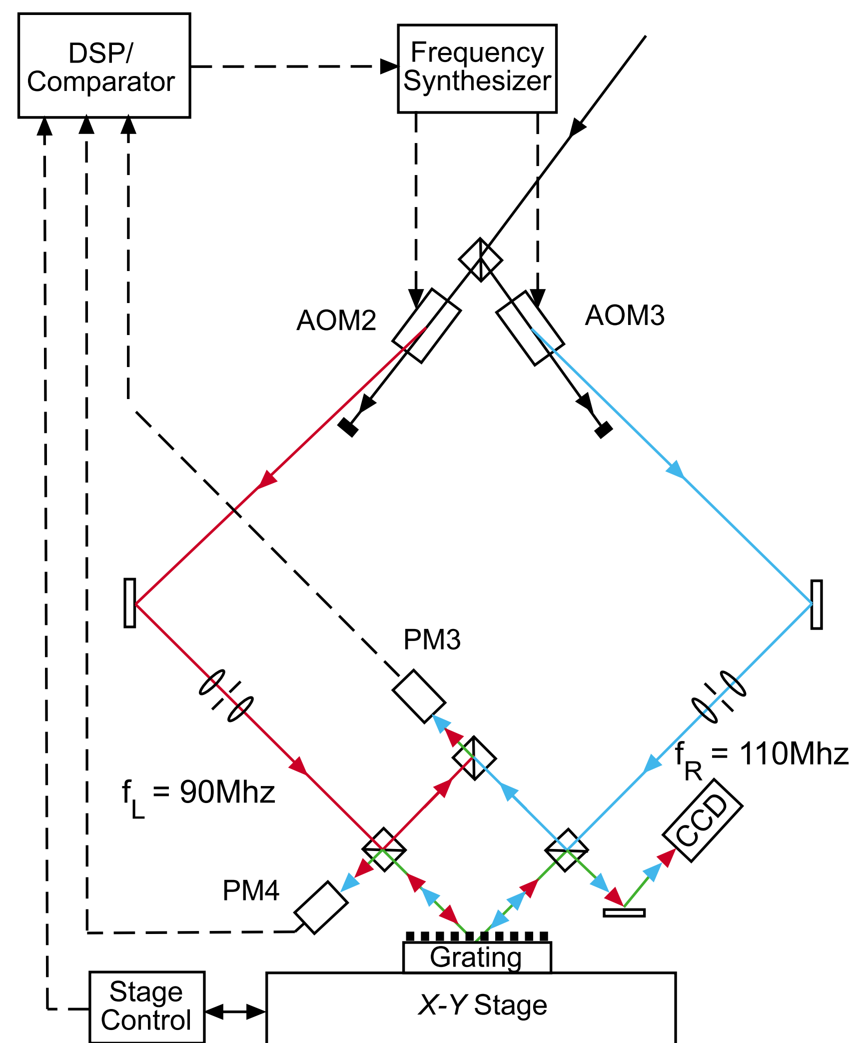
SBIL Reading and Writing Modes



(a) Writing Mode



(b) Reading Mode

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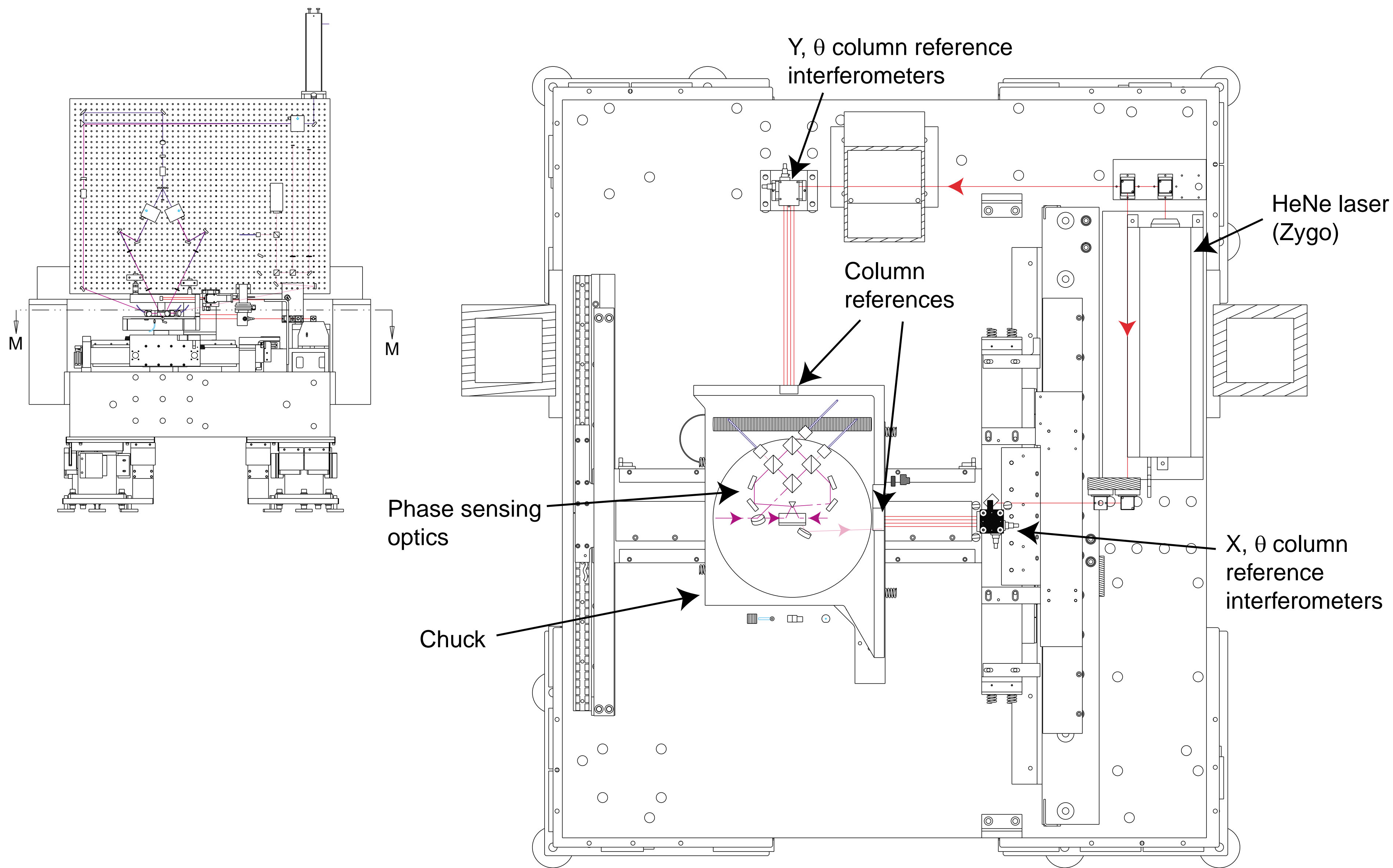
Stage and Lithography Metrology



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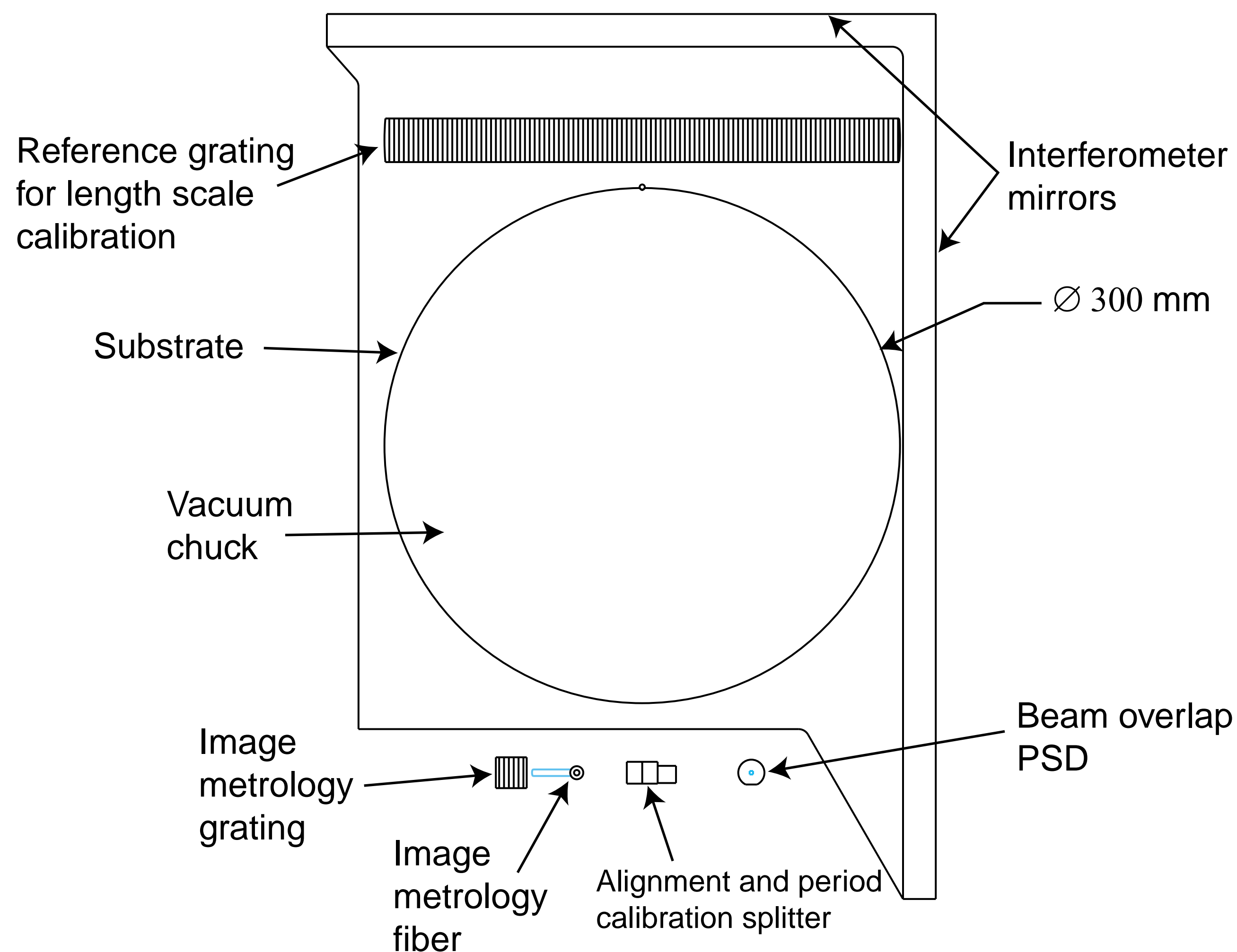
Chuck with Metrology References



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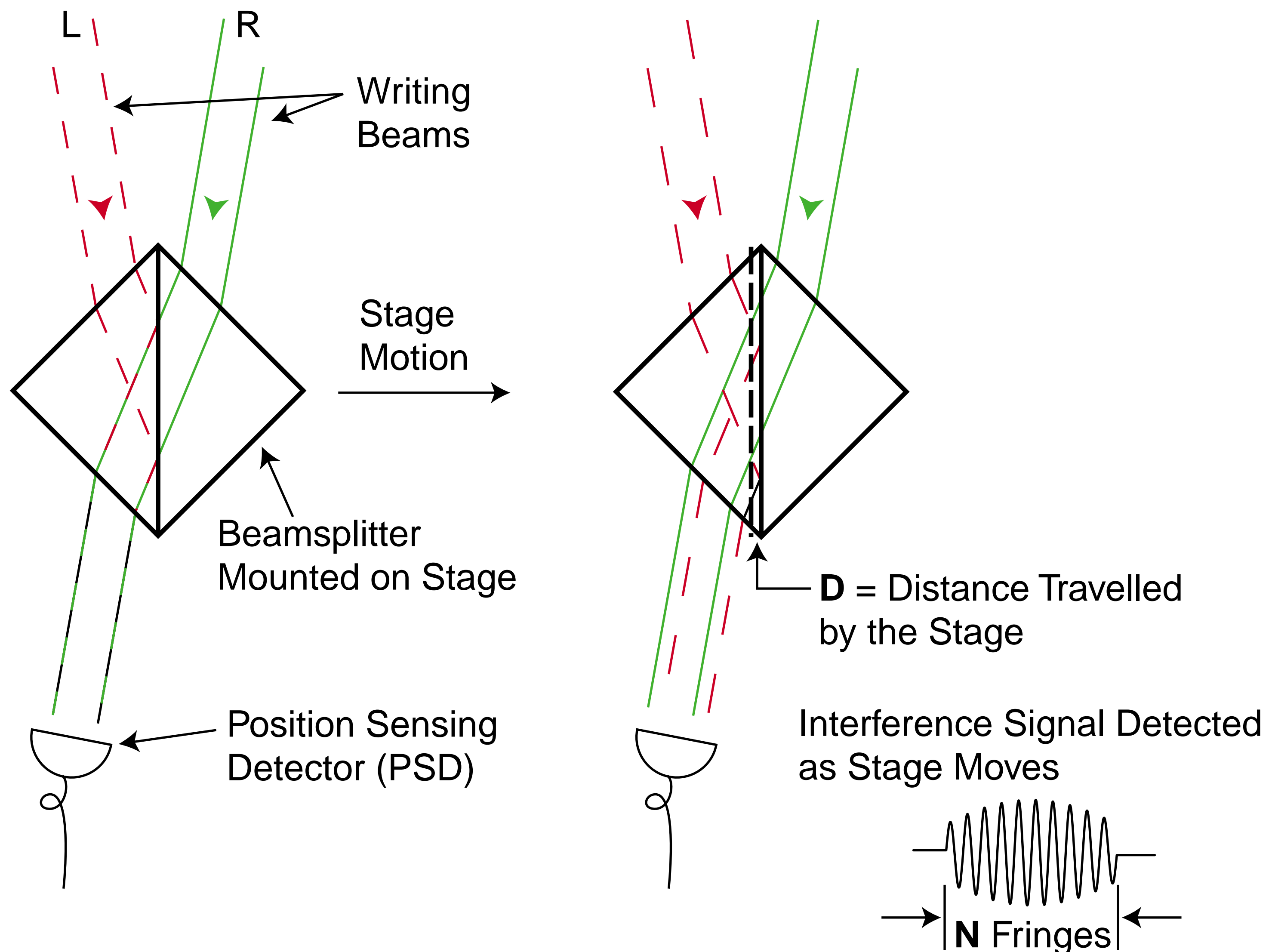
Period Measurement with a Beamsplitter



Grating Period = D/N

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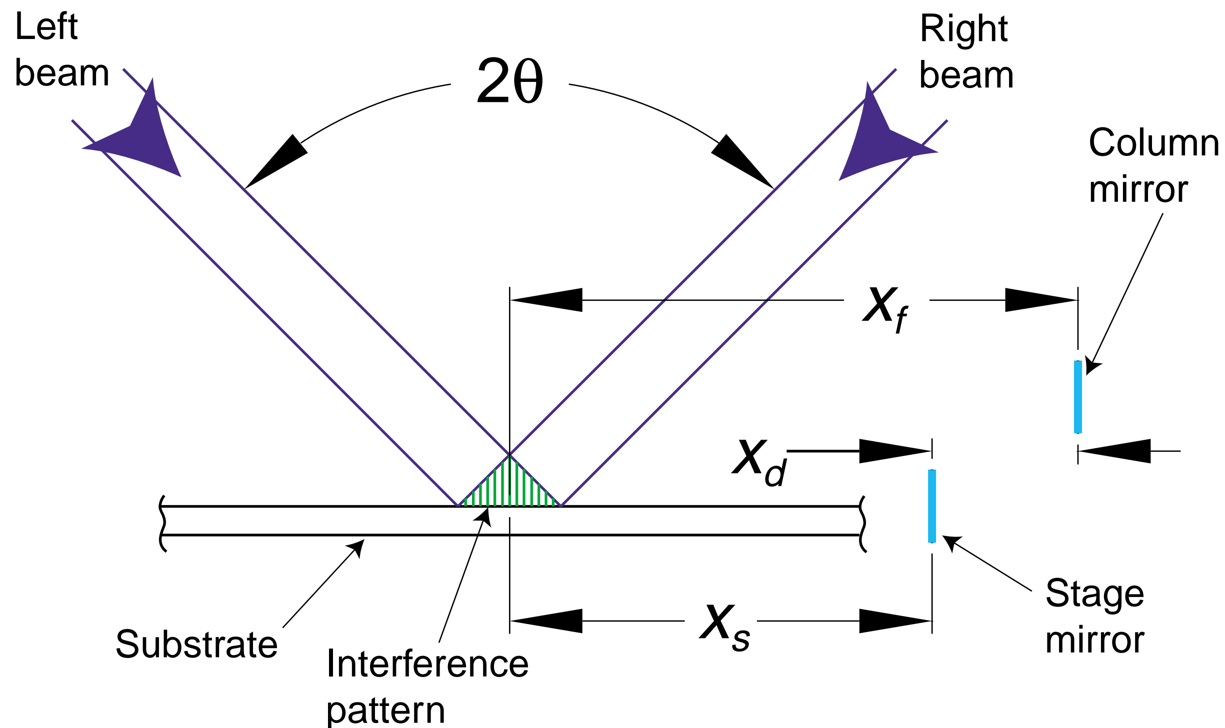
System Errors



Error Categories

Stage interferometer (x_d)

Fringe locking and metrology frame(x_f)

Substrate frame (x_s)

Period Control

Image Distortion

Conclusions

We are developing SBIL for producing gratings and grids with nanometer level distortions.

Key system requirements

- beam conditioning
- alignment
- placement accuracy