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A NOVEL METHOD FOR THE ON-CENTER TURNING OF TIGHTLY TOLERANCED MICRO ARRAYS

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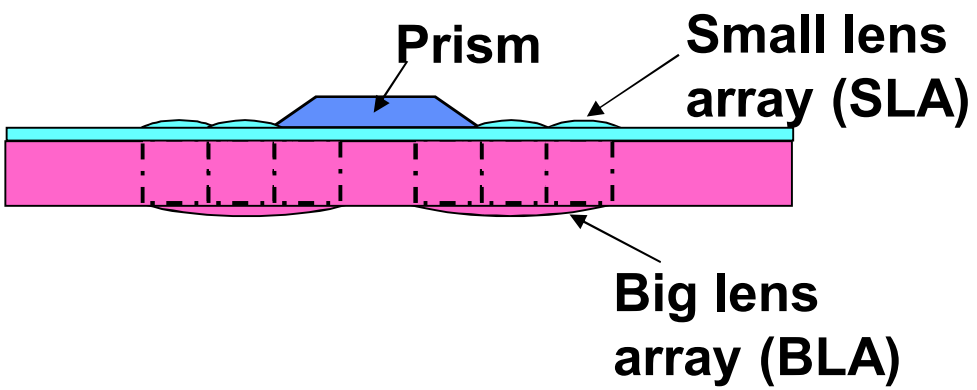
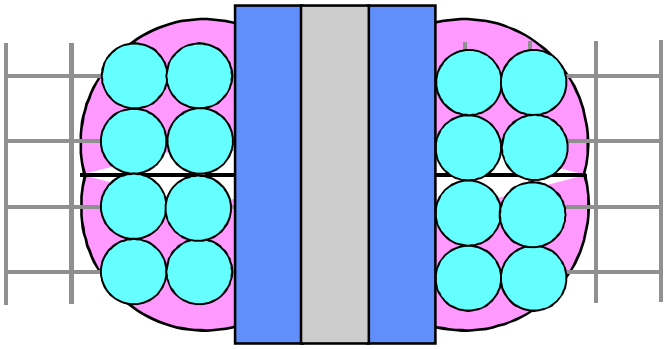
Optical System Description



Side View



Top View

- 16 Small Aspherical Lenslets 250um dia.
- 4 Large, Truncated, Aspherical Lenslets 910um dia.
- Rooftop Prism
- All on a 250um pitch spacing

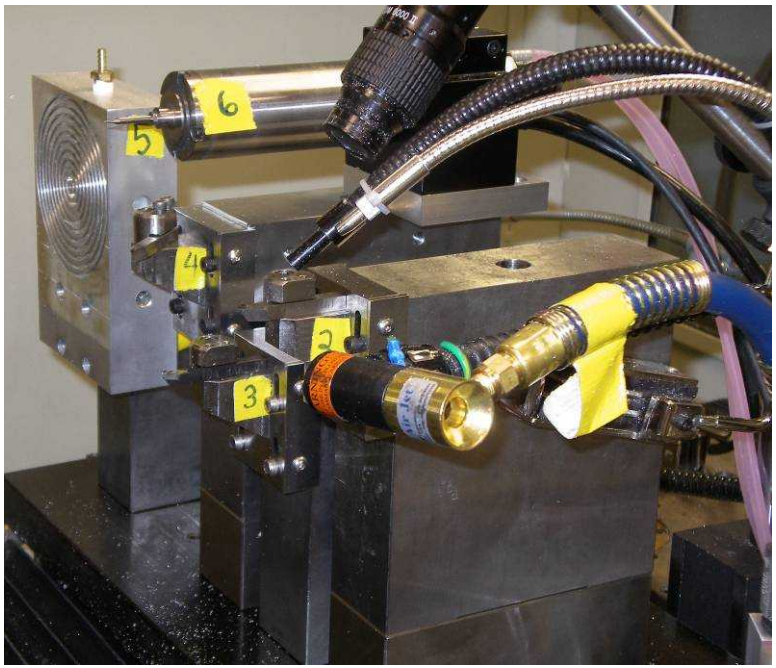
Design Tolerances

(why optical and manufacturing engineers don't get along)
(or why precision engineers have jobs)

- **Tight Tolerances**
  - 2µm Center-to-center
  - 1µm Axially (height)
  - λ/10 (155nm) Form
  - Max 15um dead zone between optics
  - Rooftop Angle 0.062° per side
  - Assembly of front and back sides
  - Multiple, truncated back side optics

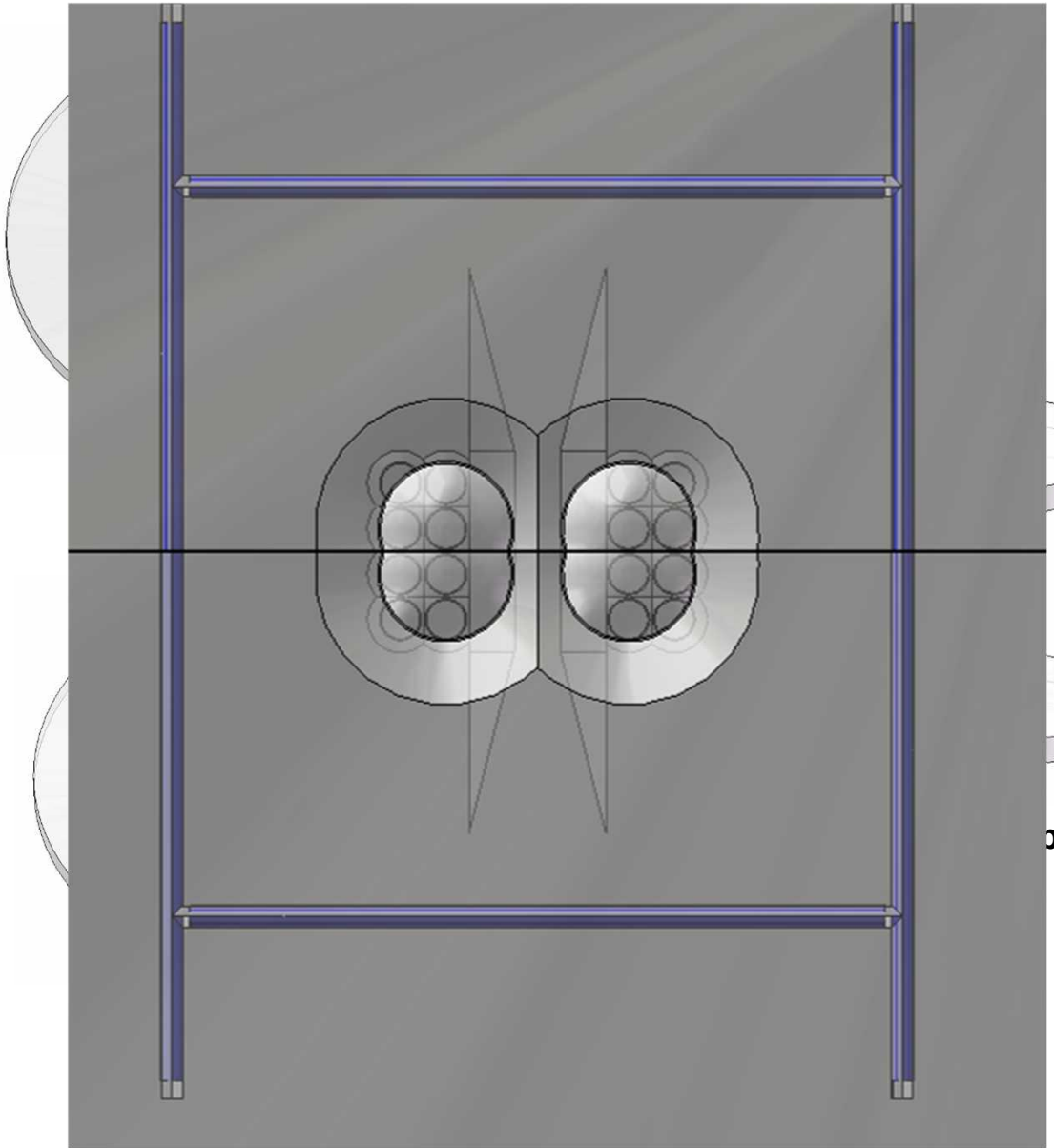
Why SPDT?

- Sag
  - Too tall for gray-scale lithography
- Form Requirement
  - Too tight for diamond milling
- Assembly
  - Allows integral assembly features
- Molding
- Challenges
  - Indexing of part
  - Large number of tools required
  - Serial Process



Why Not SPDT !!

How SPDT Affected the Design



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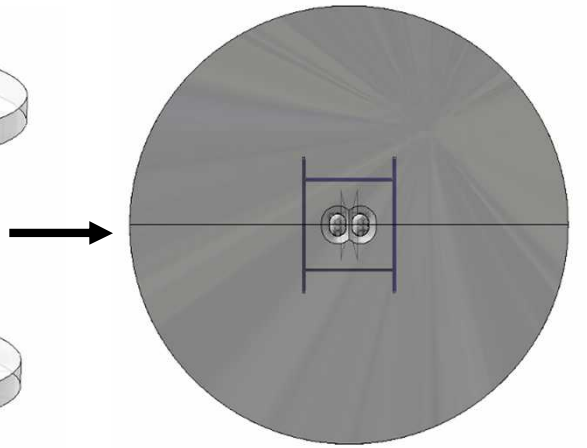

Assembly

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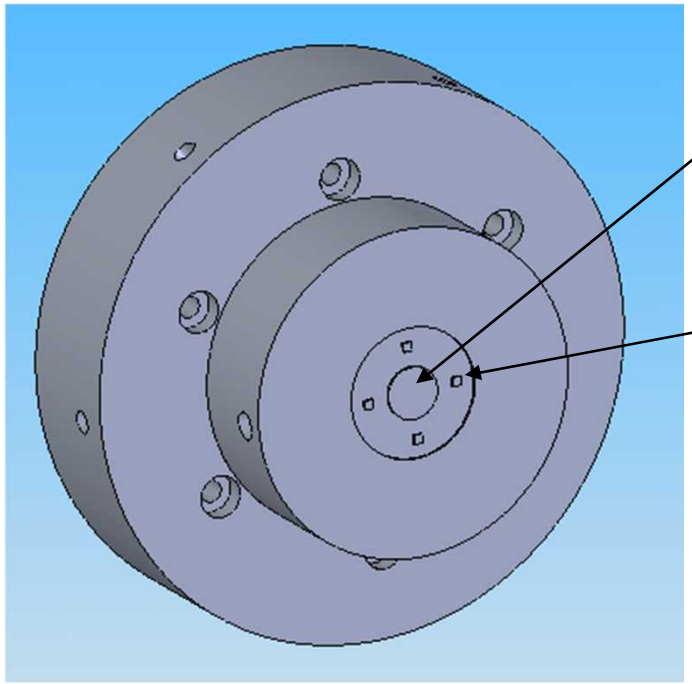
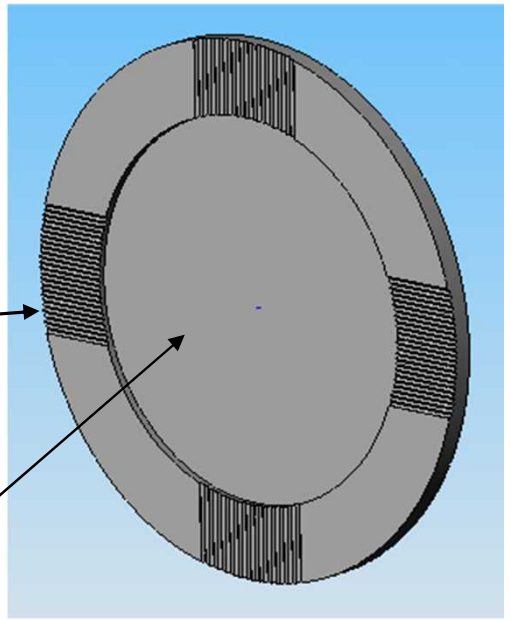
Zia Fixture (conceptual)



Vacuum Chuck

Positioning Grooves (250um)

Recess for Vacuum Surface



Polymer Part Backside

- There are both Horizontal and Vertical Grooves
- Center to Center Groove Spacing is 250um
- Part Should Contact Groove 1-2um before Vacuum Chuck and deflect to the vacuum chuck

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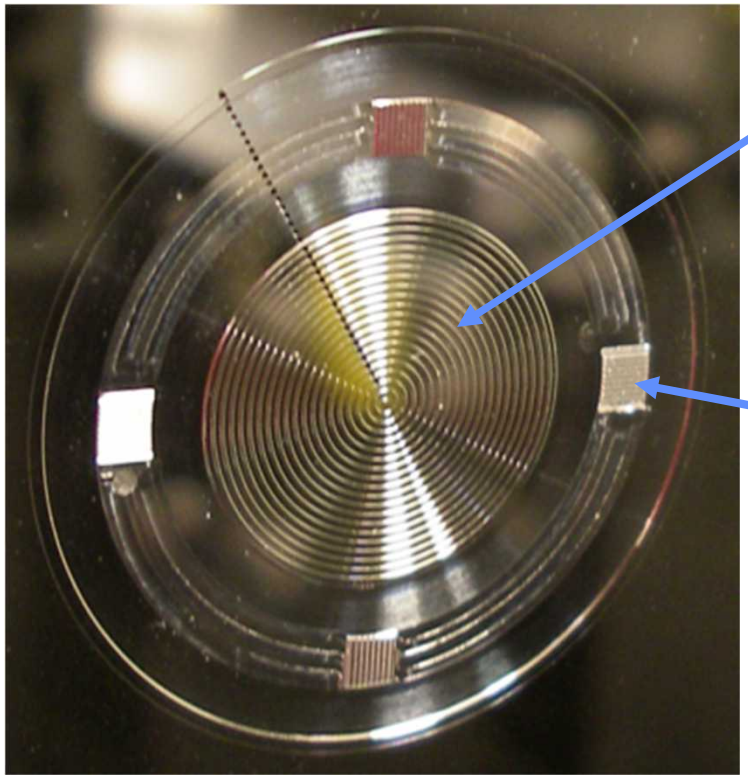
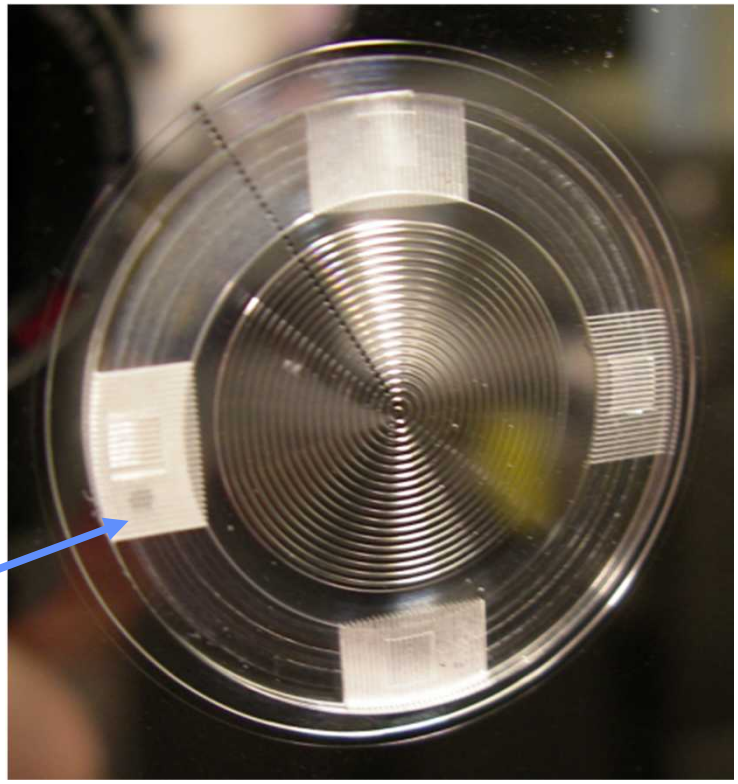
Zia Fixture (as Fabricated)



Vacuum Chuck – Prec. Desgn.

Chuck Positioning Grooves

Part Positioning Grooves



Polymer Part on Zia Fixture

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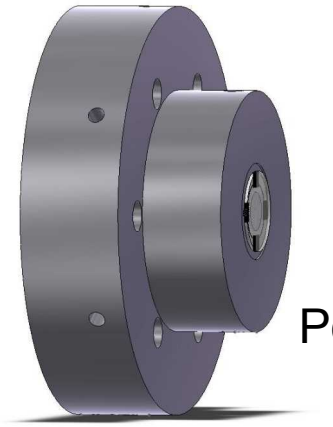
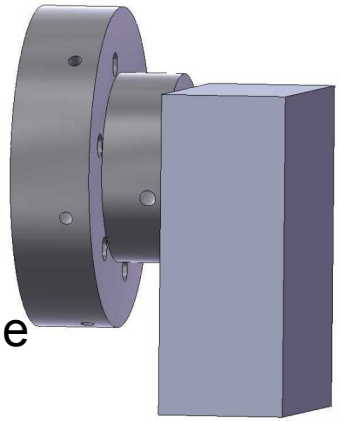
Part Transfer Process

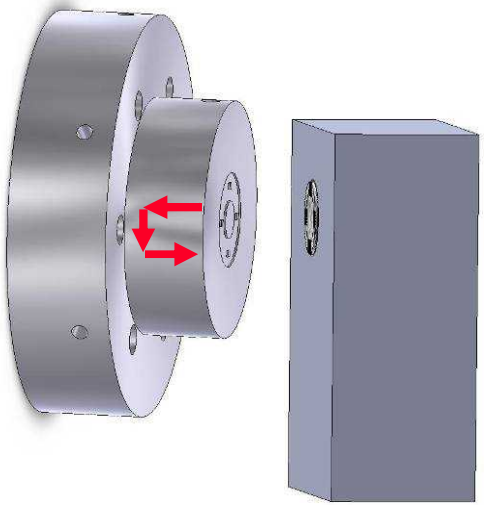


Machine Lenslet

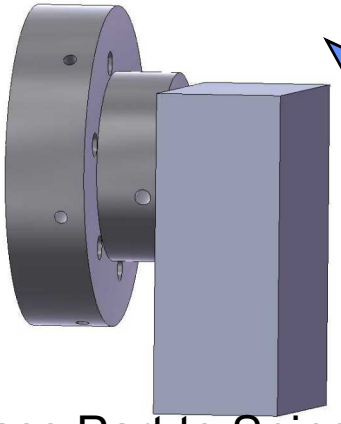
Position Spindle
To 0deg



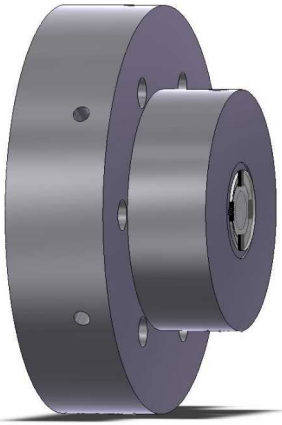
Pass Part to
Tool Post Vac Chk



Reposition Spindle



Pass Part to Spindle



Machine Lenslet

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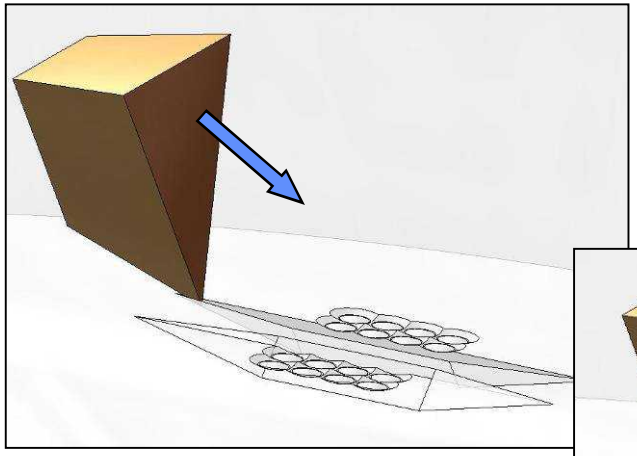
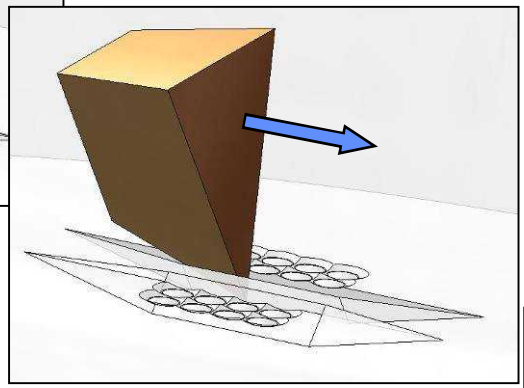
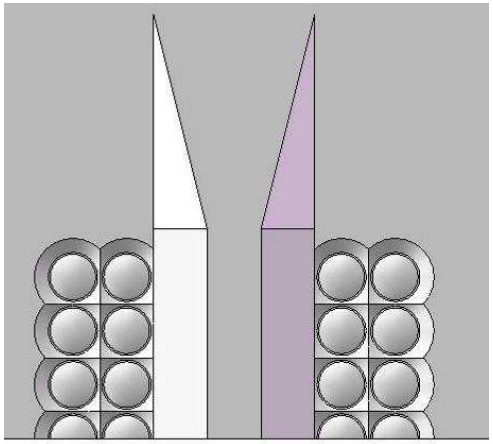
Rooftop Prisms

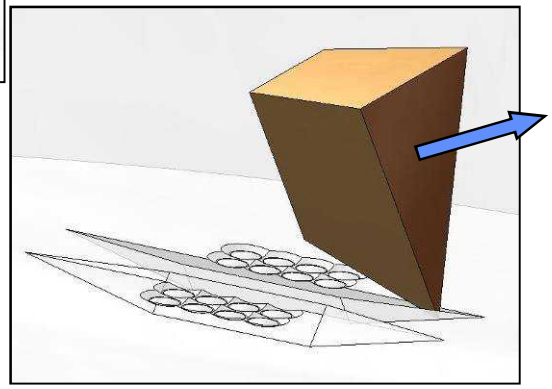


Ramp Into Part

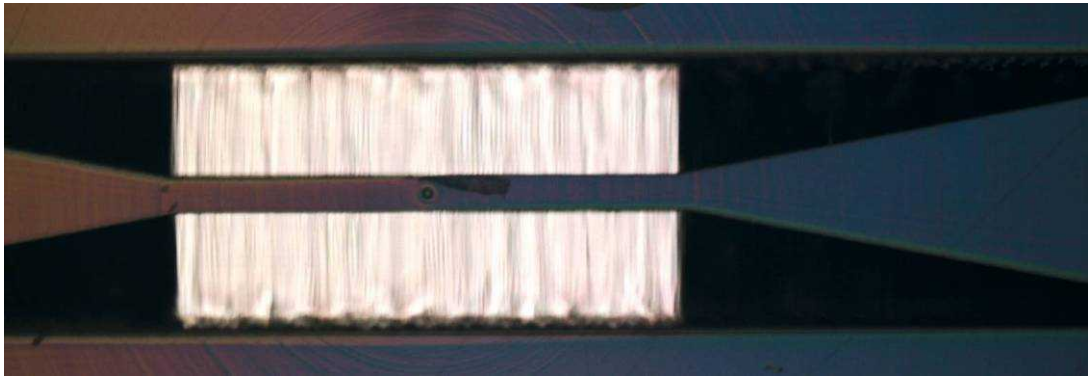


Cut Rooftop





Ramp Out of Part



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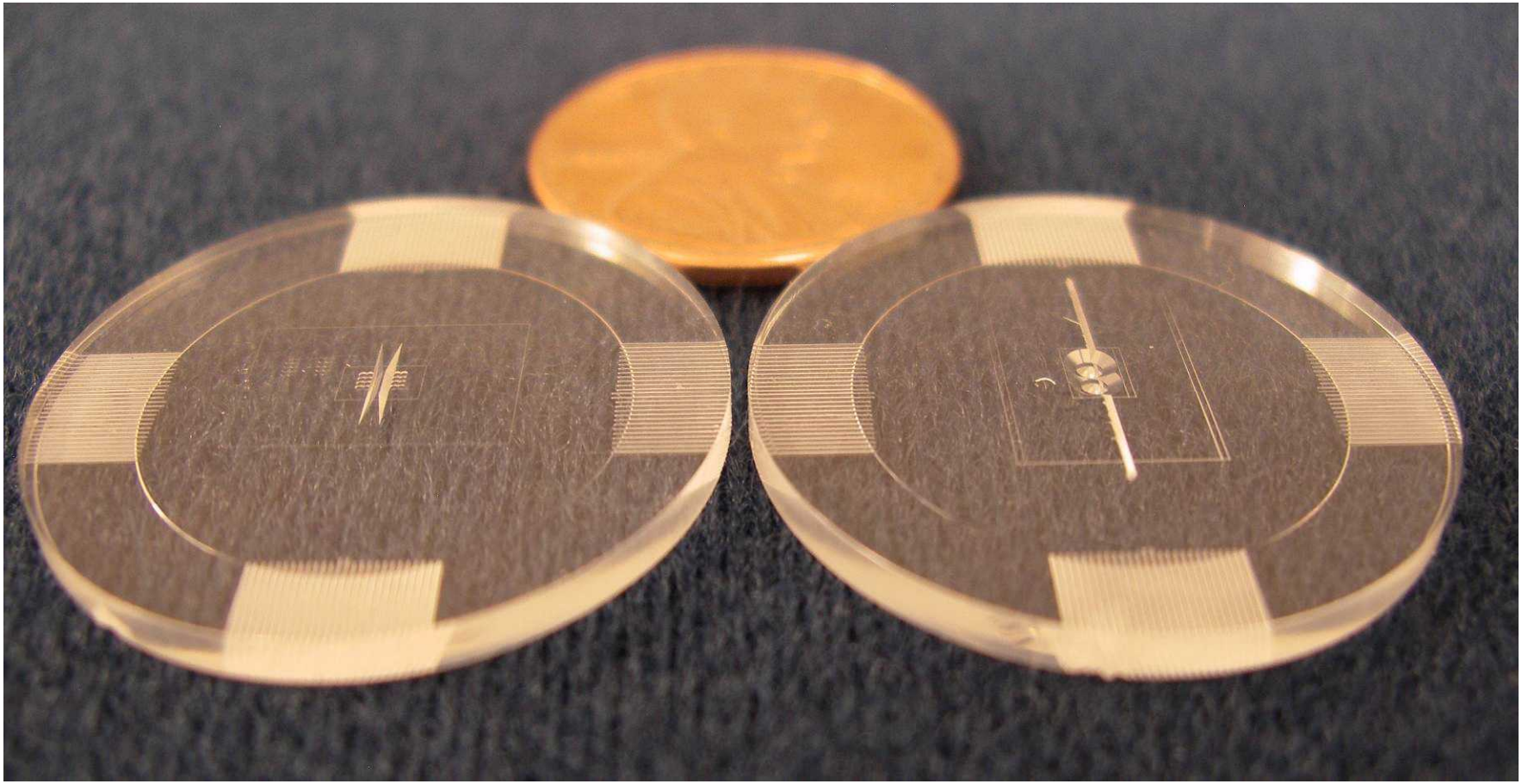
Completed Parts



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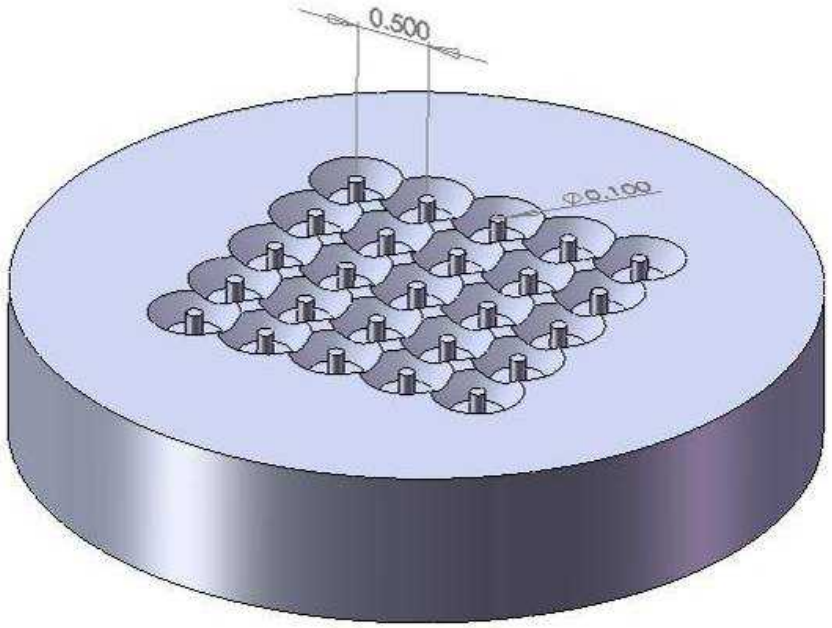
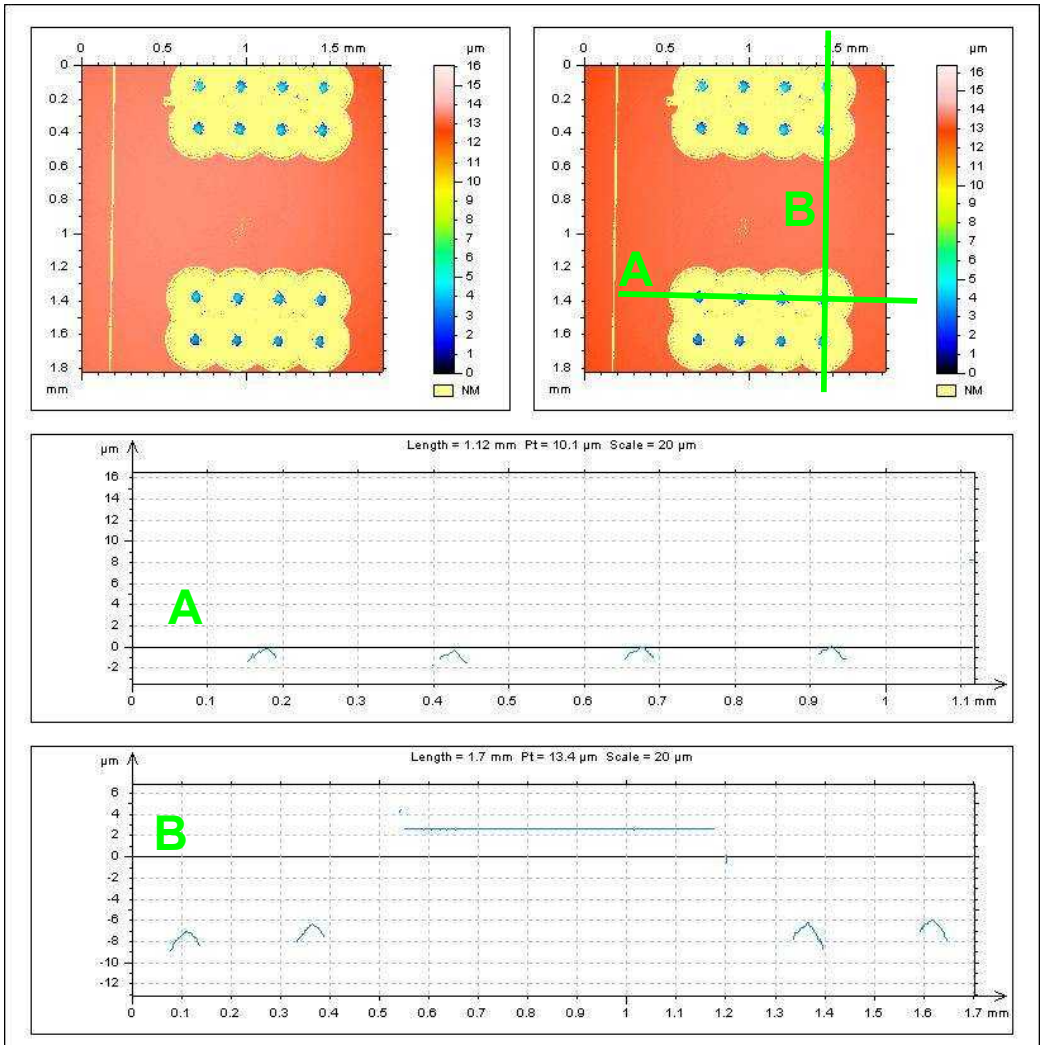
Measurements – Center to Center

- This slide will report the center to center measurements taken from a part that looks like the picture as measured on the Zeiss F25



- The results of this measurment will go here…when we do the measurement

Measurements – Axial Height



- **Axial height variation less than 1um in long and short dimensions**

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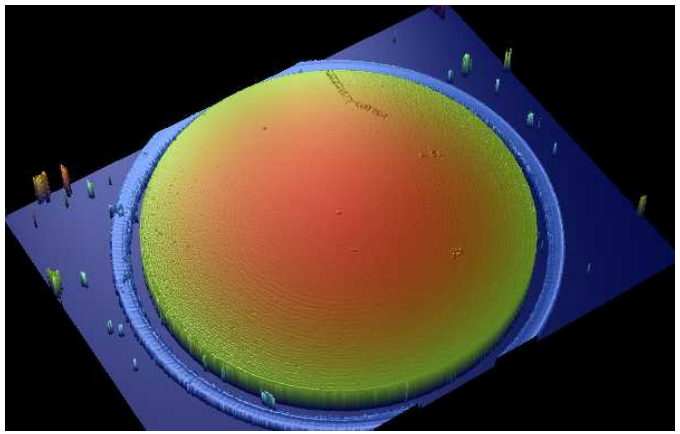
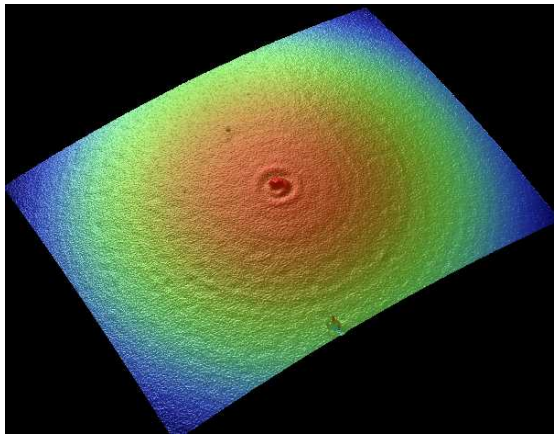
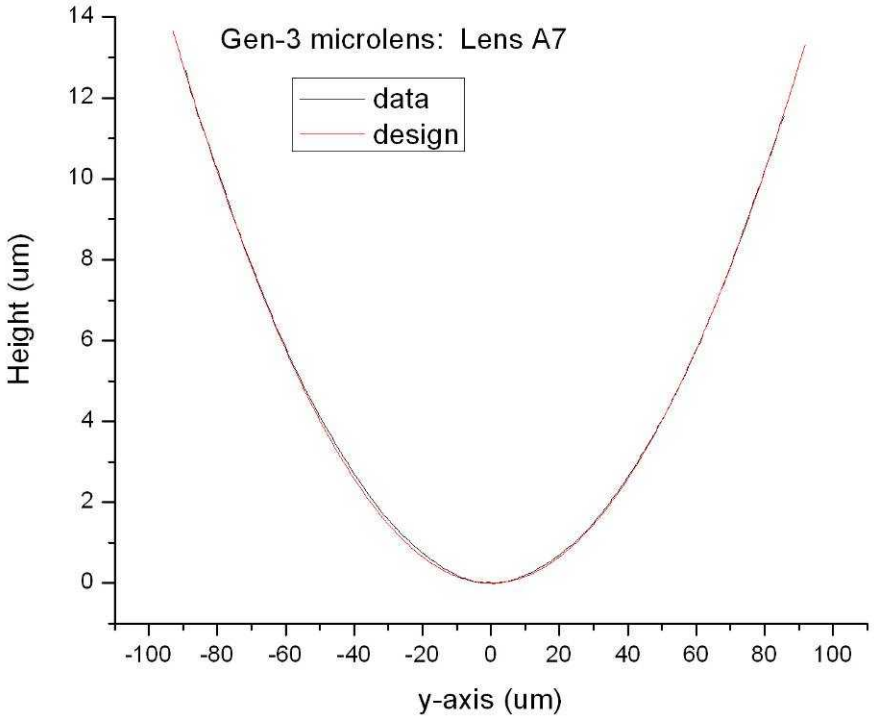
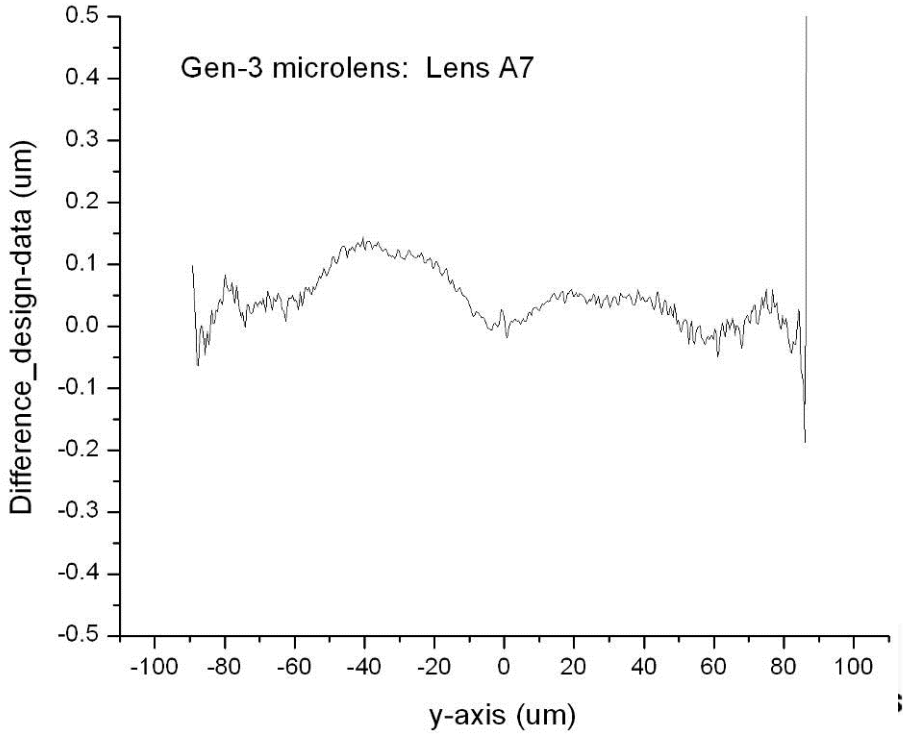
Measurements – Form/tilt









Measurements – Rooftop Angles

- This slide will have a picture of how we measure the rooftop angles and the results of measuring a part.

Conclusions

- Fabrication method is accurate and scalable
- Assembly features are manufactured in with optics
- Remaining work activities include:
  - Fabrication time
  - Rooftop surface finish
  - Further measurements of lens position and form
  - Measurements of assembly accuracy
- Lenses have good form, position, height
- A good and feasible means of creating the switch ROE

Acknowledgements

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  - Sayan D. Mukherjee
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