MEMS Deformable Mirrors for Adaptive Optics

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Iris AO, Inc

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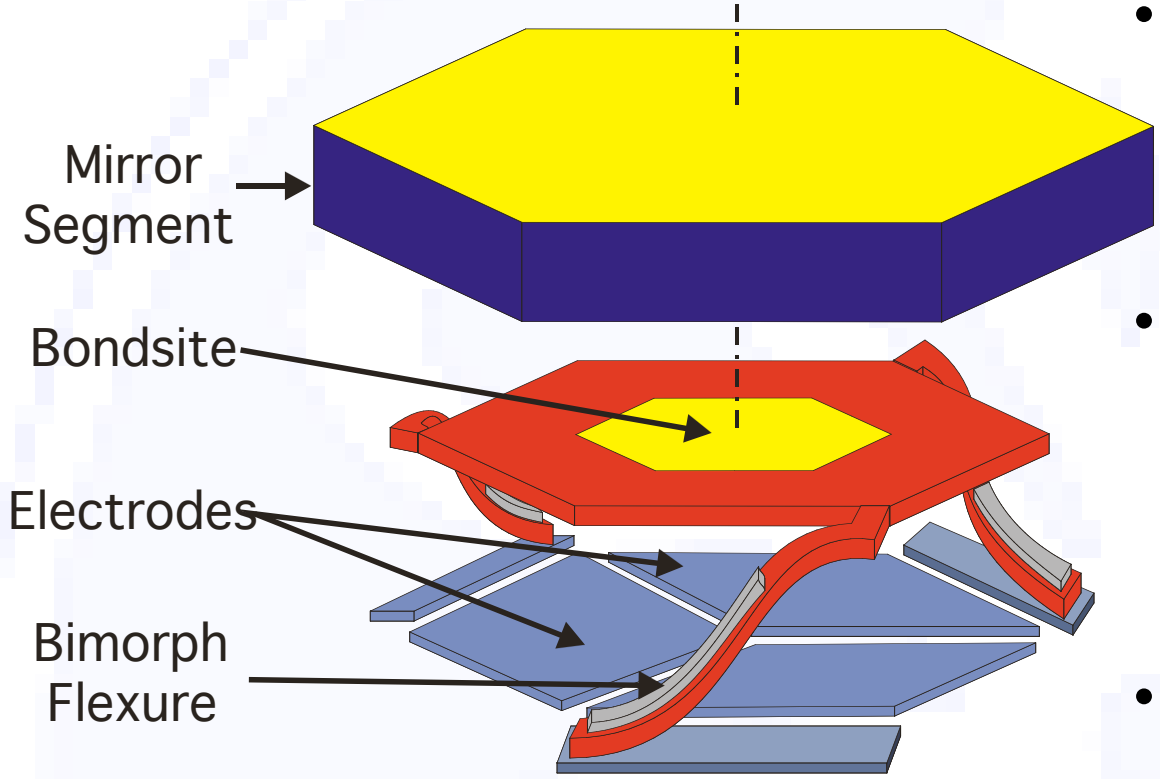
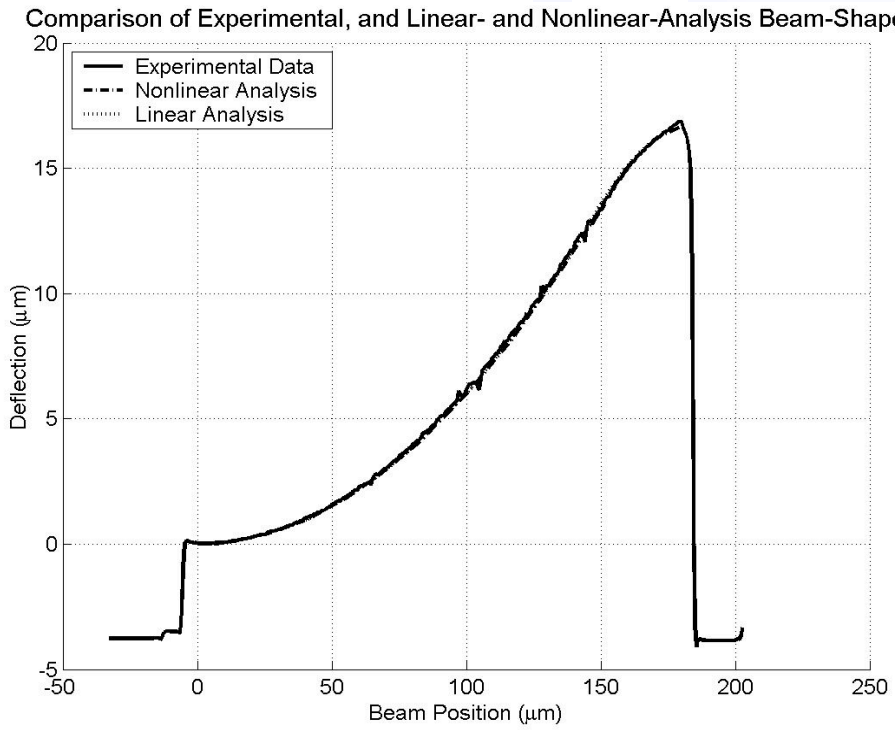
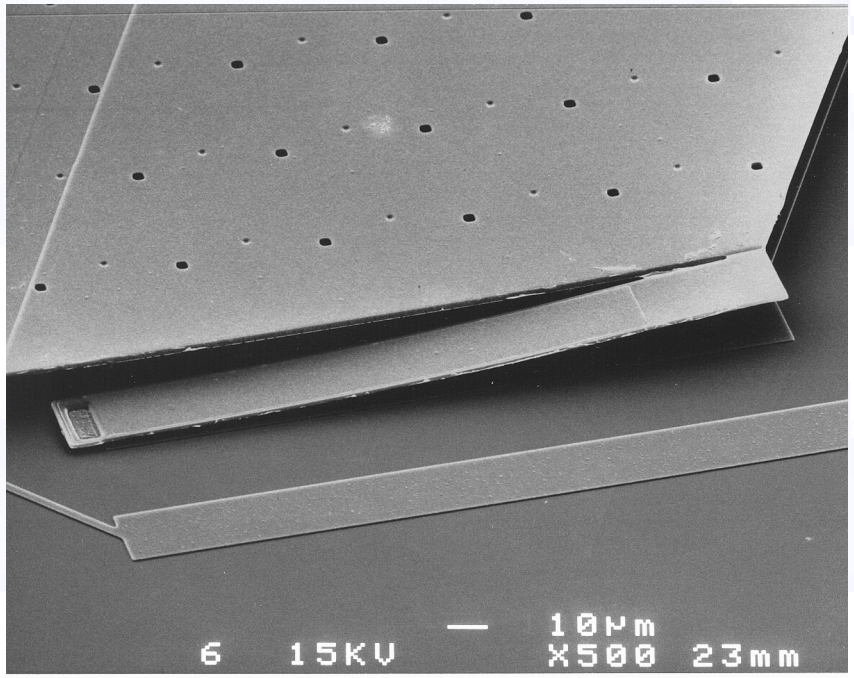
Iris AO MEMS Segmented DM



- Robust assembled mirror surface stays flat
- Temperature insensitive bimorphs elevate mirror above substrate
- Piston/tip/tilt electrostatic actuation

Bimorph Flexures





- Engineered stresses create beam shape
- Stroke determined by design, not process

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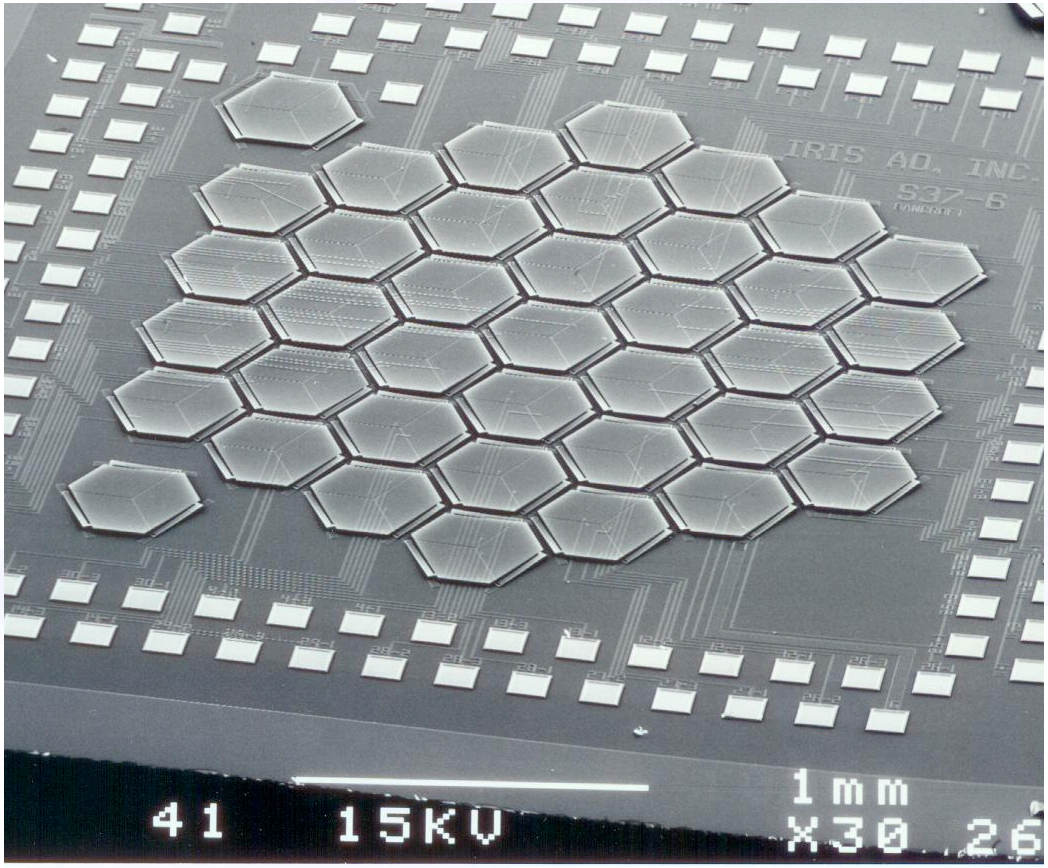
DM Electrostatic Actuators



- Actuators wired to periphery
- Electrostatic forces pull actuators down
- No hysteresis
- 4.2 mm aperture

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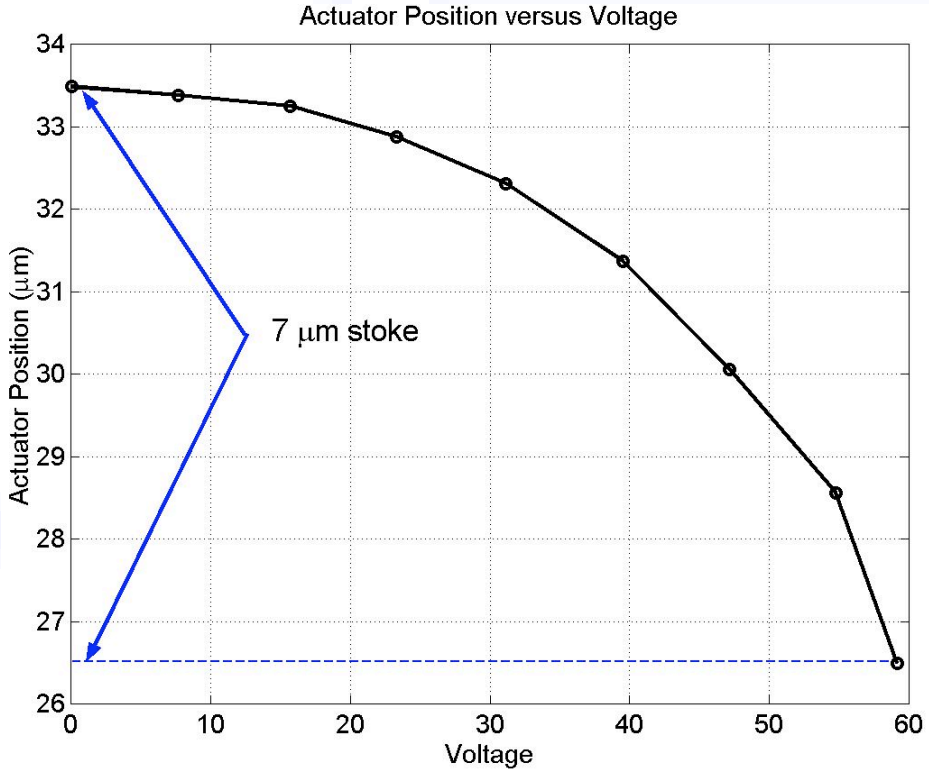
DM Stroke: *Position versus Voltage*

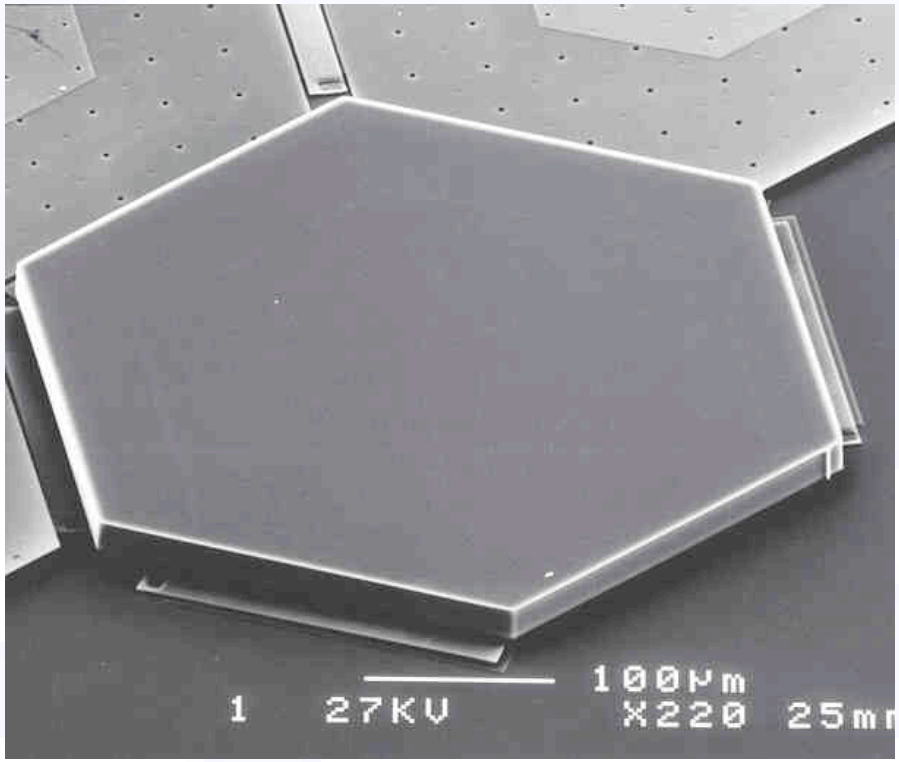


- High positioning repeatability

- Design flexibility to trade off stroke, voltage and frequency
- Stroke of up to 20 um
- Low voltage actuation

Assembled SOI Mirrors: Benefits

- Single crystal mirror has excellent flatness
- Thickness gives rigidity
  - Mirror is still flat after optical coating
  - Stays flat over varying operating conditions
    - Temperature
    - Actuation
- High fill factor
  - Mirrors cover bimorph flexures
  - Etch holes not necessary



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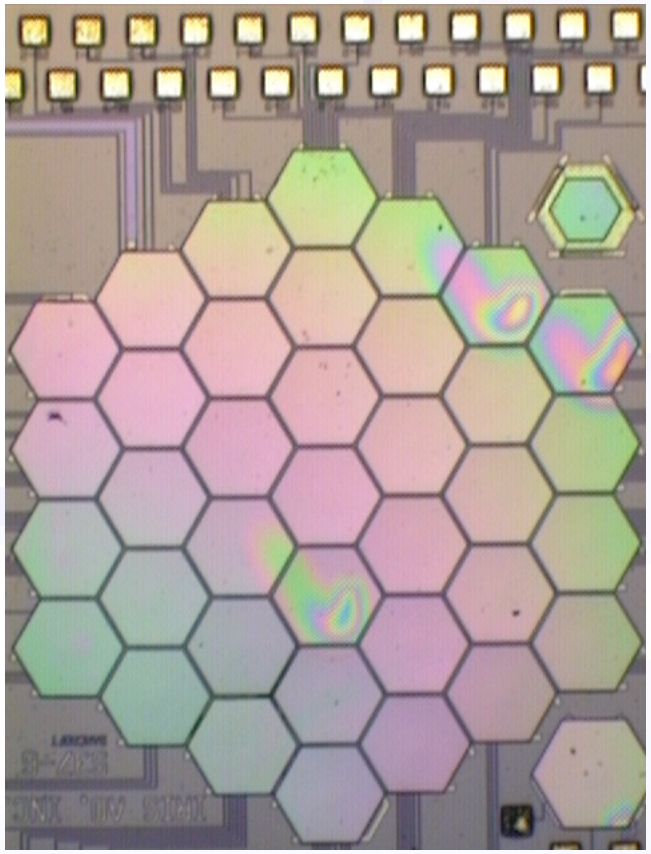
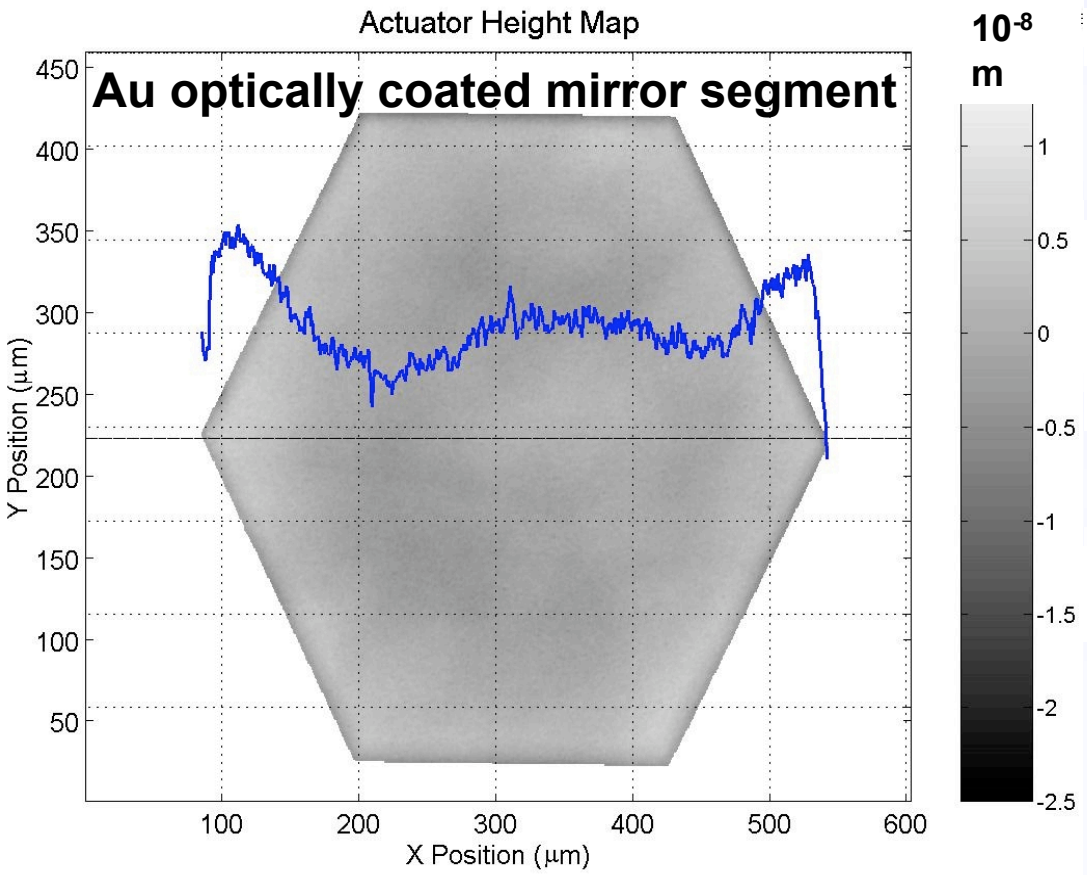
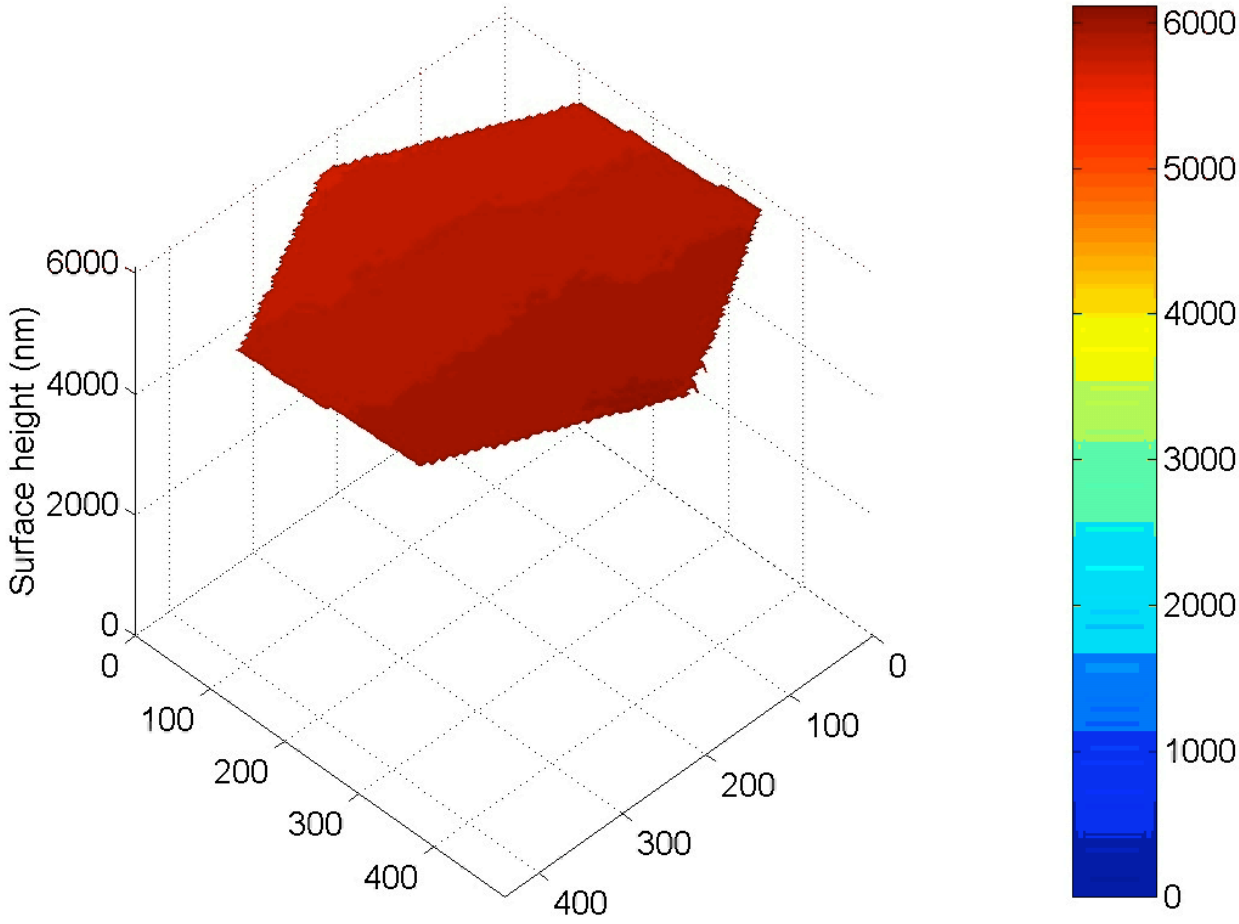
Assembled-Mirror Flatness



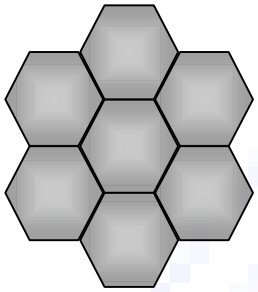


- Low rms surface errors
- < 8 nm rms on average

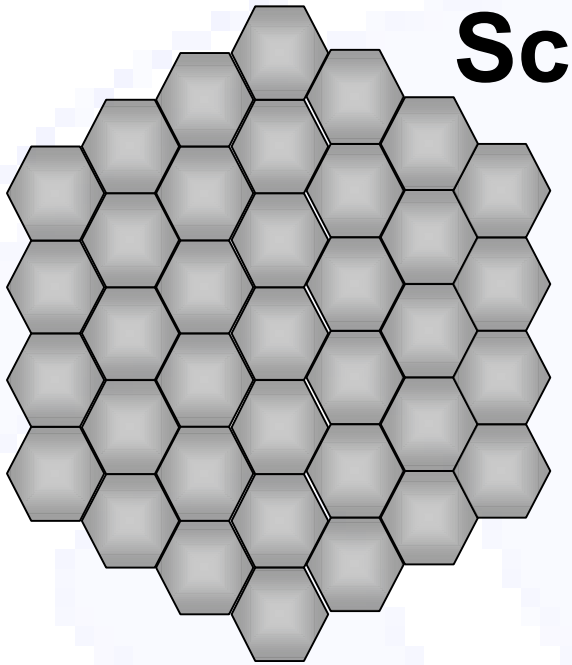
Experimental Deflection (400Hz)



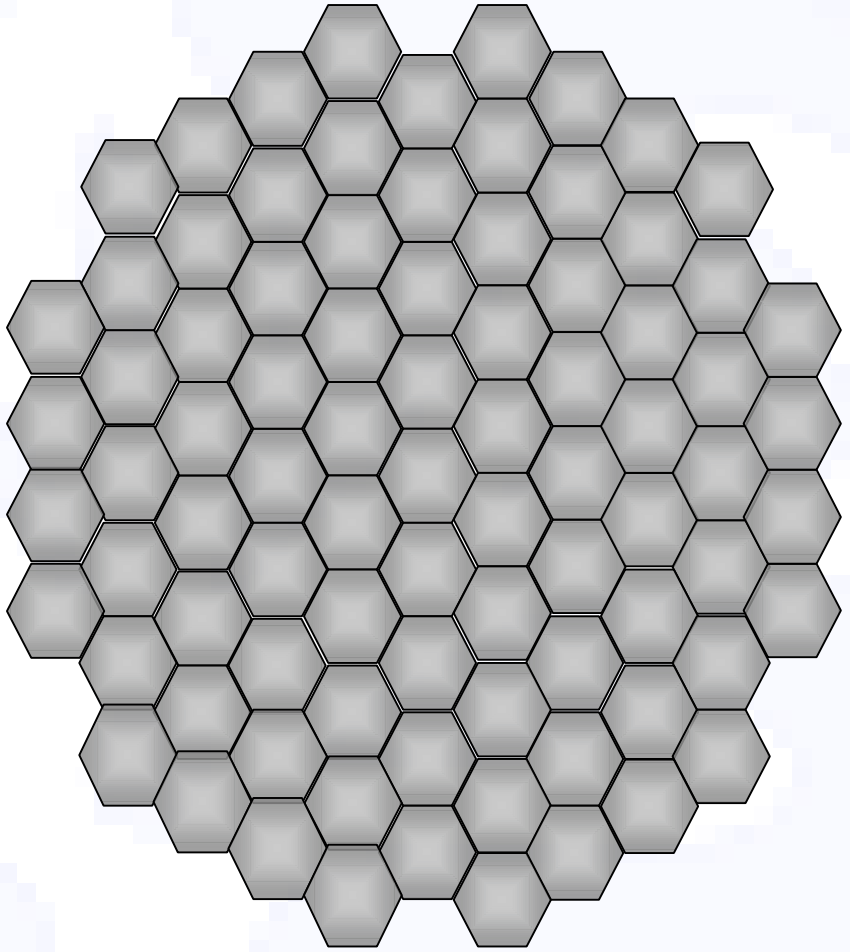
Scalable Architecture



Hearst



Bancroft



Claremont