Boston University and Boston Micromachines Corporation:

DM technology development for large telescopes

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CfAO Retreat

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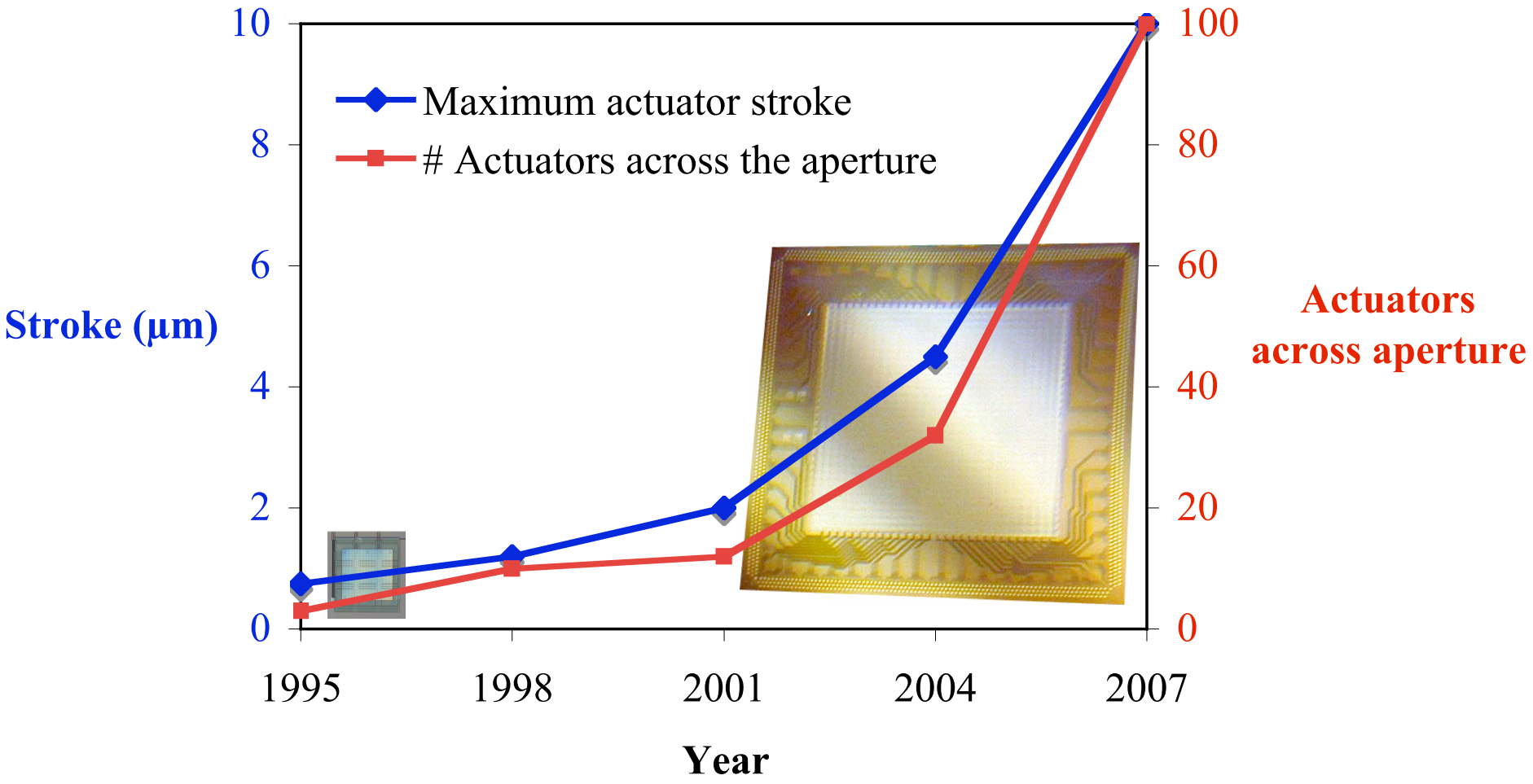
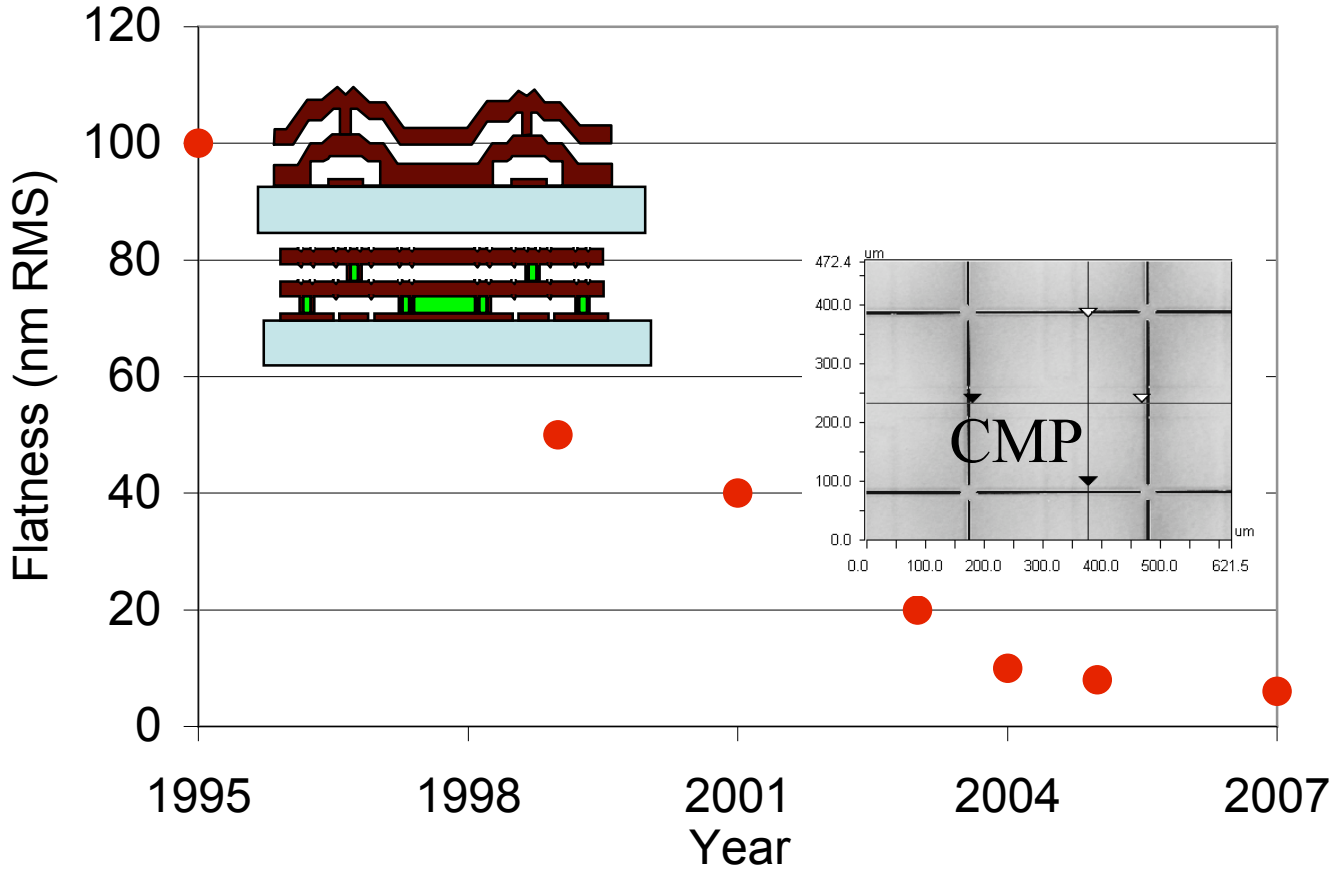
BMC DM roadmap: stroke and actuator count



BMC DM roadmap: surface flatness

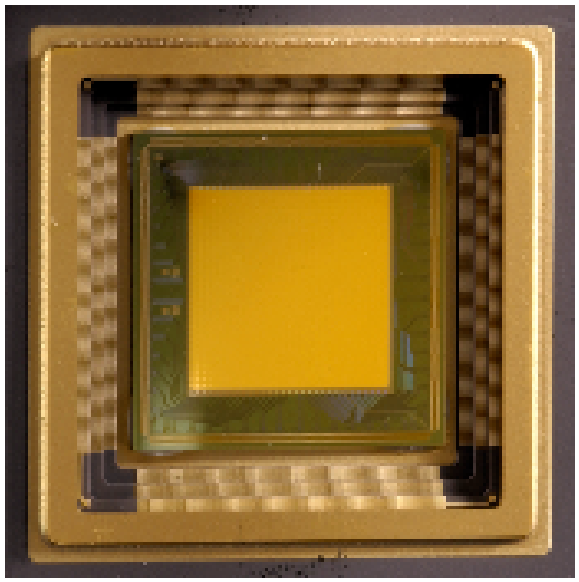


Large telescope needs

	TMT Needs	**XAOPI Needs**	**Existing BU/BMC Best Practice**	**New DM (Proposed)**
Actuator Stroke	10μm	2μm	5μm	10μm
# Actuators Across Pupil	100	64	32	100
Actuator Repeatability	5nm	1nm	3nm	<5nm

µDM1024 Performance

Number of actuators	1024
Actuator pitch	340µm
Actuator stroke/repeatability	2µm/3nm
Reflectivity (632.8 nm)	92%
Flatness (unactuated)	16nm RMS
Bandwidth (vacuum/air)	60kHz /7kHz
Aperture	10.2mm



Path to µDM10000 with 10µm stroke and 100% working array

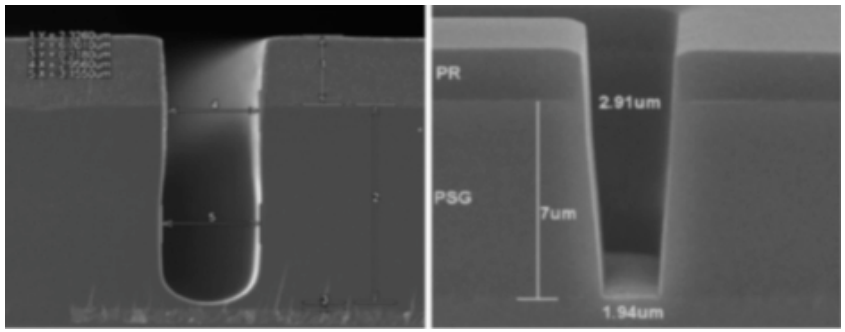
Modify actuator array, building on BMC heritage devices

Longer Stroke

16µm actuator gap
compliant actuator membrane
split electrodes
500µm actuator pitch

Larger Array Size

Buried wire layer
wirebonded (4096)
through-wafer via (10000)

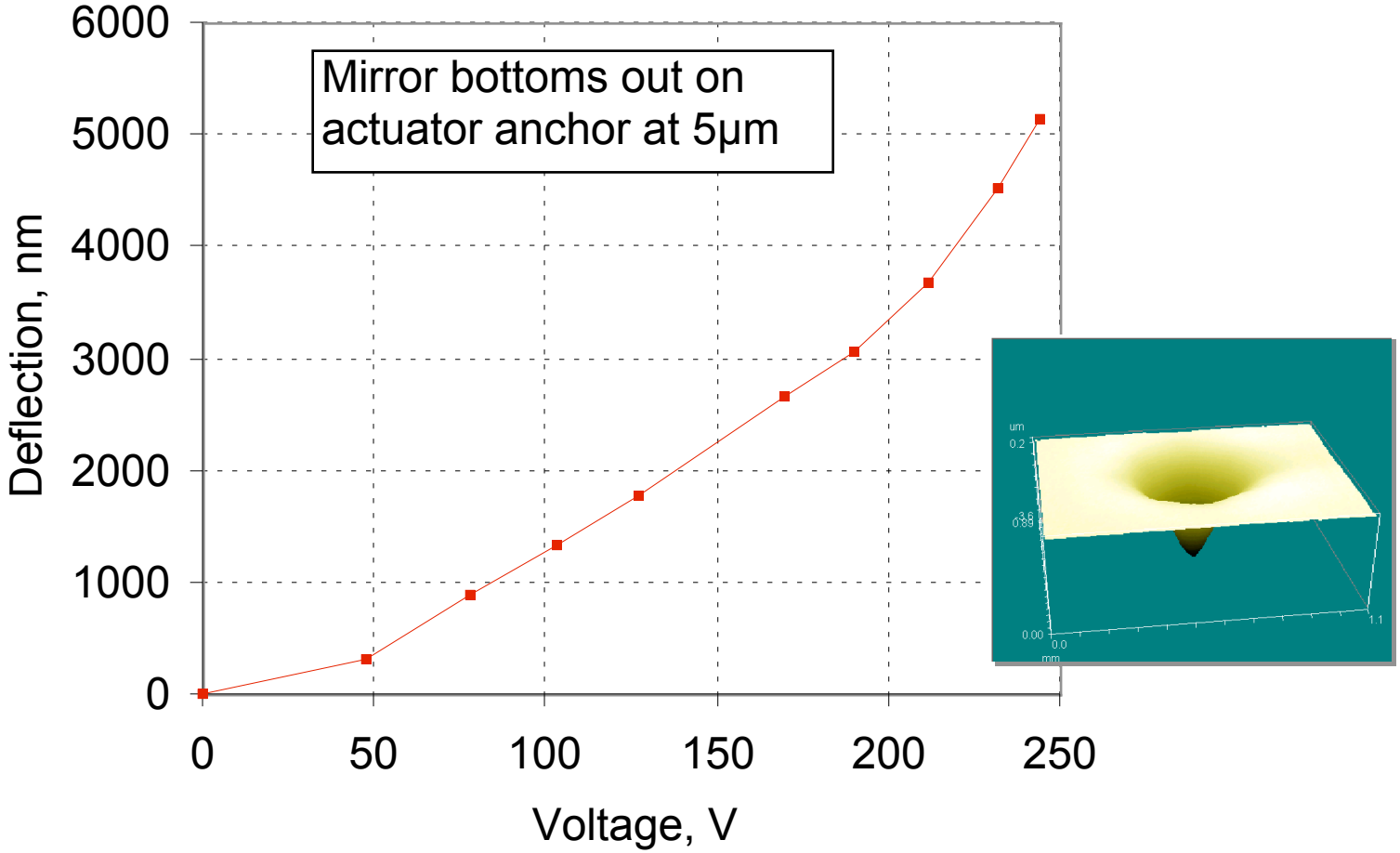


Etching 16µm oxide will be made possible by new process technology

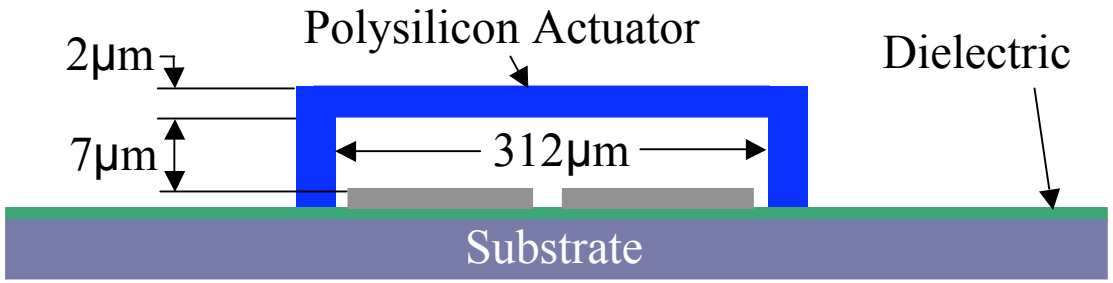
Improved yield and reliability

Improved dielectric
buried wire layer, wider lines and space
sealed or humidity-controlled environment

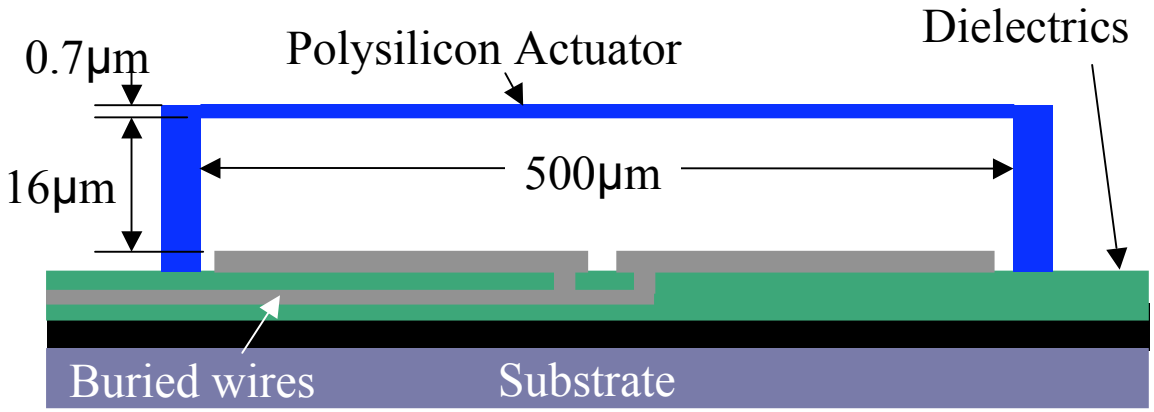
Long-stroke mirror: latest results



New actuator design

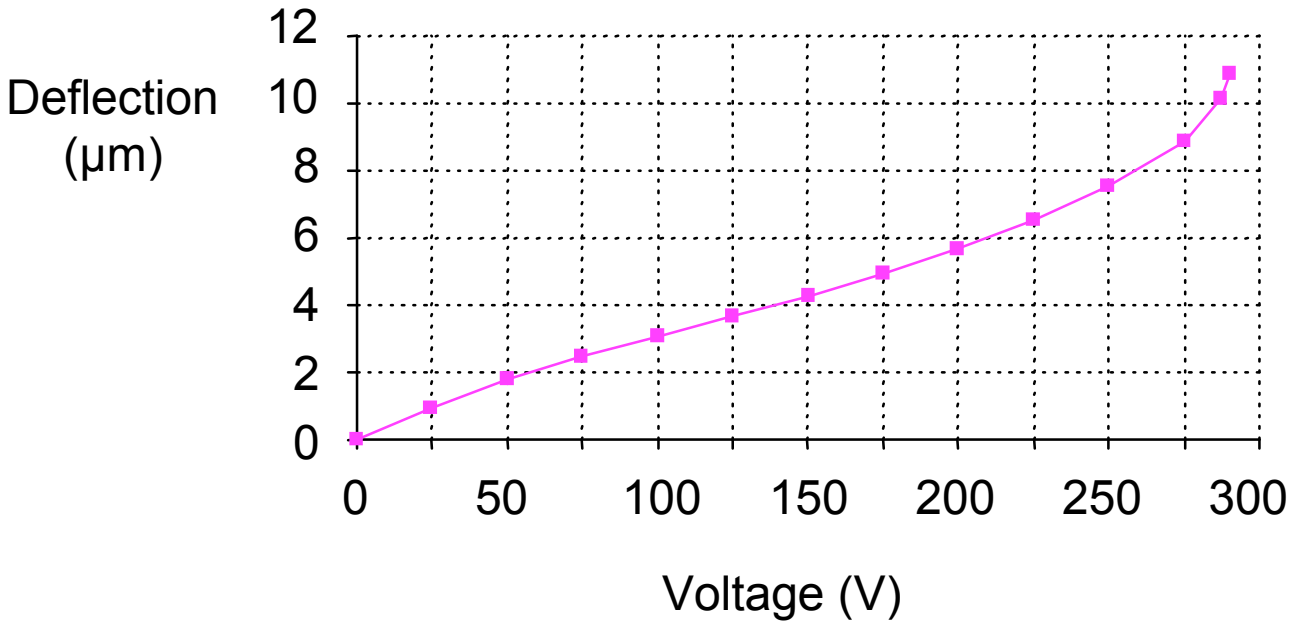


Existing 4.5μm stroke actuator, 32 x 32 array



Proposed 10μm stroke actuator, 100 x 100 array

Model results



What can be done in 2005?

Modeling: Refine model for actuator influence on existing DMs to demonstrate open-loop positioning to 5nm.

Process control experiments: Conduct short-loop experiments for: 1) buried wire routing; 2) Thick oxide deposition and etching; 3) thin, tensile actuator layer.

Design: Demonstrate and refine 10μm actuator array design; demonstrate high yield and reliability arrays.

Integration: Complete design, layout, and packaging for prototype 2μm stroke 4096 actuator device (XAOPI).