X-ray optics developments at ESA

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On behalf of the X-ray Optics team

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The Team

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Tyndall National Institute

ccm centre for concepts in mechatronics

Osservatorio Astronomico di Brera INAF

micronit microfluidics bv

Media Lario Technologies

siltronic perfect silicon solutions

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ADS

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BCV progetti s.r.l 20123 Milano, via S. Orsola 1

ZEISS We make it visible.

SRON Netherlands Institute for Space Research

SSV

DANISH NATIONAL SPACE CENTER

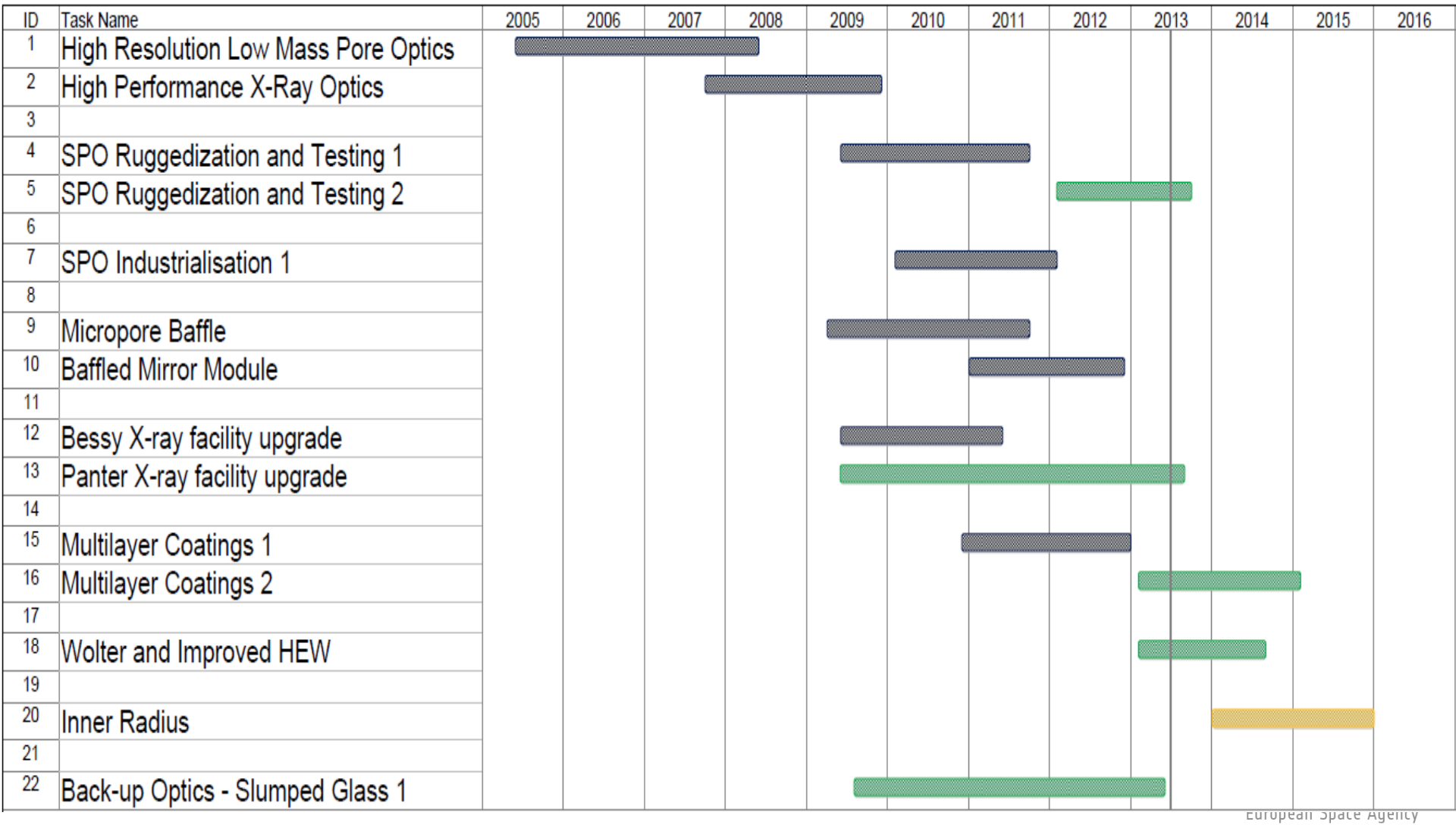
KAYSER-THREDE

MPE

Space Agency

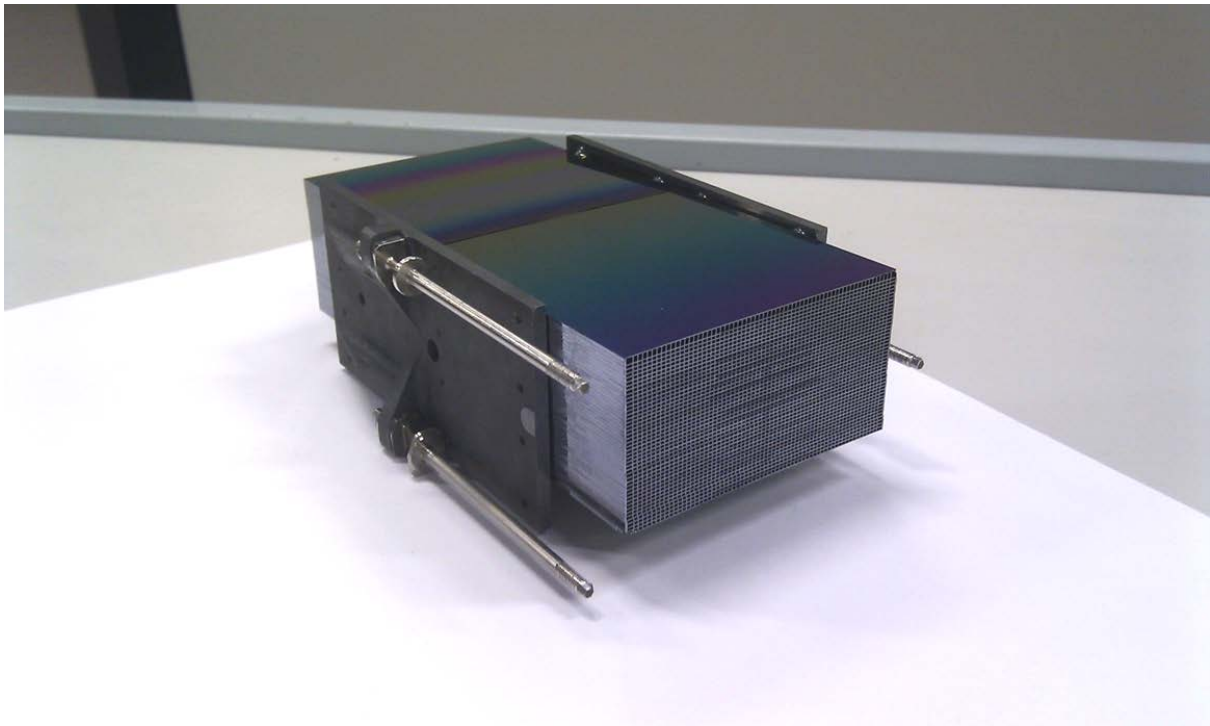
bias

ESA's X-ray Optics Technology Development Activities



Silicon Pore Optics (SPO)

- A new technology for x-ray mirrors
- Mission enabling element for next generation x-ray telescopes
- 10 times less mass and 3 times better optical resolution than XMM-Newton
- Compact and rugged mirror modules, cost effective production
- Idea formulated and demonstrated in 2004 (TRL 1, patented by ESA)
- 2011: several mirror modules built and tested (TRL 4-5)
- 2013: qualification test campaign to confirm TRL 5
- 2013: demonstration of Wolter module with 5 to 10” angular resolution on complete module



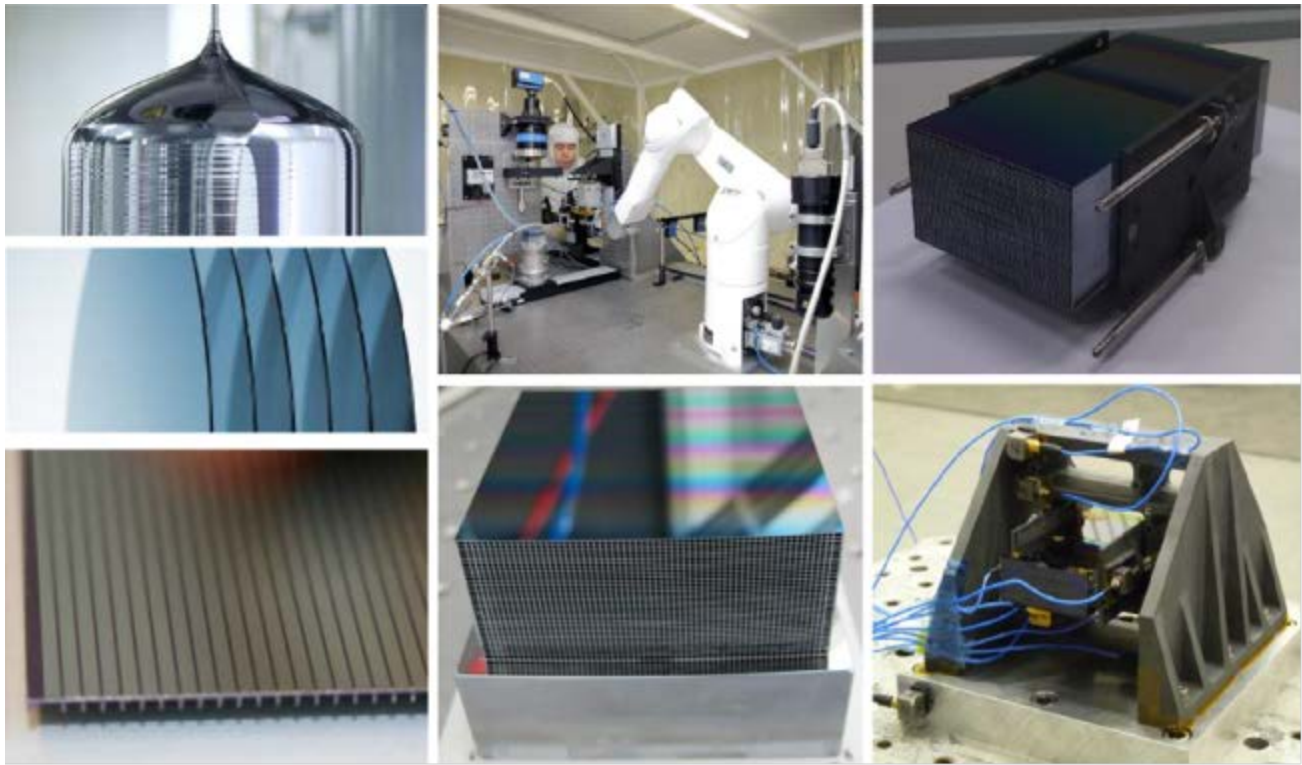
SPO Design philosophy

Low mass (10-100 better than XMM/Chandra)

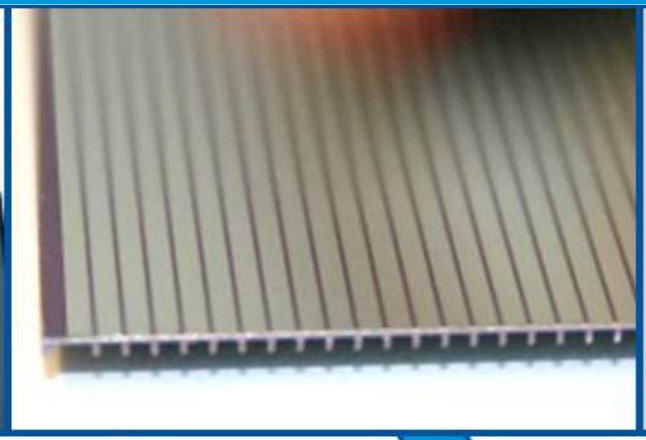
- Silicon as main material
- Very thin (170µm) structured mirrors in a pore/matrix geometry

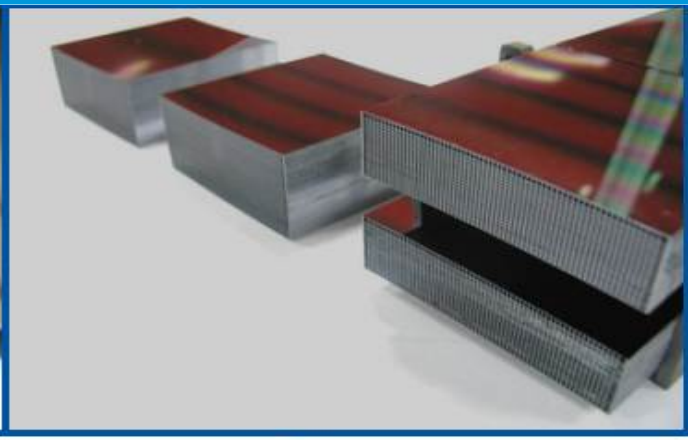
Affordable (need hundreds of MM for observatory class mission)

- Industry standard 300 mm super-polished Si wafers
- Modular approach allows for table-top sized manufacturing
- Processes adapted from semiconductor industry ease future mass production

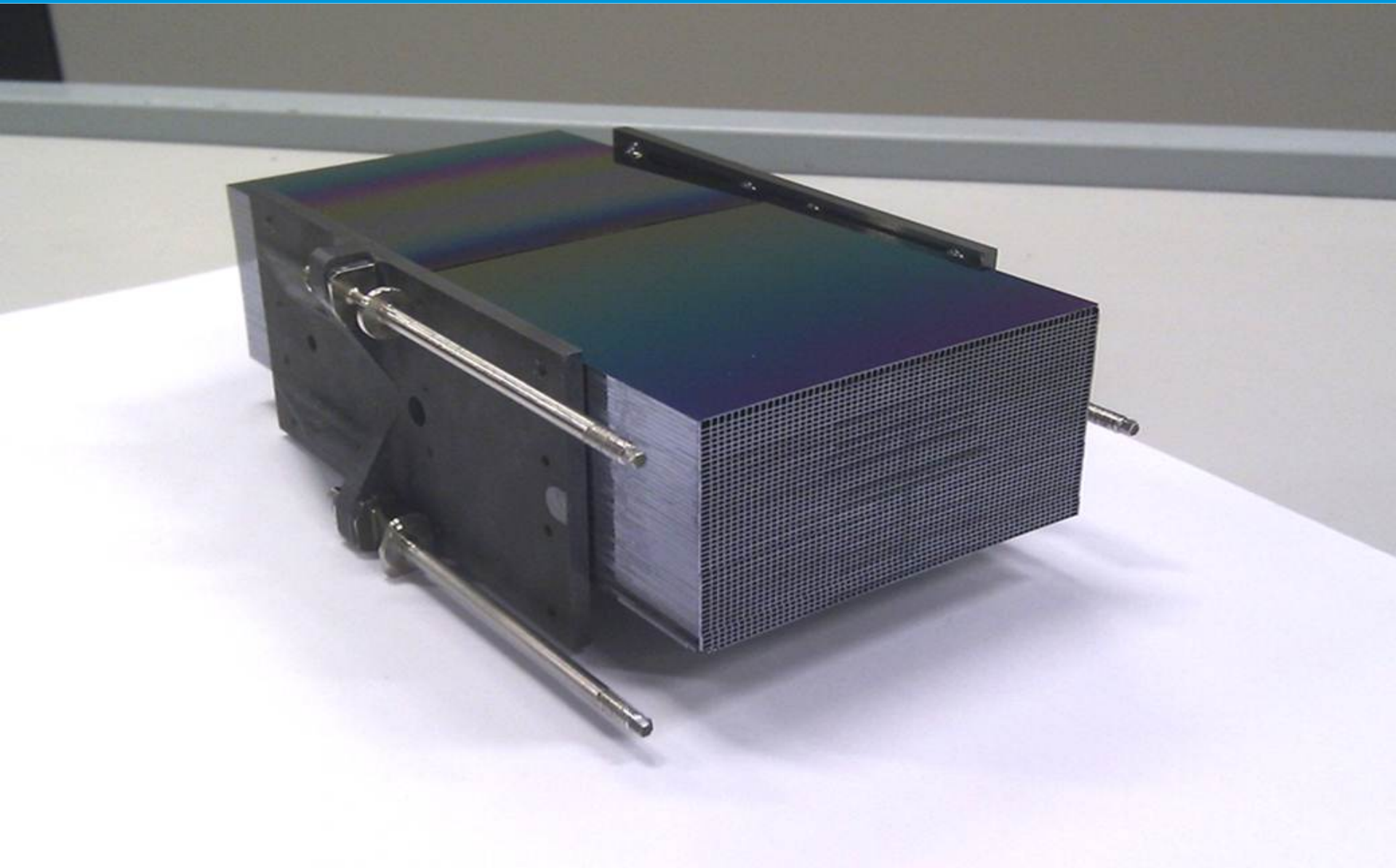


Silicon Pore Optics manufacturing: High throughput production processes

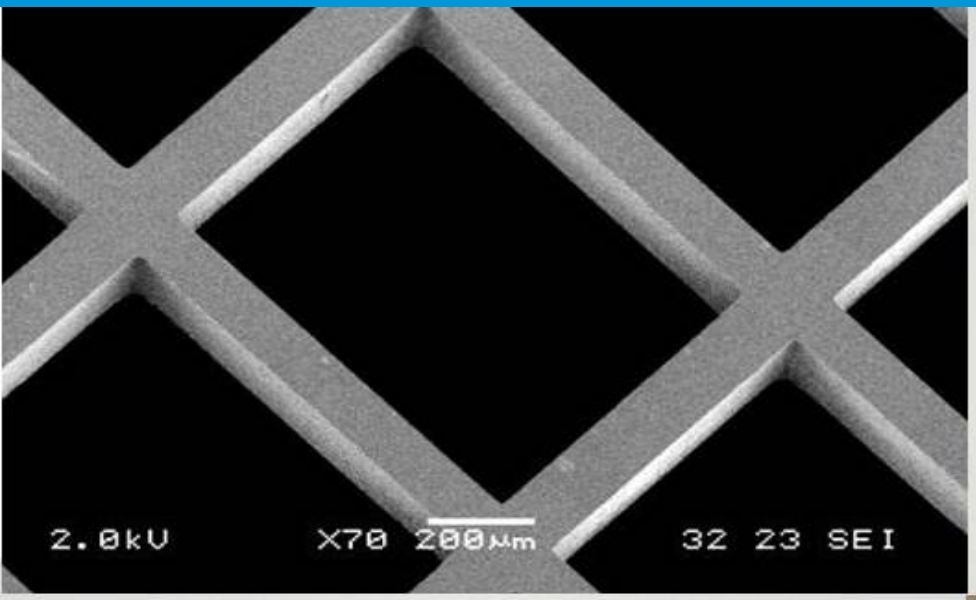


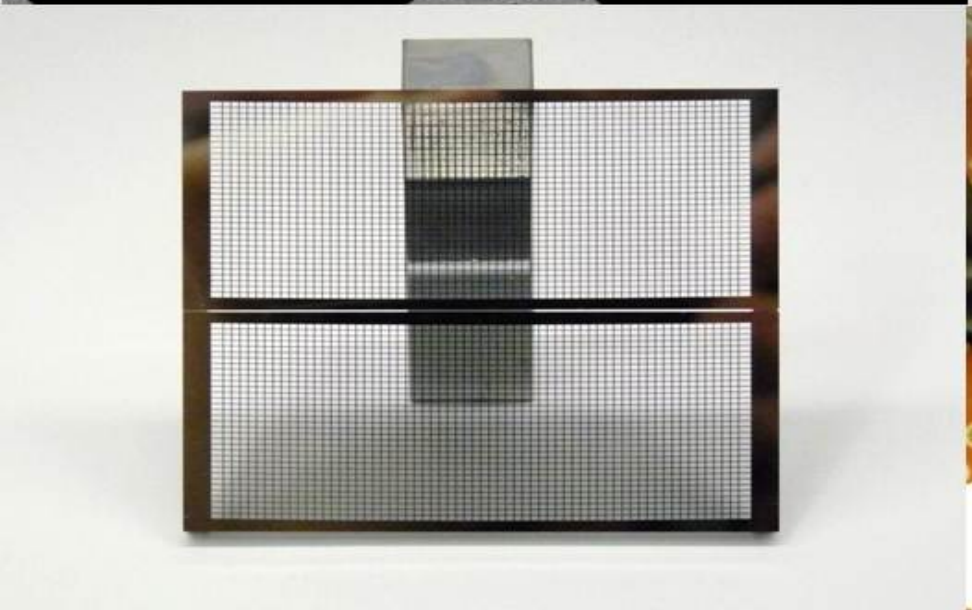


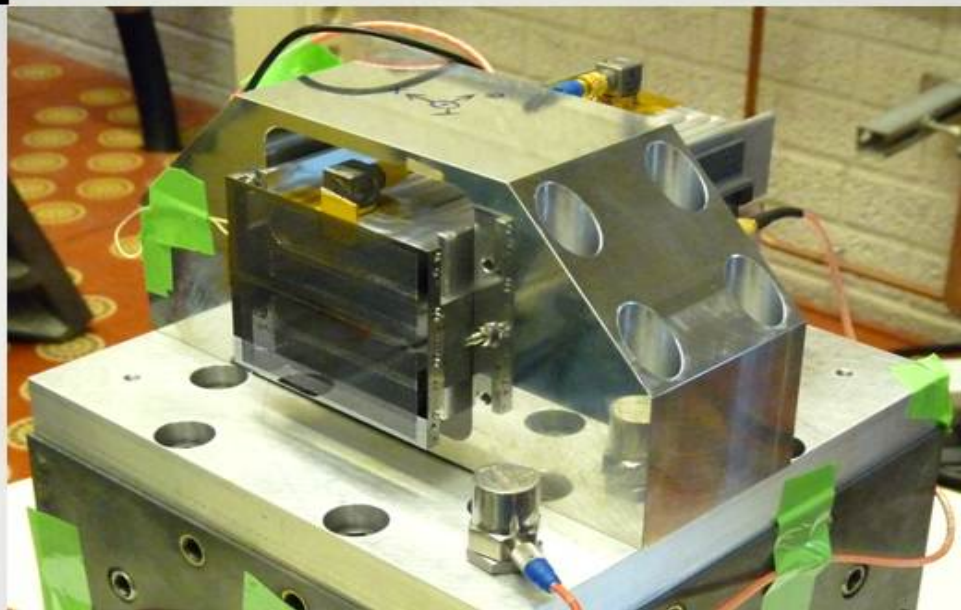
SPO Mirror Module with isostatic mount



Sieve Plate Baffles for SPO Mirror Module







Slumped Glass Optics (SGO)

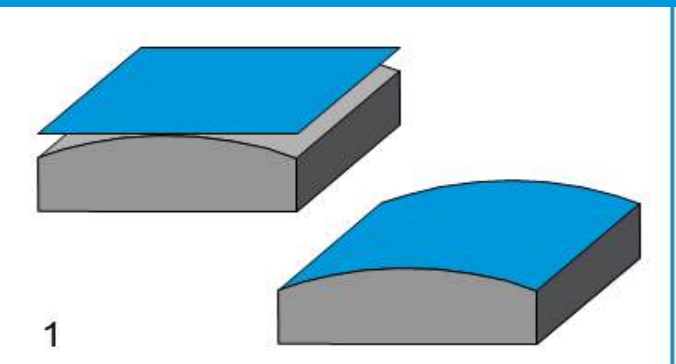
Similar Basic Elements:

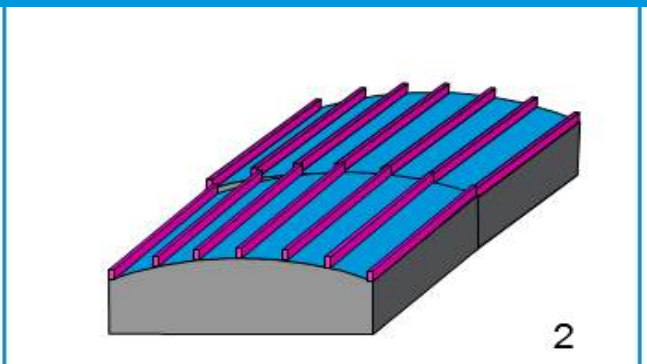
- Mirror Plates (Glass)
- Structural Ribs (Glass)
- Baseplate (Glass)
- Mounting System (Metal)

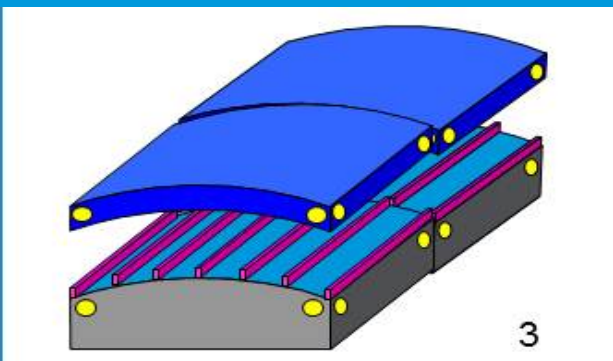
Main Differences:

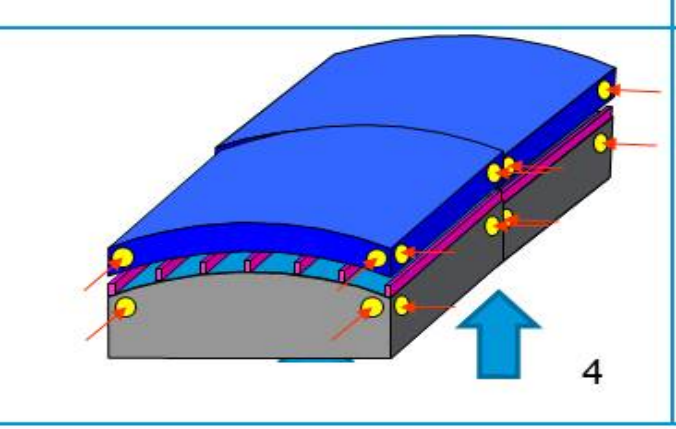
- Glass Material
- Manufacturing Processes
- Size/Number of MMs

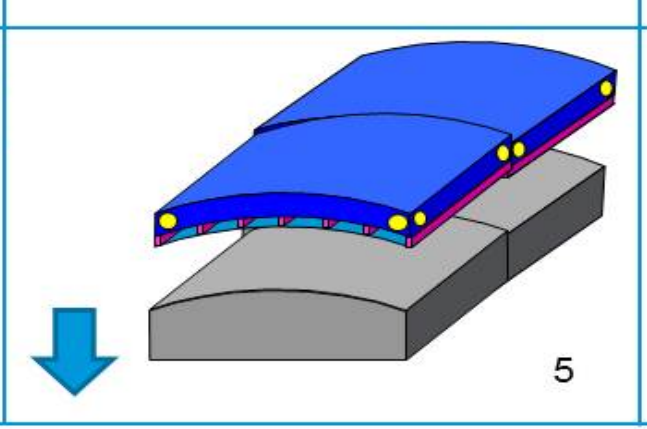
Slumped Glass Optics
Production process

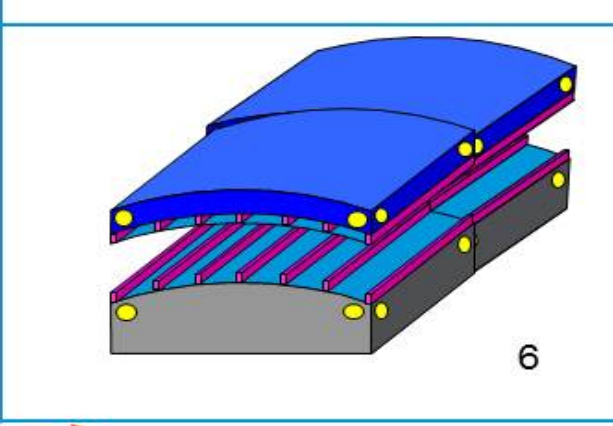


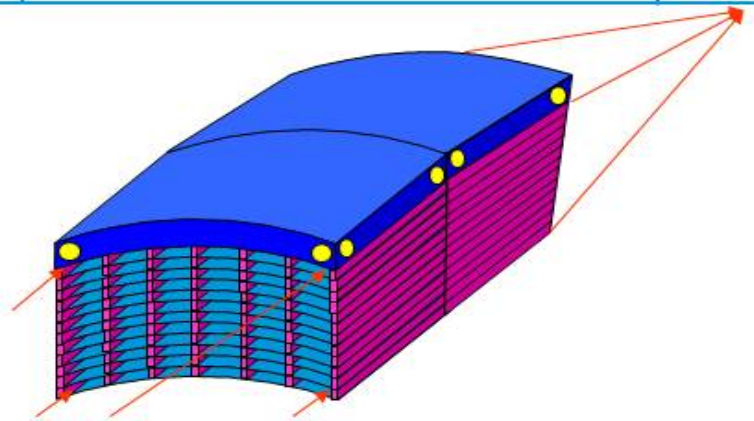






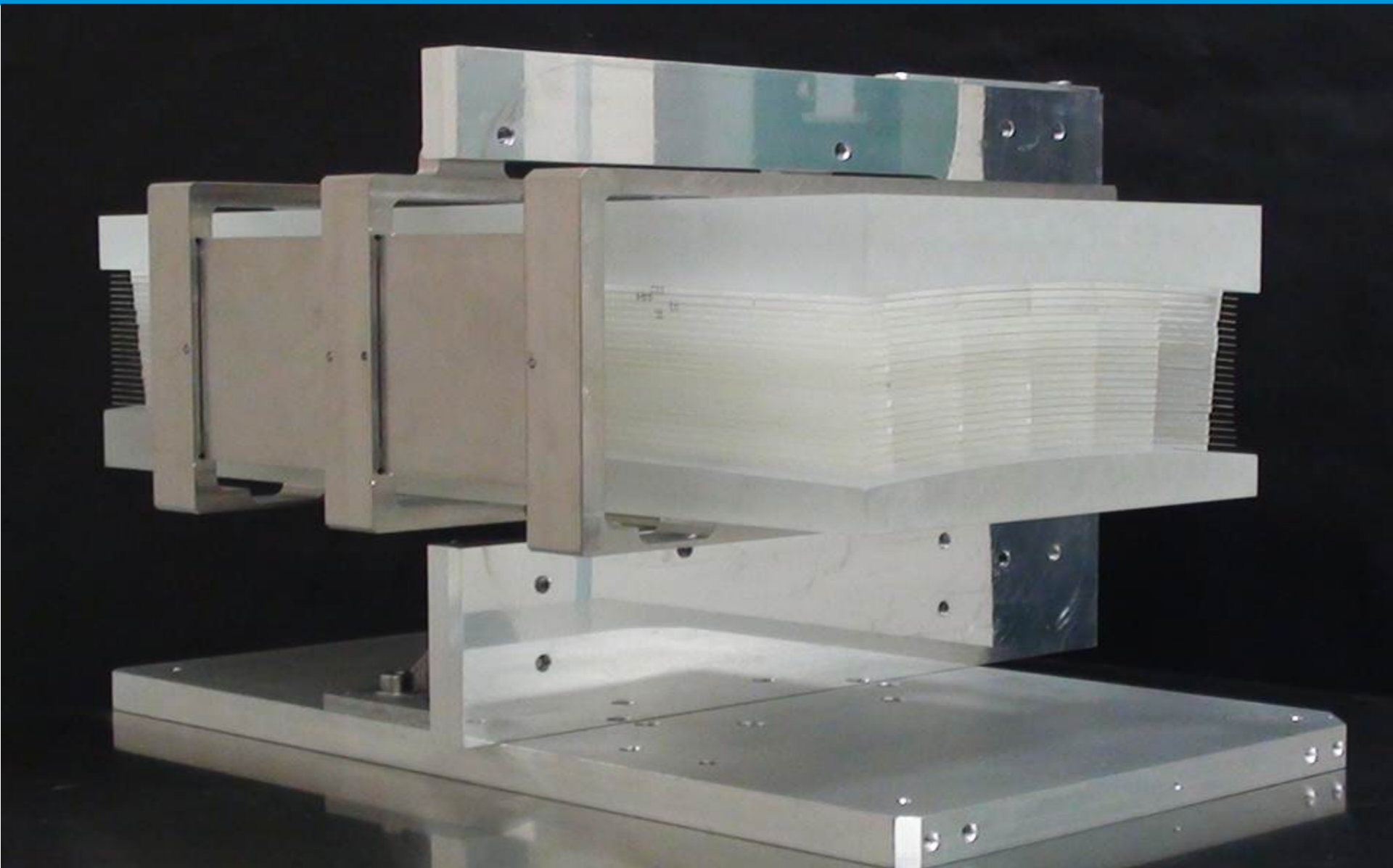




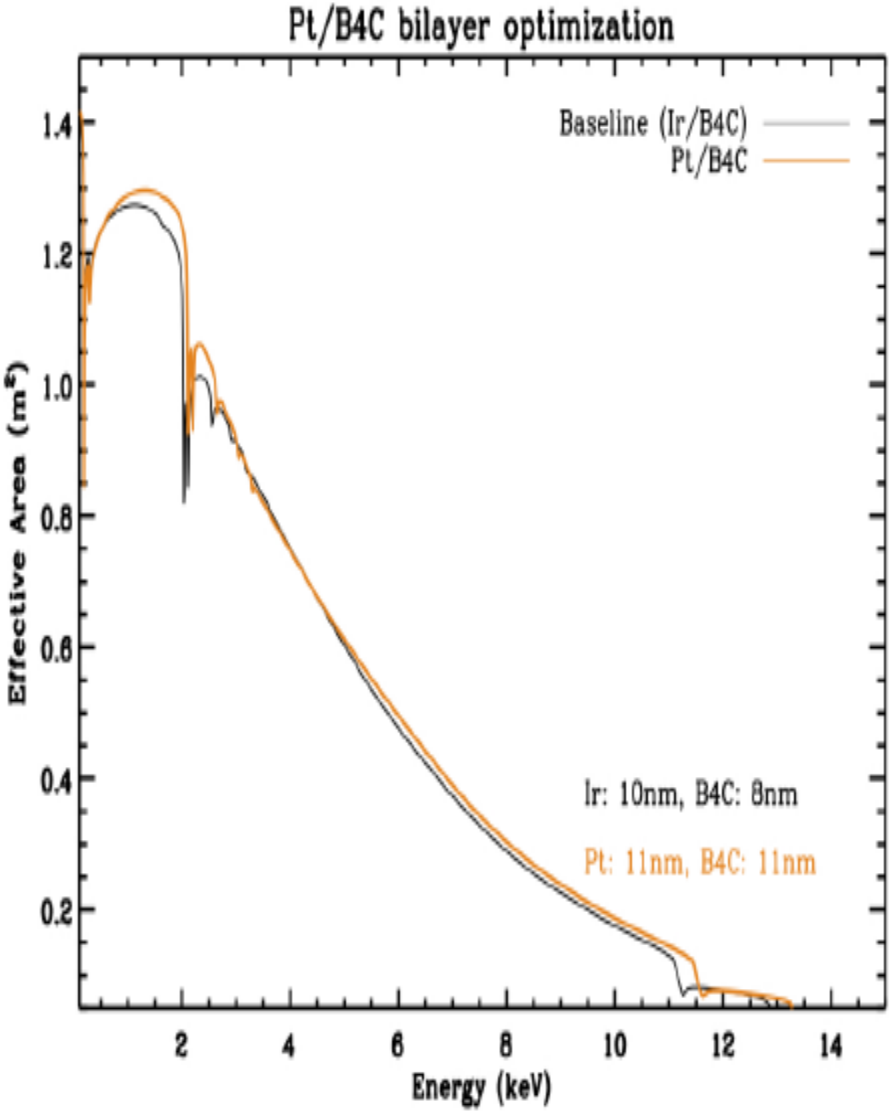


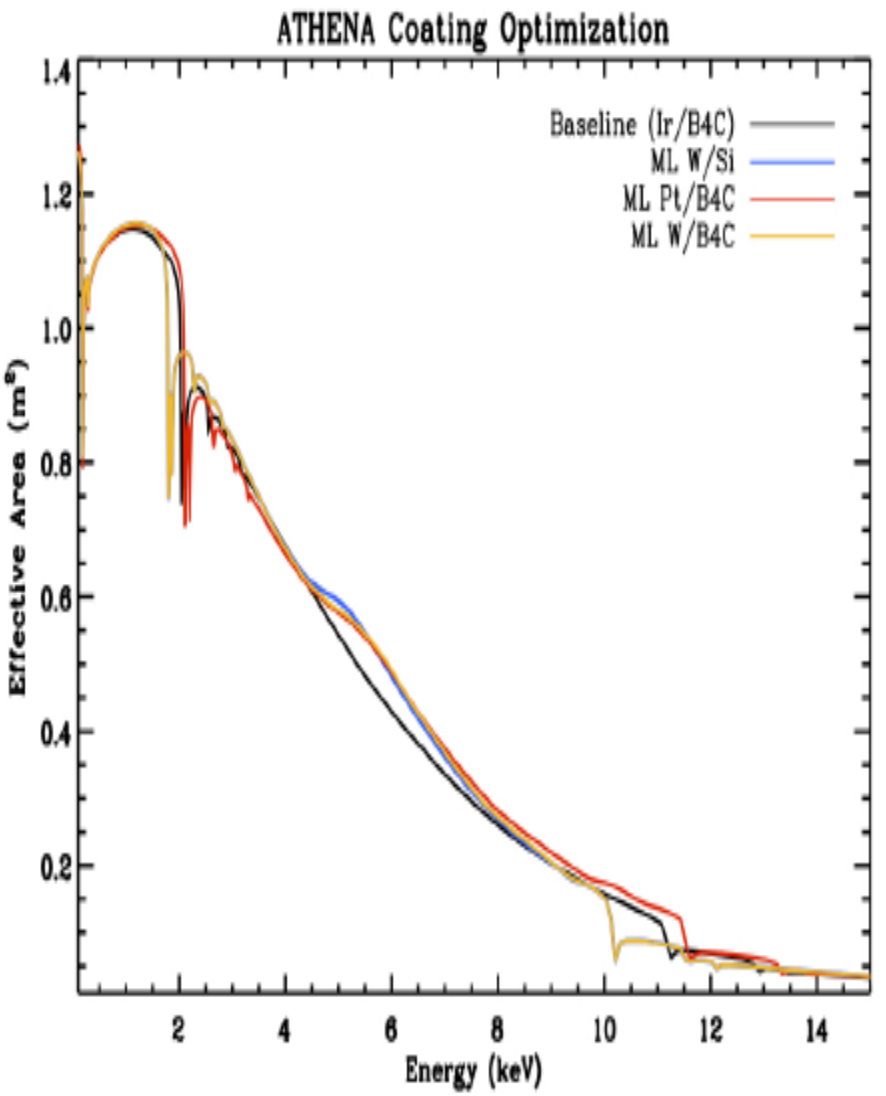
Integration Machine for Slumped Glass Optics

Slumped Glass Optics Mirror Module

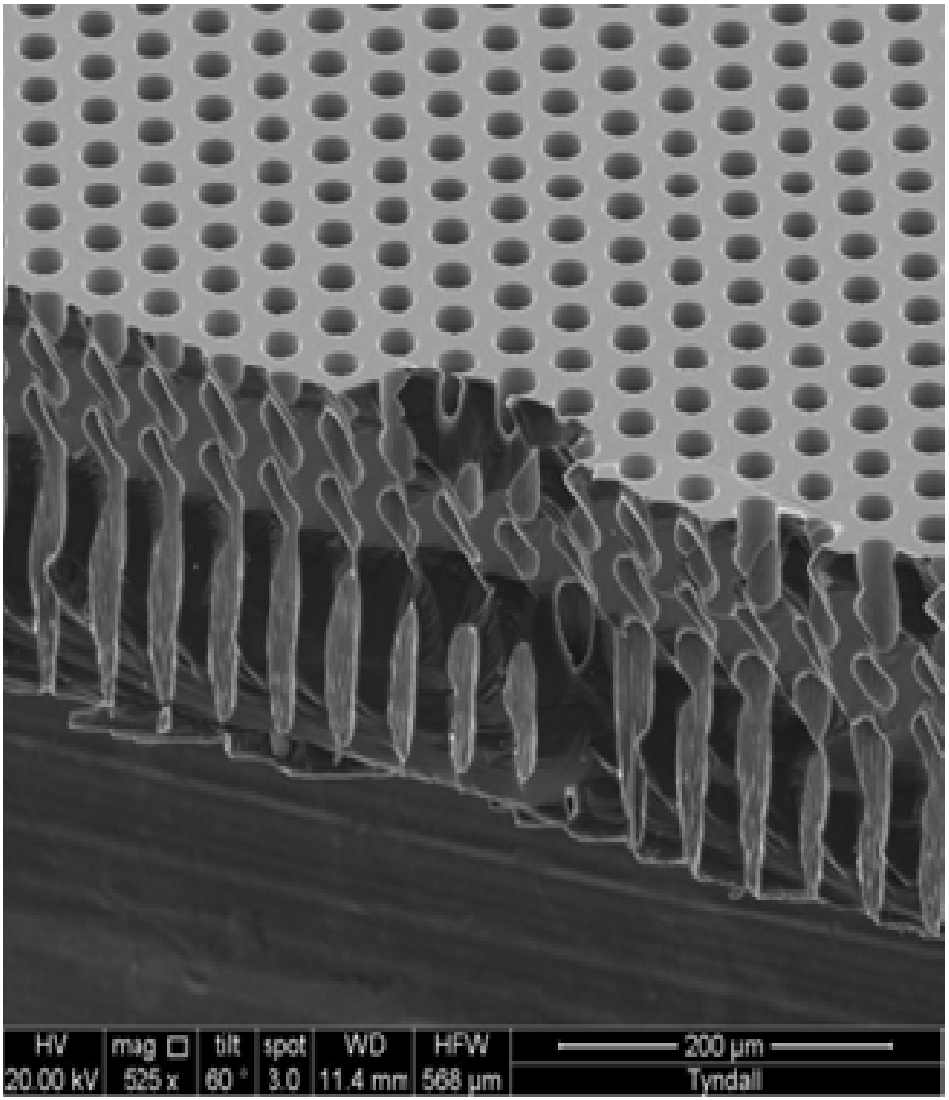


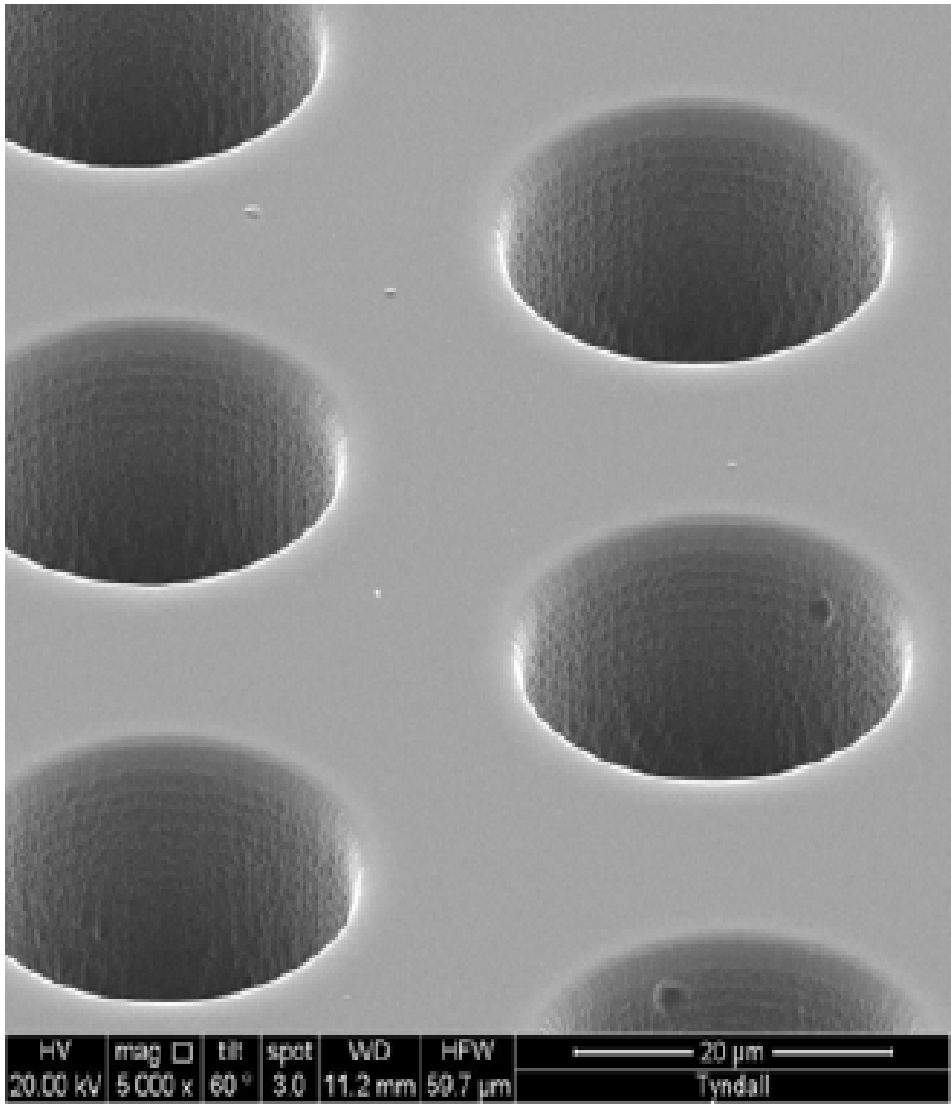
Multilayer coating optimisation for DC magnetron sputtering





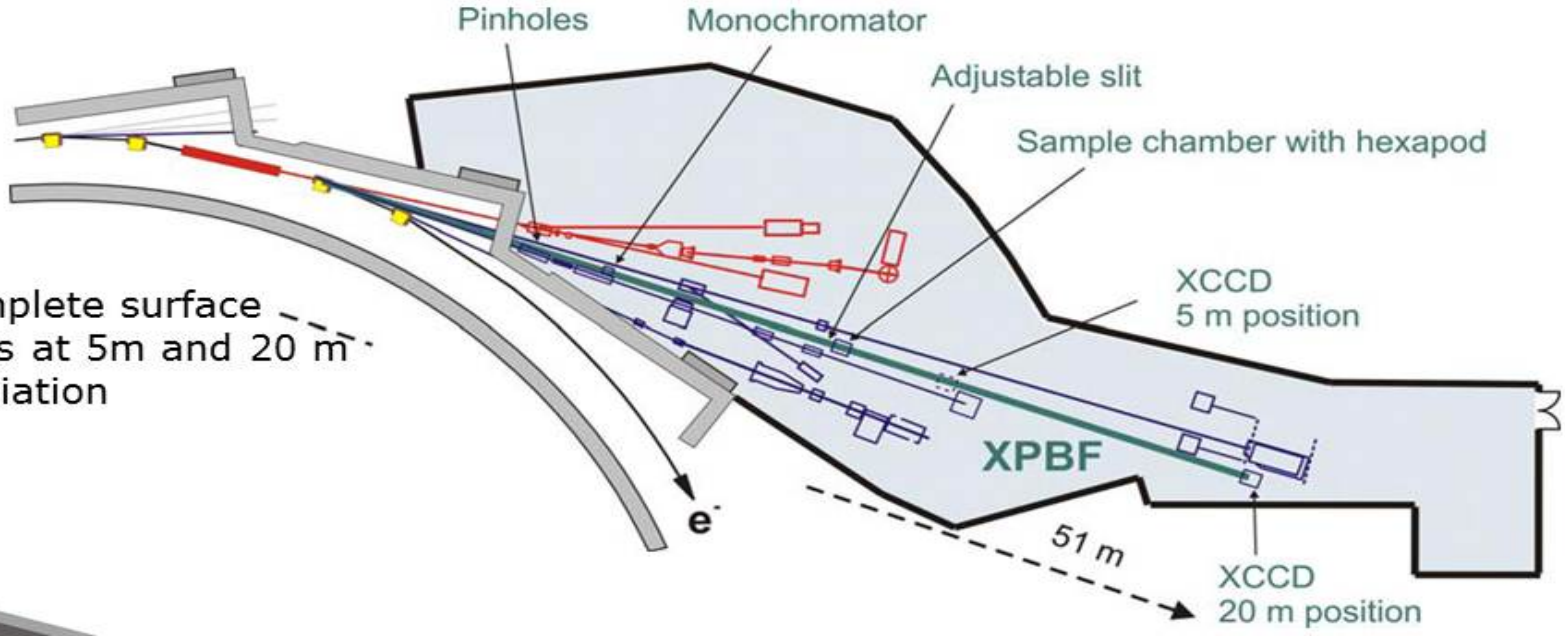
ALD coating: SEM images of a Platinum coated TSV array

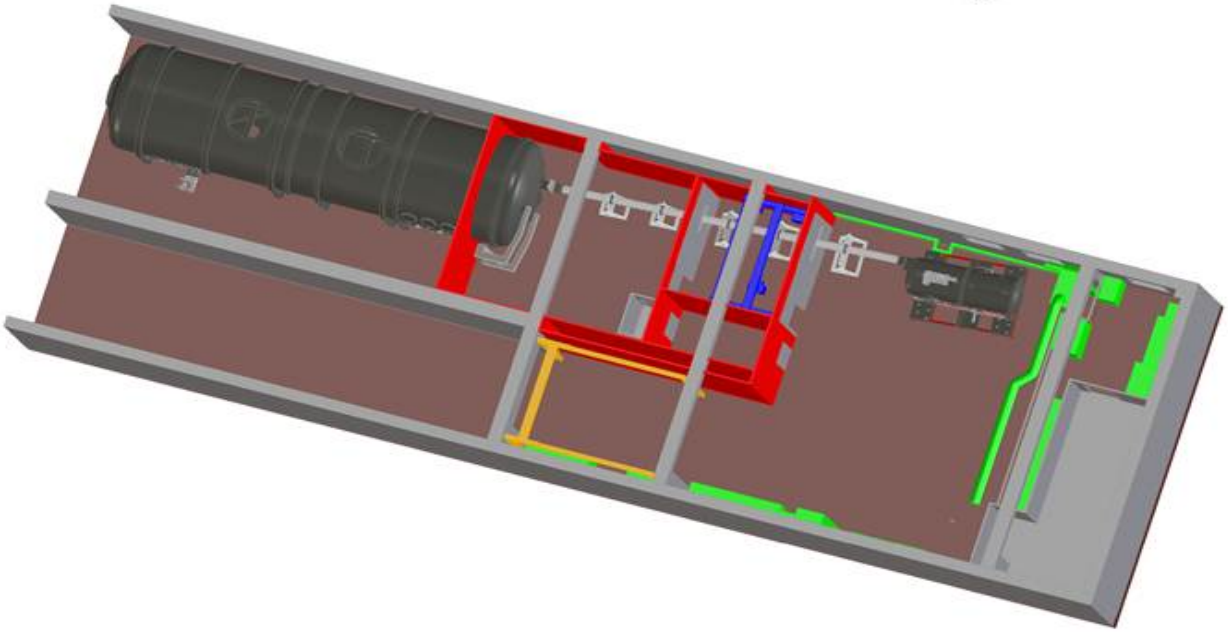




X-ray Test Facilities

BESSY II
Pencil beam
Scanning of complete surface
Detector stations at 5m and 20 m
Synchrotron radiation





PANTER
Full area illumination
Up to 20 m focal length
X-ray tubes, filters and monochromoator

Beamline extension at PANTER facility

THANK YOU