The future X-ray astrophysics missions after XMM and Chandra will require novel optics to be developed, in order to provide the combination of large effective area, low mass and adequate angular resolution. In particular the IXO mission candidate, as selected in the first slice of the Cosmic Vision 1525 programme, has stringent and demanding requirements on the performance of the required X-ray optics forming the core of the mission concept.

In a series of activities led and funded by ESA, an extensive consortium of European industries and institutions is working on the development of the Silicon Pore Optics (SPO) X-ray optics technology. The novel technology is using the latest generation Silicon wafers as starting material to produce highly modular high performance X-ray optics. Excellent quality mirror plates have been produced and successfully stacked into modules and assembled into petals. The mirror elements are fully mounted into double-reflection mirror modules and tested both at synchrotron radiation facilities and at the full illumination Panter facility.

**Science Performance Requirements (optics)**

| Metric | Requirement
|--------|-------------|
| Mirror Effective Area | 3 m² @1.25 keV  
0.65 m² @ 6 keV with a goal of 1 m²  
150 cm² @ 30 keV with a goal of 350 cm² |
| Field of View | FOV = 18' diameter
X-ray surveys, Large scale structure
| Mirror Angular Resolution | ≤ 5 arc sec HPD (0.1 – 10 keV)  
30 arc sec HPD (10 - 40 keV) with a goal of 5 arc sec |

**Mounted X-ray Optics Technologies**

- **CHANDRA**  
18500 kg/m²  
15000 kg/m² @ 1 keV
- **XMM-NEWTON**  
2300 kg/m²  
Aeff @ 1 keV
- **Si-HPO**  
200 kg/m²  
Aeff @ 1 keV
- **Glass-MPO**  
25 kg/m²  
Aeff @ 1 keV

**Silicon Pore Optics (SPO) production Steps**

- Silicon Pore Optics (SPO) production Steps
- Silicon Pore Optics (SPO) production Steps
- Silicon Pore Optics (SPO) production Steps
- Silicon Pore Optics (SPO) production Steps

**IXO Configuration studies by ESA**

- **Instrument module**
- **Optical bench deployment mechanism**
  - c+ deployable shroud
- **Service module**
- **Fixed conical optical bench**
- **Mirror assembly**
  - c+ deployable sun shield

**IXO Mirror Assembly and Structure**

- **Hierarchical fabrication of mirror assembly**
  - Mirror stack
  - Mirror module
  - Petals
  - Optical bench

**Optics Technology Developments**

- **Optical design assumption (preliminary)**
  - 8 petals
  - inner radius: 0.25 m
  - outer radius: 0.8 m
  - 256 mirror modules/petal
  - spoke width: 7 cm

**Optics Technology Roadmap**

- **High Energy Coverage using Multilayer Reflectors**
  - Without C overcoating:
    - Aeff (1.25 keV) = 2.6 m²
    - Aeff (6.00 keV) = 0.65 m²
  - With 90 Angstrom C overcoating:
    - Aeff (1.25 keV) = 3.0 m²
    - Aeff (6.00 keV) = 0.65 m²

To achieve the 3 m² Aeff at 1.25 keV requirements, the mirror modules shall be covered with a C overcoating.

**Performance Estimate**

- **X-ray metrology at BESSY II**
  - Measured Mounted Optics, Full 4 plates, double reflection: 17 ~ HEW
  - SiXm X-ray beam, scan full length of mirror

- **Full-beam metrology at Panter**
  - Measured Mounted Optics, Single pore, double reflection: 4 ~ HEW

- **With JAXA/ISAS multilayer design (courtesy H. Kunieda)**
  - Aeff (30 keV) = 150 cm²