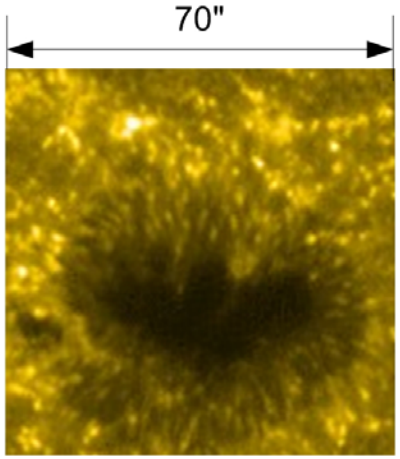
SLMS™ for Ultraviolet and Extreme Ultraviolet Imaging Applications

Phase II SBIR Contract Number NAS8-02114

Dr. David Content NASA GSFC

Advanced Lightweight Mirror for FUV Solar High Angular Resolution Photometric Imager (SHARPI)



TRACE image of sunspot
160nm, 1" resolution

Marc Jacoby
LWOS Chief Scientist
Schafer Corporation
26709 Agoura Road
Calabasas, CA 91302

818.512.4140

mjacoby@schaferalb.com

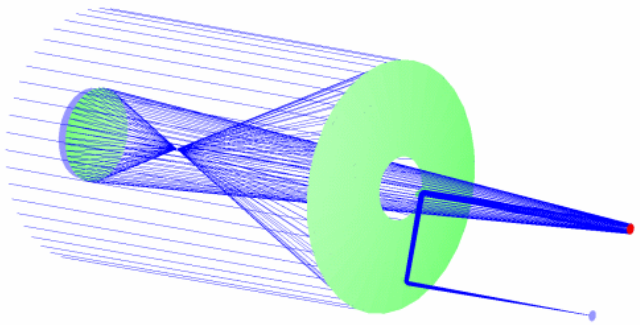
Mirror Technology Days
August 2007

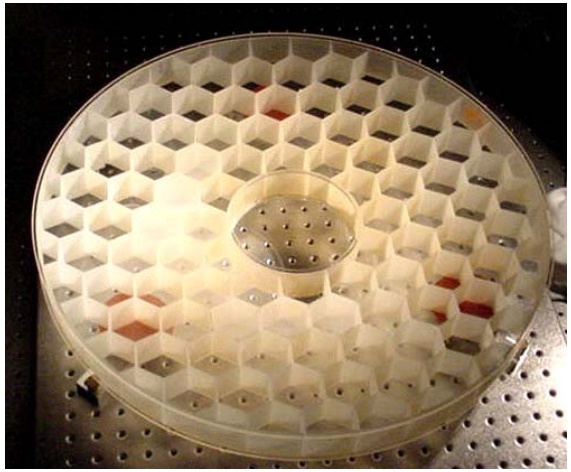
Briefing Outline

- Background
- SBIR Objectives
- PM & SM Mirror Specifications
- SHARPI SLMS™ Primary Mirror

Background

- SHARPI (Solar High Angular Resolution Photometric Imager) is a concept for an experiment to achieve 0.1-arcsecond solar imaging using a lightweight, ultraprecise 55-cm telescope in the far ultraviolet (160 nm continuum, eventually emission lines including Lyman alpha and C IV).
- SHARPI is based on a Gregorian system with a powered tertiary that produces a slow (f/93) final beam with the desired image scale (0.04 arsec per 10 mm pixel) – straightforward design for highly diffraction-limited system
- Baseline Kodak ULE mirror is high areal density (19.75 kg/m^2) and has poor thermal conductivity

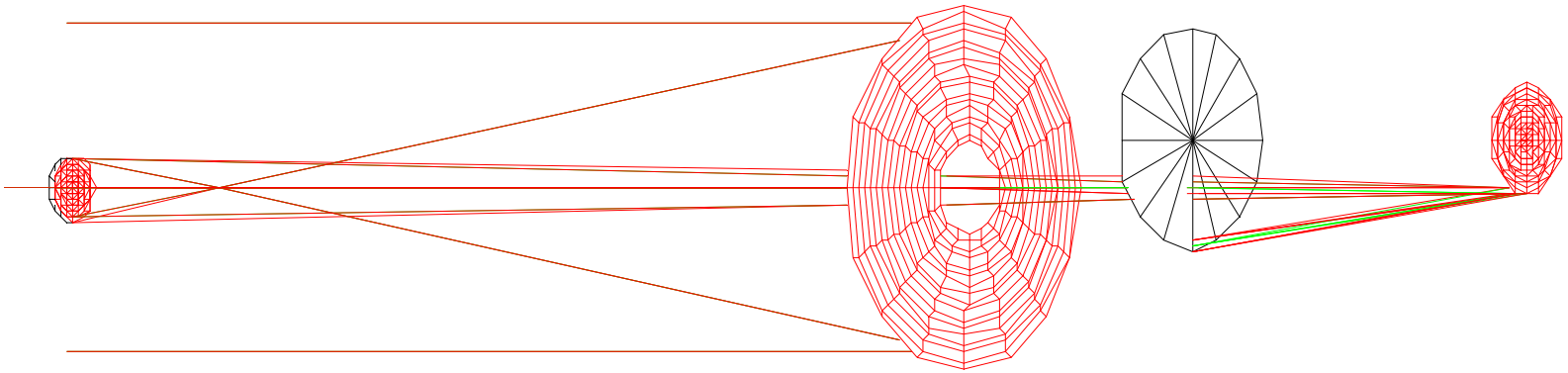




SHARPI Primary Mirror: specifications			
Material / construction		ULE / LTF	
Total mass		4.54	*kg*
Areal density		19.75	*kg/m^2*
Light weighting		92	%
Figure specifications			
Global surface figure error	(>10mm)	6.3	*nm* RMS
Microroughness	(1mm-1mm)	1	*nm* RMS

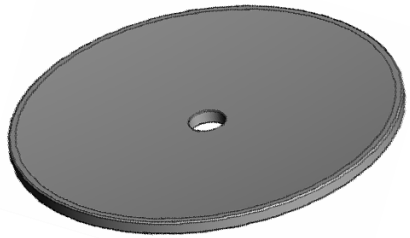
SBIR Objectives

- Use SLMS™ technology to improve areal density and dimensional stability
- Redesign SHARPI telescope based on SLMS™ technology using GSFC design
  - ⇒ Primary mirror: concave parabola, radius of curvature of 3000 mm
  - ⇒ Distance from primary to secondary: 1790 mm
  - ⇒ Secondary mirror: concave ellipse with vertex radius (Rv) 532.110 mm, conic constant (k) (-)0.696340, and clear aperture 97.864 mm
  - ⇒ Optics specified for wavelengths: 0.0632 um, 0.120 um, and 0.632 um



PM & SM Mirror Specifications

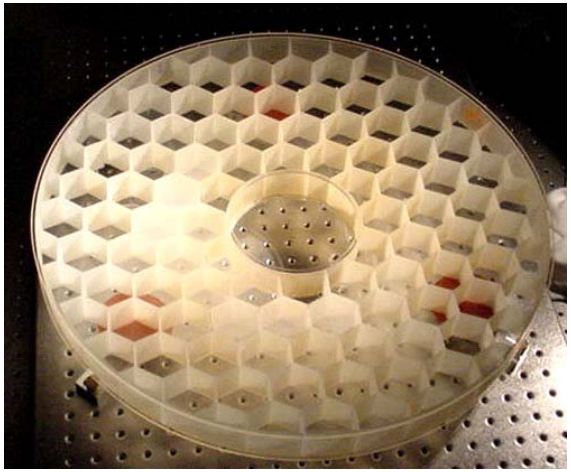
- Primary Mirror: 541 mm diameter, concave parabola, 3000 mm ROC (F/3) SLMS™ Demonstration Mirror with a 50 mm center hole, 19 mm thick – *in polishing*
- Secondary Mirror, 12 cm diameter, concave ellipse, 532.11 mm ROC (K=-0.69634), single crystal silicon – *manufactured to specification*

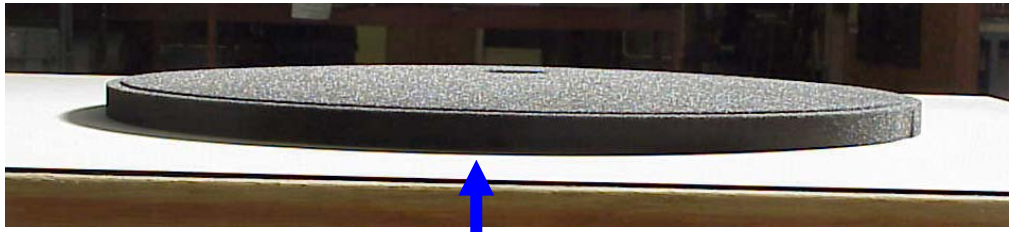


Specification	Primary Mirror	Secondary Mirror
Shape	On-axis, Parabolic	On-axis, Ellipse
Physical Aperture (PA)	55 cm	12 cm
Clear Aperture	5-8 mm > than ID of center hole to 50 cm	10 cm
Surface Figure	λ/40 rms HeNe	λ/40 rms HeNe
Surface Roughness	<10 Å rms	<10 Å rms
Surface Quality (Scratch/dig)	40/20	40/20
Radius Tolerance	-	±0.5 mm
Diameter Tolerance	±2 mm	±0.2 mm

SLMS™ For SHARPI

- Advanced Lightweight Mirror for FUV
- Baseline Mirror is ULE
  - 4.54 kg, areal density of 19.75 kg/m^2)





- SLMS™ Meniscus Design
  - 55 cm Diameter
  - 28:1 Aspect ratio
- Measured Weight of 1.85 kg
  - Areal Density = 7.8 kg/m^2
  - Less than ½ ULE mirror
- Measured 1st Frequency of 616 Hz
- Presently in Polish at Optical Surface Technologies

SLMS™ Has Lower Weight and Higher Stiffness Than ULE Baseline, While Providing Higher Thermal Conductivity and Lower Fragility

Largest SLMS™ Monolith to Date

What is wrong with YOUR air and space optics?

ISO 9001 QMI REGISTERED

Contact: Dr. Bill Goodman
Schafer Corporation
2309 Renard Place SE
Albuquerque, NM 87106
505-338-2865
wgoodman@schaferalb.com

Schafer Lightweight Optical Systems (LWOS)
Optical Services and Products

C
o