

Another source of short KB mirror
flats.

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MHATT-CAT and Univ. of Michigan

9/19/02 TWG meeting

work done with Don Walko, Peter Eng.

Special thanks to Lahsen Assoufid, Carmen Kmety-Stevenson (4ID)

Background

- For optimal performance of the GSE-CARS style bendable KB mirror system, one must procure flats with sub microradian RMS slope error and below a few Angstrom RMS roughness.
- Such optics is expensive. Example, SESO quoted on 10/5/2001, 3860\$ per flats (>10 order) (coating included) for Zerodur or Silica with < 2 microrad RMS, < 2 Ang. RMS. Lead times are long.

Old vendor still in business

- Having procured a CARS style 2 x 100 mm long mirror system, we needed flats on 7ID.
- Found out that a company formerly known as General Optics was purchased by WavePrecision GSI thus got a quote to polish two blanks provided by P. Eng. The buffed blanks were made by the optics fab. lab.
- For polishing, the quote was 1350\$ each for best effort for 1 urad slope error, and 1 Ang. Rms.

NUV-29-2001 08:34

WAVEPRECISION, INC.

805 529 4298 P.01/01

WAVE PRECISION
A GSI LUMONICS Company

Formerly General Optics, Inc.

WavePrecision, Inc.
5390 Kazuko Court
Moorpark, CA 93021
Phone (805) 529-3324
Fax (805)529-4298
www.waveprecision.com

QUOTATION NO
005522-00

To : UNIV OF CHICAGO - C/O ANL

Date: 11/29/2001

Your Request: FAX

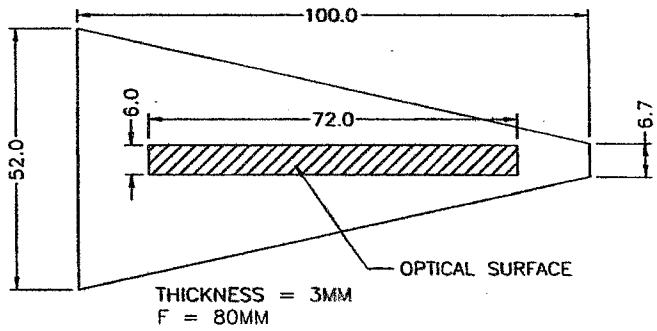
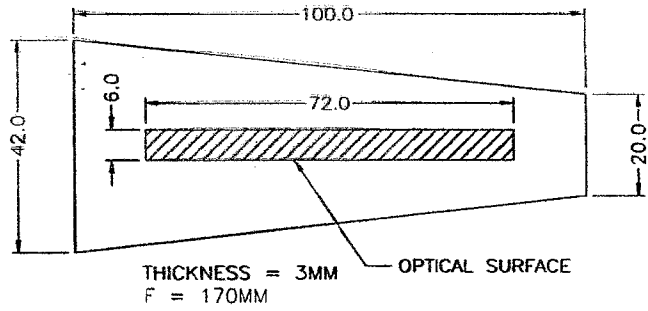
Attention : DR. ERIC DUFRESNE
Phone: (630) 252-0274
Fax: (630) 252-0279

Terms: NET 30

FOB Point: MOORPARK

We are pleased to quote your requirements as follows:

Item	Cust # - Part # / Description / Details	Quantity	Price Unit
001	<p>0565-UCH001 Rev 000 SILICON TRAPEZOIDS 42mm base x 20mm top x 100mm long x 3mm thick or 52mm base x 6.7mm top x 100mm long x 3mm thick</p> <p>Figure: Best Effort for 1 microradian slope error (due to metrology concerns) and for convex radius > 500m, and concave radius > 1km. Roughness: 1Å RMS or less, as measured on WP heterodyne profiler.</p> <p>Material: Customer to supply 2 ea. shaped Silicon blanks, at finished perimeter x 3.75mm thick, with 1mm x 45° chamfers all around and acid etched.</p> <p>The 2 pcs. may be a combination of both sizes or 2 of the same size.</p> <p>DELIVERY: 8-10 weeks ARO&M</p>	2 EA	\$ 1,350.00 EA



Si blanks
 convex radius > 500m
 concave radius > 1 Km
 Best effort for 1 μ m slope error
 and 1 Å rms or less

polishing 1350# each (110)
 complete fabrication 1650# each (410 data)

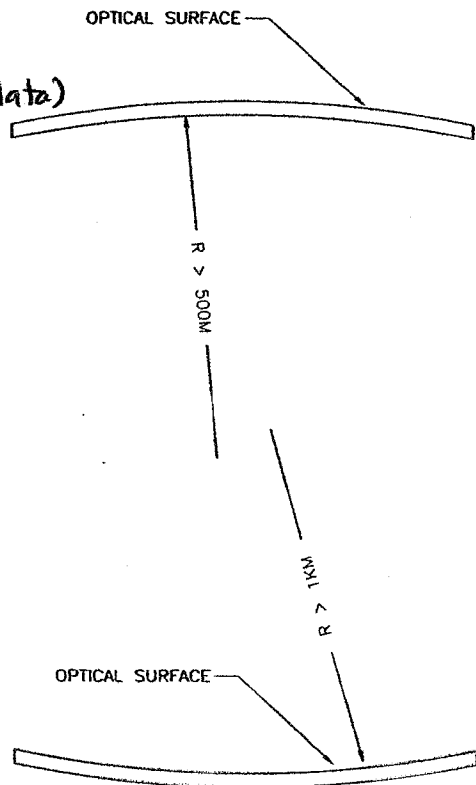


Table 1. TOPO 2D absolute RMS roughness measurement results with a 5x objective.

Mirror (#)	*RMS (Å)	**P-V (Å)	Figure (#)
1	0.8	4.7	2
	0.7	4.1	
2	0.8	4.5	3
	0.6	4.0	

TID
2/5/02

*RMS = root mean square. **P-V = peak-to-valley.

Table 1. TOPO 2D roughness measurement results with a 5x objective.

Mirror (#)	*RMS (Å)	**P-V (Å)	Figure (#)
1	0.8	4.7	2
	0.8	4.8	
2	0.7	4.5	3
	0.6	4.7	

41D-D
Mirrors
August 02

*RMS = root mean square. **P-V = peak-to-valley.

Table 2. LTP measurement results over 72 mm scan length (See text for details.).

Mirror (#)	Raw data				Residual data				Figure (#)
	slope error (μrad)		height error (nm)		slope error (μrad)		height error (nm)		
	RMS	P-V	RMS	P-V	RMS	P-V	RMS	P-V	
1	1.49	5.96	1.49	5.96	N/A	N/A	N/A	N/A	4
2	1.31	5.21	1.31	5.21	0.30*	1.35	3.7	5.2	5,6

TID
2/5/02

* radius -16.5k

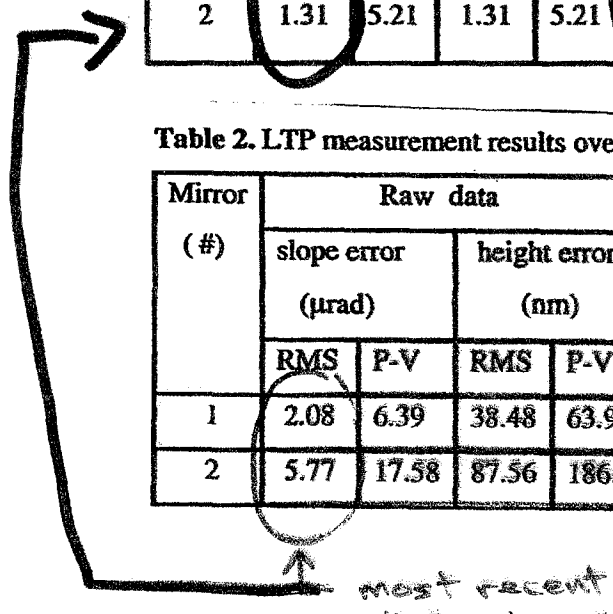
→ residual on both case within SPEI

Table 2. LTP measurement results over 72 mm scan length (See text for details.).

Mirror (#)	Raw data				Residual data				Radius (km)	Figure (#)
	slope error (μrad)		height error (nm)		slope error (μrad)		height error (nm)			
	RMS	P-V	RMS	P-V	RMS	P-V	RMS	P-V		
1	2.08	6.39	38.48	63.95	1.33	4.76	22.90	41.34	-13.05	4
2	5.77	17.58	87.56	186.0	0.91	3.92	16.47	28.20	3.67	5

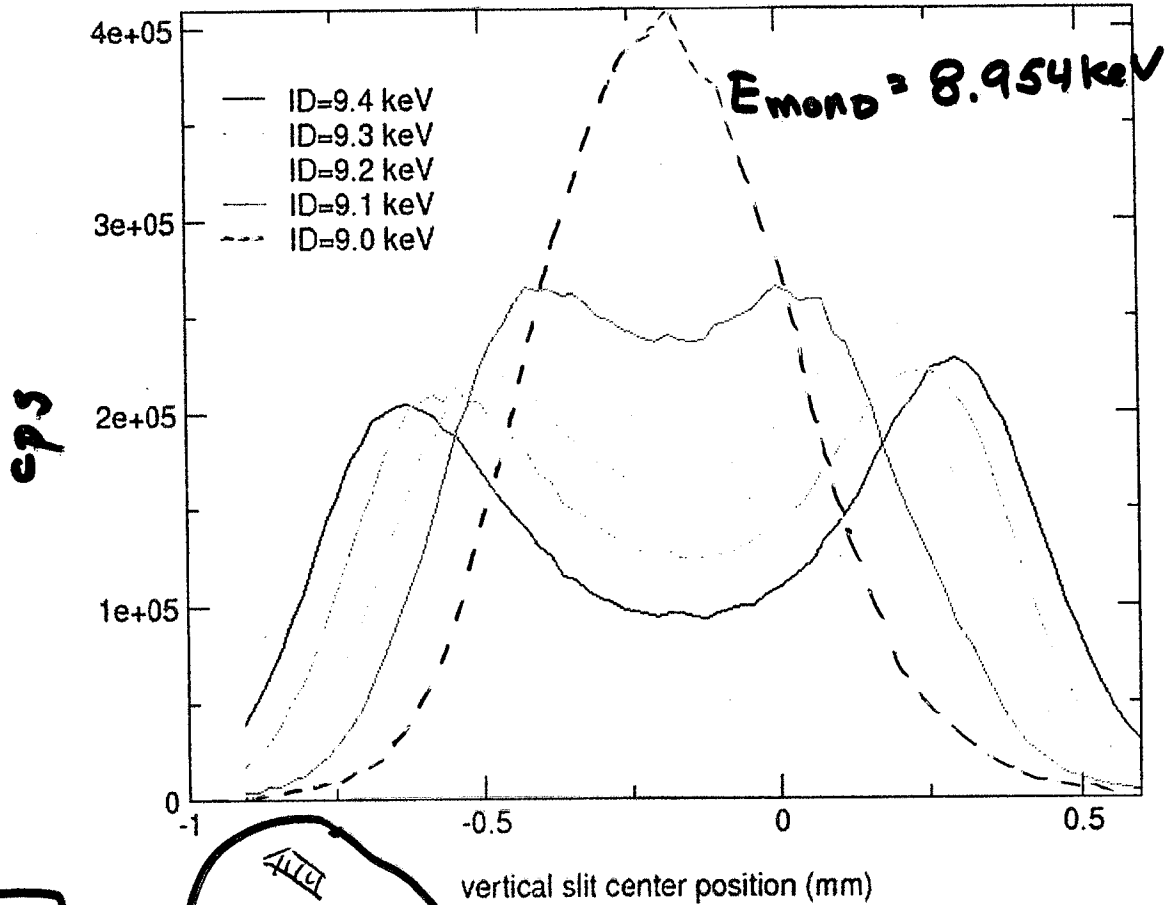
41D-D SPEI

8/29

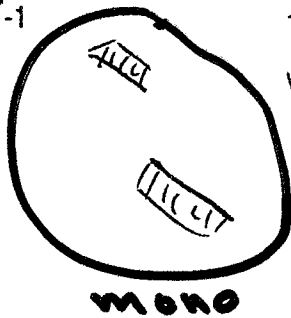


most recent 41D mirrors not nearly as good as raw data

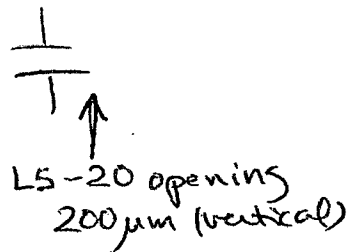
3/6/02 file=ksbetup scan 13-17 Mono set to 8.954 keV



ion chamber

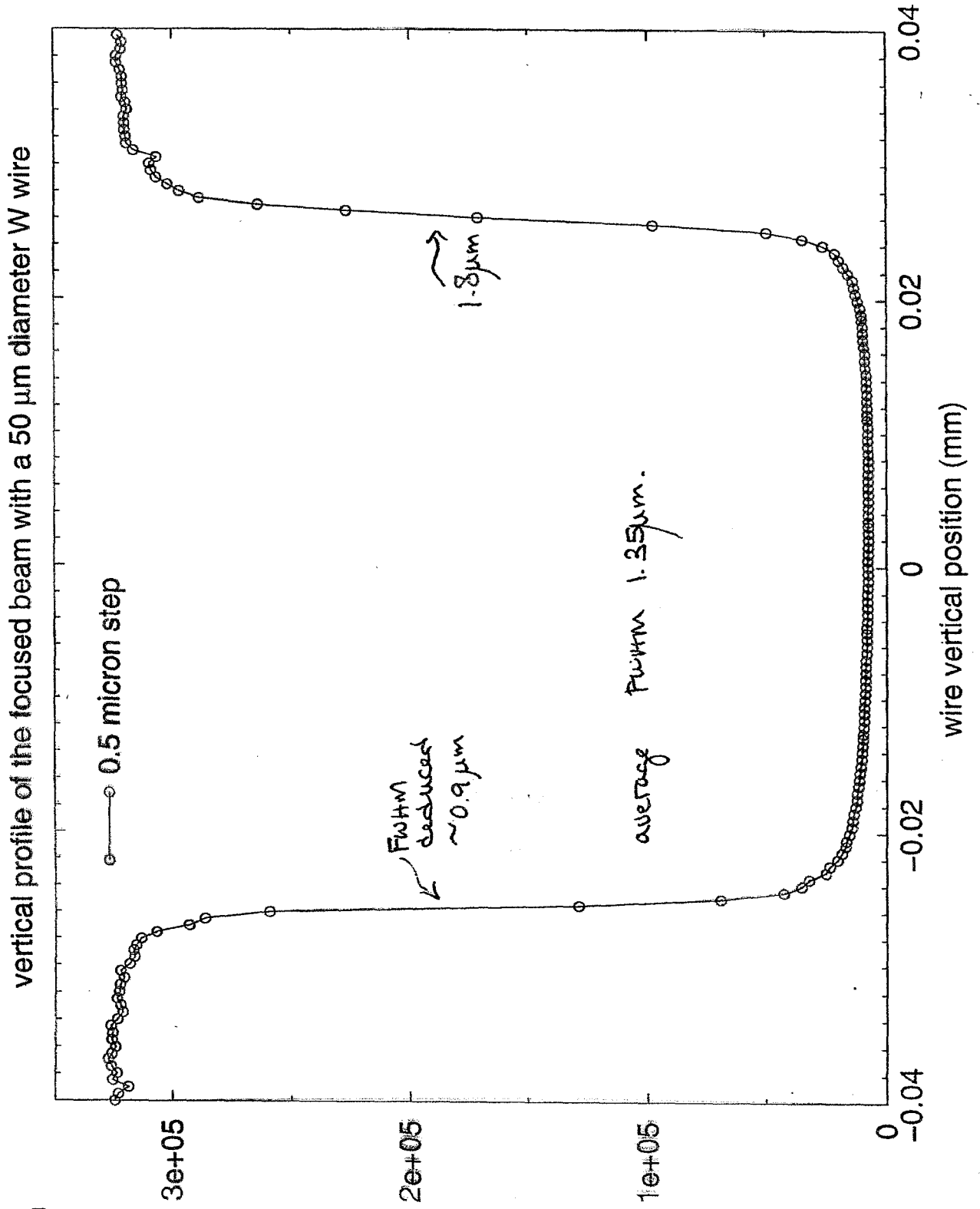


vertical slit center position (mm)



See Sandy et al, JSR 99, vol 6 p 1174-84.
 Two peaks on ID profile if $E_{mono} < E_c$,
 with
$$\theta = \pm \frac{1}{\gamma} \left[\frac{0.95 E^2 (60V) \eta}{E [keV] \lambda_{\mu} [cm]} - (1 + \kappa^2/2) \right]^{1/2}$$

$\sigma_x = 342.7 \mu\text{m}$
 $\sigma_y = 20.3 \mu\text{m}$



Conclusion

Wave Precision super polishing is excellent with sub \AA RMS finishes.

Their first job for TID resulted in excellent mirrors (i.e. polishing blanks from optics shop).

Recent mirrors from WP made entirely by ~~the~~ ^{them} resulted in good mirrors (41D) with $\sim \mu\text{-rad}$

RMS residual slope error, with residual natural curvature within specs. The most recent batch has not been tested in the beam. (41D). The raw slope errors from the latest

batch were not as good as their first attempt. It might be possible to get better mirror from them if they were made thicker.