



Certificate of Compliance

Prepared For:
UCAR
CG1-PATRICK ZMARZLY
3090 CENTER GREEN DR
BOULDER, CO 80301

Customer PO #:	P2016953
Sales Order #:	-
QC#:	-

Date Shipped:	DEC. 21, 2021
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Part #(s):
6 Calcite WP HAO Dwg. KSO-SW-01001-XX-REV A Thickness of Each Pair to be within 1 micron
Last four pages show interferograms of calcite wave plates optically contacted to parallel blocking plates at the end of lapping process before de-contacting of wave plates.
Crystal axis is in the plane of circular face. In calcite crystal, planes perpendicular to crystal axis are much softer than the planes parallel to it. This creates a limitation in achieving surface flatness better than what is shown in the interferograms. This tends to create sag on flat surface. Orientation of the sag is related to crystal axis. This sag pertains to surface flatness of less than one micron. Thicknesses of each wave plates on a blocker are same.

Notes:
THESE GOODS ARE OF US ORIGIN
Page 2 of 2

Karl Lambrecht Corporation certifies that all items in the above shipment have been manufactured, inspected and found to be in compliance with all applicable drawings, customer specifications, purchase requirements and product specifications as posted on our web site at www.klccgo.com. All documentation utilized were to the latest revision in effect on the date of the above order or as specified by the buyer. Sustaining records are on file at the Karl Lambrecht Corporation facility in Chicago and is subject to review upon request. Please contact QA@klccgo.com with any questions regarding this certificate.

CERTIFIED 
Raymond Lambrecht VP

ZONE		REV.	DESCRIPTION	DATE	APPROVED
		A	INITIAL RELEASE	2021-06-28	PZ

2.700^{+0.035}
-0.035



$\phi 34.00$ 0.00
-0.25

$\phi 28.80$

CLEAR APERTURE MIN
(85% OF PHYSICAL APERTURE)

"XX"	THICKNESS (MM), "T"	QUANTITY REQ'D	THICKNESS VARIATION
-01	1.35	2	DESIRED THICKNESS VARIATION < 1 UM BETWEEN PARTS FOR SAME NOMINAL THICKNESS
-02	2.70	2	DESIRED THICKNESS VARIATION < 1 UM BETWEEN PARTS FOR SAME NOMINAL THICKNESS
-03	5.40	2	DESIRED THICKNESS VARIATION < 1 UM BETWEEN PARTS FOR SAME NOMINAL THICKNESS
-04	10.80	2	DESIRED THICKNESS VARIATION < 1 UM BETWEEN PARTS FOR SAME NOMINAL THICKNESS

GRIND TO (MM)	POLISH TO (MM)	LAP TO (MM)
1.368	1.356	1.350
2.718	2.706	2.700
5.418	5.406	5.400
10.818	10.806	10.800

- NOTES:
1. CALCITE WAVE PLATE FABRICATED FROM SCHLIEREN FREE CALCITE.
 2. TRANSMITTED WAVEFRONT ERROR DUE TO STRIAE < $\lambda/4$ P-V @ 633 nm
 3. SURFACE QUALITY 40/20 SCRATCH DIG
 3. PARALLELISM < 5 ARC SECONDS (< 2.85 ARC SECONDS DESIRED SPECIFICATION)
 4. CRYSTAL AXIS IN THE FACE OF WAVE PLATE TO WITHIN +/- 0.25 DEGREES
 5. SURFACE FLATNESS $\lambda/2$ @ 633 NM P-V
 6. TRANSMITTED WAVEFRONT ERROR $\lambda/2$ @ 633 NM P-V
 7. WAVE PLATES ARE UNCOATED
 8. SPECIFICATIONS TO BE MET WITHIN CLEAR APERTURE
 9. VENDOR TO PROVIDE TEST DATA VERIFYING ABOVE SPECIFICATIONS

HAO High Altitude Observatory
3990 Center Green Drive
Boulder, CO 80501
303.442.1000

APPROVALS	DATE	TITLE
DRW	4/29/2021	KSD
ENG APPR.	4/29/2021	KSO Filter Calcite Set
PROJ. APPR.	06/30/2021	STATE RELEASED
SURFACE AREA (mm ²)		SIZE (DWG. NO.)
VIEW		B KSO-SW-01001-XX

SCALE: 5:1 SHEET 1 OF 1

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
ANGULAR:
FORMED: ±2°
MACHINED: ±0.5°
XX: ±0.17
XXI: ±0.26
XXII: ±0.127
DO NOT SCALE DRAWING
MATERIAL
Calcite
MASS (grams)
0.004

DFS Job #: 1256561
Acct. Key: PZ
Contact: PZ
Extension: -

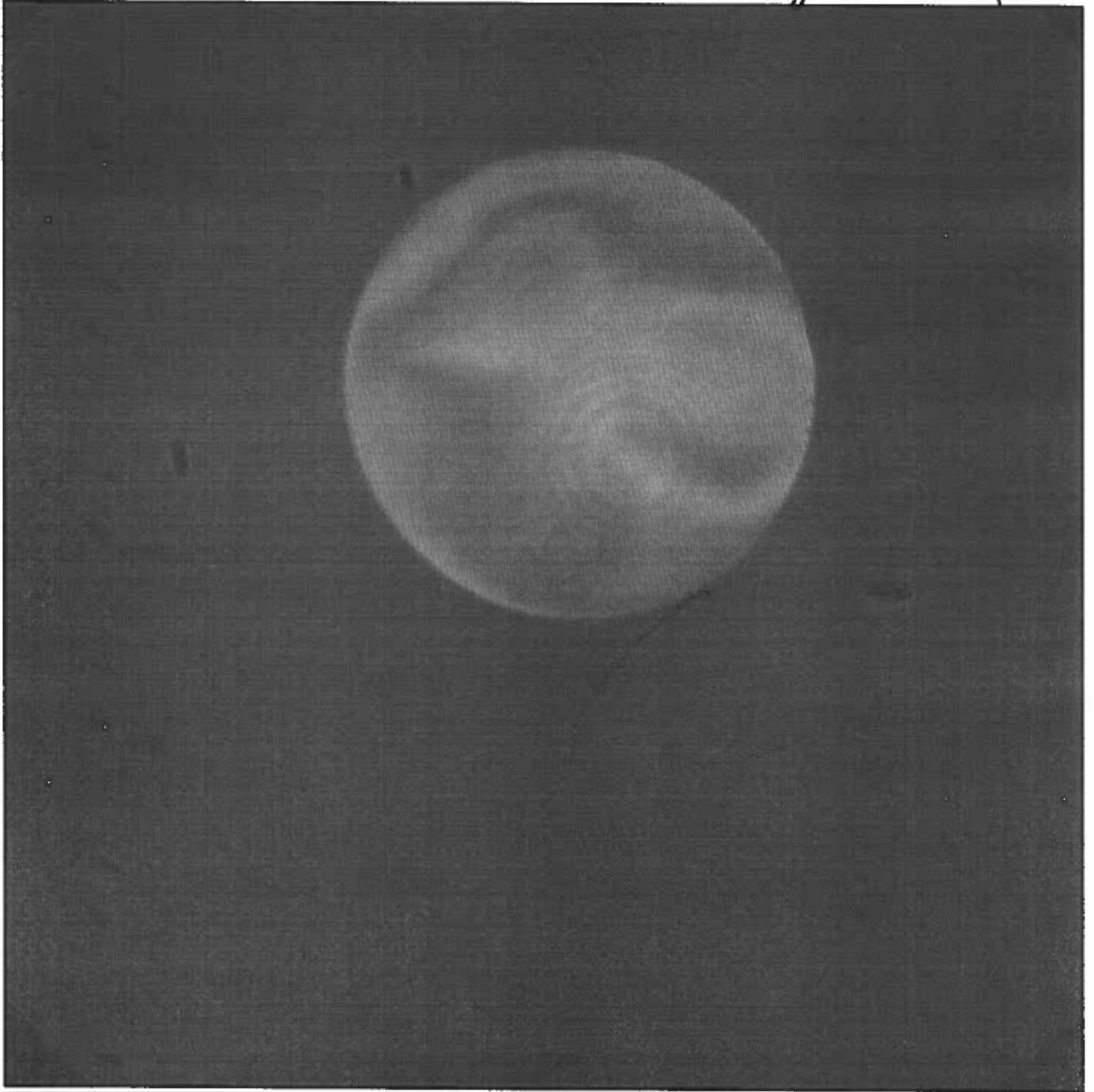
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE PROPERTY OF THE UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH (UCAR). ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF UCAR IS STRICTLY PROHIBITED.

PARALLELISM

FRINGES

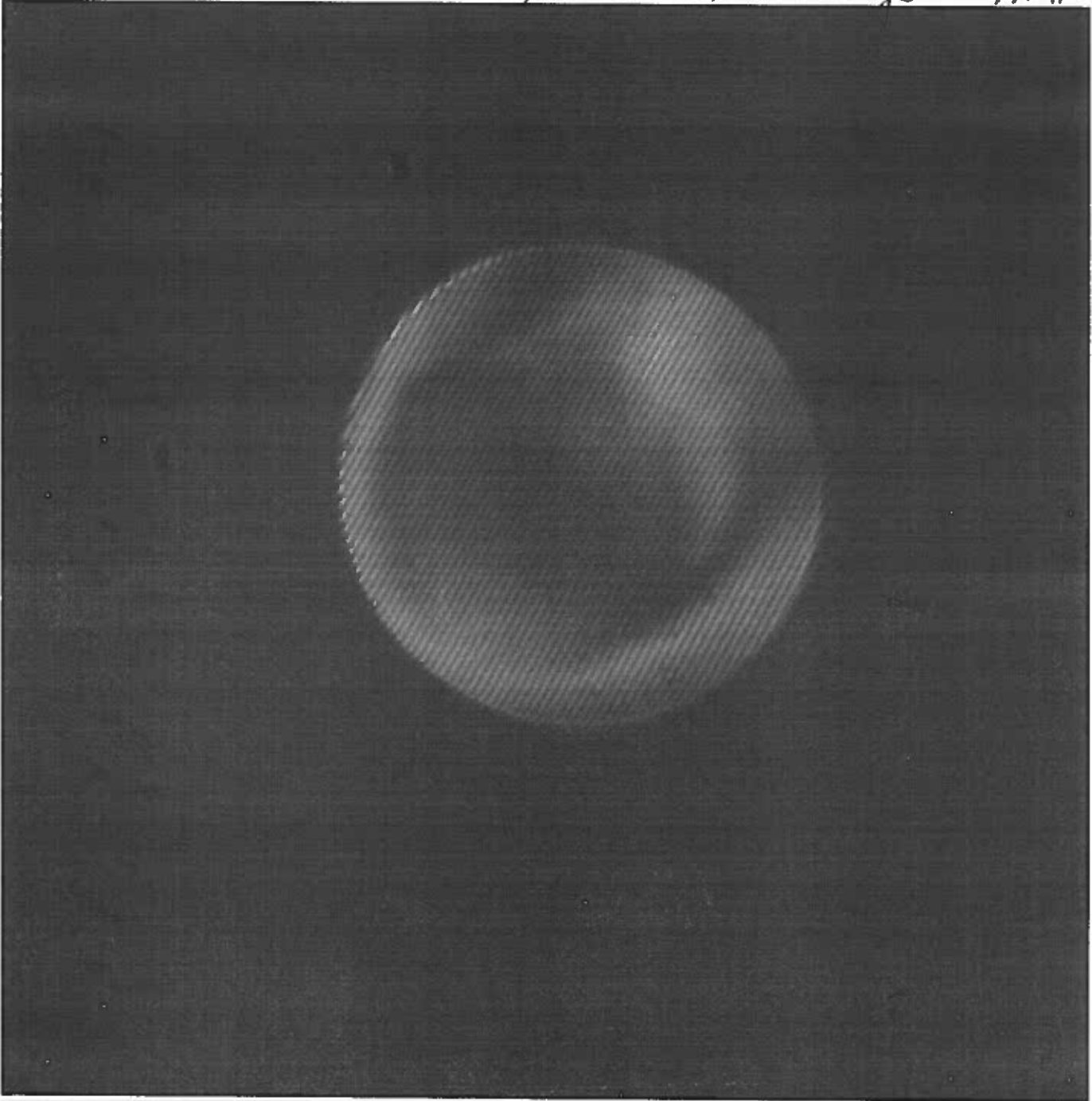
In calcite wave plates, 8 mm distance between two consecutive fringes pertains to wedge of 5 arc seconds
(reference : Optical Shop Testing by Daniel Malacara)

34 mm dia, 1.35 mm thick, Parallelism Fringes WP# 1



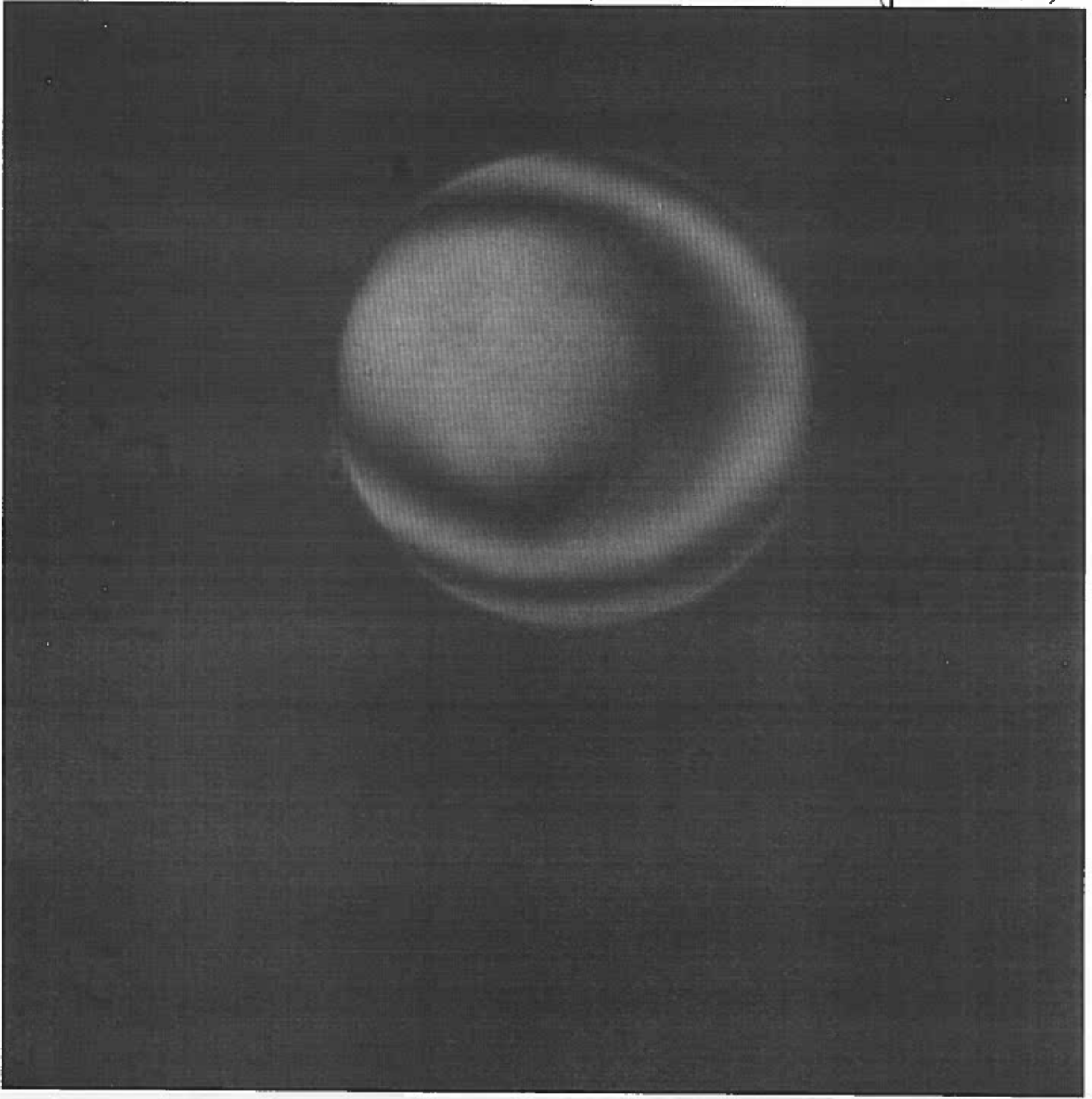
Parallelism $< 5''$

34 mm dia, 1.35 mm thick, Parallelism Fringes WP#2



Parallelism $< 5''$

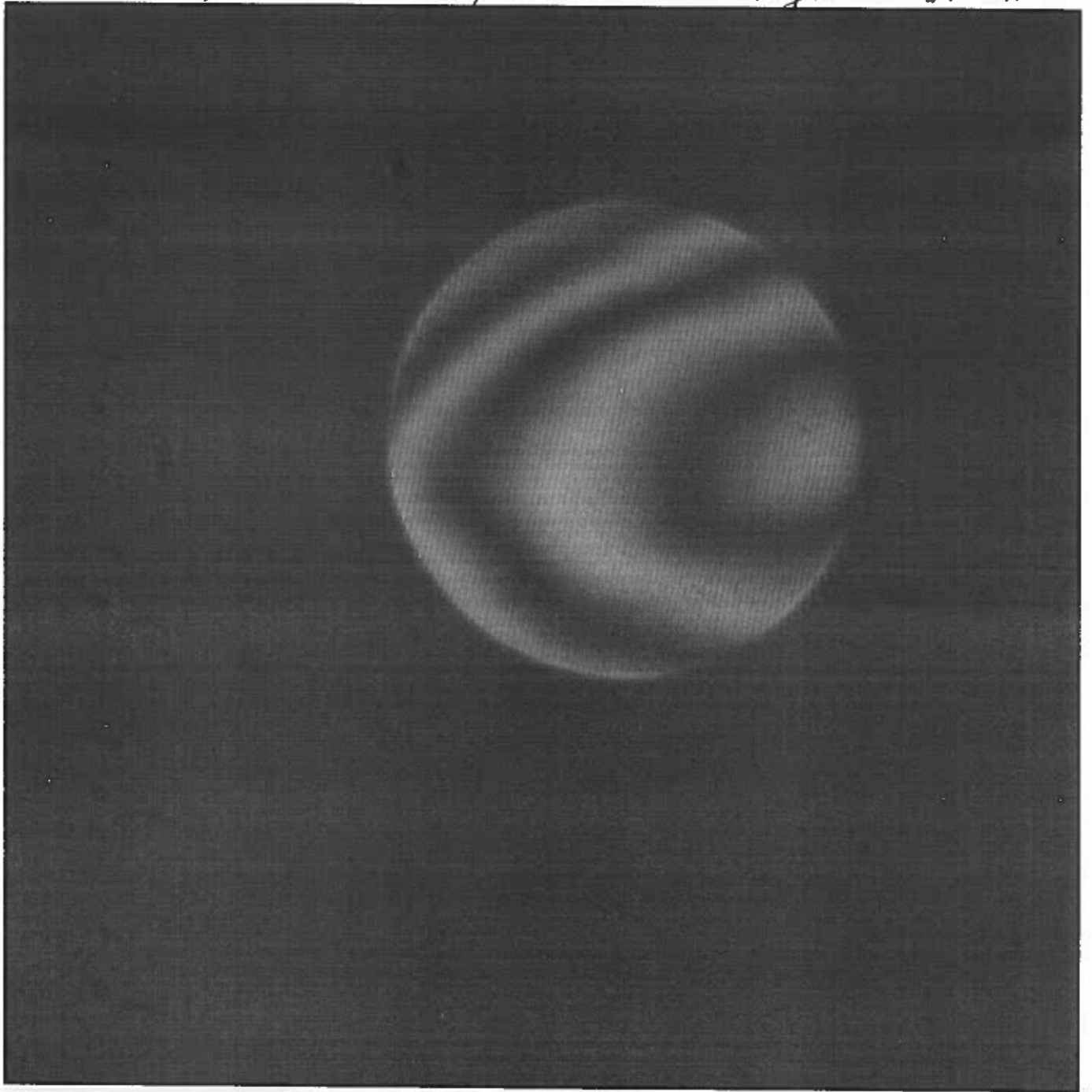
34 mm diameter, 2.7 mm thick, Parallelism Fringes WP#1



Parallelism $< 5''$

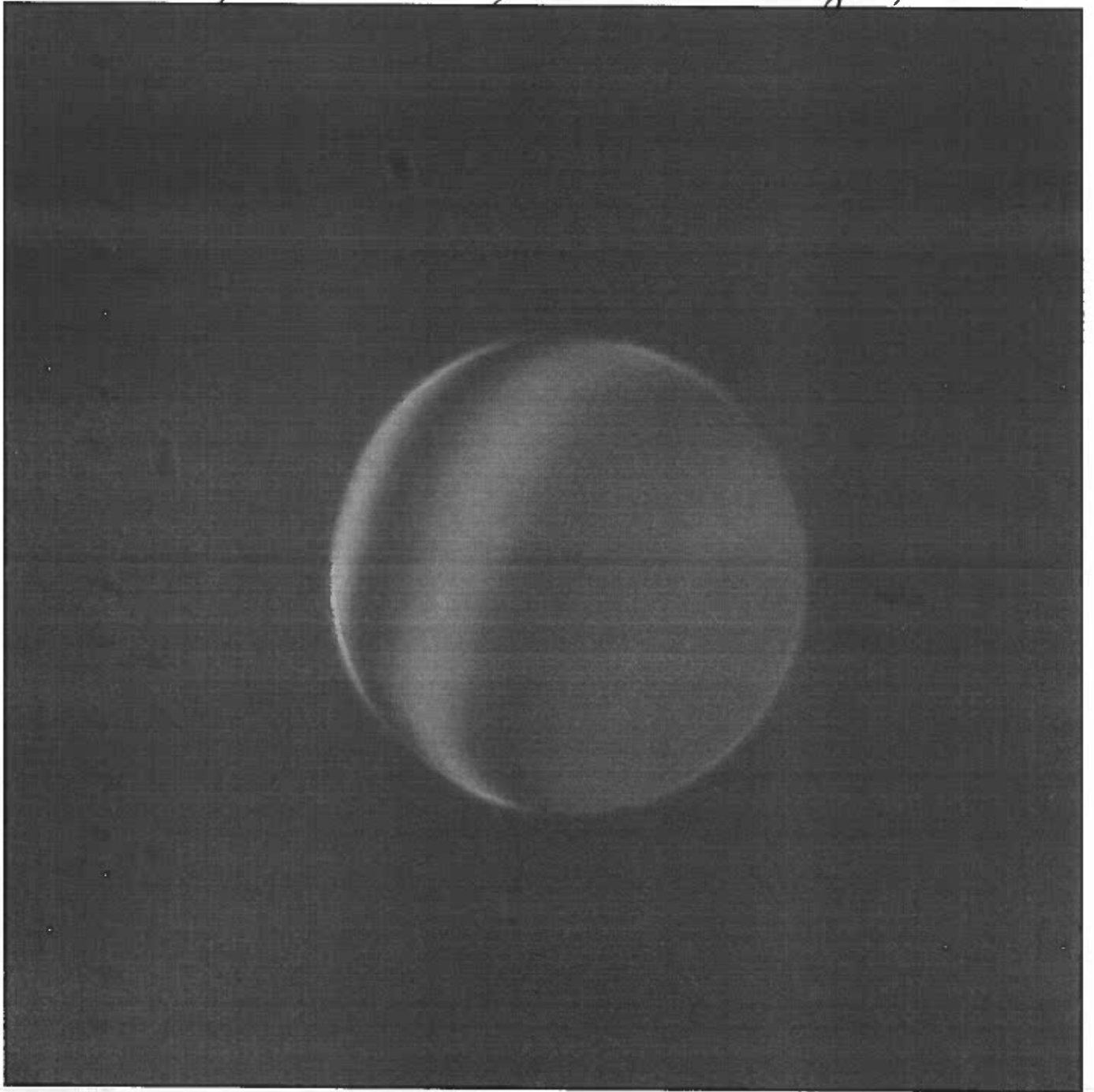
34 mm dia, 2.7 mm thick, Parallelism Fringes

WP # 2



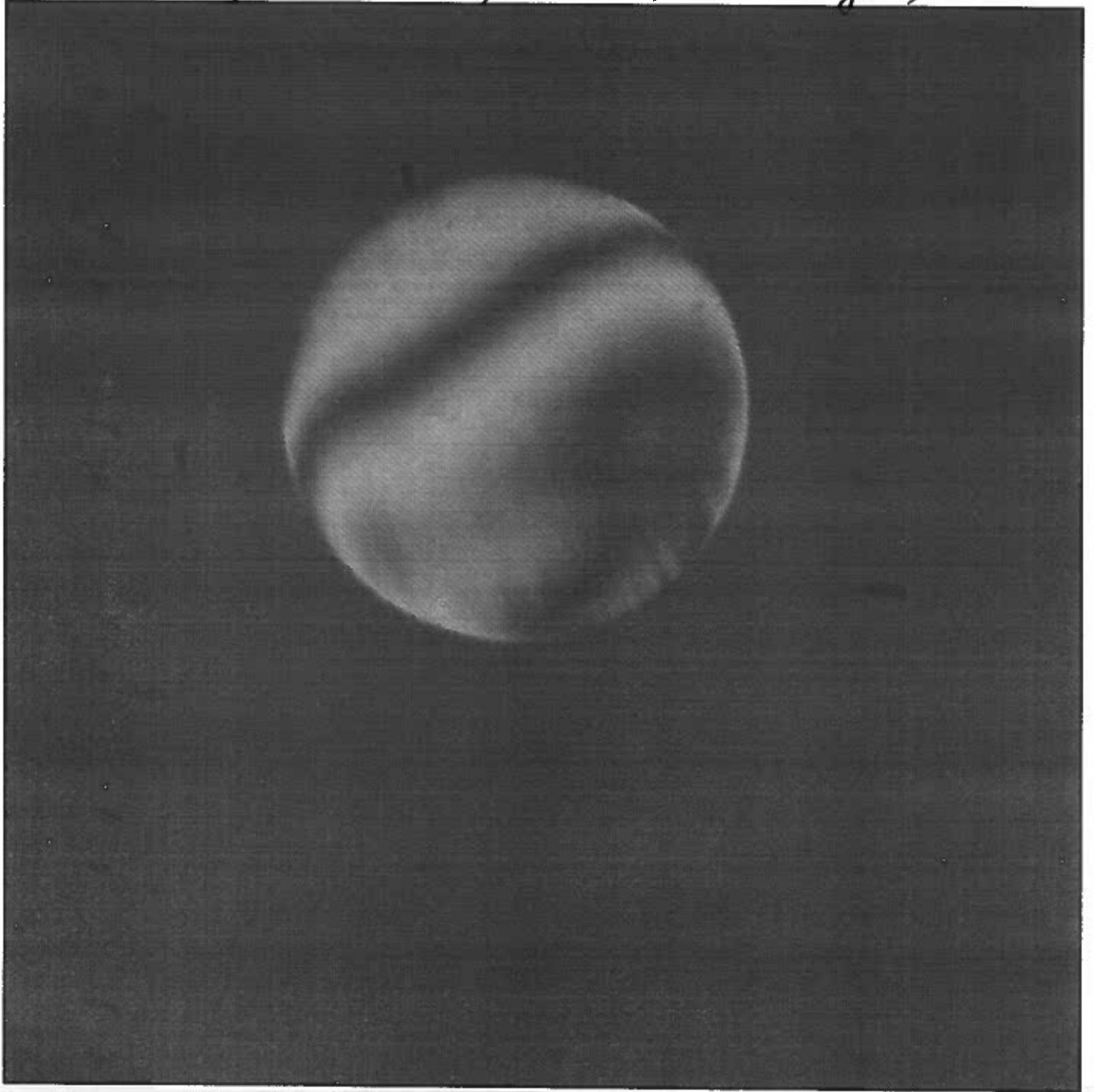
Parallelism $< 5''$

34 mm dia, 5.4 mm thick, Parallelism Fringes, WP #1



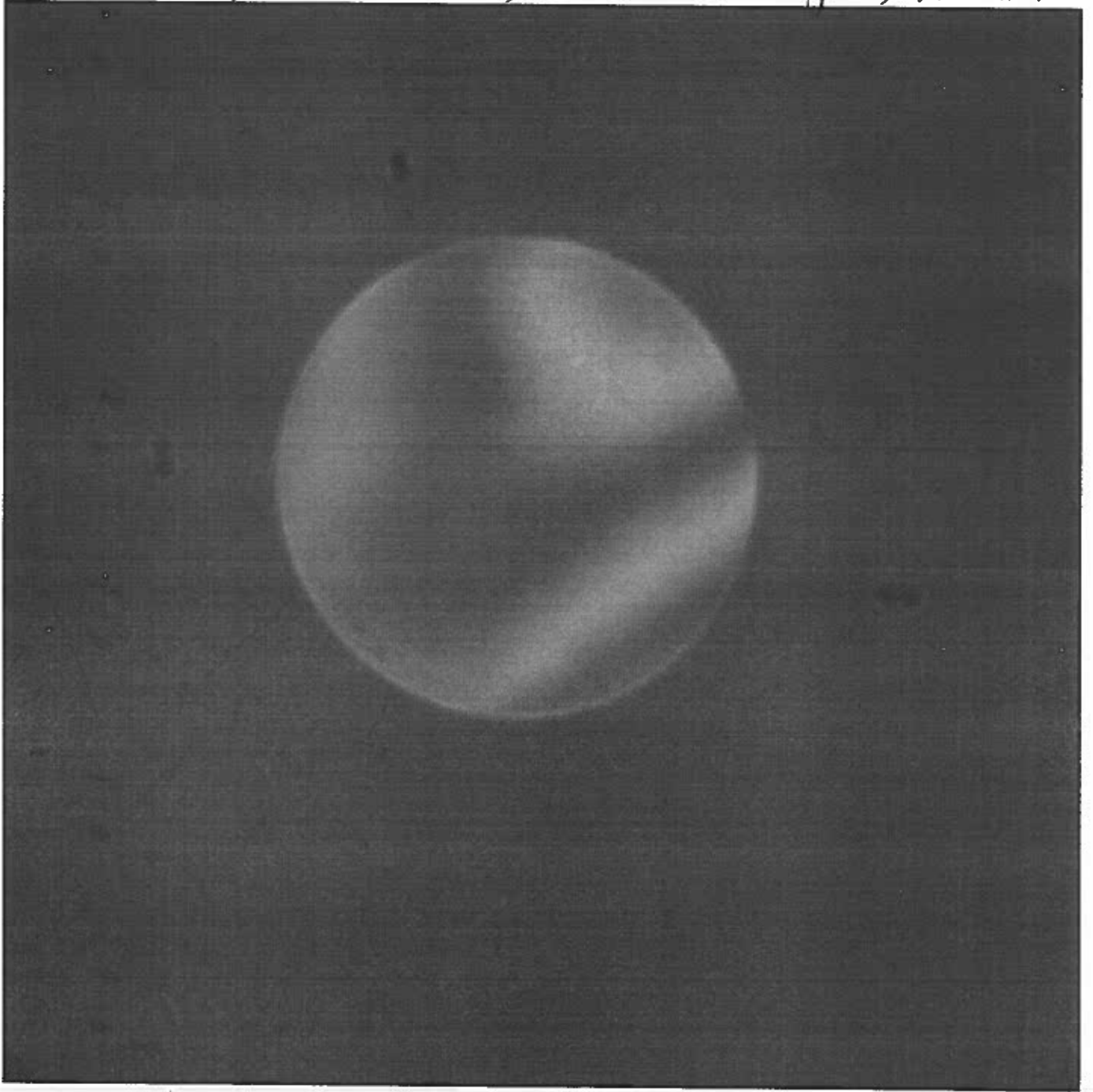
Parallelism $< 5''$

34 mm dia, 5.4 mm thick, Parallelism Fringes, WP # 2



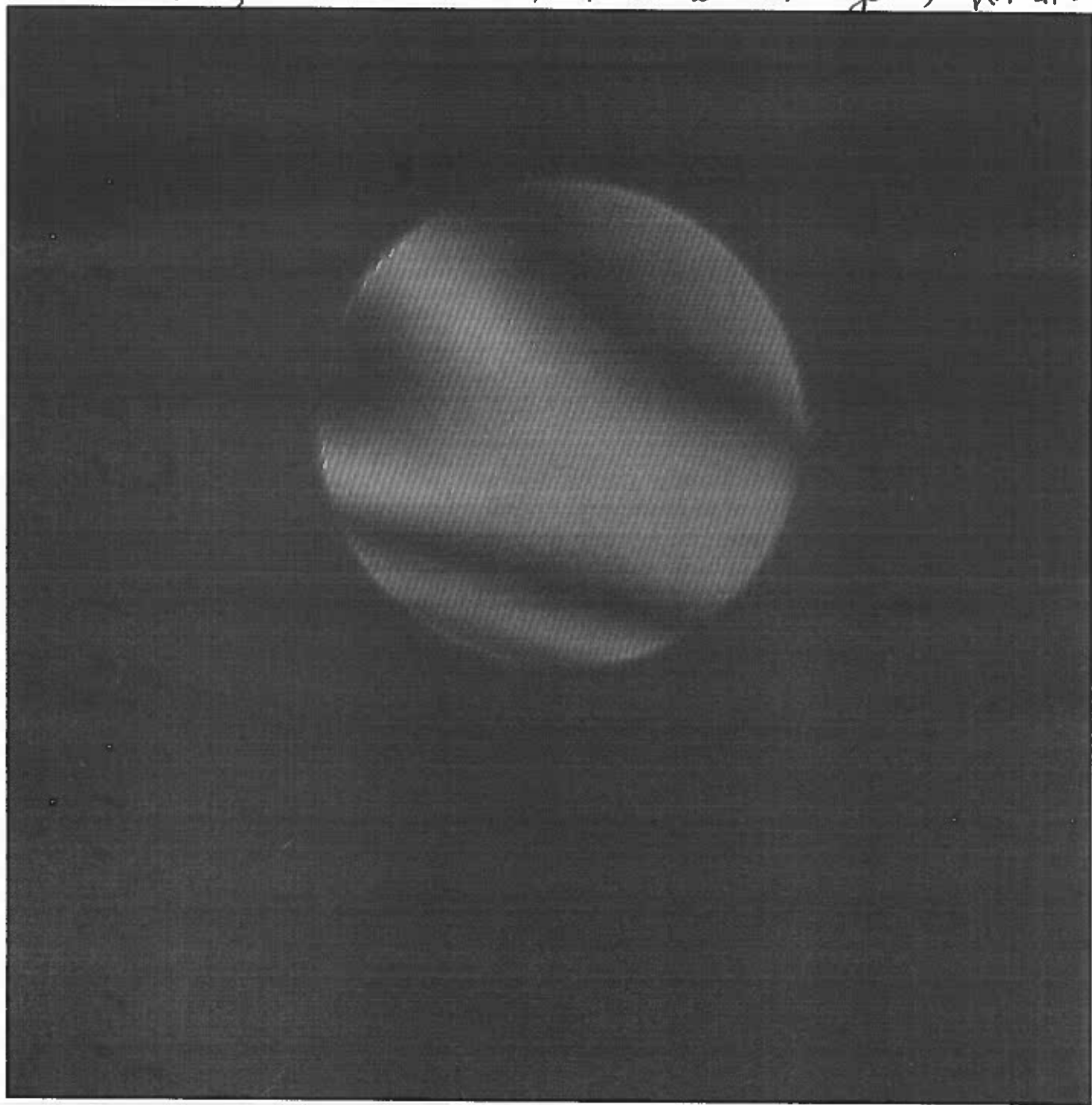
Parallelism $\leq 5''$

34 mm dia, 10.8 mm thick, Parallelism Fringes, WP #1



Parallelism $< 5''$

34 mm dia, 10.8 mm thick, Parallelism Fringes, WP #2

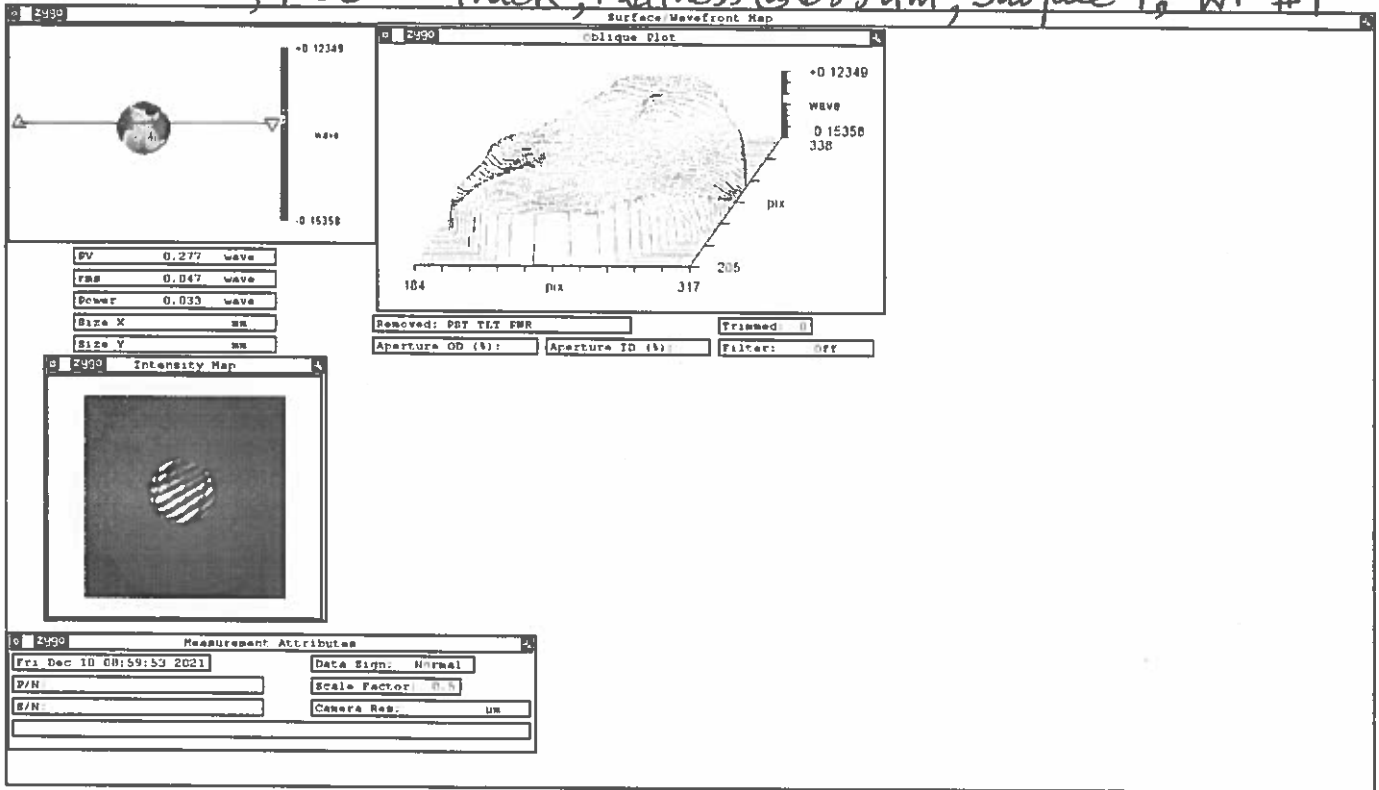


Parallelism $< 5''$

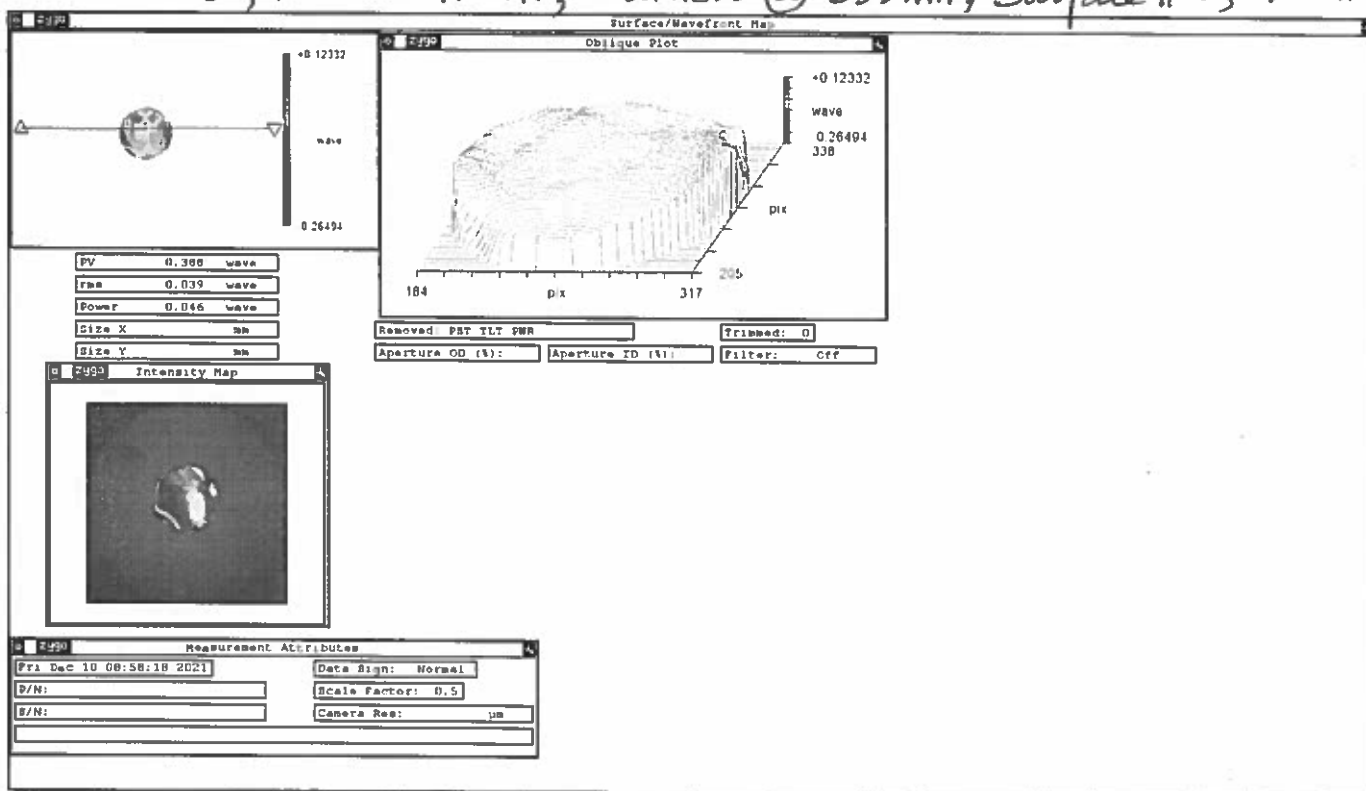
SURFACE FLATNESS

INTERFEROGRAMS

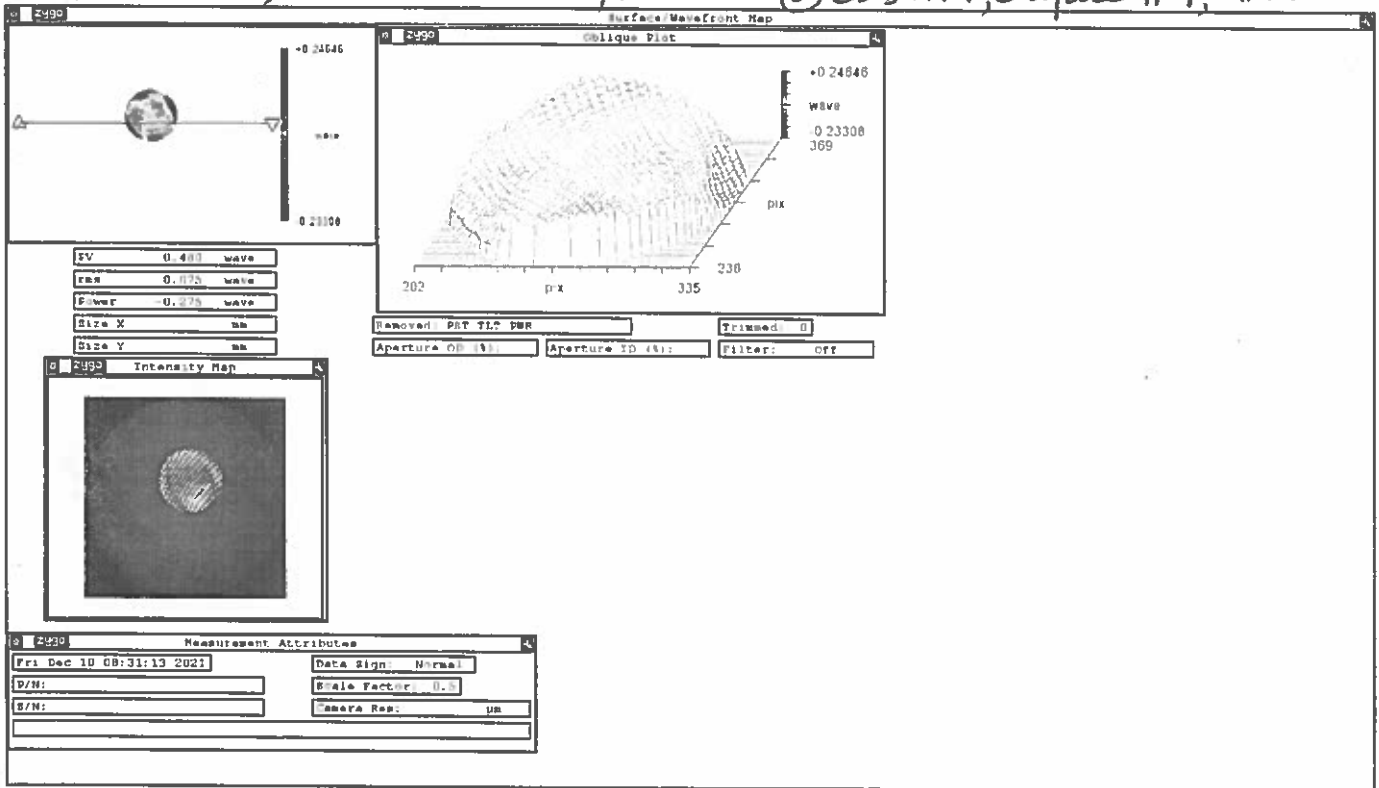
34 mm dia, 1.35 mm thick, Flatness @ 633 nm, Surface 1, WP #1



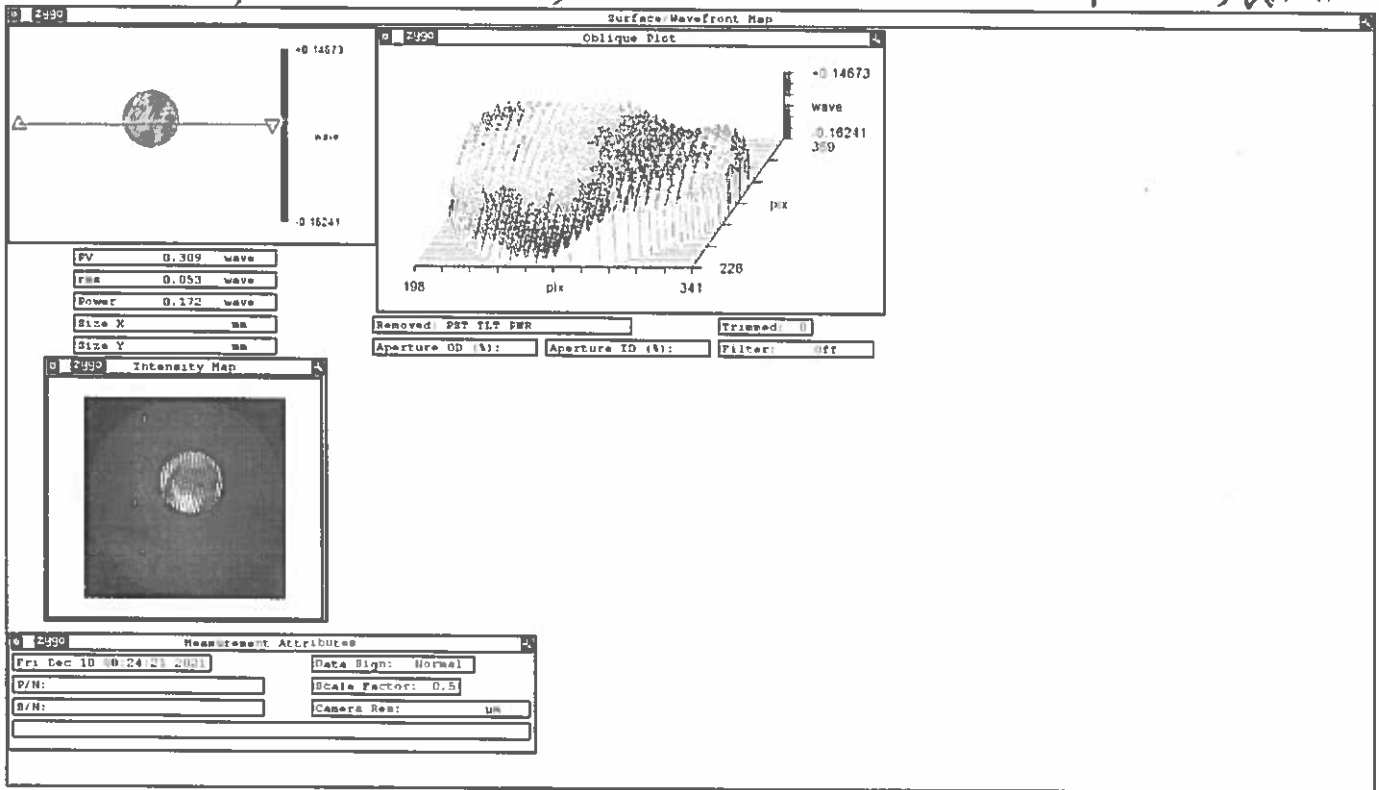
34 mm dia, 1.35 mm thick, Flatness @ 633 nm, Surface # 2, WP#1



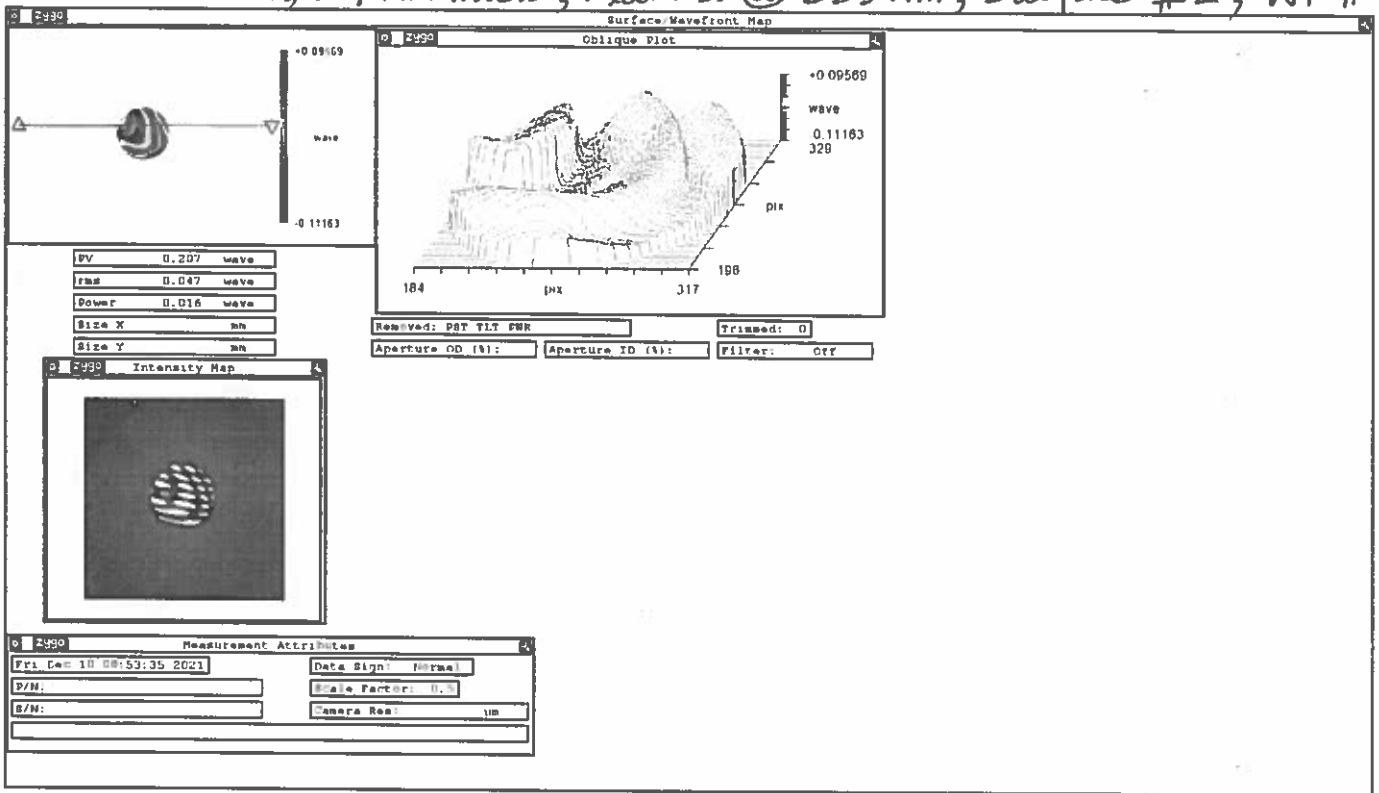
34 mm dia, 1.35 mm thick, Flatness @ 633 nm, Surface # 1, WP # 2



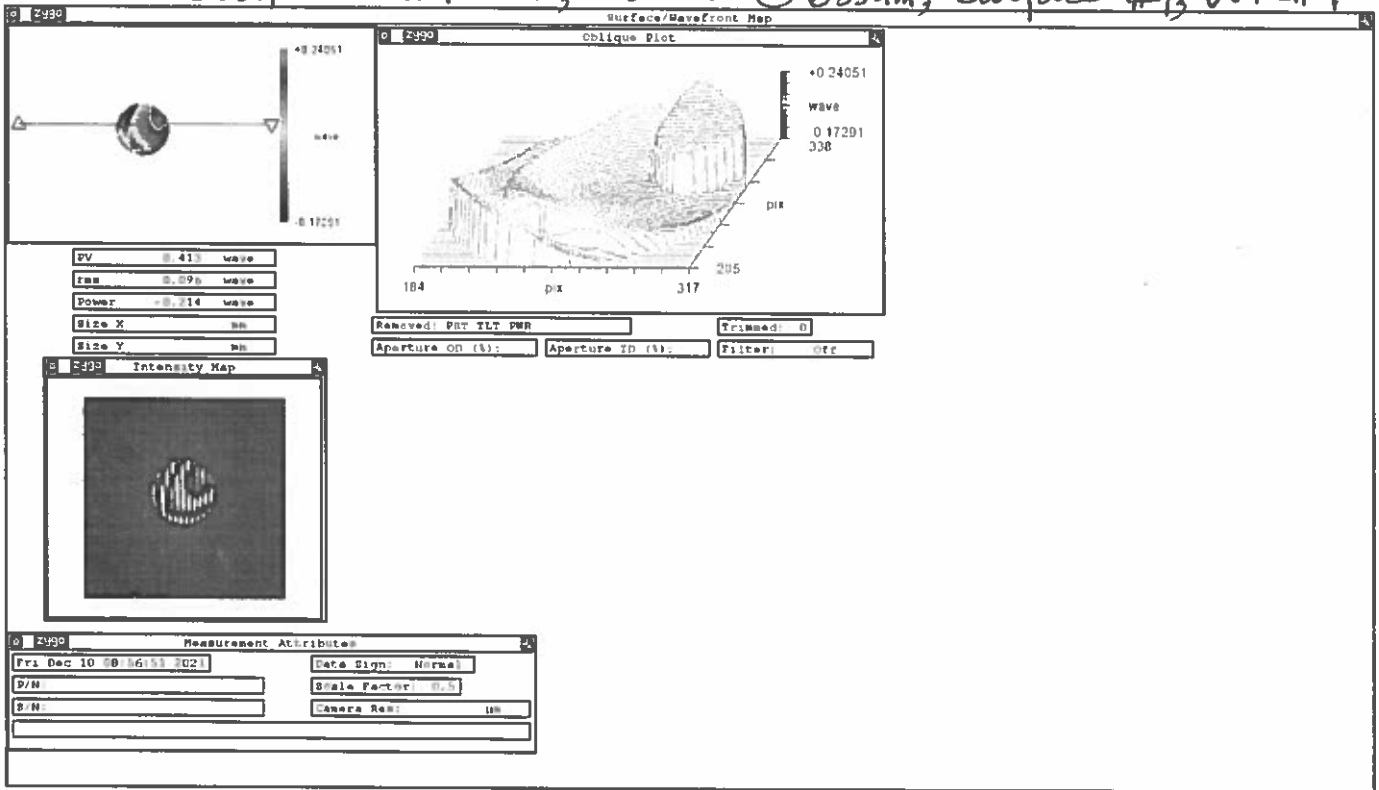
34 mm dia, 1.35 mm thick, Flatness at 633 nm, Surface #2, WP#2



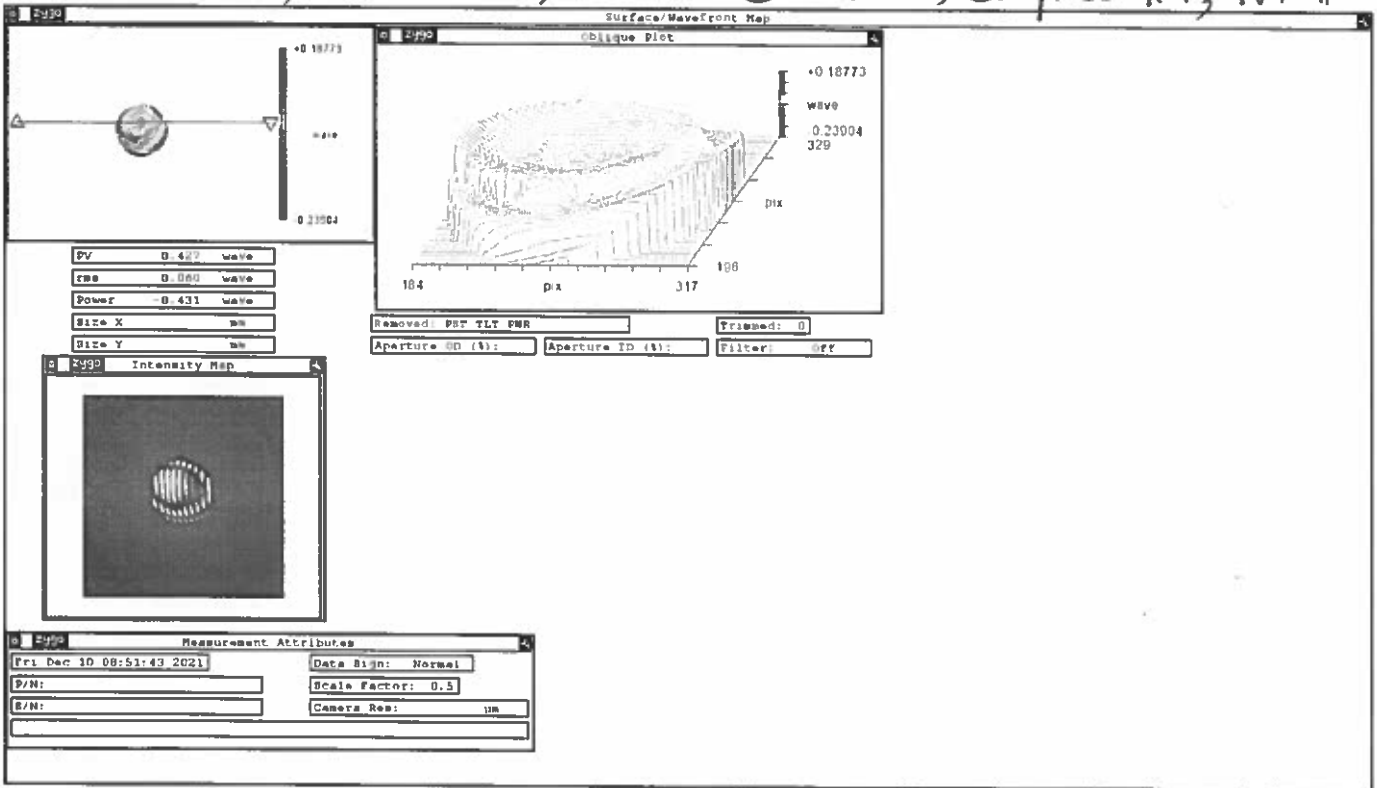
34.00 mm dia, 2.7 mm thick, Flatness @ 633 nm, Surface #2, WP #1



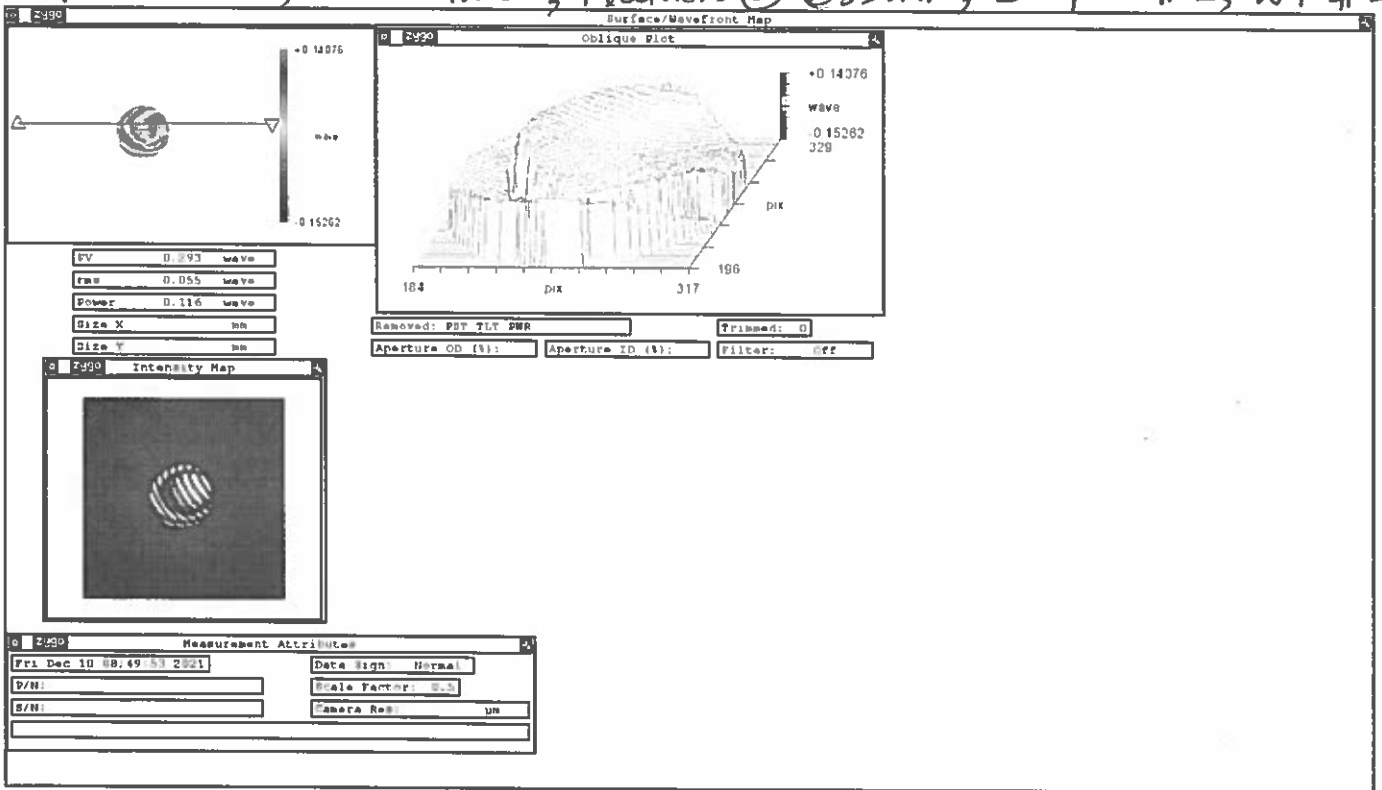
34.00 mm dia, 2.7 mm thick, Flatness @ 633nm, Surface #1, WP #1



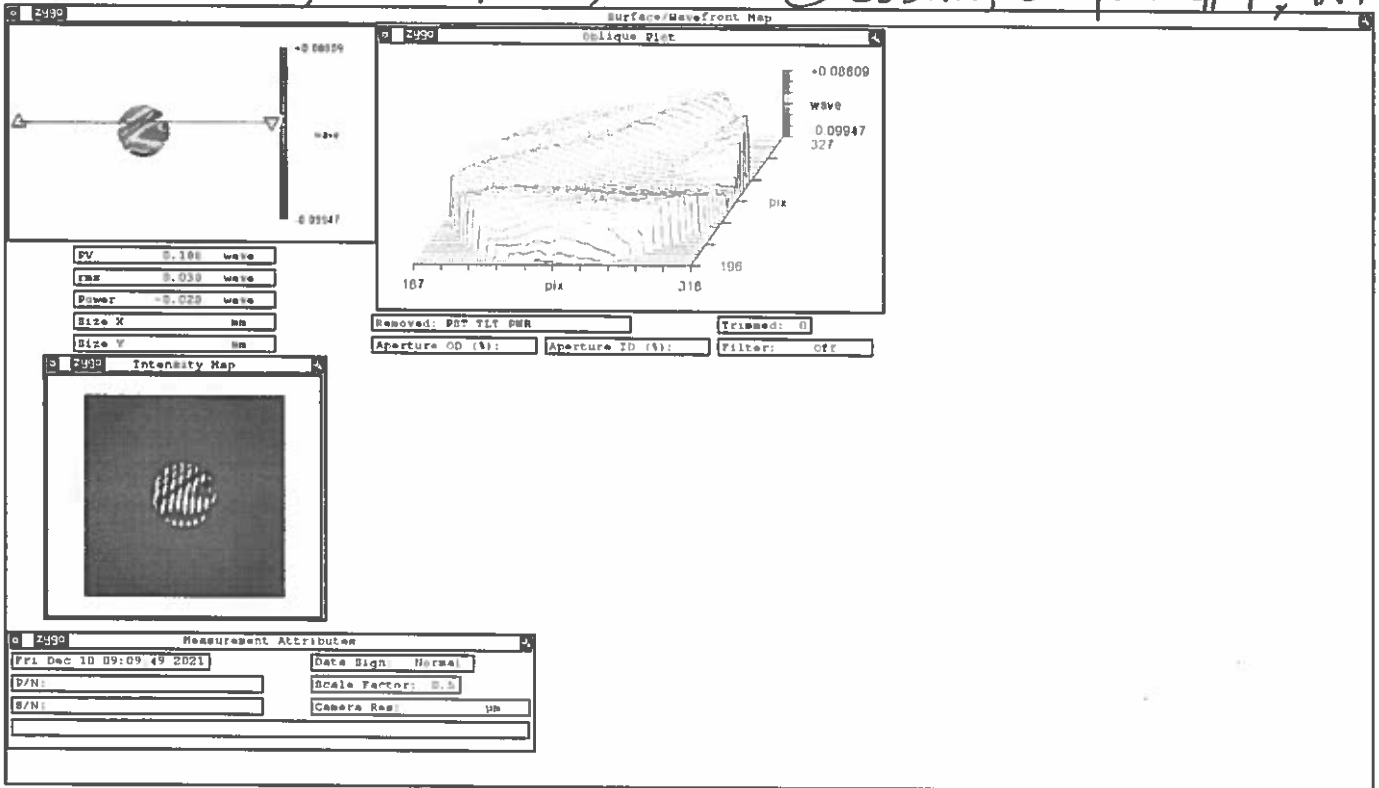
34.00 mm dia, 2.7 mm thick, Flatness @ 633 nm, Surface #1, WP #2



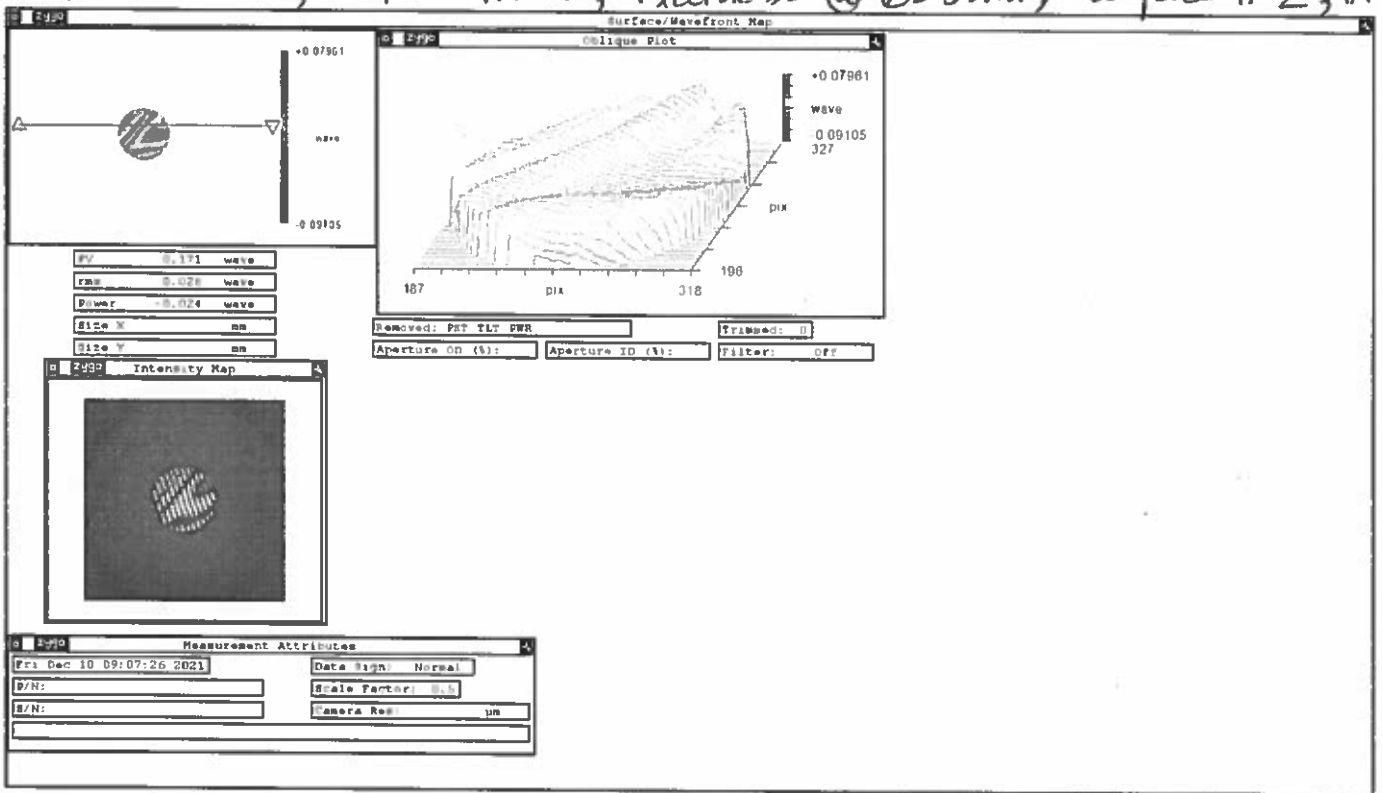
34.00 mm dia, 2.7 mm thick, Flatness @ 633 nm, Surface #2, WP #2



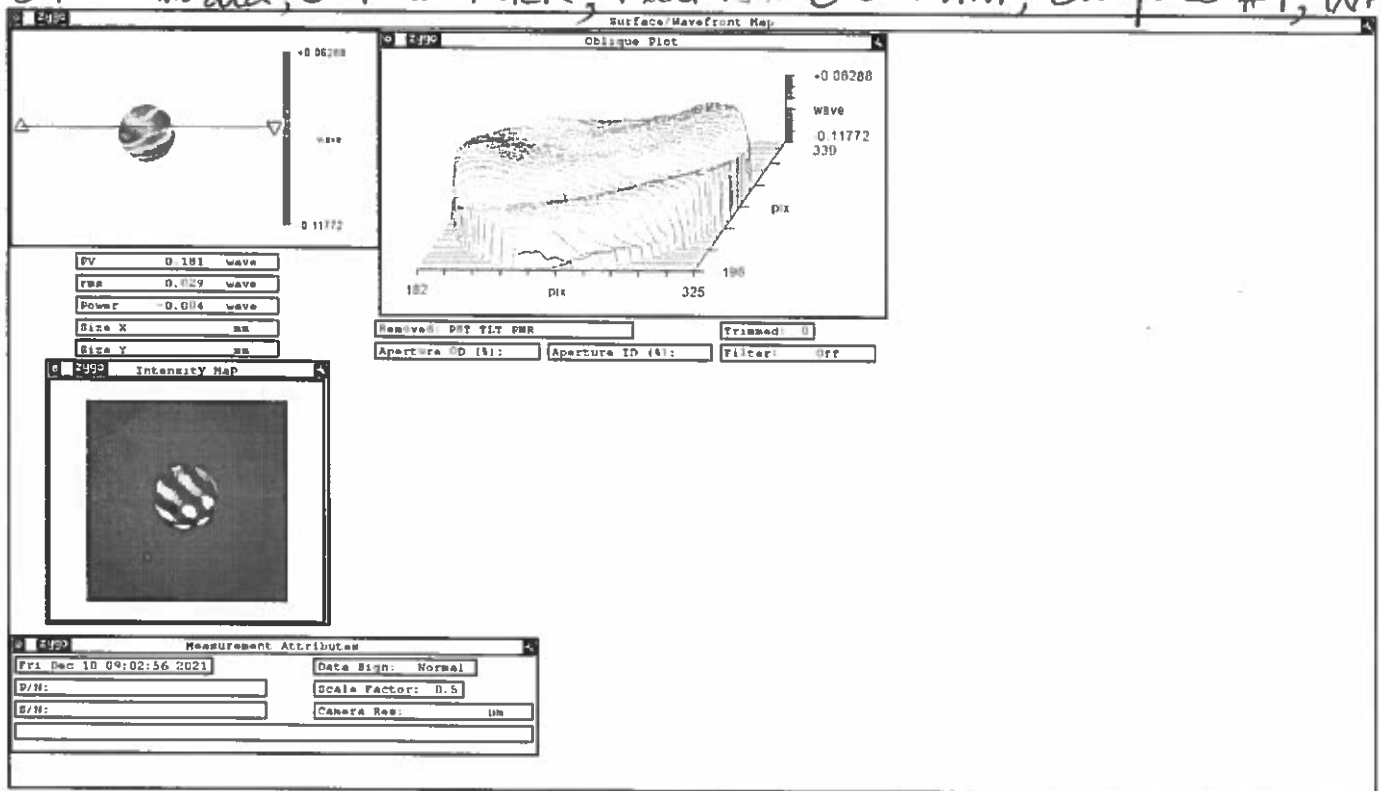
34.00 mm dia, 5.4 mm thick, Flatness @ 633 nm, Surface # 1, WP# 1



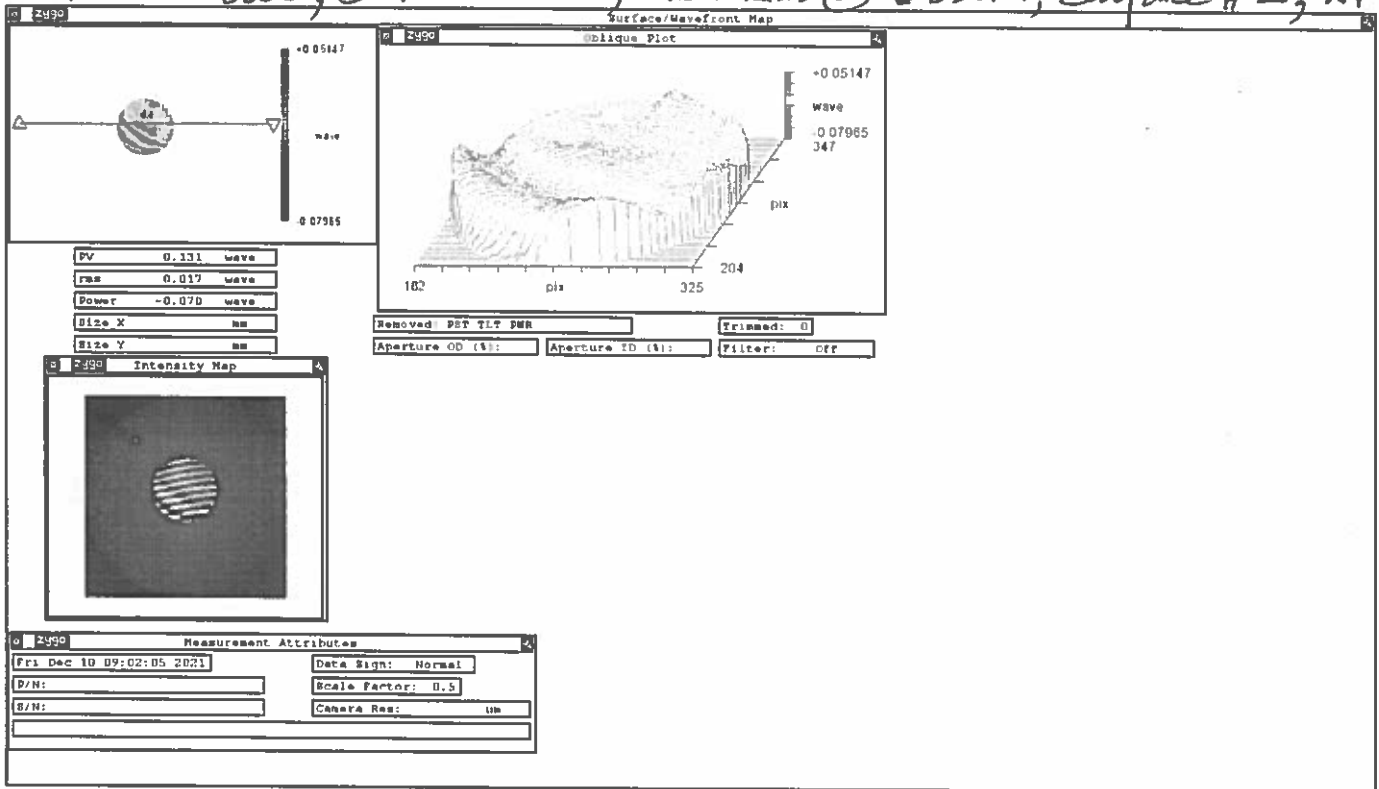
34.00 mm dia, 5.4 mm thick, Flatness @ 633nm, Surface # 2, WP# 1



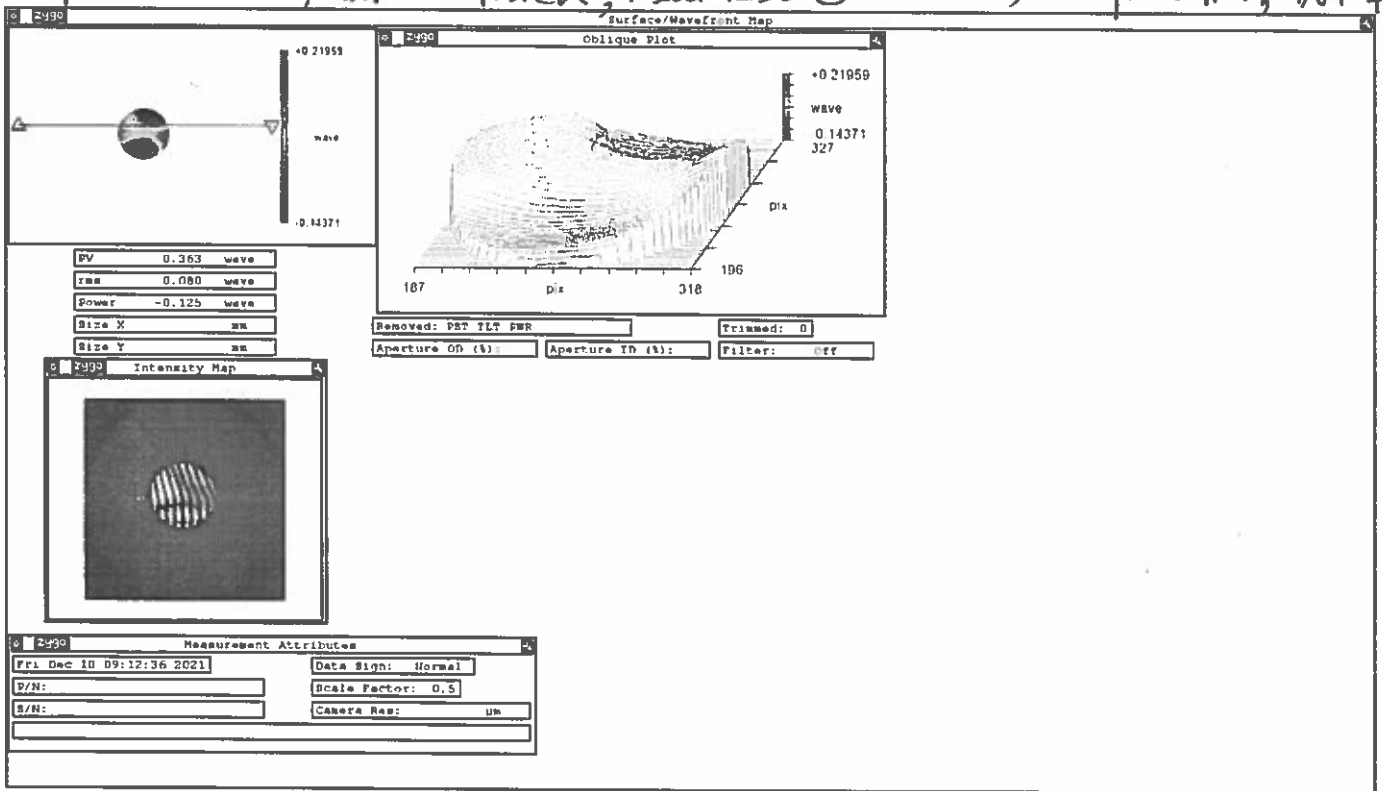
34.00 mm dia, 5.4 mm thick, Flatness @ 633 nm, Surface #1, WP#2



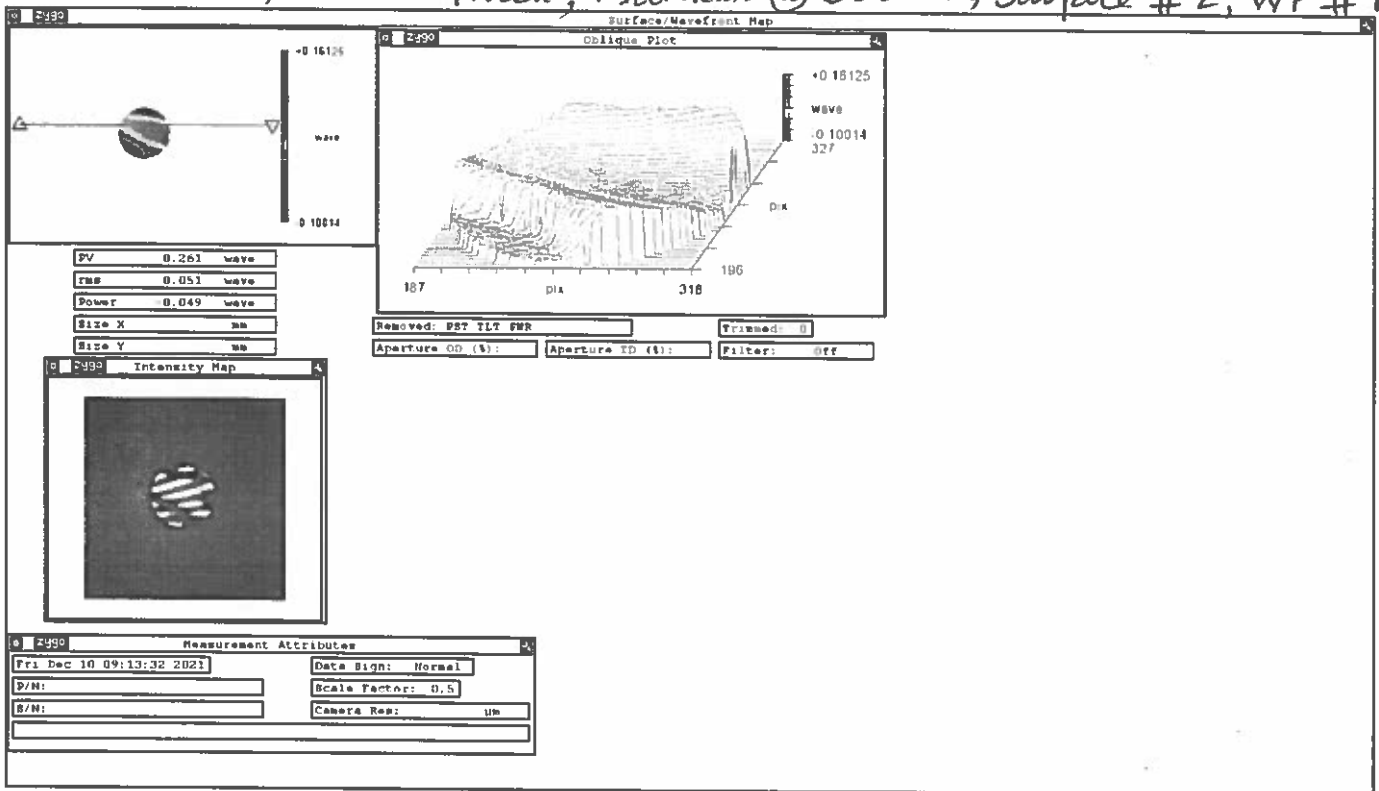
34.00 mm dia, 5.4 mm thick, Flatness @ 633um, Surface # 2, WP # 2



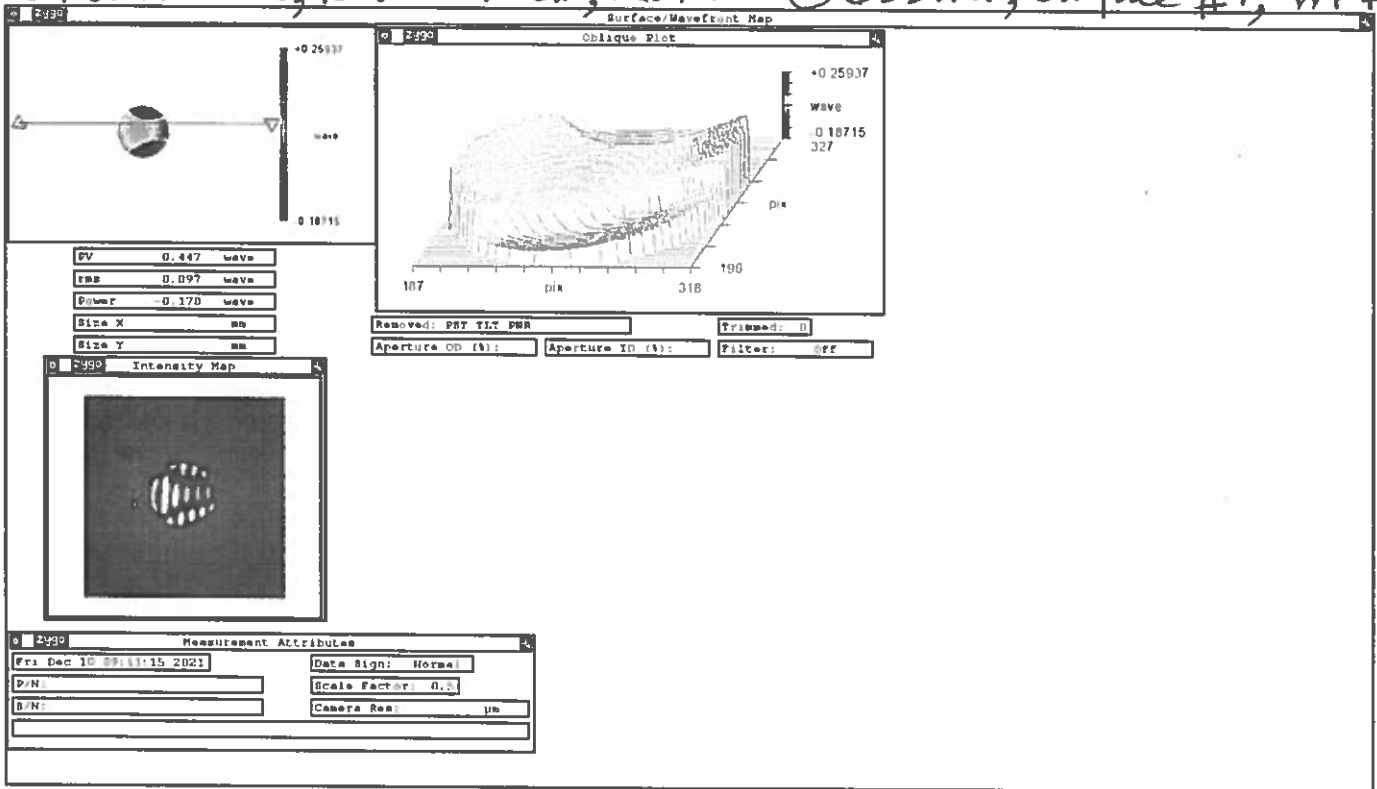
34.00 mm dia, ^{10.8}~~20.8~~ mm thick, Flatness @ 633 nm, Surface #1, WP #1



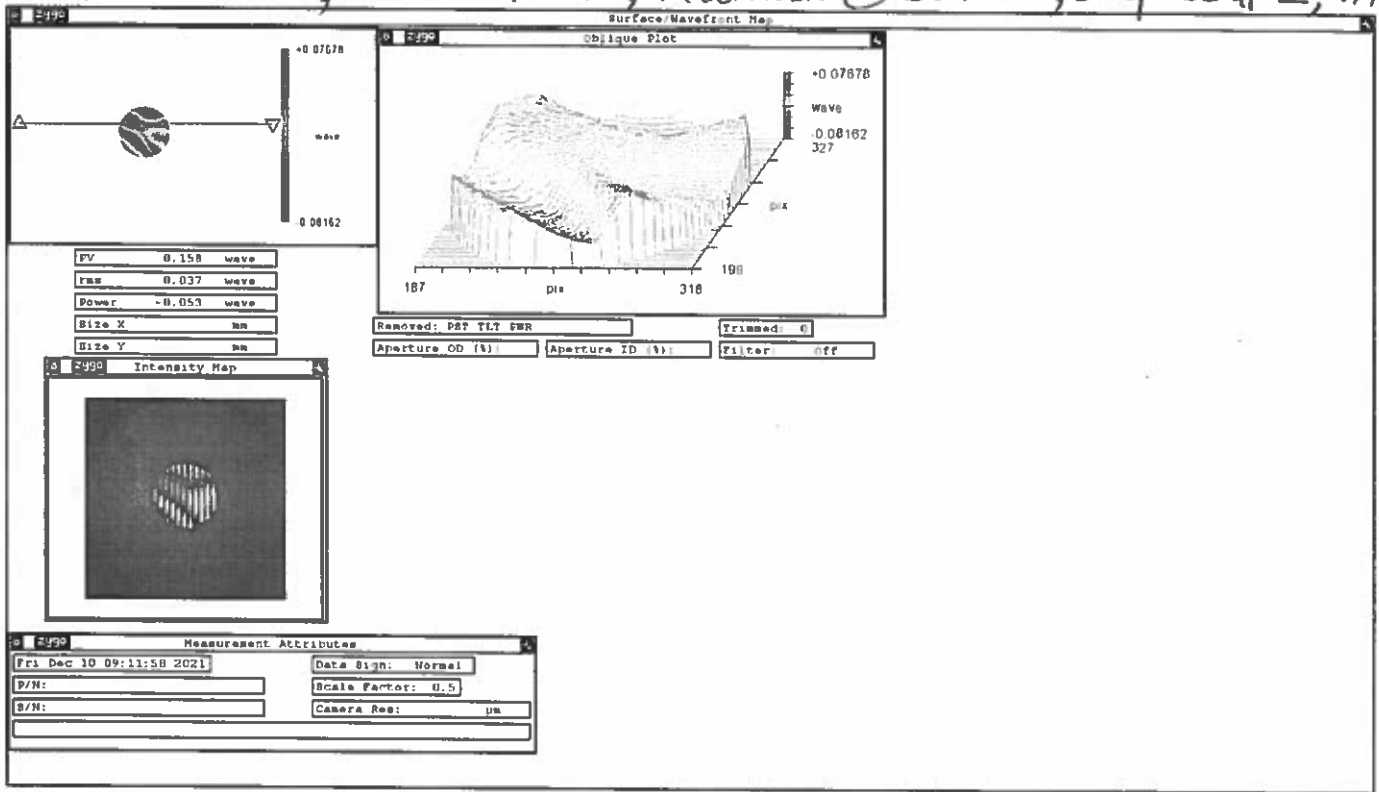
34.00mm dia, 10.8 mm thick, Flatness @ 633 nm, Surface # 2, WP # 1



34.00 mm dia, 10.8 mm thick, Flatness @ 633 nm, Surface #1, WP# 2



34.00 mm dia, 10.8 mm thick, Flatness @ 633 nm, Surface # 2, WPH 2

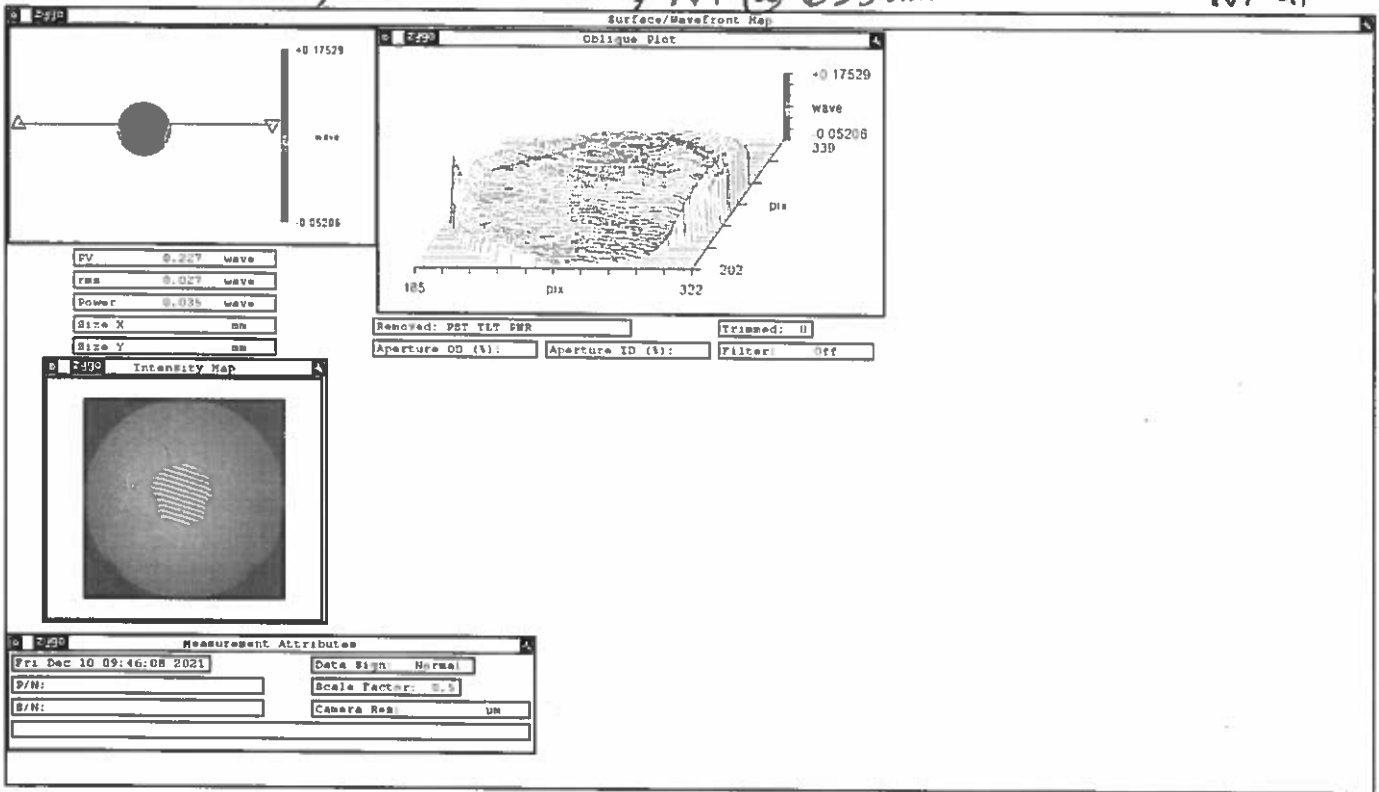


WAVE FRONT

INTERFEROGRAMS

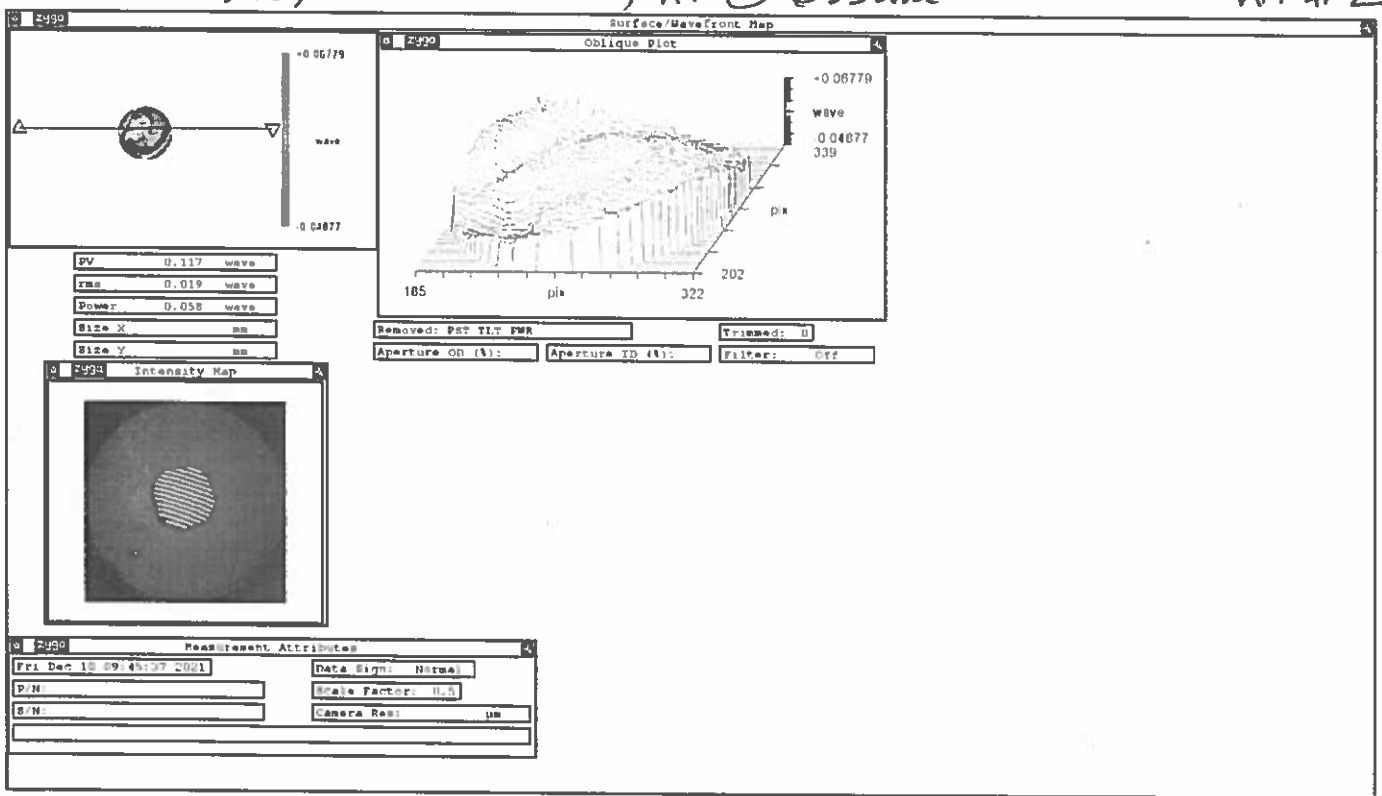
34.00 mm Dia, 1.35 mm Thick, WF @ 633 nm

WP #1



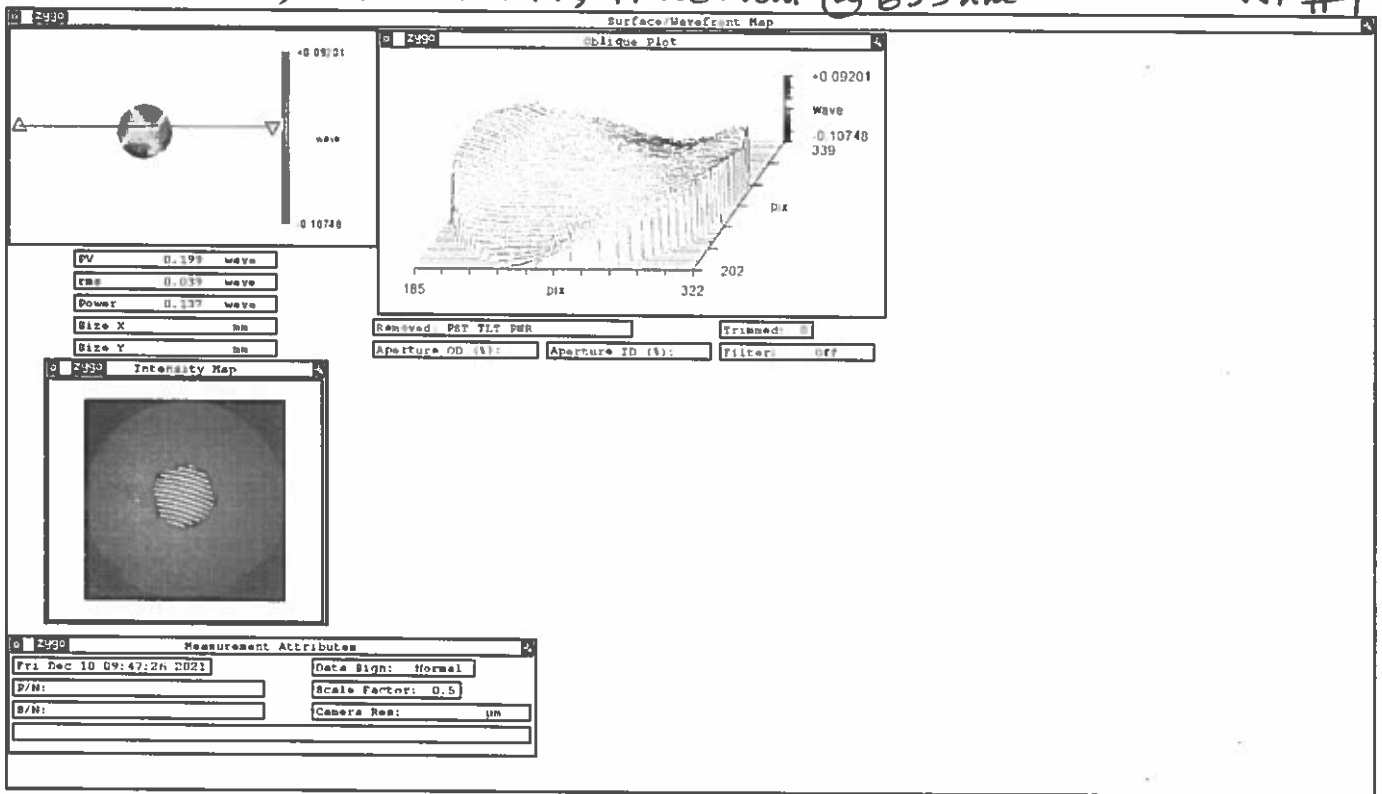
34.00 mm Dia, 1.35 mm Thick, WF @ 633nm

WP#2



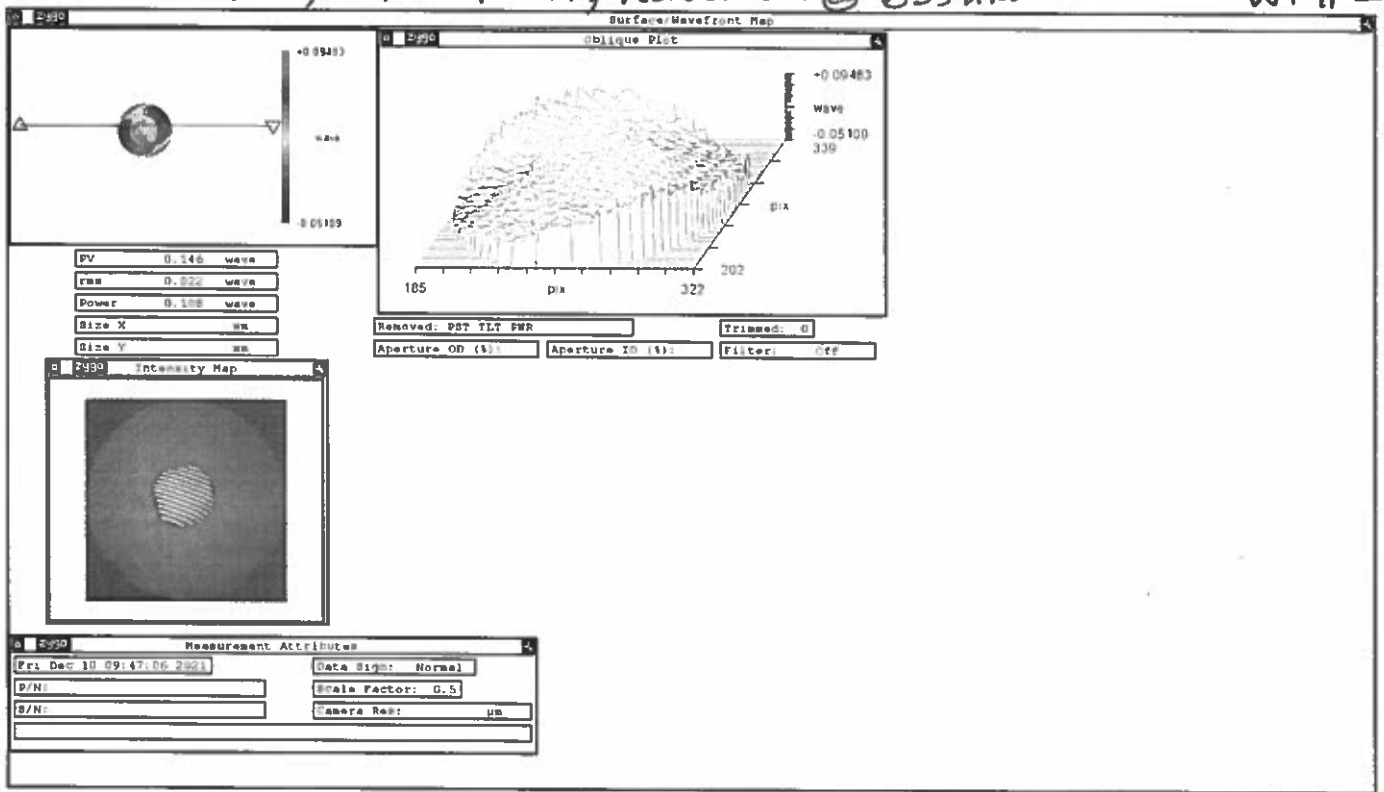
34.00 mm Dia, 2.7 mm Thick, Wave Front @ 633 nm

WP#1



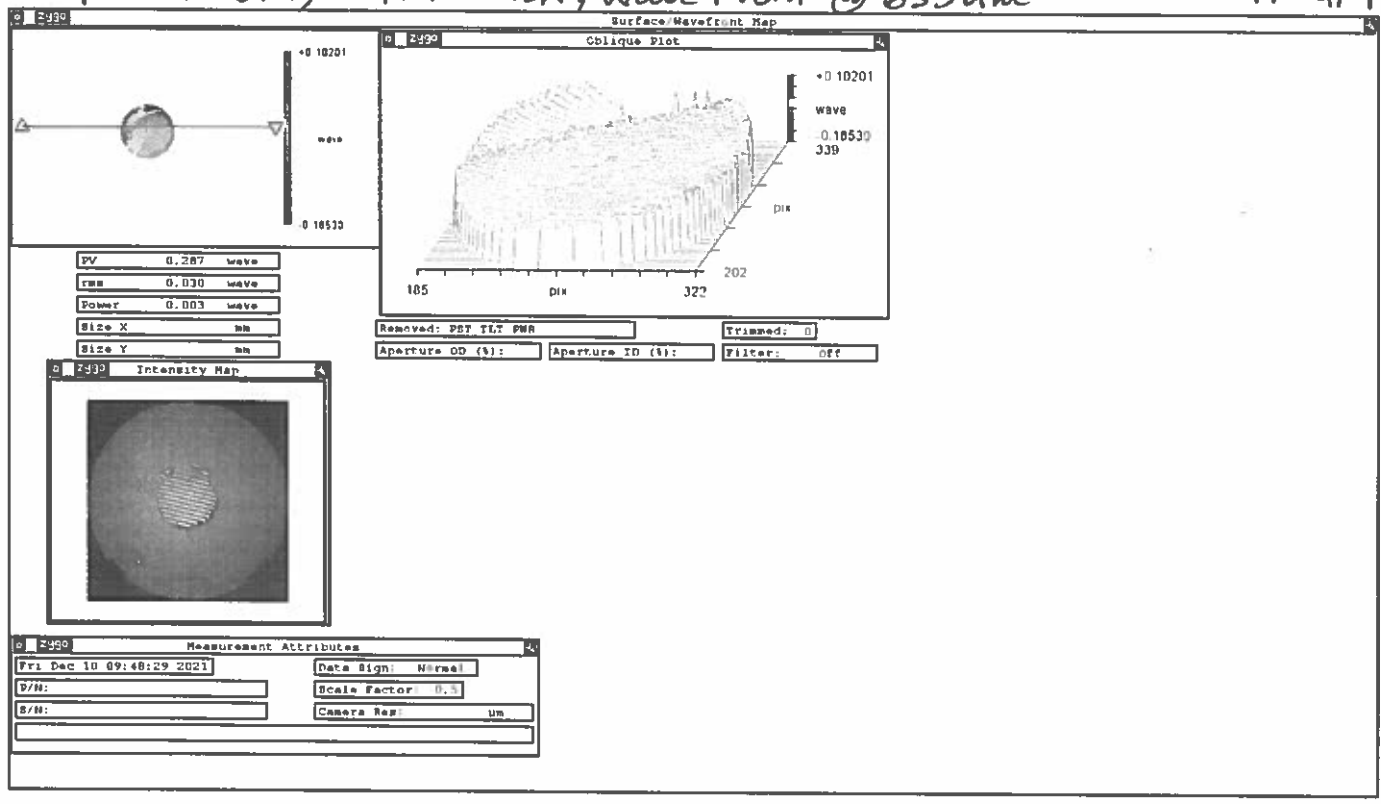
34.00 mm Dia, 2.7mm Thick, Wavefront @ 633 nm

WP# 2



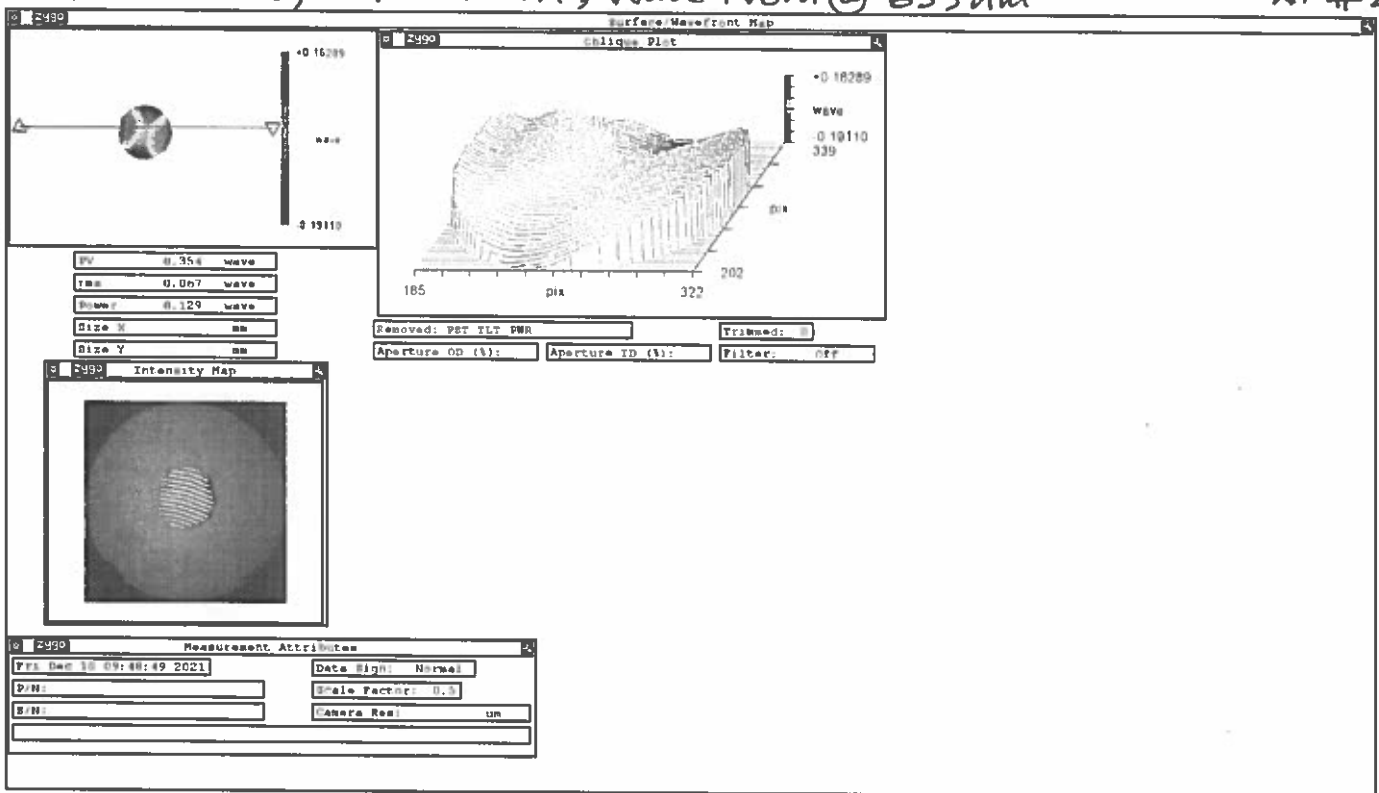
34.00 mm Dia, 5.4 mm Thick, Wave Front @ 633 nm

WP#1



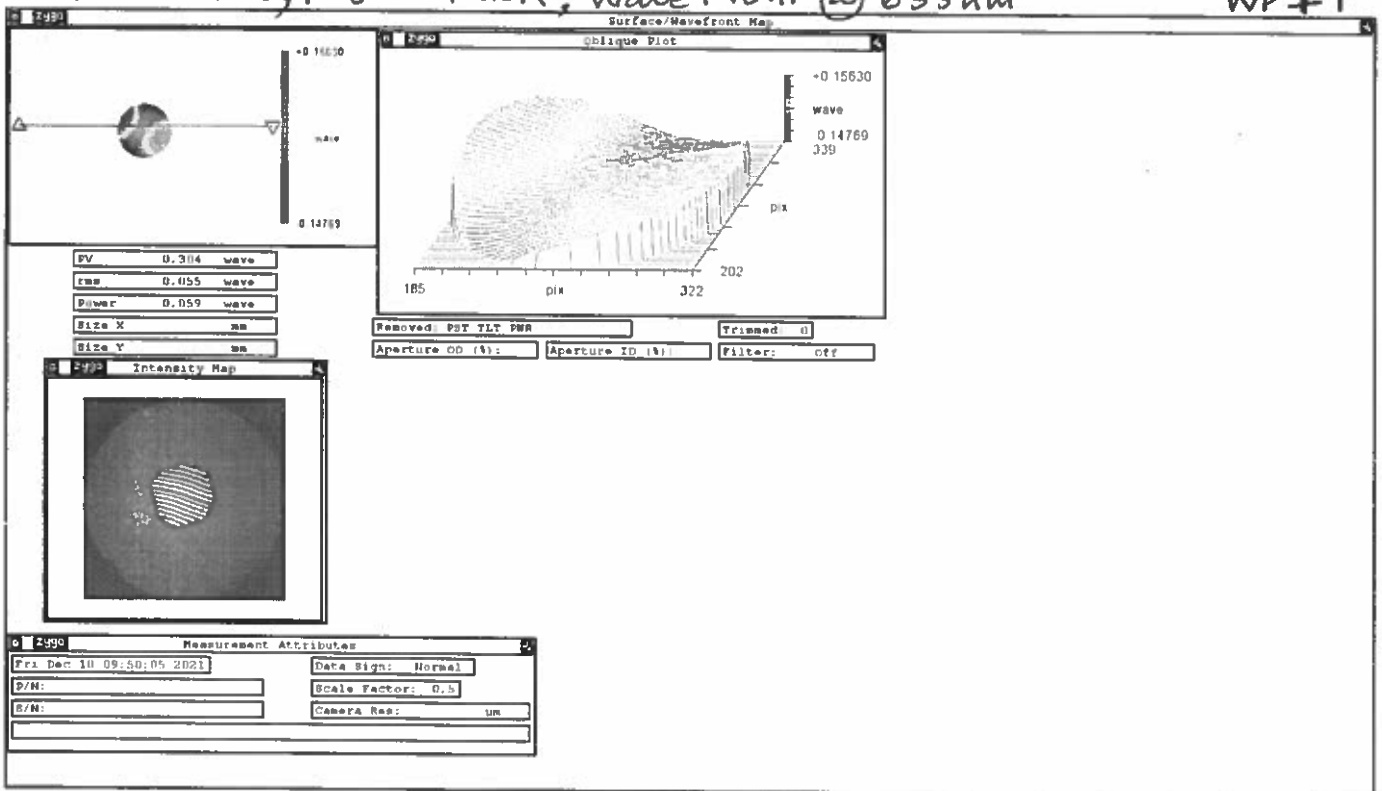
34.00 mm Dia, 5.4 mm Thick, Wave Front @ 633 nm

WP# 2



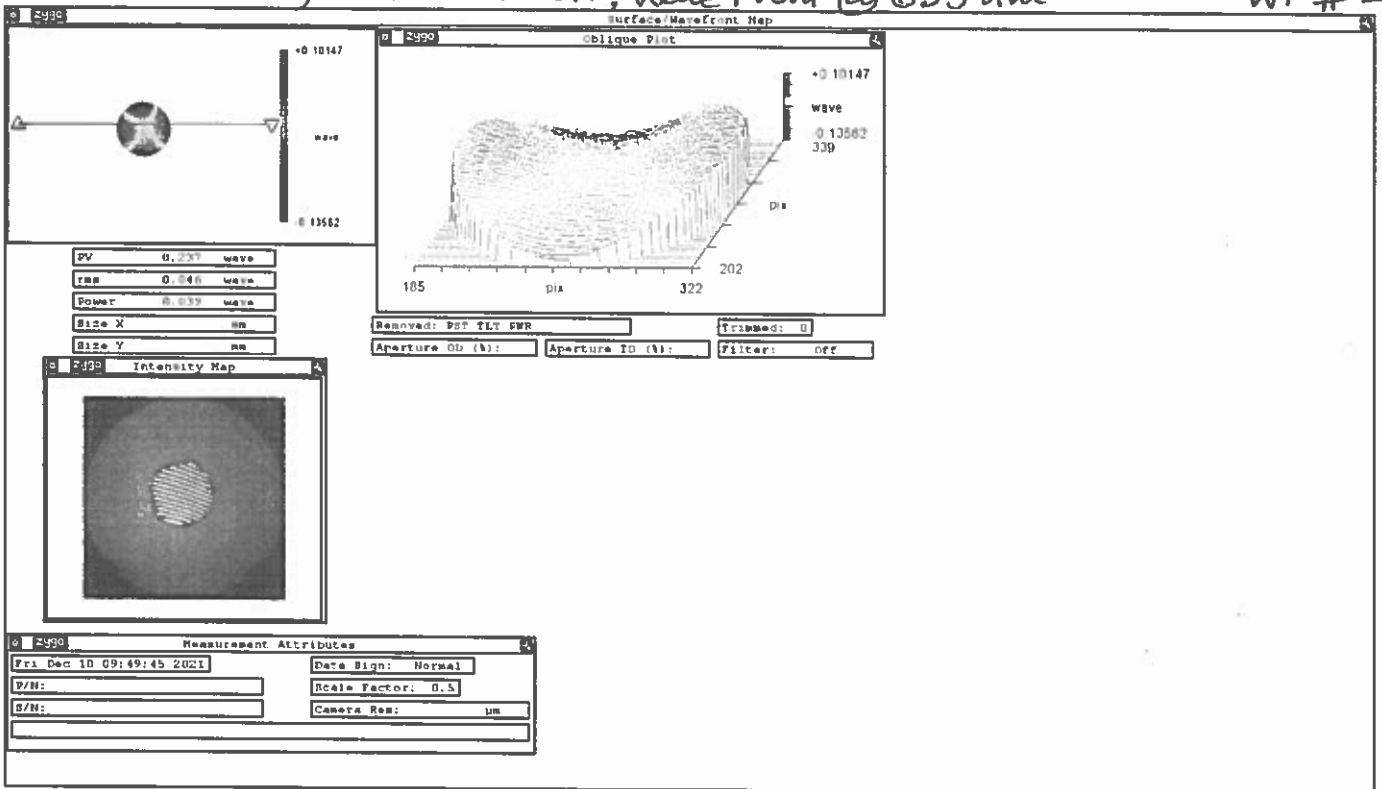
34.00 mm Dia, 10.8 mm Thick, Wave Front @ 633 nm

WP # 1



34.00 mm Dia, 10.8 mm Thick, Wave Front @ 633 nm

WP# 2

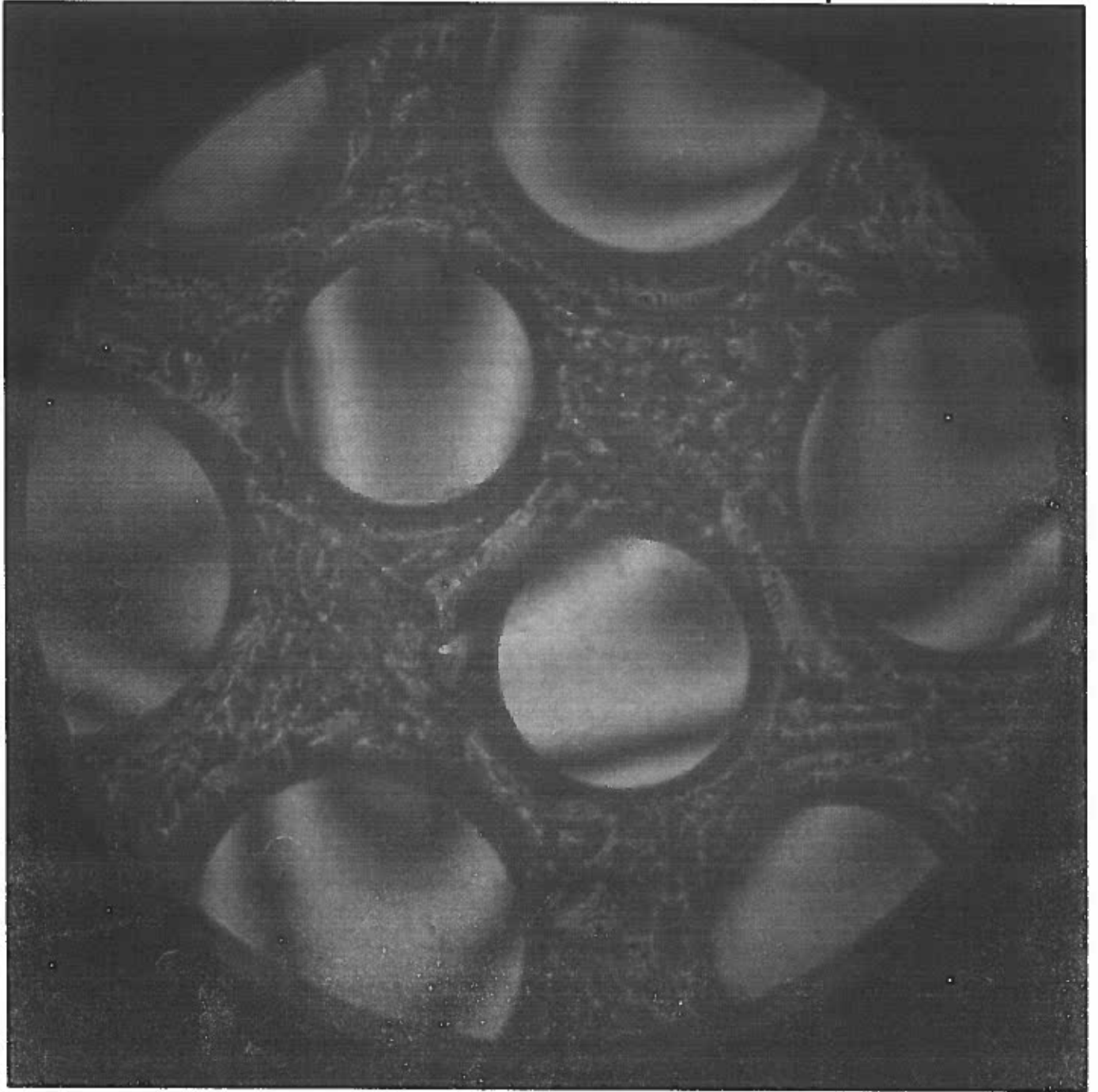


INTERFEROGRAMS OF FINISHED BLOCKERS WITH CALCITE WAVE PLATES OPTICALLY CONTACTED

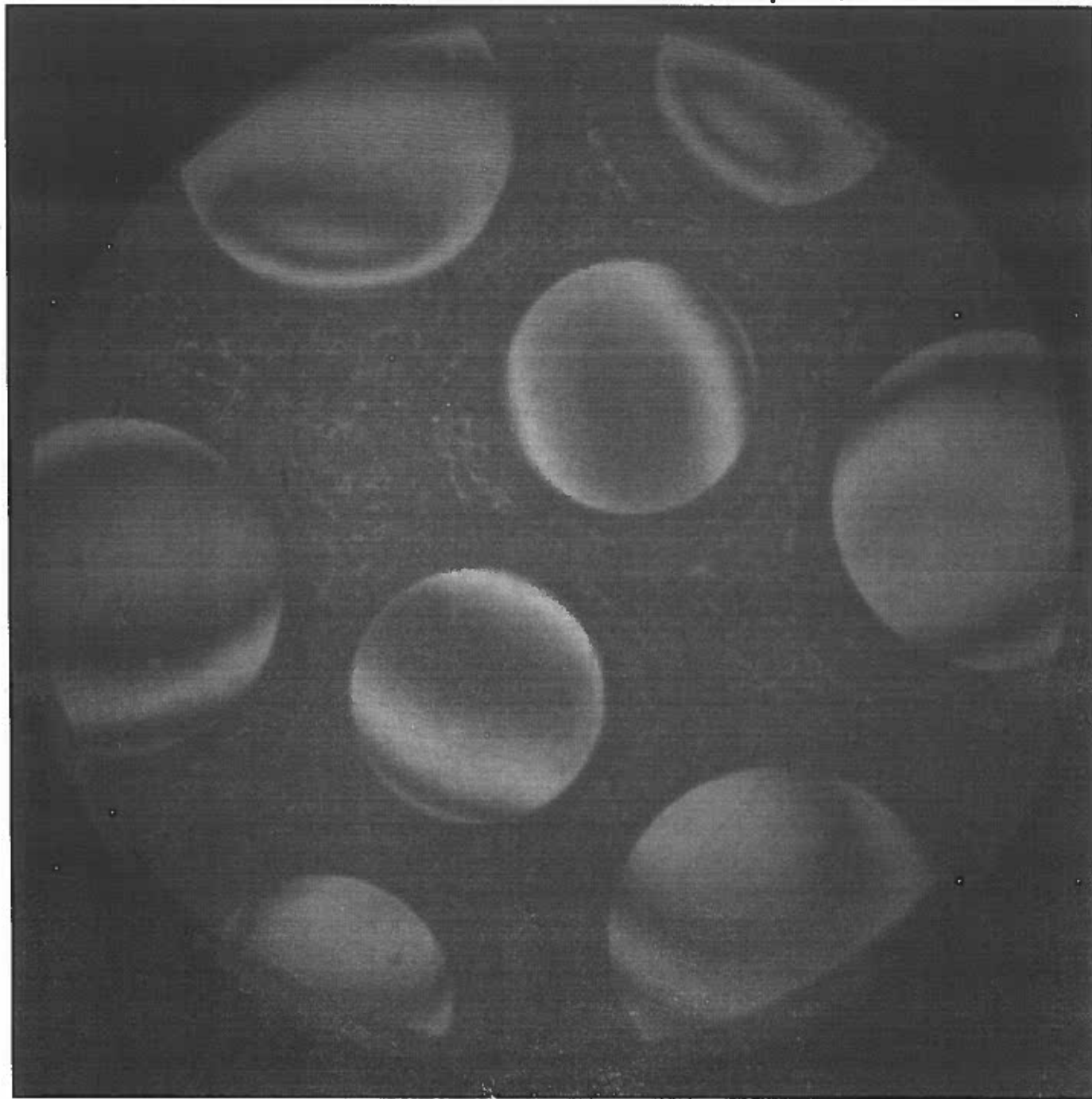
Next four pages show interferograms of calcite wave plates optically contacted to parallel blocking plates at the end of lapping process before de-contacting of wave plates.

- Crystal axis is in the plane of circular face. In calcite crystal, plane perpendicular to crystal axis is much softer than the plane parallel to it. This creates a limitation in achieving surface flatness better than what is shown in interferograms. This tends to create sag on flat surface. Orientation of the sag is related to crystal axis. This sag pertains to surface flatness of less than one micron.
-

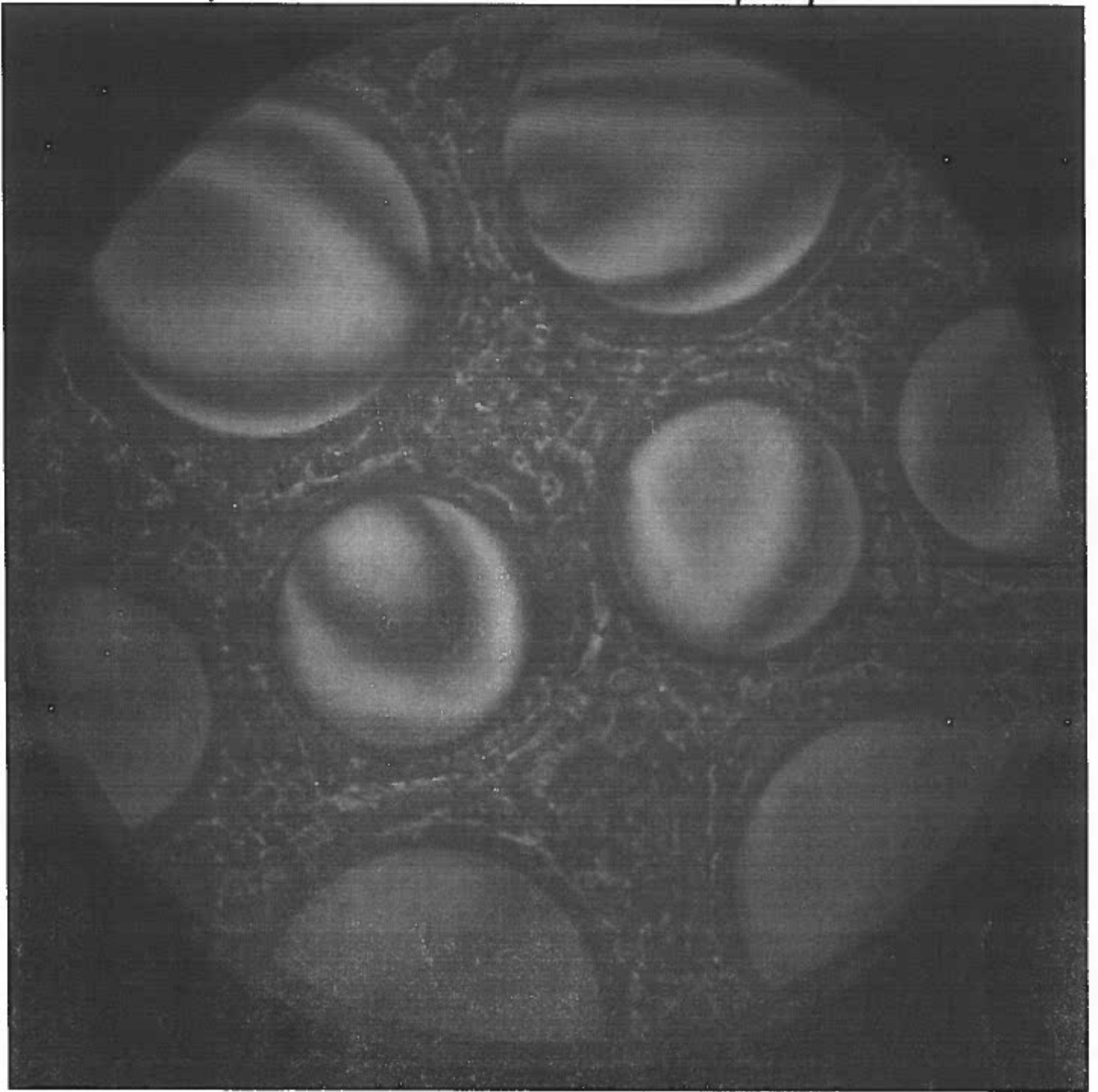
Blocker made of four 25.4 mm dia and four 34.0 mm dia
Calcite waveplates - Thickness 1.35 mm - See C of C for explanation



Blocker made of four 25.4 mm dia and four 34.0 mm dia
Calcite waveplates - Thickness 2.7 mm - See C of C for explanation



Blocker made of four 25.4 mm dia and four 34.0 mm dia
Calcite Waveplates 5.40 mm thick - See C of C for explanation



Blocker made of four 25.4mm dia and four 34.0 mm dia
Calcite Waveplates - Thickness 10.80 mm - See C of C for explanation

