Stanford University
W.W. Hansen Experimental Physics Laboratory
Gravity Probe B Relativity Mission
Stanford, California 94305-4085

GP-B Telescope "Measurement of Telescope Field of View" P0454 Rev -

January 27, 1999

Prepared: _____ Date _____
Lynn Huff, Responsible Engineer

Prepared: _____ Date _____
Ken Bower, Telescope Assembly

Approved: _____ Date _____
Paul Ehrensberger, Detector Responsible Engineer

Approved: _____ Date _____
John Lipa, Telescope Manager

Approved: _____ Date _____
Sasha Buchman, Hardware Manager

Approved: _____ Date _____
Ben Taller, Quality Assurance

MEASUREMENT OF TELESCOPE FIELD OF VIEW

- for SUGP-B Science Payload Specification PLSE – 12

- also use *GP-B Telescope Image Divider Assembly (IDA) General Alignment and Bonding Procedures* (SUGP-B P0282) for procedures concerning safety; work area requirements; fixture cleaning and acceptance; flight part inspection, handling, storage, and cleaning.

- The flight telescope used in this operation is heavy, delicate, and somewhat irreplaceable with multiple critical surfaces that can be easily damaged or contaminated by normal handling. Compliance with the above defined safe handling practices is critical.

- If at any time during this procedure flight hardware is not live monitored, verify that all flight hardware is seismically secured and protected against airborne contamination.

- ESD precautions are required. Comply with P0357 as required.

- Required personnel: one flight part handler (per P0282) and assistant, one electronics operator
- Two photometers are required for this test: one ("Photometer #1") measures the light input into the Telescope and needs to be calibrated; the other ("Photometer #2") monitors the light source and needs not be calibrated.
- Calibration of the 7" autocollimator is described in P0443
- Discrepancies and test anomalies will be recorded in a D-log, or DR if required, Quality Plan P0108

- Redline authority for this procedure is granted to the telescope responsible engineer.

This procedure addresseses the following specification:

7.2.1.3 "Minimum Field of View with Usable Signal" The fused quartz telescope shall have a field of view, including the effects of telescope misalignment, so that at least 10% of the light from any star lying at an angular separation of 60 arc sec from the telescope null point on either of the axes reaches one of the photodetectors

1) Personnel involved in this procedure should include a Telescope handler, an assistant, a Quality Assurance representative, and an electronics operator
2) Verify cleanliness of all fixturing.
3) Verify that air conditioning in the clean room has been turned off for at least four hours prior to making any measurements.
4) Attach aluminum mask to underside of the 7" autocollimator.
5) Attach Detector Package Assemblies (DPAs), Channels A and B, to the Telescope per procedure P0266. The Assemblies should be equipped with all the requisite optics and detectors (DMAs). Record serial numbers of DPA's: Channel A____ Channel B____
6) Start a data sheet, noting the time, date, and personnel present in the room.
7) Turn on the light source that supplies the light to the 7" autocollimator.
8) Place the Telescope under the 7" aperture autocollimator. *This must be a two-person operation, with both people paying close attention to the location of the Telescope to ensure that it doesn't bump into the autocollimator supports*.
9) Tip & tilt the Telescope until the spot as seen on the monitor is aligned to the spot generated by a retroreflector in the beam to within 10 seconds of arc.
10) Seismically secure the Telescope to the autocollimator supports with Kapton tape.
11) Connections between the TRE and the GSE Support Racks are made from the end of the TRE that has two round connectors. Connections to the Detector modules are made from the end of the TRE with a single round connector. Connect a long cable from the larger connector at the end of the box with two connectors to Connector 17 on the GSE Test Rack front panel A (in case there are more than one set of interface panels). Connect a second long cable from the smaller connector to Connector 15 of the same panel.
12) Repeat the previous step for the second TRE and GSE Test Rack.
13) Connect from the Single Large round connector on the other end of the TREs to the Connector Standardizer (P0408) for each DMA being used (up to four). Be careful to maintain a record of which DMA is connected to X or Y of which TRE/ Test rack combination.
14) Power the test rack computers, and run the desired version of the software, sqd360.exe or the special new version, name unknown. Record Version Number_____.
15) Power the TRE using the A power supply or the single power in the GSE support racks. Follow the procedures outlined in P0391, Help for Using the TRE Support Systems, (GSE Test Racks), Simplified Instructions for navigating the program and balancing the detector modules.
16) Record the OFFSET and CLAMP hexadecimal commands required for each DMA, so if the channels are swapped, the setup with the new levels will be quicker.
17) Turn off the room lights. Check outputs of detectors to ensure that adequate and reasonable signals are being received.
18) Use the tipping plates on the autocollimator and the read-outs to verify that the spot is centered to the Telescope's optical axis to within 2 seconds of arc.
19) Using the tipping plates on the autocollimator, move the spot off-axis in the +X direction until the signal decreases and then bottoms out.

20) Start moving the spot back towards the center in increments of 5 seconds of arc. After each 5 second movement, record position of the spot in seconds of arc and the output of the each detector on the data sheet. (In regions where the signal is changing fast, data may be taken at smaller increments).
21) Continue moving the spot through the center and out to the other edge until the signal decreases and bottoms out. Return the spot to the optical axis
22) Move the spot 12 +/- 3 seconds of arc in the +Y direction. Repeat steps 17-20.
23) Move the spot 12 +/- 3 seconds of arc in the -Y direction. Repeat steps 17-20.
24) Use the tipping plates on the autocollimator and the read-outs to verify that the spot is centered to the Telescope's optical axis to within 2 seconds of arc.
25) Move the spot off-axis in the +Y direction until the signal decreases and then bottoms out.
26) Start moving the spot back towards the center in increments of 5 seconds of arc. After each 5 second movement, record position of the spot in seconds of arc and the output of the each detector on the data sheet. (In regions where the signal is changing fast, data may be taken at smaller increments).
27) Continue moving the spot through the center and out to the other edge until the signal decreases and bottoms out. Return the spot to the optical axis.
28) Move the spot 12 +/- 3 seconds of arc in the +X direction. Repeat steps 23-26.
29) Move the spot 12 +/- 3 seconds of arc in the -X direction. Repeat steps 23-26.
30) Turn on the room lights.
31) Remove the Kapton tape from the Telescope. Rotate the Telescope 180 degrees about its optical axis. *This must be a two-person operation, with both people paying close attention to the location of the Telescope to ensure that it doesn't bump into the autocollimator supports*.
32) Tip & tilt the Telescope until the spot as seen on the monitor is aligned to the spot generated by a retroreflector in the beam to within 10 seconds of arc.
33) Seismically secure the Telescope to the autocollimator supports with Kapton tape.
34) Repeat steps 17 – 28.
35) Note on the data sheet the reading, in milliwatts, of Photometer #2.
36) Remove the Kapton tape from the Telescope and slide the Telescope out from under the 7" autocollimator. Take the Telescope to a safe area and seismically secure it with Kapton tape. *This must be a two-person operation, with both people paying close attention to the location of the Telescope to ensure that it doesn't bump into the autocollimator supports*.
37) Place the 7" condenser lens under the 7" autocollimator, and place the head of Photometer #1 at its focus.
38) Turn off the room lights.
39) Read the optical power through the lens with Photometer #1 and record as "Transmission through Condenser Lens"; Read the optical power measured by Photometer #2 and record it also.
40) Turn off the light source.
41) Read the background light level from Photometer #1 and record it on the data sheet.
42) Record the model, serial number, & calibration date of Photometer #1.
43) The Responsible Engineer and a Quality Assurance representative will review the data and the procedure and, if satisfactory, sign the data sheets.
44) The measurement is now complete

Procedure completed by _____ Date _____

Procedure completed by _____ Date _____

Procedure completed by _____ Date _____

Procedure completed by _____ Date _____

Responsible Engineer _____ Quality Assurance _____

DATA SHEET

Y Micrometer (inches)	Equivalent Angle (seconds)	X Micrometer (inches)	Equivalent Angle (seconds)	ChA Pri +	ChA Pri -	ChA Red +	ChA Red -	ChB Pri +	ChB Pri -	ChB Red +	ChB Red -

RESPONSIBLE ENGINEER: _____ QUALITY ASSURANCE: _____

DATA SHEET

Y Micrometer (inches)	Equivalent Angle (seconds)	X Micrometer (inches)	Equivalent Angle (seconds)	ChA Pri +	ChA Pri -	ChA Red +	ChA Red -	ChB Pri +	ChB Pri -	ChB Red +	ChB Red -

RESPONSIBLE ENGINEER: _____ QUALITY ASSURANCE: _____

DATA SHEET

Y Micrometer (inches)	Equivalent Angle (seconds)	X Micrometer (inches)	Equivalent Angle (seconds)	ChA Pri +	ChA Pri -	ChA Red +	ChA Red -	ChB Pri +	ChB Pri -	ChB Red +	ChB Red -

RESPONSIBLE ENGINEER: _____ QUALITY ASSURANCE: _____

DATA SHEET

Y Micrometer (inches)	Equivalent Angle (seconds)	X Micrometer (inches)	Equivalent Angle (seconds)	ChA Pri +	ChA Pri -	ChA Red +	ChA Red -	ChB Pri +	ChB Pri -	ChB Red +	ChB Red -

RESPONSIBLE ENGINEER: _____ QUALITY ASSURANCE: _____