STANFORD UNIVERSITY
W.W. HANSEN EXPERIMENTAL PHYSICS LABORATORY
GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

P0435 Rev –
UV CURRENT MEASUREMENTS IN PROBE C (RT)

GP-B SCIENCE MISSION PROCEDURE

17 June, 1999

PREPARED ______________________ ______________
B. Clarke, RE Charge Control Date

APPROVED ______________________ ______________
R. Brumley, Gyro Manager Date

APPROVED ______________________ ______________
D. Ross, QA & Safety Date

APPROVED ______________________ ______________
S. Buchman, Hardware Manager Date

1 SCOPE

This document provides the procedure for measuring electric current due to UV photoemission from each of the gyroscope rotor/UV counter-electrode pairs in the SIA. It assumes that Probe-C, with the vacuum can installed, is mounted on the Precision Manipulator per P0205(SM) in the HEPL Class 1000 Cleanroom, and that the Probe is evacuated and maintained at a pressure of not greater than 5 millitorr.

1.1 Acronyms

The following acronyms may be used in this document

PM	Precision Manipulator
T-_Q	SIA Temperature Sensor
T-_P	Probe Temperature Sensor
H-_P	Probe Heater
H-_Q	Probe Heater
GRT	Germanium Resistance Thermometer
SD	Silicon Diode
TB_	Terminal Block X
DMM	Digital Multimeter
BPS_	Belleville Preload System
SIA	Science Instrument Assembly
HEPL	Hansen Experimental Physics Lab
GPB	Gravity Probe B
QA	Quality Assurance
TD	Test Director
NA or N/A	Not Applicable
SM	Science Mission
I-_	Top Hat Connector
HEX_	Heat Exchanger
UV	ultra-violet
STU	Shuttle Test Unit

2 APPLICABLE DOCUMENTS

2.1 Plans and Procedures

P0059	GPB Contamination Control Plan
P0057	Stanford Magnetic Control Plan
P0205(SM)	Mounting Probe on Precision Manipulator
P0429AB	Pre-Integration UV Fiber Optics checkout

P0431AB	Hook-up and Check-out of All Gyro Cables with Probe Connectors
LMMS drawing 1C34103, Rev D	PROBE C CABLE CONNECTOR INTERFACE

3 GENERAL REQUIREMENTS

3.1 Environmental Requirements

This procedure will be conducted in the Stanford Class 1000 Cleanroom in the HEPL facility.

3.1.1 Cleanliness

The Class 1000 clean room where this functional testing takes place shall be maintained at the cleanliness levels specified per GPB Contamination Control Plan P0059. Certified Class 1000 paper garments shall be worn in the Class 1000 clean room.

3.1.2 Particulate Contamination

All parts and tools shall be cleaned using methods consistent with achieving Mil Spec 1246B Level 1000 cleanliness. In addition, all parts shall be maintained at level 1000 cleanliness per Procedure P0059. A portable particle counter shall monitor the local work area, to ensure that particulate counts are consistent with GP-B Contamination Control Plan P0059.

3.1.3 Magnetic Contamination

Take all necessary precautions to keep tooling and handling free of magnetic contamination.

3.2 Test Personnel

3.2.1 Integration and Test Director

The Test Director (TD) shall be Bruce Clarke. He has overall responsibility for the implementation of this procedure and shall sign off the completed procedure.

3.2.2 Other Personnel

All personnel participating in this procedure shall work under the direction of the TD who shall determine whether the person is qualified. Different people will likely be designated at different times. For this procedure, participating integration engineers are expected to be (at various times) Chris Gray and Robert Brumley. Section 6 will show all appropriate signatures.

3.3 Safety

3.3.1 General

Personnel working in the Class 1000 Cleanroom must be cognizant of probe and gurney and must take special care to avoid tripping or bumping into it.

3.3.2 Hardware Safety

3.3.2.1 Probe

Extreme care must be taken to avoid accidentally bumping the Probe or damaging the connectors. Connector savers or equivalent adapters shall be used to protect the connector pins from damage during the measurements. A properly grounded ESD wrist strap must be worn while mating to or de-mating from Probe connectors.

3.3.2.2 UV Lamp

The STU lamp is a strong source of light predominately at the 254 nm wavelength. The optical intensity at the end of the output fibers can be as high as 25 to 50 uW/mm^2. Intensities of this magnitude and wavelength can cause damage to the eyes. Care should be taken to keep the fiber end as far as possible from the eyes. Avoid looking directly into the fiber end while the lamp is on. As an added precaution, any personnel who must work in close proximity to the fiber ends while the lamp is turned on may wear a pair of UV resistant glasses.

3.3.3 Maximum Number of People in Cleanroom

Under normal operating conditions, there shall be no more than 5 people in the Class 1000 Cleanroom. This is to avoid violating legal make up air requirements, and to provide an efficient workspace. Exceptions may be made, for short periods only, on the approval of Chris Gray (Cleanroom Manager) and Robert Brumley (Test Coordinator).

3.4 Quality Assurance

Integration shall be conducted on a formal basis to approved and released procedures. The QA program office shall be notified of the start of this procedure. A Quality Assurance Representative designated by D. Ross shall review any discrepancy noted during this procedure, and approve its disposition. The presently designated QA Representative is R. Leese. Upon completion of this procedure, the QA Program Engineer, D. Ross or R. Leese, will certify his/her concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document. Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108

3.5 Red-line Authority

Authority to red-line this procedure is given solely to the TD and QA representative. Approval by the Hardware Manager shall be required if experiment functionality may be affected. QA Program Engineering concurrence is required before final review/buyoff (on last page) of the completion of the activity described in this procedure.

3.6 Procedure Computerization Special Requirements

To conveniently record data directly into the procedure thus generating the "as-built" document, the procedure will be handled in a paperless fashion until completed. The TD or QA Representative will operate a Laptop computer containing an electronic version of this procedure. The data shall be recorded by typing directly into the electronic file.

Following completion of the procedure, a hard copy of the "as-built" procedure shall be printed and signed off by all the designated parties. It shall then be filed including an electronic copy into the data base.

The electronic editing of this document shall be as follows:

- Data will be inserted into the document using normal font, i.e. non-bold, non-italic
- BLACK CAPITAL BOLD LETTERS shall designate "Signatures".
- "Redlines" shall be in RED BOLD ITALICS to make them distinguishable both on the Laptop screen and on the hard copy printout.
- Digital pictures shall be inserted into the document where appropriate.

4 REQUIRED EQUIPMENT

4.1 Flight Hardware

P/N 1C34115-102	Probe-C Assembly, w/o sunshade

4.2 Commercial Test Equipment

Description	Model	S/N	Calibration Expiration Date
(2) Keithly Autoranging Picoammeter	485	0574456 0676810	4 Sep 1999 1 Mar 2000
Keithly Programmable Electrometer	617	400929	4 Sep 1999
(2) HP 0-25 V Dual Channel DC Power Supply	E3620A E3620A	KR51302524 KR41200106	4 Sep 1999 17 Jul 1999
Resonance Ltd. mercury discharge lamp	HG ARLO-S	931807	N/A
(2) Resonance Ltd. Cs-Te photodiode	Cs-Te M-D-L	A-302 K-769	May 6, 2000 March 29, 2000

4.3 Mechanical/Electrical Special Test Equipment

Description	Part No.	Rev	Serial No.	Certification Date
(2) SMA/LEMO (male) fiber jumpers	SK-486-101	-	Op# PRC0682	29 April 1998
(1) LEMO/LEMO (female/female) fiber jumper	SK-486-102	-	Op# PRC0682	29 April 1998
(2) OPTI SMA splice bushings w/alignment sleeves	300-4SMA-2205	N/A	N/A	N/A
DiCon 1x2 Fiber Optic Switch	Model S12-L-300-N-S	-	102926	N/A
Reynolds to MHV Connector Saver				

Probe C bias connection (6- pin) connector saver				
MHV-BNC-BNC Tee	N/A	N/A	N/A	N/A

4.4 Tools

Description	Number required
UV resistant glasses	5 pair
BNC to banana adapter	4
IEEE interface cables (6' minimum)	3
BNC to alligator clip	3
Alligator clip leads (12 to 16 ")	4
Coaxial cable w/BNC connectors, 10' or longer	4
Coaxial cable w/MHV connectors, 6' minimum	1
BNC barrel connectors and TEEs	4

4.5 Expendables

Description	Quantity
Ethyl Alcohol	N/A, on hand.
Filtered Compressed Air (acceptable for Class 10 use)	N/A, on hand.
Lint free wipes and swabs (acceptable for class 10 use)	N/A, on hand.

5 COMPUTER SOFTWARE

Strawberry Tree data acquisition software
PC w/IEEE interface

6 UV CURRENT MEASUREMENTS

6.1 Set-Up and Lamp Calibration

Started 25 June at 12:00 Signed: **B. CLARKE (TD) / R. LEESE (QA)**
date time TD or QA Representative

6.1.1 Insure the optical surfaces of all fiber optic jumpers are clean by wiping them with ethyl alcohol on a lint free wipe and drying with compressed filtered air. Do not replace any plastic caps after cleaning the fiber ends.

6.1.2 All fiber optic connectors mating to the probe as well as the probe connectors themselves must be inspected for particulate contamination prior to mating. Log all mate/de-mates from the probe connectors in the appropriate log sheet (provided with probe).

6.1.3 Clear off an appropriate cleanroom table and position it near the Top Hat. On this table place the two picoammeters, one HP DC power supply, two Cs-Te diodes, the DiCon optical switch and the STU mercury discharge lamp.

6.1.4 Refer to Figures 1 and 2 when setting up the equipment as outlined in steps 6.1.5 through 6.1.9.

6.1.5 Connect the input of one of the picoammeters to one of the two Cs-Te diodes using a BNC cable. Connect the input of the other picoammeter to the other Cs-Te diode using a BNC cable. The readout connector on the diodes is marked "R" or "Readout". The suggested pairings of picoammeters and photodiodes are marked in Figure 1. Be sure to enter in Table II which picoammeter is reading which diode.

6.1.6 Plug in the HP power supply and power it on. Adjust the left channel to 25 V and the right channel to 5V then power the unit down.

6.1.7 From the right channel of the HP DC power supply, connect BNC cables such that –25 VDC will be applied between the center pin and the shield on the "G" or "Bias" connector on both of the Cs-Te diodes. Connect BNC cables, jumpers and alligator clips such that +30 V will be applied between the pin and the tab on the STU lamp. Connect BNC cables and alligator clips such that +/-5 V may be momentarily applied between the **GREEN** and **RED** pins on the DiCon optical switch. **Do not apply power yet to any of the devices.**

6.1.8 Connect one of the SMA lamp outputs to one of the diodes. This diode will monitor the lamp. Note in table II which diode and picoammeter are monitoring the lamp and which number SMA output it is.

6.1.9 Connect the DiCon switch to the LEMO output of the STU lamp. To the **GREEN** output fiber of the switch connect the LEMO/LEMO (female-female) jumper (P/N SK-486-102). Between the end of this jumper and the unused diode connect a

SMA/LEMO (male) jumper (SK-486-101). This diode will establish a switch baseline reading with respect to the lamp monitor. Note in Table II which diode is reading the switch baseline.

6.1.10 Plug in the AC power cords for the picoammeters. Power on the picoammeters and the DC power supply. Set the picoammeters to autoscale. Momentarily apply +5 V between the GREEN and RED pins on the DiCon switch. This will select the **GREEN** fiber output of the switch. Note the time that the lamp was turned on and the initial current readings from both the lamp and switch monitors.

Time Lamp on @ : ___12:40_________

Initial lamp reading: _____-4.70_____ nA

Initial switch reading: ______1.0_____ nA

6.1.11 Allow the lamp to warm for 30 minutes or until the Test Director has determined the lamp output is stable enough to perform a measurement. The equilibrium output of the lamp at the SMA connectors is ~ 4 uW. The equilibrium output though the LEMO/LEMO –switch-LEMO/LEMO-LEMO/LEMO-SMA leg is expected to be about 10% of the SMA output or ~ 0.4 uW.

6.1.12 After the lamp has warmed sufficiently and is stable, record the diode current readings and the associated optical power in Table II in the 'baseline w/switch' column for the **GREEN** switch output. Optical power is calculated by dividing the diode current by the diode sensitivity.

6.1.13 Momentarily apply –5V between the GREEN and RED pins of the DiCon switch. This will select the ORANGE fiber output. Move the LEMO/LEMO jumper (P/N SK-486-102) from the GREEN switch output to the ORANGE switch output. Record the diode current readings and the associated optical power in Table II in the 'baseline current w/switch' column for the **ORANGE** switch output. Again, optical power is calculated by dividing the diode current by the diode sensitivity.

6.1.14 Remove the switch from this leg and make the LEMO/LEMO connection between the LEMO/LEMO jumper (P/N SK-486-102) and the STU lamp output. Record the diode current readings and the associated optical power in Table II in the 'baseline w/o switch' column. Once again, optical power is calculated by dividing the diode current by the diode sensitivity.

6.1.15 Disconnect the LEMO/LEMO jumper (P/N SK-486-102) and the LEMO/SMA jumper (SK-486-101) and store. Disconnect the associated picoammeter and photo-diode and store. These are not needed for any further measurements. Reconnect the DiCon switch input (RED) to the STU lamp LEMO output.

6.1.16 Complete the "CALIBRATION SUMMARY" in Table II by dividing the "baseline power" entries for the w/ and w/o switch columns by the "baseline current" entries for the lamp.

Completed 6/25/1999 at 1415 Signed: **B. Clarke (TD) / R. Leese (QA)**
date time TD or QA Representative

6.2 Current Measurement by Optical Modulation

Started <u>6/25/1999</u> at <u>1420</u> Signed: **<u>B. Clarke (TD) / R. Leese (QA</u>**)
date time TD or QA Representative

6.2.1 Place the electrometer and the second DC power supply on the table near the probe. Plug in both devices and power them on. Set the electrometer to read current and to autoscale. Adjust the DC supply to provide 3V on the left channel then power the device down.

6.2.2 Hook up the electronics cabling per figure 3. Begin with the appropriate ground plane connection and bias connection for Gyro #1, fixture A as indicated in Table I.

6.2.3 Connect the picoammeter reading the lamp and the electrometer to the data acquisition system via the IEEE port.

6.2.4 Verify that the system clock on the data acquisition computer agrees with the room clock to within 30 seconds. Start the ‘Strawberry Tree’ data acquisition routine and load and start the file ‘UVSTRIP.WBB’. Make any software adjustments necessary such that the data acquisition is reading both the picoammeter and the electrometer.

6.2.5 Adjust the IEEE sampling rate for both the picoammeter and the electrometer to 1 Hz. Adjust the running average to 60 seconds. Adjust the logging period to 2 seconds. The scale of the chart output may be adjusted as deemed necessary by the operator.

6.2.6 Place the STU lamp close enough to the optical LEMO connector on the top hat so that the optical connection can be made per figure 4 without straining the optical fiber. Make this optical connection (**GREEN** switch output to the top hat optical LEMO connector for Gyro #1, fixture A as indicated in Table I).

6.2.7 Power on the DC supply. This will bias the fixture with respect to the rotor at +3V. Enter the data log file name at the appropriate place in the data acquisition routine and begin logging. Record this file name in Table III.

6.2.8 The **GREEN** leg of the optical switch is selected by momentarily applying +5V between the **GREEN** and **RED** pins. The **GREEN** leg is de-selected by momentarily applying -5V between the **GREEN** and **RED** pins.

6.2.9 Select the **GREEN** leg of the switch.

6.2.10 After enough time has passed for the averaged lamp and current values to become stable, record the averaged lamp value under “lamp monitor” and the averaged current value under “UV ON” in Table III.

6.2.11 De-select the **GREEN** leg of the switch.

6.2.12 After enough time has passed for the averaged lamp and current values to become stable, record the averaged lamp value under "lamp monitor" and the averaged current value under "UV OFF" in Table III.

6.2.13 Steps 6.2.10 through 6.2.12 may be repeated as many times as deemed necessary by the Test Director in order to achieve a good measurement. Use Table V as a scratch sheet to keep track of the progress of the test. Only one set of ON/OFF readings need be entered in Table III for each bias setting.

6.2.14 Adjust the bias voltage to 0V. Repeat 6.2.9 through 6.2.13.

6.2.15 Adjust the bias voltage to –3V. Repeat 6.2.9 through 6.2.13.

6.2.16 Stop logging data. Adjust the bias voltage to 3V and power down the DC supply.

6.2.17 Move the bias connection and the fiber optic connection to Gyro #1, fiber B per Table I. Repeat 6.2.7 through 6.2.16.

6.2.18 Move the bias connection, the fiber optic connection and the ground plane connection to Gyro #2, fiber A per Table I. Repeat 6.2.7 through 6.2.16.

6.2.19 Move the bias connection and the fiber optic connection to Gyro #2, fiber B per Table I. Repeat 6.2.7 through 6.2.16.

6.2.20 Move the bias connection, the fiber optic connection and the ground plane connection to Gyro #3, fiber A per Table I. Repeat 6.2.7 through 6.2.16.

6.2.21 Move the bias connection and the fiber optic connection to Gyro #3, fiber B per Table I. Repeat 6.2.7 through 6.2.16.

6.2.22 Move the bias connection, the fiber optic connection and the ground plane connection to Gyro #4, fiber A per Table I. Repeat 6.2.7 through 6.2.16.

6.2.23 Move the bias connection and the fiber optic connection to Gyro #4, fiber B per Table I. Repeat 6.2.7 through 6.2.16.

6.2.24 Remove the fiber optic and bias connection at the top hat.

6.2.25 Complete Table III.

<u>The "UV @ rotor" is calculated as follows</u>:
C = "uW @ top hat / nA @ monitor " for the appropriate fiber leg from Table II
M = "lamp monitor" from Table III
L = "optical losses w/o LEMOs" from Table I

$$UV\ Power\ @\ rotor = C * M * 10^{(-L/10)}$$

<u>The "Normalized current" is calculated as follows:</u>

Normalized current = (net current) / (UV power @ rotor)

Completed 26 June at 1400 Signed: **B. Clarke (TD) / R. Leese (QA)**
date time TD or QA Representative

TD determined from the data collected on GYRO #1, fiber A

6.3 Current Measurement by Bias Modulation (optional)

Section 6.3 will be performed only if the results of section 6.2, as shown in Table III, are ambiguous. The interpretation of the results of section 6.2 is left to the Test Director with concurrence by the QA representative required to proceed, whether 6.3 is to be performed or not.

Started 26 June at 1500 Signed: **B. Clarke (TD) / R. Leese (QA)**
date time TD or QA Representative

6.3.1 Remove the DiCon fiber optic switch from the optical path. The fiber optic connection at the top hat will now be directly to the LEMO output of the STU lamp. The output fibers on the STU lamp are only about 18" long. Depending on the probe orientation, this may require that the lamp be placed on a stand in order to make the optical connection without straining the fiber. Place the lamp such that the connection can be made to Gyro #1, fiber A per Table I.

6.3.2 Make the bias connection and the ground plane connection for Gyro #1, fiber A per Table I.

6.3.3 Make the optical connection between the STU lamp output LEMO and the top hat optical LEMO for Gyro #1, fiber A per Table I.

6.3.4 Power on the DC supply. This will bias the fixture with respect to the rotor at +3V. Enter the data log file name at the appropriate place in the data acquisition routine and begin logging. Record this file name in Table IV.

6.3.5 After enough time has passed for the averaged lamp and current values to become stable, record the averaged lamp value under "lamp monitor" and the averaged current value under "UV ON" in Table III.

6.3.6 Adjust the bias voltage to 0V. Repeat 6.3.5.

6.3.7 Adjust the bias voltage to -3V. Repeat 6.3.5.

6.3.8 Break the optical connection at the top hat. Adjust the bias voltage to 3V.

6.3.9 After enough time has passed for the averaged lamp and current values to become stable, record the averaged lamp value under "lamp monitor" and the averaged current value under "UV OFF" in Table IV.

6.3.10 Adjust the bias voltage to 0V. Repeat 6.3.9.

6.3.11 Adjust the bias voltage to -3V. Repeat 6.3.9.

6.3.12 Steps 6.3.5 through 6.3.11 may be repeated as many times as deemed necessary by the Test Director in order to achieve a good measurement. Use Table VI as a scratch sheet to keep track of the progress of the test. Only one set of ON/OFF readings need be entered in Table III for each bias setting.

6.3.13 Stop logging data. Adjust the bias voltage to 3V and power down the DC supply.

6.3.14 Move the bias connection and the fiber optic connection to Gyro #1, fiber B per Table I. Repeat 6.3.4 through 6.3.13.

6.3.15 Move the bias connection, the fiber optic connection and the ground plane connection to Gyro #2, fiber A per Table I. Repeat 6.3.4 through 6.3.13.

6.3.16 Move the bias connection and the fiber optic connection to Gyro #2, fiber B per Table I. Repeat 6.3.4 through 6.3.13.

6.3.17 Move the bias connection, the fiber optic connection and the ground plane connection to Gyro #3, fiber A per Table I. Repeat 6.3.4 through 6.3.13.

6.3.18 Move the bias connection and the fiber optic connection to Gyro #3, fiber B per Table I. Repeat 6.3.4 through 6.3.13.

6.3.19 Move the bias connection, the fiber optic connection and the ground plane connection to Gyro #4, fiber A per Table I. Repeat 6.3.4 through 6.3.13.

6.3.20 Move the bias connection and the fiber optic connection to Gyro #4, fiber B per Table I. Repeat 6.3.4 through 6.3.13.

6.3.21 Remove the fiber optic and bias connection at the top hat.

6.3.22 Complete Table IV.

<u>The “UV @ rotor” is calculated as follows</u>:
C = “uW @ top hat / nA @ monitor “ for the “LAMP LEMO OPTICAL OUTPUT” from Table II
M = “lamp monitor” from Table IV
L = “optical losses w/o LEMOs” from Table I

*UV Power @ rotor = C * M * 10 $^{(-L / 10)}$*

<u>The “Normalized current” is calculated as follows:</u>

Normalized current = (net current) / (UV power @ rotor)

Completed <u>26 June</u> at <u>1800</u> Signed: **<u>B. Clarke (TD) / R. Leese (QA</u>**<u>)</u>
date time TD or QA Representative

7 PROCEDURE COMPLETION

The results obtained in the performance of this procedure are acceptable:

Integration Engineer(s)

____________________________________ Date ______________

____________________________________ Date ______________

____________________________________ Date ______________

Discrepancies if any:

Test Director __**BRUCE CLARKE**__ Date 26 June 1999

The information obtained under this assembly and test procedure is as represented and the documentation is complete and correct:

RT Test Manager ___________________________ Date ____________

QA Representative ___________________________ Date ____________

Program QA Engineer___________________________ Date ____________

8 DATA BASE ENTRY

The following data shall be entered into the GP-B Data Base:

Name, number and revision of this procedure

An electronic copy of this document

A copy of the “as-built” procedure with data and pictures, when completed.

TABLE I - PROBE C UV OPTICAL AND BIAS CONNECTIONS

[Bias and Ground Plane pin assignments and optical losses are per P0429AB and P0431AB]

GYRO	UV fixture	Top Hat LEMO	BIAS Connector - Pin #	Ground Plane @ Top Hat	Optical losses w/ LEMOs (dB)	Optical losses w/o LEMOs (dB)
1	A	PM IIII	BGPM - 4	CG18	4.75	1.70
	B	UV12 II	BG34 -1		5.73	2.69
2	A	UV12 IIII	BG34 - 3	CG28	6.35	3.30
	B	UV12 III	BG34 - 4		6.43	3.38
3	A	UV34 I	BG12 -1	CG38	6.09	3.04
	B	UV34 II	BG12 -2		6.73	3.68
4	A	UV34 III	BG12 -3	CG48	5.88	2.83
	B	UV34 IIII	BG12 -4		5.58	2.53

TABLE II - LAMP MONITOR CALIBRATION

Picoammeter s/n	Diode Location	Cs-Te Diode S/N	Diode Sensitivity (nA/uW)	SMA number		
574456	Lamp	A-302	14.97	2		
284094	Switch Baseline	K-769	16.00	N/A		
	Baseline Current (-nA)			Baseline power (uW)		
	w/switch	w/o switch	lamp	w/switch	w/o switch	lamp
GREEN	5.695	N/A	26.810	0.36	N/A	1.79
ORANGE	5.030	N/A	26.830	0.31	N/A	1.79
LAMP LEMO	N/A	13.128	26.830	N/A	0.82	1.79

CALIBRATION SUMMARY	GREEN OPTICAL OUTPUT	ORANGE OPTICAL OUTPUT	LAMP LEMO OPTICAL OUTPUT
uW @ top hat per nA @ monitor	0.0133	0.0117	0.0306

The UV power at the rotor is calculated using these calibrations, the lamp monitor output and "losses w/o LEMOs" from Table I.

TABLE III - CURRENT MEASUREMENTS BY OPTICAL MODULATION

GYRO #	UV fixture	filename	Bias (V)	CURRENT (fA) UV ON	UV OFF	net	lamp monitor (nA)	UV @ rotor (uW)	Normalized Current (fA/uW)	Switch output
1	A	UV1A000.DAT	3.0	-52	-76	24	41.350	0.371	65	GREEN
			0.0	44	65	-21	42.080	0.378	-56	GREEN
			-3.0	12	69	-57	42.840	0.385	-148	GREEN
	B	UV1B000.DAT	3.0	51	45	6	43.980	0.314	19	GREEN
			0.0	22	54	-32	44.120	0.315	-101	GREEN
			-3.0	-74	-89	15	44.220	0.316	47	GREEN
2	A		3.0			0		0.000	#DIV/0!	GREEN
			0.0			0		0.000	#DIV/0!	GREEN
			-3.0			0		0.000	#DIV/0!	GREEN
	B		3.0			0		0.000	#DIV/0!	GREEN
			0.0			0		0.000	#DIV/0!	GREEN
			-3.0			0		0.000	#DIV/0!	GREEN
3	A		3.0			0		0.000	#DIV/0!	GREEN
			0.0			0		0.000	#DIV/0!	GREEN
			-3.0			0		0.000	#DIV/0!	GREEN
	B		3.0			0		0.000	#DIV/0!	GREEN
			0.0			0		0.000	#DIV/0!	GREEN
			-3.0			0		0.000	#DIV/0!	GREEN
4	A		3.0			0		0.000	#DIV/0!	GREEN
			0.0			0		0.000	#DIV/0!	GREEN
			-3.0			0		0.000	#DIV/0!	GREEN
	B		3.0			0		0.000	#DIV/0!	GREEN
			0.0			0		0.000	#DIV/0!	GREEN
			-3.0			0		0.000	#DIV/0!	GREEN

Normalized current should be > +10 fA/uW under +3V bias and < -30 fA/uW under -3V bias.
Current under the 0V bias condition is recorded but not specified.

Too much noise pick-up for optical modulation to work. Move on to Bias Modulation.
B. Clarke

TABLE IV - CURRENT MEASUREMENTS BY BIAS MODULATION

GYRO #	UV fixture	filename	Bias (V)	CURRENT (fA) UV ON	UV OFF	net	lamp monitor (nA)	UV @ rotor (uW)	Normalized Current (fA/uW)
1	A	UV1A001.DAT	3	114	30	84	45.49	0.941	89
			0	-15	30	-45	45.48	0.940	-48
			-3	-47	30	-77	45.46	0.940	-82
	B	UV1B001.DAT	3	72	33	39	36.90	0.607	64
			0	28	33	-5	36.42	0.600	-8
			-3	14	33	-19	36.10	0.594	-32
2	A	UV2A001.DAT	3	69	44	25	37.28	0.533	47
			0	38	44	-6	37.66	0.539	-11
			-3	-4	44	-48	37.99	0.543	-88
	B	UV2B001.DAT	3	61	42	19	36.06	0.506	38
			0	46	42	4	36.76	0.516	8
			-3	26	42	-16	37.26	0.523	-31
3	A	UV3A001.DAT	3	89	45	44	42.92	0.652	68
			0	25	45	-20	43.13	0.655	-31
			-3	-15	45	-60	43.35	0.658	-91
	B	UV3B001.DAT	3	55	10	45	41.98	0.550	82
			0	25	10	15	41.71	0.547	27
			-3	-50	10	-60	41.54	0.544	-110
4	A	UV4A001.DAT	3	28	-5	33	38.18	0.609	54
			0	-15	-5	-10	37.50	0.598	-17
			-3	-65	-5	-60	36.77	0.586	-102
	B	UV4B001.DAT	3	-20	-45	25	32.36	0.553	45
			0	-75	-45	-30	30.85	0.527	-57
			-3	-105	-45	-60	29.60	0.506	-119

Normalized current should be > +10 fA/uW under +3V bias and < -30 fA/uW under -3V bias.
Current under the 0V bias condition is recorded but not specified.

Current values based on strip chart data - see Chart 1 through Chart 8.

TABLE V – OPTICAL MODULATION RUNNING RECORD

TIME	BIAS (V)	LAMP (nA)	CURRENT (fA)	COMMENT
1435	+3	-26.45	-27	UV ON
1549	+3	-41.17	-54	ON – Gyro #1 - Fiber A – 6/25/1999
1550	+3	-41.27	-76	OFF
1552	+3	-41.45	-52	ON
1555	+3	-41.64	15	OFF
1556	+3	-41.72	47	ON
1557	0	-41.83	24	OFF
1558	0	-41.94	44	ON
1600	0	-42.03	65	OFF
1601	0	-42.13	31	ON
1602	0	-42.24	50	OFF
1603	0	-42.39	-47	ON
1604	0	-42.47	-50	OFF
1606	-3	-42.58	-105	OFF
1607	-3	-42.64	-91	ON
1608	-3	-42.69	-3	OFF
1610	-3	-42.76	9	ON
1611	-3	-42.82	69	OFF
1612	-3	-42.88	12	ON
1632	+3	-43.91	-124	OFF - Gyro #1 – Fiber B
1635	+3	-43.93	5	ON
1636	+3	-43.95	42	OFF
1637	+3	-43.97	51	ON
1638	+3	-44.00	45	OFF
1640	+3	-44.03	44	ON
1643	0	-44.10	-88	ON
1645	0	-44.13	-90	OFF
1647	0	-44.11	-35	ON
1648	0	-44.11	15	OFF
1649	0	-44.12	22	ON
1650	0	-44.13	54	OFF
1651	0	-44.14	18	ON
1653	+3	-44.15	28	ON
1654	+3	-44.16	34	OFF
1655	+3	-44.18	39	ON
1656	-3	-44.21	-74	ON
1658	-3	-44.23	-89	OFF
1703	-3	-44.22	7	ON
1705	-3	-44.23	29	OFF

1706	-3	-44.24	4	ON
1708	+3	-44.26	-5	ON
				See file UV2AP30.DAT for following:
1336	+3	-41.10	88	ON - Gyro #2 – Fiber A - 6/26/1999
1342	0	-42.08	85	OFF – see file UV2AP00.DAT
1344	0	-42.29	63	ON
1345	0	-42.45	79	OFF
1345	0	-42.54	60	ON
1346	0	-42.65	68	OFF
1347	0	-42.78	69	ON
1348	0	-42.96	64	OFF
1349	0	-43.05	57	ON
1351	-3	-43.35	40	ON – see file UV2AN30.DAT
1353	-3	-43.55	0	OFF
1354	-3	-43.66	-52	ON

TABLE VI – BIAS MODULATION RUNNING RECORD

TIME	BIAS (V)	LAMP (nA)	CURRENT (fA)	COMMENT
				The following measurements use Paragraph 6.3 optional test method
1509	+3	-45.49	114	ON – Gyro #1 – Fiber A
1510	0	-45.48	-15	ON – File name UV1A001.DAT
1511	-3	-45.46	-36	ON
1512	-3	0	27	OFF
1512	0	0	33	OFF
1513	+3	0	30	OFF
1522	+3	-42.92	120	ON – Gyro #3 – Fiber A
1523	0	-43.13	25	ON– File name UV3A001.DAT
1524	-3	43.35	-15	ON
1526	-3	0	50	OFF
1528	0	0	79	OFF
1529	+3	0	90	OFF
1539	+3	-38.52	82	ON – Gyro #3 – Fiber B
1540	0	-39.18	55	ON– File name UV3B001.DAT
1541	-3	-39.85	25	ON
1547	-3	-41.54	-50	ON
1548	0	-41.71	-18	ON
1549	+3	-41.98	25	ON
1550	+3	0	5	OFF
1551	0	0	-1	OFF
1552	-3	0	-5	OFF
1558	-3	-36.77	-60	ON – Gyro #4 – Fiber A
1559	0	-37.50	-19	ON – File name UV4A001.DAT
1600	+3	-38.18	27	ON
1601	+3	0	3	OFF
1603	0	0	-1	OFF
1604	-3	0	-10	OFF

TIME	BIAS (V)	LAMP (nA)	CURRENT (fA)	COMMENT
1614	-3	-29.60	-97	ON – Gyro #4 – Fiber B
1615	0	-30.85	-64	ON – File name UV4B001.DAT
1617	+3	-32.36	-32	ON
1618	+3	0	-52	OFF
1619	0	0	-35	OFF
1621	-3	0	-41	OFF
1653	-3	-36.10	16	ON – Gyro #1 – Fiber B
1654	0	-36.42	29	ON – File name UV1B001.DAT
1655	+3	-36.90	71	ON
1656	+3	0	32	OFF
1657	0	0	29	OFF
1659	-3	0	32	OFF
1718	+3	-37.28	72	ON – Gyro #2 – Fiber A
1719	0	-37.66	38	ON – File name UV2A001.DAT
1720	-3	-37.99	2	ON
1721	-3	0	44	OFF
1723	0	0	45	OFF
1725	+3	0	28	OFF
1743	+3	-36.06	60	ON – Gyro #2 – Fiber B
1744	0	-36.76	45	ON – File name UV2B001.DAT
1746	-3	-37.26	26	ON
1747	-3	0	40	OFF
1749	0	0	20 (drifting)	OFF
1750	+3	0	-50 (drifting)	OFF

CHART 1 - UV1A001.DAT

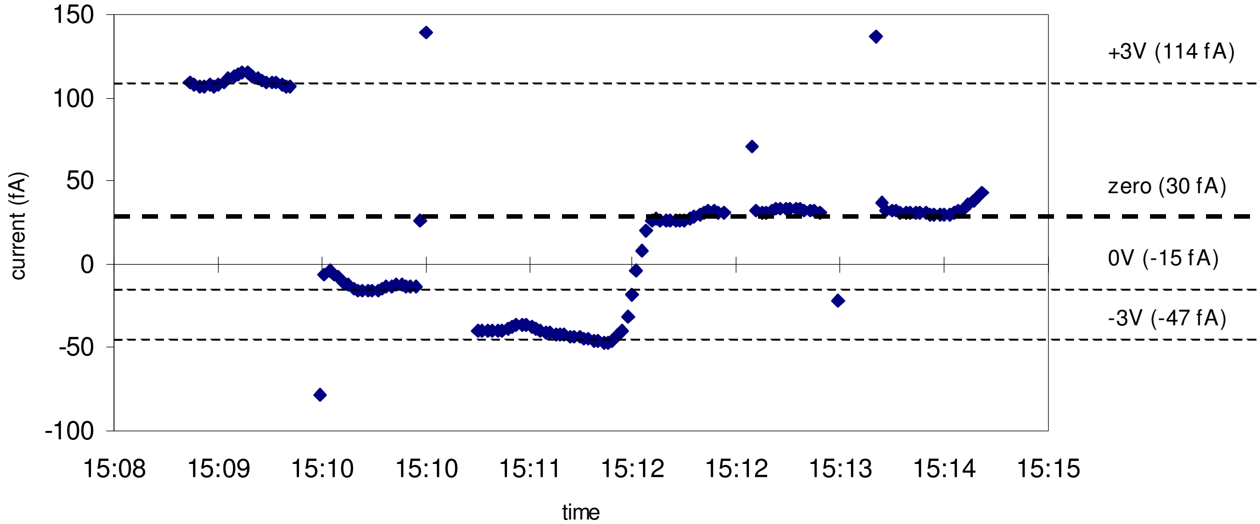


CHART 2 - UV1B001.DAT

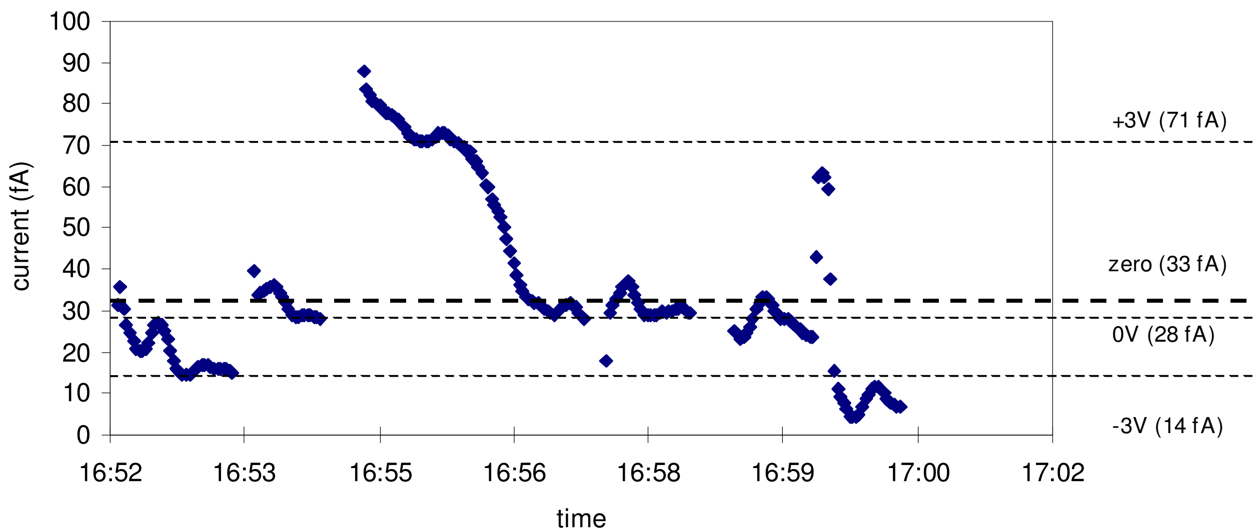


CHART 3 - UV2A001.DAT

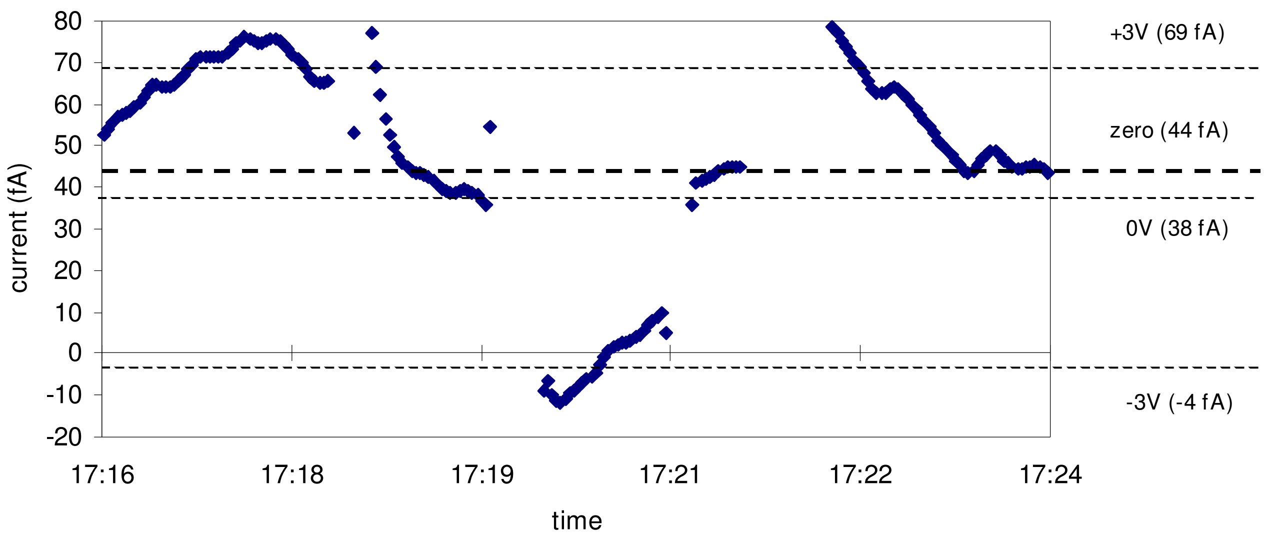


CHART 4 - UV2B001.DAT

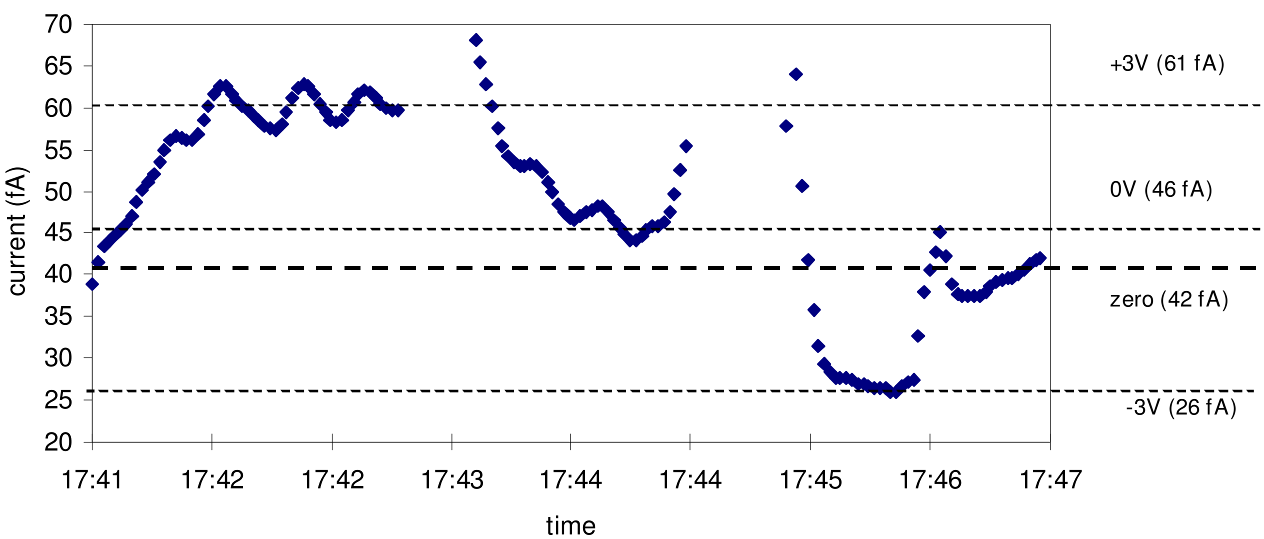


CHART 5 - UV3A001.DAT

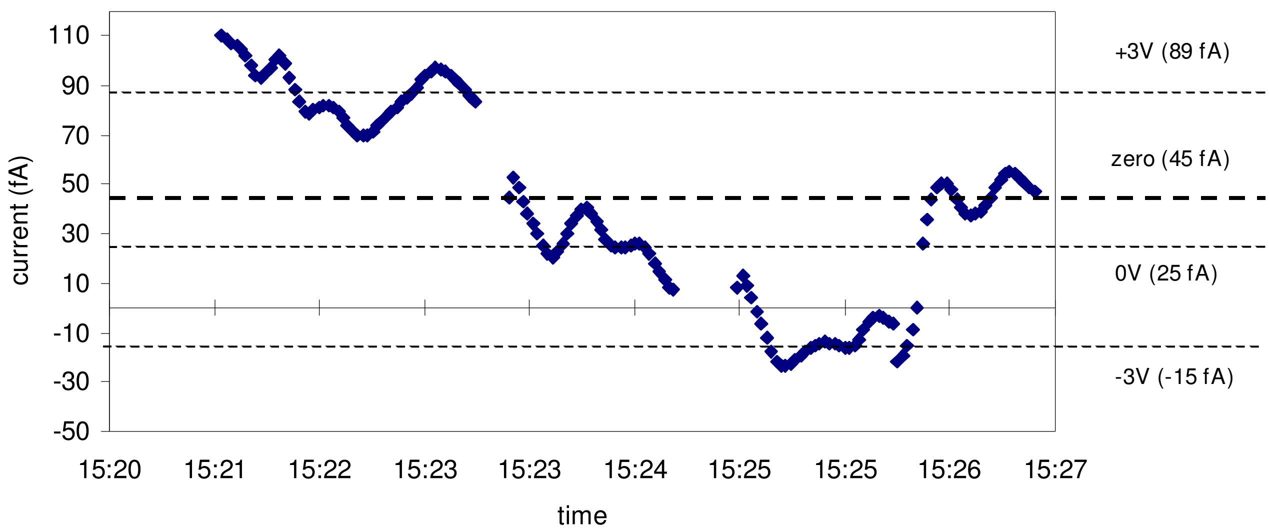


CHART 6 - UV3B001.DAT

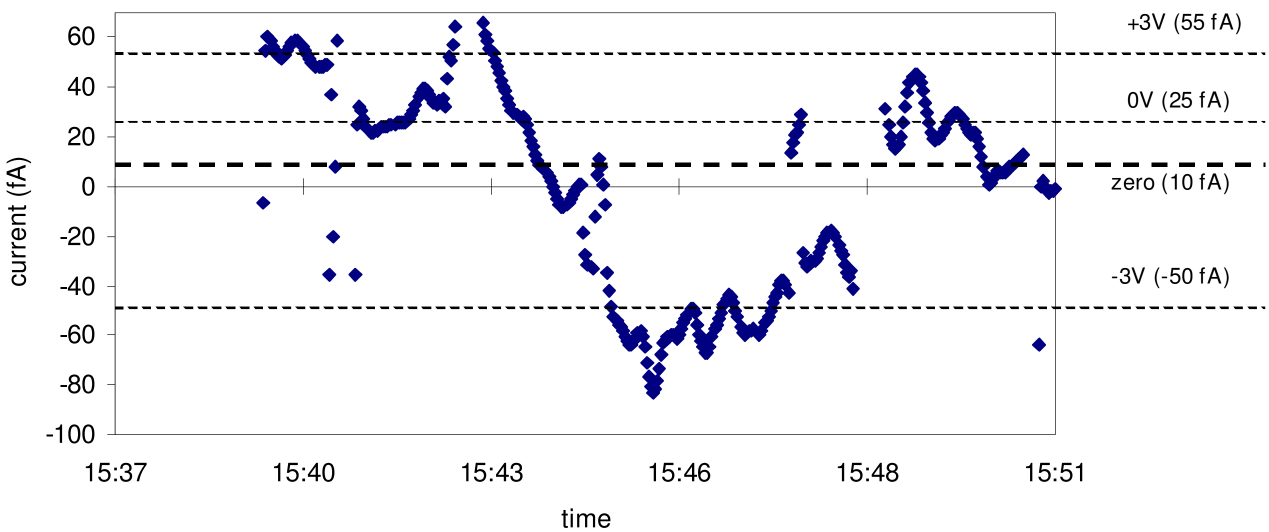


CHART 7 - UV4A001.DAT

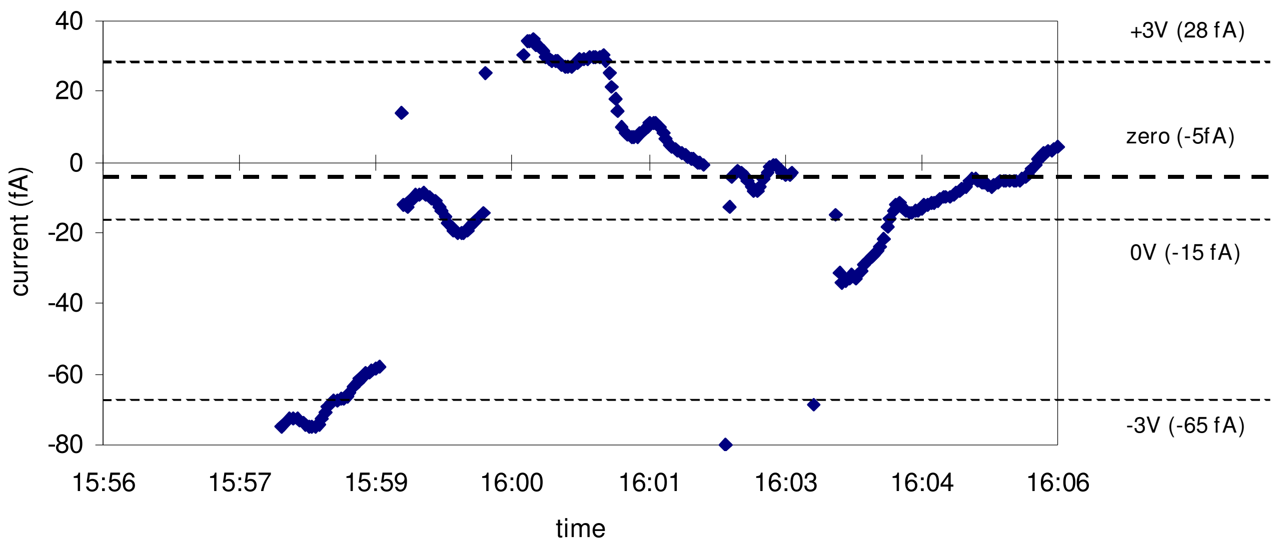
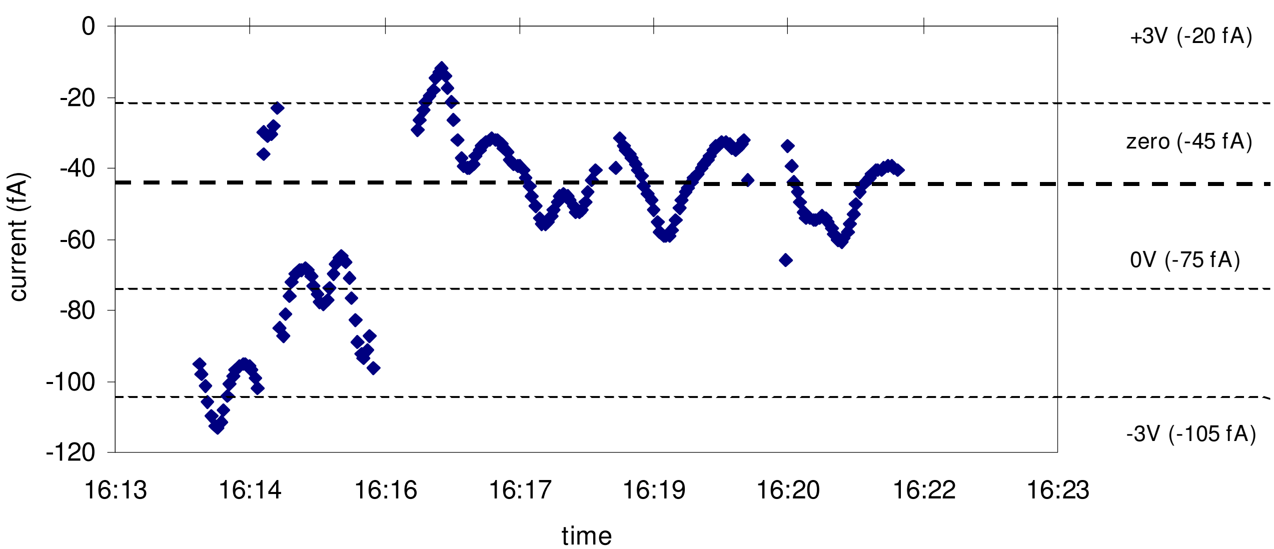


CHART 8 - UV4B001.DAT



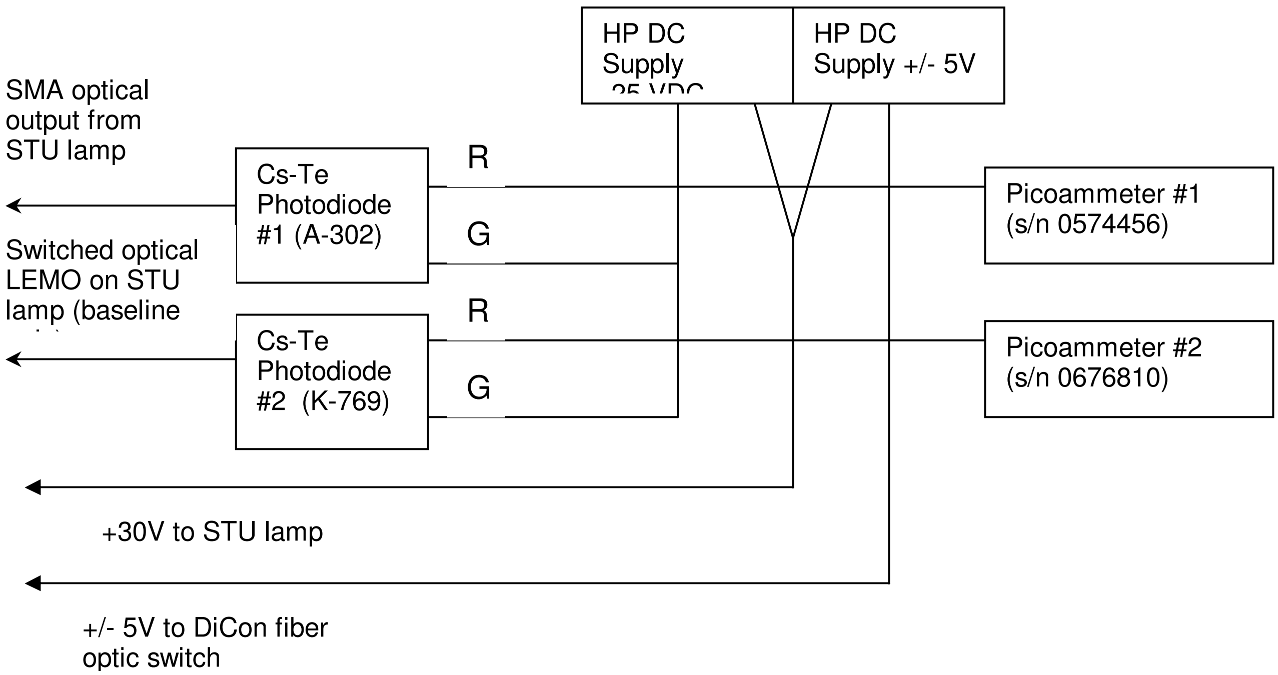


FIGURE 1 – Electronics Set-up – Lamp Calibration

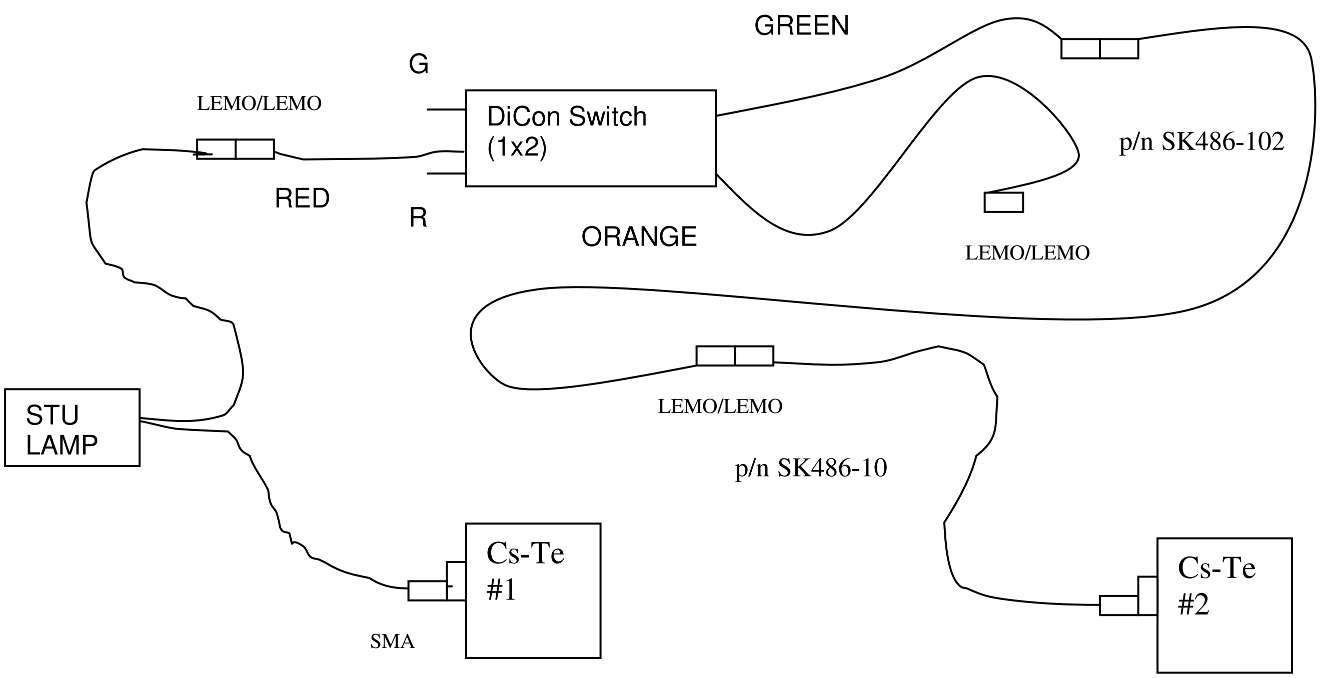


FIGURE 2 – Optical Path Set-up – Lamp Calibration

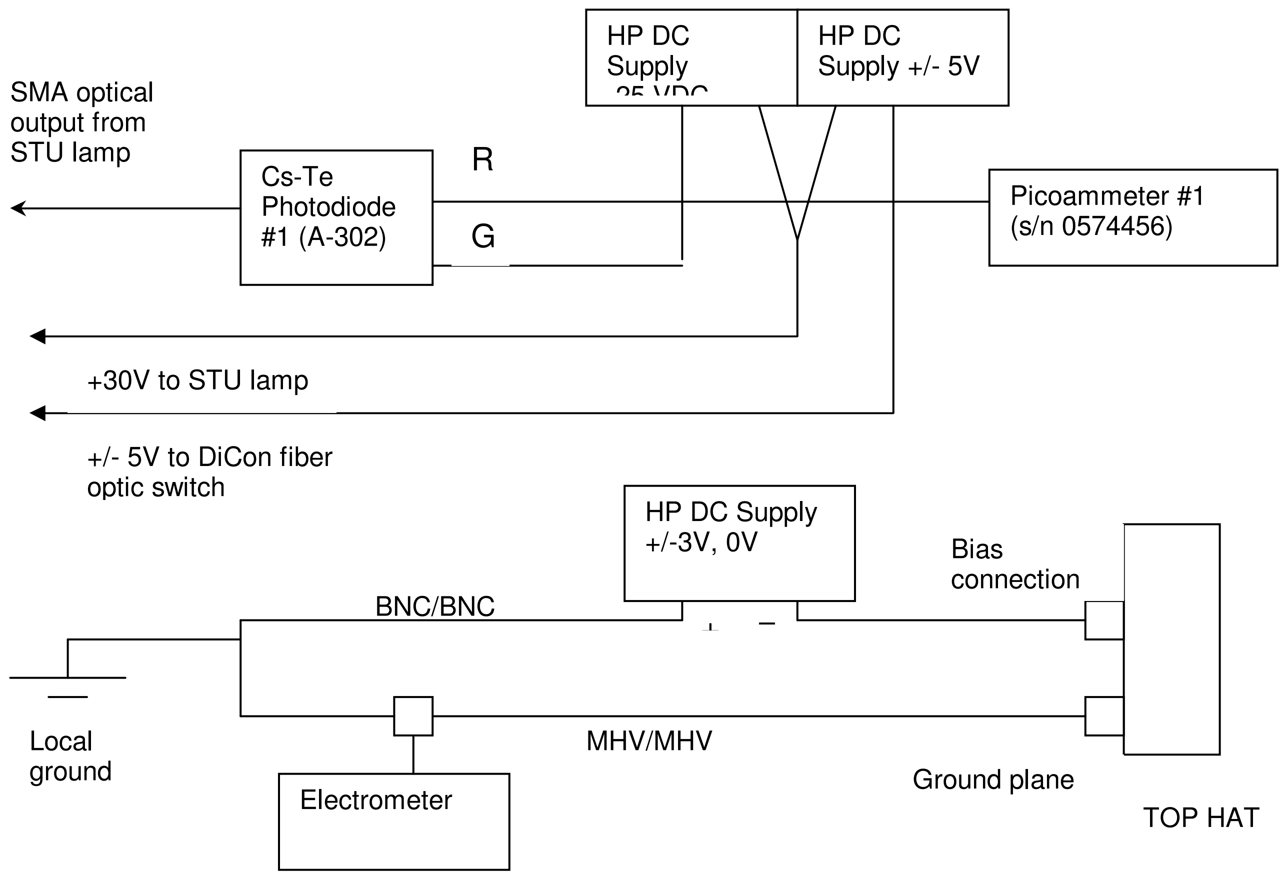


FIGURE 3 – Electronics Set-Up - Current Measurement

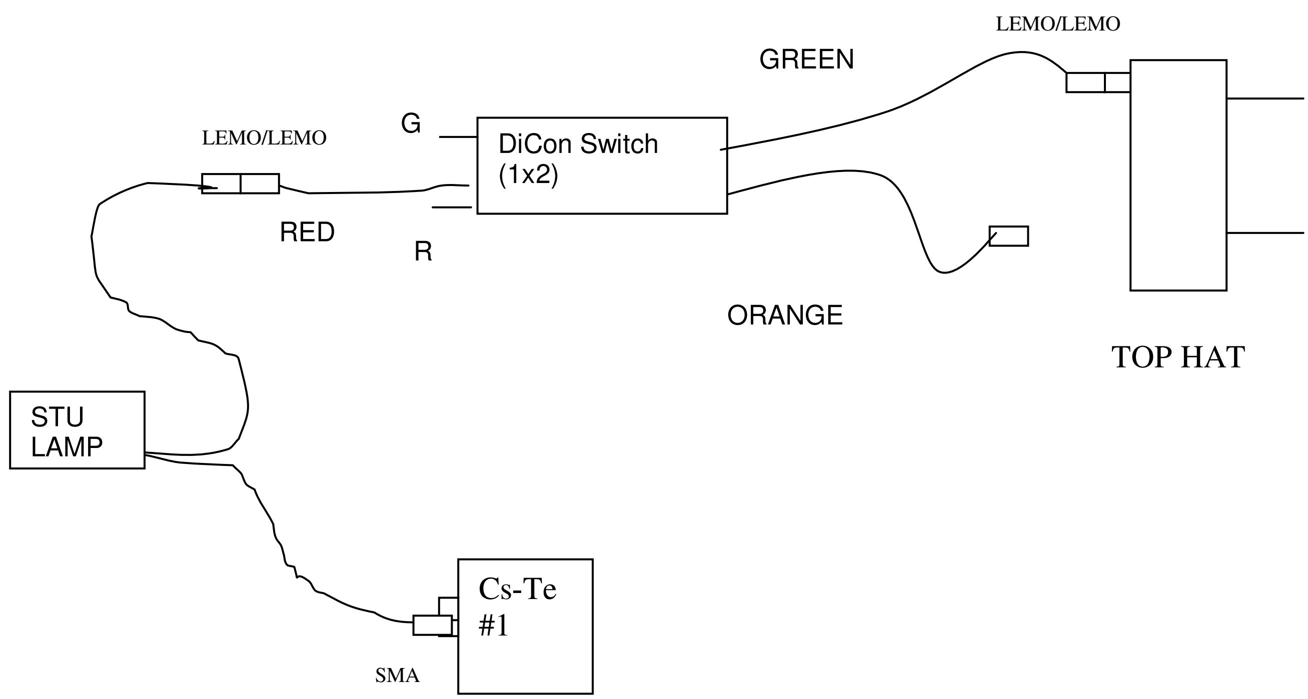


FIGURE 4 – Optical Set-Up – Current Measurement

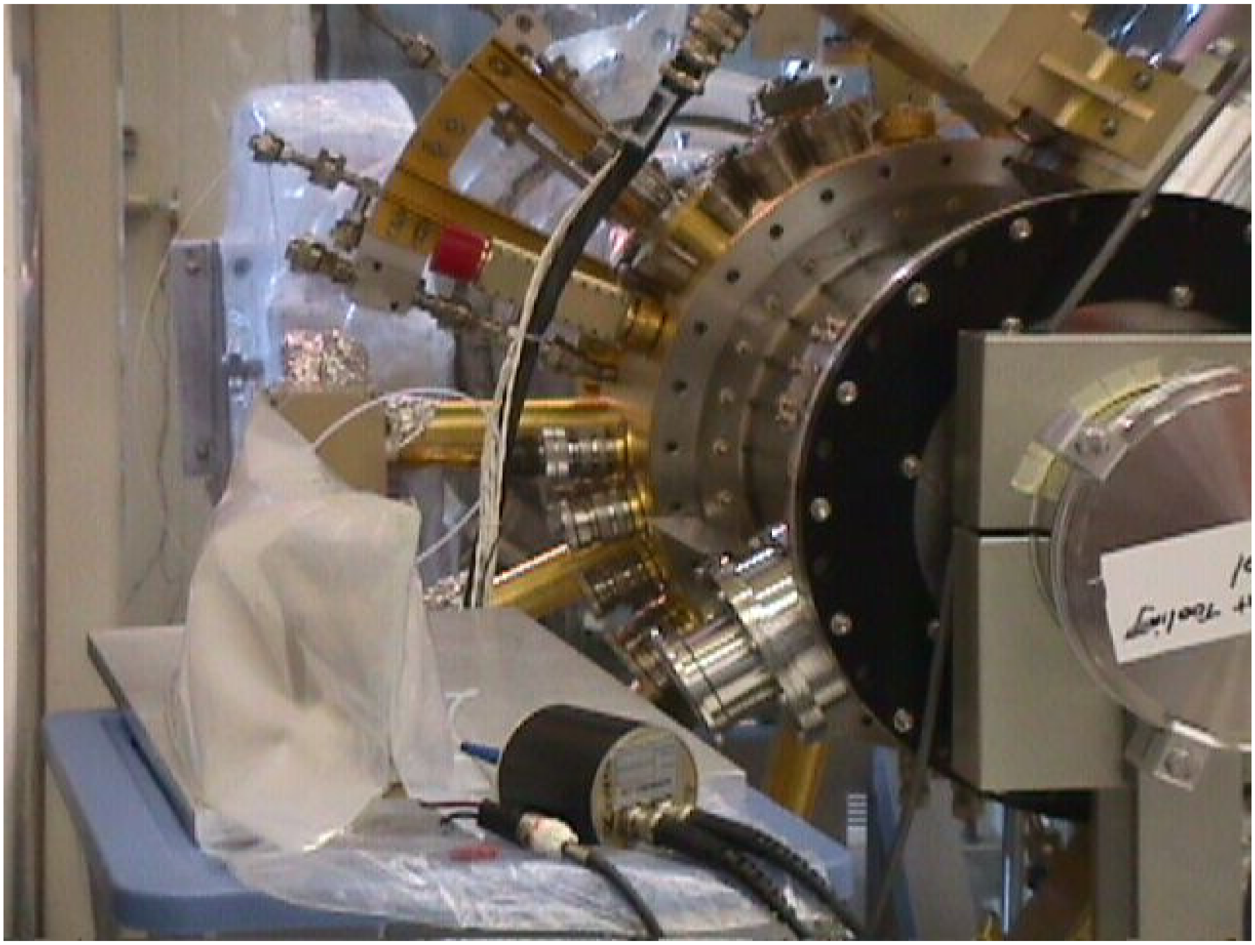


Photo 1 – Resonance STU Hg lamp wrapped in nylon and mounted to a ½" aluminum plate (to stabilize temperature) is coupled into Probe C through a fiber optic LEMO connector. The intensity of the lamp is monitored using a Cs-Te photodiode (black cylinder in foreground).

Photo 2 – Electronics set-up includes a Keithly electrometer for measuring the photo-current, a Keithly picoammeter for monitoring the lamp intensity and two HP DC power supplies which provide Hg lamp power as well as bias voltage.

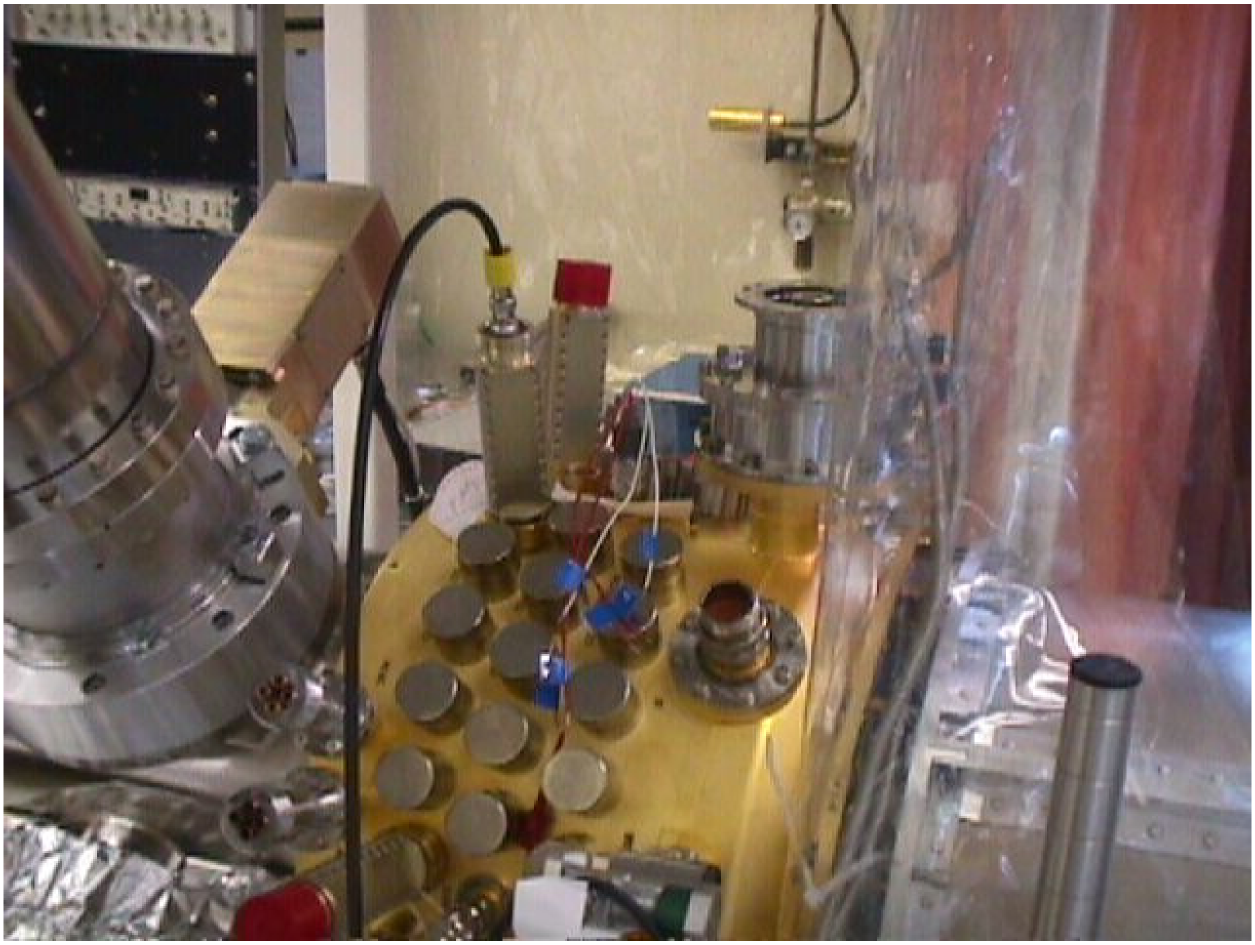


Photo 3 – Connection to the ground plane is made through a MHV-MHV cable (yellow tape) shown connected here to a Reynolds/MHV on the top hat. The bias connection is made through a pigtail connector saver (tagged w/ blue tape – center of photo).