

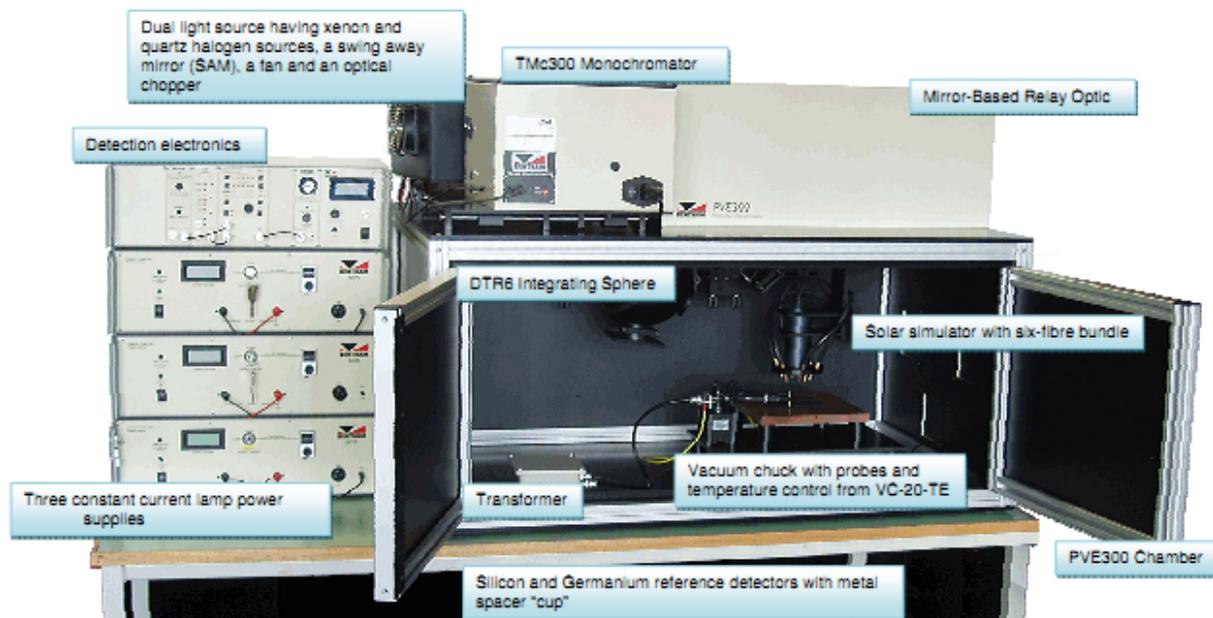
Standard Operating Procedure (SOP)

Bentham PVE300 - Quantum Efficiency Measurement System

System Introduction:

As can be seen in picture below, the Building Blocks of Instrumentation System are as follows:

- Light Source
- Bias Light
- Wavelength Selection : Monochromator /Filter
- Coupling Optics
- Lock-in-Amplifier



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Check-points in experiment:

1. Initialization of all units
 - i. Xenon Lamp power supply
 - ii. Quartz Halogen Lamp power supply
 - iii. Monochromator
 - iv. Detection electronics box
 - v. Computer system
2. Detector calibration in the desired mode
 - i. Transformer mode
 - ii. AC mode
 - iii. DC mode
3. Probing the sample
 - i. Identify the contacts on the solar cell
 - ii. Identify the probing assembly to be used for the cell based on contact configurations.
4. Position of the Mirror Inside the enclosure of PVE300
 - i. EQE measurement: Next to left side stopper, near the integrating sphere
 - ii. Reflectance/transmittance measurement: Next to the right side stopper, near to optical fibres of light bias.

Precautions:

1. Always switch ON the Xenon Lamp power supply first since it has connections to the fan unit cooling the lamp assembly.
2. Turn ON detection electronics and monochromator **ONLY AFTER** power supplies for the lamps are ON and they are stabilized for 5 minutes.
3. Do NOT turn ON/OFF the power supply for any of the lamps i.e. Xenon lamp, Quartz halogen lamp or the lamp for measurement under bias when detection electronics is ON. To start any lamp, stop the measurement software, switch OFF the detection electronics first and then power up the lamps.
4. Do NOT change the settings on the power supplies for the lamps.
5. Handle micro-positioner needles carefully ensuring they are neither scratching the sample surface not breaking due to excessive pressure.
6. Ensure the mode of measurement selected in software corresponds to the connections of the solar cell made with detection electronics.
7. Do NOT touch mirror, integrating sphere and any part of optical assembly (reflectance standard, port reducers etc.) with bare hands. Always wear gloves.

8. Ensure the position of the mirror is correct corresponding to EQE measurement and reflectance/transmittance measurement to focus beam in vertical/horizontal plane respectively.
9. Ensure that the integrating sphere is moved carefully on optical rail, by holding it firmly, during reflectance/transmittance measurement and note down its position.
10. Ensure the position of the mirror inside the PVE300 enclosure is correct as per the desired measurement.
11. Do NOT take any measurements when front panel of Lock In Amplifier shows “Overload”.

General Procedure

A. Initialization of all units

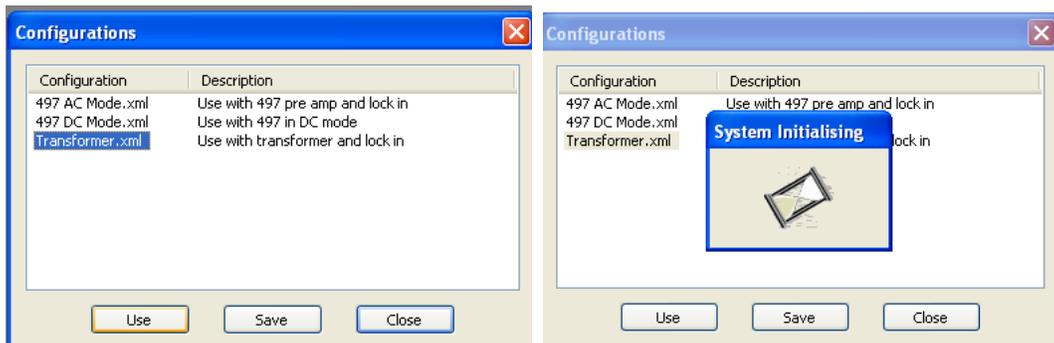
1. Switch On the Xenon Lamp by powering it with constant current source 605 (which is kept under the table). Initially the Lamp failed red LED will glow, wait for 15-20 seconds, the Lamp will start.



2. Switch On the Quartz Halogen Lamp by powering it with constant current source 605 (which is kept under the table).
3. Switch On the monochromator and the detection electronics unit.



4. Switch On the computer system and enter the desired mode of Benwin+ software.

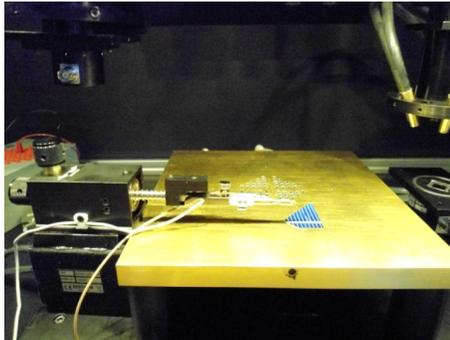


B. Probing the sample

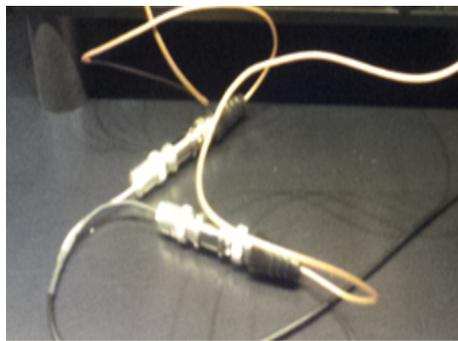
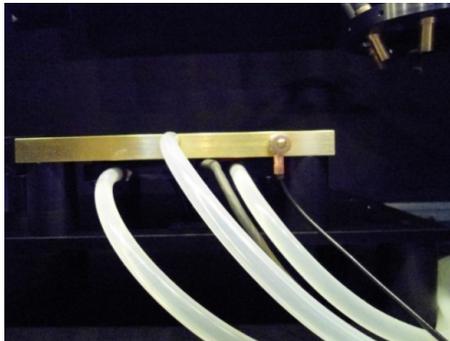
B.1 Based on Configuration of contacts

I. Standard finger-busbar pattern on front and Al metallization on backside

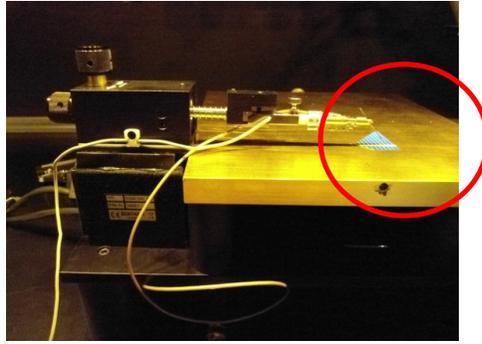
1. Place the sample on vacuum chuck so that backside metallization makes contact with the chuck.



2. The temperature controlled vacuum chuck is connected to one of the terminal of the BNC cable.



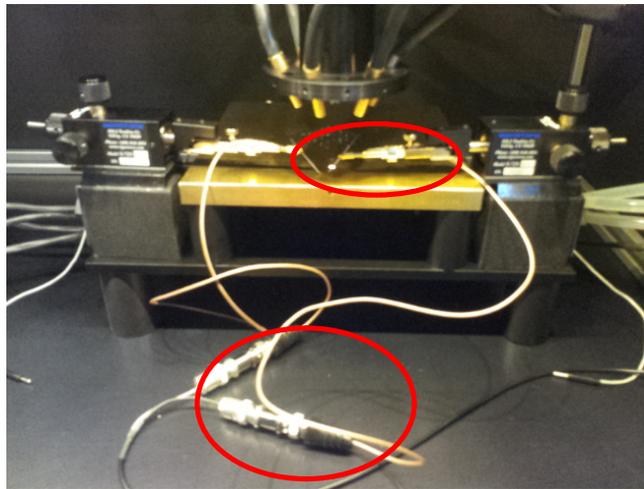
3. Connect the other terminal of the BNC cable to the signatone microprobe.



4. Now probe the front side busbar or finger of the solar cell with the help needle of magnetic base microprobe.

II. Both contacts on front side of the cell

1. Place the sample on the chuck but the chuck acts just like a mechanical support since both the contacts are on front side of the cell.
2. Connect the terminals of the BNC cable to the two signature microprobes.
3. Now probe the one contact of the solar cell with the help needle of magnetic base one magnetic base microprobe and the other with another magnetic base microprobe needle.

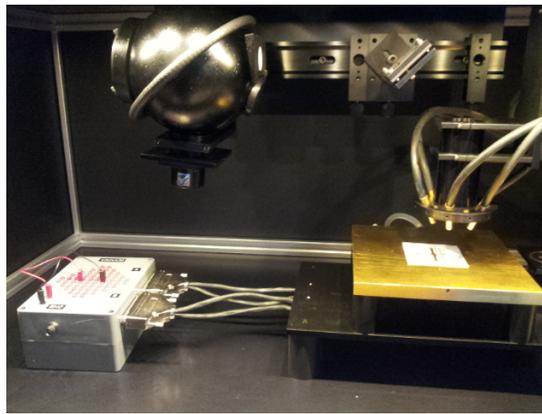
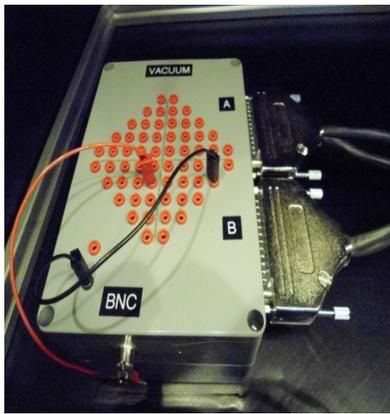


III. Both contacts on back side of the cell

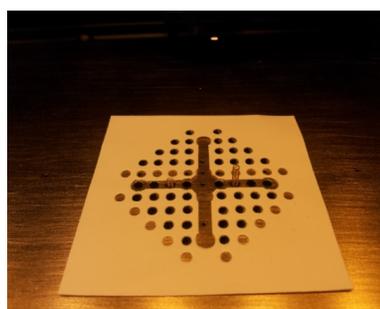
1. Place the gold coated springs in the apertures provided in the chuck.



2. Take out the connections from the same points on the pattern provided on the box.
3. Connect the box to the chuck with -pin connector.



4. Put the insulating mask on the chuck on aperture pattern to avoid shorting of contacts on the cell.

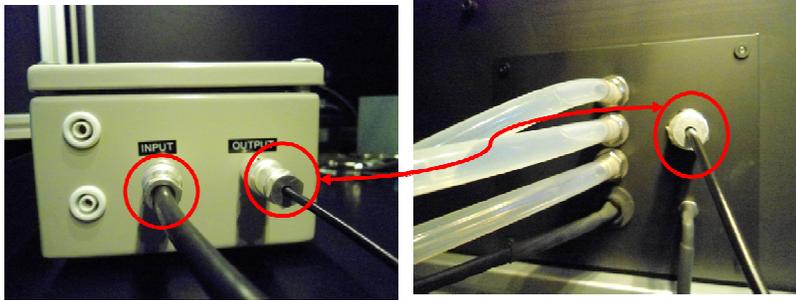


5. Place the cell on the chuck in such a way that the two gold springs put in aperture make contact with the two contacts on the back side of solar cell.

B.2 Based on mode of measurement

I. In transformer mode

1. Connect the output terminal of two-input –one output BNC to input of the transformer.
2. Connect the output of the transformer to the skin of the system box as shown in pictures below.



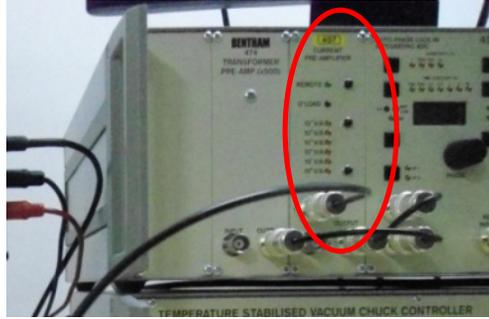
3. Make sure that the cable from the outside of the skin of the box is connected in transformer in detection electronics.



4. Ensure the chopper is ON.
5. Set the frequency of chopper to 590Hz by adjusting the reading on dial to 295.

II. In AC mode

1. Connect the output terminal of two-input –one output BNC to the skin of the box.
2. Connect the cable from the outside of the skin of to the current pre-amplifier unit (497) in detection electronics.



3. Ensure the chopper is ON.
4. Set the frequency of chopper to the desired value by adjusting the reading on dial to 1/2 of the desired frequency.

III. In DC mode

1. Connect the output terminal of two-input –one output BNC to the skin of the box.
2. Connect the cable from the outside of the skin of to the current pre-amplifier unit (497) in detection electronics similar to that in ac mode.
3. Ensure the chopper is off.



4. Confirm that the chopper is off by crosschecking that the REF low LED is glowing.

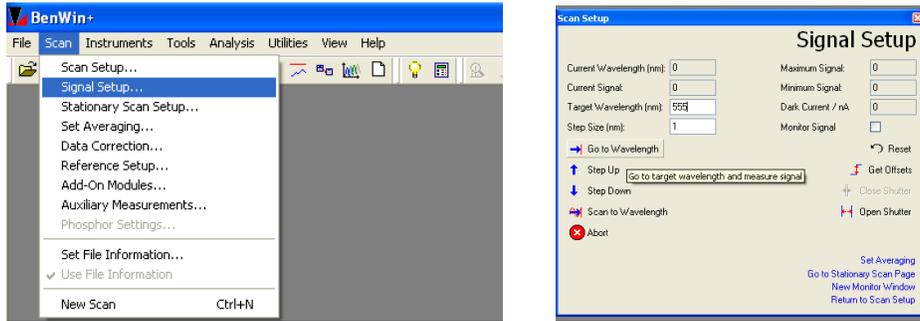
C. Detector Calibration:

1. Connect the output of the Si detector to the input of the transformer unit for transformer mode of measurement and connect the output of the transformer to the skin connection of the assembly.

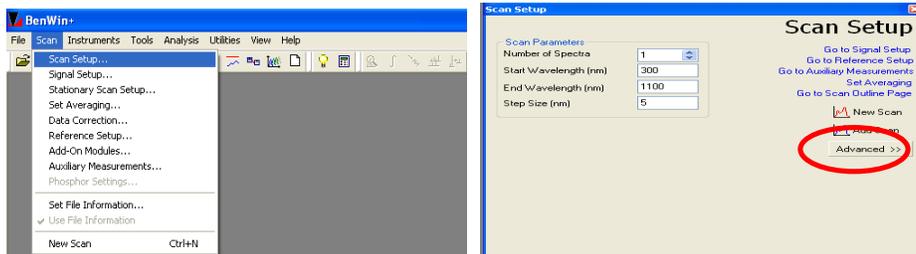
OR

Connect the output of the Si detector to the skin of the box directly for ac/dc mode of measurement.

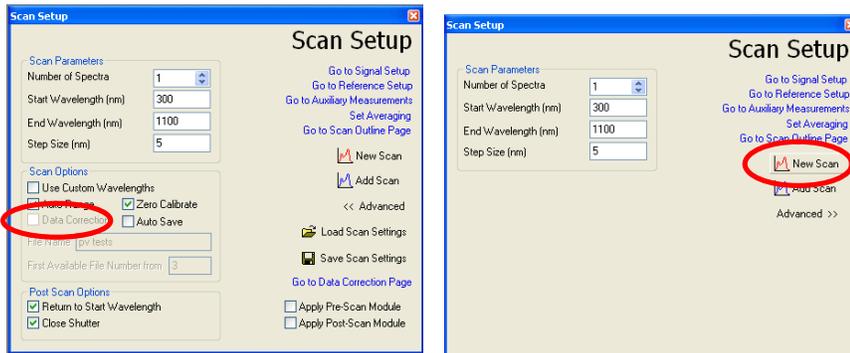
- Go to “Signal Setup..” in Scan menu, enter “Target Wavelength” as 555, which is in visible range and click on “Go to Wavelength”.



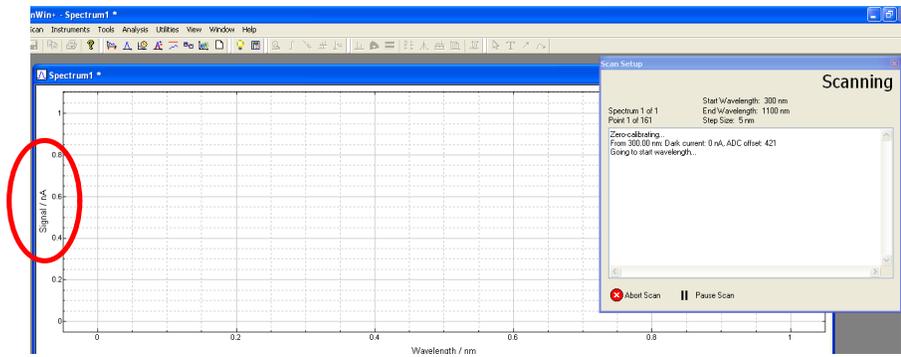
- Focus the beam on the center of reference Si detector.
- Go to “Scan Setup..” in Scan menu, enter the start wavelength as “300” nm and End Wavelength as “1100” nm. Number of spectra “1” and Step Size “5” nm.



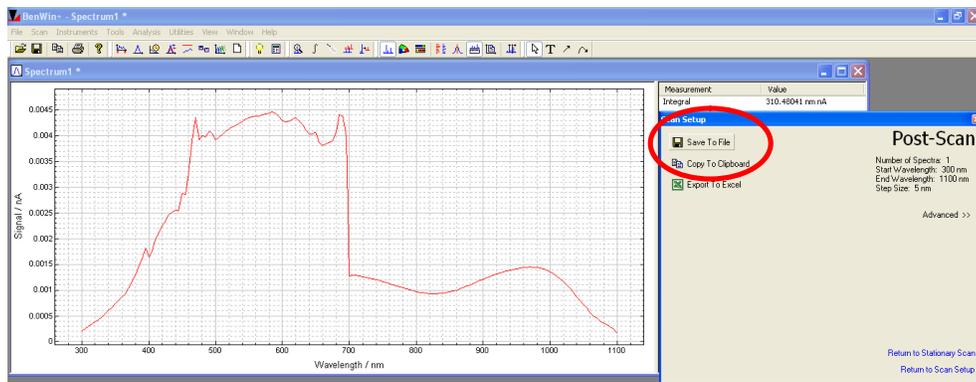
- Click on the “Advanced>>” tab and confirm that the “Data Correction” box is NOT checked and click on “New Scan” tab.



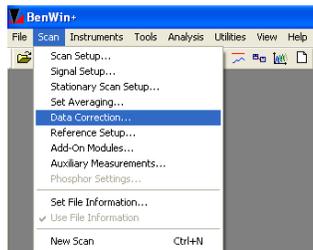
- Scanning will be started, confirm the unit of the raw Signal is “nA”.



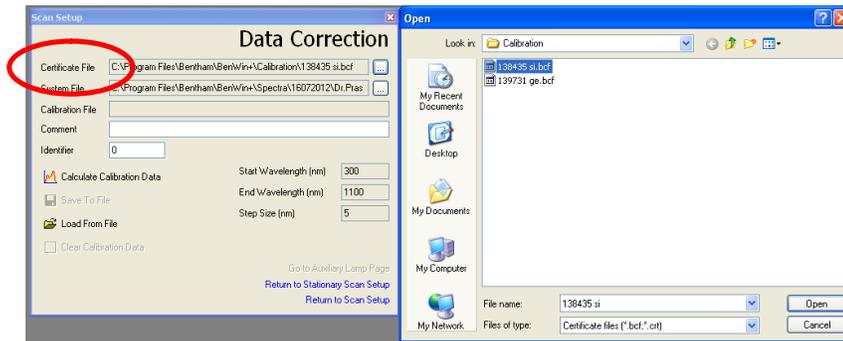
7. Save the raw signal to a file “Si_raw” in the folder spectra by creating new folder with the “ddmmyyyy” as a name.



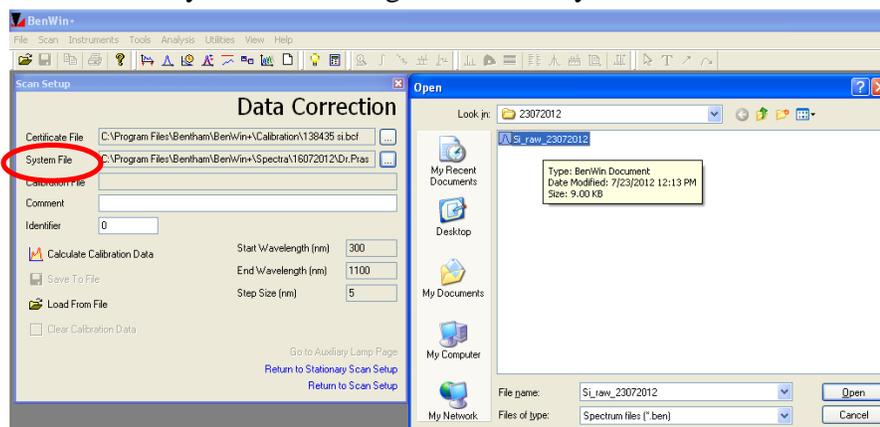
8. Go to “Data Correction..” in the Scan menu.



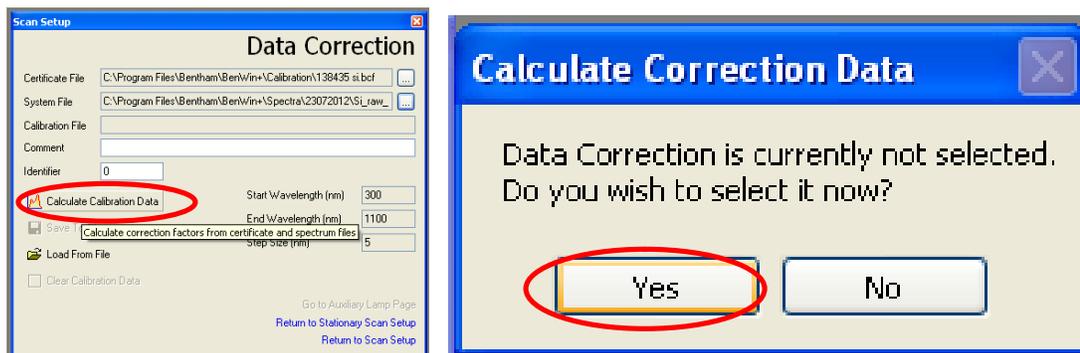
9. Select “138435 si.bcf” as a Certificate File in Data Correction window.



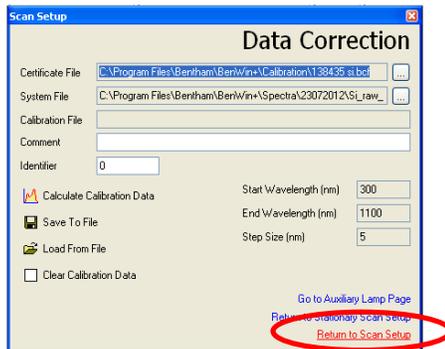
10. Select recently created raw signal file as a System File in Data Correction window.



11. Click on “Calculate Calibration Data” button. A pop up will ask whether the Data Correction to be applied or not. Click on “Yes” to apply data correction in subsequent measurements.



12. Return to scan setup by selecting the link “Return to Scan Setup” in the same “Data Correction” window or by going through Scan menu.

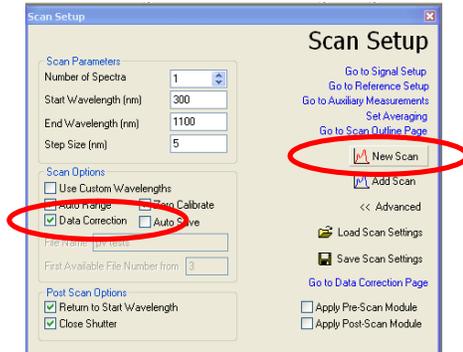


13. Enter the data as follows:
Number of spectra 1
Start Wavelength (nm) 300

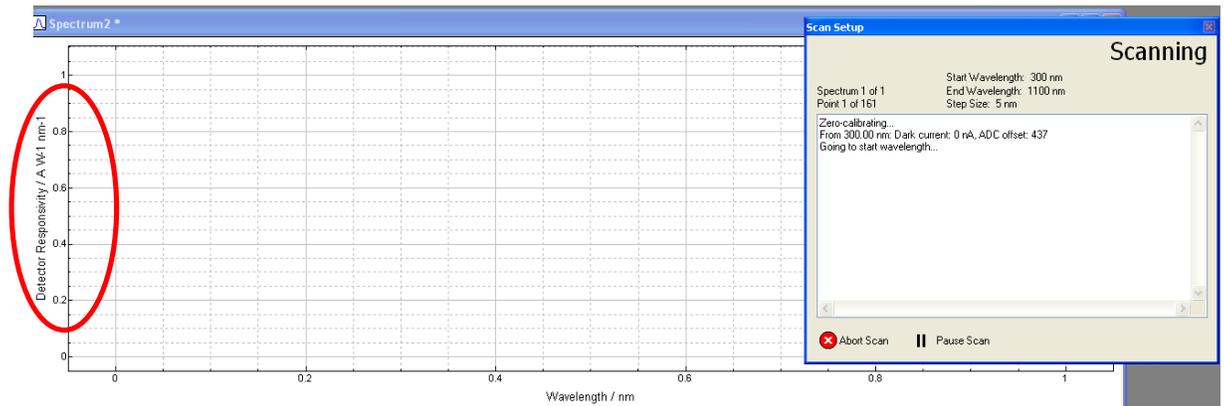
End Wavelength (nm) 1100

Step Size (nm) 5.

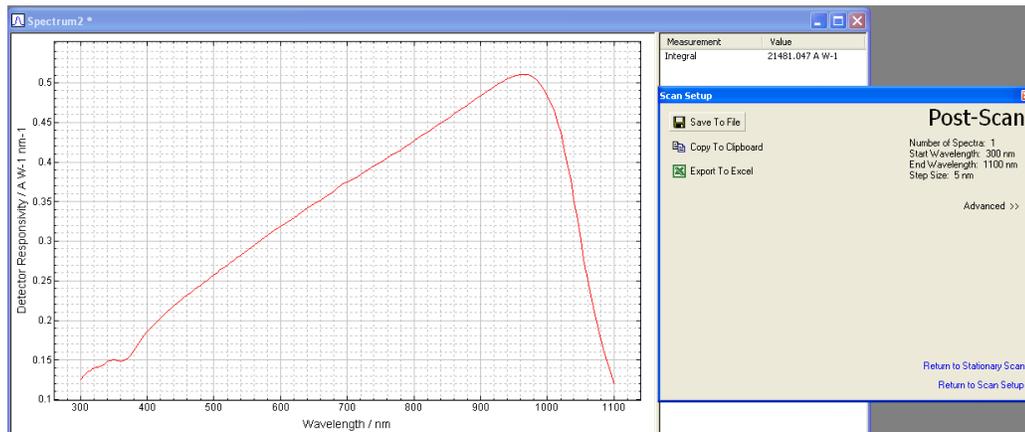
Confirm the Data Correction box is checked now and Click on the “New Scan” button.

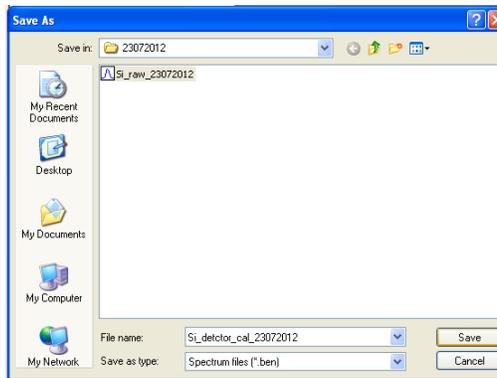


14. Now the scan will start, confirm the Y axis data is Detector responsivity in “ $A \cdot W^{-1}$ nm⁻¹”.



15. After completing the scan save the file to the newly created folder with date as “Si_detector_cal”.



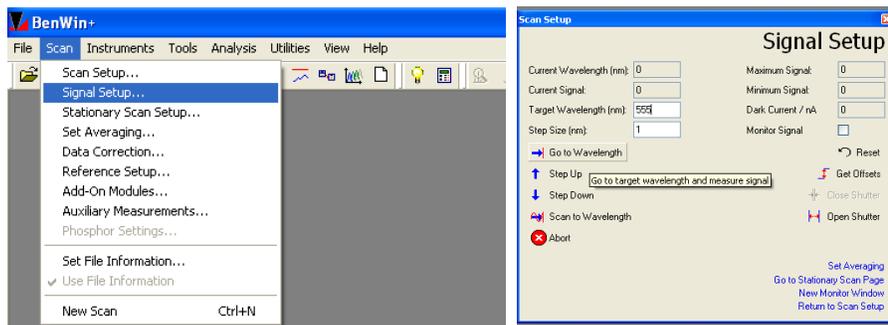


16. Execute similar procedure for detector calibration for Ge detector if measurements are expected in 800-1800nm wavelength range.

D. Measurement of Detector responsivity and external quantum efficiency(EQE)

D.1 In transformer mode

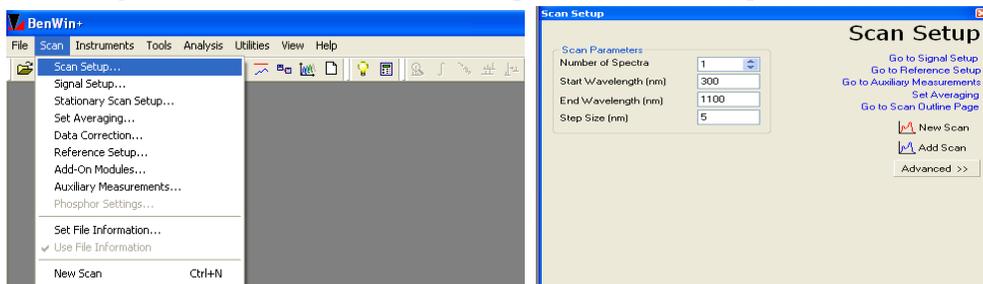
1. After completion of probing, go to “Signal Setup..” in Scan menu, enter “Target Wavelength” as 555 (or any wavelength which is in visible range) and click on “Go to Wavelength”.



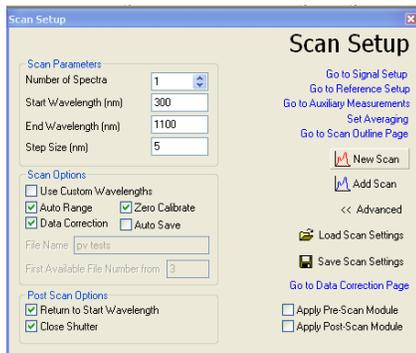
2. Focus the beam on the solar cell such that it is not getting reflected from contacts e.g. from fingers or busbar in silicon solar cell.
3. Execute quick check by ensuring that the value on channel A in the front panel of the 218 display is positive when beam is made incident on solar cell. Else swap the probing connections of the two contacts coming from the solar cell.



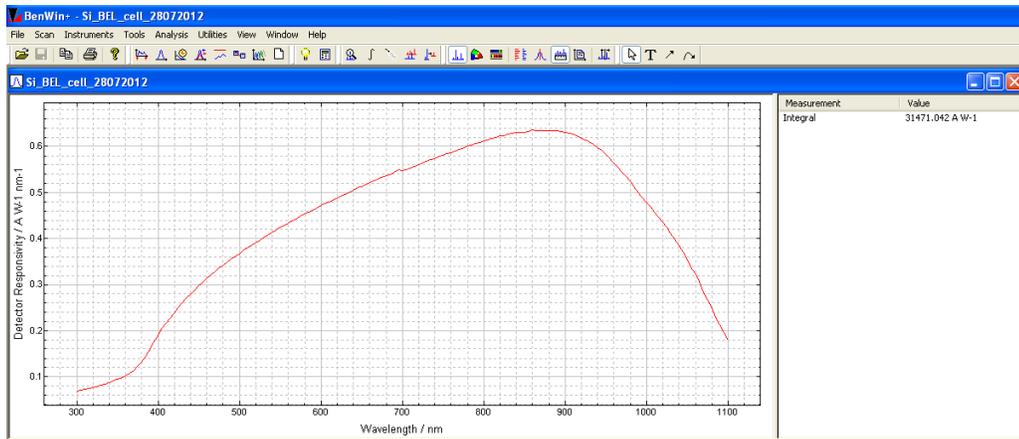
4. Go to “Scan Setup..” in Scan menu, enter the start wavelength as “300” nm and End Wavelength as “1100” nm. Number of spectra “1” and Step Size “5” nm.



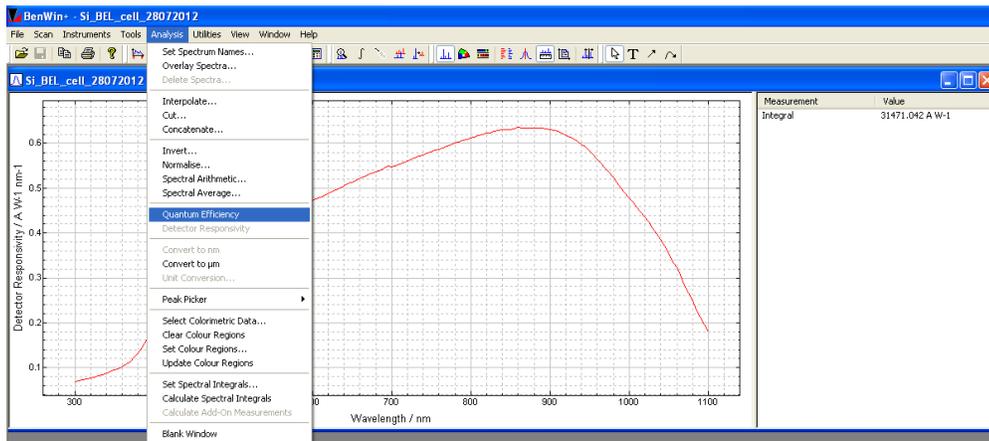
5. Click on the “Advanced>>” tab and confirm that the “Data Correction” box is checked and click on “New Scan” tab to start the scan.



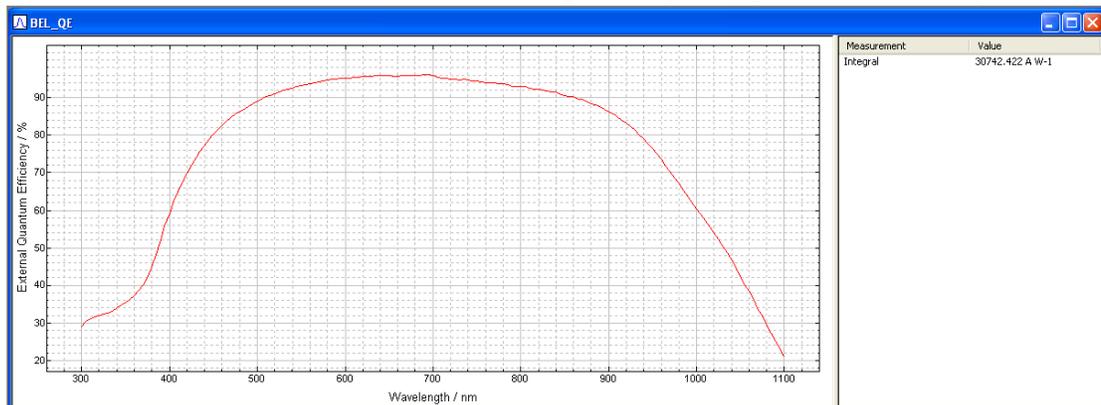
6. After completion of the scan, save the detector responsivity of the solar cell with proper name in your folder with name in ddmmyyyy format.



7. Go to “Quantum Efficiency” in “Analysis” menu, to view the Quantum efficiency curve for the industrial solar cell for which the detector responsivity have been recorded.

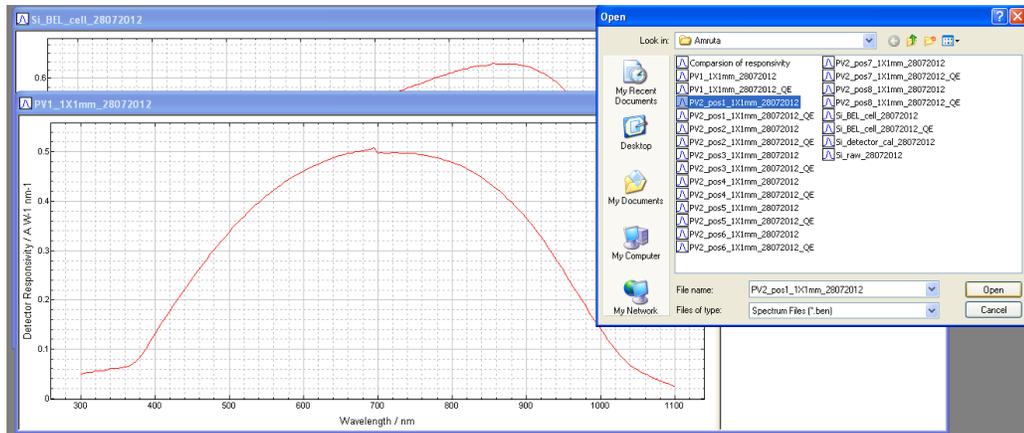


8. Note the difference between the detector responsivity and quantum efficiency curves.

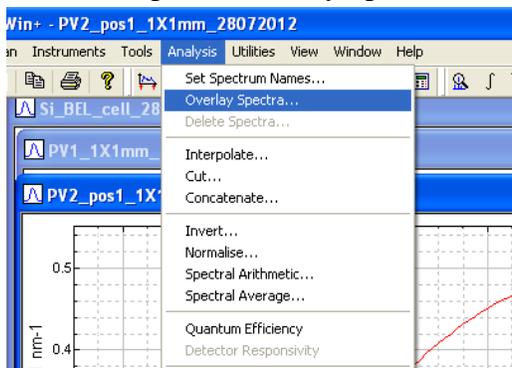


9. Save the Quantum efficiency curve for the solar cell in your folder with name “dd_mm_yyyy”.

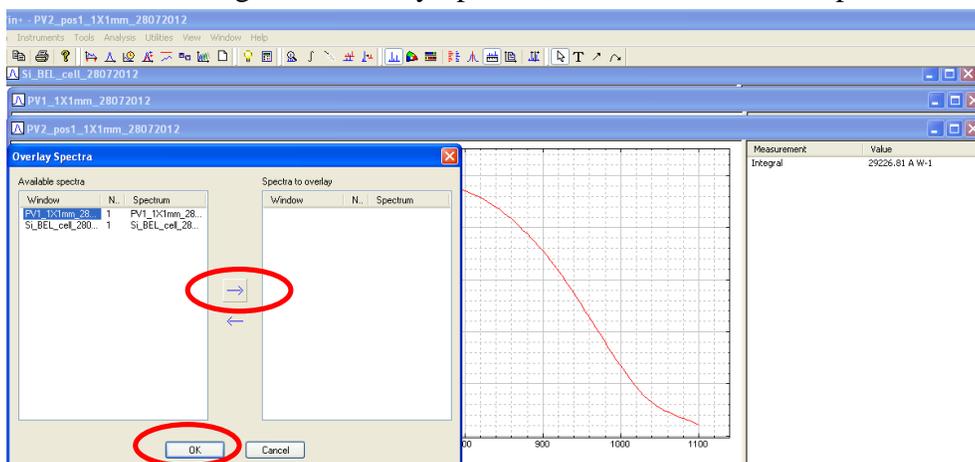
10. Repeat the procedure of detector responsivity measurement, for all the solar cell and save the results accordingly.
11. If the results are to be compared for different samples then after completing the measurements, open both the files having external quantum efficiency curves.



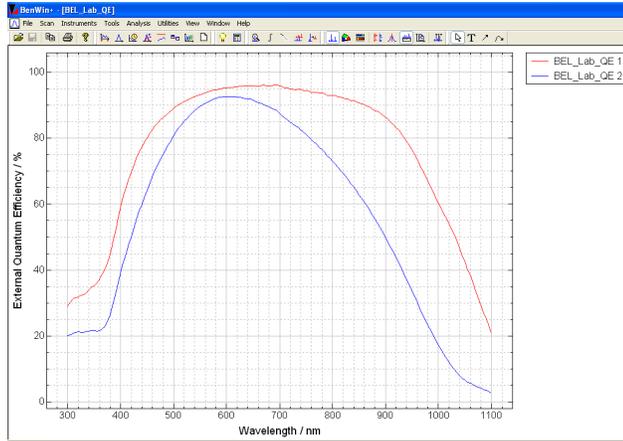
12. Select the option “Overlay Spectra” in “Analysis” menu.



13. Select the spectrum to be overlaid with the selected spectrum using right side pointing arrow, in the dialog box “Overlay Spectra”, which shows list of open files.

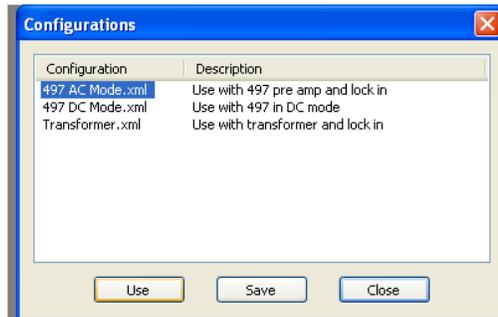


14. Click on Ok to complete the selection. Observe the overlaid spectra corresponding to industrial and in house-lab fabricated solar cells. Save the overlaid spectra in your folder.



D.2 AC mode

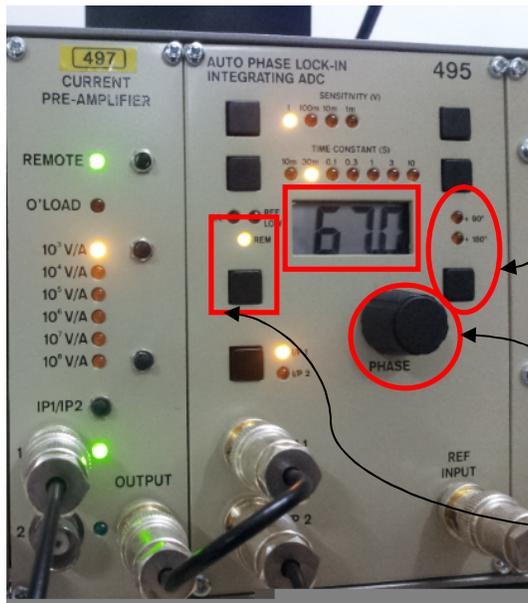
1. Ensure that while starting the software Benwin+, ac mode is selected.



2. Ensure that the connection from the skin of the box is coming to current pre-amplifier unit 497 in detection electronics box and check the chopper frequency on the dial is 1/2 of the desired frequency. (as mentioned in the probing section).
3. Confirm that the detector calibration is done in ac mode.
4. Check the signals coming to A and B channels of the 218 display unit are positive and equal.



5. If both these signals are NOT positive, adjust the phase variable on the Auto Phase Lock In Integrating ADC unit, by pushing the RTL button below the 180° LED.



Adjust the phase to 0°, 90°, 180°, 270° by pushing this RTL button

Get the equal values the signals on A & B channels with this PHASE knob

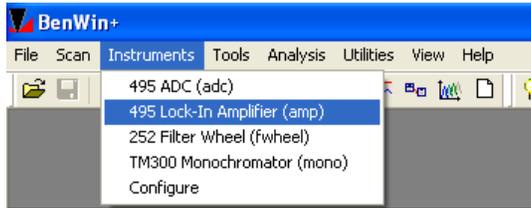
Phase variable adjustment through software by pushing this RTL button to make REM LED glow

If LED against 180° is glowing, it corresponds to phase shift of 180°. If the LED against 90° is glowing then it corresponds to 90° phase shift. If both of them are glowing it is 270° and if none of them are glowing it is 0°. So adjust the phase variable quadrant so that values on both A and B channels are positive.

6. Once the values on both the channels A and B are made positive, ensure that they are equal too. To get this adjust the phase offset visible in the display by using Phase knob on Auto Phase Lock-In Integrating ADC 495 unit. If the REM LED on the 495 is glowing, then the phase offset can NOT be changed from the front panel of the 495

unit, but it can be operated through system software. If user wants to adjust it through front panel, switch OFF the REM LED by pressing the RTL button below it.

- Adjust the phase offset from the computer system (if not adjusted from the front panel of the lock-in amplifier or confirm the adjustments from hardware through software) by going in to “Instruments” menu. Select the 495 Lock-In Amplifier.



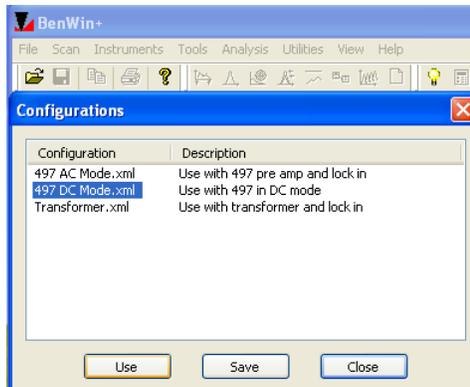
- Enter the proper values of Phase Variable and phase offset and Phase variable so that when “Start” button is clicked the values at Channel 1 and Channel 2 are equal.



- Keep on varying “Phase Variable” until values become equal.
- Once equal values appear on Channel 1 and Channel 2, click on “Apply” to send this settings from software to Lock-In Amplifier hardware unit.
- Ensure the values of Phase Variable and Phase offset in the above Window appear on front Panel of Lock-In Amplifier after clicking on Apply. Also observe that “REM” LED glows when data is sent from computer system to the hardware.
- Follow the normal calibration and measurement procedures mentioned for transformer mode here onwards.
- Repeat the Phase adjustment for each measurement separately and even repeat it for calibration on detector and actual measurement separately too.

D.3 DC mode

- Ensure that while starting the software Benwin+, dc mode is selected.

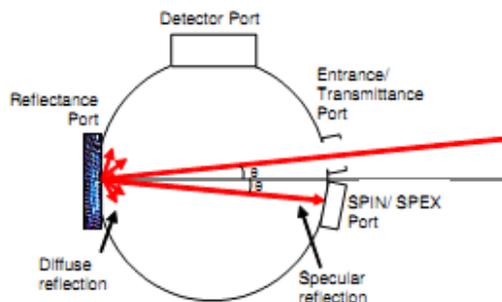


2. Confirm that chopper is OFF and REF Low red LED is glowing on front panel of detection electronics (as mentioned in the probing section).
3. Ensure that the connection from the skin of the box is coming to current pre-amplifier unit 497 in detection electronics box. (as mentioned in the probing section).
4. Check the value on “C” channel of front display unit of 218 when the beam in the desired wavelength range, in which solar cell’s response lies, is made incident on solar cell.
5. Ensure that detector calibration is done in dc mode and follow the same procedure mentioned in the transformer mode.

E. Reflectance/transmittance measurement

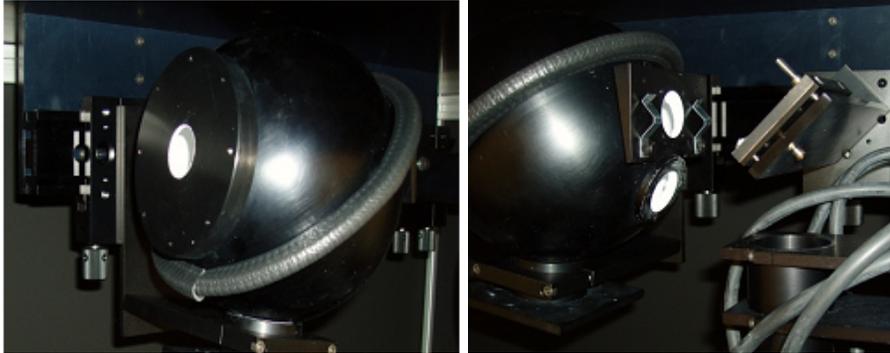
E.1 Hardware Settings:

1. Adjust the position of the integrating sphere and mirror correctly to focus the beam onto the plane of transmittance sample port (at the front end of the integrating sphere) for transmittance measurement and onto the plane of reflectance sample port (at the back end of the integrating sphere) for reflectance measurement.

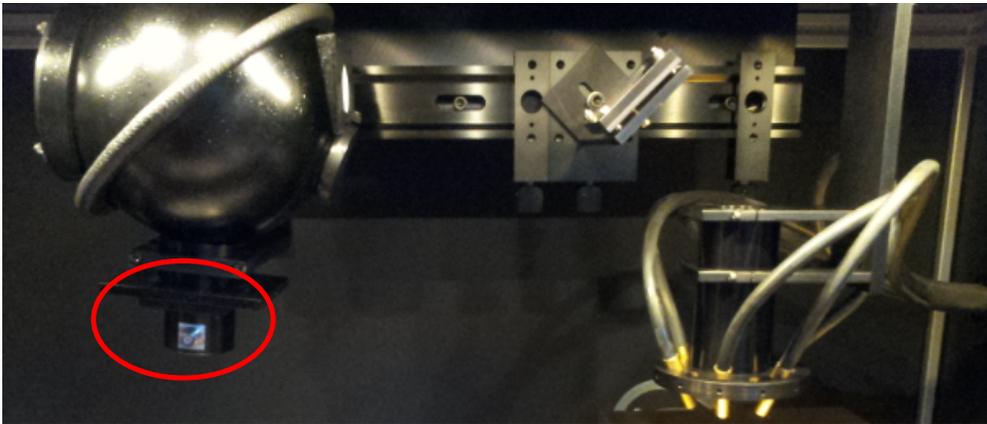


2. Change the position of the mirror against the rightmost stopper so that the beam gets diverted to integrating sphere (i.e. in the horizontal plane) instead of getting incident on the chuck as shown in figure above.

3. Adjust the position of the integrating sphere at the right side of the left most stopper on the optical rail for transmittance measurement or at the left side of the middle stopper during reflectance measurement.

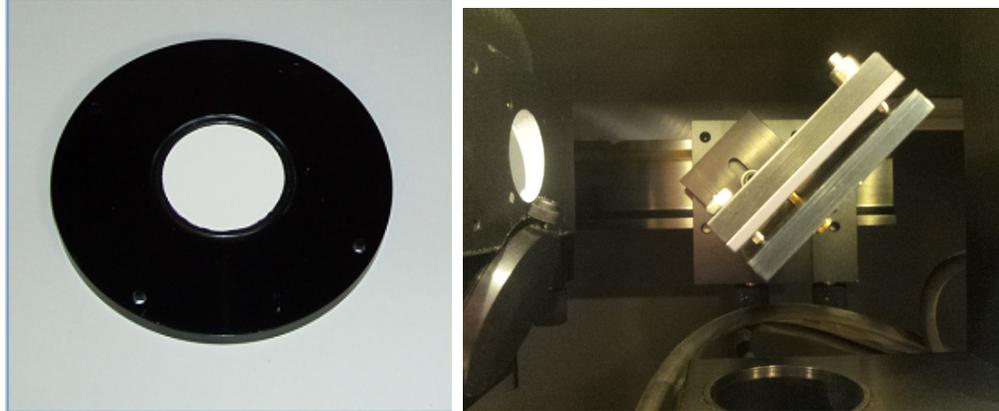


4. Hold the integrating sphere firmly while loosening its screw and while moving it to the desired position. When the sphere is reached the desired position, tighten the screw properly so that angle of integrating sphere is maintained.
5. During both the transmittance and reflectance measurement, execute the calibration against the reference standard.
6. Connect the BNC cable from the reference standard at the bottom of the integrating sphere to the skin of the box and from outside of the box to the 497 current pre-amplifier input.

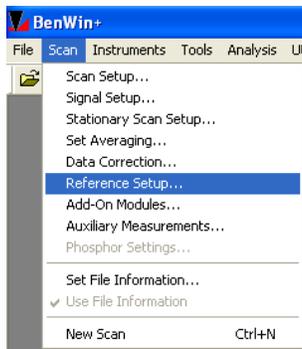


E.2 Transmittance Measurement:

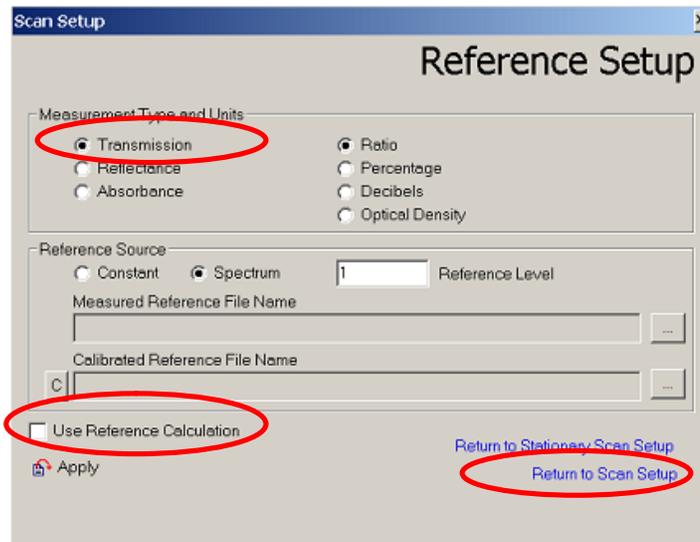
7. During 100% transmittance measurement, place the reflectance port cover (shown in figure below) at the reflectance port and keep the transmittance port unobstructed (as shown in figure below).



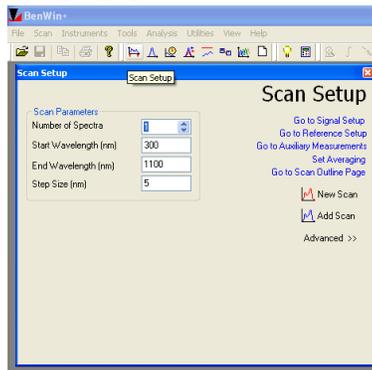
8. Go to “Reference Setup” Window in the Scan Menu or select it from shortcut on toolbar as shown in figure ().



9. Select the Measurement Type and Units as “Transmission” and desired units.
10. During calibration, ensure that “Use Reference Calculation” checkbox is NOT selected.

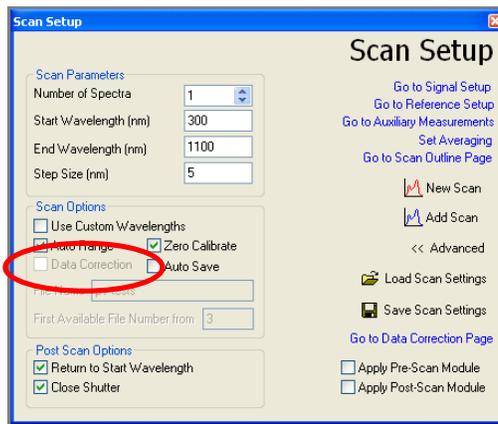


- Go to “Scan Setup” from Scan Menu or from “Return to Scan Setup” on “Reference Setup” page.

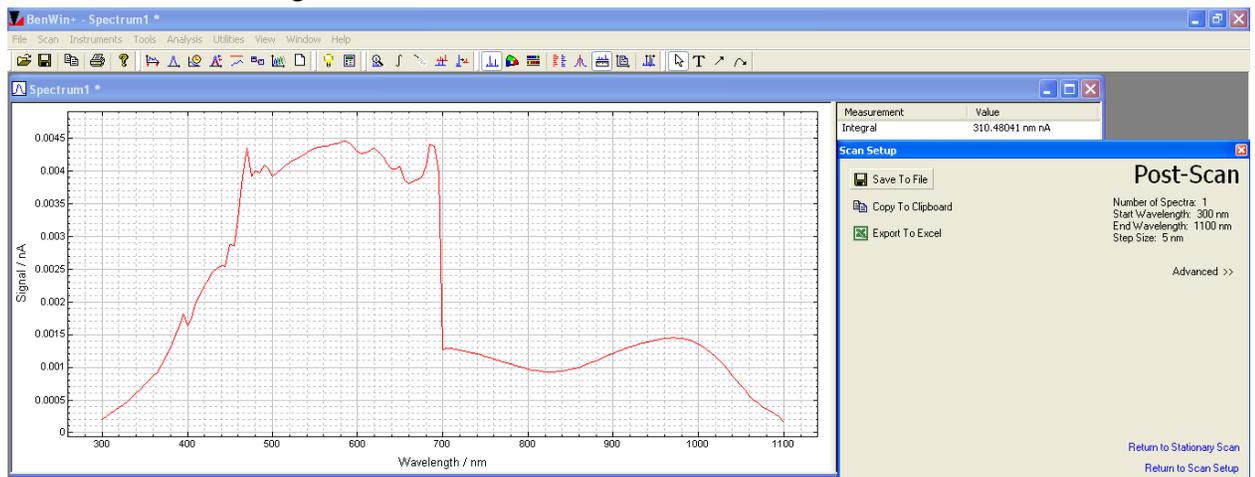


- Enter proper Start Wavelength and End Wavelength as well as Step Size and Number of Spectra.

- Go to Advanced tab to ensure that “Data Correction” checkbox is NOT selected.



- Start “New Scan” and generate the raw data file for 100% transmission.



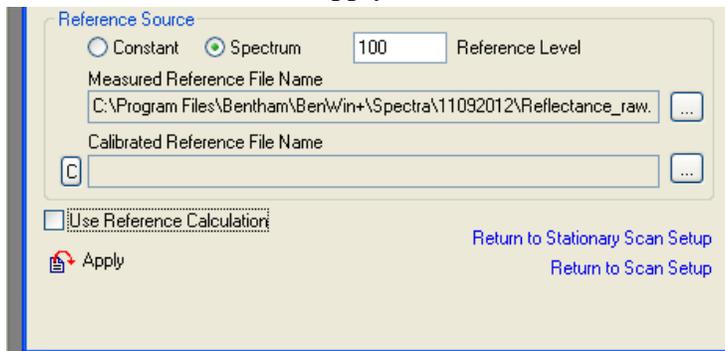
15. Place the sample at transmittance port now with the help of mounting clips, facing the front side of the sample to the beam.



16. Adjust the beam properly on the active area of the solar cell and ensure that it is not falling on the contacts.
17. Use the port reducers for measurements on the solar cells of smaller sizes so that beam light is falling on the cell ONLY and not getting lost in ambient.

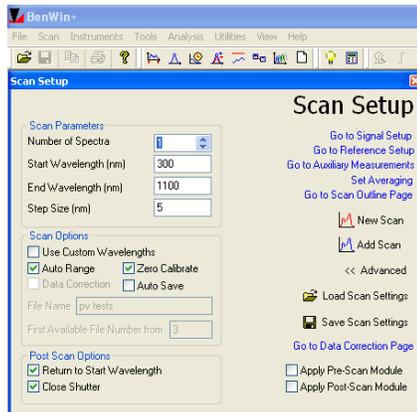


18. Now go to “Reference Setup”. Select the raw file generated for 100% transmission in “Measured Reference file Name” section and select “Use Reference calculation” checkbox and click on “Apply”.



19. Go to “Scan setup” and enter desired wavelength range.

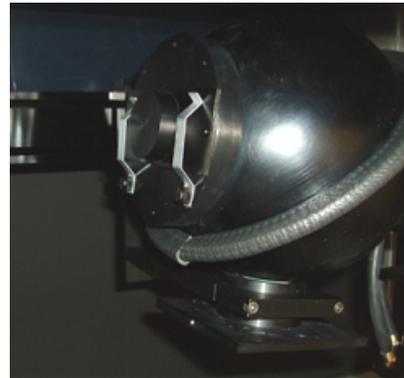
20. Ensure “Data Correction” checkbox is NOT selected and start “New Scan”.



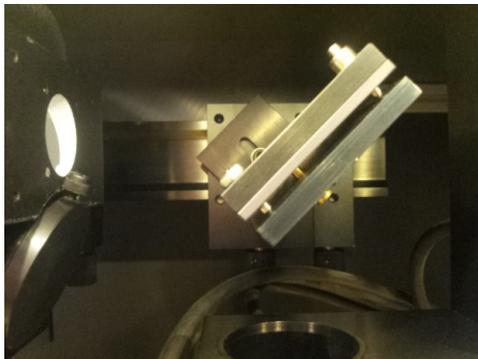
21. Ensure the Y-axis of plot is showing Transmittance data.

E.3 Reflectance Measurement:

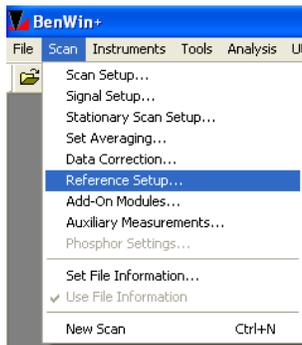
22. During 100% reflectance measurement, place the 100% reflectance standard (shown in figure below) at the reflectance port.



23. Keep the transmittance port unobstructed (as shown in figure below).

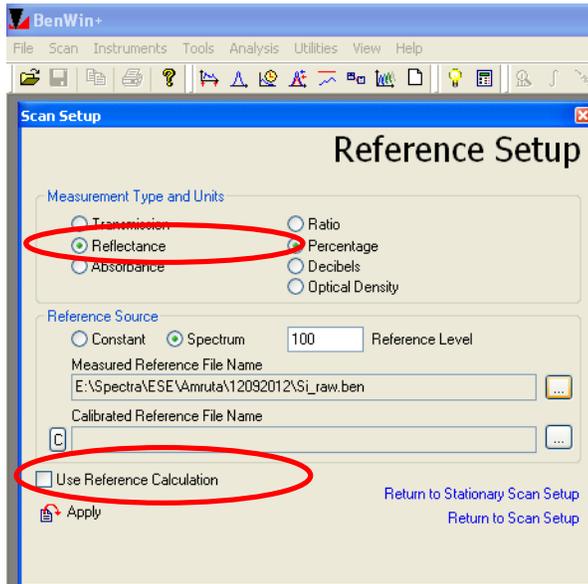


24. Go to “Reference Setup” Window in the Scan Menu or select it from shortcut on toolbar.

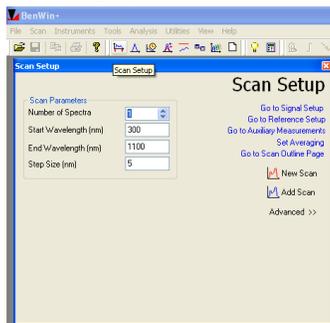


25. Select the Measurement Type and Units as “Reflectance” and appropriate units.

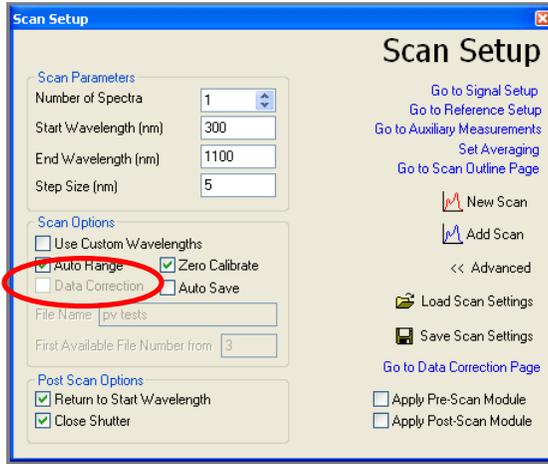
26. During calibration, ensure that “Use Reference Calculation” checkbox is NOT selected.



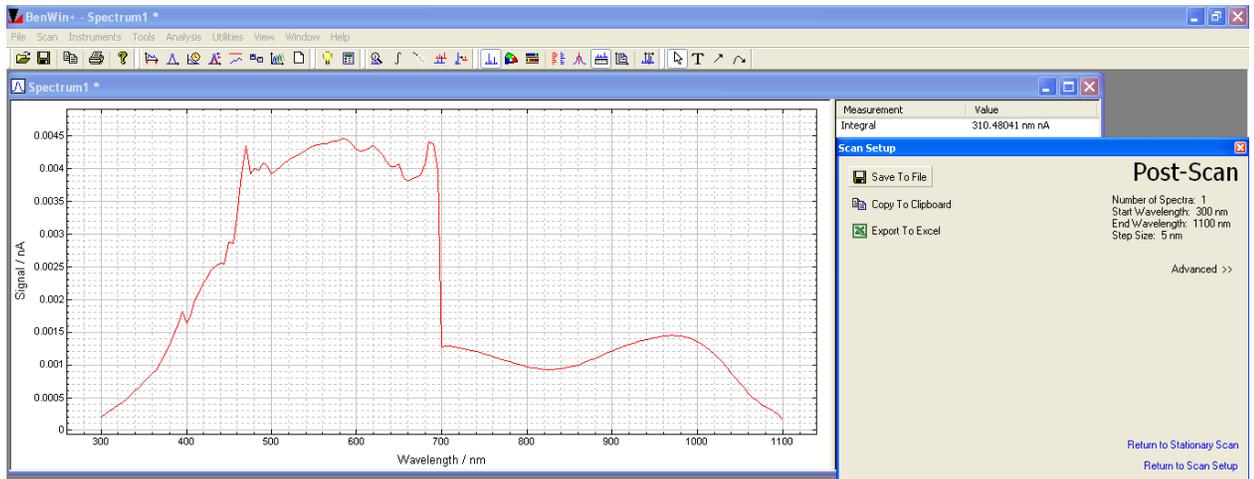
27. Go to “Scan Setup” from Scan Menu or from “Return to Scan Setup” on “Reference Setup” page.



28. Enter proper Start Wavelength and End Wavelength as well as Step Size and Number of Spectra.
29. Go to Advanced tab to ensure that “Data Correction” checkbox is NOT selected.



30. Start “New Scan” and generate the raw data file for 100% reflectance.



31. Place the sample at reflectance port now with the help of mounting clips, facing the front side of the sample to the beam.



32. Adjust the beam properly on the active area of the solar cell and ensure that it is not falling on the contacts with the help of port viewer



33. Use the port reducers for measurements on the solar cells of smaller sizes so that beam light is falling on the cell ONLY and not getting lost in ambient as shown in figure ().



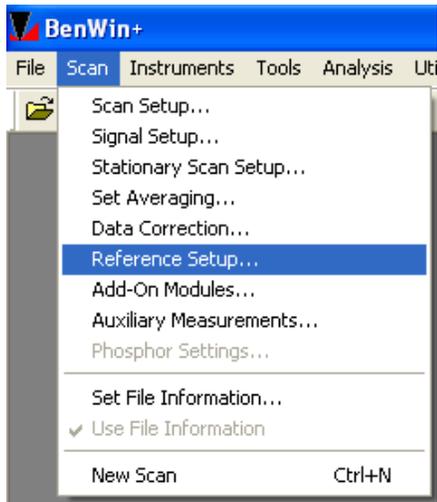
34. Use appropriate light trap at SPIN/SPEX port of the integrating sphere to differentiate between specular inclusive (SPIN-total) reflectance and specular exclusive (SPEX – direct) reflectance measurement.
35. Place the white plate like light trap for SPIN reflectance measurement.



36. Place black cone like light trap for SPEX reflectance measurement.

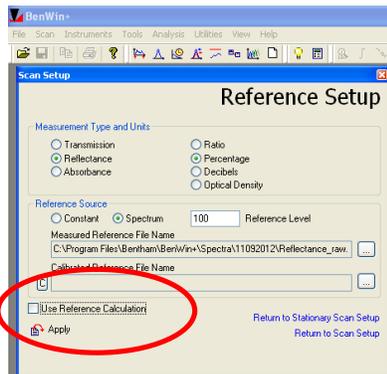


37. Now go to “Reference Setup”.

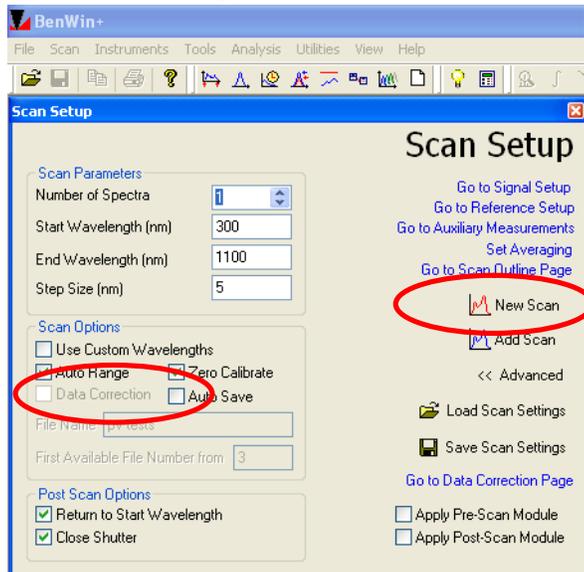


38. Select the raw file generated for 100% reflectance standard in “Measured Reference file Name” section.

39. Select “Use Reference calculation” checkbox and click on “Apply”.

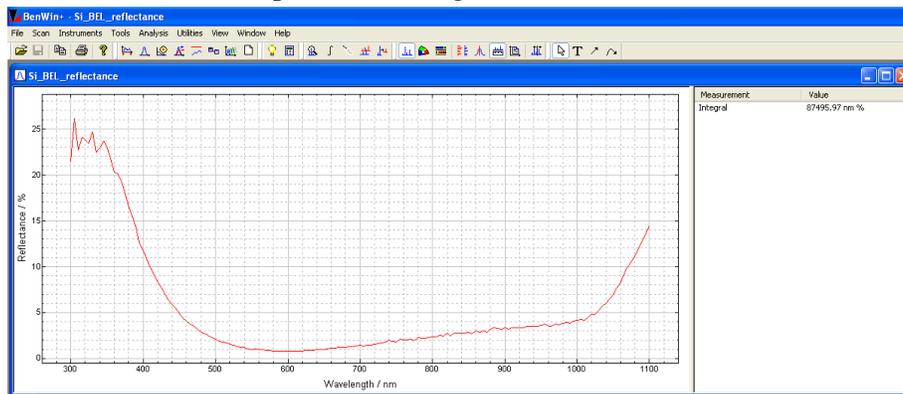


40. Go to “Scan setup” and enter desired wavelength range.



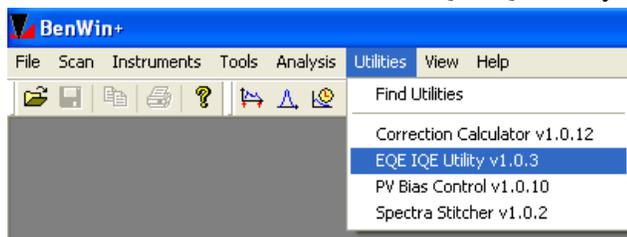
41. Ensure “Data Correction” checkbox is NOT selected and start “New Scan”.

42. Ensure the Y-axis of plot is showing Reflectance data.

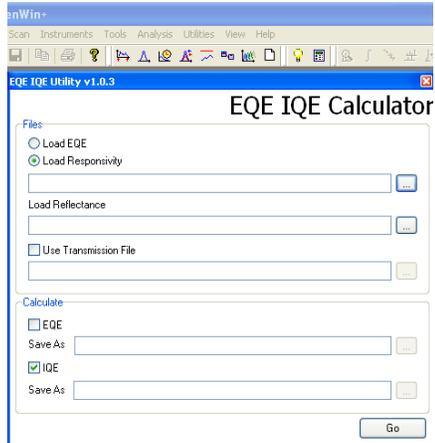


F. Internal Quantum efficiency (IQE) measurement

1. Using the Benwin+ software, find the internal quantum efficiency (IQE) using Detector responsivity/EQE file and reflectance file.
2. Go to “Utilities” menu, select “EQE IQE utility v1.0.3”.



3. Load either the responsivity/EQE curve, by checking proper option in EQE IQE calculator dialog box.



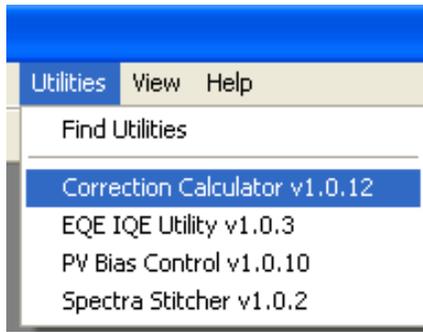
4. Browse the saved responsivity/QE file and reflectance and/or transmittance files in the “Files” option and tick the IQE check box in “Calculate” option.
5. Save the IQE curve file with proper naming convention in your folder.

G. Double calibration of detectors from 300-1800nm

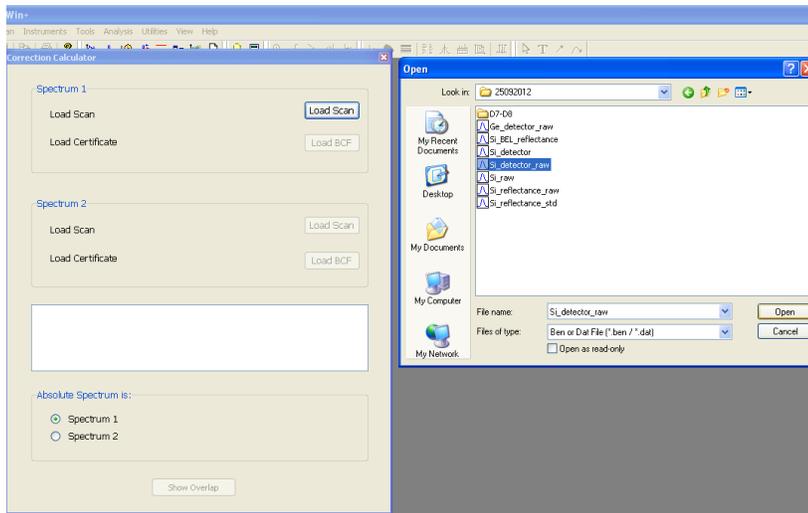
1. Use the detector calibration procedure (Step 1 to 7) mentioned in section (C) with Si detector.
2. Replace the Si detector with Ge detector and repeat the same procedure Step 1 to 7 mentioned in section (C).



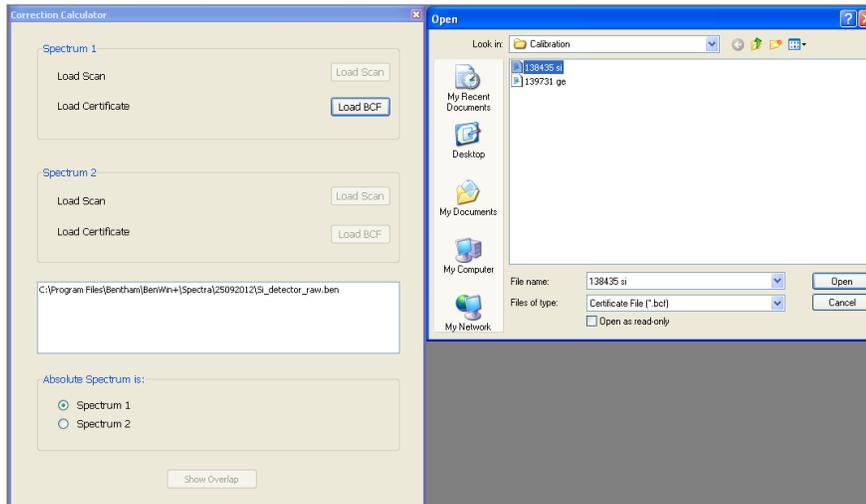
3. Go to “Correction Calculator” in “Utilities” menu.



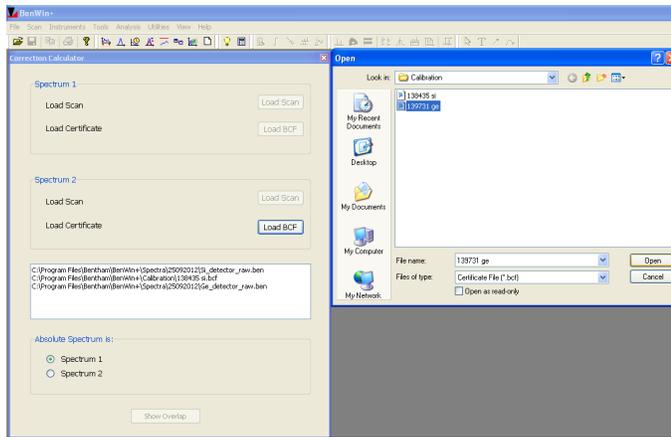
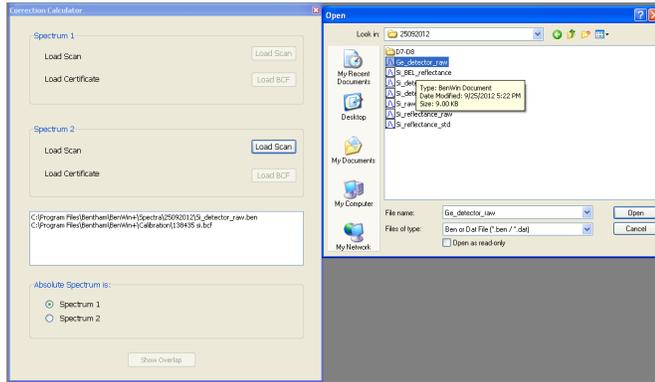
4. Load the raw file generated for Si detector in step in the Spectrum 1 section of window below using “Load Scan”.



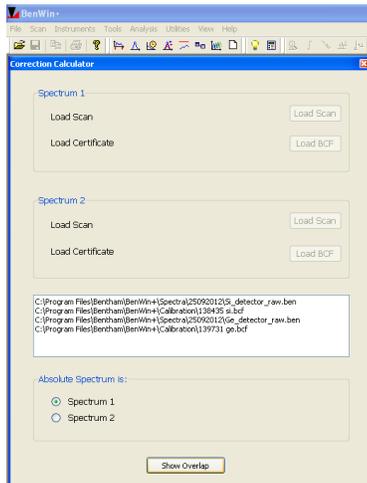
5. Load certificate file for Si detector from Calibration folder using “Load Certificate” in “Spectrum1” section.



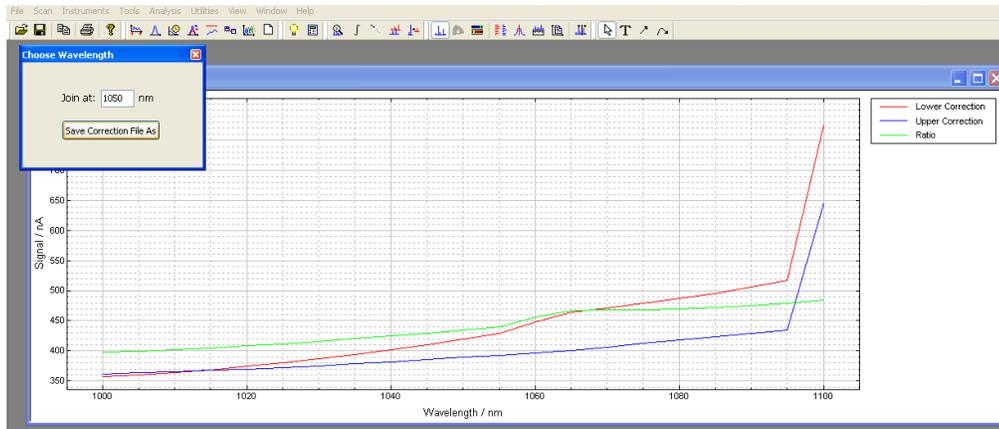
- Repeat the same procedure with Ge detector raw file generated in Step (2) and Ge detector certificate file from Calibration folder in “Spectrum 2” section.



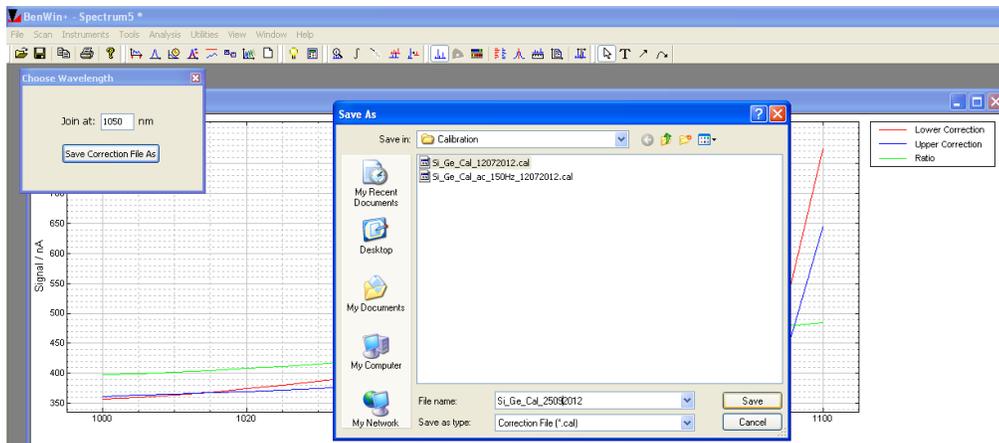
- To generate calibration file for 300-1800 wavelength range, select either Si or Ge detector spectrum as Absolute one (with respect to which other will be calibrated) using Spectrum 1 or Spectrum 2 radio button from “Absolute spectrum” section.
- Check for the overlap by clicking on the “Show Overlap” button.



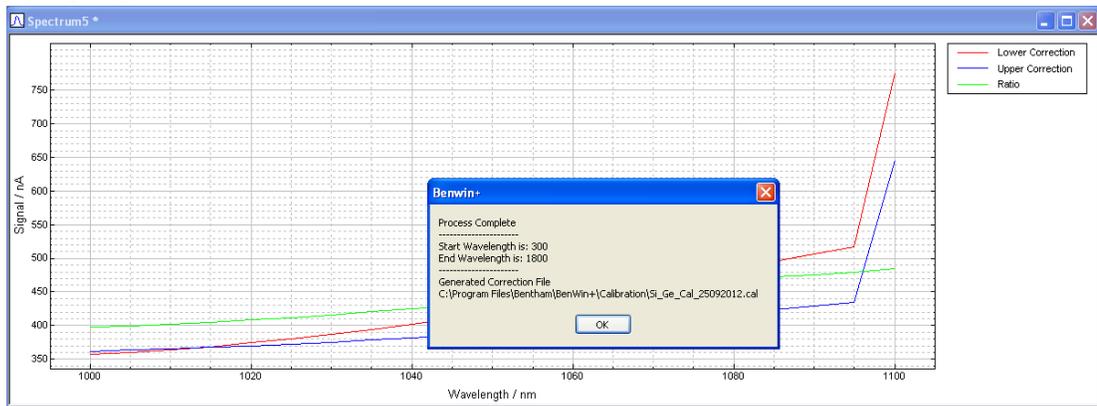
9. Since the Si detector spectrum can be generated from 300-1100nm and Ge detector spectrum from 800-1800nm, it prompts for Joining point in Overlapping wavelength range. Enter appropriate value of wavelength where two spectra will be joined.

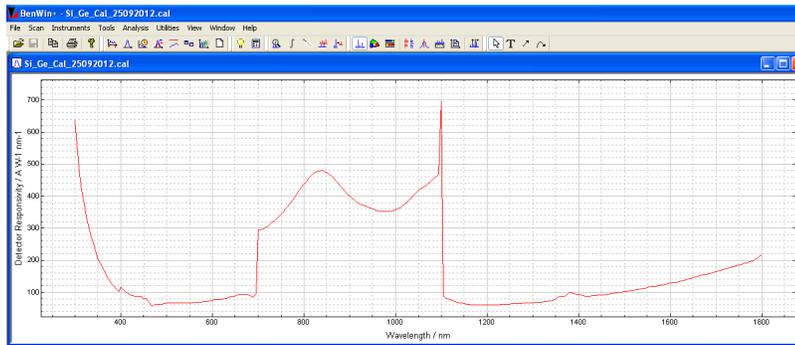


10. Save Calibration file with proper name so that it can be used for any measurement here onwards within 300-1800nm range.

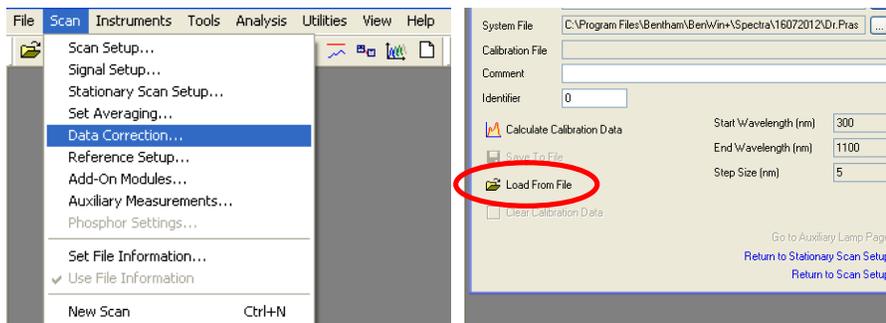


14. Make note of destination folder of Calibration file generated from the below prompting window:





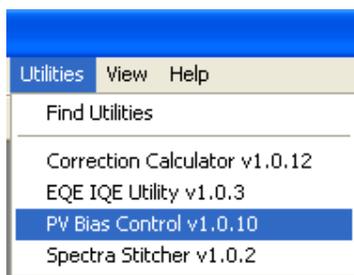
- Go to “Data Correction” in Scan Menu for data calibration and instead of entering certificate file, load the calibration file generated above using “Load from file” button.



- Enter the raw file in System file similar to normal detector calibration step.
- Click on “Calculate Calibration Data” in the data correction window to complete the data calibration within 300-1800 nm range.
- Use the normal procedure for EQE in section (D) to proceed with regular measurements within 300-1800nm range.

H. Measurement under bias light

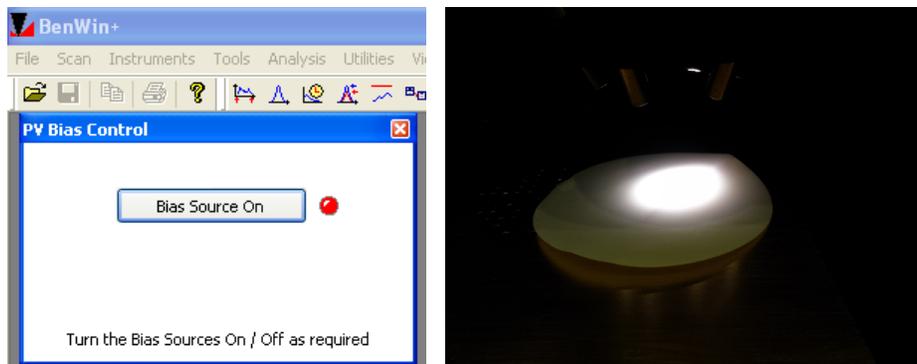
- Ensure that the probing is done either for “Transformer Mode” or “AC mode”.
- Go to “Utilities” menu and select “PV Bias Control”.



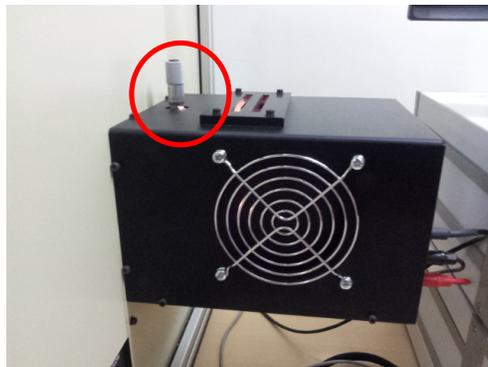
3. Ensure that the constant current power supply is ON for the Bias light Source (3rd unit under the table).



4. Click on “Bias Source ON” to open the shutter of PV bias lamp to PVE300 system unit and observe the white bias light on the chuck.



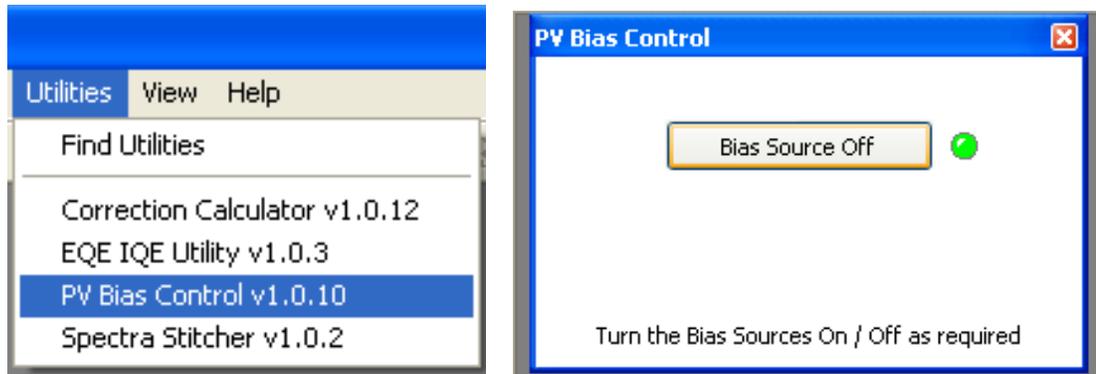
5. Follow the standard calibration and measurement procedures (transformer/ac mode) mentioned in the sections above in presence of the bias light.
6. Vary the intensity of the white bias light by moving the micrometer shown in the figure below:



7. Note down the reading on vertical and circular scale of micrometer screw gauge, to ensure every-time measurements are carried out under similar intensity conditions.
8. Observe the lock-in amplifier during the measurements under light bias. Ensure the intensity is within desired limits by monitoring lock-In amplifier front panel. If front

panel of Lock-In amplifier shows overload, lower the intensity of bias light and repeat the measurements.

9. Switch off the Bias light when measurements are NOT to be done under bias light by going to “Utilities/PV Bias Control” and clicking on “Bias Source off”.



10. For calibration of intensity, refer to the Appendix named “Queries to Bentham”.
11. Insert the Class B filter available to do the measurements under more real operating conditions.

Note:

For multi-junction solar cell measurement, appropriate filters have to be bought. Refer to the Video of Standard Operating procedures.

I. Temperature control of chuck

1. Switch ON the Bentham VC-TE-20 unit with the switch on the backside of it. Ensure the unit is ON by checking whether the green power LED is glowing.



2. Use the toggle switch below temperature display to check Present value of Chuck by the toggling it at CHUCK side and check the set value by moving it to TARGET side.

3. Set the chuck temperature to the desired TARGET value by using the black/red knob button below the CHUCK/TARGET toggle switch.
4. Pull the black dial of the knob button outside and move it clockwise/anticlockwise to set the chuck to TARGET value which will be displayed on the TEMPERATURE display, when toggle switch is in TARGET position.
5. Once desired TARGET temperature is set for the chuck, Move the toggle switch to CHUCK side, to monitor present value of the chuck.
6. Use Water flow & Cooler switches to start water circulation and to maintain the temperature of the chuck at the desired value.



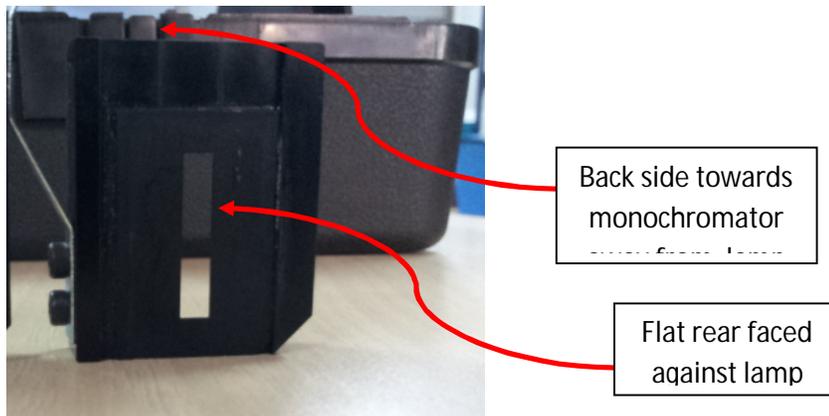
7. Ensure that the room temperature is maintained correctly if chuck temperature is set to the values smaller than 25°C. If chuck temperature is quite below the room temperature, moisture may get condensed on the chuck in humid atmosphere and water can drip on the chuck. Be careful while setting lower temperatures.
8. Switch ON the Vacuum supply by using the switch on the VC-TE-20 unit when sample is required to be held with vacuum.

J. Changing the slits

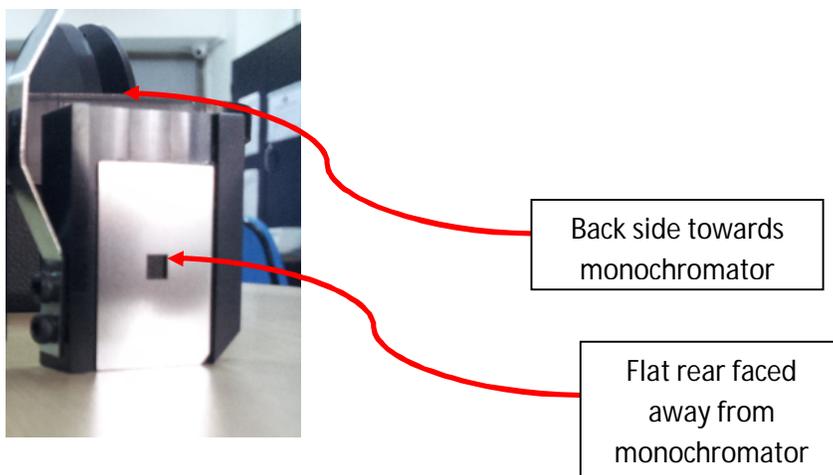
1. Do NOT remove/change the slits without prior permission of System Owner (SO). Special request has to be sent justifying change of slits before changing the slits and once the requested is granted by SO, following procedure is to be performed with critical care.
2. Identify the pair of slits required for your measurement from the table below:

Entrance Slits (mm)	Bandwidth produced (nm)	Exit slits (mm)
0.74	2	0.74X0.74
1.85	5	1.85X1.85
		1.5X1.5
		1.5X5
		1.85X3.7
3.7	10	3.7X3.7
		4.2X4.2

3. Remove the fixed slit cover with M3 allen key.
4. Using the pincers, pull out slit is place.
5. Mark the slits which were in use and put them back in the assembly after completion of your measurement procedure.
6. Place the slit in the holder such that if you look at a slit and its construction then you can see there is a metal U shape that has the slit plate glued onto it. This slit plate is away from the monochromator.
7. Push fixed slit down firmly into the place.
8. Ensure that slit orientation is correct; otherwise it can lead to wavelength error.
9. Entrance slits configuration:



10. Exit slit configuration



K. Cleaning Procedure:

1. Clean all the units: monochromator, lamp, power supplies, detection electronics box and computer system with the dry lint free cloth.
2. Clean the optical units such as integrating sphere, transmittance/reflectance sample ports, optical rail with dry lint free cloth.
3. Do NOT touch mirror in PVE300 unit with bare hands. Wear hand gloves while cleaning optical units and blower for removing dust particles from mirror.
4. Use small amount of IPA, to clean the floor PVE300 system box and the chuck (if required). Do NOT pour IPA in any case, directly on any of the parts, it can damage the system. Just wet the cloth and use it for box floor and chuck cleaning ONLY.
5. Ensure that the water in the transparent reservoir of temperature controller unit is never dried. Fill it time to time, if it seems to be evaporated. Use DI water.
6. Start the temperature controller unit and with the switch on the backside of the VC-TE-20 unit.
7. Switch ON the water flow with the Switch besides flow pipes so that there is water circulation for some time (1-2minutes).



8. Switch OFF the unit with the switch from the back.

SOP Prepared By- System Owner: Amruta Pravin Joshi
Faculty In-charge: Prof. K. L. Narsimhan