

**Horiba Jobin-Yvon
LabRAM Aramis - Raman Spectrometer**

The Aramis Raman system is a software selectable multi-wavelength Raman system with mapping capabilities with a 400mm monochromator and CCD detector. Mapping is possible through a motorized stage for mapping with “autofocus” and DuoScan laser rastering for mapping within the objective field of view.

System specs:

Lasers: 325nm, 532nm, 633nm, and 785nm

Gratings: 300g/mm, 600g/mm, 1800g/mm, 2400g/mm

Objective lens: 10x, 50x, 100x, 40x (for UV work)

The Raman scattering technique is a vibrational molecular spectroscopy which derives from an inelastic light scattering process. With Raman spectroscopy, a laser photon is scattered by a sample molecule and loses (or gains) energy during the process. The amount of energy lost is seen as a change in energy (wavelength) of the irradiating photon. This energy loss is characteristic for a particular bond in the molecule. Raman can best be thought of as producing a precise spectral fingerprint, unique to a molecule or indeed and individual molecular structure.

Safety

Laser emission – The user must be aware of laser emission from the Aramis system at all times. The system is safety interlocked to prevent laser emission while the microscope stage doors are open. Anyone caught defeating this safety interlock will have access to this system revoked.

CLASS 1 LASER PRODUCT

The LabRAM ARAMIS operates with laser sources emitting visible or invisible continuous laser radiation typically below 300 mW. The LabRAM ARAMIS is a fully enclosed instrument providing no access to the laser beam. Safety switches placed on the doors of the instrument turn the laser off instantly when opened, and allow the user to operate the instrument safely.

DANGER! Do not remove the covers of the instrument. Do not modify the instrument.

Moving Components - The User must observe caution when loading and unloading samples from the sample stage. The X and Y position are only to be moved by joystick control. Manual stage movement will damage the X and Y motors. Course focusing can be performed by using the left side focus knob (located on the left side below the sample stage), fine focus should be accomplished by using the joystick control.

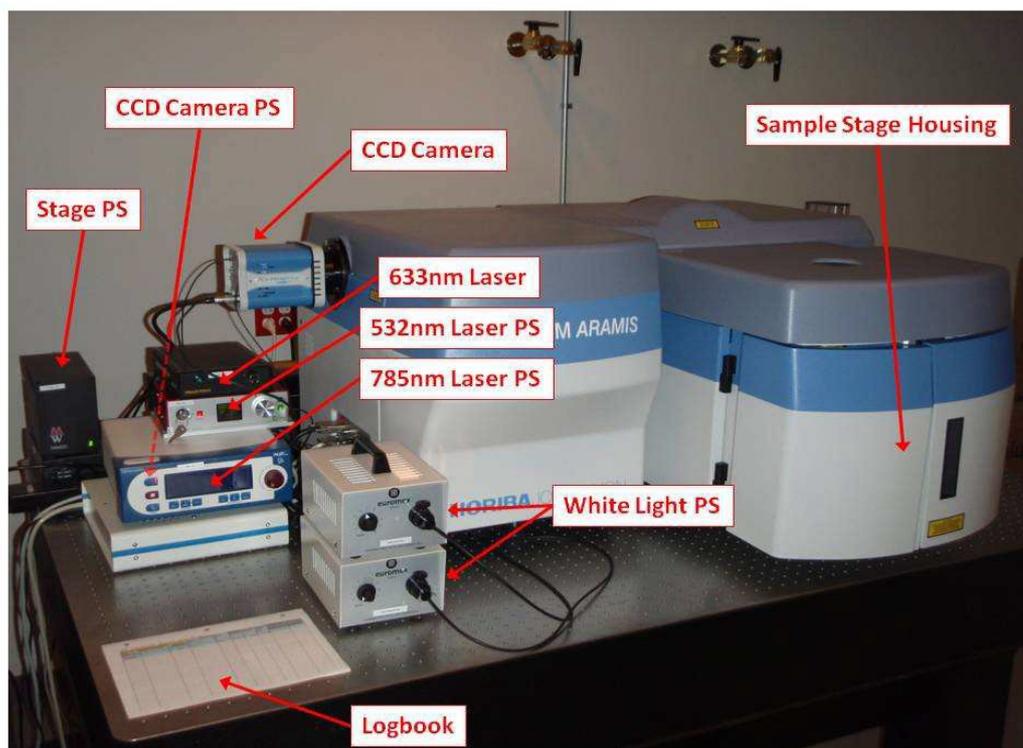
1.0 Pre-Operation

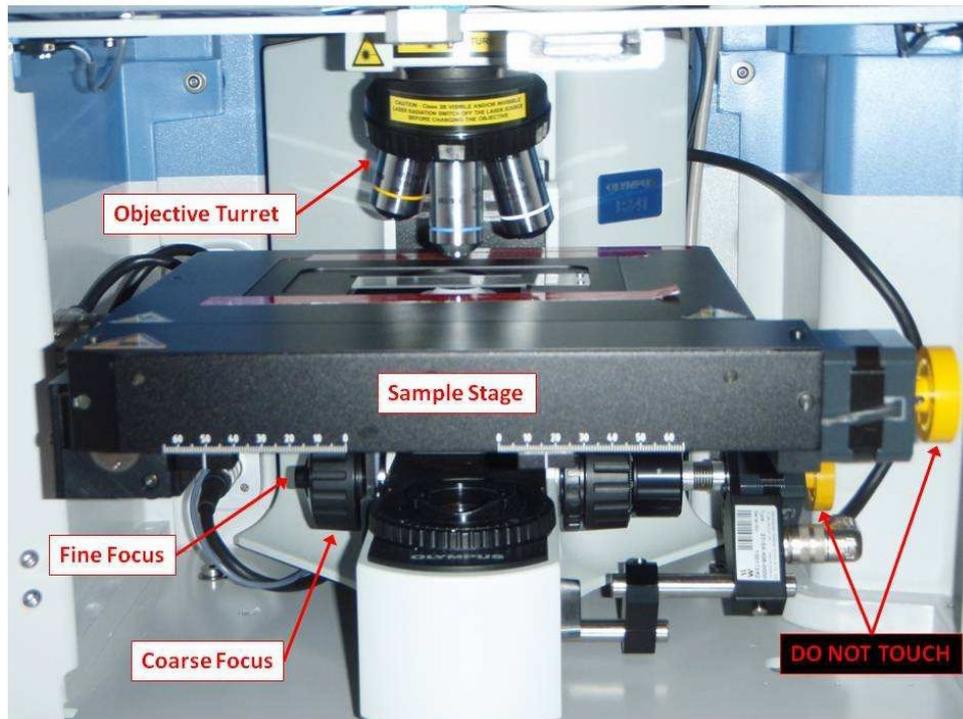
1.1 Tool Reservations may be made via the IAC Page.

1.2 Change gloves. **WARNING** No solvents or liquids are allowed near the machine, change your gloves before operation!!

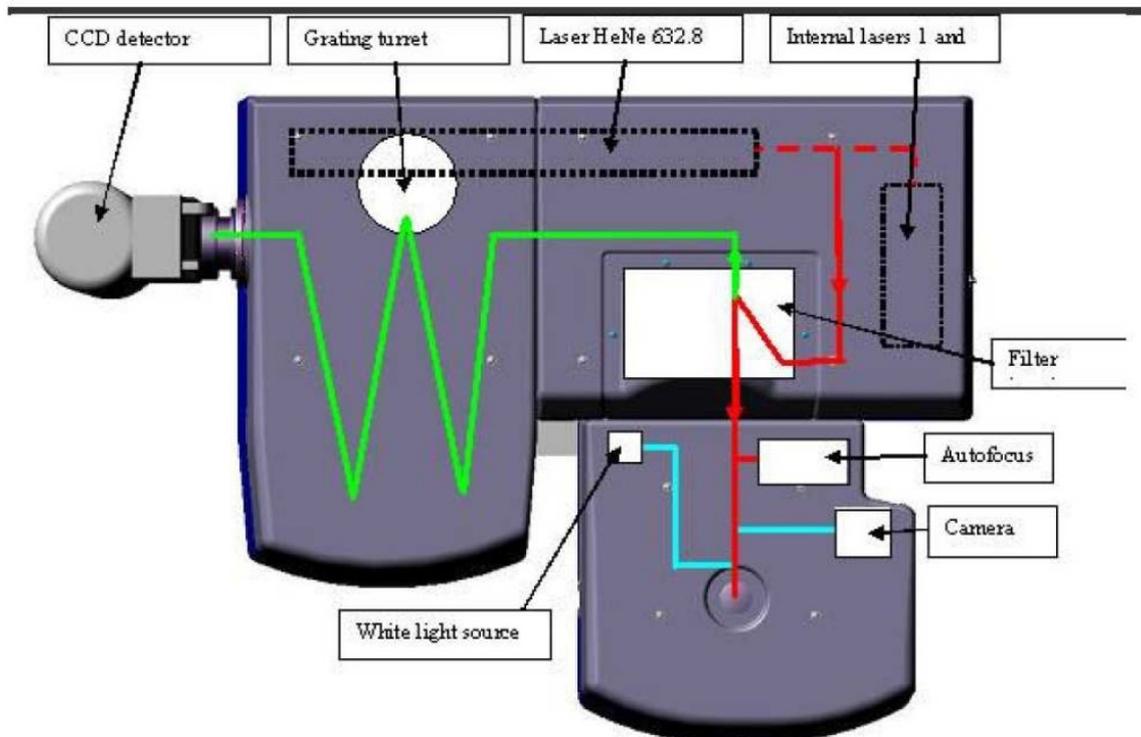
1.3 Log into the tool by using the login control system.

2.0 Hardware Overview Images





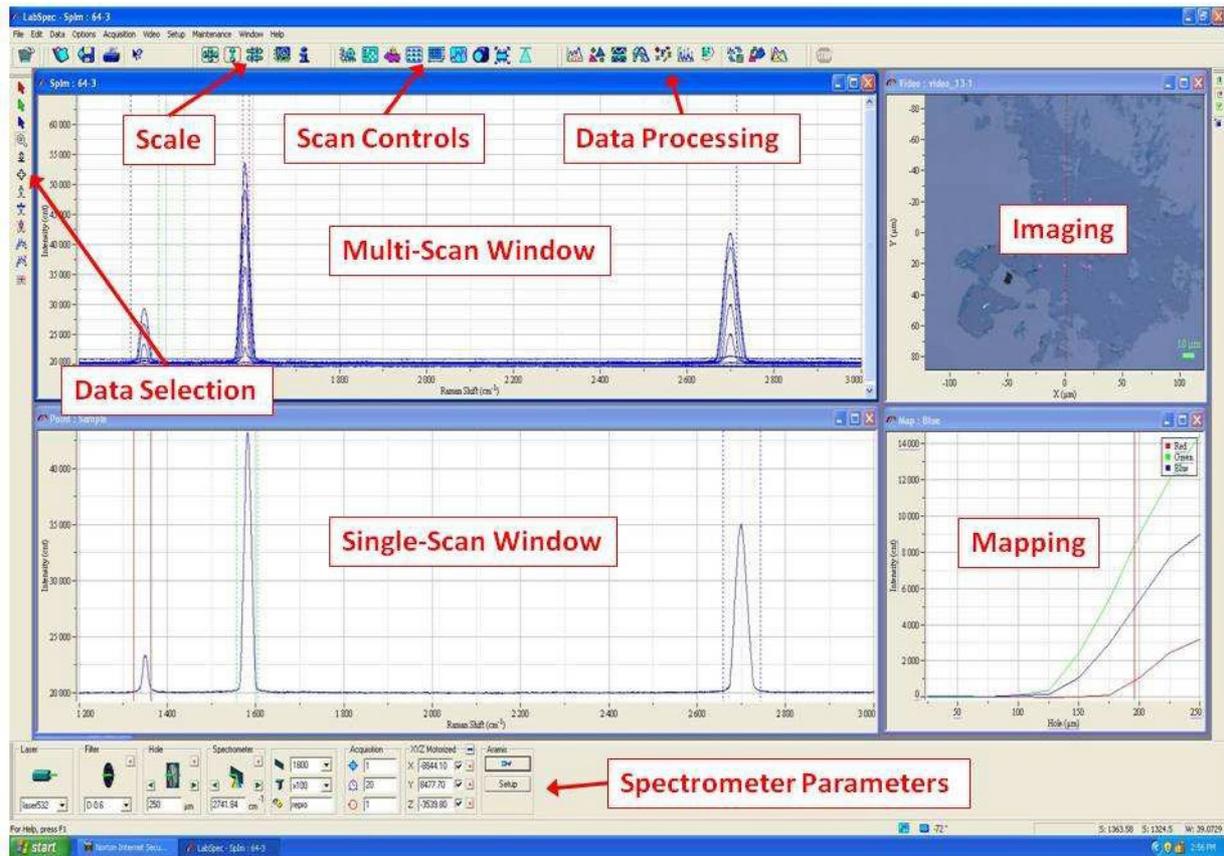
CONFIGURATION OF THE INSTRUMENT



3.1 User Interface Overview

3.2 Overview

LabSPEC 5 – the software used to run the LabRAM spectrometer – can be found on the desktop. The software user interface consists of four control panels (labeled here as: Data Selection, Scale, Scan Controls, Data Processing, and Spectrometer Parameters). See below for descriptions of useful functions for basic operation.



Data management toolbar becomes visible on the right side of the software window once data spectra are open. This provides toggling between different data plots or allows multiple plots in one window. Useful when saving data since only highlighted window and current data plot are saved.

3.3 Spectrometer Parameter Toolbar:



- A. Laser selection: 785nm , 633nm (listed as “HeNE”), 532nm , 325nm (listed as “External Laser”)
- B. Neutral density filter selection (see below for selection)

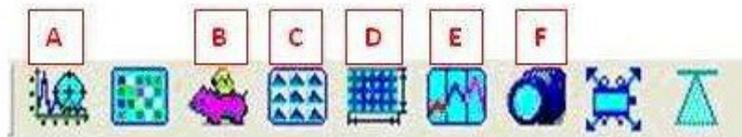
Filter number	Percent transparency
D 0.3	50%
D 0.6	25%
D 1	10%
D 2	1.0%
D 3	0.1%
D 4	0.01%
---	No filter

- C. Confocal hole size (25 μm to 500 μm)
- D. Grating center position
- E. Grating selection (300g/mm, 600g/mm, 1800g/mm, 2400g/mm)

Grating type	Spectral range	Notes
300 g/mm	0nm to 5700nm	-
600 g/mm	0nm to 2856nm	Best for visible low resolution
1800 g/mm	0nm to 952nm	Best for visible high resolution
2400 g/mm	0nm to 714nm	Best for UV, high resolution

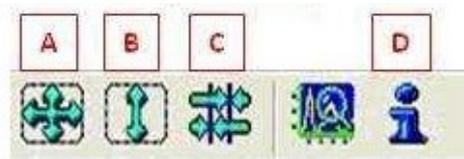
- Microscope objective lens (10x, 50x, 100x 40x for UV only)
- Filename
- F. Acquisition
 - Continuous mode time (seconds)
 - Snapshot time (seconds)
 - Number of accumulations (for averaging, typically set to 2)
- G. Stage position (Click the star to zero the position) units are μm
- H. Laser shutter OPEN/CLOSE, and Setup. In the Setup menu, you will select between visible and UV work and between DuoScan or normal scan control

3.4 Scan Controls toolbar:



- A. Begins continuous mode acquisition (continuous scanning). Useful for alignments and calibrations.
- B. Begins snapshot mode acquisition (single scan)
- C. Begins mapping mode acquisition
- D. Mapping mode parameter menu
- E. Snapshot mode parameter menu
- F. Activates white-light imaging camera (NOTE: Camera must be turned off before data acquisition begins)

3.5 Scale toolbar:



- A. Fits spectrum or image so that all acquired data fits into the window.
- B. Normalizes only with respect to intensity (i.e. does not adjust the x-axis)
- C. Centers the data selection lines
- D. Retrieves all saved parameters about the selected spectrum

4.1 Operation for Basic Raman and PhotoLuminescence

4.2 Power on system

- a. Computer, system power, stage power and CCD power should be on already. Check the CCD temperature, lower right bottom of the LabSpec 5 software page. The appropriate temperature will be -70C or lower.



**CCD MUST BE AT LOW TEMPERATURE TO PROPERLY OPERATE.
HIGHER TEMPERATURES WILL INCREASE THE BACKGROUND NOISE
AND INCREASE A CHANCE OF DAMAGING THE CCD.**

- b. Power on the lasers you will be using:
 - 785nm – Turn on the main power, wait until the system has initialized, then press the “laser ON/OFF” button. (system will read: “Act 200mA”)
 - 633nm – Turn the key.
 - 532nm – Turn the key, wait for system to initialize, press “Enable”. (system will read: “Laser Emission”)
 - 325nm – Turn the key, laser will start in a few moments. Please allow 30 minutes for this laser to fully energize.
- c. Full screen the LabSpec 5 software. If needed, open “LabSpec 5” from the desktop.

4.3 Sample loading

- a. Turn on white lamp, either top or bottom illumination. Typical setting is 4 to 6.
- b. Click the “Video” icon (Scan Control Toolbar – F) to open white light shutter and start the imaging
- c. Close the laser shutter prior to opening the doors to the microscope stage (Spectrometer Parameter Toolbar - H). This is to ensure the laser will not be transmitted through the objective lens.
- d. Select the appropriate objective lens on the microscope. Select the corresponding objective lens on the computer (Spectrometer Parameter Toolbar – E, objective lens). This places the correct scaling on the image
- e. Load sample onto the stage. There is a tab to hold a standard glass slide. Care should be taken to avoid touching the end of the objective lens.
- f. Using the manual coarse focus, bring sample into approximate focus position



DO NOT CRASH OBJECTIVE LENS INTO THE SAMPLE OR STAGE!

- g. To move the sample stage in XY, you must use the stage joystick. Manual stage movement will damage the stage motors.



THE JOYSTICK CONTROL IS SENSITIVE TO MOVEMENT. SMALL MOVEMENTS IN X AND Y RESULT IN SLOW STAGE TRAVEL. LARGER JOYSTICK MOVEMENT RESULTS IN FASTER STAGE TRAVEL. SAME FOR Z TRAVEL WITH ROTATION OF XY JOYSTICK KNOB.

- h. Use the video screen and the joystick to bring the sample surface into optical focus. A clockwise knob twist raises the stage while a counterclockwise twist will lower the stage.

NOTE: Z - Stage Drift possible

It is possible that the stage can drift in the z-direction over time (generally the stage drifts down with respect to the objective lens). This can make it difficult to obtain consistent data during long acquisitions. Use the following 3-step procedure to minimize Z-drift when focusing:

- 1) Focus in on the sample by turning the joystick counterclockwise to move the objective lens closer to the sample.
- 2) Once a coarse focus is obtained, make any minor adjustments necessary by toggling the focus.
- 3) Finally, be sure that the last adjustment is a counterclockwise turn of the joystick. This will ensure the stage gears are engaged before coming to a stop.

You can test the z-drift by comparing the laser focus before and after a typical measurement. If significant drift persists with this procedure, please notify NRF staff.

4.4 Selecting and focusing the laser

- a. Select the laser from the pull down menu (Spectrometer Parameter Toolbar - A) Wait for the system to adjust internal optics.
- b. Open the laser shutter (Spectrometer Parameter Toolbar - H). The green dot in the center of the image is the approximate laser spot position.
- c. Focus the laser with the joystick by twisting the joystick knob. (A good focus will have a small dark spot surrounded by bright annular rings in the center of the video) Typically a focused image is not a focused laser spot.
- d. Close laser shutter. The position of this shutter before a data scan will determine the position after the scan. Closed shutter before scan and software will close shutter after scan. This can reduce sample damage on sensitive samples.
- e. Enter the "Setup" menu (Spectrometer Parameter Toolbar – H, Setup) and select UV (for 325nm laser) or Visible (for all other lasers).

4.5 Collecting Data:

4.4.1 Area of interest

Find you area of interest using the Video image and the joystick to move the sample stage. Place the area of interest under the green dot (middle of the image). Turn off “Video” by clicking the “STOP” icon on the top tool bar. The last image will freeze and the white light shutter will close.

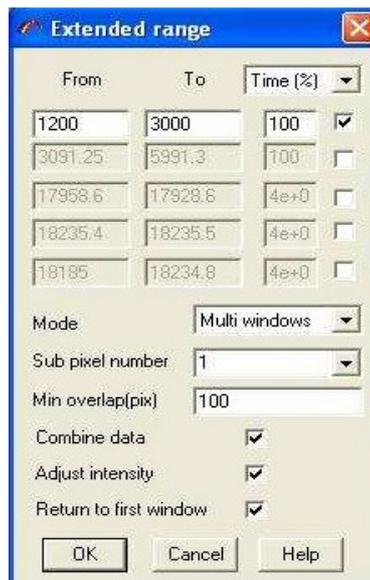
To save the image of your area of interest , highlight the video box. Under the “File” menu, select “Save As”. Choose an image file type and save the image in your user directory within the “Data” folder on the desktop. This image will not have the xy axis or the scale bar.

To save the image with scale bar, choose “Save Picture as” under the File menu. This used the .wmf extension and the saved image will incorporate the xy axis and scale bar.

4.4.2 Basic Raman Analysis:

- Open the “Options” menu, top menu of LabSpec5 software. Click on “units” and select “ cm^{-1} ” . This puts the system in a narrow spectrum scan mode for Raman.
- Select the N.D. filter (Spectrometer Parameter Toolbar - B)
- Select the confocal hole size (Spectrometer Parameter Toolbar –C)

To acquire a range of data, open Snapshot Mode Parameter menu (Scan Control toolbar – E). This will bring up the Extended Range menu displayed below. Select the spectral range and time percentage. You may also select to acquire several windows of data. The Mode should either read “Single Scan” or “Multi window”.



CAUTION  **CAUTION** Leave

the “min overlap (pix)” at 100!

- e. Select grating pitch density (Spectrometer Parameter Toolbar – E, Grating)
- f. Select file name prefix (Spectrometer Parameter Toolbar - E, Data name)
- g. Select the real time data exposure time in seconds (Spectrometer Parameter Toolbar – F, RTD Exposure time)
- h. Select the data acquisition exposure time in seconds (Spectrometer Parameter Toolbar – F, Exposure time)
- i. Select the number of accumulations for each data point (Spectrometer Parameter Toolbar – F, Accumulation number)

IMPORTANT: Click “Stop” button in upper right hand corner to ensure video mode is off.

- k. Click Spectrum Acquisition (Scan Control toolbar - B).

4.4.3 Basic PL Analysis

- a. Open the “Options” menu, top menu of LabSpec5 software. Click on “units” and select “nm” or “eV” units. This puts the system in a wider spectrum scan mode for PL.
- b. Select the N.D. filter (Spectrometer Parameter Toolbar - B)
- c. Select the confocal hole size (Spectrometer Parameter Toolbar –C)

To set the range of data, open Snapshot Mode Parameter menu (Scan Control toolbar – E). This will bring up the Extended Range menu displayed below. Select the spectral range and time percentage. For one scan, leave the Time (%) at 100. You may also select to acquire several windows of data, all the windows should add to 100%. For best PL results, select “autoscan” in the Mode dropdown menu. This will eliminate non-uniformity in the CCD.

CAUTION  **CAUTION** Leave

the “min overlap (pix)” at 100!

- e. Select grating pitch density (Spectrometer Parameter Toolbar – E, Grating)
- f. Select file name prefix (Spectrometer Parameter Toolbar - E, Data name)
- g. Select the real time data exposure time in seconds (Spectrometer Parameter Toolbar – F, RTD Exposure time)
- h. Select the data acquisition exposure time in seconds (Spectrometer Parameter Toolbar – F, Exposure time)

- i. Select the number of accumulations for each data point (Spectrometer Parameter Toolbar – F, Accumulation number)

IMPORTANT: Click “Stop” button in upper right hand corner to ensure video mode is off.

- k. Click Spectrum Acquisition (Scan Control toolbar - B).

4.4.4 Saving data sets

In order to save a data set, that data set must be highlighted. If multiple data sets are open, the desired data set can be selected using the right side vertical toolbar. Each data set will be represented by a different color circle. Each data set must be saved separately.

- a. Select desired data set to be saved
- b. Under “File” on the top menu, select “Save As”.
- c. It is recommended that each data set be saved in the labSpec5 extension .ngs
- d. For a column data format, select .txt for a data only output file. This data set can be imported into a spreadsheet program for plotting.

NOTE: Please save data to the DATA folder on the desktop. You may create a separate folder for your data within this DATA folder.

5.1 Shutdown

- a. Turn off the lasers:

785nm – Turn off the laser with the “laser ON/OFF” button (system will read: “Act 0mA”), then turn off the main power.

633nm – Turn the key off

532nm – Turn the key off

325nm – Turn the key off. Fan will continue to run for several minutes,

- b. Remove sample from sample stage. First lower the stage completely to safely remove the sample. Close doors to the microscope stage
- c. Leave the LabSpec5 software open, it can be minimized if desired.
- d. Copy data to a removable memory drive.
- e. Log out using the Login control system.

6.0 Troubleshooting

The Horiba Aramis system is designed to be a simple interface, multiuser instrument. If issues occur during data collection or general operation, please close the LabSpec5 software (do not reboot the computer) and restart the software. This will reinitialize communication with the instrument and will most times correct the issue. If this does not correct the issue, shut down instrument and contact IAC staff.

Emergency Information:

Medical Emergencies: Contact 911 and Public Safety (609) 258-1000

Room / facility emergencies: Contact Public Safety (609) 258-1000

Issues related to the instrument:

1. Contact IAC Staff.
2. Leave system as is.

Audible/Siren Emergency Alerts:

Follow previous steps and leave the building.

Emergency Contact Information:

Nan Yao: Office (609)258-6394; Cell (908) 922-2236 Email: nyao@princeton.edu

John Schreiber: Office (609)258-0034; Cell (215) 431-4670 Email: js51@princeton.edu

Paul Shao: Office (609)258-3851; Cell (847) 721-086 Email: pshao@princeton.edu