



## SpectraSuite® Spectrometer Operating Software

### Installation and Operation Manual Document Number 000-20000-300-02-201101

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# Table of Contents

About This Manual .....	vii
Document Purpose and Intended Audience.....	vii
What's New in this Document .....	vii
Document Summary.....	vii
Product-Related Documentation .....	viii
Upgrades.....	ix
<b><u>Chapter 1: Introduction .....</u></b>	<b>1</b>
Product Overview .....	1
USB Spectrometer and Device Control.....	1
Features .....	2
SpectraSuite in the Future.....	2
Spectroscopic Functions.....	2
Getting Updates.....	3
<b><u>Chapter 2: Installation .....</u></b>	<b>5</b>
Overview .....	5
Installing SpectraSuite .....	5
Retrieving from a CD .....	5
Downloading from the Ocean Optics Website.....	6
Installing Device Drivers for Windows 64-Bit Installations .....	9
Windows 7 64-bit Driver Installation Process .....	9
Windows Vista 64-bit Driver Installation Process .....	13
<b><u>Chapter 3: Controls and Indicators .....</u></b>	<b>19</b>
Overview .....	19
Graph Controls .....	19
Zoom Tools.....	20
Zoom History Toolbar .....	23
Spectrum Storage Tools.....	23
Processing Tools .....	23
Spectrum IO Tools.....	24
Layer Tools.....	25

**Table of Contents**


---

Other Controls .....	27
Acquisition Controls .....	27
 Peak Finding .....	27
Indicators .....	29
Status.....	29
Update Available .....	30
Progress Bar.....	31

## **Chapter 4: File Menu Functions.....** 33

Overview .....	33
New .....	33
Spectrum Graph .....	34
Regression Utility.....	35
Spectrum Table .....	36
High-Speed Acquisition .....	37
Absorbance Measurement .....	44
Transmission Measurement .....	44
Reflection Measurement.....	44
Relative Irradiance Measurement .....	44
Gated Fluorescence Measurement .....	44
Curie Fluorescence Measurement .....	45
Absolute Irradiance Graph.....	45
New Absolute Irradiance Measurement .....	46
New Concentration Measurement.....	46
Color Measurement .....	47
Strip Chart.....	47
Strip Chart Table .....	51
Open .....	51
Dark .....	51
Reference .....	51
Processed Spectrum .....	51
Spectrum Collection .....	53
Save .....	53
Save Spectra Collection .....	53
Save Spectrum .....	53
Store.....	54
Dark .....	54
Reference .....	55
Convert Spectra.....	55

---

Screen Capture .....	55
Exit .....	56
<b>Chapter 5: View Menu Functions.....</b>	<b>57</b>
Overview .....	57
Scale .....	57
Empty.....	57
Graph Layer Options .....	57
Annotations.....	58
Chart.....	59
Cursor.....	59
Peaks.....	59
Image.....	59
Draw .....	59
Trendline.....	59
Overlay .....	60
Visible Spectrum.....	60
Spectrum Range.....	60
Legend.....	61
Toolbars .....	61
Acquisition .....	62
Acquisition Controls.....	63
Correction .....	63
Data Display .....	63
Memory.....	64
Preprocessing.....	64
SeaChanger .....	64
Testing .....	68
Trigger .....	68
Strobe-Gate Delay .....	68
Small Toolbar Icons .....	68
Customize.....	68
<b>Chapter 6: Spectrometer Menu Functions.....</b>	<b>69</b>
Overview .....	69
Acquisition .....	69
Acquisition Console .....	69
Pause Acquisition/Resume Acquisition .....	70
Terminate Acquisition .....	70

**Table of Contents**


---

Acquisition Controls .....	70
Network Spectrometer .....	71
Spectrometer Simulation .....	71
Show Devices.....	71
Spectrometer Features .....	71
QE65000 Spectrometer Exposure Image Features .....	74
MMS Raman Spectrometer Features.....	75
Rescan Devices.....	80
Remove Spectra.....	80
<b>Chapter 7: Processing Menu Functions.....</b>	<b>81</b>
Overview .....	81
Color.....	81
Edit Color Settings .....	81
Other .....	81
Absorbance by Relative Transmission .....	81
Kubelka-Monk K/S Calculation .....	81
Pre-processing .....	82
Remove Preprocessor.....	82
Nonunity Correction .....	82
Add Reference Monitor.....	83
Post-processing.....	85
Differentiate .....	85
Processing Mode.....	85
Scope.....	86
Scope Minus Dark .....	86
Absorbance .....	86
Transmission .....	87
Reflection.....	87
Relative Irradiance.....	88
Absolute Irradiance.....	88
Conversions.....	88
Scope.....	88
Absolute Irradiance.....	89
Collection Area .....	89
Calibration.....	90
Combine Calibration Files .....	90
New Energy, Power, Photons .....	91
New Photometry Measurement.....	93

X-axis Units .....	96
Unit Preferences.....	96
Set Color Temperature .....	97
Exporting Processed Data.....	98
Set Laser Wavelength .....	101
Edit Result Colors.....	101
 <b>Chapter 8: Tools Menu Functions .....</b>	<b>103</b>
Overview .....	103
Custom Libraries .....	103
Supported Arguments.....	104
Threading.....	104
Sample Code.....	104
Add New External Library.....	105
Configure External Library.....	106
Save Library Configuration.....	107
Load Library Configuration .....	107
Remove External Library .....	108
Remove Library Configuration.....	108
View Library Triggers.....	108
Triggers .....	108
Configure New Trigger .....	108
Remove a Trigger.....	109
View Triggers.....	109
3D Data Viewer .....	109
Locale Configurator .....	110
New Mikropack Device .....	110
Remove Mikropack Device .....	110
Options.....	110
IDE Configuration .....	111
SpectraSuite Settings .....	111
Template Manager .....	111
Module Manager.....	112
Update Center .....	113
 <b>Chapter 9: Window Menu Functions .....</b>	<b>119</b>
Overview .....	119
Close All Documents .....	119
Documents .....	119

---

**Table of Contents**

Close Window .....	120
Maximize/Restore Window .....	120
Output .....	120
<b><u>Chapter 10: Strip Charts.....</u></b>	<b>123</b>
Overview .....	123
Creating Strip Charts .....	123
Saving Strip Chart Data .....	128
Strip Chart Controls .....	128
<b><u>Appendix A: Experiment Tutorials .....</u></b>	<b>129</b>
Overview .....	129
Preparing for Experiments .....	129
Application Tips .....	131
Taking Reference and Dark Spectra.....	131
Absorbance Experiments.....	132
Concentration Experiments .....	137
Transmission Experiments .....	146
Reflection Experiments.....	149
Irradiance Experiments.....	152
Absolute Irradiance.....	153
Relative Irradiance.....	163
Fluorescence .....	166
Color Experiments .....	168
Color Measurement Screen Controls .....	176
<b><u>Appendix B: Troubleshooting.....</u></b>	<b>179</b>
<b><u>Index .....</u></b>	<b>183</b>

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# About This Manual

## Document Purpose and Intended Audience

This document provides you with an installation and configuration instructions to get your system up and running. In addition, user interface for SpectraSuite® is provided.

## What's New in this Document

This version of the *SpectraSuite Spectrometer Operating Software Installation and Operation Manual* updates the manual to the core release 2.0.154.

## Document Summary

Chapter	Description
Chapter 1: <a href="#"><i>Introduction</i></a>	Provides an overview of the SpectraSuite operating software.
Chapter 2: <a href="#"><i>Installation</i></a>	Contains instructions for installing and configuring the SpectraSuite software.
Chapter 3: <a href="#"><i>Controls and Indicators</i></a>	Illustrates options for customizing your graph view. Also contains information for peak finding.
Chapter 4: <a href="#"><i>File Menu Functions</i></a>	Contains descriptions of the functions on the File menu.
Chapter 5: <a href="#"><i>View Menu Functions</i></a>	Contains a description of the functions on the View menu.
Chapter 6: <a href="#"><i>Spectrometer Menu Functions</i></a>	Contains descriptions of the functions on the Spectrometer menu.
Chapter 7: <a href="#"><i>Processing Menu Functions</i></a>	Contains descriptions of the functions on the Processing menu.
Chapter 8: <a href="#"><i>Tools Menu Functions</i></a>	Discusses the selections available in the Tools menu.
Chapter 9: <a href="#"><i>Window Menu Functions</i></a>	Contains information for the Window menu functions.
Chapter 10: <a href="#"><i>Strip Charts</i></a>	Provides instructions for using the Strip Charts feature.

## About This Manual

Chapter	Description
Appendix A: <a href="#"><u>Experiment Tutorials</u></a>	Contains instructions for performing sample experiments using an Ocean Optics spectrometer and SpectraSuite software.
Appendix B: <a href="#"><u>Troubleshooting</u></a>	Provides a table of possible problems and suggested solutions.

## Product-Related Documentation

- [ADC1000-USB Operating Instructions](#)
- Amadeus and Quantum Software User's Guide
- [ARCoptix ANIR Fourier Transform Spectrometer](#)
- [External Triggering Options Instructions](#)
- [External Triggering Options for Spectrometers with Firmware 3.0 and Above](#)
- [HR2000 and HR2000CG-UV-NIR Series High-Resolution Fiber Optic Spectrometers Installation and Operation Manual](#)
- [HR2000+ High-speed Fiber Optic Spectrometer Installation and Operation Manual](#)
- [HR4000 and HR4000CG-UV-NIR Series High-resolution Fiber Optic Spectrometers Installation and Operation Manual](#)
- [Jaz Installation and Operation Manual](#)
- [MMS Raman Spectrometer Installation and Operation Manual](#)
- [NIR Near Infrared Fiber Optic Spectrometers Installation and Operation Manual](#)
- [NIRQuest Near Infrared Spectrometer Installation and Operation Manual](#)
- [QE65000 Scientific-grade Fiber Optic Spectrometer Installation and Operation Manual](#)
- [Red Tide USB650 Fiber Optic Spectrometer Installation and Operation Manual](#)
- [Remora Installation and Operation Manual](#)
- [S2000 Miniature Fiber Optic Spectrometers and Accessories Operating Manual and User's Guide](#)
- [USB2000 Fiber Optic Spectrometer Installation and Operation Manual](#)
- [USB2000+ Fiber Optic Spectrometer Installation and Operation Manual](#)
- [USB4000 Spectrometer Installation and Operation Manual](#)

You can access documentation for Ocean Optics products by visiting our website at <http://www.oceanoptics.com>. Select *Technical* → *Operating Instructions*, then choose the appropriate document from the available drop-down lists. Or, use the **Search by Model Number** field at the bottom of the web page.

You can also access operating instructions for Ocean Optics products on the *Software and Technical Resources* CD included with the system.

Engineering-level documentation is located on our website at *Technical → Engineering Docs*.

SeaChanger documentation is located at <http://seachangeronline.com/>.

## Upgrades

Occasionally, you may find that you need Ocean Optics to make a change or an upgrade to your system. To facilitate these changes, you must first contact Customer Support and obtain a Return Merchandise Authorization (RMA) number. Please contact Ocean Optics for specific instructions when returning a product.



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# Chapter 1

# Introduction

## Product Overview

SpectraSuite® is a modular, Java-based spectroscopy software platform that operates on Windows, Macintosh and Linux operating systems. The software can control any Ocean Optics USB spectrometer and device. The SpectraSuite interface looks and feels the same on all operating systems yet retains the familiar appearance of an application native to each OS. Ocean Optics is the first to offer such a flexible, feature-packed application with this level of cross-platform capability.

SpectraSuite is the platform for all future Ocean Optics application software development. Current software applications including OOIChem, OOIColor and OOIIrrad-C have been migrated to the SpectraSuite platform, with applications such as OOI Sensors and OOILIBS coming in the near future.

## USB Spectrometer and Device Control

SpectraSuite easily manages multiple USB spectrometers – each with different acquisition parameters – in multiple windows, and provides graphical and numeric representation of spectra from each spectrometer. Using SpectraSuite, you can combine data from multiple sources for applications that include upwelling/downwelling measurements, dual-beam referencing and process monitoring.

SpectraSuite can be used with the following Ocean Optics spectrometers when they are interfacing to a computer through their USB port:

- S2000 Spectrometer (with A/D Converter)
- USB650 Spectrometer
- USB2000 Spectrometer
- USB2000+ Spectrometer
- USB2000-FLG Spectrometer
- USB4000 Spectrometer
- HR2000 High-resolution Spectrometer
- HR2000+High-resolution Spectrometer
- HR4000 High-resolution Spectrometer
- Jaz System
- QE65000 Scientific-grade Spectrometer
- NIR-512 Near-IR Spectrometer
- NIR256-2.1 and NIR256-2.5 Near-IR Spectrometers

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## 1: Introduction

- NIRQuest512, 512-2.2 and 512-2.5 Near-IR Spectrometers
- NIRQuest256-2.1 and 256-2.5 Near-IR Spectrometers
- Maya2000 and Maya2000-Pro Spectrometers
- MMS Raman Spectrometer
- Arcoptix ANIR series FTS Spectrometers
- Torus
- STS Micro Spectrometer

SpectraSuite also supports the following USB devices:

- ADC1000-USB A/D Converter
- Spectral Hyper Adapter (SHA-1)

In addition, SpectraSuite is compatible with the Remora Wi-Fi™ /Ethernet Adapter.

## Features

**Platform Independent** – The SpectraSuite is a platform-independent application that provides graphical and numeric representation of spectra in one window. SpectraSuite can operate on a Windows, Linux, or Macintosh operating system.

**Variety of Storage Formats** – Spectrasuite stores and provides data in a variety of other formats including tab-delimited ASCII (for Excel or other analysis packages), Grams SPC, and JCAMP.

**Advanced Data Capture Control** – SpectraSuite provides the user with advanced control of episodic data capture attributes. For instance, a user can acquire data for a fixed number of scans or for a specific interval. Initiation of each scan can be externally triggered or event-driven. Captured data is quickly stored into a systems memory at speeds as fast as 1 scan per msec with speeds limited by hardware performance.

**Independent Control of Multiple USB Devices** – Multiple USB devices can be monitored on the same graph in a single window; each of these devices can be controlled independently.

## SpectraSuite in the Future

SpectraSuite is constantly evolving. With the purchase of SpectraSuite, you are entitled to one year of free, web-based, automatic upgrades (see [Getting Updates](#)).

## Spectroscopic Functions

SpectraSuite allows you to perform the three basic spectroscopic experiments – absorbance, reflectance and emission, as well as absolute irradiance, color and chemical concentration. Signal-processing functions such as electrical dark-signal correction, stray light correction, boxcar pixel smoothing and signal averaging are also included. Scope mode, the spectrometer operating mode in which raw data (signal) is acquired by the detector, allows you to establish these signal-conditioning parameters. The basic concept for the software is that real-time display of data allows users to evaluate the effectiveness of their experimental setups and data processing selections, make changes to these parameters, instantly see the effects and save the data. Most spectrometer-system operating software does not allow such signal-conditioning flexibility.

With SpectraSuite, you can perform time-acquisition experiments for kinetics applications. As part of the time-acquisition function (strip charts), you can monitor and report single wavelengths, and you can average between wavelengths and find the integral between two wavelengths. In addition, you can perform reference monitoring in a variety of ways: single wavelength (1 or 2 channels), integrated intensity (starting and ending wavelengths for 1 or 2 channels) and wavelength-by-wavelength (2 channels).

SpectraSuite gives you complete control of setting the parameters for all system functions such as acquiring data, designing the graph display, and using spectra overlays. SpectraSuite has the benefit of providing various software-controlled triggering options for external events such as laser firing or light source pulsing.

Other advanced features give you several data-collection options. You can independently store and retrieve dark, reference, sample and processed spectra. All data can be saved to disk using autoincremented filenames. You can save data as ASCII files or in the native GRAMS/32 SPC or JCAMP format. One feature prints the spectra and another copies spectral data into other software such as Excel and Word.

## Getting Updates

SpectraSuite software features one year of free, web-based automatic upgrades when you buy the software. This service requires that you register the first time you connect. You can purchase renewals for half the software price per year.

The update icon () appears on the lower right corner of the SpectraSuite screen when updates are available for your software (see [Update Available](#) for more information on this icon). Click on this icon, or select **Tools | Update Center** from the SpectraSuite menu to go to the Update Center. Follow the steps in the Update Center wizard to update your SpectraSuite software. If you encounter a problem when updating, you can obtain the latest full installer from the Software Downloads page on the Ocean Optics website at <http://www.oceanoptics.com/technical/softwaredownloads.asp>, and then reinstall.



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## Chapter 2

# Installation

## Overview

The following sections will guide you in installing SpectraSuite on a Windows, Macintosh or Linux operating system.

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### Note

Do NOT connect the spectrometer to the computer until you install the SpectraSuite software. Follow the instructions contained in this chapter to properly connect and configure your system.

---

## Installing SpectraSuite

SpectraSuite can be downloaded from the Ocean Optics Software Downloads site, or retrieved from the CD that you received with your purchase of the software.

This section contains instructions for installing SpectraSuite using both methods on each of the following operating systems:

- Microsoft Windows – Windows 2000, XP; 32-bit and 64-bit
- Apple Macintosh – OS X version 10.0 or later
- Linux – Red Hat 9 or later, Fedora (any version), Debian 3.1 or later (Sarge), SUSE (9.0 or later), Centos (any version), and Ubuntu

## Retrieving from a CD

Your SpectraSuite software is shipped to you from Ocean Optics on a CD. The software is located either on the main **Software and Technical Resources** CD, or (in the case of the Windows 64-bit version) on a separate CD labeled **SpectraSuite Windows 64-bit Version**. You will need the password located on the jacket of the CD containing your SpectraSuite software to complete the installation.

► **Procedure**

1. Insert the CD that you received containing your SpectraSuite software into your computer.
2. Select the SpectraSuite software for your computer's operating platform via the CD interface. Then follow the prompts in the installation wizard.

Or,

Browse to the appropriate SpectraSuite set-up file for your computer and double-click it to start the software installation. Set-up files are as follows:

- Windows 32-bit: SpectraSuiteSetup\_Windows.exe
- Windows 64-bit: SpectraSuiteSetup\_Windows64.exe
- Mac: SpectraSuiteSetup\_Mac.dmg
- Linux: SpectraSuiteSetup\_Linux

## Downloading from the Ocean Optics Website

### Installing on a Windows Platform

Total download is approximately 50 MB (32-bit) or 70 MB (64-bit).

► **Procedure**

1. Close all other applications running on the computer.
2. Start Internet Explorer.
2. Browse to the Software Downloads page on the Ocean Optics website at <http://www.oceanoptics.com/technical/softwaredownloads.asp>.
3. Click on the SpectraSuite software appropriate for your Windows operating system.
4. Save the software to the desired location. The default installation directory is \Program Files\Ocean Optics\SpectraSuite. The installer wizard guides you through the installation process. The SpectraSuite icon location is Start | Programs | Ocean Optics | SpectraSuite | SpectraSuite and the current user's desktop.

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**Note**

If you have previously installed the 64-bit Beta release, you must first uninstall SpectraSuite, plug your spectrometer in and then uninstall the spectrometer driver from the Windows Device Manager before proceeding.

When you plug your spectrometer in again, the Found New Hardware wizard will launch. Tell the wizard to allow you to specify the location of the drives and browse to the SystemFiles directory of the SpectraSuite installation (by default this will be C:\Program Files\Ocean Optics\SpectraSuite\SystemFiles). Continue through the wizard normally. If the wizard prompts for the location of a DLL, look in C:\Program Files\Ocean Optics\SpectraSuite\SystemFiles\amd64.

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## Installing on a Macintosh Platform

You must be logged on as an administrative user to install SpectraSuite on your Mac. Total download is less than 25 MB.

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**Note**

Because of an incompatibility issue between Apple's Java Virtual Machine and a framework used by SpectraSuite, Snow Leopard users must install an old version of the Apple JVM in order to get full functionality. See the [Running SpectraSuite on Snow Leopard document](#) located on the Ocean Optics [Software Downloads](#) page. This document explains the necessary steps. Please note that if you perform a software update, you'll need to go through the steps again.

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### ► **Procedure**

1. Download the Mac OS X installer from the Software Downloads page on the Ocean Optics website at <http://www.oceanoptics.com/technical/softwaredownloads.asp>. The saved file will usually be located either on your Desktop or in your Downloads folder.
2. Double-click the SpectraSuiteSetup\_Mac.dmg file to mount the disk image. A new SpectraSuite icon resembling a disk drive appears on your desktop. The new icon should open automatically (if it doesn't, double-click it).
3. Copy the SpectraSuite icon to your desktop.
4. When the installation is complete, drag the SpectraSuite drive icon to the trash can.

## Installing on a Linux Platform

Total download is approximately 45 MB.

### ► **Procedure**

1. Download the Linux installer from the Software Downloads page on the Ocean Optics website at <http://www.oceanoptics.com/technical/softwaredownloads.asp>.
2. Start a terminal window and enter the following commands:

```
chmod 755 ~/Desktop/SpectraSuiteSetup_Linux.bin  
sudo ~/Desktop/SpectraSuiteSetup_Linux.bin
```

You are prompted for your password, which allows you to execute the setup as root. Contact your system administrator if you do not have password.

If the sudo command does not work (it may not be set up for your user account), then enter the following:

```
su  
(enter password for root)  
~/Desktop/SpectraSuiteSetup_Linux.bin
```

The Linux version of SpectraSuite requires some libraries that may not be installed by default, depending on the Linux distribution. The following are libraries required, and are not provided as part of SpectraSuite:

- libstdc++ version 6.
- libXp version 6 (earlier versions may work too). In Fedora Core 3 and 4, this is provided in xorg-x11-deprecated-libs.
- libusb version 0.1.10 or newer (should be provided in a libusb package or can be downloaded from <http://libusb.sourceforge.net/download.html#stable>).

It may be necessary to modify SELinux (Security Enhanced Linux) restrictions before SpectraSuite will run. It is possible to remove SELinux auditing by running 'setenforce Permissive' as root or by customizing your SELinux policies. The SpectraSuite installer does not modify system security settings.

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### Note

The default installation directory is /usr/local/OceanOptics/SpectraSuite.

A symbolic link is put in /usr/bin so that you can enter **spectrasuite** on any command line to start the program.



The SpectraSuite icon () location varies by installation, but will be under either Applications or Other under the Application Launcher menu.

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# Installing Device Drivers for Windows 64-Bit Installations

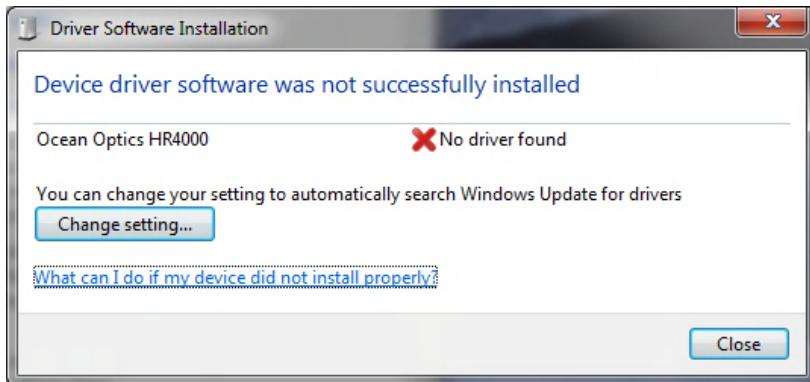
Hardware device driver installation is seamless on Microsoft Windows 32-bit operating systems when you connect your spectrometer to your computer. However, 64-bit Windows 7 and Vista systems require a bit more care when connecting your spectrometer for the first time. See the following sections for more information.

## Windows 7 64-bit Driver Installation Process

Use the following procedure when connecting your spectrometer to a Windows 7 64-bit system. This procedure uses the connection of an HR4000 Spectrometer as an example.

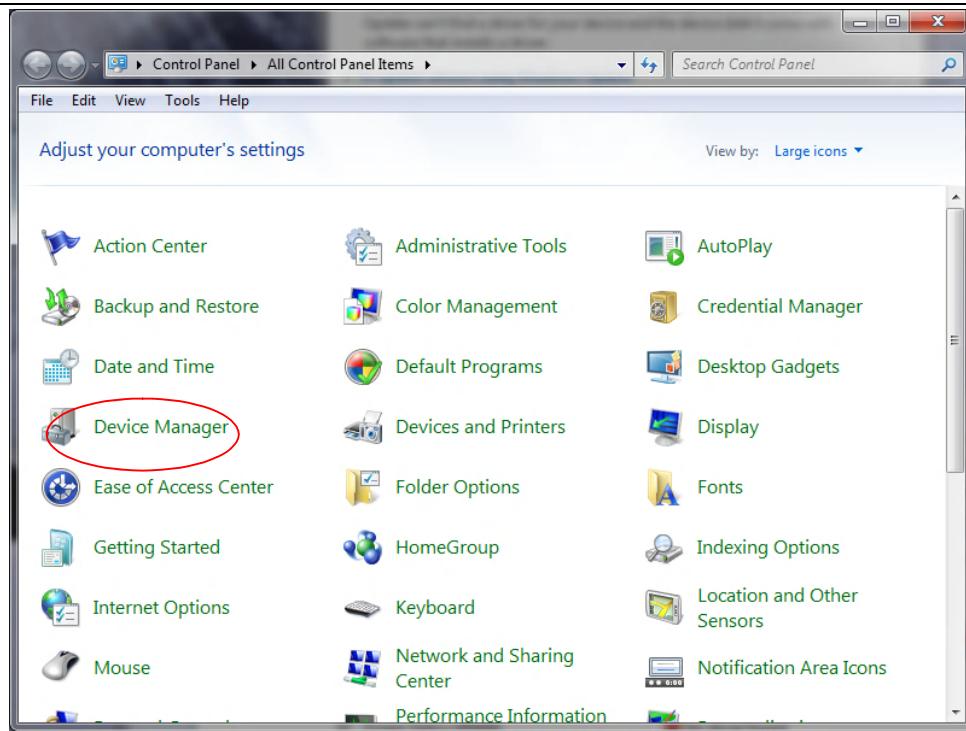
### ► **Procedure**

1. Connect your spectrometer to your computer. The following screen appears.

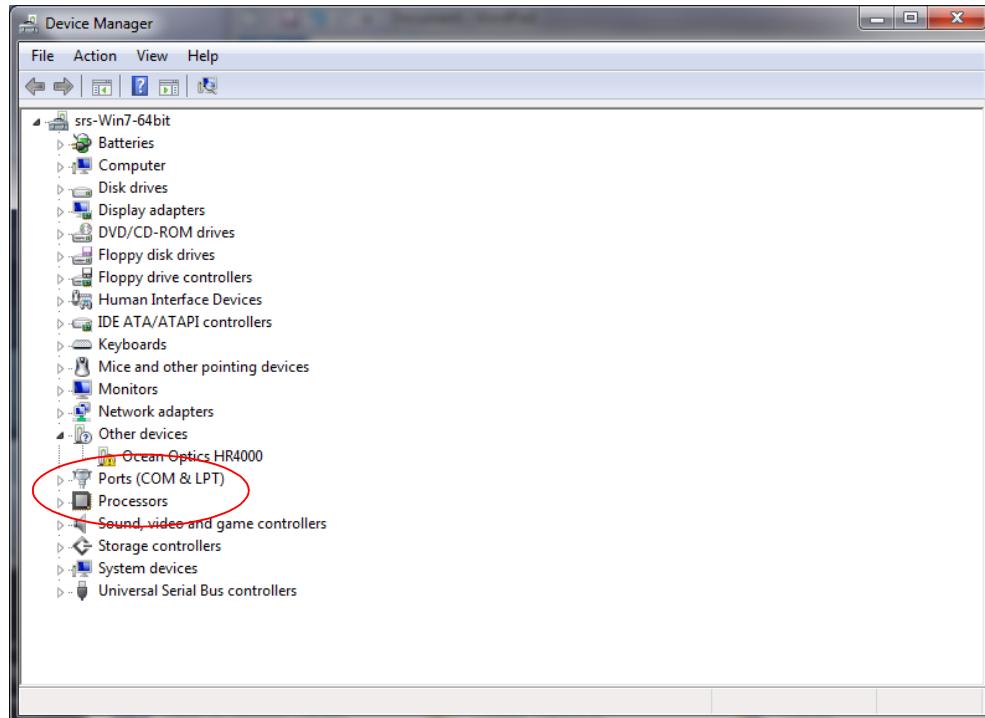


2. Click **Close**.
3. Install the driver. To do this, open the Control Panel. The following screen appears:

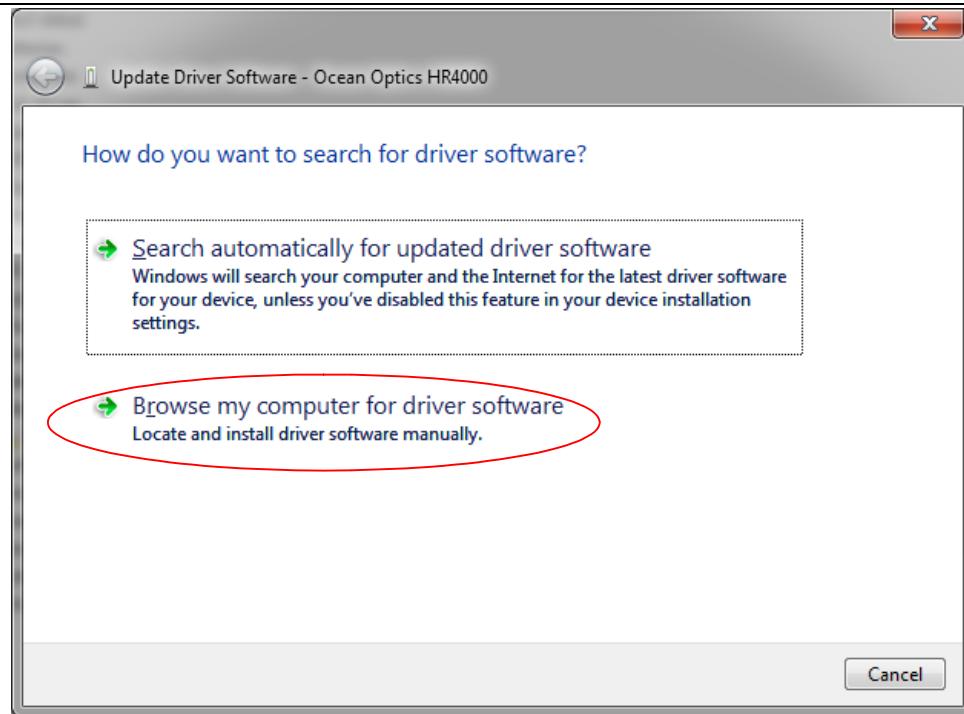
## 2: Installation



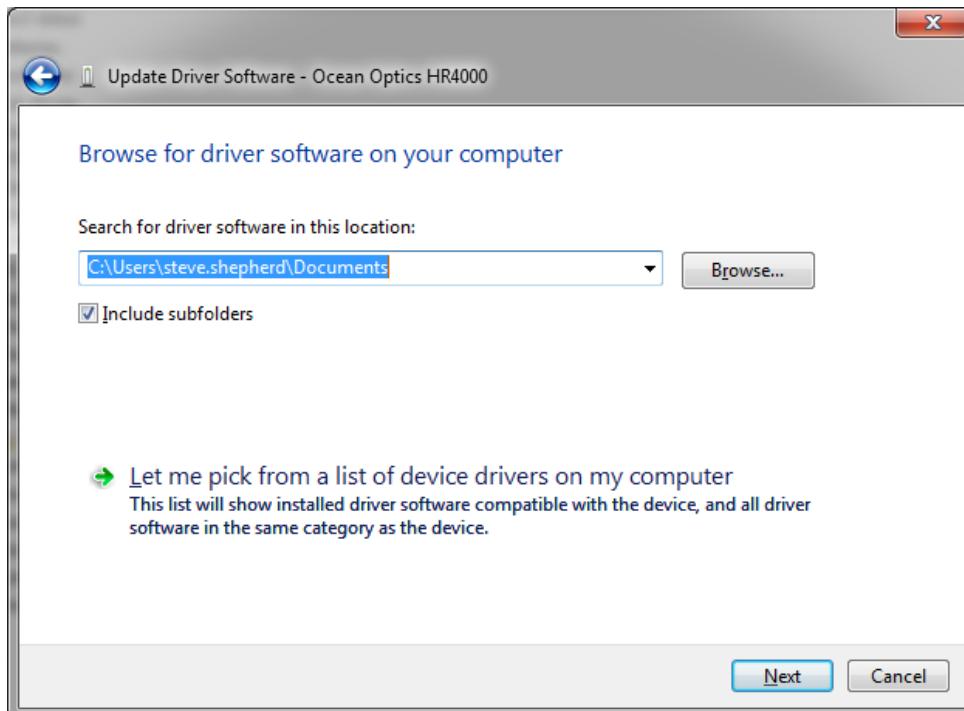
3. Click **Device Manager**.



4. Under **Other devices**, right-click on the Ocean Optics spectrometer and choose **update driver software**. The following screen appears.

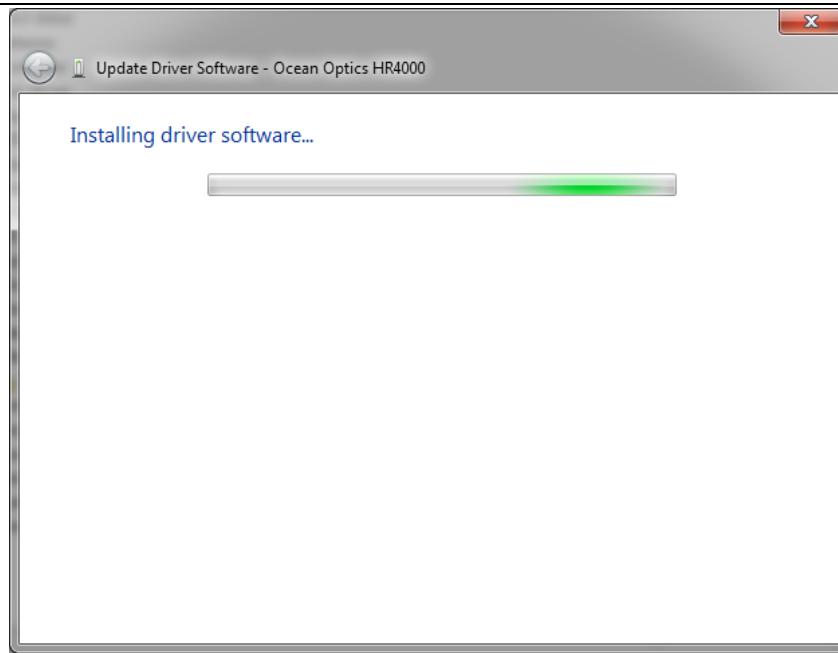


5. Choose **Browse my computer for driver software**.

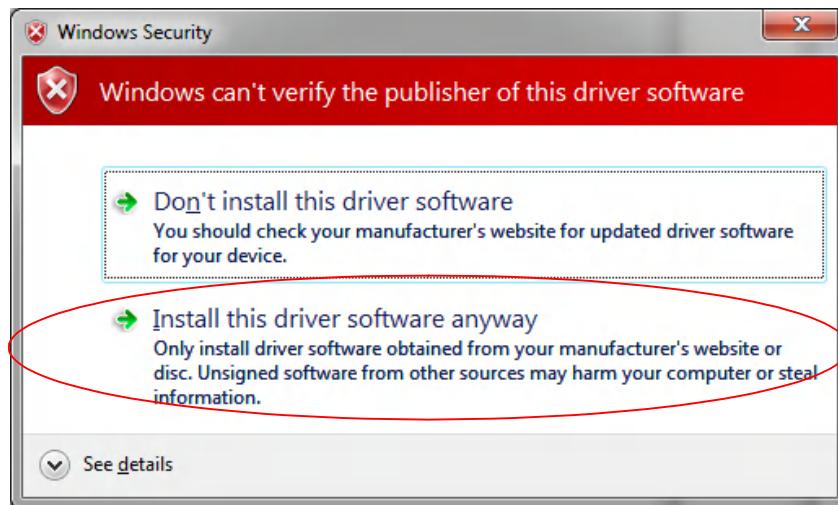


6. Navigate to C:\Program Files\Ocean Optics\SpectraSuite\SystemFiles and click **OK**. Then click **Next**. The following screen appears:

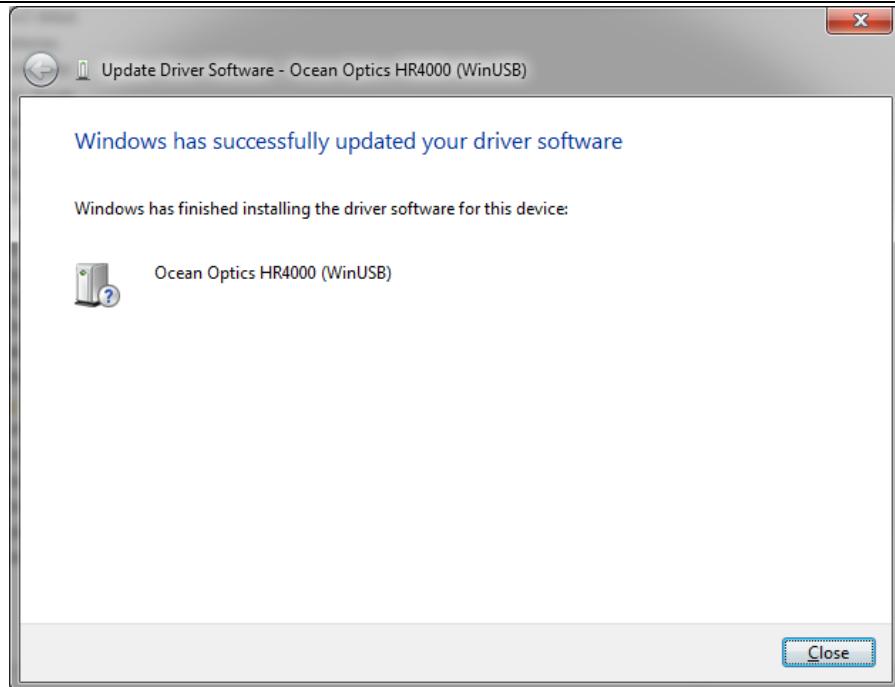
## 2: Installation



7. When the following pop-up screen appears, choose **Install this driver software anyway**.



8. When the driver installation is successful, you will see the following screen:

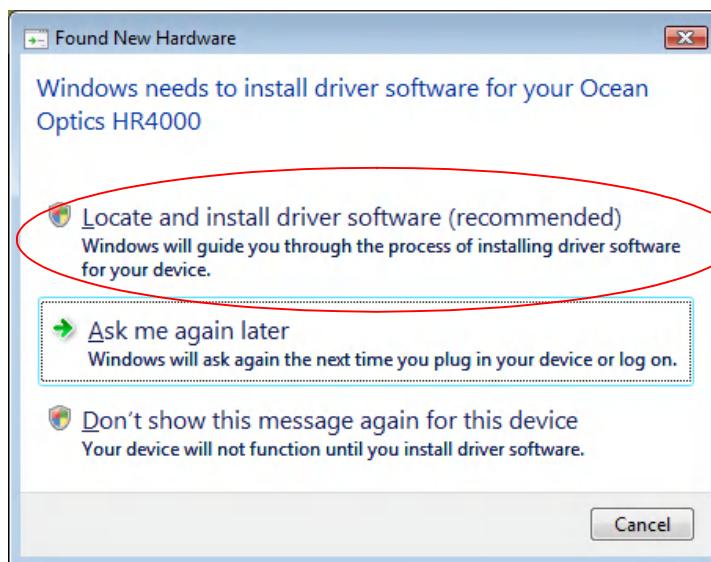


## Windows Vista 64-bit Driver Installation Process

Use the following procedure when connecting your spectrometer to a Windows Vista 64-bit system. This procedure uses the connection of an HR4000 Spectrometer as an example.

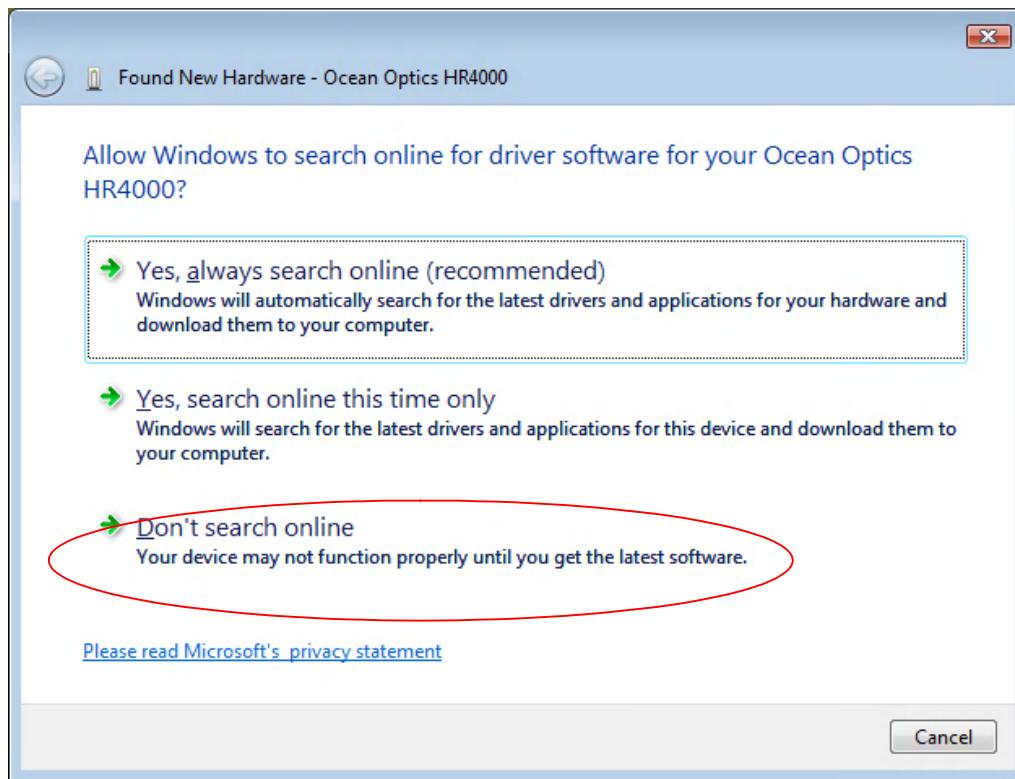
### ► **Procedure**

1. Connect your spectrometer to your computer. The following screen appears.

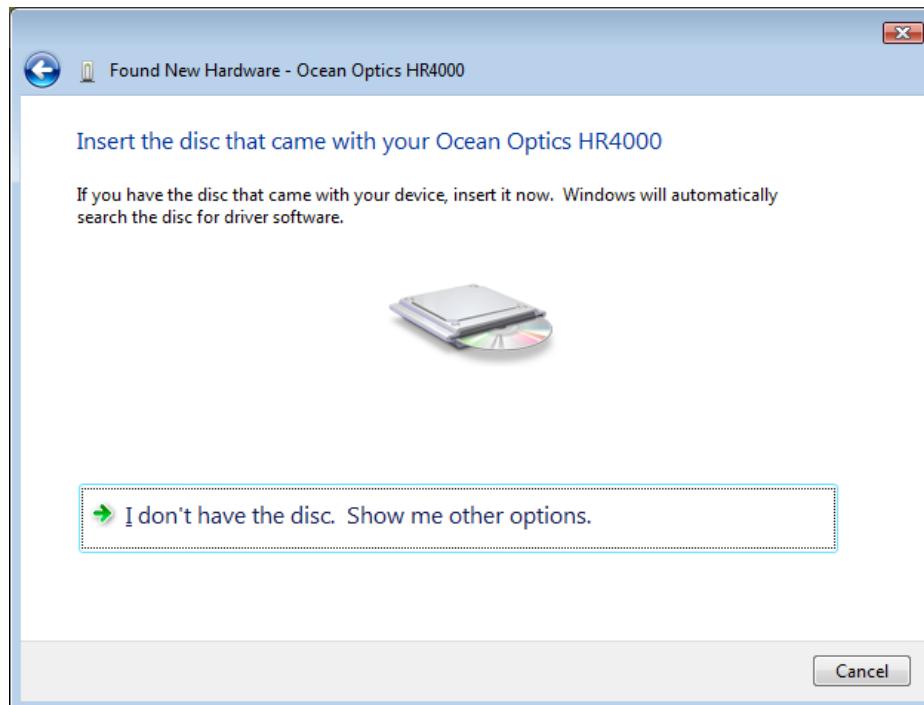


**2: Installation**

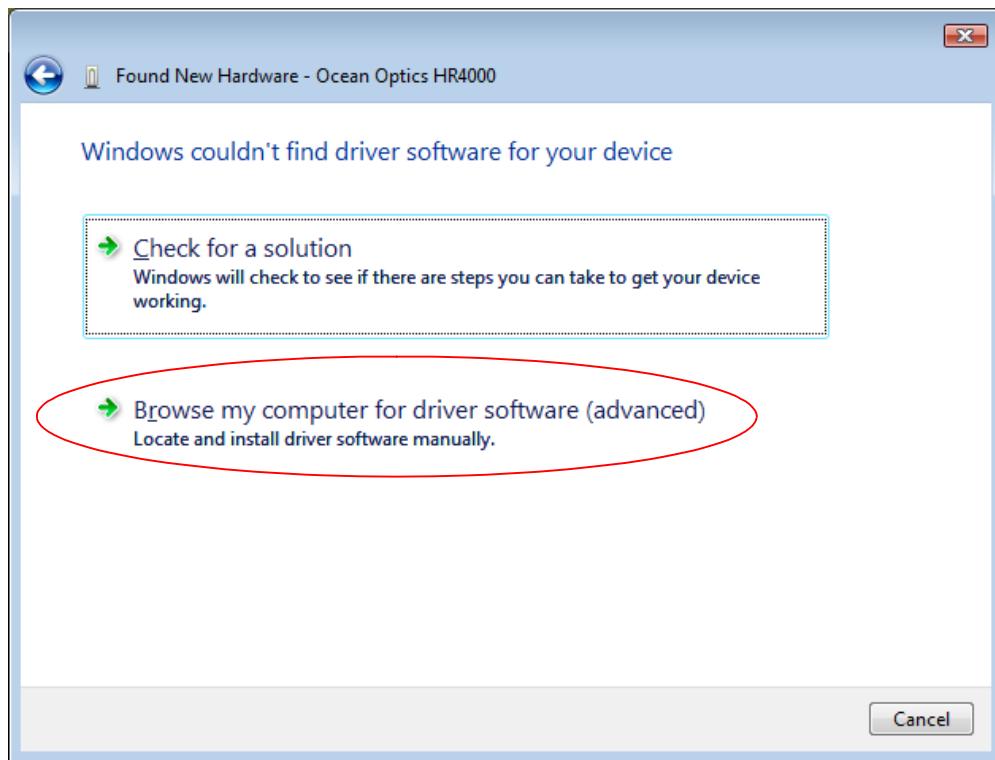
2. Choose **Locate and install driver software**. The following screen appears:



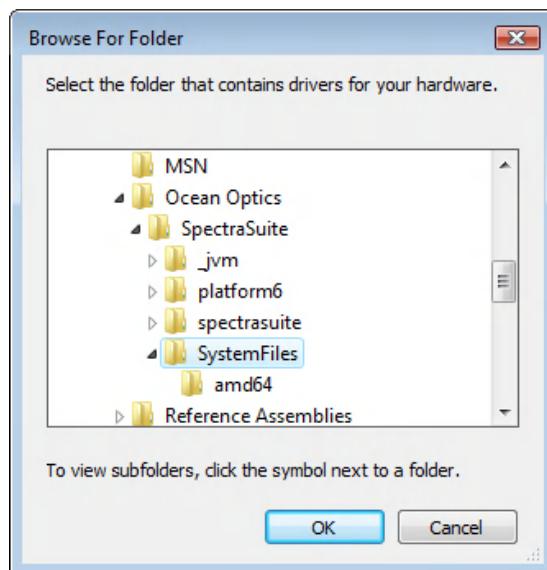
3. Choose **Don't search online**. When the dialog box appears asking for your permission to continue, click **Yes**.



4. Choose **I don't have the disk.**

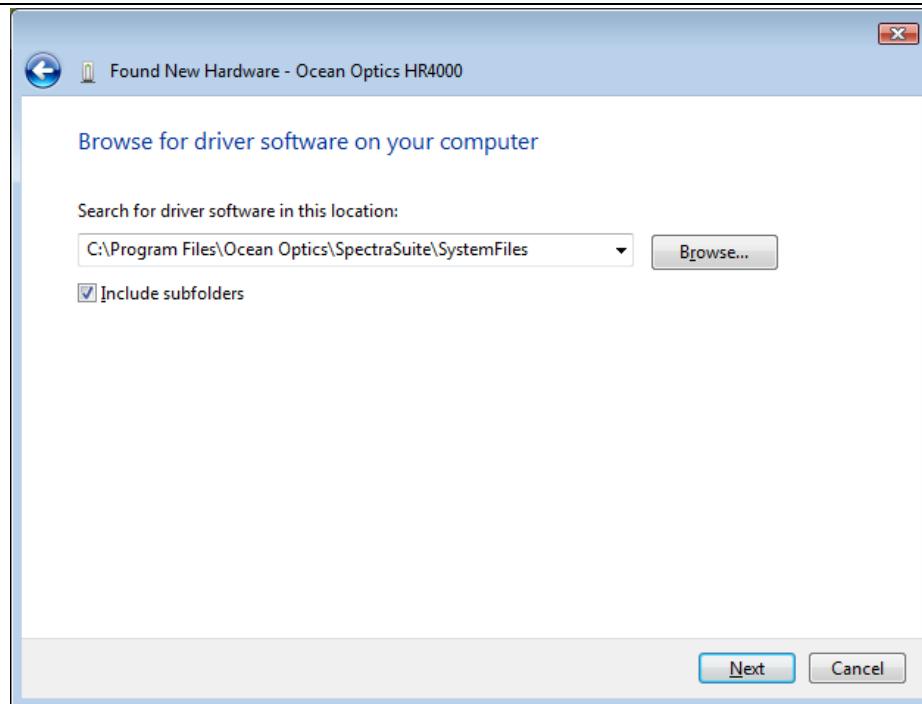


5. Choose **Browse my computer for driver software (advanced).**
6. Navigate to C:\Program Files\Ocean Optics\SpectraSuite\SystemFiles. Highlight this folder and click **OK**.

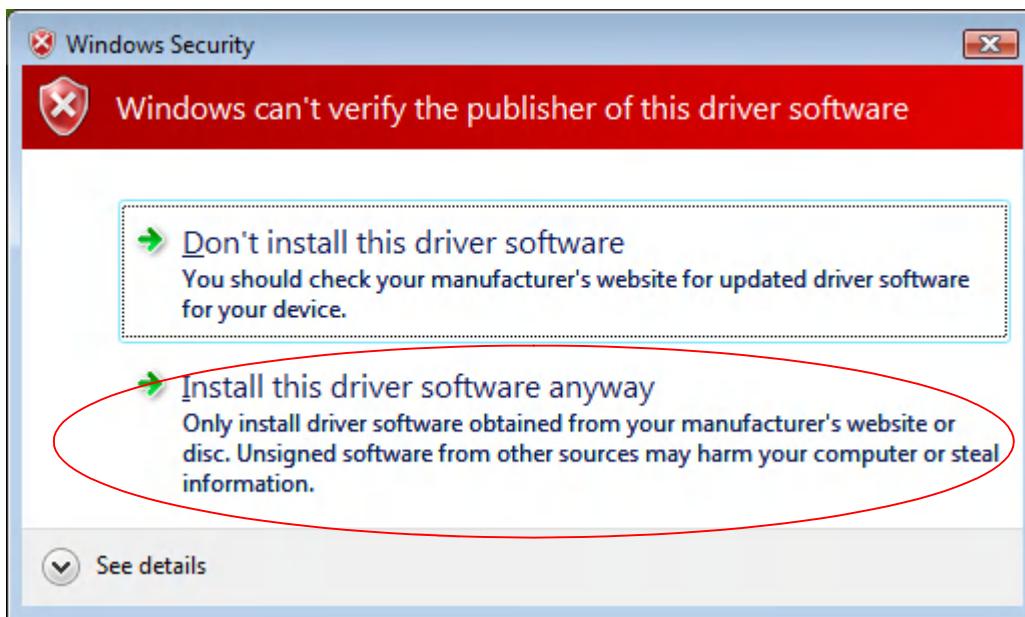


7. When the **Found New Hardware** screen appears, click **Next**.

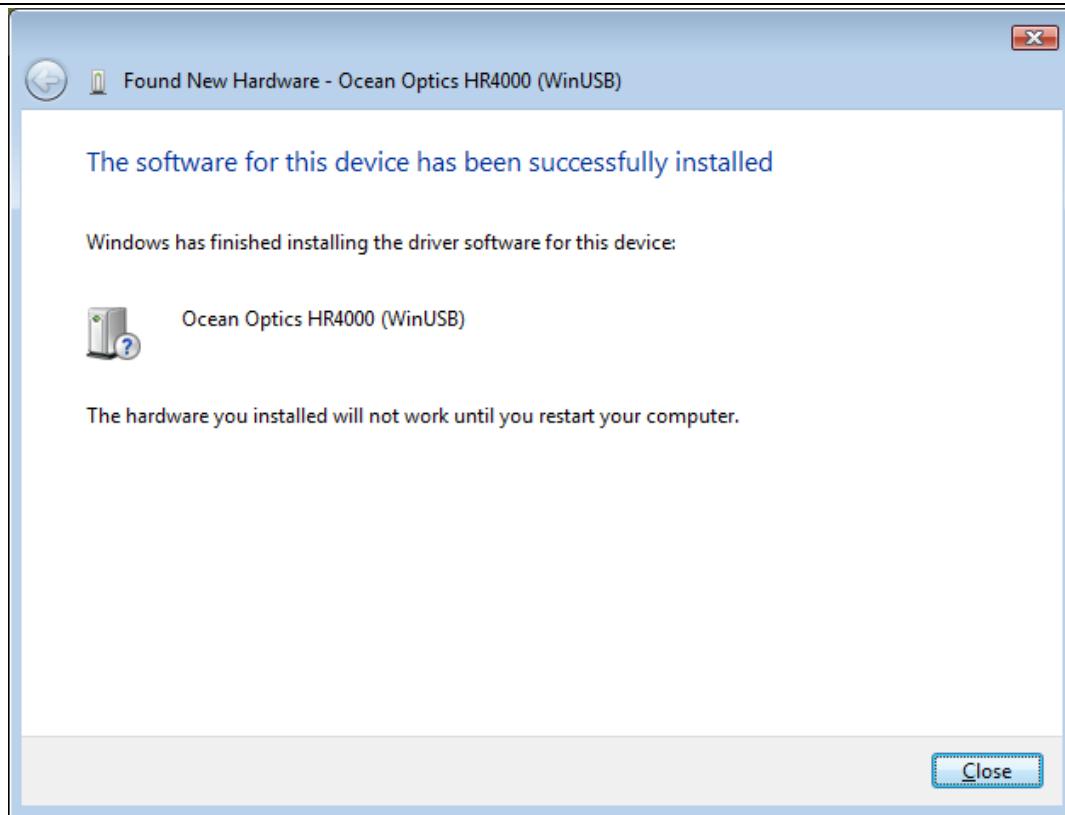
## 2: Installation



8. On the Windows Security screen, click **Install this driver software anyway**.



9. When the driver installation is successful, you will see the following screen:



10. Restart your computer for your driver installation changes to take effect.



# Chapter 3

# Controls and Indicators

## Overview

SpectraSuite consists of a number of visual controls in the form of icons and buttons. This chapter describes these controls and how to use them.

Some menu selections and controls require that some action to be taken before they can be used. When unavailable, the controls are grayed-out. Many of these requirements will be lifted so that the software will ask what to do when it is not appropriate to take an action yet, but until then, the behavior is as follows:

Acquisition parameters, storing dark/reference spectra, and the Strip Chart require an unambiguous selection of an acquisition. If no acquisitions are running, try starting one. If more than one acquisition is started, try clicking on the desired trend in the graph to select the correct target. Similarly, try expanding the tree under the icon of the spectrometer and see how the controls respond to selecting each item. Right-click these items (or Control-click in MacOSX) to see additional actions for each.

Minus dark requires a dark spectrum to be stored.

A, T, R, and I (relative irradiance) require a dark and reference to be stored.

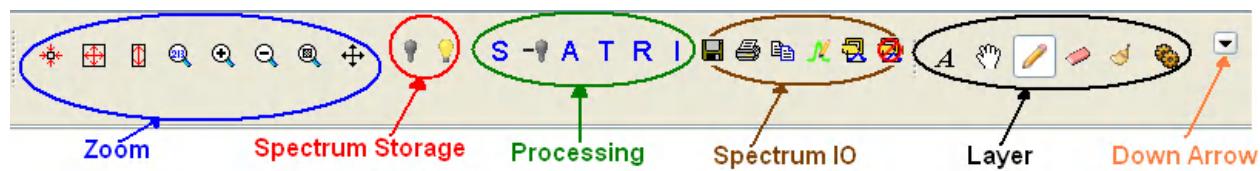
Absolute Irradiance mode (I) requires a calibration and a stored dark spectrum.

Photometry and energy/power/photons measurements require an active absolute irradiance calculation.

## Graph Controls

The heart of the SpectraSuite application is the spectrum graph. SpectraSuite provides you with a wide variety of options to customize and monitor your graph views.

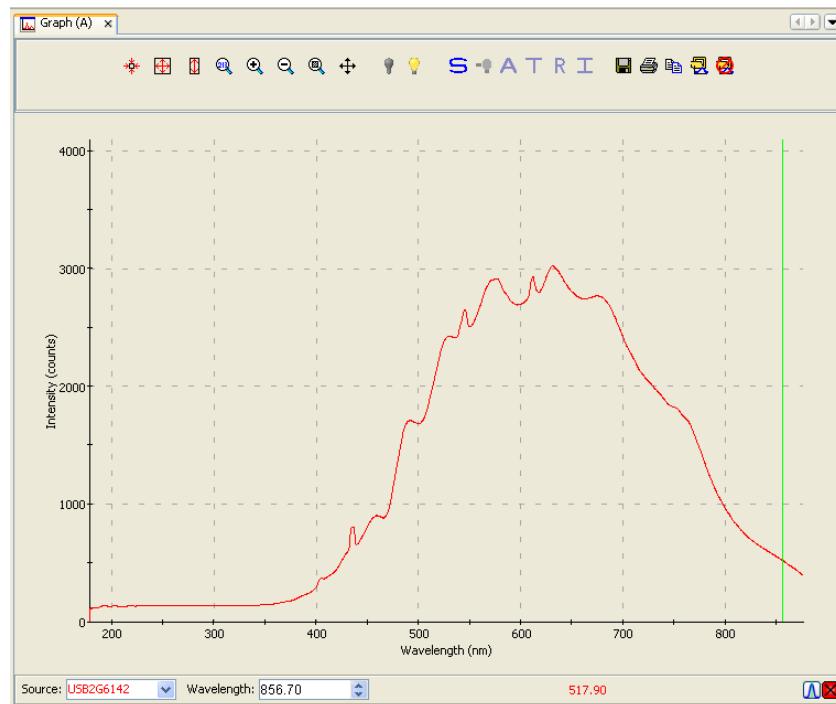
Controls are organized into the following toolbars that can be displayed or hidden using the Down Arrow button ( ).



## Zoom Tools

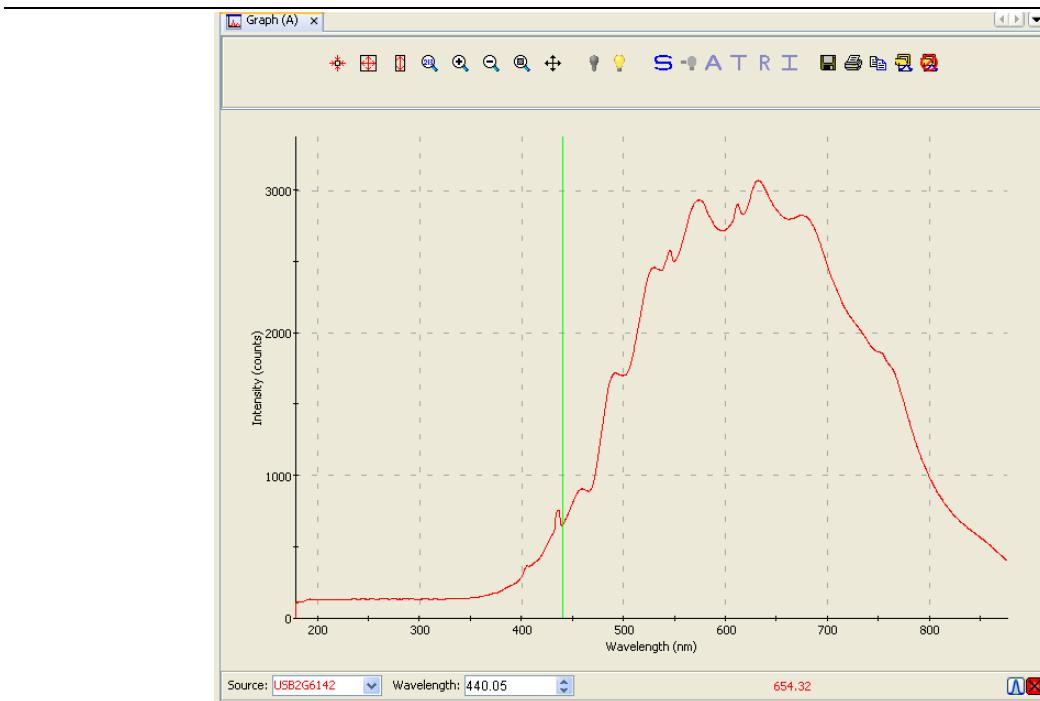
### Zoom Out to Maximum

This control zooms out to display a full view of the spectrum graph.



### Scale Graph to Fill Window

This control adjusts the graph display so that the section of the graph relevant to the spectrum line is shown, but no more. Both the x and y axis are adjusted. In this example, the graph is zoomed in so that the Y axis (Intensity) above 3500 no longer appears since the graph line does not extend that far.

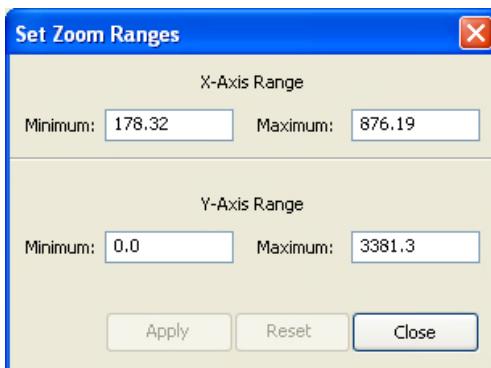


### Scale Graph Height to Fill Window

Use this control to zoom in on a graph so that the full height of the spectrum line is shown, but no more. Unlike the Scale Graph to Fill Window control, only the y axis is adjusted.

### Manually Set Numeric Ranges

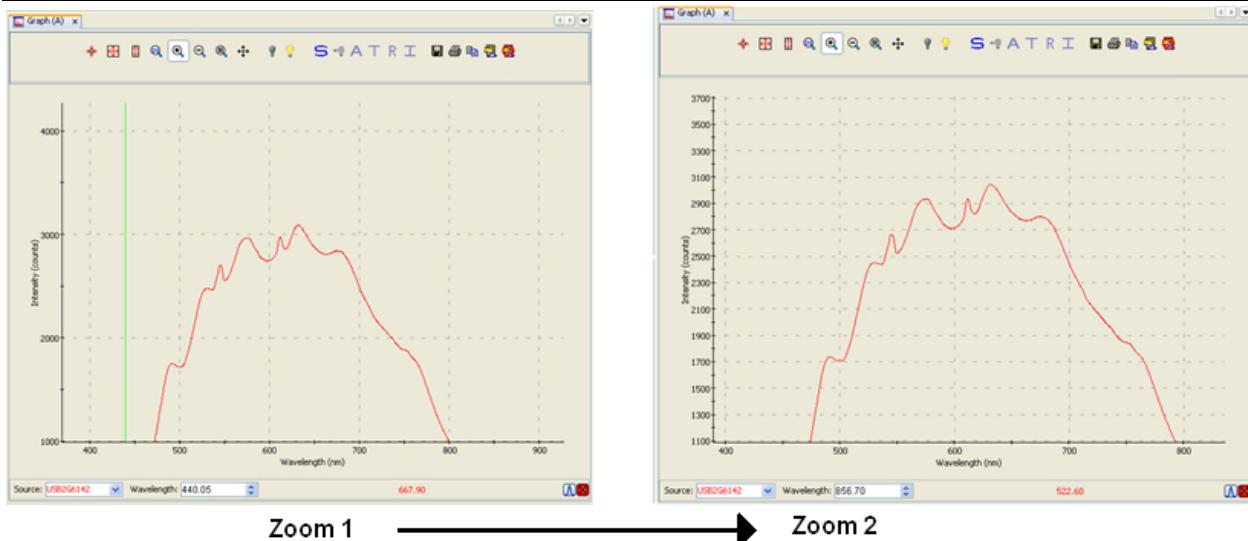
This control enables you to set the exact zoom coordinates. When you click on the control, the Set Zoom Ranges dialog box appears so that you can enter the desired coordinates.



### Zoom In

Use this control to zoom in on the graph. Each time you click this control, the display zooms in further.

### 3: Controls and Indicators



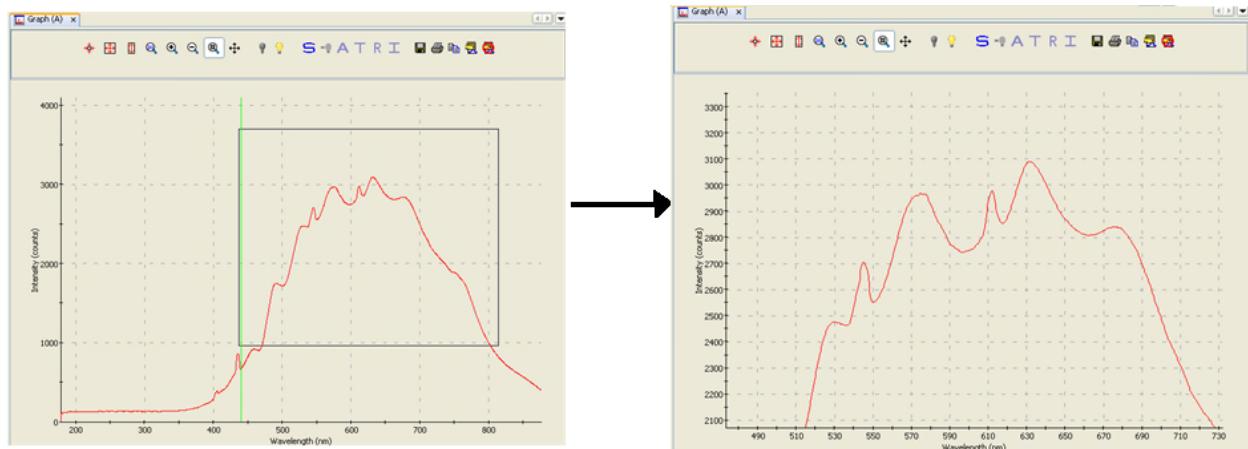
You can also use the mouse wheel to zoom in on the graph centered around the cursor (green vertical line).

#### **Zoom Out**

Use this control to reverse the zoom in process.

#### **Zoom to Region**

This control allows you to select a section of the graph to zoom in on. When you click the control, a cursor appears on the screen, enabling you to box-in a region to zoom in on.



#### **Toggle Graph Pane**

Use this control when you have more than one graph and want to switch between graph displays.

## Zoom History Toolbar

This toolbar enables you to switch between previous zoom actions performed. You can make this toolbar visible via the Down arrow next to the Layer toolbar.

Using these tools, you can do the following:

- Change to a previous zoom setting
- Change to the next zoom setting

## Spectrum Storage Tools

Icon	Meaning
	Store dark spectrum
	Store reference spectrum

These tools are also available from the **File | Store** menu. See [Store](#) for more information on these functions.

## Processing Tools

Icon	Meaning
	Scope Mode
	Scope Minus Dark Mode
	Absorbance Mode
	Transmission Mode
	Reflection Mode
	Relative Irradiance Mode

These tools can also be accessed from the **Processing | Processing Mode** menu.

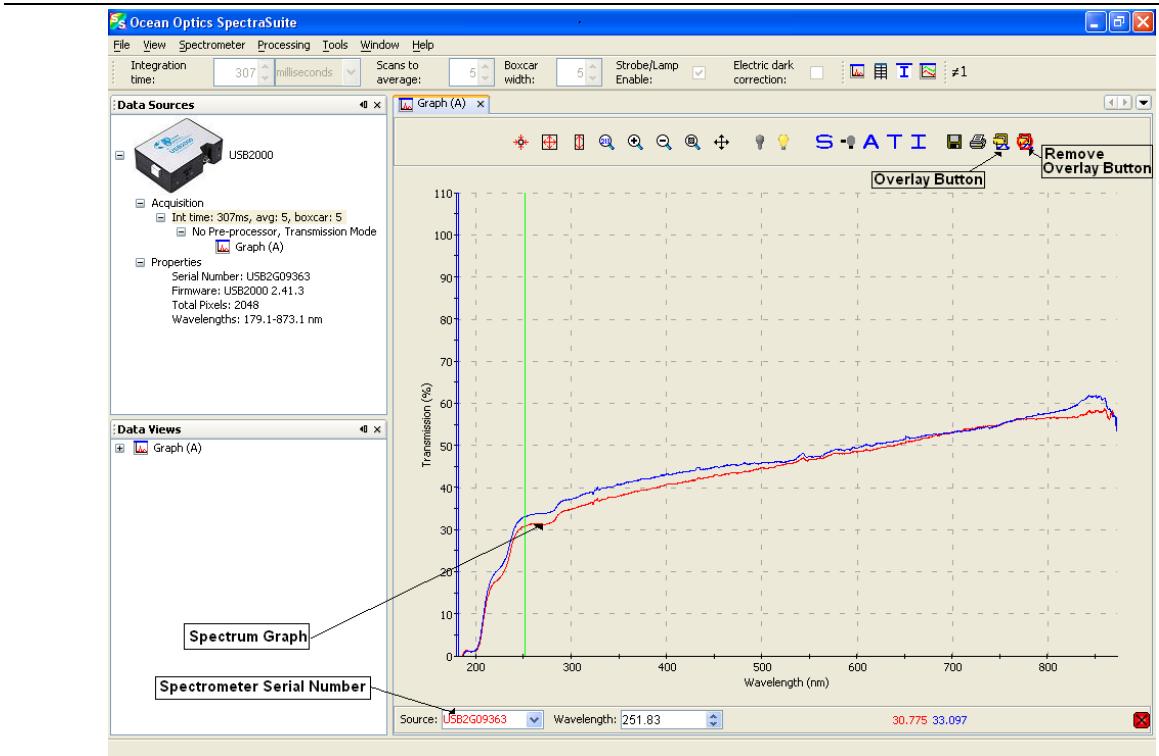
## Spectrum IO Tools

Icon	Meaning
	Save Spectra. Click to save data in either a Grams SPC format, JCAMP format, binary format (which only SpectraSuite can read) or tab-delimited format (can be opened in an Excel spreadsheet).
	Opens the SpectraSuite Printing dialog box. Select what you want to print and to where (system printer, PDF file). You can select to print various layers on your graph, zoom in to a section of the graph, and add a title, if desired. You can adjust the font size and display of grid lines. The Preview button displays a view of how your printout will look.
	Copy spectral data to clipboard.
	Copy graphical spectra to clipboard.
	Convert active spectrum to overlay.
	Overlay spectral data. Overlays a previously saved spectrum onto the current graph. See <a href="#">Overlay Spectral Data</a> for more information.
	Delete overlay spectra. Deletes any spectra that have been overlaid on the current graph.



### Overlay Spectral Data

The Overlay Spectral Data control enables you to display a saved spectrum on the current spectrum. Click this control, and then browse for the file that you want to overlay on the current graph. The overlay shows the spectrometer serial number and the filename that you loaded the overlay from.



## Layer Tools

The Layer tools provide you with functions to write captions and other meaningful data on your graphs. Select the tools using the Layer Toolbar.

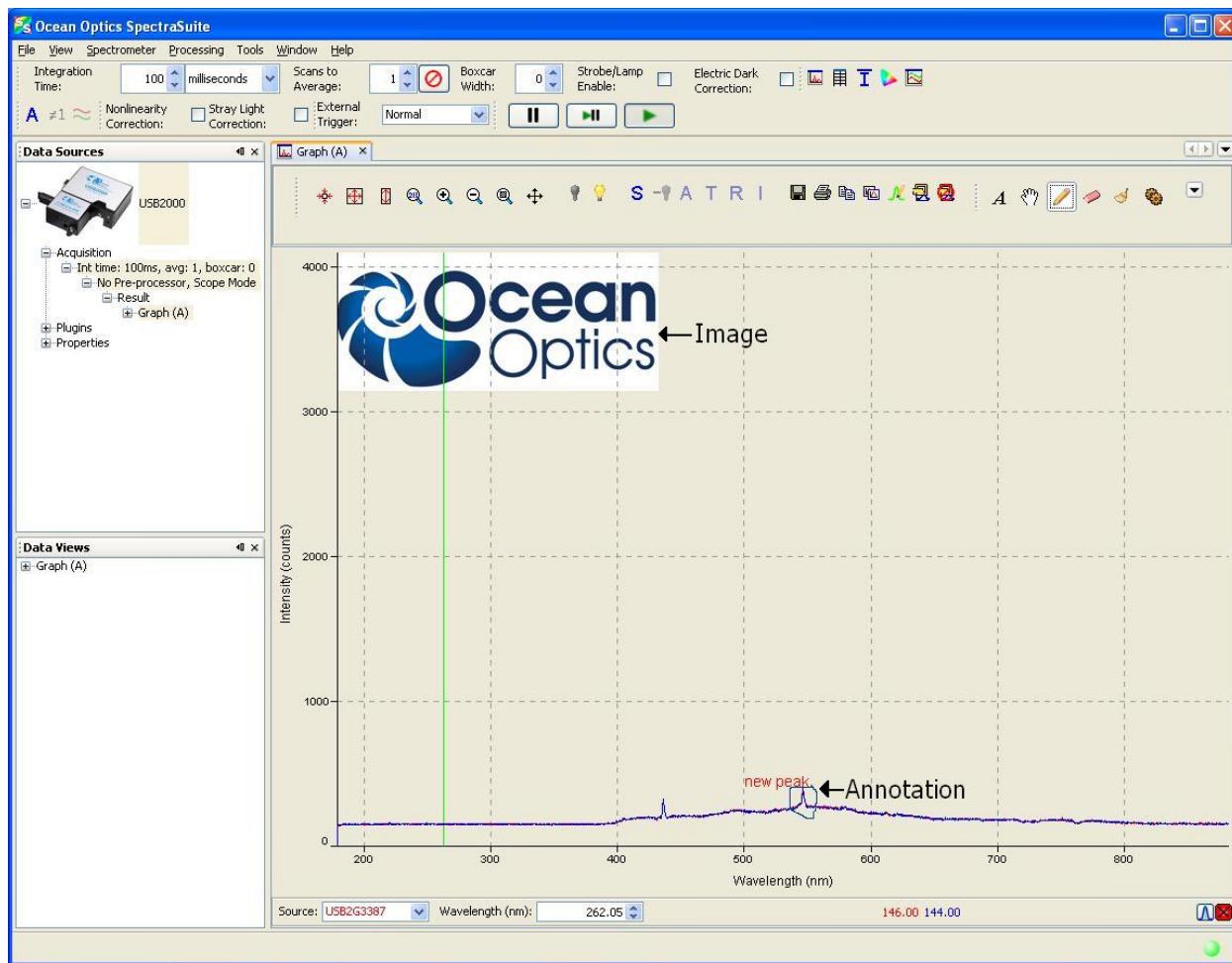


Tool	Function
	<b>Add New Annotation.</b> Displays the New Annotation dialog box to add a new annotation to the selected graph.
	<b>Select and Drag Annotation.</b> Allows you to grab an annotation on the graph and drag it to another location.
	<b>Draw.</b> Allows you to draw freehand (using the mouse) on the graph.
	<b>Erase Areas of Drawing Layer.</b> Erases selected portions of the drawing created with the Draw tool (pencil).

### 3: Controls and Indicators

Tool	Function
	<b>Clear Drawing Layer.</b> Clears the entire drawing made with the Draw tool (pencil).
	<b>Graph Layer Options.</b> Displays the Graph Layer Options dialog box (see Graph Layer Options).

The following figure shows a graph with an image layer and an annotation circled with the drawing tool.



# Other Controls

## Acquisition Controls

Much like controls on a VCR, the Acquisition Controls allow you to pause and resume continuous spectra acquisition, and perform a single acquisition.

Control	Action
	Pause selected acquisition
	Perform single acquisition
	Resume selected acquisition

## Peak Finding

This control (located in the bottom, right corner of the graph) allows you to create a threshold on your spectral graph to isolate peaks.

---

### Note

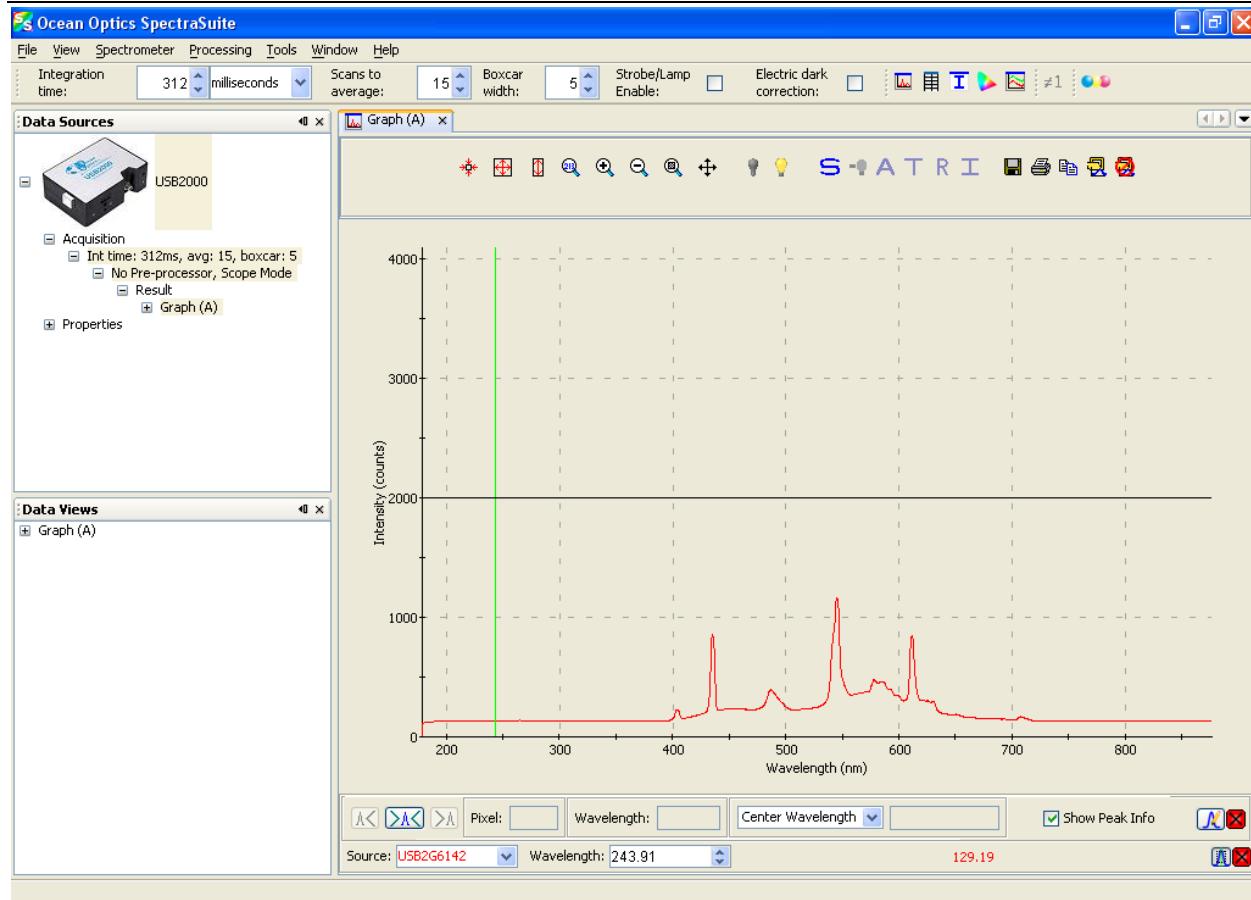
If this control does not display on your graph, click in the graph to make it appear.

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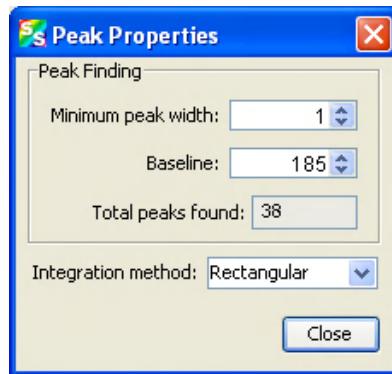
### ► *Procedure*

1. Click  . A threshold line appears on the graph, along with more Peak Finding controls. The threshold is set high and in most cases, should be adjusted.

### 3: Controls and Indicators



- Click  to display the Peak Properties dialog box to set the threshold.

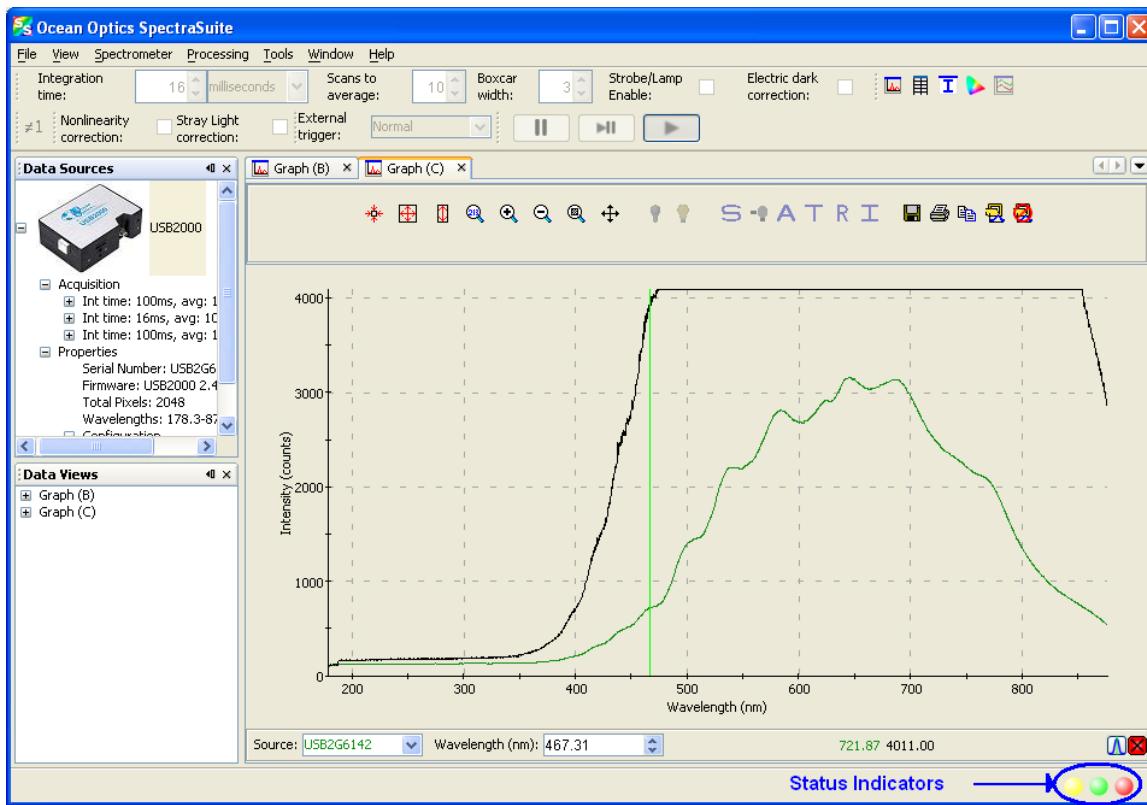


- Set the threshold at the level needed to isolate the desired peaks. The threshold line moves into the location you selected.
- Use  and  to move the cursor to the next peak (left or right), and  to snap to the peak. The peak wavelength value appears in the Wavelength field below the graph.
- Check **Show Peak Info** checkbox to display peak data in the Pixel and Wavelength boxes.

# Indicators

## Status

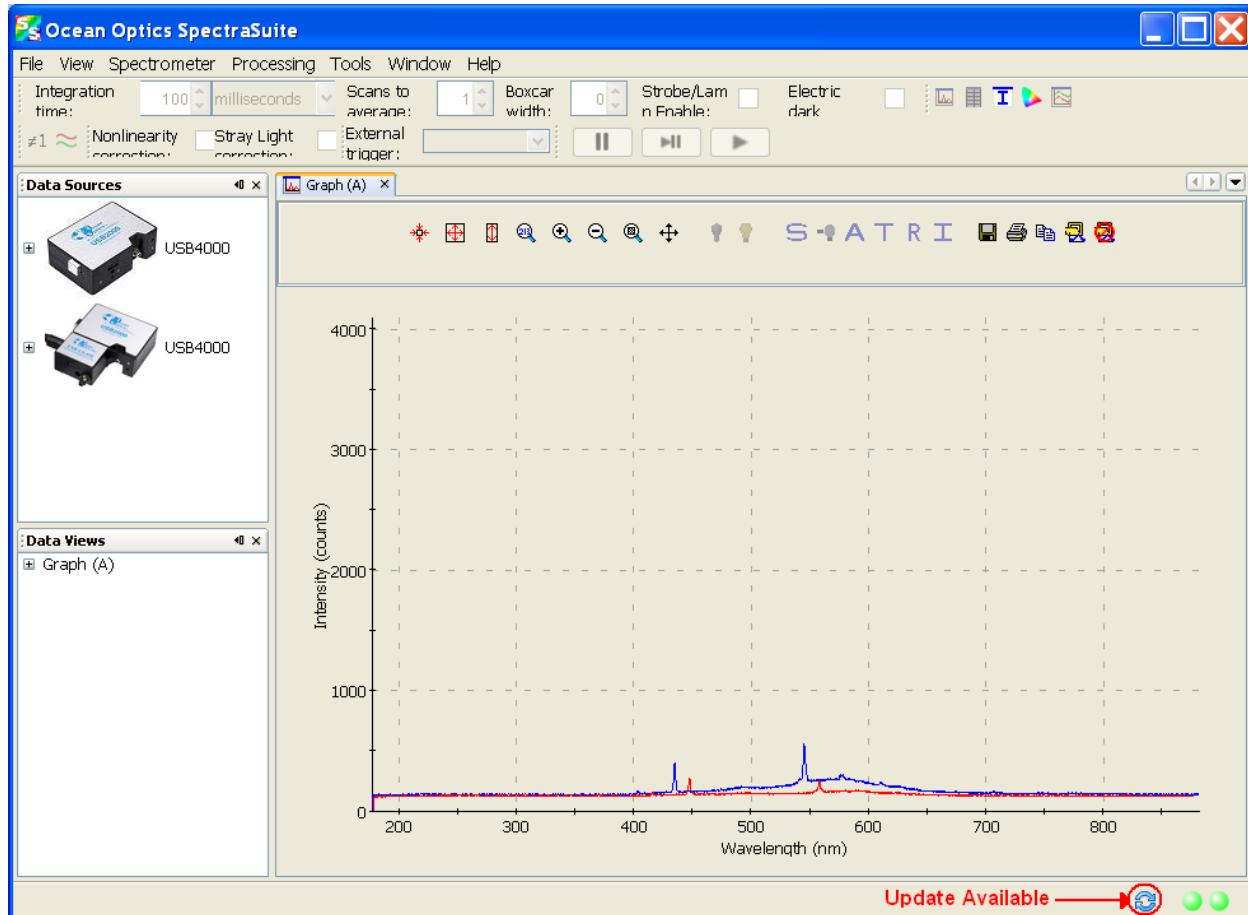
SpectraSuite provides you with feedback as to the status of the acquisitions you have graphed. The indicators refer to spectra shown on the graph currently displayed, as well as spectra on any other graphs that you have open (that appear on the graphs accessed from the tabs at the top of the screen). The feedback is in the bottom, right corner of the screen in the form of different colored circles. In the following example, two status indicators are shown for both spectral lines on Graph C, while a third indicator appears for the spectral line on Graph B.



Indicator	Meaning
	Recent acquisition within normal ranges
	Saturated signal
	Acquisition is paused
	Idle

Each circle corresponds to a graphed spectrum. If you pass the arrow pointer over a circle, it displays the spectrometer to which it refers and the related settings (e.g., **USB2G6142**, **Int time: 20 ms, avg: 10**, **boxcar: 3**). Click on a circle to select its associated spectrometer.

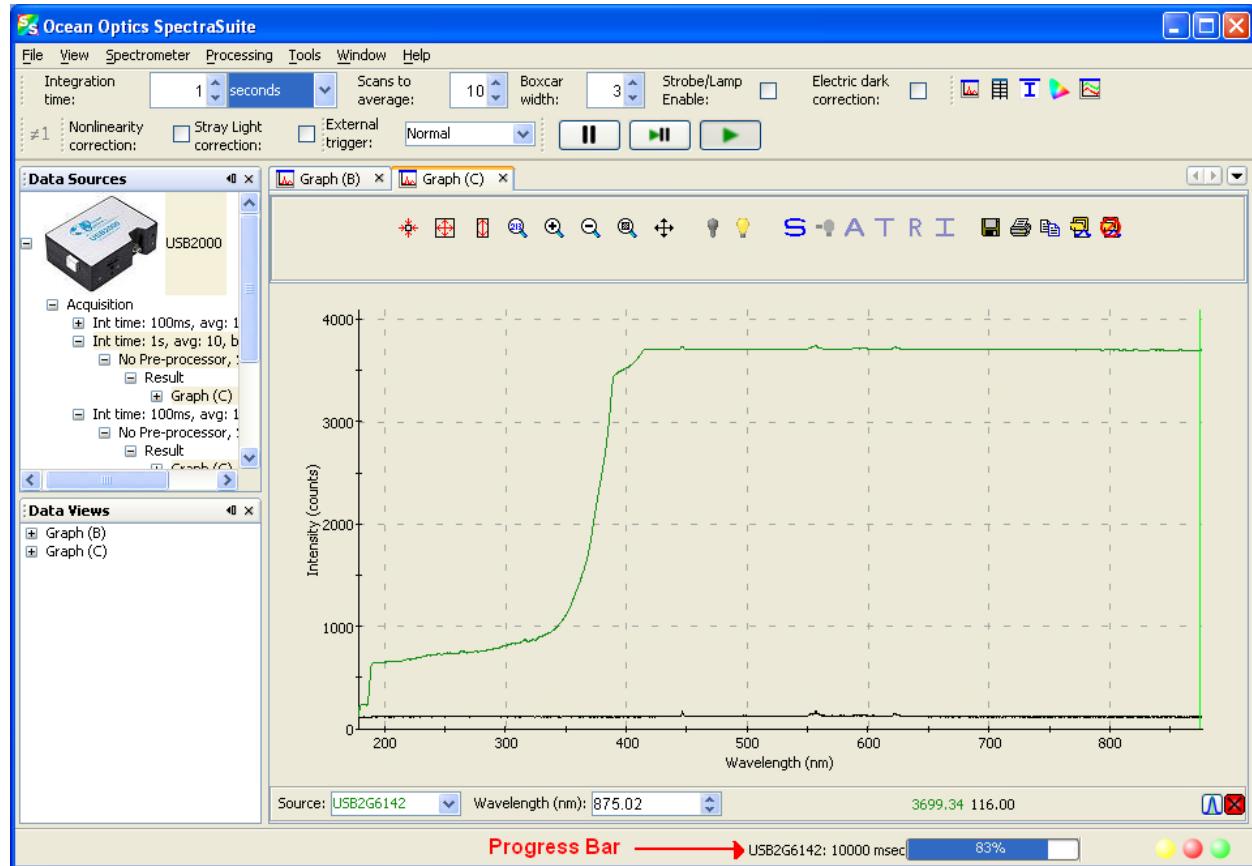
# Update Available



Indicator	Meaning
	A software update is available to be downloaded. Go to <b>Tools   Update center</b> .

## Progress Bar

If an acquisition takes longer than one second, a progress bar appears at the bottom of the screen. A progress bar can appear for each connected spectrometer that is acquiring data.





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# Chapter 4

# File Menu Functions

## Overview

This chapter details the various options and functions available from the File menu in SpectraSuite. Where applicable, each section contains the associated toolbar icon below the section heading. Click on these icons in SpectraSuite to perform the described function.

## New

The New menu selection displays the following list of functions that also are available from the Data Display toolbar:

[Spectrum Graph](#)

[Regression Utility](#)

[High-Speed Acquisition](#)

[Absorbance Measurement](#)

[Transmission Measurement](#)

[Reflection Measurement](#)

[Relative Irradiance Measurement](#)

[Gated Fluorescence Measurement](#)

[Curie Fluorescence Measurement](#)

[Absolute Irradiance Graph](#)

[New Absolute Irradiance Measurement](#)

[New Concentration Measurement](#)

[Color Measurement](#)

[Strip Chart](#)

[Strip Chart Table](#)

## Spectrum Graph



The Spectrum Graph menu option displays a new curve of spectral data on the open graph based on the parameters set in the Acquisition toolbar. Each new curve you create appears as a different color in the graph. Graphs appear in scope mode by default.

If you click on a curve, its corresponding parameters appear in the Acquisition toolbar. The data source (spectrometer) is listed in the Source box.

### ► Procedure

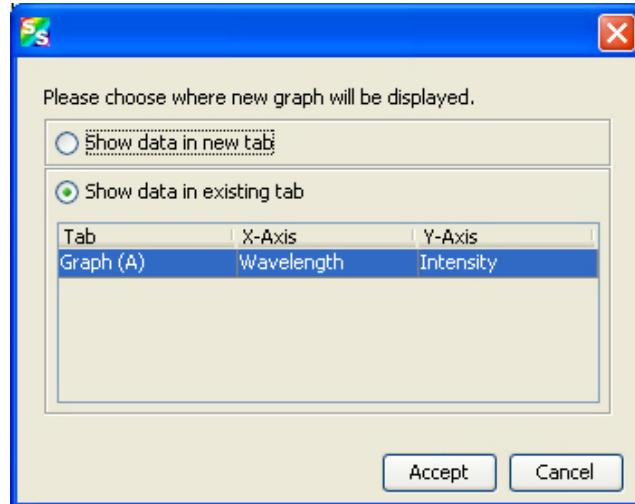
To display a spectral graph, follow the steps below:

1. Select **File | New | Spectrum Graph**

Or

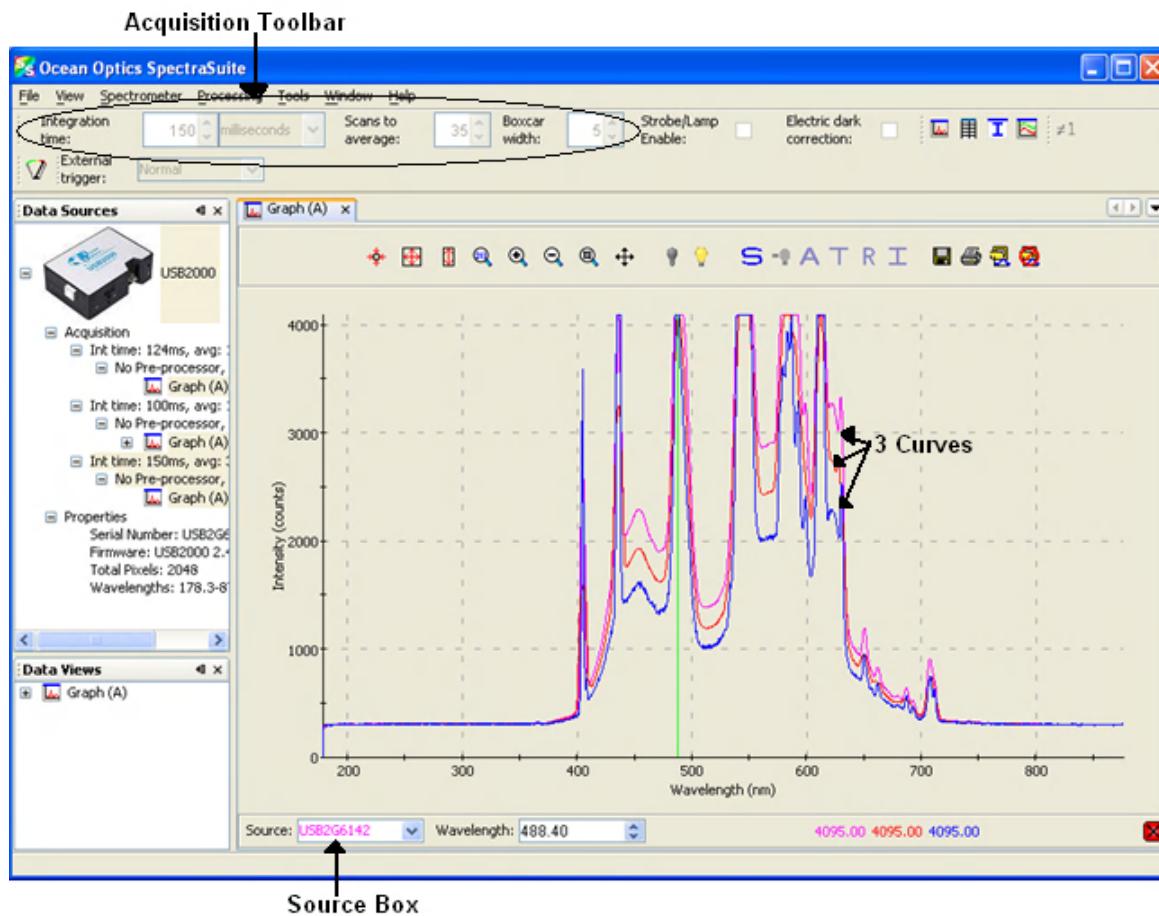


Click in the Data Display toolbar. A dialog box appears asking if you want to display the new graph in the current graph tab, or start a new graph tab.



2. Choose where the new graph will be displayed and click **Accept**.
3. Set the desired parameters (integration time, scans to average, and boxcar width).

The sample below shows a graph with three spectral curves (blue, pink and orange) in the same graph tab.

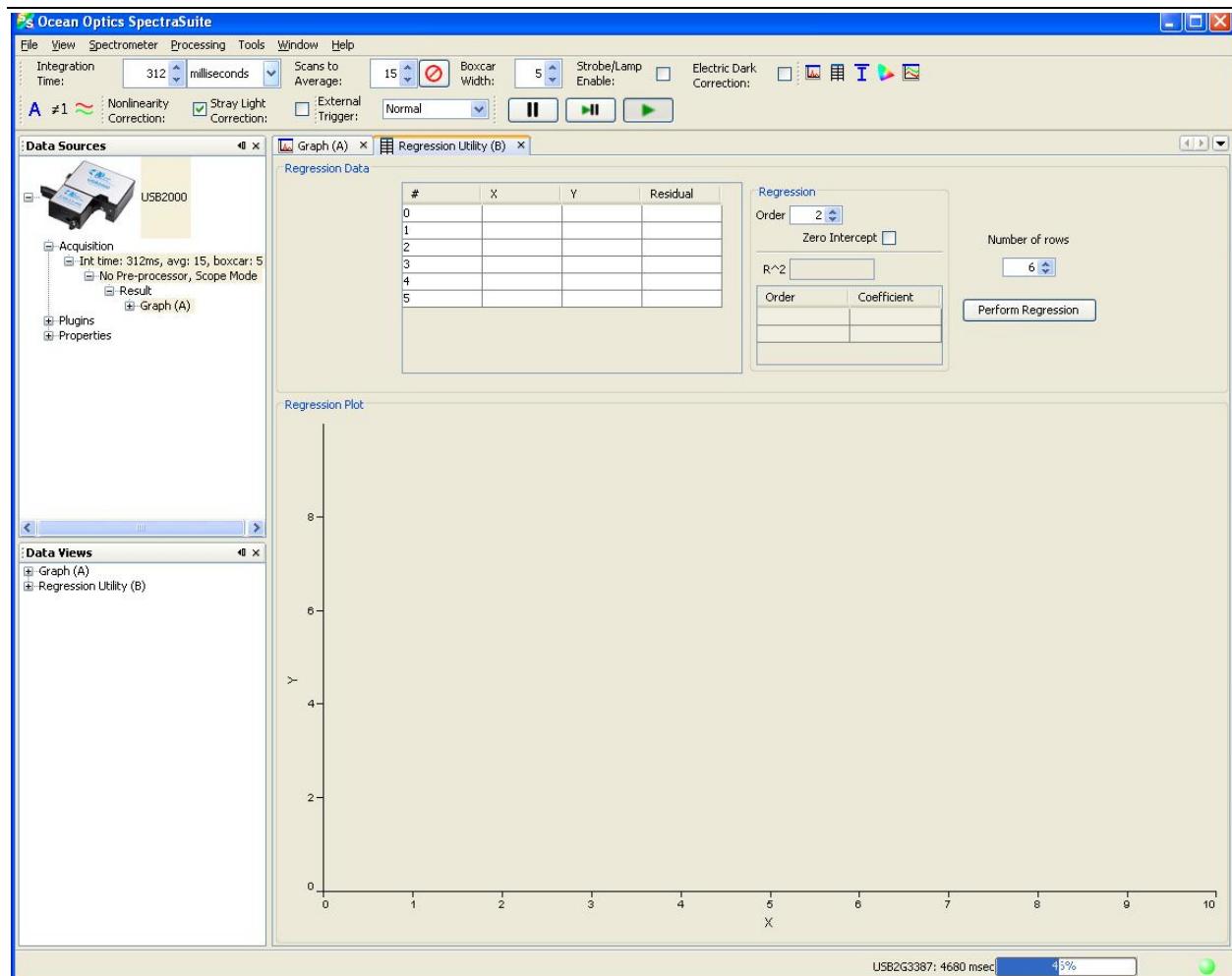


## Regression Utility



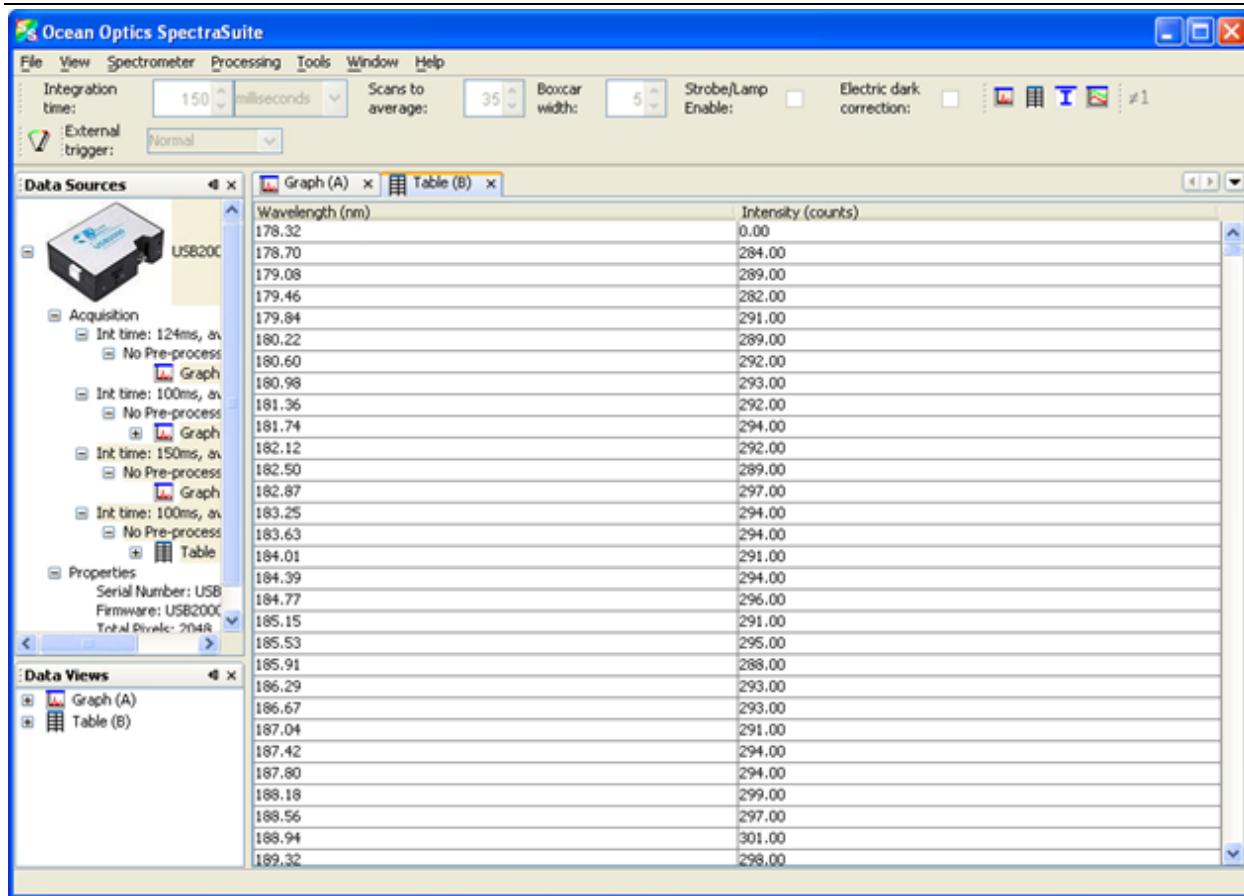
The Regression Utility menu option allows you to perform an n-order regression on the fly using the values that you specify.

#### 4: File Menu Functions



## Spectrum Table

 The Spectrum Table menu selection displays a spectral graph in tabular format. Select **File | Spectrum Table** from the menu or click  in the Data Display toolbar. The spectrum table appears.



## High-Speed Acquisition

 Use this menu selection if you want to capture every scan at a very fast rate (20 ms or faster). SpectraSuite performs this high-speed data acquisition by capturing raw data without slowing it down by processing it. This captured high-speed data is called a spectra collection.

A spectra collection can be viewed in either a graph or table format. You can also view the captured data in a 3-dimensional graph.

It's best to store your reference and dark spectra using the regular graph window before performing a high-speed data acquisition. The following procedure assumes that you do so.

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### Note

When high-speed acquisition is acquiring data, all other acquisitions will be temporarily stopped.

---

## High-Speed Data Capturing

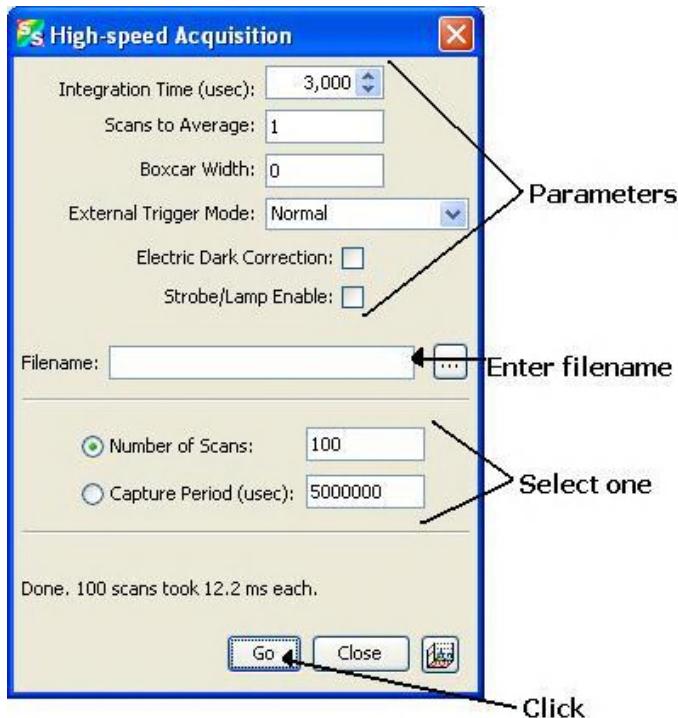
### ► Procedure

1. Save reference spectrum to a file. See [Reference](#).
2. Save a dark spectrum to a file. See [Dark](#).

### Caution

To ensure accurate data, be sure that you have selected the same parameters (integration time, scans to average, and boxcar width) for your high-speed acquisition that you used when capturing your dark and reference spectra.

3. Select **File | New | High Speed Acquisition**. If you have other acquisitions running, a warning message appears telling you that all other acquisitions will be stopped when you are acquiring high speed data. Either stop all your other acquisitions, or click **OK** on this message and SpectraSuite will temporarily stop them. The **High-speed Acquisition** dialog box appears.



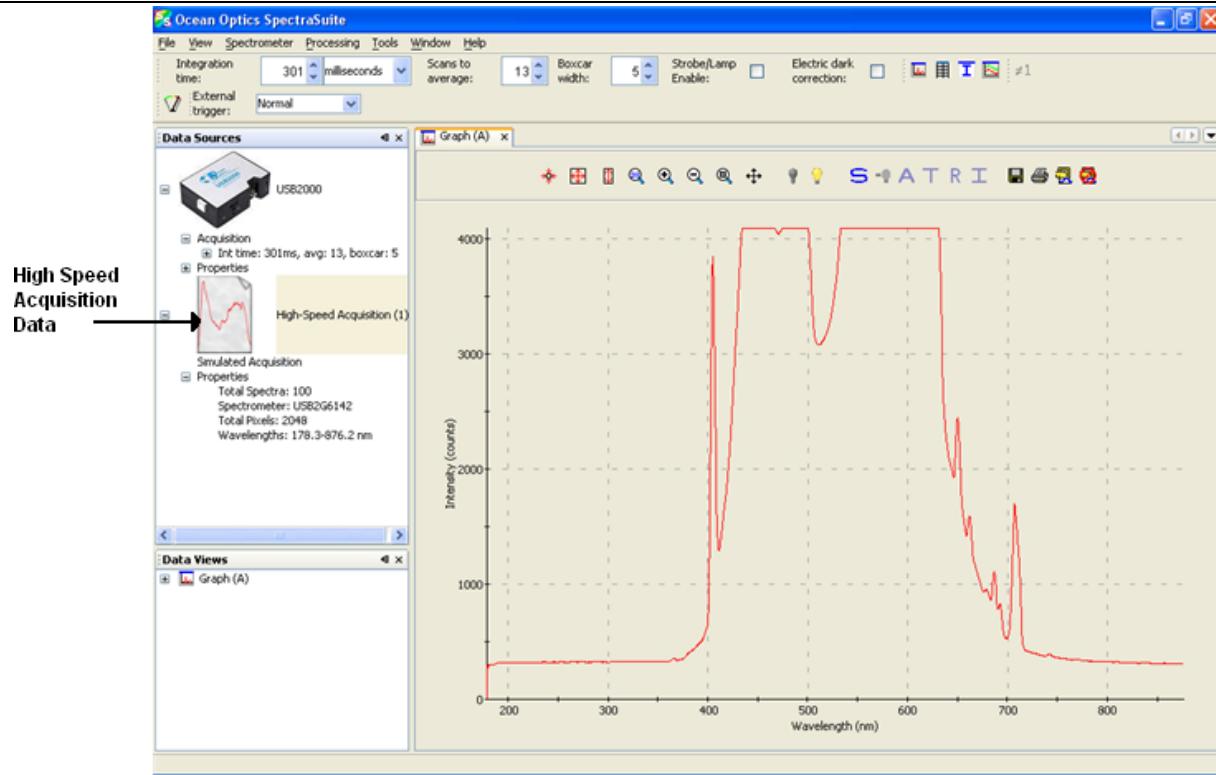
The top third of the form lists the parameters selected in the main graph window.

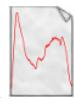
4. Enter the following information:

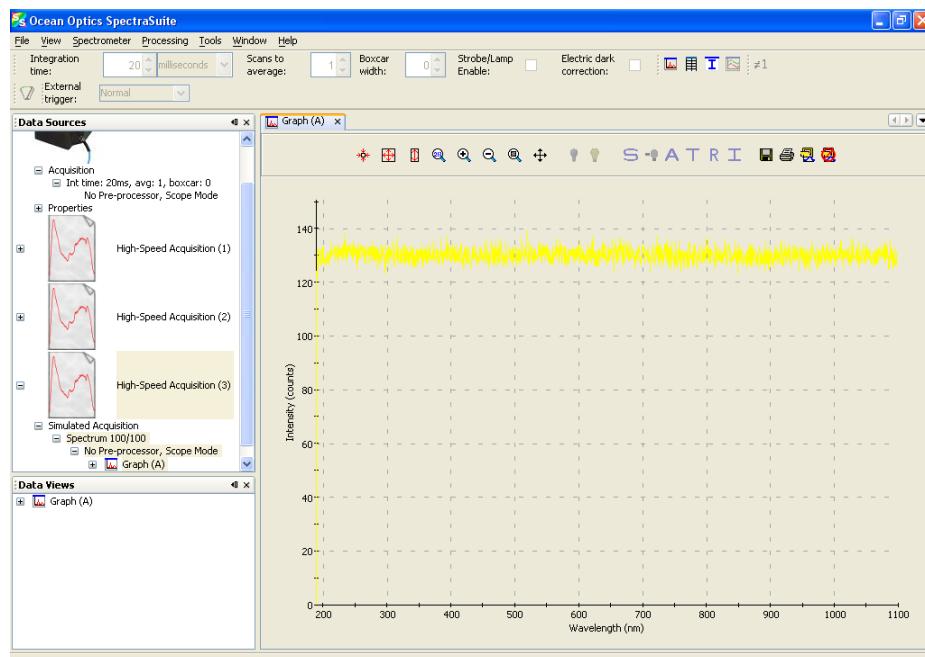
Field	Selection
Integration Time (μsec)	Specify the integration time in μsec.
Scans to Average	Enter the number of scans to average
Boxcar Width	Enter the boxcar width
External Trigger Mode	Select the external trigger mode (Normal, Software, Synchronization, External Hardware)
Electric Dark Correction	Enable this option for electric dark correction
Strobe/Lamp Enable	Enable this option to turn on the lamp
Filename	Enter the name or browse to the file where you want to store data in a tab-delimited format.
Number of Scans Or Capture Period (μsec)	Choose one of these methods of data acquisition Acquire a fixed number of scans (fastest method) Specify a time period for data capture

5. Click . Your high-speed acquisition data appears in the **Data Sources** pane.

#### 4: File Menu Functions



6. Right-click on . A menu displays the following selections:
- **Spectrum Graph** – Displays a graph of the spectra



- **Spectrum Table** – Displays spectra data in a table format

Wavelength (nm)	Intensity (counts)	Wavelength (nm)	Intensity (counts)
178.32	0.00	178.32	0.00
178.70	283.00	178.70	288.00
179.08	282.00	179.08	289.00
179.46	284.00	179.46	283.00
179.84	282.00	179.84	287.00
180.22	286.00	180.22	288.00
180.60	288.00	180.60	287.00
180.98	294.00	180.98	289.00
181.36	293.00	181.36	292.00
181.74	291.00	181.74	294.00
182.12	289.00	182.12	291.00
182.50	291.00	182.50	293.00
182.87	294.00	182.87	292.00
183.25	289.00	183.25	289.00
183.63	292.00	183.63	292.00
184.01	296.00	184.01	293.00
184.39	295.00	184.39	295.00
184.77	291.00	184.77	292.00
185.15	293.00	185.15	294.00
185.53	293.00	185.53	292.00
185.91	292.00	185.91	293.00
186.29	297.00	186.29	287.00
186.67	288.00	186.67	292.00
187.04	294.00	187.04	292.00
187.42	293.00	187.42	290.00
187.80	295.00	187.80	291.00
188.18	295.00	188.18	289.00
188.56	293.00	188.56	293.00
188.94	287.00	188.94	294.00

- **Save Spectra Collection** – Stores the high-speed spectra in a file. See [Creating a 3-D Chart of High-Speed Acquisition Spectra](#) for more information about what can be done with stored high-speed spectra data.
- **3D Spectrum Terrain** – Allows you to view intensity vs. wavelength over time in a 3-dimensional format.
- **Export Grams SPC** – Exports data in a file format (SPC) to load into GRAMS spectroscopy software.
- **Remove Spectra** – Deletes the captured high-speed spectra collection data. You can also select **Spectrometer | Remove Spectra**.

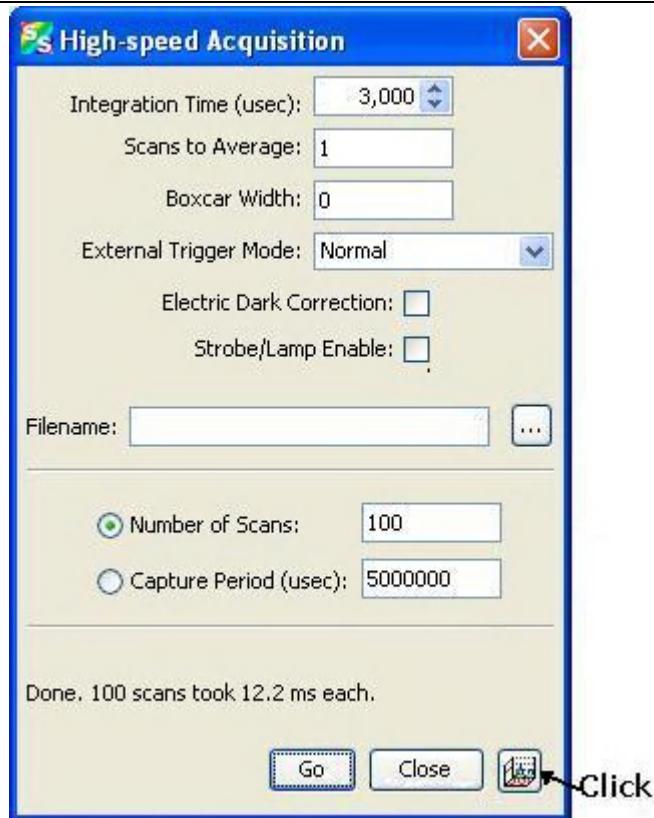
## Creating a 3-D Chart of High-Speed Acquisition Spectra

You can create a 3-dimensional representation of the data over time in graph form. The navigation controls enable you to view the graph from different angles. Click on any point in the graph to display its value and wavelength.

### ► **Procedure**

To create a 3-D graph,

1. Start a high-speed data acquisition. See [High-Speed Acquisition](#) for more information.



2. Click  on the High-speed acquisition screen. The 3-dimensional graph appears.

## Using High-speed Acquisition Spectra

A spectra collection that you have stored using the high-speed acquisition feature has a variety of uses such as the following:

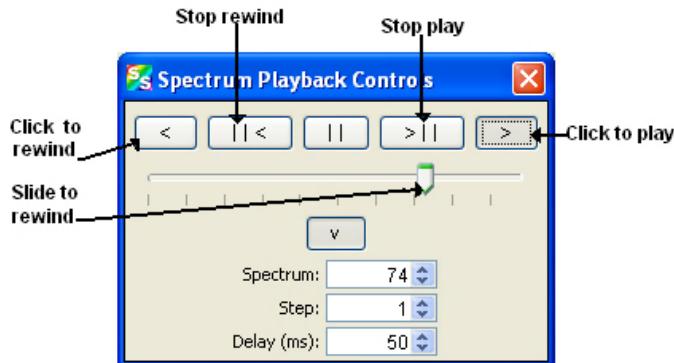
You can replay the spectra, fast forward, rewind, etc. just like any recorded data.

You can also conduct further experiments on the recorded data (absorbance, transmission, etc.) by clicking on the appropriate icon (A, T, R, or I).

### ► Procedure

To replay recorded data,

1. Start a high-speed data acquisition. See [High-Speed Acquisition](#) to display a high-speed acquisition graph..
2. Right-click on the desired spectrum listed under **Simulated Acquisition** in the **Data Sources** pane. A menu appears.
3. Select **Spectrum Playback Controls**. The **Spectrum Playback Controls** dialog box appears.

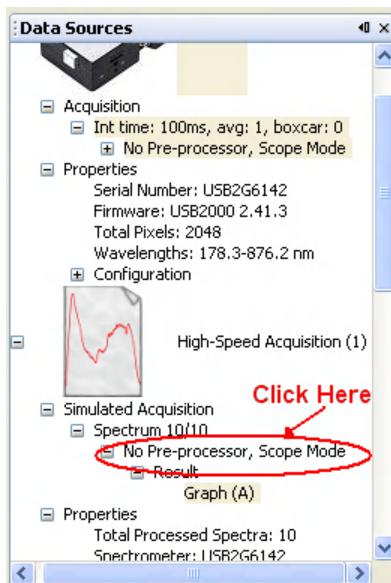


- Rewind the recording, then press to play the recorded spectrum graph.

### ► Procedure

To do further processing on recorded data,

- Begin playback of recorded data. Note that the tree in the **Data Sources** pane populates with the usual acquisition data.
- If needed, load preprocessing data (dark and reference spectra) by right-clicking on **No pre-processor, Scope Mode** in the **Data Sources** pane and selecting **Load Reference Spectrum** and **Load Dark Spectrum**. Browse to the desired reference and dark files.



Or, you can store reference and dark spectra at any time during playback if you have the necessary data in your collection.

---

**4: File Menu Functions**

3. Once you have loaded the processed spectrum files, you can switch to another mode (Absorbance, Transmission, etc.) by clicking on the appropriate icon (**A**, **T**, etc.).

## Absorbance Measurement

**A** The Absorbance Measurement menu selection launches the Absorbance Measurement Wizard to facilitate taking an absorbance measurement using SpectraSuite. The wizard leads you through the steps necessary to take an absorbance measurement:

1. Selecting your source
2. Setting the data acquisition parameters
3. Taking a reference spectrum
4. Taking a dark spectrum

See [Absorbance Experiments](#) for more information on taking an absorbance measurement.

## Transmission Measurement

**T** The Transmission Measurement menu selection launches the Transmission Measurement wizard to help you through the process of taking a transmission measurement.

## Reflection Measurement

**R** The Reflection Measurement menu selection launches the Reflection Measurement wizard to help you through the process of taking a reflection measurement.

## Relative Irradiance Measurement

**I** The Relative Irradiance menu selection launches the Relative Irradiance Measurement wizard to help you through the process of taking a relative irradiance measurement.

## Gated Fluorescence Measurement

**F** The New Gated Fluorescence Measurement menu selection is activated when you are using a spectrometer with a gated detector (such as the USB2000-FLG). When you select this menu item, a wizard leads you through the steps necessary to take a gated fluorescence measurement:

1. Selecting your source
2. Setting the data acquisition parameters

- 
- 3. Taking a reference spectrum
  - 4. Taking a dark spectrum
  - 5. Setting your gated delay

See [Fluorescence](#) for more information on taking a fluorescence measurement.

## Curie Fluorescence Measurement

 The New Curie Fluorescence Measurement menu selection is activated when you are using a Curie UV-VIS Emission Spectrofluorometer (serial number starts with CUR).

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### Note

The Curie UV-VIS Emission Spectrofluorometer is a discontinued product.

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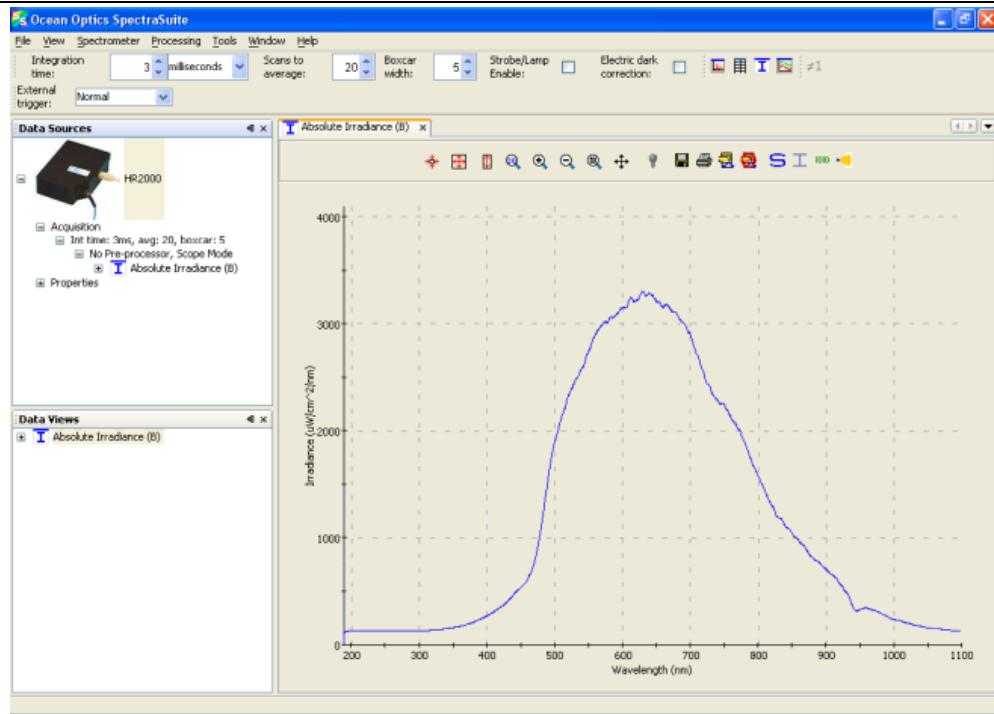
When you select this menu item, a wizard leads you through the steps necessary to take a fluorescence measurement with a Curie spectrofluorometer.

## Absolute Irradiance Graph

The Absolute Irradiance Graph menu selection displays the Absolute Irradiance graph. With SpectraSuite, you can display multiple spectra from multiple devices with independent calibrations. You can also calculate integrated intensities (watts, joules, photons) and photometric quantities (lux, lumen, candela).

Select **File | Absolute Irradiance Graph** from the menu. The Absolute Irradiance Graph in Scope mode appears. See [Absolute Irradiance](#) in Appendix A: Experiment Tutorials for more information.

#### 4: File Menu Functions



## New Absolute Irradiance Measurement

 The New Absolute Irradiance Measurement menu selection launches the Absolute Irradiance Wizard to facilitate taking an absolute irradiance measurement using SpectraSuite. The wizard leads you through the steps necessary to take an absolute irradiance measurement:

1. Selecting your source
2. Setting the data acquisition parameters
3. Taking a reference spectrum
4. Taking a dark spectrum
5. Calibrating the spectrometer

See [Absolute Irradiance](#) for more information on taking an absolute irradiance measurement.

## New Concentration Measurement

 Concentration is the amount of a specified substance in a solution. Graphs of absorbance vs. concentration are known as Beer's Law plots. These are prepared by measuring the light absorbed by a series of solutions with different *known* concentrations. The length of the sample, such as the path length of our cuvette holder, and the wavelength chosen for monitoring the amount of light absorbed are constants. A linear plot from taking scans of these standard solutions with known concentrations is then obtained. The plot is then used to determine the *unknown* concentrations of substances in solutions.

## Color Measurement

With SpectraSuite, you can calculate and report the Color Rendering Index (CRI) and Correlated Color Temperature (CCT) for your samples. SpectraSuite will compute all color measurements except RGB. You can only perform color measurements on one spectrometer at a time.

Emissive color measurements – Require a spectrometer, which has been calibrated to take irradiance readings (either relative or absolute). SpectraSuite gives you the option of choosing to measure either emissive or reflective color from either absolute or relative irradiance.

Reflective color measurements – Do not require an irradiance calibration, but they do require a reference spectrum. This reference scan is taken with the same optical configuration, except a perfect reflector is placed at the same location as the samples.

## Strip Chart

SpectraSuite allows you to use Strip Charts to track processes, perform kinetic analyses, and monitor spectral events all as a function of time. The Strip Chart shows you how the value that you selected appears over time. This value can be any of the following:

- One pixel (a single wavelength)
- The average of a range of pixels
- An integral calculated by one of three methods representing the area beneath the graph's trend line

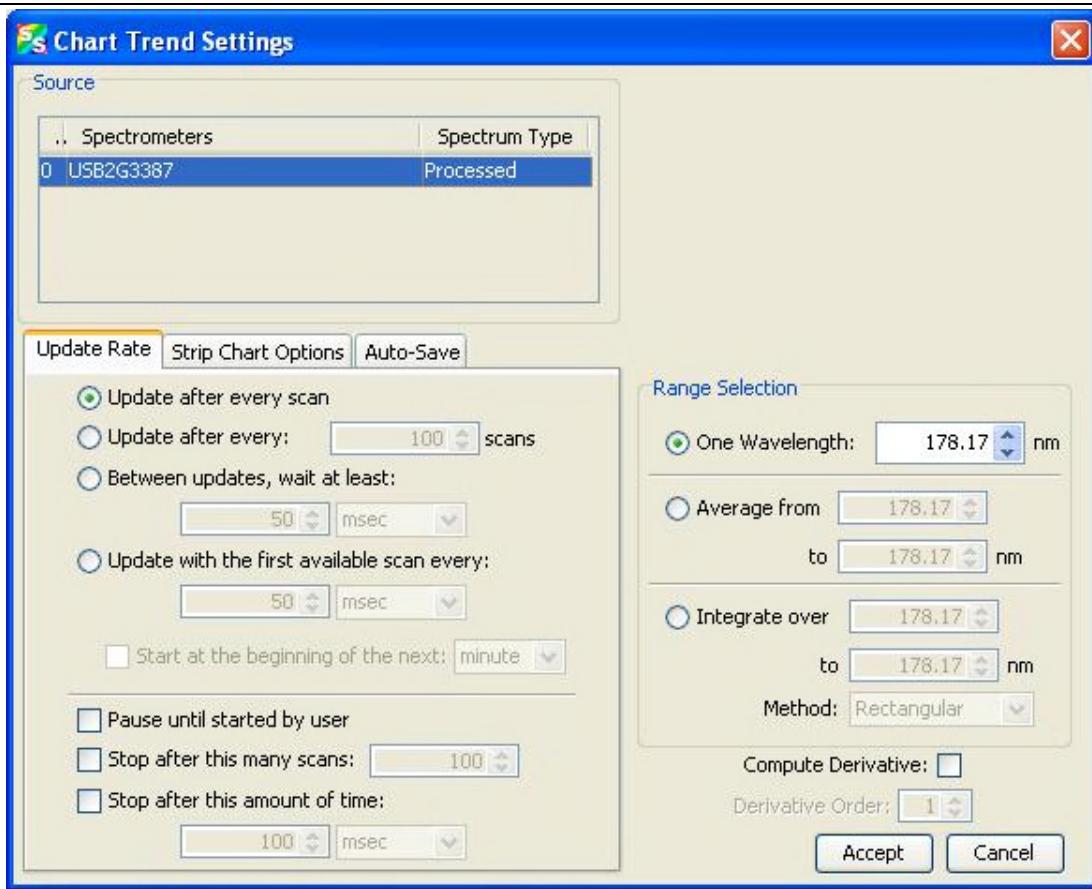
You can acquire this data using any processing mode (transmission, absorbance, etc.).

### ► **Procedure**

1. Place SpectraSuite in Scope mode by clicking the Scope () icon in the Experiment mode toolbar or selecting **Processing | Processing Mode | Scope** from the menu.
2. Store a reference spectra and dark spectra.
3. Choose the measurement mode (absorbance, transmission, etc.).
4. Click the Strip Chart button ()

OR

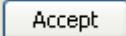
Select **File | New | Strip Chart** from the menu. The **Chart Trend Settings** dialog box opens.

**4: File Menu Functions**


5. Enter the following data to create your Strip Chart:

Tab	Selections
Update Rate  <b>NOTES:</b> This is independent of the integration time. The longer the time between updates, the less computer memory that is used.	Select the frequency of updates: after every scan; after every x scan; wait x msec, sec, minutes, hours; or update with the first available scan every x msec, sec, minutes, hours.  Select when to stop updating: pause until started by user; stop after x scans; or stop after x msec, sec, minutes, hours.
Strip Chart Options	Trend Line Color: Select a color for the graph's trend line.  Scale Trend Value: If you would like to adjust your data, enter the appropriate information in this field.
Auto-Save	Enable Trend Auto-Save: Check this box to enable auto-saving of strip chart data.  Save to Directory: Select the directory and file name for the auto-saved data.

Tab	Selections
	<p>Padding Digits: Enter the number of digits to be used when appending to a file (enter 3 to save hundreds of files, enter 4 to save thousands, etc. up to 15), for example: spectrumfile001 through spectrumfile999 if 3 is selected.</p> <p>Preview: The name of the file where you can preview saved data (in .txt format) is automatically populated.</p> <p>Save after every: Enter the desired number of msec, sec, minutes, or hours.</p> <p>Clear Trend from Memory After Save: Enable this checkbox if you want to automatically clear trend data from memory after saving.</p>
Range Selection	<p>Select from the following:</p> <p>One wavelength – For one pixel (used in fluorescence, for example). Select the wavelength.</p> <p>Average from – For a range of pixels. Select the starting and ending wavelengths.</p> <p>Integrate over – For the area underneath the trend line. Select the starting and ending wavelengths. Then, select the method for calculating the continuous area underneath the graph curve: Rectangular, Simpson's, or Trapezoid.</p> <p>Compute Derivative – Allows you to compute the mathematical derivatives of spectral data and display them.</p>

6. Click . The Strip Chart Options dialog box appears. Strip Chart Options lists all of the Strip Charts that you have created, along with the options that you have set for each one. Use this dialog box to add, edit, remove, or clear trends.

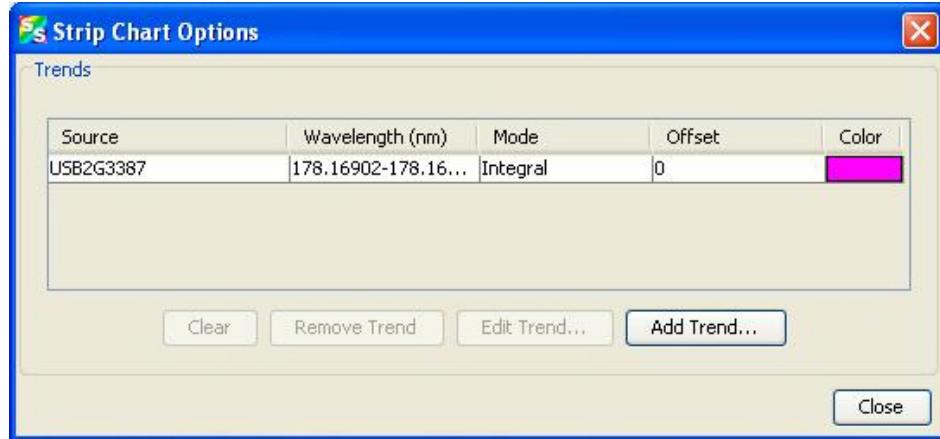
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### Note

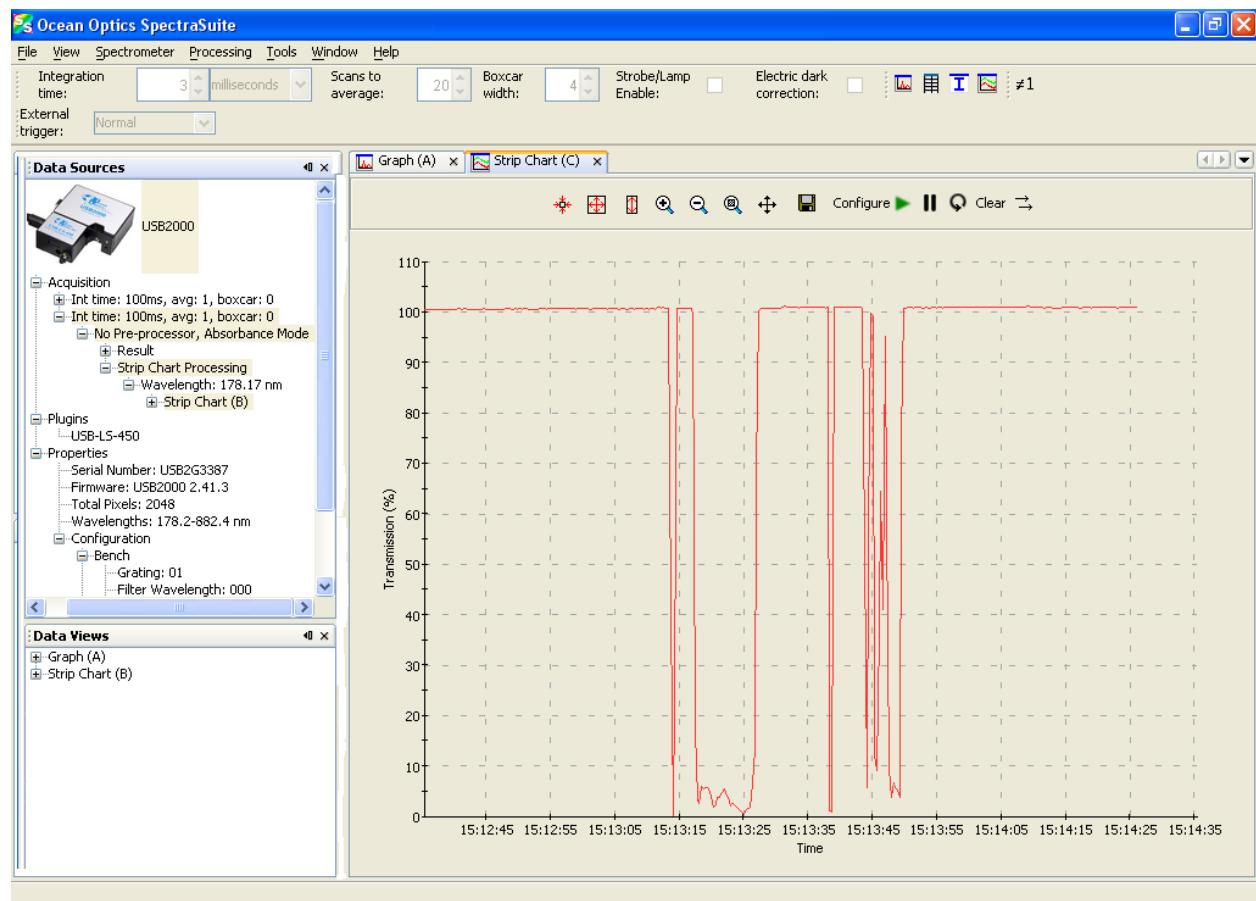
Highlight the desired trend to make the **Clear**, **Remove Trend**, and **Edit Trend** buttons active.

---

#### 4: File Menu Functions



- Click **Accept**. The strip chart you created appears. Note the time scale along the x-axis. The y-axis in this example shows the percentage transmission for the selected pixel(s).
- To add another trend to this graph, click **Add Trend...**.



## Strip Chart Table

Select **File | New | Strip Chart Table** to create a table to track a value over time. The table is updated with a new row for each new observation.

## Open

Selecting the **Open** menu option allows you to load previously saved dark spectra, reference spectra, processed spectra, or all stored all spectra files. Select the type of spectrum to load, then browse to where the file is stored.

### Dark

A dark spectrum is a spectrum taken with the light path blocked.

Select **File | Open | Load Dark Spectrum** to select and open one or more dark spectra.

### Reference

A reference spectrum is a spectrum taken with the light source on and a blank in the sampling region.

Select **File | Open | Load Reference Spectrum** to select and load one or more reference spectra.

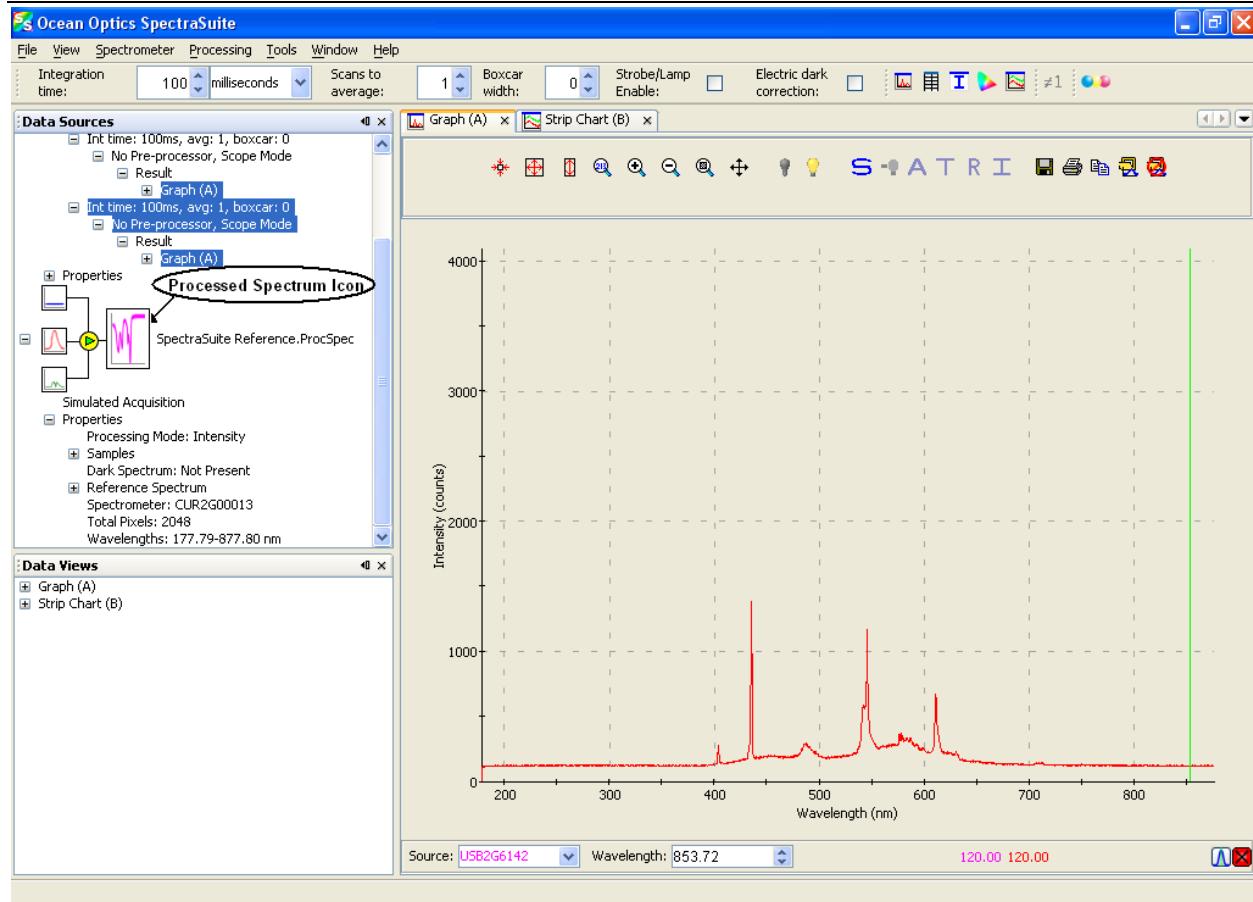
### Processed Spectrum

You have the ability to load a previously stored processed spectrum file.

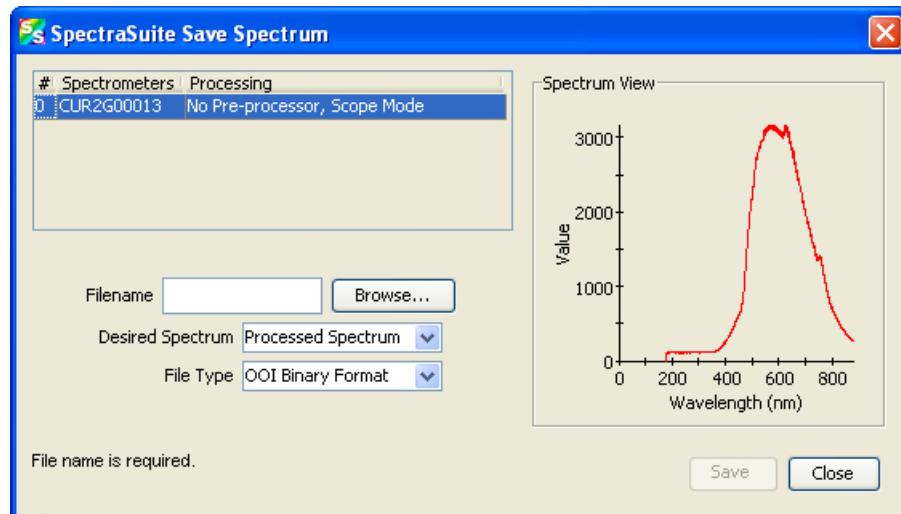
#### ► **Procedure**

1. Select **File | Open | Load Processed Spectrum** from the menu.
2. Type the file name or browse to the location of the desired processed spectrum file and open the file. The Processed Spectrum icon appears in the **Data Sources** pane.

#### 4: File Menu Functions



3. You can save this processed spectrum back out to a file as processed, reference or dark spectrum. Right-click on the Processed Spectrum icon and select **Save Spectrum** to display the SpectraSuite **Save Spectrum** dialog box.



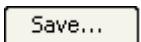
4. Enter the file name or browse to a desired file, select the desired spectrum (processed, reference or dark), and select the file type (binary or tab-delimited).

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**Tip**

Save the file as tab-delimited if you want to display it in an Excel spreadsheet.

---

5. Click  Save...

## Spectrum Collection

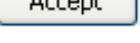
A spectrum collection is created when you perform a high-speed acquisition. Select **File | Open | Load Spectrum Collection** to browse to and open a spectrum collection from a high-speed acquisition. You can load a single file or directory of files as a collection. To load a directory of files, select the directory instead of an individual file.

## Save

### Save Spectra Collection

Select **File | Save | Save Spectra Collection** from the menu and enter a file name or type Ctrl + S to save your spectra collection to a file. Also see [Exporting Processed Data](#) for information on exporting data to a file.

### Save Spectrum

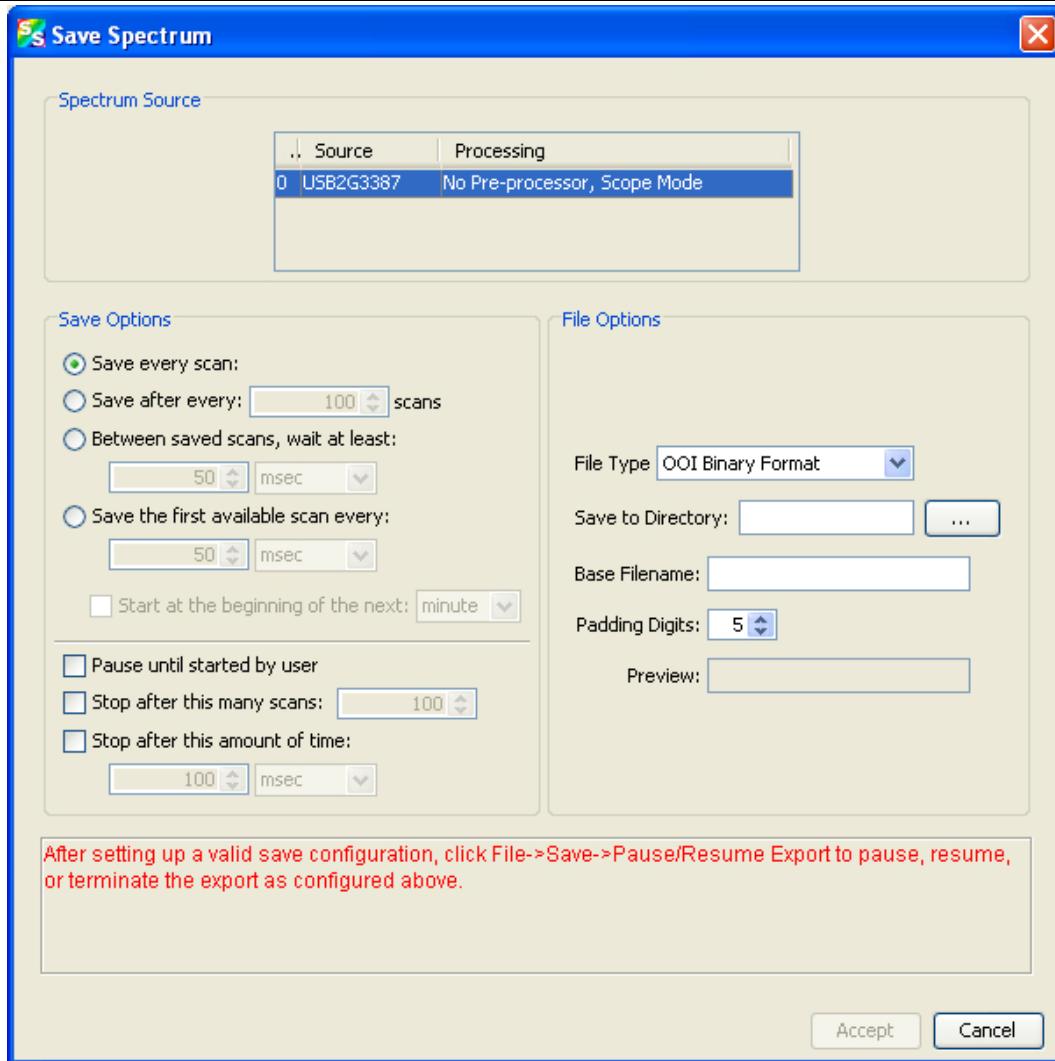
This menu options displays the Save Spectrum dialog box. Use this box to configure how you want to save your spectra. After you set the options and click  Accept.

To change these settings, select **File | Save | Configure Export**.

To start/pause the export based on your settings, select **File | Save | Pause/Resume Export**.

To cancel the export of the spectra, select **File | Save | Stop Export**.

#### 4: File Menu Functions



## Store

Use this menu selection to store reference and dark spectra before running your experiment.

## Dark

A dark spectrum is a spectrum taken with the light path blocked.

Select **File | Store | Store Dark Spectrum** from the menu to save a dark spectrum to a file. You can also click  in the graph toolbar.

## Reference

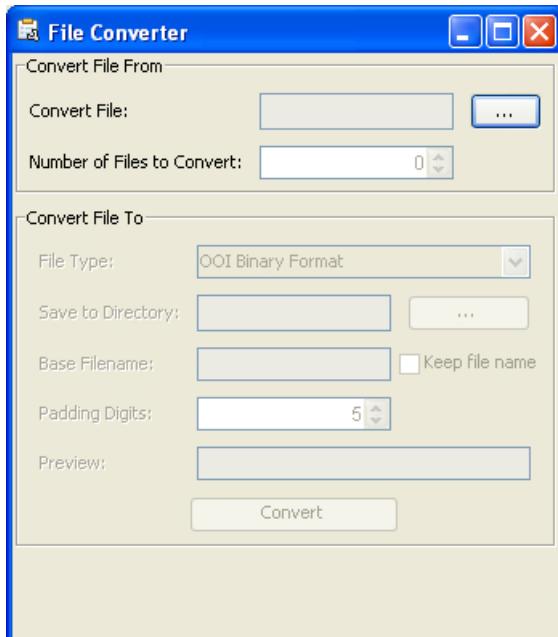
A reference spectrum is a spectrum taken with the light source on and a blank in the sampling region.

Select **File | Store | Store Reference Spectrum** to store a reference spectrum file. You can also click 

## Convert Spectra

This function enables you to convert between file types.

Select **File | Convert Spectra**. The **File Converter** dialog box appears. Use this dialog box to select the file(s) to convert and to specify the file type desired.



## Screen Capture

This function takes a snapshot of the current SpectraSuite window, or the entire computer screen and stores it in the format and location that you specify.

### ► **Procedure**

1. Select **File | Screen Capture**. The **Screen Capture Config.** dialog box appears.

---

**4: File Menu Functions**

2. Select to capture either the just SpectraSuite window or the entire computer screen.
3. If you don't want to capture the screen immediately, set a delay time.
4. Select to store the captured image as a PNG or JPG file.
5. Click .
6. You are prompted to choose a name and location to store the captured file, then click .

## Exit

---

### Caution

**For Mac operating systems, do NOT attempt to exit from the SpectraSuite application by using Quit SpectraSuite. If you do so, the application could hang. Should this occur, unplug, then replug in the spectrometer(s) before restarting SpectraSuite to make the application work again.**

---

Select **File | Exit** from the menu to exit the SpectraSuite application. A shutdown confirmation dialog box appears. Click **Yes** to exit SpectraSuite.

Alternately, you can click the top right **X** box of the application's display window.

---

### Note

If your system gets hung after requesting SpectraSuite to shut down, press the Escape key twice to exit the application.

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## Chapter 5

# View Menu Functions

## Overview

This section details the various options and functions available from the **View** menu in SpectraSuite.

## Scale

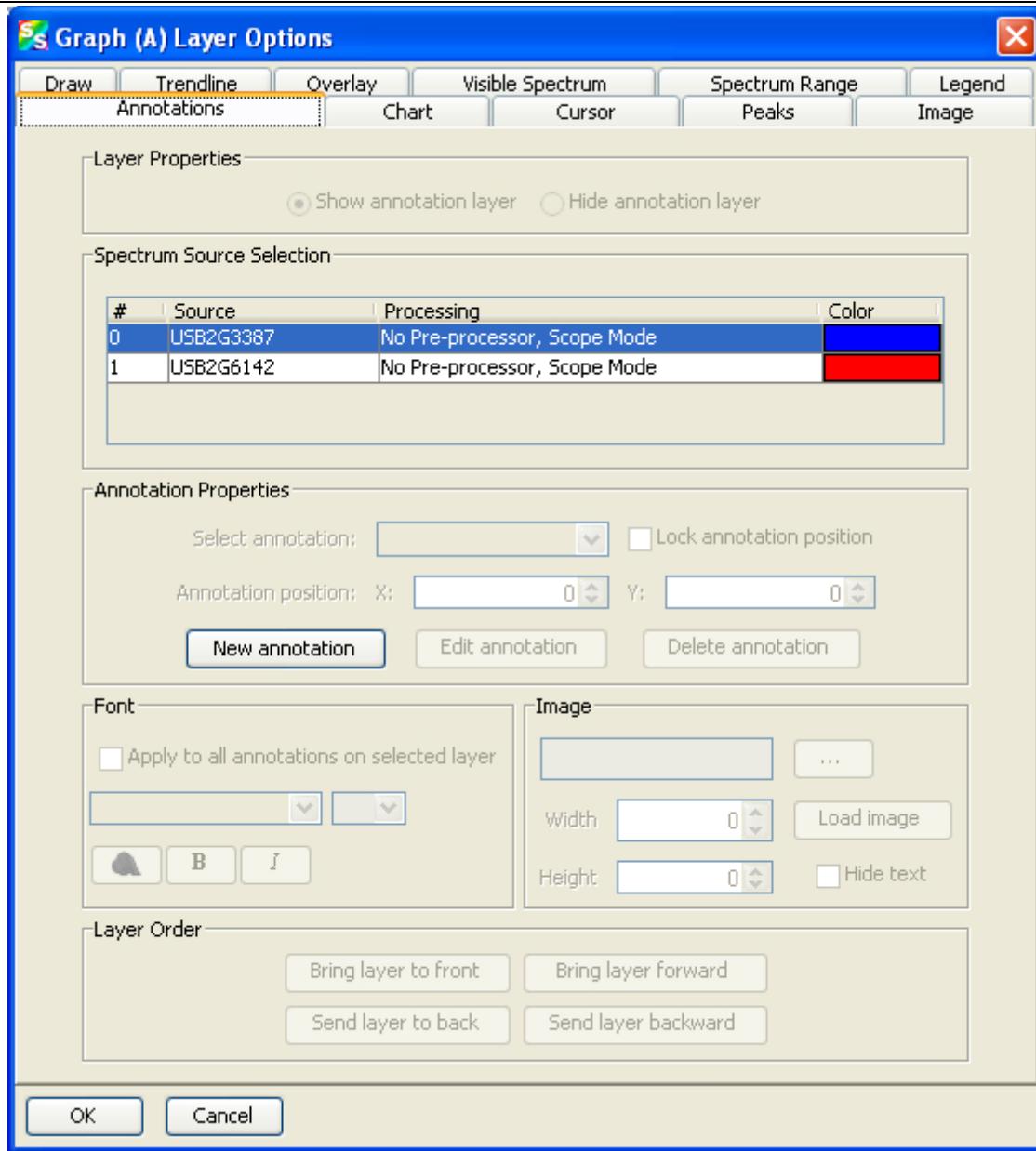
## Empty

This menu selection is for future use.

## Graph Layer Options

Select **View | Graph Layer Options**, right-click on the graph and select **Graph Layer Options**, click  , or type CTRL+ALT+L to display the Graph Layer Options dialog box. The Graph Layers feature provides more control over the customization of your graph window.

## 5: View Menu Functions



## Annotations

The Annotations functionality allows you to add text or an image to a specific location on the graph. Annotations are associated with a specific source (selectable by you), and when the source is removed, the annotations associated with it are removed as well. A subset of this functionality is also available by right-clicking on the graph or clicking  (to add an annotation).

## Chart

Use Chart to modify the following chart settings on the graph:

- Chart line pattern
- Chart line width
- Font size
- Chart background
- Number precision for x and y axes
- Number spacing for x and y axes
- Tick spacing for x and y axes
- Grid spacing for x and y axes
- Grid lines
- Grid line color

## Cursor

Use the Cursor tab to modify the cursor color.

## Peaks

Peaks functionality enables you to perform the following peak monitoring actions:

Display values on the graph relating to the peak such as peak value, center wavelength, pixel number, centroid, etc.

Set an alarm when a peak is reached. You can pause the acquisition, save the spectrum, and sound a customizable alarm.

## Image

This option allows you to add a background image to your graph. You can set the size and orientation of the image, as well as flipping, rotating, stretching and skewing it. You can also lock the image in place for a given unit range.

## Draw



Provides tools for modifying the appearance of the line created by the drawing tool ( ).

## Trendline

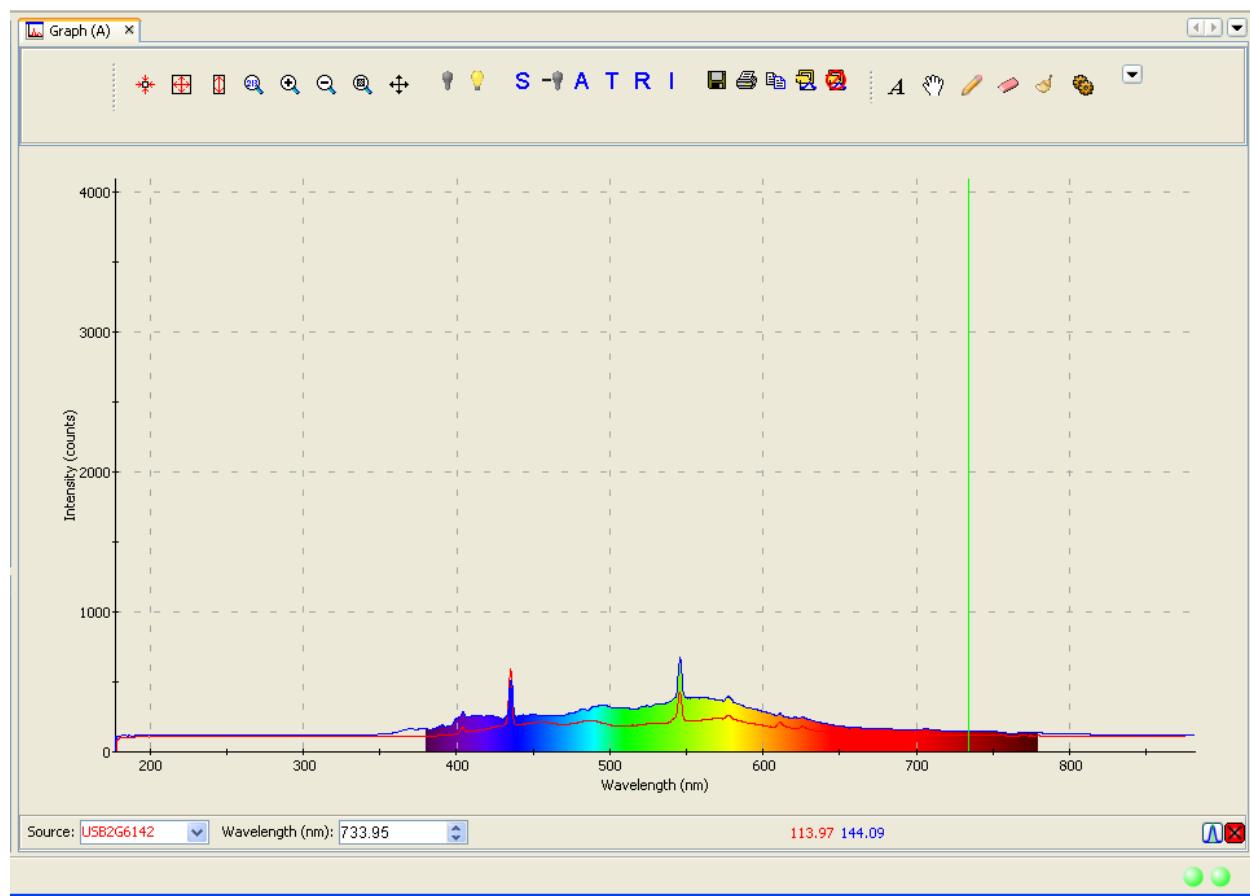
This option enables you to change the color and width of the trend line for the selected graph.

## Overlay

Use this function to add an overlay to the selected graph.

## Visible Spectrum

This option allows you to display the visible spectrum on your graph. You can display the spectrum the full height of the chart, as a bar on the x-axis, or beneath the selected trend line (as shown in figure below).

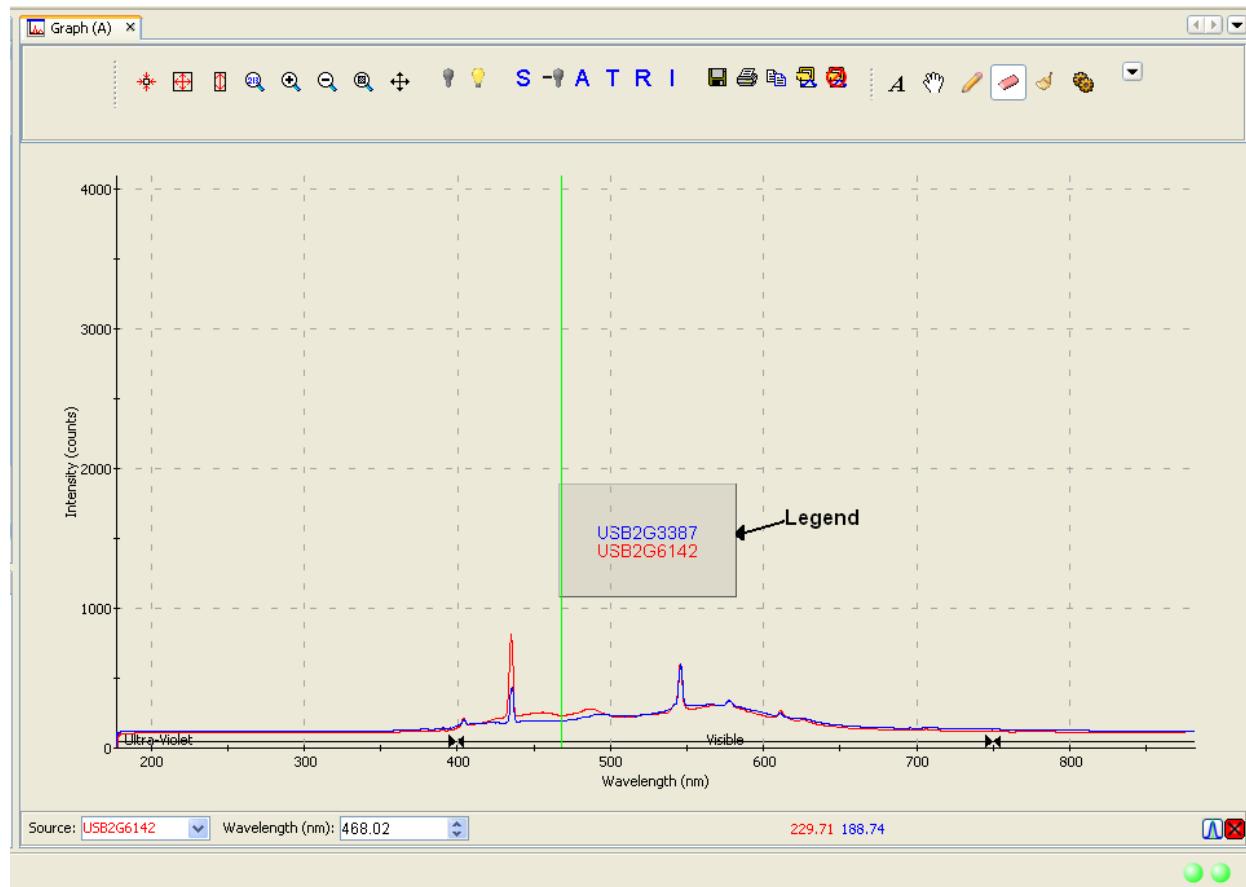


## Spectrum Range

Spectrum Range allows you to display captions for the following spectrum ranges: Gamma, X-ray, UV, Visible, Near infrared, Mid infrared, Far infrared, Microwaves, and Radiowaves.

## Legend

Use this option to add a customizable legend to your graph. The legend shows the spectrometer serial number and the name of the file that you loaded the overlay from, if applicable.

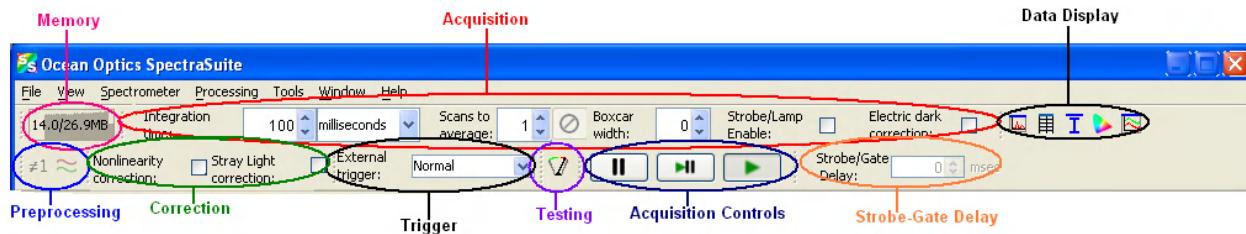


## Toolbars

This menu item controls which toolbars are visible on the SpectraSuite window. Click on the following selections to toggle the toolbar on and off. When a toolbar is visible, a checkmark appears next to the menu selection.

## 5: View Menu Functions

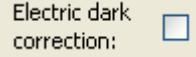
The toolbars available from this menu item are shown on the SpectraSuite window in the figure below:



# Acquisition

Select **View | Acquisition** to display/hide the tools related to the data being acquired and displayed in SpectraSuite.

Tool	Function
Integration time: <input type="button" value="3"/> milliseconds <input type="button"/>	Specifies the integration time of the spectrometer, which is analogous to the shutter speed of a camera. The higher the integration time, the longer the detector monitors the incoming photons. If your Scope mode intensity is too low, increase this value. If the intensity is too high, decrease this value.
Scans to average: <input type="button" value="1"/>	Adjust the integration time so that the greatest amount of light that you anticipate for your application causes a signal of about 85% of spectrometer's capability (for example, 3500 for spectrometers with a total of 4096 counts, 14000 counts for spectrometers with a total of 16384 counts, 50000 for spectrometers with a total of 65535 counts). While watching the graph trace, adjust the integration time until the signal intensity level is appropriate for the device. The integration time specified controls enabled spectrometer channels in the active spectral window.
<input type="button"/>	Specifies the number of discrete spectral acquisitions that the device driver accumulates before SpectraSuite receives a spectrum. The higher the value, the better the signal-to-noise ratio (S:N). The S:N will improve by the square root of the number of scans averaged.
<input type="button"/>	Stop averaging scans.
Boxcar width: <input type="button" value="0"/>	Sets the boxcar smoothing width, a technique that averages across spectral data. This technique averages a group of adjacent detector elements. A value of 5, for example, averages each data point with 5 points to its left and 5 points to its right.
	The greater this value, the smoother the data and the higher the signal-to-noise ratio. If the value entered is too high, a loss in spectral resolution will result. The S:N will improve by the square root of the number of pixels averaged.

Tool	Function
 <b>Enable:</b> <input type="checkbox"/>	<p>Enables or disables the spectrometer strobe control function.</p> <p>This function toggles the S0 line of the spectrometer.</p>
 <b>Electric dark correction:</b> <input type="checkbox"/>	<p>Enables or disables the correction of the spectral data for electrical dark signal.</p> <p>For example, if the first 24 pixels in the spectrometer, while producing an electrical signal, do not respond to light then this option subtracts the average value of these first 24 pixels from the entire spectrum.</p>

## Acquisition Controls

Select **View | Toolbars | AcquisitionControls** to display/hide the tools for pausing and resuming continuous spectra acquisition. A control is also available for performing a single acquisition.

Control	Action
	Pause selected acquisition
	Perform single acquisition
	Resume selected acquisition

## Correction

This toolbar has one tool: the nonlinearity correction checkbox. This tool enables/disables the detector linearity feature. The Correction toolbar only displays when you select it with **View | Toolbars | Correction**; it is absent from the screen by default.

## Data Display

The Data Display toolbar contains the icons for the following graph functions:

Icon	Function
	<p><b>Spectrum Graph.</b> Displays a new spectrum curve on the current graph with the parameters selected in the Acquisition toolbar. Each spectrum curve appears on the graph in a different color. The Acquisition parameters for each curve are listed in the Data Sources pane.</p>

## 5: View Menu Functions

Icon	Function
	<b>Spectrum Table.</b> Displays the data acquisition in a table format. A tab for the table appears at the top pf the graph pane. See <a href="#">Regression Utility</a> for more information.
	<b>Absolute Irradiance Graph.</b> Displays a graph of absolute irradiance data. This graph appears on its own page with a tab at the top of the graph pane. It is also listed in the <b>Data Views</b> section.
	<b>Color Measurement.</b> Launches the Color Measurement wizard. See <a href="#">Color Measurement</a> for more information.
	<b>Strip Chart.</b> Allows you to track processes, perform kinetic analyses, and monitor spectral events all as a function of time. See <a href="#">Strip Charts</a> for more information.

## Memory

The Memory toolbar consists of a display of the memory being used by the SpectraSuite application

(). Click this icon to force SpectraSuite to clean unneeded data from memory. The Memory toolbar only appears when you select it with **View | Toolbars | Memory**; it is absent from the screen by default.

## Preprocessing

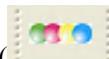
The Preprocessing toolbar contains icons for the following functions:

Icon	Function
	<b>Nonunity correction.</b> Performs a calculation to compensate for a reflection standard that is not perfectly white.
	<b>Add Reference Monitor.</b> Adjusts the signal to compensate for variations in spectral intensity based on light source and system drift.
	<b>Absorbance by Relative Transmission.</b> See <a href="#">Absorbance by Relative Transmission</a> .

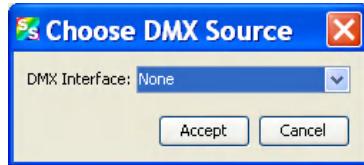
## SeaChanger

This control () enables you to adjust the SeaChanger Color Engine(s) connected to a CDS LanBox-LCE, via Ethernet cable. You must have a Red Tide (USB650) spectrometer with an attached light source to use this SpectraSuite function.

► **Procedure**



1. Click the SeaChanger control (  ) in the toolbar. The **Choose DMX Source** dialog box appears.

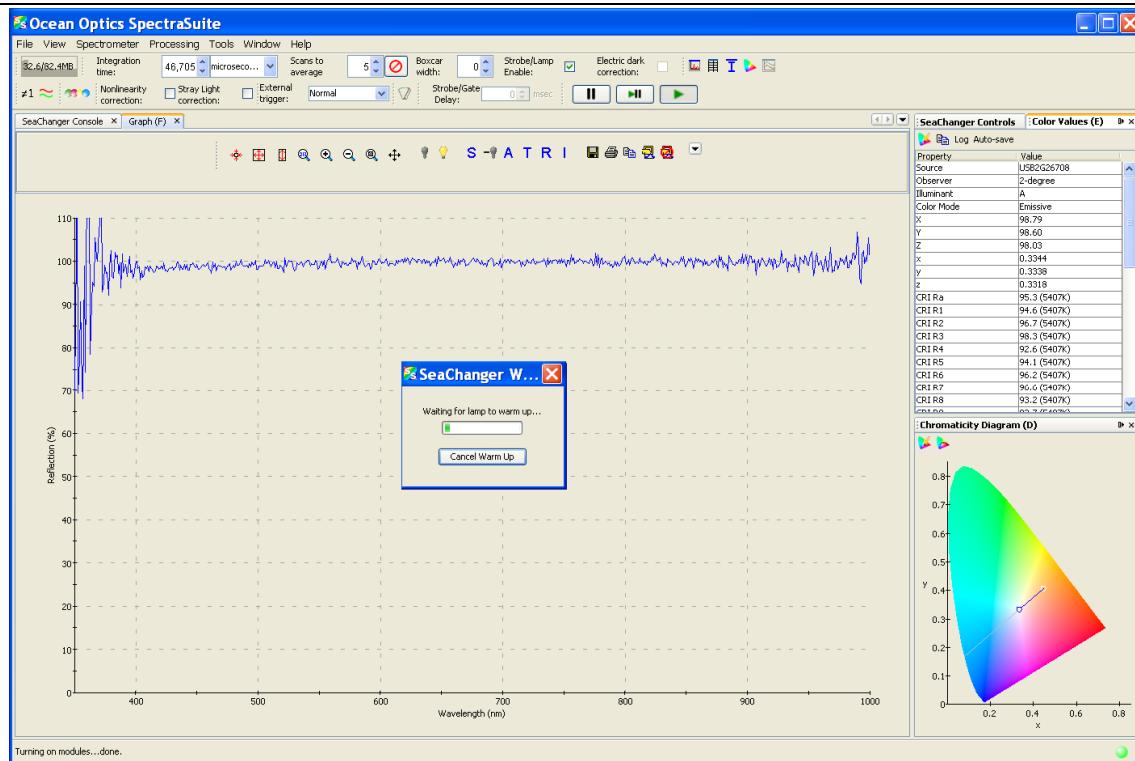


2. Select **None** or **LanBox DMX** for your source, then click  .
  - a. If you selected None, go on to Step 3.
  - b. If you selected LanBox DMX, the SeaChanger DMX Login dialog box appears. Enter the required information for the Ethernet connection to the LanBox-LCE.



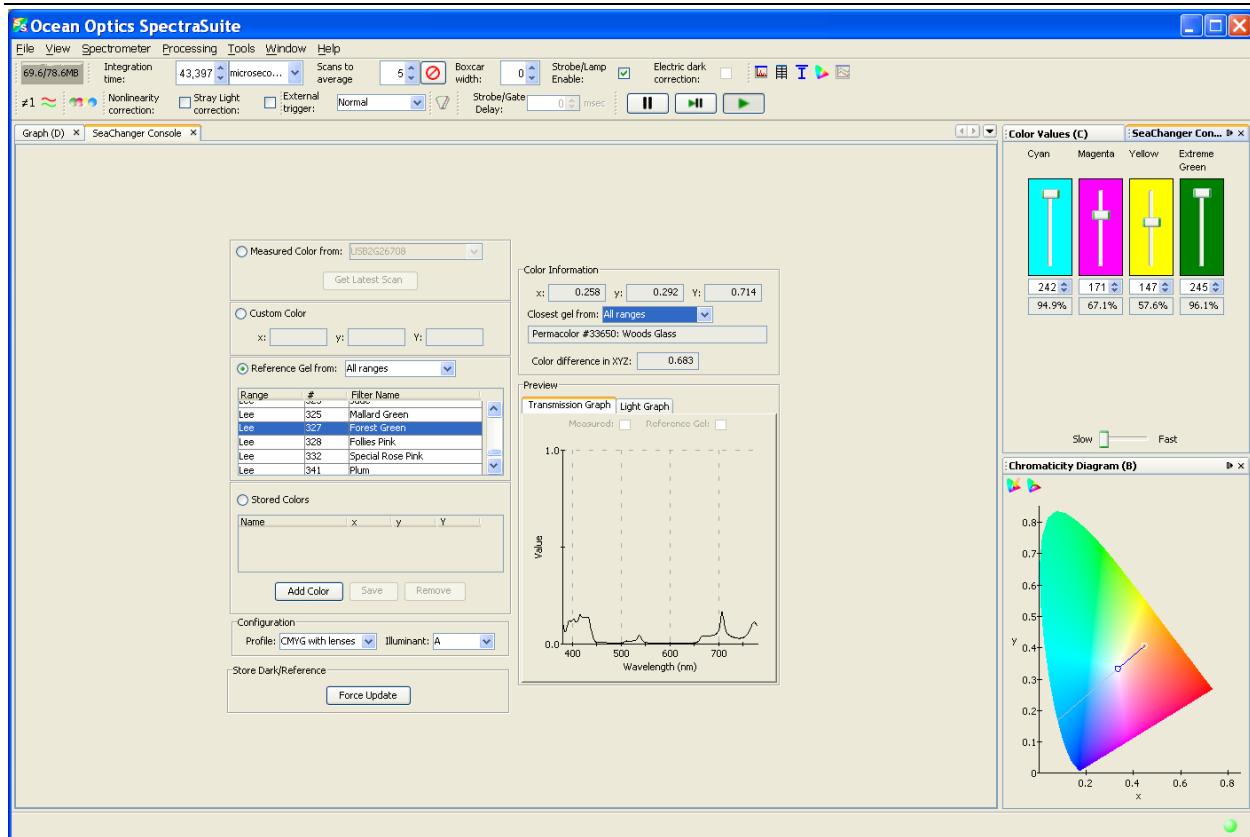
A graph appears with a message that the lamp is warming up.

## 5: View Menu Functions



During this time, an initialization process occurs in which SpectraSuite automatically does the following for you:

- Turns on the light source.
  - Calibrates to the correct integration time.
  - Stores a reference spectrum.
  - Turns the lamp off to store a dark spectrum.
  - Starts a transmission measurement.
  - Adds a color measurement for emissive color.
  - Starts the SeaChanger's LanBox DMX console and calibrates the measurements until they're stabilized.
3. The SeaChanger Console screen appears enabling you to change the parameters listed in the table below.



Parameter	Meaning
Measure Color from	Select the serial number of the spectrometer
Custom Color	Select a custom color
Reference Gel from	Select All ranges, Cinegel, Cinelux, Roscolux, Permacolor, or Lee
Stored Colors	Add, Save, Remove
Configuration	CYMG with lenses, CYMG w/o
Store Dark/Reference	Force Update
Color Information x , y, Y Closest gel from Color difference in XYZ	Select All ranges, Cinegel, Cinelux, Roscolux, Permacolor, or Lee
Preview	Allows you to preview the Transmission graph and the Light graph.

The controls in the upper right panel allow you to change the color of the SeaChanger by individually controlling its color wheels.

## Testing

The Testing toolbar consists of the speed benchmark (⌚). This feature allows you to see how fast the SpectraSuite application is running (how long it takes from the time the data is acquired until all the calculations have been performed. The Testing toolbar only displays when you select it with **View | Toolbars | Testing**; it is absent from the screen by default.

## Trigger

The External Trigger selection box on the Trigger toolbar enables you to set the following trigger modes of the spectrometer:

- Normal – free running
- Software – Integration time is controlled by frequency of triggers
- External Hardware – Hardware fixed or jumpered integration time

## Strobe-Gate Delay

This control enables you to set the gating delay in msec.

## Small Toolbar Icons

For future use.

## Customize

This menu selection allows you to customize your toolbars with functions that you choose from the Customize Toolbars dialog box.



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## Chapter 6

# Spectrometer Menu Functions

## Overview

This chapter details the various options and functions available from the **Spectrometer** menu in SpectraSuite.

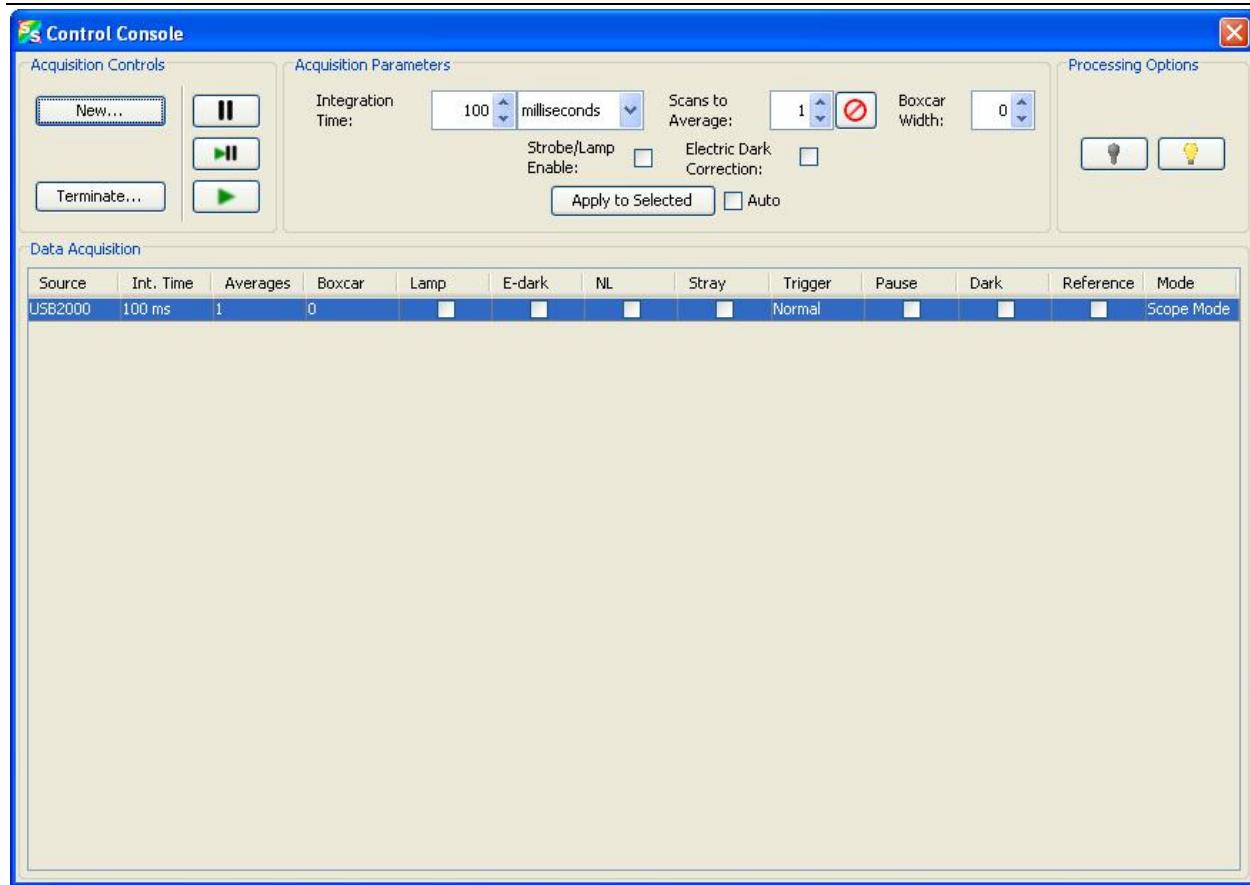
## Acquisition

This menu selection consists of options that control starting and stopping SpectraSuite's acquisition of spectral data. If you have more than one acquisition running, you must select the desired spectrometer in the Data Sources pane. To do this, click on the line under the spectrometer that lists the integration time, scans to average and boxcar width.

## Acquisition Console

Select **Spectrometer | Acquisition | Acquisition Console** to display the **Console Control** dialog box. This dialog box consolidates the acquisition controls and parameters on a single screen for easy access.

## 6: Spectrometer Menu Functions



## Pause Acquisition/Resume Acquisition

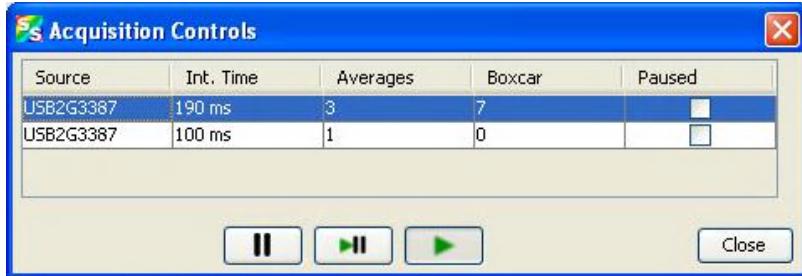
These menu selections toggle to pause and restart data acquisition. When you start the SpectraSuite application, it comes up acquiring spectral data in Scope mode from the attached spectrometers. If you are monitoring more than one spectrometer, select the desired spectrometer in the Data Sources pane, and choose either **Spectrometer | Acquisition | Pause Acquisition** to temporarily pause the acquisition. Select **Spectrometer | Acquisition | Resume Acquisition** to resume the acquisition.

## Terminate Acquisition

To completely stop spectral acquisition on a spectrometer, select the desired spectrometer in the Data Sources pane (if you are monitoring more than one), then select **Spectrometer | Acquisition | Terminate Acquisition**.

## Acquisition Controls

Select **Spectrometer | Acquisition | Acquisition Controls** to display the **Acquisition Controls** dialog box. This dialog box allows you to select a specific acquisition to pause and restart.



## Network Spectrometer

Use this menu selection to configure a spectrometer with a wireless network connection such as Jaz via an Ethernet connection or a spectrometer with a Remora adapter. Selecting **Spectrometer | Network Spectrometer** displays the Network Spectrometer Configuration Wizard.

## Spectrometer Simulation

This function provides a generic spectrometer with simulated blackbody data.

## Show Devices

This feature allows you to redisplay the Data Sources and Data Views panes if they have been closed.

## Spectrometer Features

This option provides access to additional functionality available with the attached OOI spectrometers. You must select a spectrometer in the **Data Sources** pane to make this menu selection active. To display the Features dialog box, do one of the following:

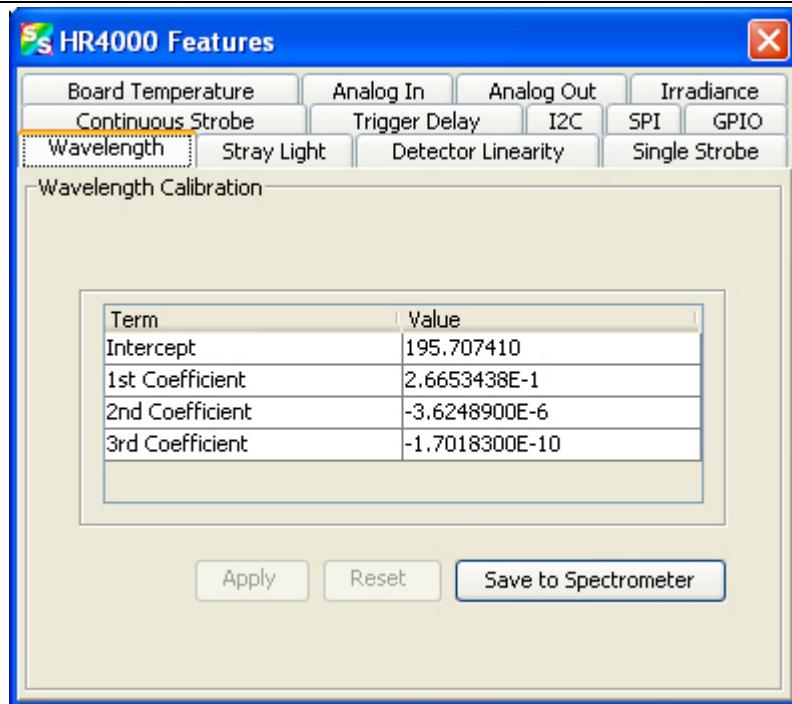
Select **Spectrometer | Spectrometer Features** from the menu, or

Right-click on the device in the Data Sources pane and select **Spectrometer Features**.

Each attached device type has unique features, so see the documentation for your particular device to learn more about the available options and their settings. The MMS Raman Spectrometer has unique features. See [QE65000 Spectrometer](#) for more information.

The following is an example of the HR4000 Spectrometer Features dialog box.

## 6: Spectrometer Menu Functions



Many of the features listed for the HR4000 Spectrometer are also valid for other spectrometers. The table below lists all spectrometer features. Check your spectrometer to see which features apply to your model.

Feature	Meaning
Analog In	Set the input voltage and the update interval. Analog input can be accessed from the spectrometer's accessory connector.
Analog Out	Analog output can be used for multiple applications such as single pixel intensity analysis or programmable reference/dimmer to light sources. Set the analog output on this screen.
Autonulling	Autonulling is an enhanced electrical dark correction. Set the autonulling status and value on this screen.
Board Temperature	The HR and QE spectrometers contain a temperature sensor chip on the printed circuit board. Use this screen to set the temperature parameters.
Channel Features	For the ADC1000-USB and spectrometers such as Jaz with more than one channel. Enable each channel by checking the box.
Continuous Strobe	Set the continuous strobe delay. The Continuous Strobe signal is a programmable frequency pulse-train.
Detector Linearity	Use this screen to change the linearity coefficients.
External Trigger Delay	Set the counts for the external hardware trigger.
GPIO	Set the General Purpose Input/Output values on this screen.

<b>Feature</b>	<b>Meaning</b>
Hardware Trigger	The spectrometer uses an external rising edge of a TTL signal to begin a single integration cycle. Set the delay (counts) on this screen.
Internal Trigger	Use this tab to select the trigger source and the Trigger period. See your spectrometer's manual and the External Triggering document for more information on triggering for your spectrometer model.
I2C	The Inter-Integrated Circuit 2-wire serial bus is widely used in embedded systems applications. With I <sup>2</sup> C you can add peripherals to your system without using valuable resources like I/O ports. The I2C bus communications parameters are set on this screen.
Indy	This tab appears for Jaz systems containing the Industrial (Indy) module. See the Jaz Installation and Operation manual for more information on JAZ-INDY.
Irradiance	Use this screen to load and save irradiance calibration factors.
LS-450	This tab appears if a USB-LS-450 light source is attached to your spectrometer. Check the box for Pulsed LED mode, if desired.
LS-450 Calibration Constants	This tab appears if a USB-LS-450 light source is attached to your spectrometer.
LS-450 Current Out	This tab appears if a USB-LS-450 light source is attached to your spectrometer. Adjust the analog output current.
Multi Channel Provider	This screen appears for an ADC1000.
Single Strobe	The Single Strobe signal is a programmable TTL pulse that occurs at a user determined time during each integration period. Set the counts for the high and low transition delay. <b>NOTE:</b> The High Transition Delay must always be lower than the Low Transition Delay.
SPI	The Serial Peripheral Interface is a 3-wire interface that can be used to communicate to multiple slave devices. Access the SPI bus communications functions on this screen.
Stray Light	Enter the stray light correction coefficient in this screen.
TEC	For QE65000 spectrometers, set the parameters for the TE cooled CCD array on this screen.
Thermoelectric	For NIR spectrometers.
Trigger Delay	Same as External Trigger Delay.
UV/VIS	ISS-UV-VIS Enable visible lamp, set visible lamp intensity, enable UV lamp, set UV lamp intensity

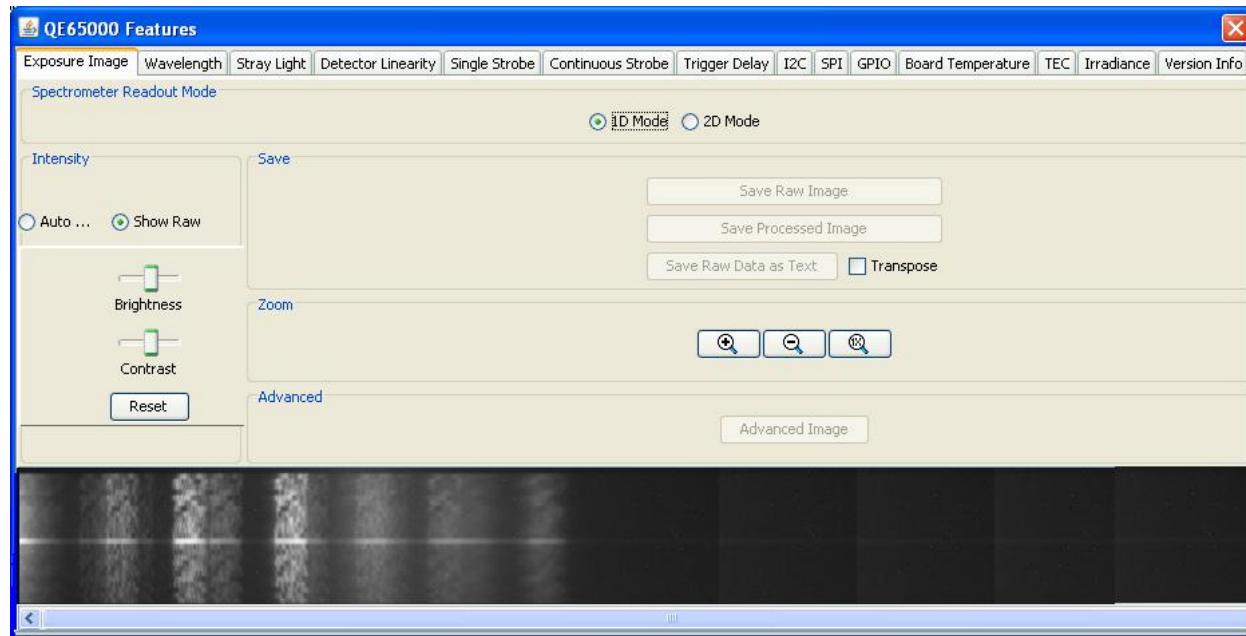
## 6: Spectrometer Menu Functions

Feature	Meaning
Wavelength	Allows you to enter or change the spectrometer's wavelength calibration coefficients. Wavelength coefficients are provided on the Wavelength Calibration Data Sheet that came with the spectrometer.
Network Spectrometer	Enables you to configure a wireless connection for a spectrometer using the Remora adapter or a Jaz spectrometer with the Ethernet module.

## QE65000 Spectrometer Exposure Image Features

The following are CCD exposure image features for the QE65000 Spectrometer. Use this screen to view the raw data coming from the detector for visualization and analysis. The bottom of this screen displays the actual CCD image (a 2-dimensional image of the detector). Each light stripe is a spectral line. The vertical white lines correspond to peaks.

### Exposure Image

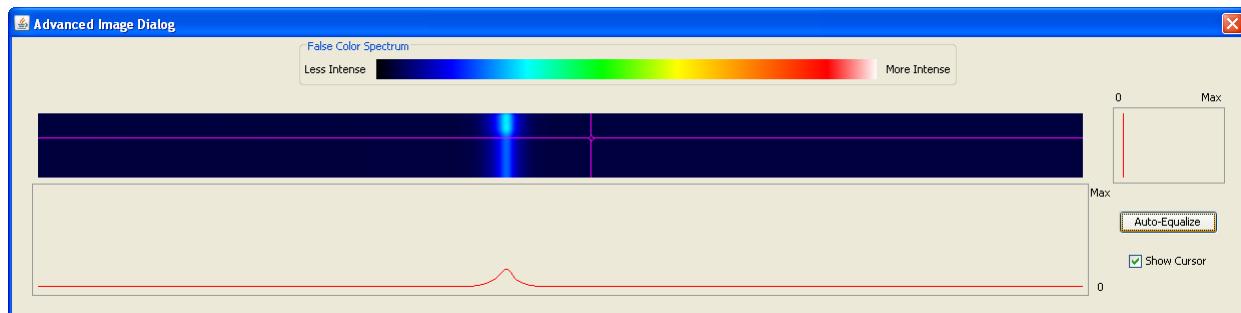


Feature	Meaning
Spectrometer Readout Mode	Select either 1- or 2-dimensional: 1D: A snapshot of the detector (detector image is static) 2D: View updates every time a new scan completes (detector image is dynamic)
Intensity Auto Equalize	Controls how the image is processed and provides the following controls: Adjust for better contrast in the CCD image.

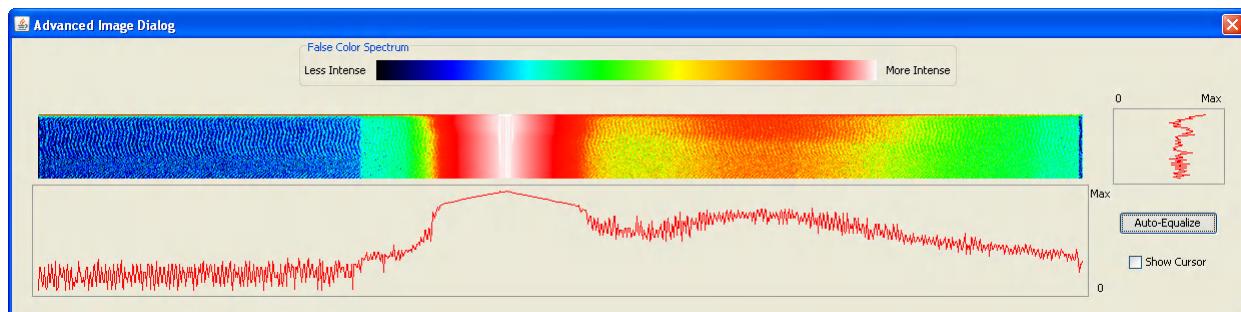
Feature	Meaning
Show Raw Brightness/Contrast Reset	Displays the raw image. Adjust the brightness/contrast of the image. Resets the brightness and contrast to the default (middle of scale)
Save Save Raw Image/Processed Image Save Raw Data as Text Transpose	Save the raw/processed image to a jpg, png, gif, bmp or x-png file. Save the raw data as a text file. Transpose the image.
Save Raw Data as Text	Save the raw data as a text file.
Zoom	Standard controls to zoom in/out
Advanced	Displays a dialog box. See for more information.

## Advanced Image Dialog Box

The **Advanced Image** button allows you can access even more features of the image seen by the detector as shown in the examples below.



**Auto Equalize Disabled**



**Auto Equalize Enabled**

**False Color Spectrum** – Provides a legend for the coloration of the transformed gray-scale detector image shown just below the legend.

## 6: Spectrometer Menu Functions

**Detector Image** – Shown just below the False Color Spectrum frame is the detector image as seen before in the Exposure Image tab that has been colorized as indicated by the False Color Spectrum.



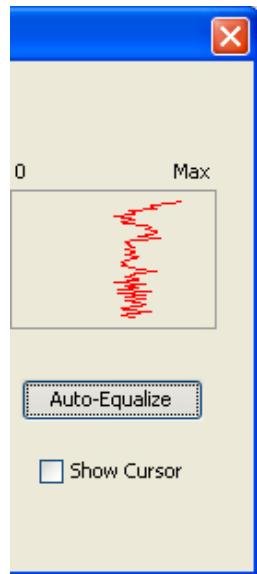
**Horizontal Variation Plot**

---

### NOTE

You must select a pixel in the detector array by clicking on the detector image to activate the horizontal and vertical variation plots.

**Horizontal Variation** – Below the detector image is a plot of intensity across the current row number given by the present location of the cursor. For example if the cursor is located at pixel in row 32 column 350, then this plot would show the variation in the pixels located in row 32. The scale of the plot is between zero (minimum) and the saturation value of the detector (maximum).



**Vertical Variation** – To the right of the detector image is a plot of intensity for all the pixels in the current column, as indicated by the location of the cursor. For example, if the cursor is located at row 32 and column 350, then this plot would show the variation in the pixels located in column 350 on the detector. The scale for this plot is between zero (minimum) and the saturation value of an individual pixel (maximum).

**Auto Equalize** – This button performs exactly the same function on the colorized detector image as it did on the grey-scale detector image on the Exposure Image tab. See the **Auto Equalize Enabled** figure on the previous page.

**Show Cursor** – Controls the visibility of crosshairs that display the current location of the cursor, as seen on the detector image detector. By checking this box, the cursor becomes visible. By unchecking this box, the cursor will disappear when the user selects another location for the cursor is selected.

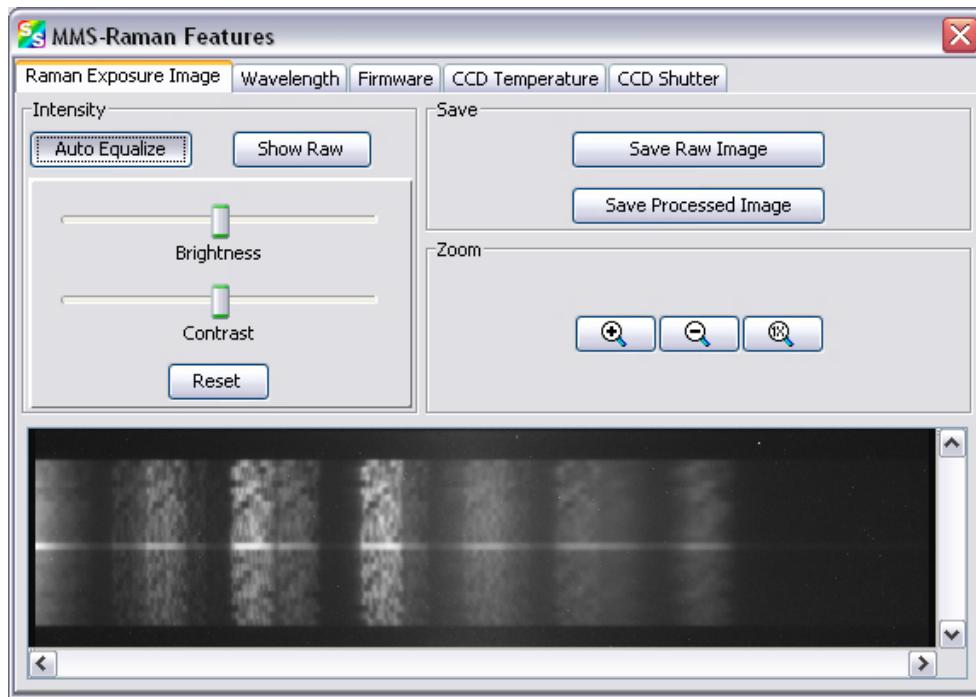
**Vertical Variation Plot**

## MMS Raman Spectrometer Features

The following are special features for the MMS Raman Spectrometer.

## Raman Exposure Image

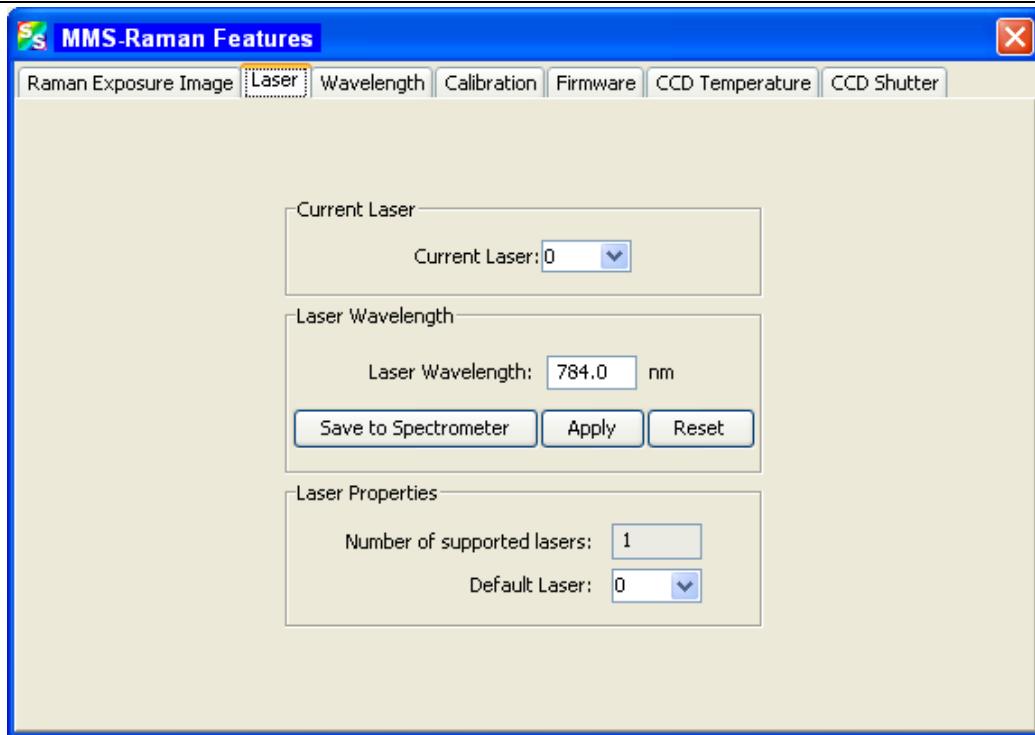
The following are CCD exposure image features for the MMS Raman Spectrometer. Use this screen to view the raw data coming from the detector if your spectral graph looks incorrect. The bottom of this screen displays the actual CCD image (a 2-dimensional image of the detector). Each light stripe is a spectral line. The vertical white lines correspond to peaks.



## Laser

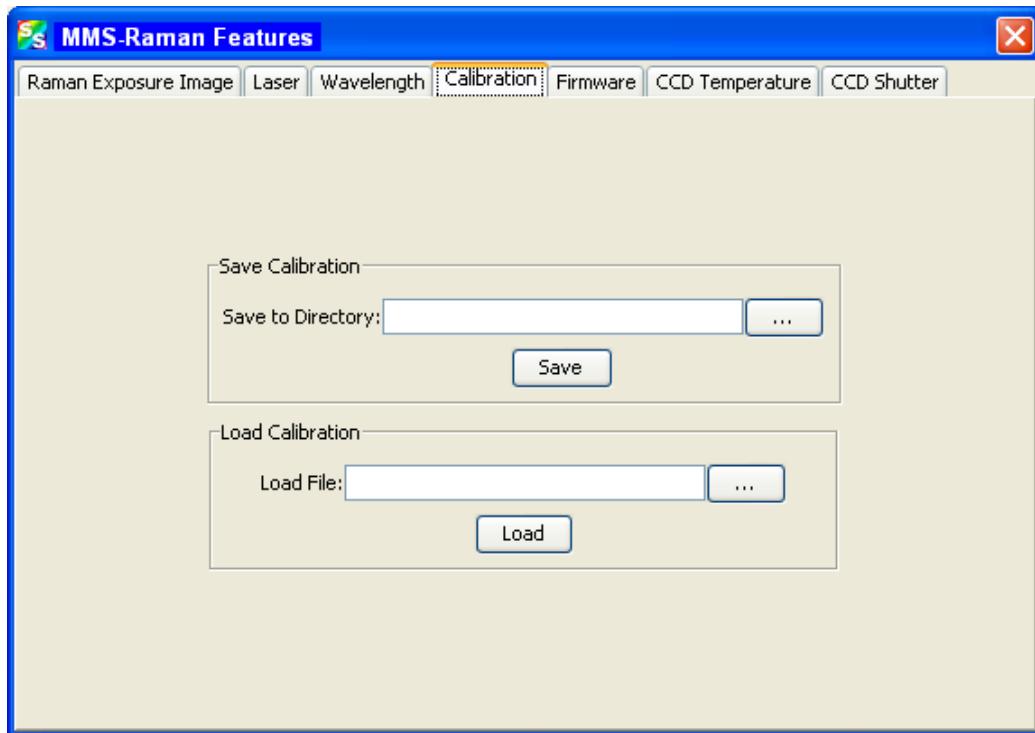
Use this screen to enter specific information for the laser being used.

## 6: Spectrometer Menu Functions



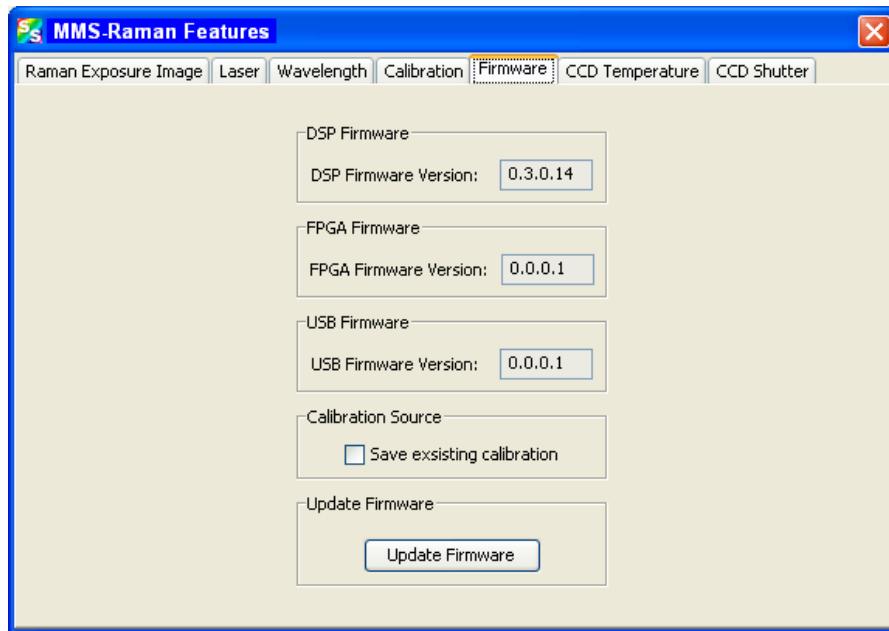
## Calibration

Use this screen to save or load calibration files.



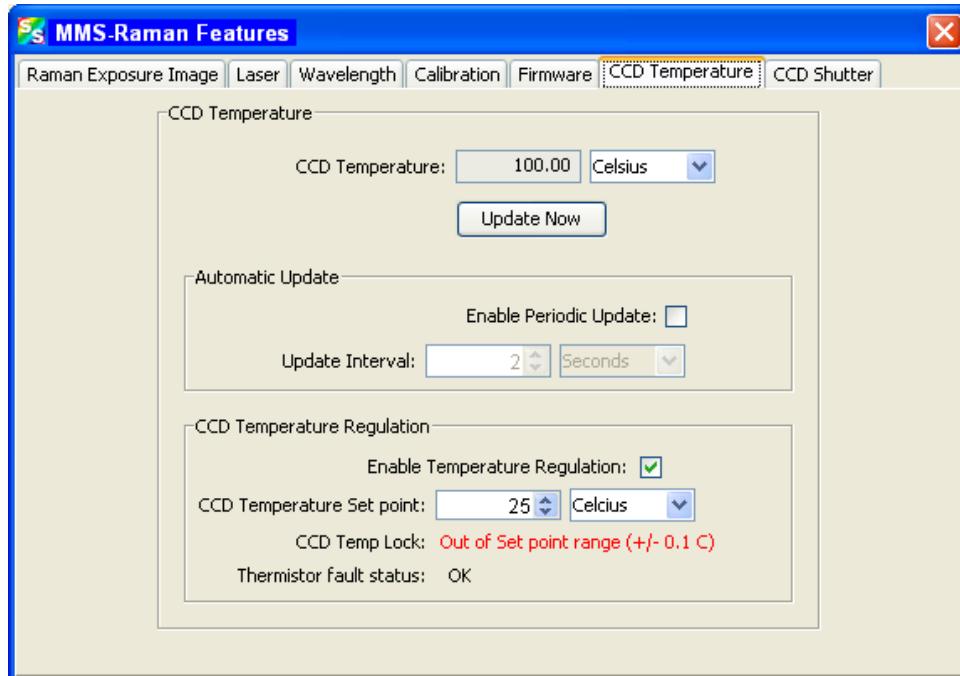
## Firmware

Use this screen to update the firmware. You must stop all acquisitions before updating the firmware.



## CCD Temperature

Use this screen to regulate the CCD temperature.



## CCD Shutter

This feature allows you to control the CCD shutter. Close the shutter to store a dark spectrum.



## Rescan Devices

Use this menu selection if you plug in a device after starting the SpectraSuite application. SpectraSuite then displays the new device in the Data Sources pane.

## Remove Spectra

This menu selection deletes the captured high-speed spectra collection data. You can also right-click on the high-speed spectra collection icon in the **Data Views** pane and select **Remove Spectra**. See [High-Speed Acquisition](#) for more information.

---

# Chapter 7

# Processing Menu Functions

## Overview

This section provides information on the various signal processing functions available under the Processing menu selection.

## Color

### Edit Color Settings

This menu item allows you to make changes to the color settings for color measurements.

## Other

### Absorbance by Relative Transmission

Enables you to calculate absorbance via relative transmission using the following equation:

$$A/cm = \frac{\log_{10}(T_1) - \log_{10}(T_2)}{t_2 - t_1}$$

### Kubelka-Monk K/S Calculation

Enables you to process color samples with opacities greater than 75% using the following Kubelka-Monk equation that defines a relationship between spectral reflectance (R%) and its absorption (K) and scattering characteristics:

$$\frac{K}{S} = \frac{[1 - 0.01 R]^2}{2[0.01R]}$$

## Pre-processing

Preprocessing functions currently include the following:

Nonunity correction

Add Reference Monitor

You can also remove the preprocessing function.

## Remove Preprocessor

Select **Processing | Pre-processing | Remove Preprocessor** to remove the nonunity correction preprocessing function.

## Nonunity Correction

Select **Processing | Pre-processing | Non-unity correction** for reflection experiments if you need to perform a calculation to compensate for a reflection standard that is not perfectly white. You can also access this function with the  icon in the Preprocessing toolbar.

SpectraSuite provides the  icon for storing a reference. The default assumption is that the reference is equal to exactly 100% reflection. This works for comparative work, but it will not yield accurate quantitative results.

The better procedure is to use a file of nominal reflectivity values or NIST-traceable values for your particular standard. These files are available for download from this page for the WS-1-SL, STAN-SSH and STAN-SSL standards. If you are using a WS-1, there are significant potential errors. The WS-1-SL is recommended as a substitute.

### ► Procedure

1. Set up your experiment as usual by choosing the appropriate integration period (so the signal to noise will be high but the spectra for the standard or samples won't be off-scale). Choose scans to average and box car smoothing to obtain the desired signal-to-noise.
2. Store dark and reference spectra and switch to %R (or %T) scales. SpectraSuite will make your graph read 100% +/- random noise across the spectra.
3. Click on the  icon.

4. The wizard asks for the location of the file. Use the browse function to find the appropriate file. These files are text files with a \*.STANDARD file extension. The file format must be exactly as expected or SpectraSuite won't be able to load it properly. The files that you can download from this page are ready to be used.
5. Once you load the file, the contents of the file header are shown as well as a graph of the reflectivity values.
6. Click  to make your stored reference read the values from the file, interpolated to the wavelength at each pixel. You can take a new reference spectrum at any time without having to go through the wizard again.

---

#### Note

You can use your own materials as a reference. The data in the reference file consists of a header, then a pair of numbers wavelength and value. SpectraSuite will interpolate from the data set to the wavelengths used by the particular spectrometer you have connected.

Make a copy of a working file, and then edit the contents. Be sure to change the starting and ending wavelength in the file header, and use decimal values for reflectivity.

---

## Add Reference Monitor

Select **Processing | Pre-processing | Add Reference Monitor** to adjust the signal to compensate for variations in spectral intensity based on light source and system drift. The reference spectrum for the reference acquisition is the starting "ideal" state of the lamp. Any deviations the lamp makes from that reference spectrum will cause compensation in the sample acquisition.

For extended experiments, you will achieve optimal results if you take frequent reference spectra. If this is not possible, however, you can choose to monitor your light source and instruct SpectraSuite to correct for any drift that might occur. There are two types of drift: Spectrally uniform and spectrally nonuniform. The drift associated with a tungsten lamp is often spectrally uniform, but the drift associated with a deuterium lamp is not.

Reference Monitoring allows you to monitor a reference for variations in spectral intensity based on light source and system drift. To monitor a reference, the following conditions must be met:

You are using either multiple spectrometers (and spectra overlap in the area to be referenced), or one spectrometer with multiple acquisitions, and

You have stored both a reference and dark spectrum. Once these spectra have been stored, the Reference Monitoring function is activated (is available for use).

### ► Procedure

To perform reference monitoring:

1. Start an acquisition on the spectrometer that will monitor the lamp. Adjust the acquisition parameters so that the spectrum is on scale.
2. Store a reference and dark spectrum for that acquisition.
3. Start an acquisition on the spectrometer that will measure the sample.
4. Store a dark spectrum for the sample acquisition.
5. Click on the sample acquisition graph,

Or,

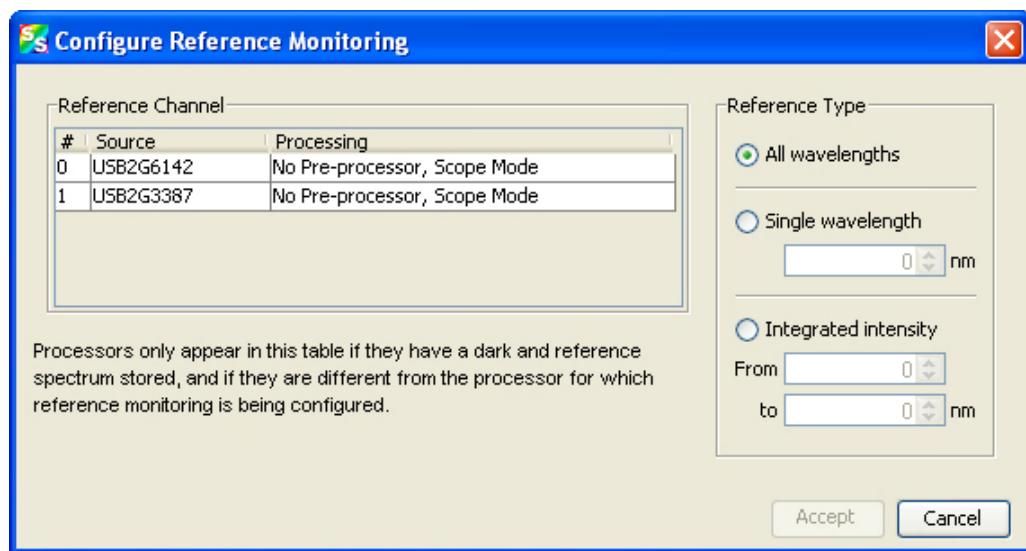
In the Data Sources pane, select the processing node for the sample acquisition (**No pre-processor**, etc.). The reference monitoring action should enable.



6. Click 

Or,

Select **Processing | Preprocessing | Add Reference Monitor**. The **Configure Reference Monitoring** dialog box appears:



7. Select the desired reference channel.
8. Select the Reference Type as follows:

Selection	Meaning
All wavelengths	Requires a minimum of two spectrometer channels in your system, both configured for overlapping wavelength ranges. Corrects for both uniform and nonuniform drift.
Single wavelength	Use this selection for pixel-by pixel drift correction.
Integrated intensity	Use this selection if the lamp is going to drift uniformly

9. Click  .

## Post-processing

Currently, the only menu item available for Post-processing is Differentiate.

### Differentiate

This menu item allows you to choose to display derivative graphs with respect to wavelength. Select **Processing | Post-processing | Differentiate**, then make the desired selections in the pop-up screen:



Selection	Meaning
Enter the order of differentiation	Enter a value from 1-5
Select numerical method	Select single-sided or double-sided differentiation

## Processing Mode

Processing mode functions include all of the modes necessary to conduct experiments. These modes are also available from the toolbar above the graph. See [Experiment Tutorials](#) for more information about how to conduct experiments using the processing modes.

## Scope

Select **Processing | Processing Mode | Scope** to switch the current spectral window into Scope mode.

You can also click  in the graph's toolbar.

The signal graphed in Scope mode is the raw voltage coming out of the A/D converter. This spectral view mode provides complete control of signal processing functions before taking absorbance, transmission, reflection, and relative irradiance measurements. This mode reflects the intensity of the light source, the reflectivity of the grating and mirrors in the spectrometer, the transmission efficiency of the fibers, the response of the detector, and the spectral characteristics of the sample.

Use Scope mode when configuring your setup, adjusting the integration time, and taking a reference and a dark scan.

## Scope Minus Dark

Select **Processing | Processing Mode | Scope Minus Dark** to switch the current spectral window into Scope mode and subtract the stored dark spectra from each spectrometer channel before SpectraSuite displays it. You can also click  in the graph's toolbar.

See the description of Scope mode ([Scope](#)) for more information.

## Absorbance

Select **Processing | Processing Mode | Absorbance** to switch the current window into Absorbance mode.

You can also click  in the graph's toolbar. You must first store reference and dark spectra in Scope mode before you can access Absorbance mode.

SpectraSuite uses an equation to determine the concentration of a species in solution (illustrated below). The software uses this equation to evaluate each pixel on the detector and produce the absorbance spectrum:

$$A_{\lambda} = - \log_{10} \left( \frac{S_{\lambda} - D_{\lambda}}{R_{\lambda} - D_{\lambda}} \right)$$

Where:

$S$  = Sample intensity at wavelength  $\lambda$

$D$  = Dark intensity at wavelength  $\lambda$

$R$  = Reference intensity at wavelength  $\lambda$

The concentration of a species in a solution directly affects the absorbance of the solution. This relationship, known as Beer's Law, is expressed as:

$$A_{\lambda} = \varepsilon_{\lambda} c \ell$$

Where:

$A$  = Absorbance at wavelength  $\lambda$ ,

$\varepsilon_\lambda$  = Extinction coefficient of the absorbing species at wavelength  $\lambda$

$c$  = Concentration of the absorbing species and  $\ell$  is the optical path length of the absorption.

See [Experiment Tutorials](#) for information on conducting an experiment in Absorbance mode.

## Transmission

Select **Processing | Processing Mode | Transmission** to switch the current window into Transmission mode. You can also click  in the graph's toolbar. This is also the spectral processing mode used for reflection spectroscopy, as the math necessary to compute reflection is identical to that required for transmission. You must first store reference and dark spectra in Scope mode before you can access Transmission mode.

SpectraSuite calculates the transmission of a solution using the following equation:

$$\%T_\lambda = \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \times 100\%$$

Where:

$S_\lambda$  = Sample intensity at wavelength  $\lambda$

$D_\lambda$  = Dark intensity at wavelength  $\lambda$

$R_\lambda$  = Reference intensity at wavelength  $\lambda$

See [Experiment Tutorials](#) for information on conducting an experiment in Transmission mode.

## Reflection

Select **Processing | Processing Mode | Reflection** to switch the current window into Reflection mode.

You can also click  in the graph's toolbar. Reflection mode is also the spectral processing mode used for transmission spectroscopy, as the math necessary to compute transmission is identical to that required for reflection.

You must take reference and dark spectra in Scope mode before you can access Reflection mode.

SpectraSuite calculates the reflection of a solution using the following equation:

$$\%T_\lambda = \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \times 100\%$$

Where:

$S_\lambda$  = Sample intensity at wavelength  $\lambda$

$D_\lambda$  = Dark intensity at wavelength  $\lambda$

$R_\lambda$  = Reference intensity at wavelength  $\lambda$

See [Experiment Tutorials](#) for information on conducting an experiment in Reflection mode.

## Relative Irradiance

Select **Processing | Processing Mode | Relative Irradiance** to switch the current window into Relative Irradiance mode. You can also click  in the graph's toolbar.

Before you can access Relative Irradiance mode, you must take a reference spectrum in Scope mode of a blackbody of known color temperature. Additionally, you must obtain a dark spectrum by removing the fiber from the reference lamp and preventing light from entering it.

Relative irradiance spectra are a measure of the intensity of a light source relative to a reference emission source. SpectraSuite calculates relative irradiance using the following equation:

$$I_{\lambda} = B_{\lambda} \left( \frac{S_{\lambda} - D_{\lambda}}{R_{\lambda} - D_{\lambda}} \right)$$

Where:

$B_{\lambda}$  = Relative energy of the reference calculated from the color temperature

$S_{\lambda}$  = Sample intensity at wavelength  $\lambda$

$D_{\lambda}$  = Dark intensity at wavelength  $\lambda$

$R_{\lambda}$  = Reference intensity at wavelength  $\lambda$

See [Experiment Tutorials](#) for information on conducting an experiment in Relative Irradiance mode.

## Absolute Irradiance

Irradiance is the amount of light present on a particular area, such as the fiber's cross-section at its tip, a cosine corrector's surface, or the integrating sphere's surface (measures the total optical output of a light source inserted into the integrating sphere).

## Conversions

When using Absolute Irradiance, this menu selection allows you to choose from the following values for the Y-axis: J/m<sup>2</sup>/nm, J/nm, W/m<sup>2</sup>/nm, W/nm, dBm/nm, eV/nm, mol photons/nm,  $\mu$ J/cm<sup>2</sup>/nm,  $\mu$ J/nm,  $\mu$ W/nm,  $\mu$ mol photons/nm.

## Scope

This menu selection allows you to completely control signal processing prior to calibrating the spectral response of your system and taking measurements. Use caution when operating in Scope mode since this mode represents a combination of several factors such as the intensity of the light source, the reflectivity of the grating and mirrors in the spectrometer, the transmission quality of the fibers, the response of the detector, and the spectral characteristics of the sample.

## Absolute Irradiance

Select **Processing | Absolute Irradiance | Absolute Irradiance** to create a new graph of spectral data Absolute Irradiance mode. You can also click  in the Data Display toolbar to use the wizard to create an Absolute Irradiance graph.

Absolute Irradiance Mode calculates the true irradiance of a spectrum, displayed in actual  $\mu\text{W}/\text{cm}^2/\text{nm}$  (or  $\mu\text{W}/\text{nm}$  when using an integrating sphere) incident on the probe's collection area. You do not need to store reference spectrum first since absolute irradiance is not relative to another measurement. However, you must store a dark spectrum and have a calibration file before you can measure absolute irradiance.

If your spectrometer was calibrated by Ocean Optics, you should have received a CD containing the Radiometric Calibration Files specific to your spectrometer. If you do not have these files, then you must create your own spectrometer calibration files using calibrated light sources that have lamp files for absolute irradiance.

See [Experiment Tutorials](#) for information on conducting an experiment in Absolute Irradiance mode.

## Collection Area

Select **Processing | Absolute Irradiance | Collection Area** to enter the specifications of the collection area.



The Collection Area dialog box offers the following options:

**Use Integrating Sphere** – Enable this option only if one of the following applies:

- You have an integrating sphere and the proper calibration light source to calibrate your system.
- The light source being measured is completely inside the integrating sphere. If you are using a FOIS-1 integrating sphere, you must use the LS-1-CAL-INT calibrated light source to calibrate your system. Otherwise, you must have the complete system with the integrating sphere calibrated by Ocean Optics.

Once your system has been calibrated, if the light source will not be located within the integrating sphere, you must enable the **Fiber Diameter** option and enter a value (in microns) equivalent to the diameter of the opening in the integrating sphere that is capturing the light. See **Fiber Diameter** below for more information.

**Collection Area** – If you know the actual collection area, enter it here. The default is 1.

## 7: Processing Menu Functions

**Fiber Diameter** – If the light source is not inside the integrating sphere, you must enable this option and enter a value in the field (in microns) equivalent to the diameter of the opening of the integrating sphere that is capturing the measured light. There are 25,400 microns per inch. For example, for the FOIS-1, the value would be 9525 microns (equals 3/8 of an inch).

However, if a light source is inserted into the sphere, this value is ignored. If a cosine corrector is used, define the light collection area as follows:

If this cosine corrector is used . . .	Enter this diameter (in um) . . .
CC-3 or CC-3-UV	3900
CC-3-DA	7140

SpectraSuite then calculates the collection area from the fiber diameter.

## Calibration

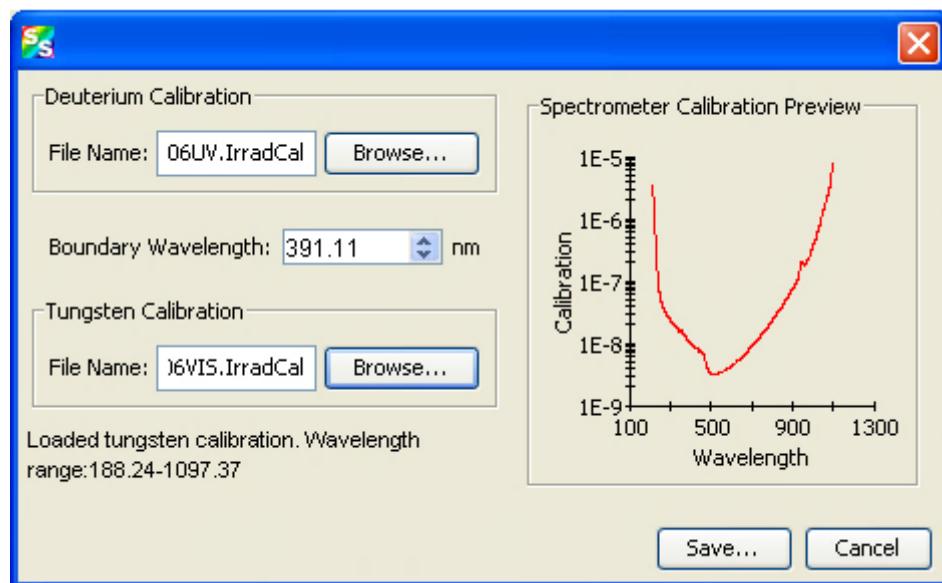
You can calibrate your spectrometer in two ways:

Ocean Optics can calibrate the spectrometer for you and send you the resulting calibration file, or

You can calibrate the spectrometer yourself using a light source (calibration lamp) with known spectral output (microwatts per square centimeter per nanometer) using this menu item.

## Combine Calibration Files

This feature allows you to combine two spectrometer calibration files **that you have created**; one file using a calibrated deuterium lamp source (UV) and the other using a calibrated tungsten lamp source (VIS). This will result in a spectrometer calibration file that can be used across the entire spectral range.



► **Procedure**

1. Select **Processing | Absolute Irradiance | Combine Calibration Files**.
2. Enter the file name of the spectrometer calibration file you created with the deuterium lamp source or browse to the desired file.
3. Enter the file name of the spectrometer calibration file that you created with a tungsten lamp source or browse to the desired file.
4. In the Boundary Wavelength field, select the wavelength at which point the two files will be joined or go on to Step 5 to just accept the value provided by SpectraSuite.
5. Click  **Save...**. The graph of the combined files appears in the **Spectrometer Calibration Preview**.

## New Energy, Power, Photons

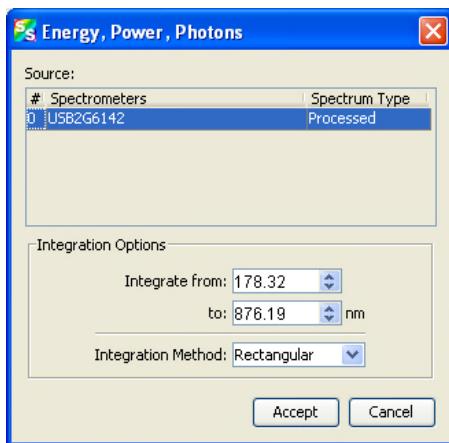
This feature enables you to measure integrated intensities. Radiometric values require that you specify the wavelength range. You must be in Absolute Irradiance mode (click  ) for this menu selection to be active.

► **Procedure**

1. Create a new graph of spectral data in Absolute Irradiance mode. See [Absolute Irradiance](#) in Appendix A: [Experiment Tutorials](#) for detailed instructions.
2. Select **Processing | Absolute Irradiance | New Energy, Power, Photons** to display the Energy, Power, Photons dialog box.

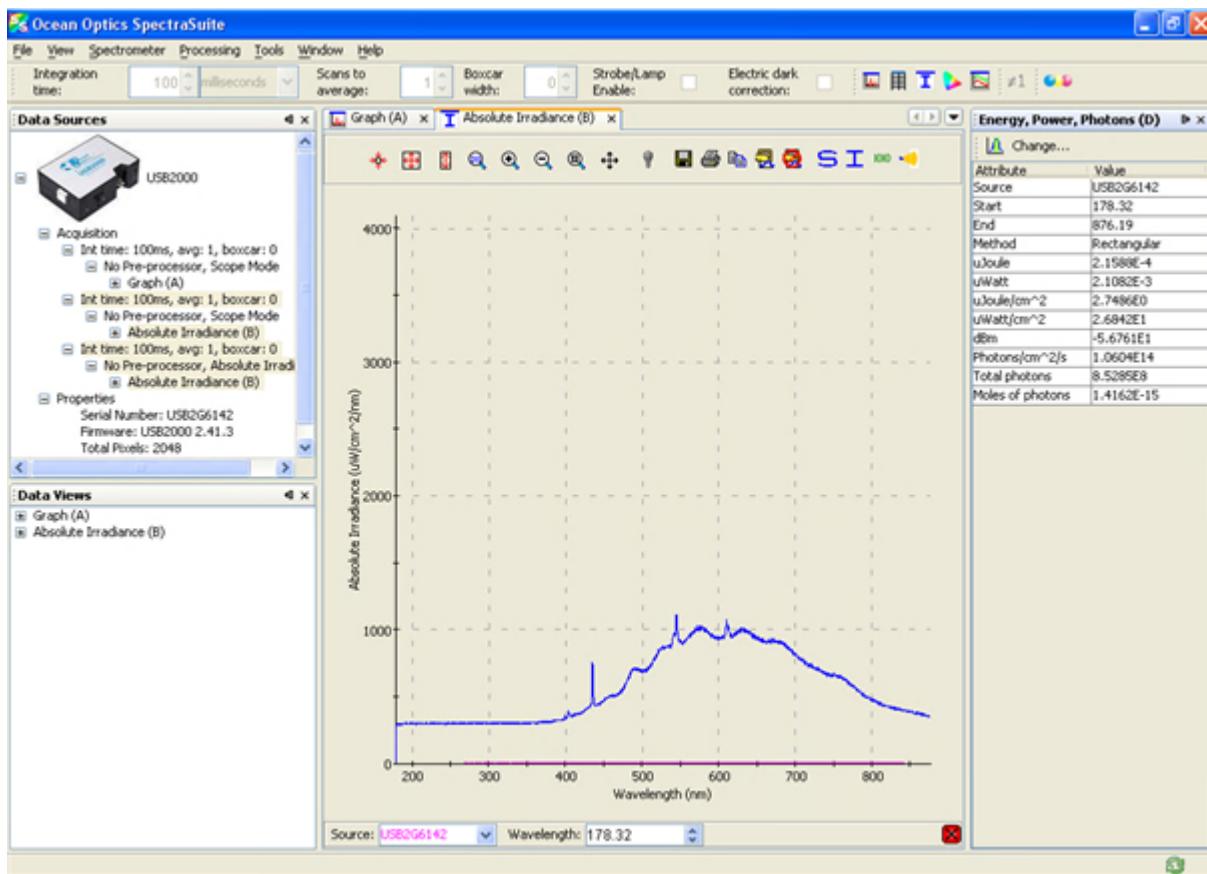
OR

Click  on an Absolute Irradiance graph.



## 7: Processing Menu Functions

3. If more than one Absolute Irradiance graph is open, select the desired spectrometer by highlighting it under **Source**.
4. Enter the wavelength range to integrate in the Integration Options section.
5. Enter the **Integration Method**, either Rectangular, Simpson's (Rule), or Trapezoid.
6. Click **Accept** when finished. The Energy, Power, Photons table appears to the right of the graph. You can change these values by clicking the Change icon () in the Energy, Power, Photons table.



This table is described below:

Attribute	Meaning
Source	The absolute irradiance source you selected in Step 3.
Start	The starting wavelength you selected in Step 4.
End	The ending wavelength you selected in Step 4.
Method	The integration method you selected in Step 5.

<b>Attribute</b>	<b>Meaning</b>
$\mu\text{Joule}$	The calculated energy of the sample in microjoules.
$\mu\text{Watt}$	The calculated power of the sample in microwatts.
$\mu\text{Joule}/\text{cm}^2$	The calculated energy per square centimeter of the sample microjoules. .
$\text{Joule}/\text{m}^2$	The calculated energy per square meter of the sample in Joules.
$\mu\text{Watt}/\text{cm}^2$	The calculated power per square centimeter of the sample in microwatts
$\text{Watt}/\text{m}^2$	The calculated power per square meter of the sample in Watts.
$\text{dBm}$	The decibels referenced to one milliwatt. Used to calculate power for lasers.
$\text{Photons}/\text{cm}^2/\text{s}$	The number of photons per square centimeter emitted from the sample each second.
Total photons	The total number of photons calculated.
Moles of photons	The moles of photons calculated.
eV	Electron volts.

## New Photometry Measurement

This menu selection enables you to take photometry measurements such as lumen, lux, and candela. Phototropic/Scotopic values are calculated over a 380 to 780 nm wavelength range. Scotopic conditions are defined when the luminance is less than some hundredths of a candela per square meter ( $\text{cd}/\text{m}^2$ ). The difference between this scotopic vision (low-level condition) compared to a photopic (high-level condition) affects the calculations for Lumen, Lux, and Candela by using the  $V'(\lambda)$  spectral luminous efficiency curve instead of the  $V(\lambda)$  curve.

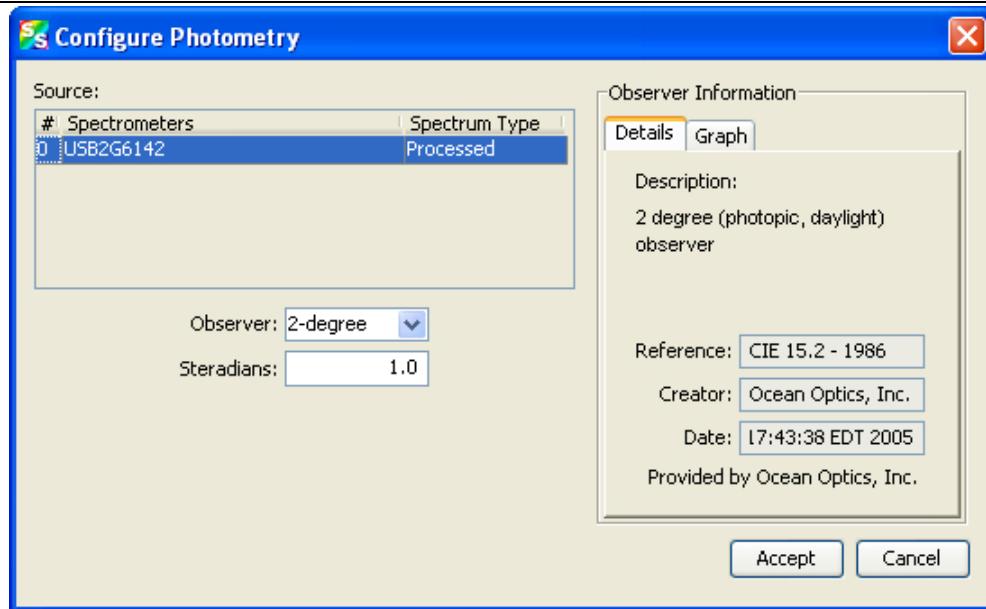
You must be in Absolute Irradiance mode (click  ) for this menu selection to be active.

### ► **Procedure**

1. Create a new graph of spectral data in Absolute Irradiance mode. See [Absolute Irradiance](#) in Appendix A: [Experiment Tutorials](#) for detailed instructions.
2. Select **Processing | Absolute Irradiance | New Photometry Measurement** to display the **Configure Photometry** dialog box.

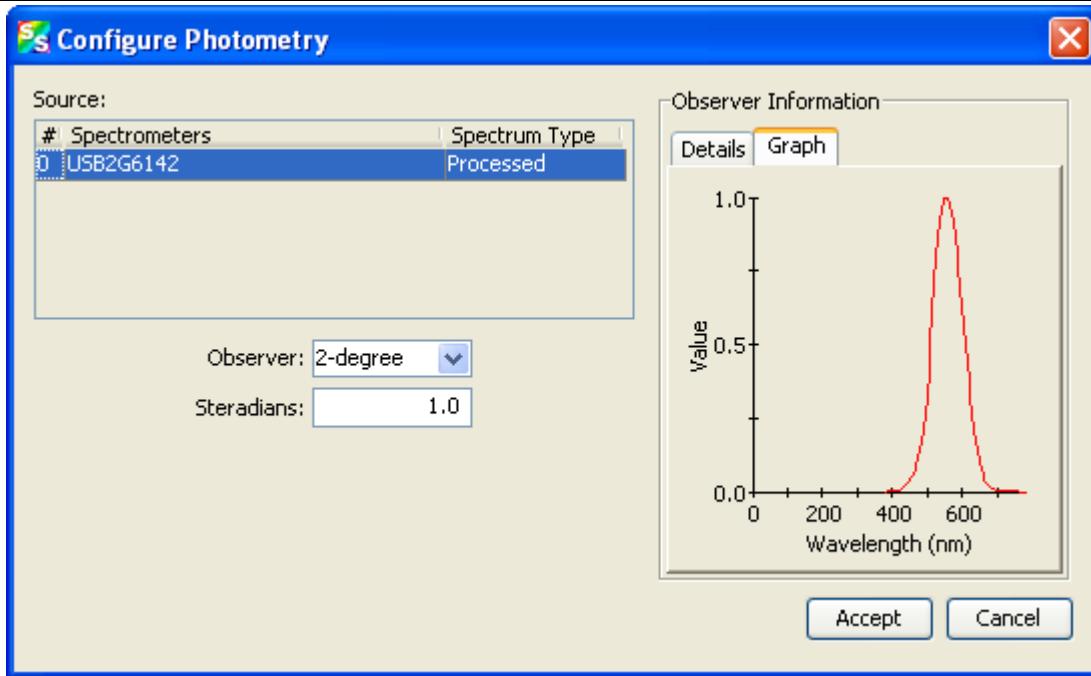
OR

Click  on an Absolute Irradiance graph.

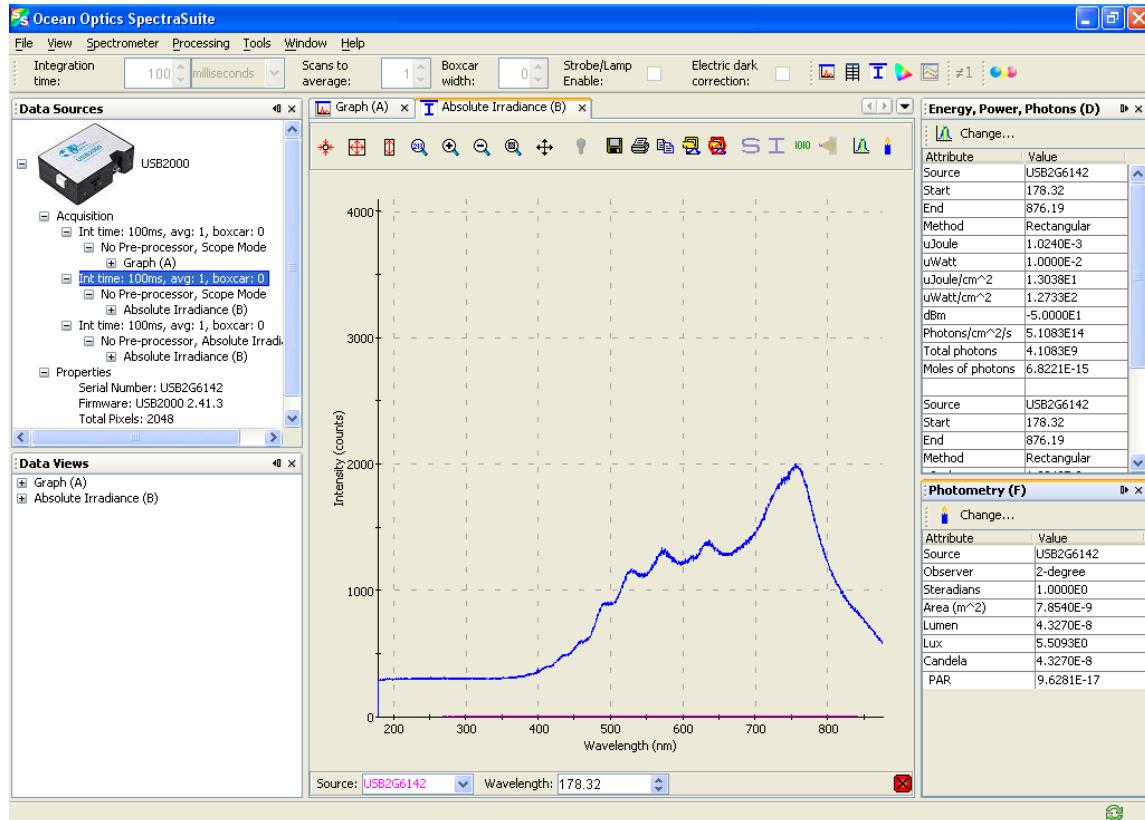


3. If more than one Absolute Irradiance graph is open, select the desired spectrometer by highlighting it under **Source**.
4. Select the **Observer** from the drop-down list.
5. Use the default **Steradians** (1.0) or enter your own value. (If the steradians value is 1, then candela = lumens).

The right section of the dialog box displays Observer Information in Detail or Graph form (Graph form is shown below, Detail form is shown on the previous page).



6. Click **Accept**. The Photometry table appears to the right of the graph. You can change these values by clicking the Change icon () in the Photometry table.



## 7: Processing Menu Functions

The Photometry table is described below:

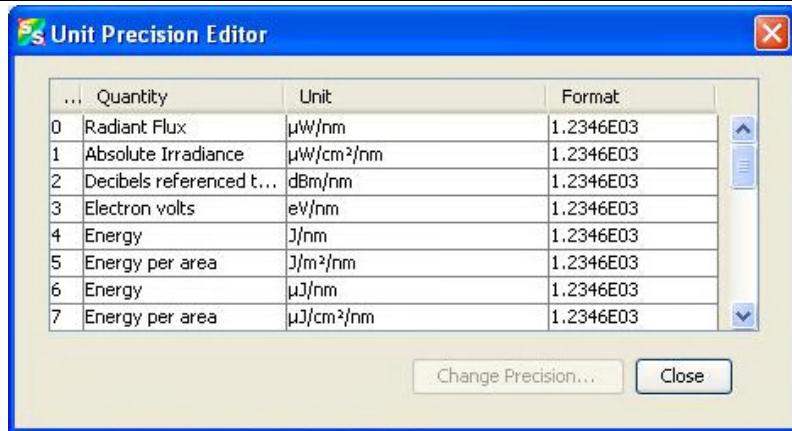
Attribute	Meaning
Source	The absolute irradiance source you selected in Step 3.
Observer	The type of observer you chose in Step 5.
Steradians	A unit of measurement used to describe the solid angle of a cone from the surface of a sphere to the center of the sphere. It is a solid angular measurement used when calculating illumination. The Lumens value is divided by the Steradians value to obtain Candela.
Area (m <sup>2</sup> )	The light collection area per meter squared.
Lumen	The lumen value. A lumen is a “light watt.” Lumens are calculated as the absolute spectral response of the human eye.
Lux	The lux values. The lux value is obtained by calculating the lumen per square meter. Lux is also called a meter candle.
Candela	The luminous intensity of the sample, based on international standards.
PAR (μm/photons)	Photosynthetic Active Radiation. The number of moles of photons between 400 -- 700 nm measured by absolute irradiance. To vary the 400-700 nm range, you can specify the moles of photons range using <a href="#">New Energy, Power, Photons</a> .
PAR (μmol photons/m <sup>2</sup> s)	Photosynthetic Active Radiation measured in terms of collection area and time.

## X-axis Units

This menu item allows you to select the units for the x-axis on the spectrum graph. Choose from Gigahertz, Microns, Pixels, Raman Shifts, Nanometers, and Wavenumbers. The default value is Wavelength (nm).

## Unit Preferences

Selecting Processing | Unit Preferences displays the Unit Precision Editor, which allows you to set the precision reported for various units of measure.

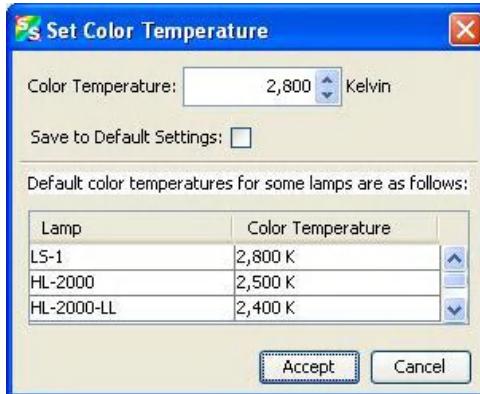


## Set Color Temperature

Setting the color temperature is useful if you have a lamp and you know what its temperature is. You can use the lamp color temperature that you set here when doing a color measurement (see [Fluorescence](#)).

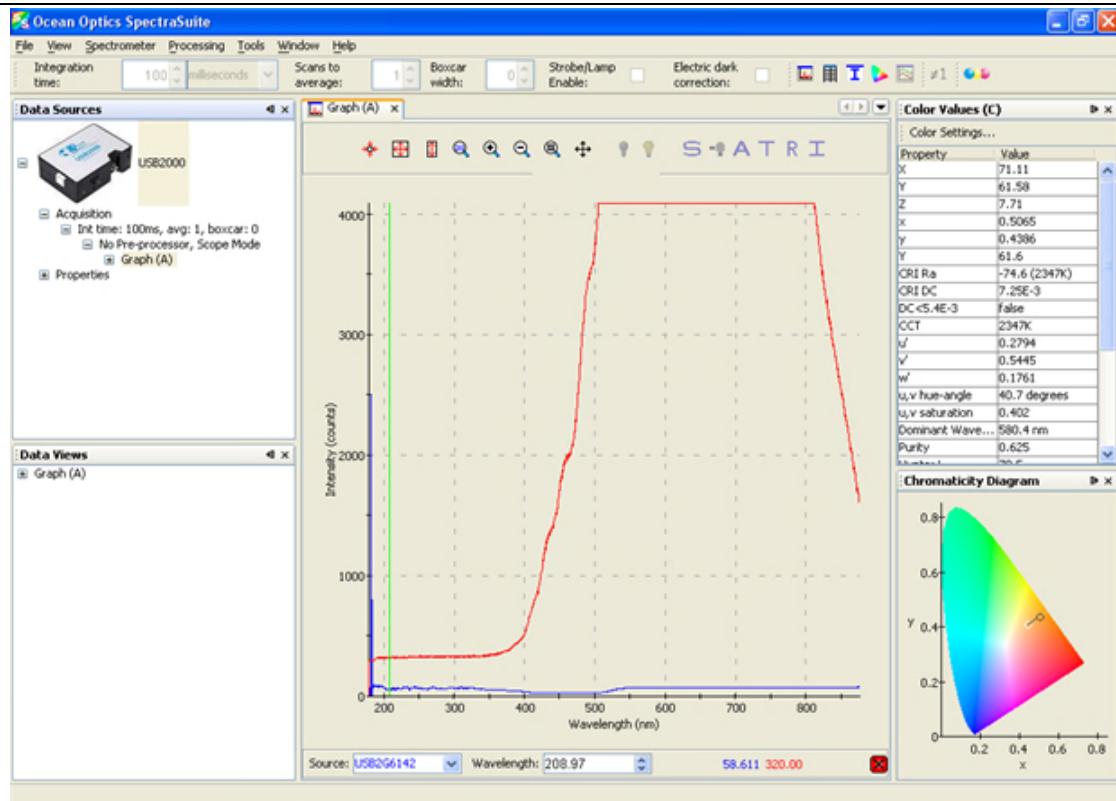
### ► Procedure

1. Select **Processing | Select Color Temperature** to display the Configure Photometry dialog box.



2. Set the desired color temperature (in Kelvin) and click **Accept**. The color value that you set here appears in the Color Values pane of the Color Measurement window.

## 7: Processing Menu Functions

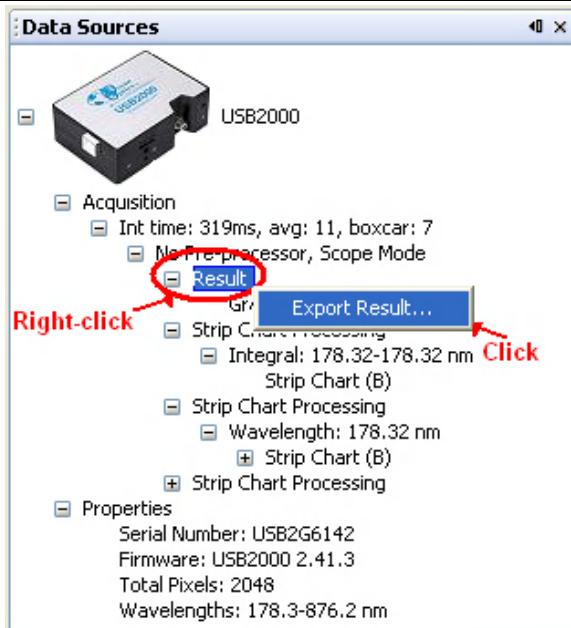


# Exporting Processed Data

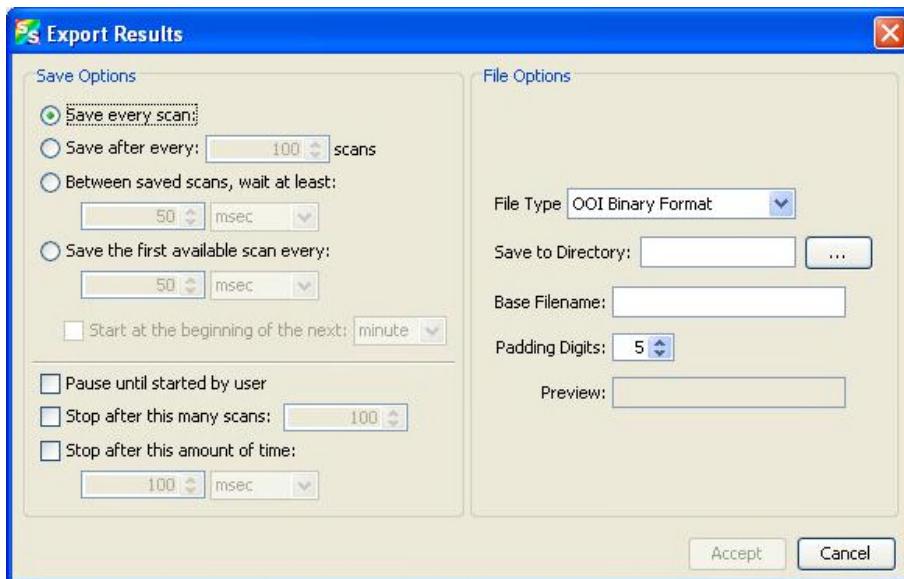
SpectraSuite provides the capability of saving and exporting processed data to a binary or tab-delimited file. When combined with external triggering, this feature can be used to automatically save full spectra timed to one or more external events.

### ► Procedure

1. Right-click on **Result** in the tree in the Data Sources or Data Views pane and select **Export Result**.



The dialog box for exporting data appears.



2. Enter the following information:

Field	Selections
Save options:	Saves:
Save every scan	Every scan
Save after every: x scans	After every x scans

## 7: Processing Menu Functions

Field	Selections
Between saved scans, wait at least:	Scans that occur at the interval selected
Save the first available scan every	The first scan that occurs after the interval selected
Start at the beginning of the next	If you select to save the first available scan, choose to start at the beginning of the next minute, hour or day.
File options:	Enter:
File Type	Grams SPC, JCAMP, OOI Binary Format or Tab Delimited
Save to directory	The desired directory or browse to the desired directory
Base Filename	The name of the files
Padding Digits	Enter the number of digits to be used when appending to a file (enter 3 to save hundreds of files, enter 4 to save thousands, etc. up to 15), for example: spectrumfile001 through spectrumfile999 if 3 is selected
Preview	For future use

3. Click **Accept** to start the export.

Color Save00000 - Notepad												
Source	Observer	Illuminant	Color Mode	X	Y	Z	x	y	z	CRI	R <sub>a</sub>	CRI
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4849	0.3710	0.1441	84.5	(2096K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4849	0.3710	0.1441	84.5	(2096K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4891	0.3739	0.1371	85.9	(2075K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4891	0.3739	0.1371	85.9	(2075K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4885	0.3720	0.1396	83.3	(2068K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4885	0.3720	0.1396	83.3	(2068K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3755	0.1387	84.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3749	0.1397	88.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3749	0.1397	88.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4830	0.3721	0.1449	86.2	(2124K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4830	0.3721	0.1449	86.2	(2124K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4842	0.3703	0.1456	85.6	(2098K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4842	0.3703	0.1456	85.6	(2098K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4887	0.3721	0.1392	85.6	(2066K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4887	0.3721	0.1392	85.6	(2066K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4847	0.3703	0.1449	84.1	(2093K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4847	0.3703	0.1449	84.1	(2093K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4896	0.3760	0.1354	87.0	(2095K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4886	0.3760	0.1354	87.0	(2095K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3725	0.1431	85.9	(2113K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3725	0.1431	85.9	(2113K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3720	0.1437	87.7	(2110K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3720	0.1437	87.7	(2110K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4806	0.3699	0.1494	84.2	(2132K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4806	0.3699	0.1494	84.2	(2132K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4812	0.3724	0.1464	82.9	(2144K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4812	0.3724	0.1464	82.9	(2144K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4856	0.3688	0.1456	83.4	(2073K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4856	0.3688	0.1456	83.4	(2073K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3731	0.1410	84.9	(2101K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3731	0.1410	84.9	(2101K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4866	0.3731	0.1403	83.5	(2094K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4866	0.3731	0.1403	83.5	(2094K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4918	0.3691	0.1391	85.0	(2016K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4918	0.3691	0.1391	85.0	(2016K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3747	0.1410	86.8	(2130K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3747	0.1410	86.8	(2130K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4790	0.3748	0.1461	84.7	(2186K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4790	0.3748	0.1461	84.7	(2186K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4841	0.3740	0.1419	85.9	(2127K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4841	0.3740	0.1419	85.9	(2127K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3704	0.1442	83.8	(2087K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3704	0.1442	83.8	(2087K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4864	0.3761	0.1375	85.1	(2118K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4864	0.3761	0.1375	85.1	(2118K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4851	0.3750	0.1400	88.1	(2123K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4851	0.3750	0.1400	88.1	(2123K)	

## Set Laser Wavelength

Use this menu item when you are doing Raman spectroscopy. Enter the wavelength of the laser you are using. You must enter a wavelength before you can access the Raman Shifts menu item.

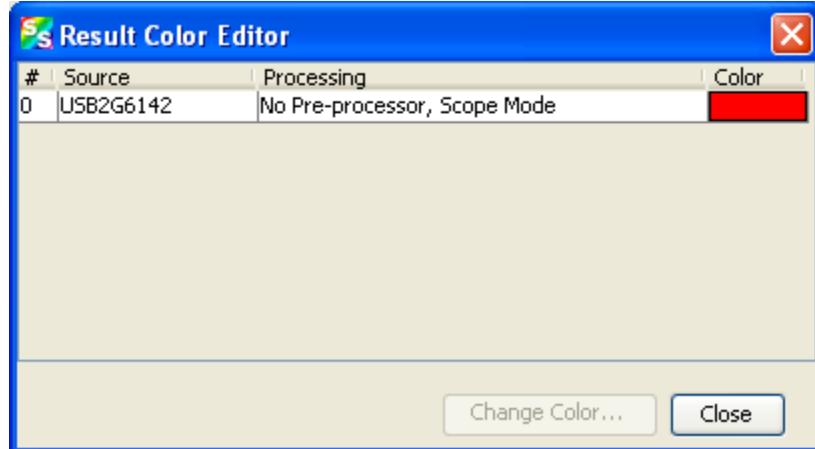


## Edit Result Colors

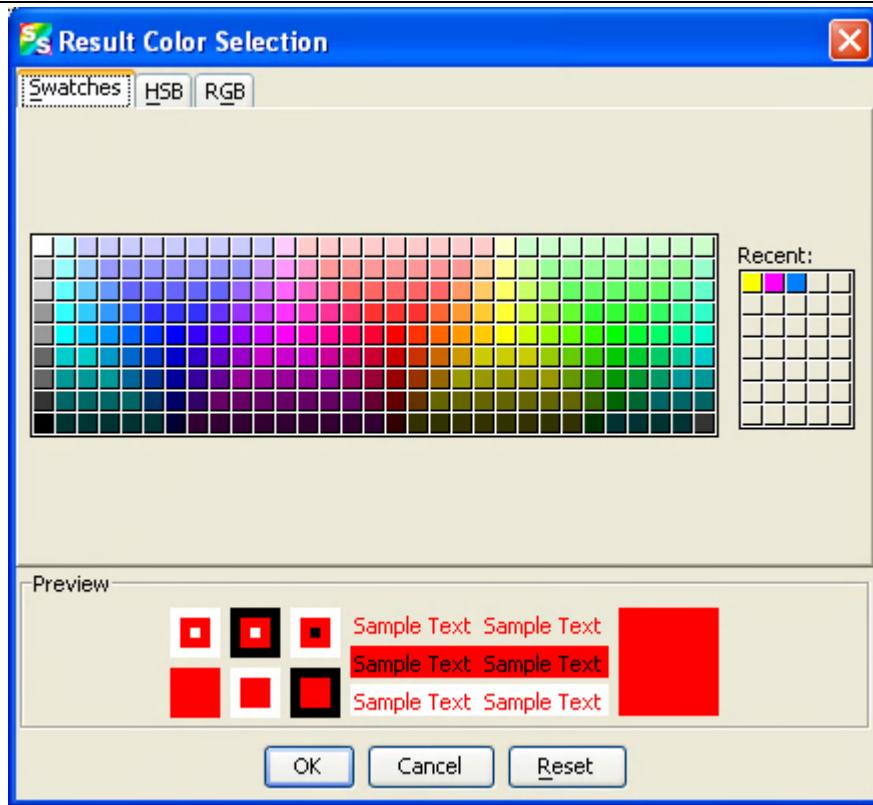
This function allows you to choose the color in which your data is displayed. The color selected will apply to all graphs in which that data appears, including Absolute Irradiance and Strip Charts.

### ► **Procedure**

1. Select **Processing | Edit Result Colors** to display the Result Color Editor dialog box.



2. Highlight the desired source and click **Change Color**. The Result Color Selection dialog box appears.



This dialog box provides three methods of selecting color -- by swatches, HSB (hue, saturation and brightness), or RGB (red, green, blue)..

3. Select the tab corresponding to the color selection method you wish to use.
4. Select the desired color. The **Recent** graphic lists any colors that you have recently chosen. You can select one of the recent colors instead of creating a new one. Once you have selected a color, the Preview panel displays an example of the color you have chosen.  
If the color is what you want, click the **OK** button. If you wish to reselect the original color, click the **Reset** button, then click **OK**.
5. The screen returns to the Result Color Editor dialog box. Click **Close**. The graph now displays in the selected color.

---

# Chapter 8

# Tools Menu Functions

## Overview

The tools menu provides the functionality to access the update center, select NetBeans settings for SpectraSuite modules, accept user-created plug-ins, and control the SpectraSuite parameters.

## Custom Libraries

SpectraSuite provides the capability of creating a button in the SpectraSuite GUI that, when pressed, calls an external function of your choosing. It is possible to call a C function from a DLL, .so, or .jnilib file (that is, under Windows, Linux, or MacOSX), or a Java function from a .jar file (on any platform). The function will take a single integer value that you specify when linking to the function.

In addition to calling user functions, these events will be capable of changing the spectrometer state, e.g. GPIO settings. To make a button that calls external code, it is necessary to identify the function (**Tools | Custom Libraries | Add New External Library**), then map a button to it (**Tools | Custom Libraries | Configure External Library**).

See the following rules before using this feature:

- Libraries must be written either C or Java
- Java libraries are expected to be packaged in a .jar file and the function to be invoked is expected to be in a public method of class (the method does not need to be static)
- C libraries must be compiled into a dynamic library (dll on Windows, so on Linux, dylib on Mac OS)
- C libraries must be compiled with a C compiler (such as gcc) and may not be compiled with a C++ compiler (such as Microsoft Visual Studio's C++ Compiler)
- If using a C library, you must know the name of the function you want to invoke within SpectraSuite
- Any C function used is expected to have a return type of void

Java methods may have any return type, but at this time there is no way to gather the method's return data within SpectraSuite.

## Supported Arguments

Currently, functions may take either of the following as arguments:

- A single integer: When you set up the triggering in SpectraSuite to call your function, you will supply the value for the integer that is passed to your function.
- A spectrum: This will consist of three arguments – an array of wavelength values, an array of pixel values, and an integer denoting the length of the wavelength/pixel value arrays. When you set up the triggering in SpectraSuite to call your function, you will be prompted with a list of currently-running acquisitions and asked to select which acquisition the wavelength and pixel values should be taken from. When the function is called, the most recent wavelength and pixel values will be taken from the acquisition you chose and passed as arguments to your function.

## Threading

If you have trouble getting SpectraSuite to call a function more than once, you need to know that SpectraSuite calls your library's function in new thread and waits for the thread to return before it will call your library's function again. The feature was designed this way to prevent large amounts of memory from being used. Therefore, it is important to make sure that your function will return, or it won't be called again.

## Sample Code

Examples of Java classes that contain a method that can be invoked are as follows:

```
// A class with a method that takes an integer as an argument
public class IntegerTestClass {
    // Constructor
    public IntegerTestClass() {
        // initialization code goes here
    }

    public void run(int argument) {
        // handling code here
    }
}

// A class with a method that takes a spectrum as an argument
public class SpectrumTestClass {
    // Constructor
    public SpectrumTestClass () {
        // initialization code goes here
    }

    public void run(double[] wavelengths, double[] pixels,
```

```

        int numberOfPixels) {
    // handling code here
}
}

```

Examples of C functions that can be invoked are as follows:

```

// A function that takes an integer as an argument
void run(int argument) {
    // handling code here
}

// A function that takes a spectrum as an argument
// Note here that the parameters must be pointers to arrays of
// the appropriate type - e.g. (double *) instead of (double[])
void run(double * wavelengths, double * pixels,
         int numberOfPixels) {
    // handling code here
}

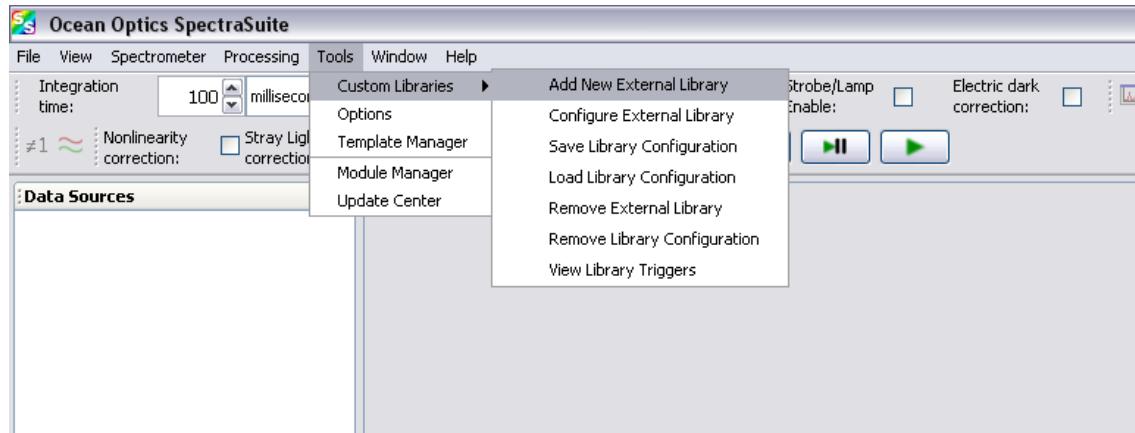
```

## Add New External Library

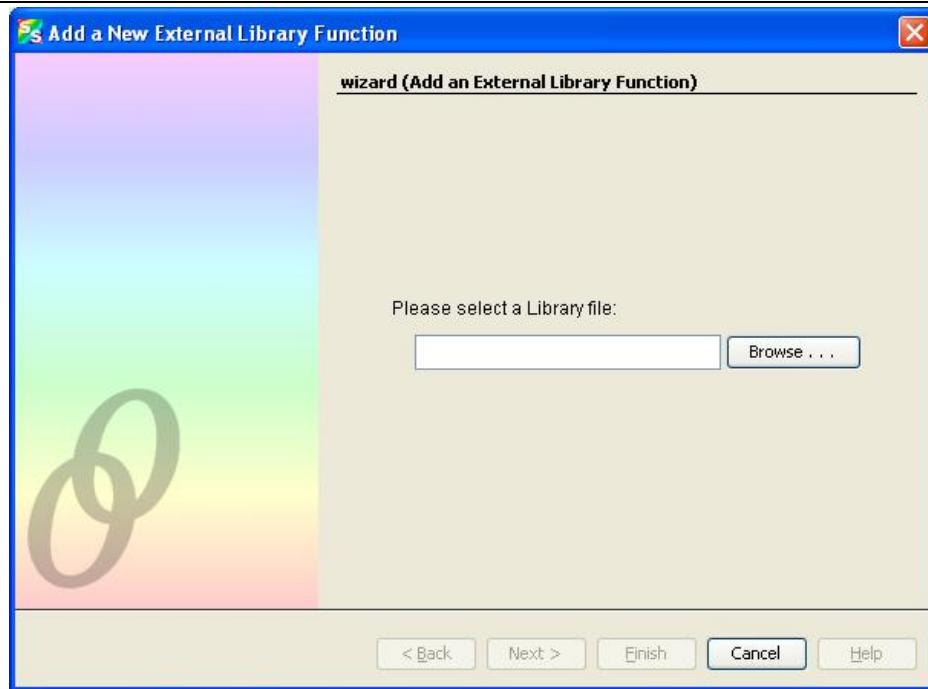
Use this function to add an external library of your choice.

### ► ***Procedure***

1. Select **Tools | Custom Libraries | Add New External Library** from the menu.



2. Browse to the desired library.



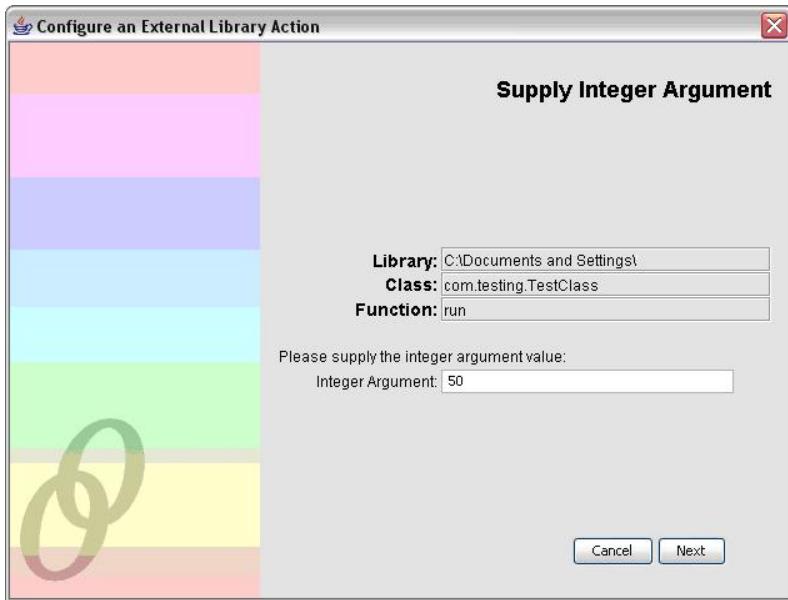
3. Confirm the language in which the library was written.
4. **For Java**, select the class that contains the class method you want to use from those in the list box. The list box contains all of the classes in the Jar file.  
**For a C Library**, you can skip this step.
5. **For Java**, select the class method from the list box. The class must be public and can only take a single integer as an argument.  
**For a C Library**, supply the function name.
6. Select the argument type. Currently, only the user-defined integer argument type is supported.
7. Supply a name for the function. This name will be used to identify the function and as the text on any buttons that you create to invoke the function.
8. Add a short description for the function. This description will be used as tool-tip text.
9. Click **Finish** to add the new function.

## Configure External Library

Use this function to configure the new external library that you just added.

### ► Procedure

1. Select **Tools | Custom Libraries | Configure External Library** from the menu.
2. Select the function you added from the list box.
3. Select the Button method to invoke the function. This is the only method available at this time. This will create a button for you to click.
4. Supply the value of the integer that you want to be passed to the function when it is invoked from SpectraSuite. The following screen displays for the User-Defined Integer argument type (selected in Step 6 above).



5. Click **Finish** on the final confirmation screen.

## Save Library Configuration

Select **Tools | Custom Libraries | Save Library Configuration** from the menu to save the library configuration.

## Load Library Configuration

Select **Tools | Custom Libraries | Load Library Configuration** from the menu to load the library configuration.

## Remove External Library

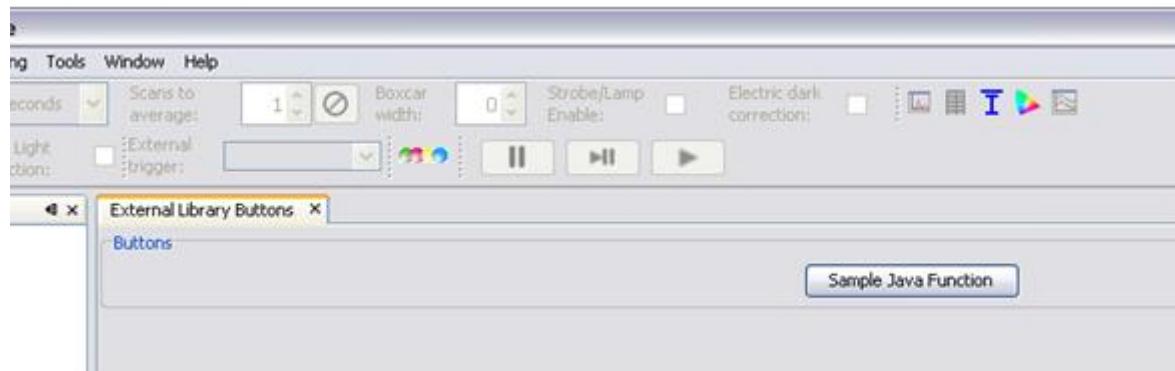
Select **Tools | Custom Libraries | Remove External Library** from the menu to remove the external library that you created.

## Remove Library Configuration

Select **Tools | Custom Libraries | Remove Library Configuration** from the menu to remove the library configuration that you created.

## View Library Triggers

Select **Tools | Custom Libraries | View Library Triggers** from the menu to view the external library buttons that you have created.



## Triggers

The Triggers menu enables you to configure certain triggers that you want SpectraSuite to monitor for. When the configured trigger is reached, SpectraSuite reacts as you have specified in your trigger configuration.

## Configure New Trigger

Select **Tools | Triggers | Configure New Trigger** to cause one of the following events to trigger a prescribed action from SpectraSuite to alert you that the event has occurred:

- Spectrum goes above or below a preset value
- The spectrometer is saturated
- A user-defined button is clicked

- A current loop output signal is detected for USB-AOUT and LS-450-4/20 devices (the signal will appear across Pin 6 –Ground and Pin 8-Signal). Using this wizard, you supply whatever values you want to correspond to 4.0 mA and whatever value you want to correspond to 20 mA. The defaults are set to 0-65535, but you can change these to be appropriate for other modes as well (e.g., for absorbance you would scale from 0.0-4.0, for transmission it would be 0-100, etc).

## Remove a Trigger

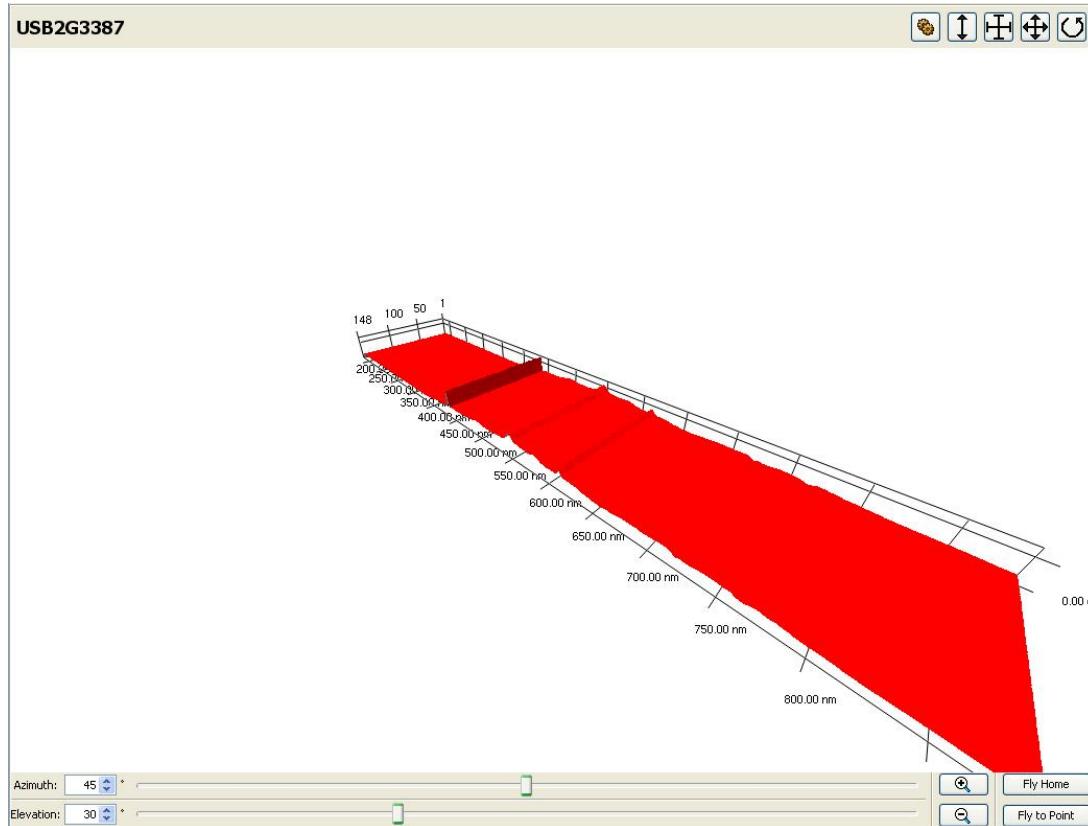
Select **Tools | Triggers | Remove a Trigger** from the menu to remove a triggering event that has been set using **Tools | Triggers | Configure New Trigger**.

## View Triggers

Use this menu item to view the triggers that have been set using **Tools | Triggers | Configure New Trigger**.

## 3D Data Viewer

Select **Tools | 3D Data Viewer** to display a 3-dimensional version of the graph similar to the one shown below. This function provides the capability of adjusting the three axes (x, y and z), changing data and background colors, etc.



## Locale Configurator

This function enables you to customize SpectraSuite for your operating system (Windows, Mac or Linux) and your geographic region. It also saves the SpectraSuite User directory to a location that you specify. You must be running SpectraSuite as an Administrator to use this feature.

## New Mikropack Device

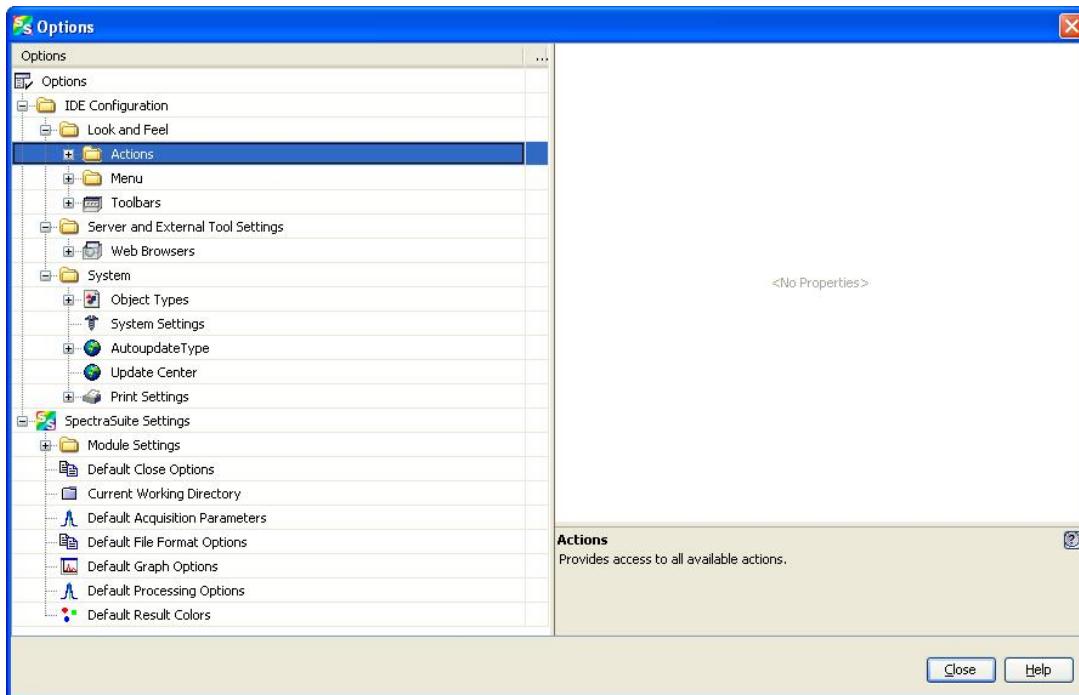
This function connects an MPM-2000 or MonoScan 2000 through its serial port.

## Remove Mikropack Device

This function removes the connection of the MPM-2000 or Monoscan 2000 set up through **Tools | New Mikropack Device**.

## Options

Options is a powerful tool that enables you to specify the defaults for SpectraSuite parameters all in one location.

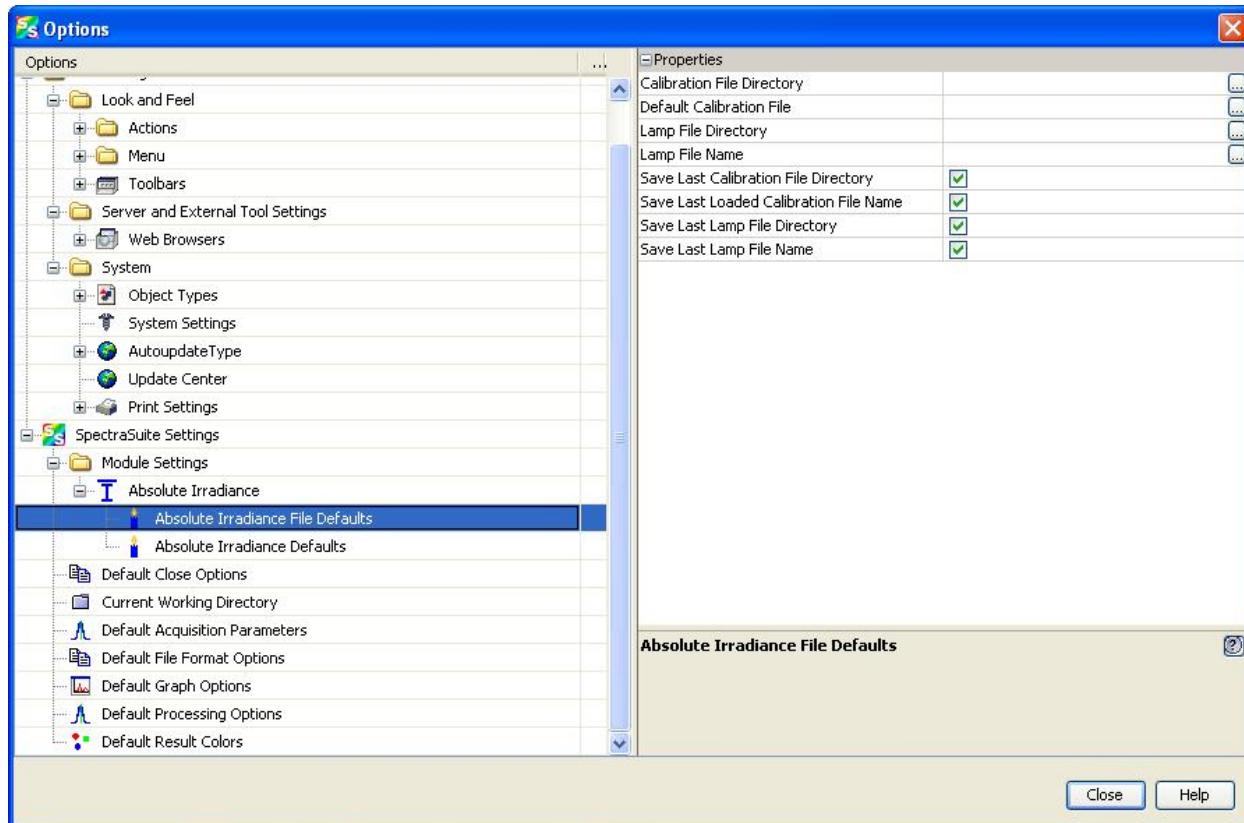


## IDE Configuration

This tool enables you to change default aspects of the SpectraSuite user interface such as the interface look and feel, server and external tool settings, and system settings.

## SpectraSuite Settings

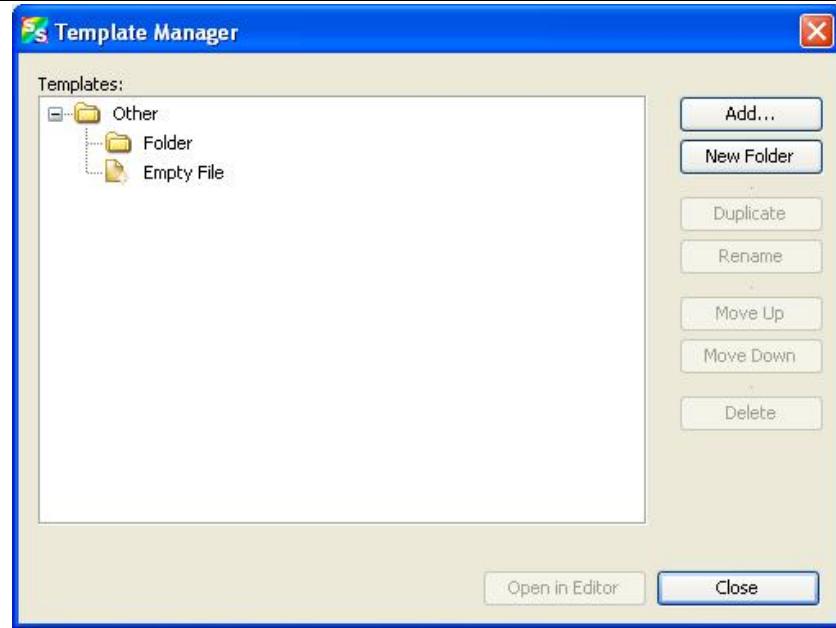
You can set parameters for your spectrometer(s) to persist through shutdown and restart using this option.



## Template Manager

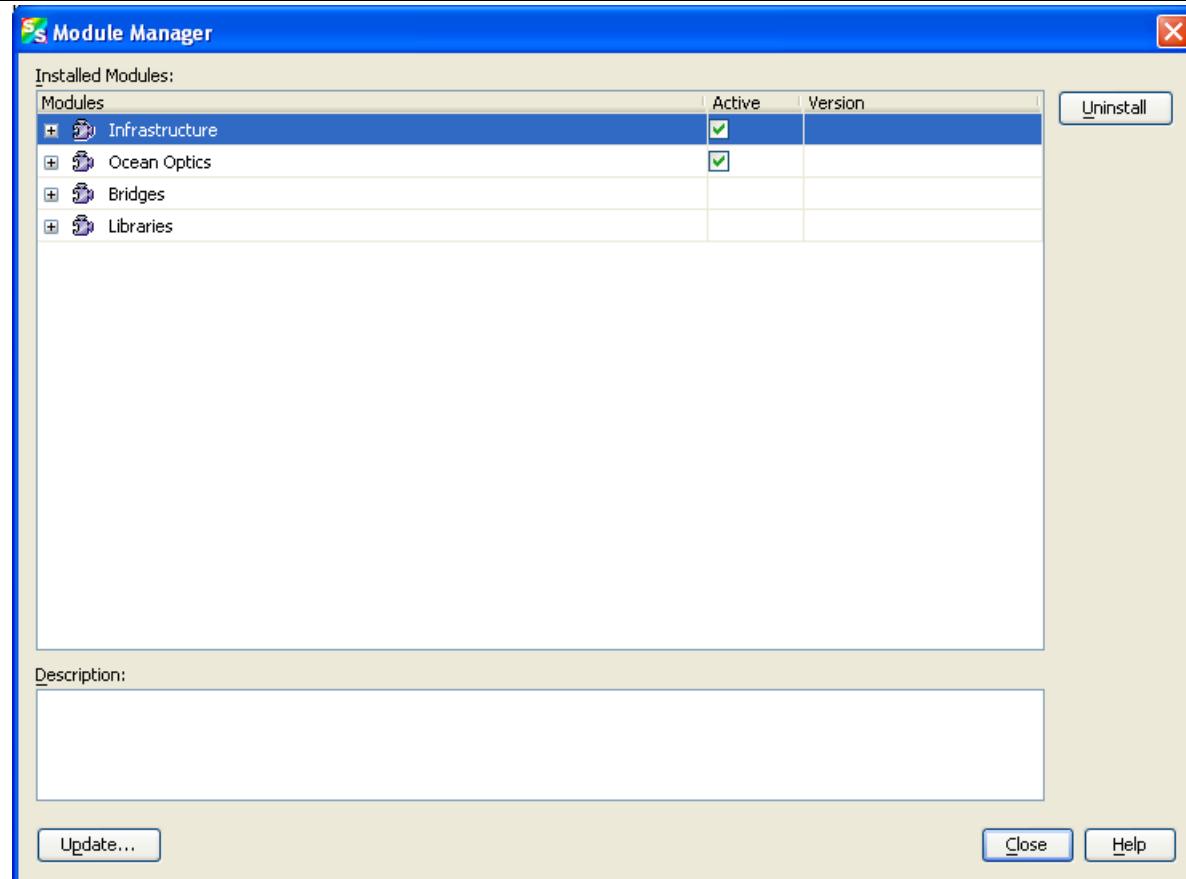
Future enhancement.

## 8: Tools Menu Functions



## Module Manager

The Module Manager displays a list of installed SpectraSuite modules. You can select modules to uninstall and /or update.



## Update Center

The Update Center contains a link to allow you to connect to Ocean Optic's site to download updated SpectraSuite modules. To download upgrades to SpectraSuite, you must sign up for a yearly subscription (SpectraSuite-U). Bug fixes are provided free to all SpectraSuite customers.

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### Note

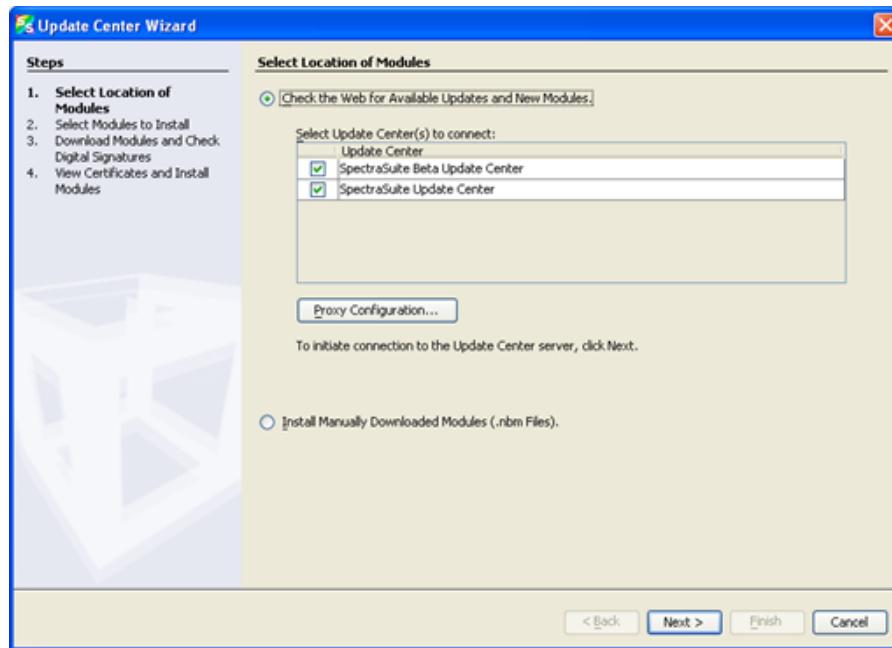
If the installation computer is not connected to the Internet, download the update files on another computer and copy them to the installation computer using a USB flash drive or CD. Extract the files to a convenient location, then from within the Update Center wizard, select **Install Manually Downloaded Modules (.nbm Files)** and browse to the directory containing the downloaded files.

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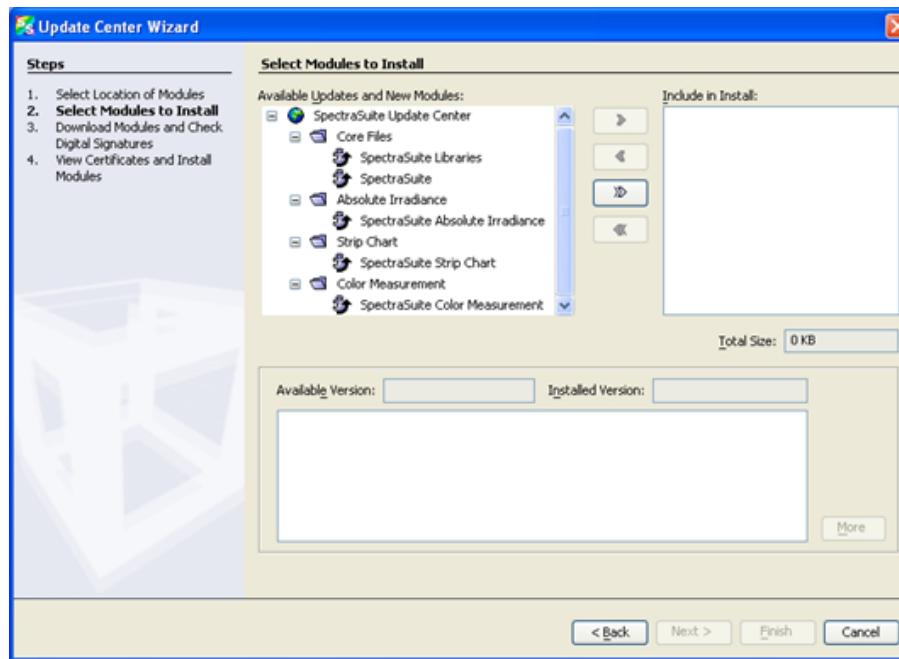
## ► Procedure

To download SpectraSuite updates,

1. Select **Tools | Update Center**. The Update Center Wizard appears.



2. Click **Next >** to connect to the update center. The second Update Center Wizard screen appears.

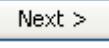


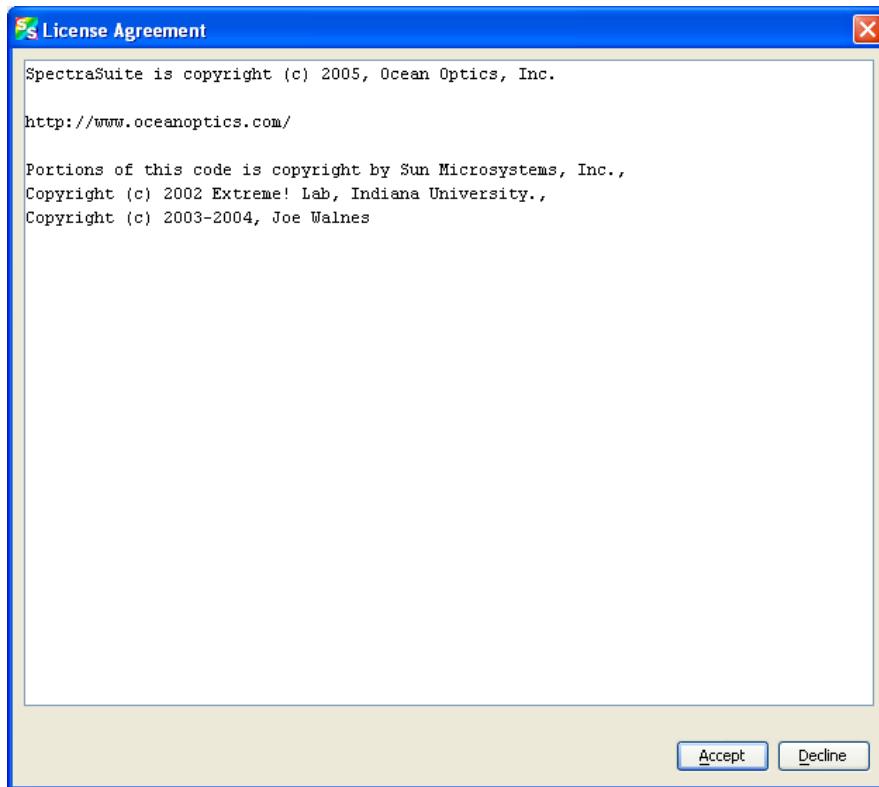
3. Click  to move the all files/modules to the **Include in Install** pane.

Or,

Highlight the desired core files and/or modules to update and click  to move the selected files modules to the **Include in Install** pane. When you highlight a module or file, the size and modification date appear in the lower pane.

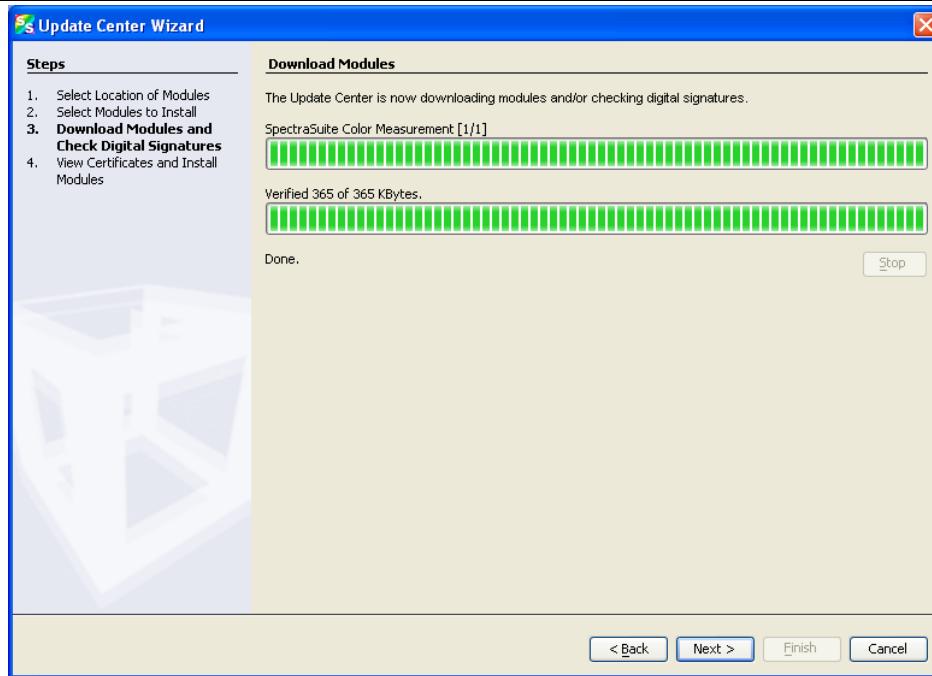
Applicable version levels appear in the **Available Version** and **Installed Version** boxes.

4. Click  to display the SpectraSuite license agreement.

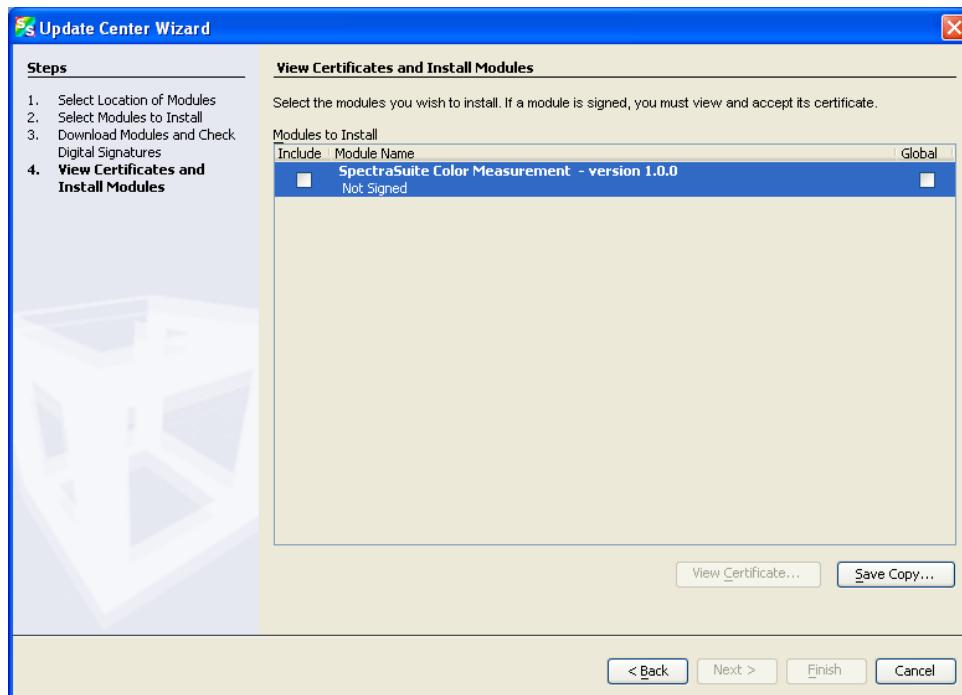


5. Click  to accept the license agreement and start the download. The progress of the download appears on the next screen.

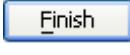
## 8: Tools Menu Functions



6. Click . The next Update Center Wizard screen appears.



7. Check the boxes on both sides (both Install and Global) next to the files/modules you want to install. If a module is signed, you must first view and accept its certificate. If the module isn't signed, a dialog box appears asking you to confirm that you want to install an unsigned module.

Then click  Finish to install the module(s). The Restart the IDE dialog box appears asking you whether you want to restart the IDE now or wait until later. If you choose to restart now, a dialog box appears asking you to confirm that you want to quit the SpectraSuite application. Once the IDE is restarted, the updates become active.



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# Chapter 9

# Window Menu Functions

## Overview

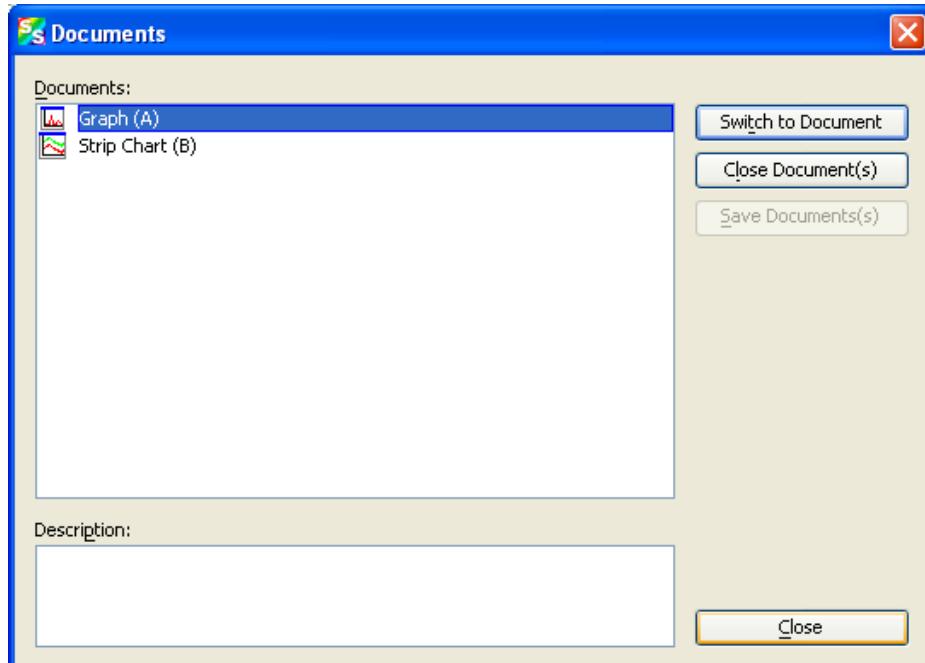
The Windows menu provides functions for manipulating the SpectraSuite graph windows.

## Close All Documents

Use this function to immediately close all the SpectraSuite open graphs.

## Documents

Select **Window | Documents** to display the Documents dialog box. Use this dialog box to switch the SpectraSuite display to one you select, close selected document(s), or save selected document(s).

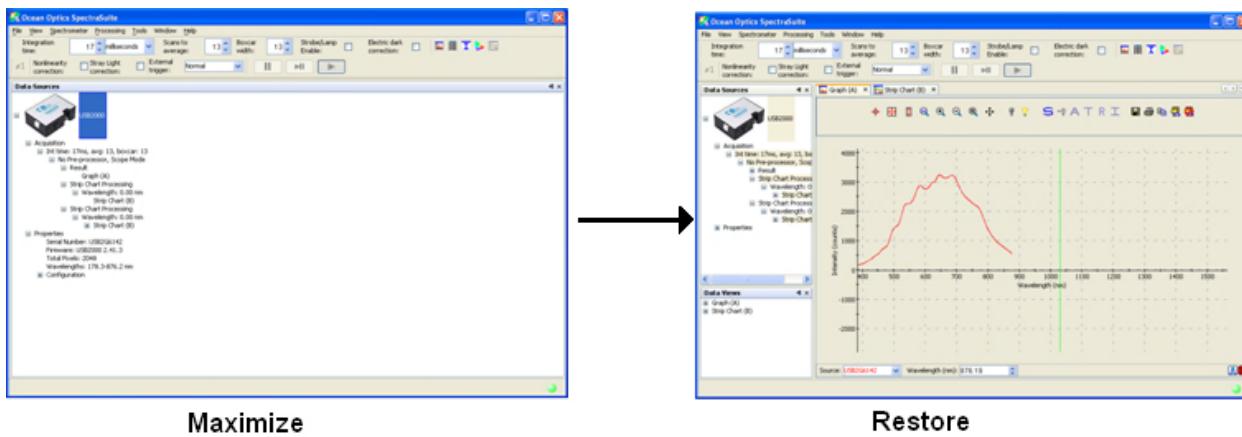


## Close Window

Use this selection to close the currently selected graph window.

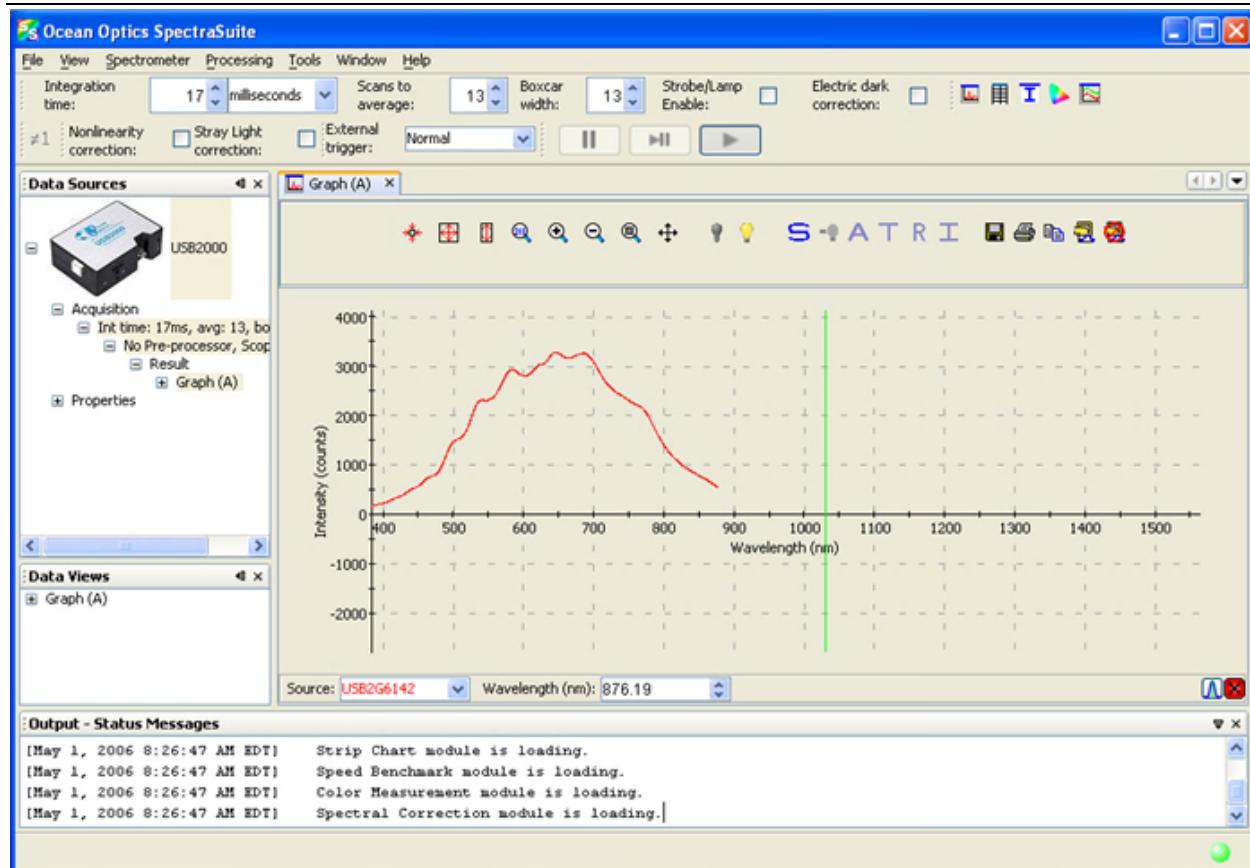
## Maximize/Restore Window

This selection toggles between maximizing the SpectraSuite currently selected SpectraSuite pane to fill the entire SpectraSuite window, and redisplaying (restoring) these panes in the window. See the example of a maximized Data Sources pane below.



## Output

Select **Window | Output** to display a list of SpectraSuite status messages in a pane below the SpectraSuite window.





---

# Chapter 10

# Strip Charts

## Overview

SpectraSuite allows you to use Strip Charts to track processes, perform kinetic analyses, and monitor spectral events all as a function of time. The Strip Chart shows you how the value that you selected appears over time. This value can be any of the following:

- One pixel (a single wavelength)
- The average of a range of pixels
- An integral calculated by one of three methods representing the area beneath the graph's trend line

You can acquire this data using any processing mode (transmission, absorbance, etc.).

## Creating Strip Charts

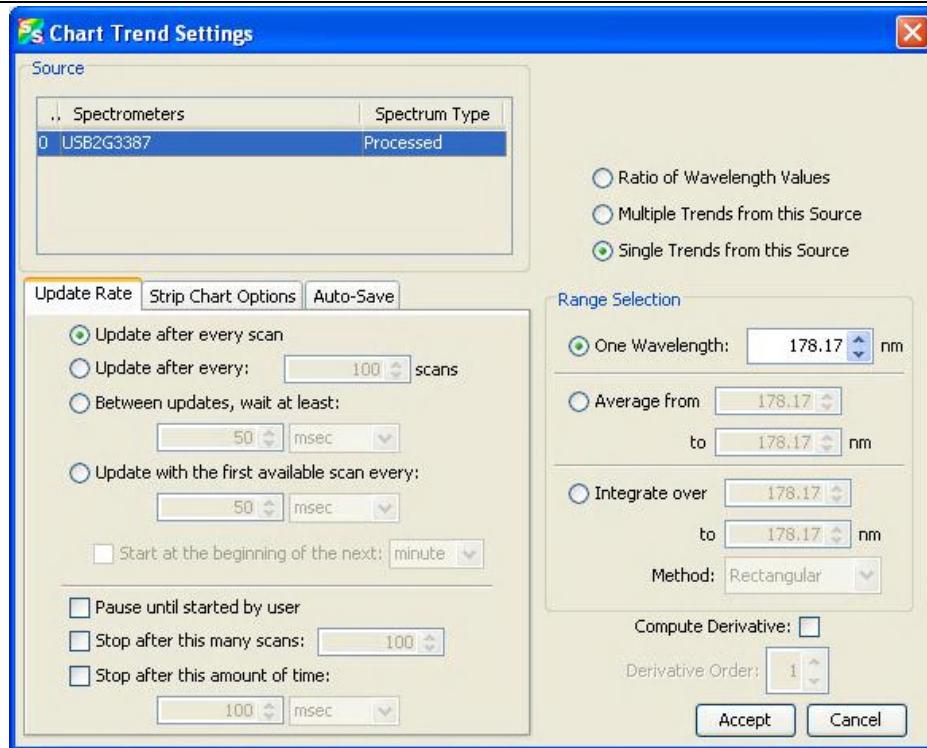
### ► *Procedure*

1. Place SpectraSuite in Scope mode by clicking the Scope () icon in the Experiment mode toolbar or selecting **Processing | Processing Mode | Scope** from the menu.
2. Store a reference spectrum and a dark spectrum.
3. Choose the measurement mode (absorbance, transmission, etc.).
4. Click the Strip Chart button ()

OR

Select **File | New | Strip Chart** from the menu.

The **Chart Trend Settings** dialog box opens with the Update Rate tab shown.

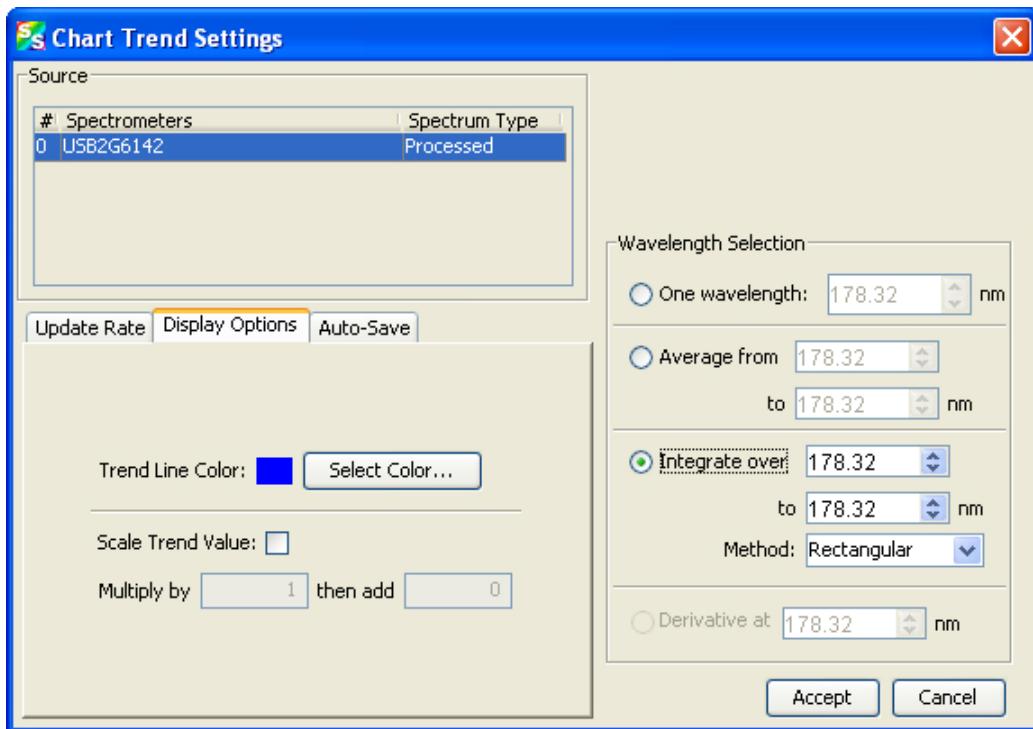


5. Enter the following data to create your Strip Chart:

Field	Selections
Source	Select the source of the Strip Chart.
Select one of the following:	
Ratio of Wavelength Values	Displays the Ratiometric Configuration Wizard to help you to select the wavelength to use as the numerator and the divisor for the ratio.
Multiple Trends from this Source	Displays a screen to choose multiple trend options such as number of trends, range selection, compute derivative, and scale trend value.
Single Trends from this Source	Activates the Range Selection field on the lower right portion of this screen.
Update Rate tab:	Updates the strip chart:
Update after every scan	After every scan
Update after every x scans	After the number of scans selected
Between updates, wait at least	After the interval selected between updates
Update with the first scan every	After the first scan, then at the interval selected
Start at the beginning of the next	At the beginning of each new selected interval

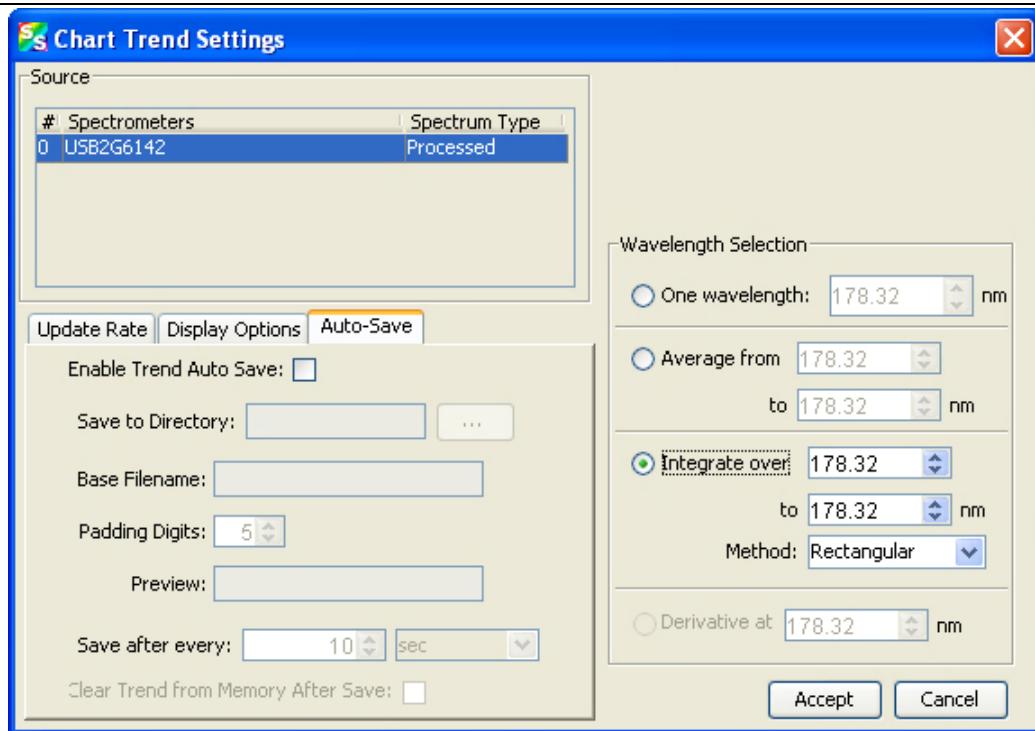
Field	Selections
Range Selection  This section varies, depending on the units chosen for the x-axis (see <a href="#">X-axis Units</a> )	Select the type of data for which you want to view the time trend from the following: <ul style="list-style-type: none"> <li>• One wavelength – For one pixel (used in fluorescence, for example). Select the wavelength.</li> <li>• Average from – For a range of pixels. Select the starting and ending wavelengths.</li> <li>• Integrate over – For the area underneath the trend line. Select the starting and ending wavelengths. Then, select the method for calculating the continuous area underneath the graph curve: Rectangular, Simpson's, or Trapezoid.</li> </ul>

6. Click the Display Options tab.



Field	Selections
Display Options	Select a color for the graph's trend line.
Scale Trend Value	If you would like to adjust your data, enter the appropriate information in this field.

7. Click the Auto-Save tab.



Field	Selections
Auto-Save: Enable Trend Auto-Save Save to Directory Base Filename Padding Digits  Preview Save after every  Clear Trend from Memory After Save	Enables the auto-save option Enter the directory where you want to save the files Enter the filename to be used Enter the number of digits to be used when appending to a file (enter 3 to save hundreds of files, enter 4 to save thousands, etc. up to 15), for example: spectrumfile001 through spectrumfile999 if 3 is selected For future use Enter the time interval for the save. If set to 0, every scan is saved. Flushes the data from memory after each autosave to conserve memory usage.

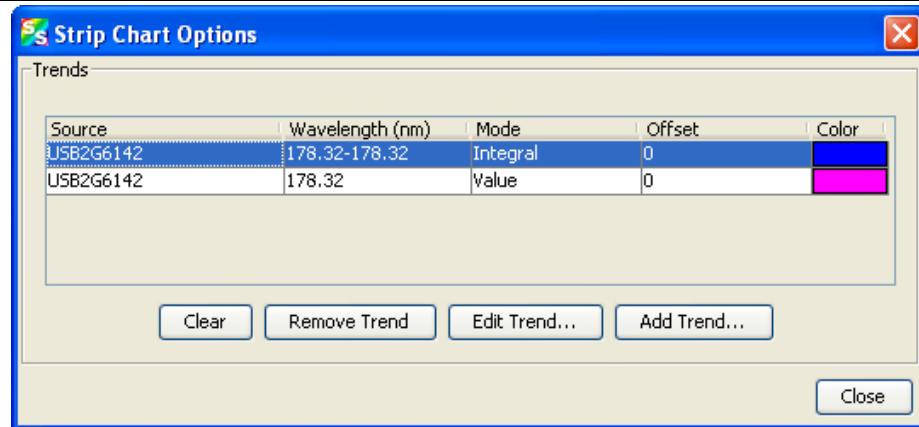
8. Click **Accept**. The **Strip Chart Options** dialog box appears. **Strip Chart Options** lists all of the Strip Charts that you have created, along with the options that you have set for each one. Use this dialog box to add, edit, remove, or clear trends.

---

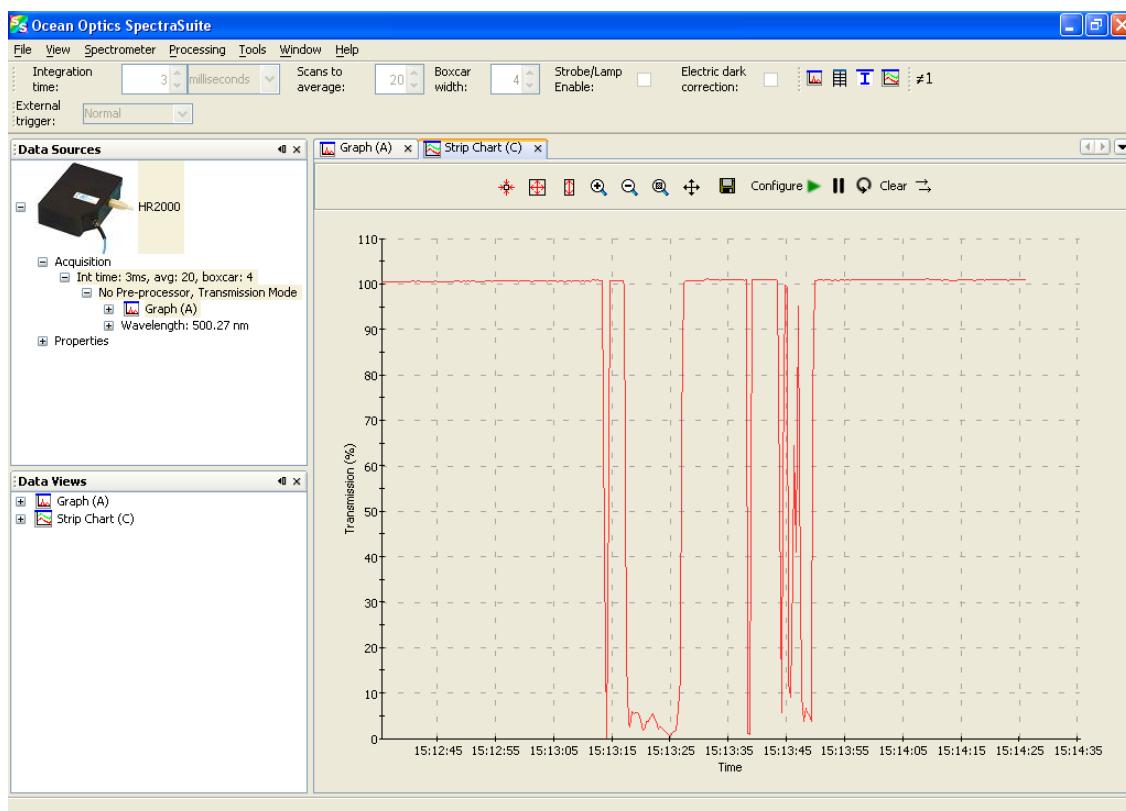
### Note

Highlight the desired trend to make the **Clear**, **Remove Trend**, and **Edit Trend** buttons active.

---



9. Click **Close**. The strip chart you created appears. Note the time scale along the x-axis. The y-axis in this example shows the percentage transmission for the selected pixel(s).
10. To add another trend to this graph, click **Add Trend...**.



# Saving Strip Chart Data

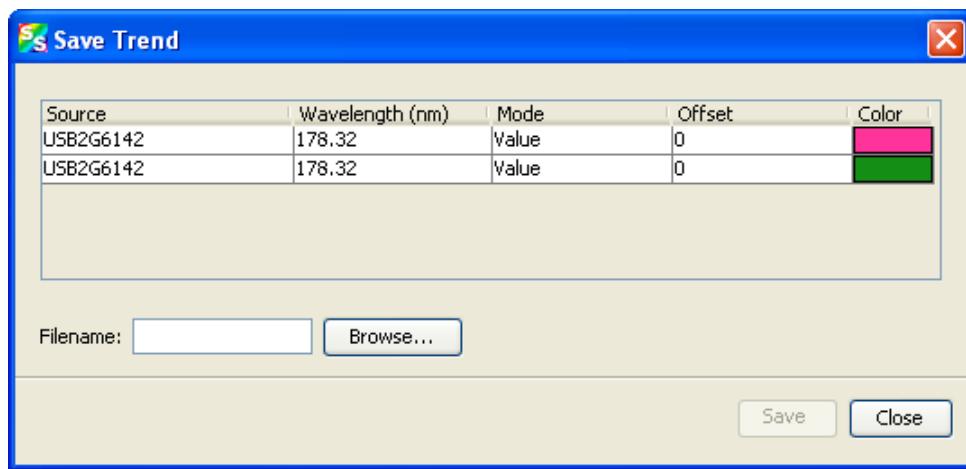
## Note

See [Creating Strip Charts](#) for information on autosaving.

### ► Procedure

To save strip chart data:

- From the Strip Chart graph, click . The **Save Trend** dialog box appears.



- Select the trend to save and enter a file name. Then click .

# Strip Chart Controls

Use the following controls to adjust the display of your strip chart.

Control	Action
	Resumes any strip chart trends you have paused.
	Pauses all strip chart trends.
	Restarts any strip chart trends with a fixed length or duration (see <a href="#">Creating Strip Charts</a> ).
	Clears all strip chart trends.
	Automatically scrolls the strip chart graph to the newest data.

---

## Appendix A

# Experiment Tutorials

## Overview

The following sections contain information on conducting sample experiments using a USB2000 Spectrometer and SpectraSuite.

For information on experiments with Ocean Optics spectrometers other than the USB2000, consult the operating instructions for your particular spectrometer model.

## Preparing for Experiments

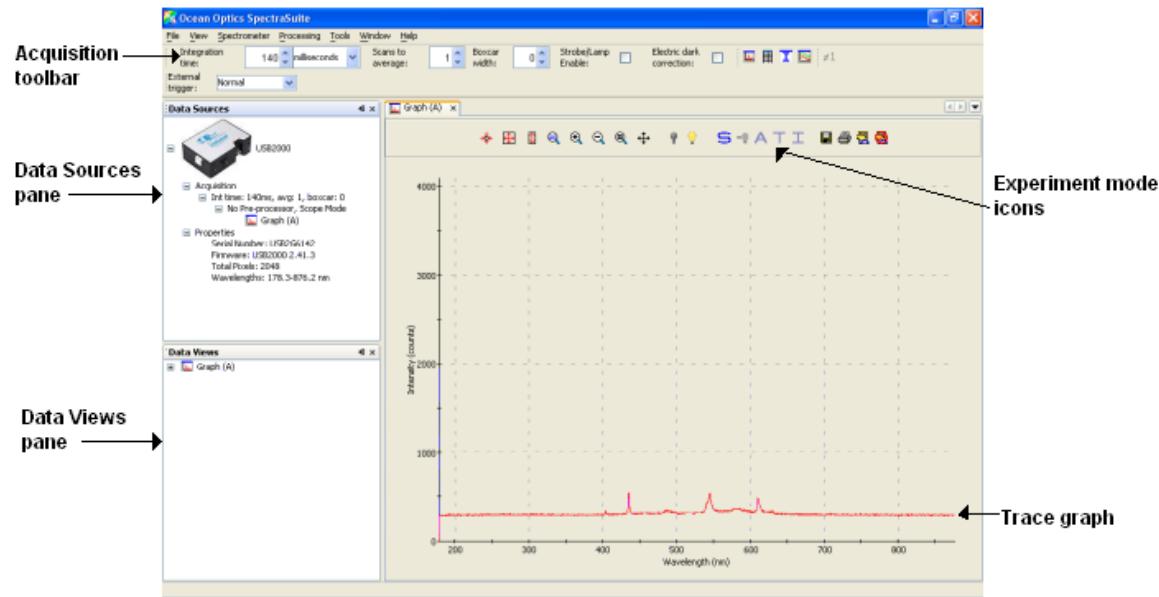
Verify that you have correctly installed SpectraSuite, installed the spectrometer, and configured the light source and other sampling optics.

If you followed the previous steps and started SpectraSuite, the spectrometer is already acquiring data in Scope mode. Even with no light in the spectrometer, SpectraSuite should display a dynamic trace in the bottom of the graph window. If you allow light into the spectrometer, the graph trace should rise with increasing light intensity. This indicates that you correctly installed the software and hardware.

Note the spectrometer(s) that you have installed are listed in the Data Sources pane. Information for each spectrometer listed in this pane consists of the following:

Acquisition parameters that you set via the (integration time, scans-to-average, boxcar smoothing), Whether reference and/or dark spectra have been stored, the graph (A, B, C, etc.) associated with this spectrometer that appears in the right pane (important if you have installed more than one spectrometer), Spectrometer's properties (serial number, firmware level, number of pixels, and wavelengths).

## A: Experiment Tutorials



Once you install the hardware and software, and establish your sampling system, you are ready to take measurements.

This section details the following types of experiments:

[Absorbance Experiments](#)

[Concentration Experiments](#)

[Transmission Experiments](#)

[Reflection Experiments](#)

[Irradiance Experiments](#)

[Color Experiments](#)

The type of measurement you will take determines the configuration of the sampling optics for your system. Furthermore, your choice of reference and data analysis determines how SpectraSuite presents the results.

---

### Note

For each measurement, you must first take a reference and dark spectrum before the experiment mode icon (**A**, **T**, **I**) on the toolbar becomes active. After you take a reference and a dark spectrum, you can take as many measurement scans as needed. However, if you change any sampling variable (integration time, averaging, smoothing, fiber size, etc.), you must store a new reference and dark spectrum.

---

## Application Tips

If the signal you collect is saturating the spectrometer (intensity greater than the maximum value for the spectrometer), you can decrease the light level on scale in scope mode by:

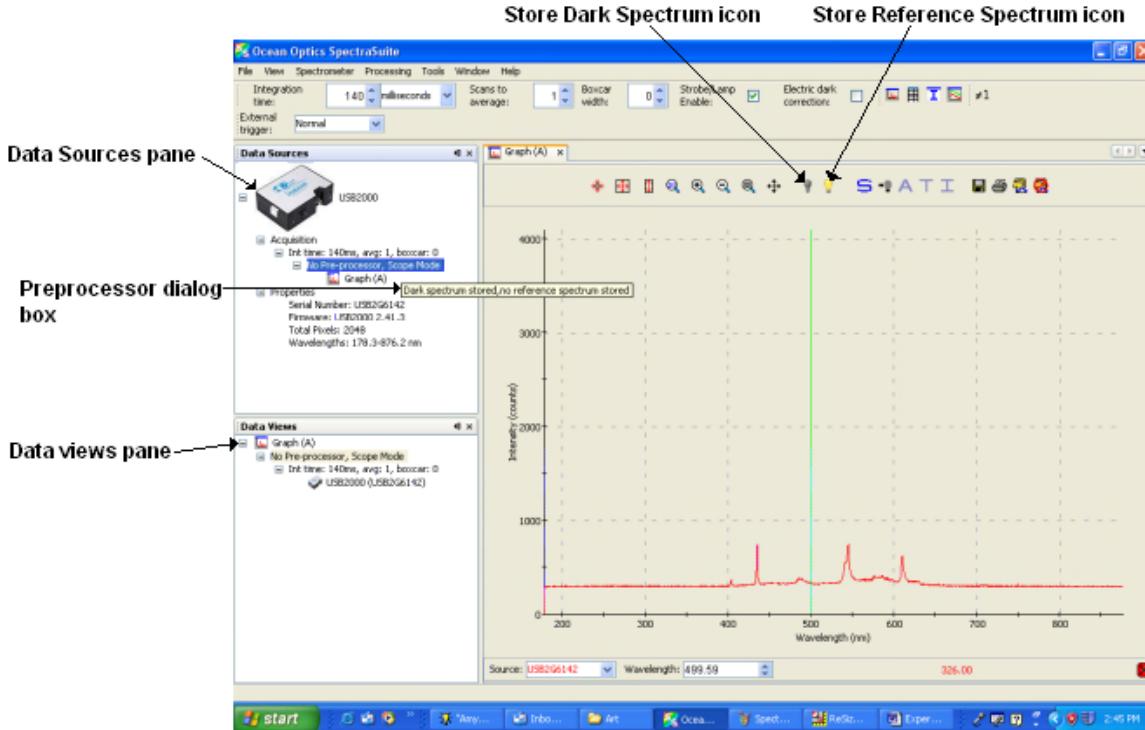
- Decreasing the integration time
- Attenuating the light going into the spectrometer
- Using a smaller diameter fiber
- Using a neutral density filter with the correct optical density

If the signal you collect has too little light, you can increase the light level on scale in scope mode by:

- Increasing the integration time
- Using a larger diameter fiber
- Removing any optical filters

## Taking Reference and Dark Spectra

Reference and dark spectra must be stored before collecting experiment data. If you pass the cursor over the **No-preprocessor** line in either the Data Sources or Data Views pane, a dialog box informs you whether reference and/or dark spectra have been stored.



#### A: Experiment Tutorials

A reference spectrum is taken when the light source is on and there is no sample present. Click the Store Reference Spectrum icon () to take a reference spectrum.

A dark spectrum is taken in the absence of light. Block the light path, uncheck the **Strobe/Lamp Enable** option on SpectraSuite's Acquisition toolbar, or turn off the lamp, and then click the Store Dark Spectrum icon () to take a dark spectrum.

## Absorbance Experiments

Absorbance spectra are a measure of how much light a sample absorbs. For most samples, absorbance relates linearly to the concentration of the substance. SpectraSuite calculates absorbance ( $A_\lambda$ ) using the following equation.

$$A_\lambda = - \log_{10} \left( \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \right)$$

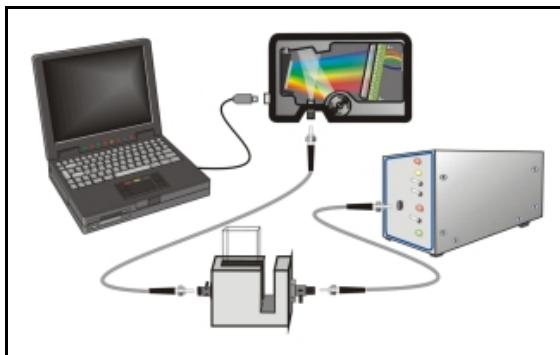
Where:

$S_\lambda$  = Sample intensity at wavelength  $\lambda$

$D_\lambda$  = Dark intensity at wavelength  $\lambda$

$R_\lambda$  = Reference intensity at wavelength  $\lambda$

Typical absorbance setup: The light source (far right) sends light via an input fiber into a cuvette in a cuvette holder (bottom center). The light interacts with the sample. The output fiber carries light from the sample to the spectrometer (top center) connected to the computer (far left).

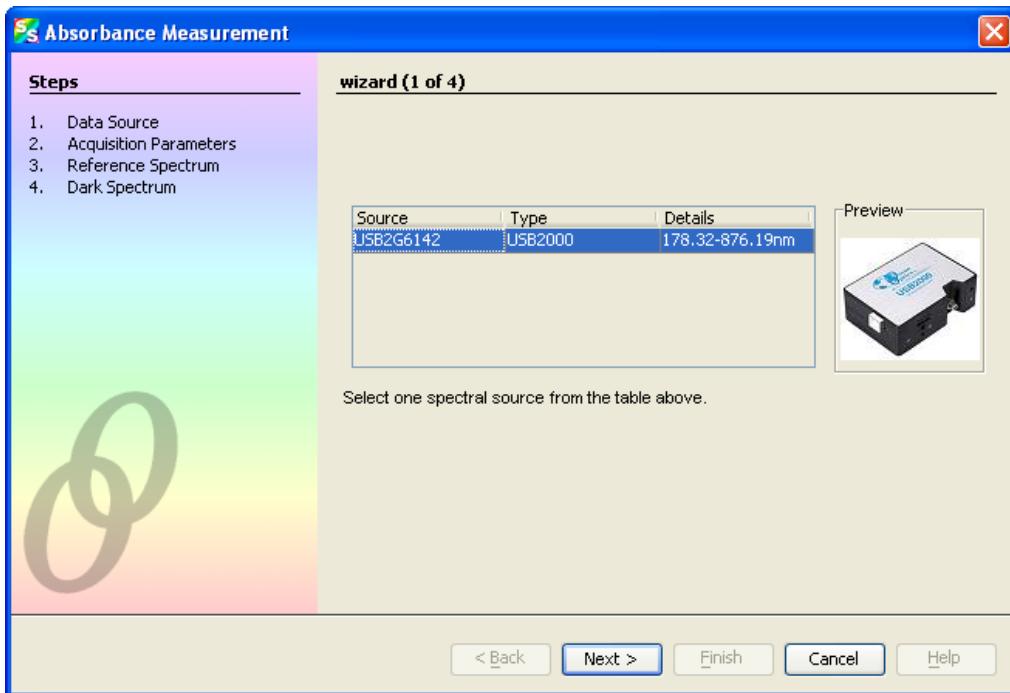


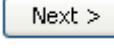
Absorbance is also proportional to the concentration of the substance interacting with the light (this is known as Beer's Law). Common absorption applications include the quantification of chemical concentrations in aqueous or gaseous samples.

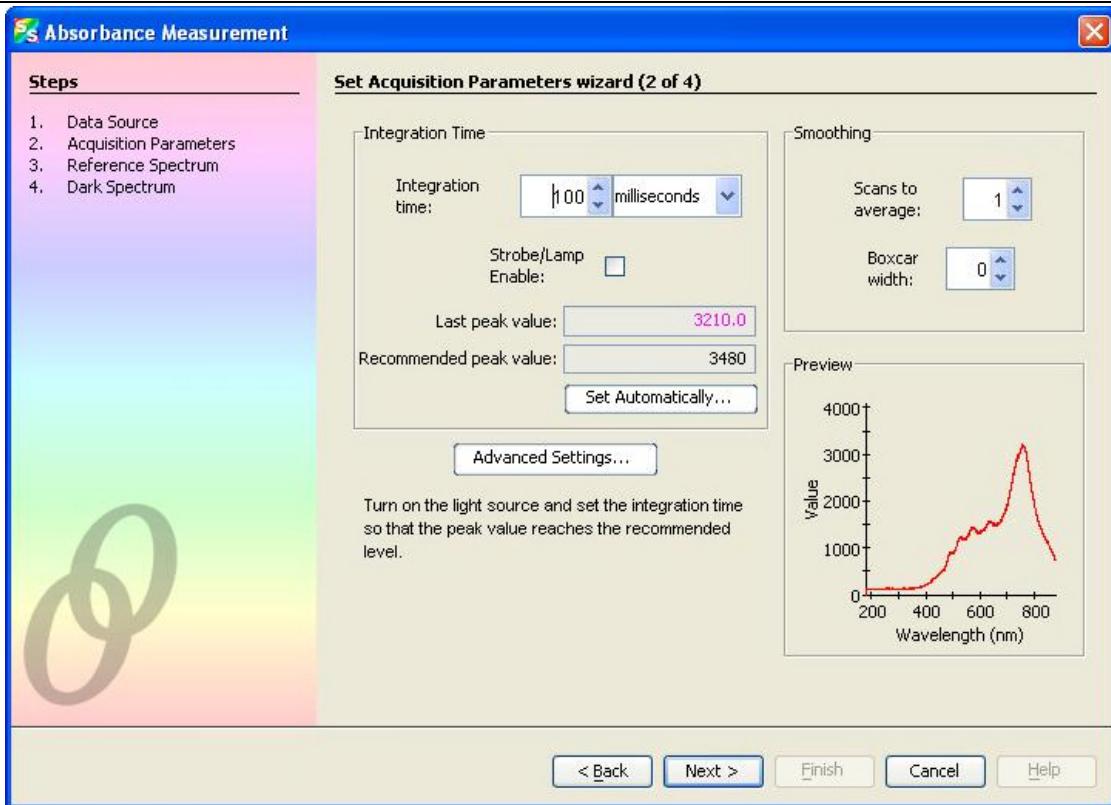
## ► Procedure

Follow the steps below to take an absorbance measurement using SpectraSuite:

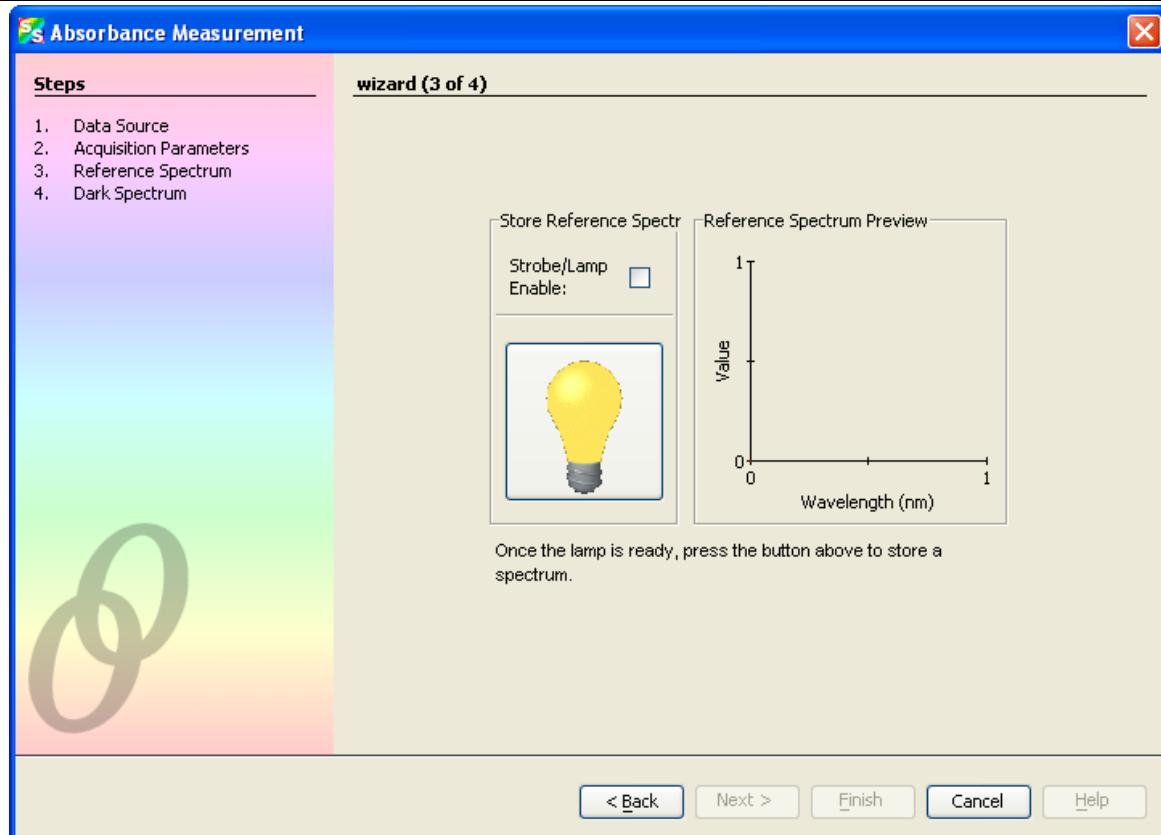
1. Place SpectraSuite in Scope mode by clicking the Scope () icon in the Experiment mode toolbar or selecting **Processing | Processing Mode | Scope** from the menu.
2. Ensure that the entire signal is on scale. The intensity of the reference signal's peak differs depending on the device being used. If necessary, adjust the integration time until the intensity is appropriate for your device.
3. Select **File | New | Absorbance Measurement** from the menu or click  to start the Absorbance Measurement Wizard.



4. Select the source of your absorbance measurement and click . The second page of the wizard appears.

**A: Experiment Tutorials**


5. Turn on your light source and set your acquisition parameters so that the peak value reaches the recommended level. In most cases, clicking **Set Automatically...** should provide the optimum settings for the experiment. Then click **Next >**. The third page of the wizard appears.



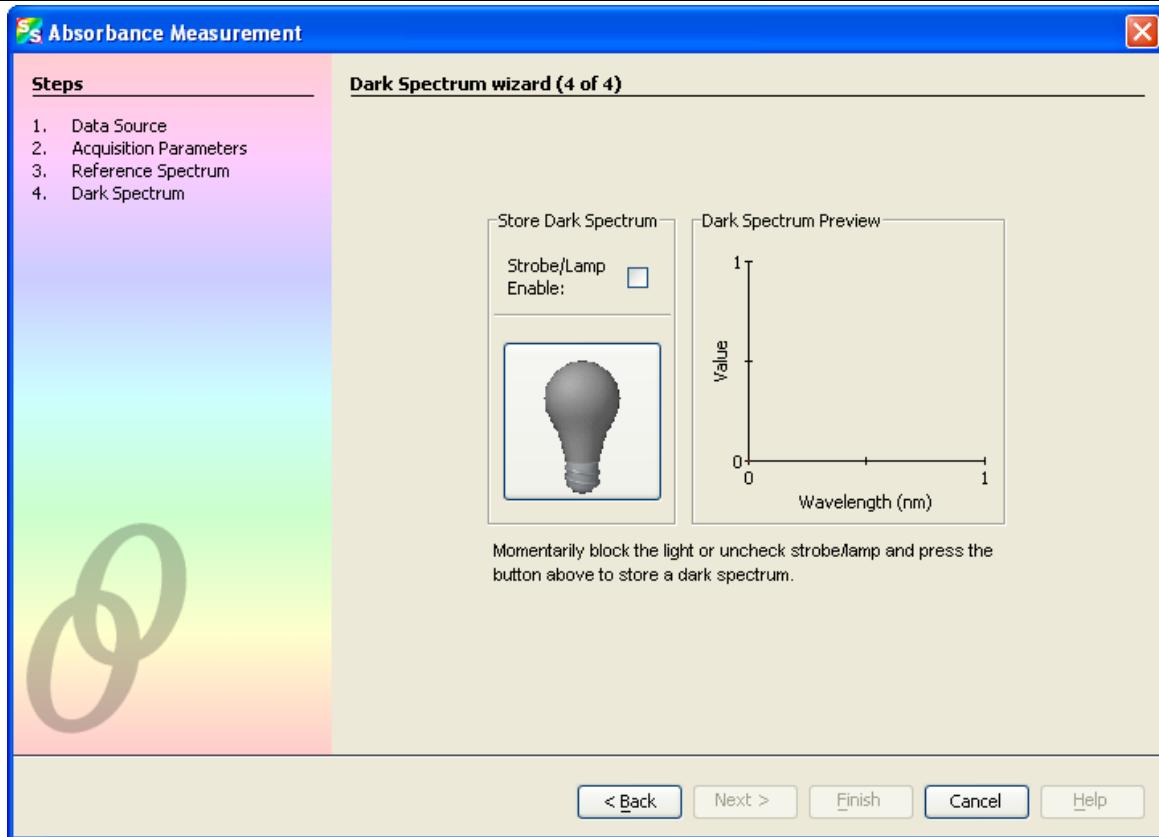
6. If you have not already done so, place a sample of the solvent into a cuvette to take a reference spectrum. You must take a reference spectrum before measuring absorbance.

### Note

Do not put the sample itself in the path when taking a reference spectrum, only the solvent.

7. Click the Store Reference Spectrum (💡) icon on the screen. This command merely stores a reference spectrum in memory. You must click the Save Spectra (💾) icon on the toolbar to permanently save the reference spectrum to disk.

Then click **Next >**. The fourth page of the wizard appears.

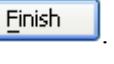


8. Block the light path to the spectrometer, uncheck the **Strobe/Lamp Enable** box, or turn the light source off. Then, take a dark spectrum by clicking . You must take a dark spectrum before measuring absorbance.

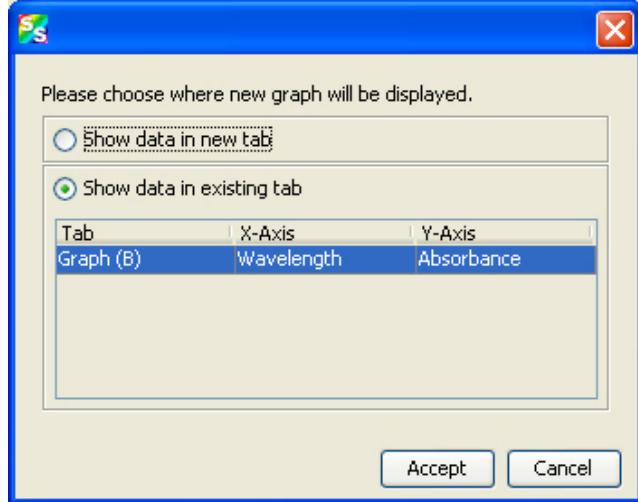
This command merely stores a dark spectrum in memory. You must click the Save Spectra () icon on the toolbar to permanently save the spectrum to disk.

### Note

If possible, do not turn off the light source when taking a dark spectrum. If you must turn off your light source to store a dark spectrum, allow enough time for the lamp to warm up again before continuing your experiment. After the lamp warms up again, store a new reference.

9. Put the sample in place and ensure that the light path is clear. Then, click .

If you have already taken one or more absorbance measurements, a dialog box appears asking you to specify whether to display the new data in a new graph, or on the existing graph.



Note the following changes on the screen:

- The experiment mode listed in the Data Sources and Data Views panes changes to **Absorbance Mode**.
- The units listed on the Graph pane changes to **Absorbance (OD)**.

10. To permanently save the spectrum to disk, click the Save Spectra () icon on the toolbar.

---

#### Note

If you change any sampling variable (integration time, averaging, smoothing, fiber size, etc.), you must store a new reference and dark spectrum.

---

## Concentration Experiments

To discover the unknown concentration of a substance in a solution, you must first take spectral scans of a series of solutions with different known concentrations of the same substance. You begin this process by taking an absorbance spectrum of the solution with the highest known concentration.

While going through the wizard, when asked to store a reference spectrum, put a cuvette full of your solvent in the spectrometer's cuvette holder.

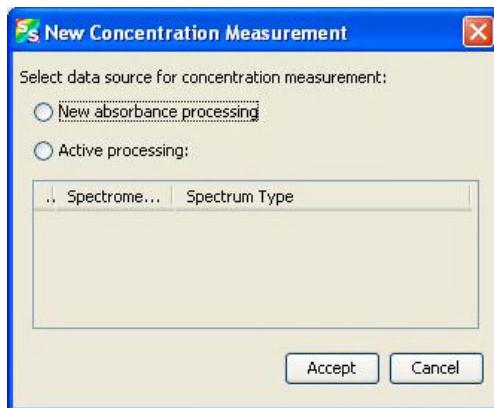
There are three methods you can use to calculate the concentration of a sample:

- Using Beer's Law (see [Calculating Concentration Using Beer's Law](#))
- Calibrating from a solution of known concentration (see [Calibrating from Solutions of Known Concentration](#))
- Loading a previously stored calibration from a file (see [Loading Calibration from an Existing File](#))

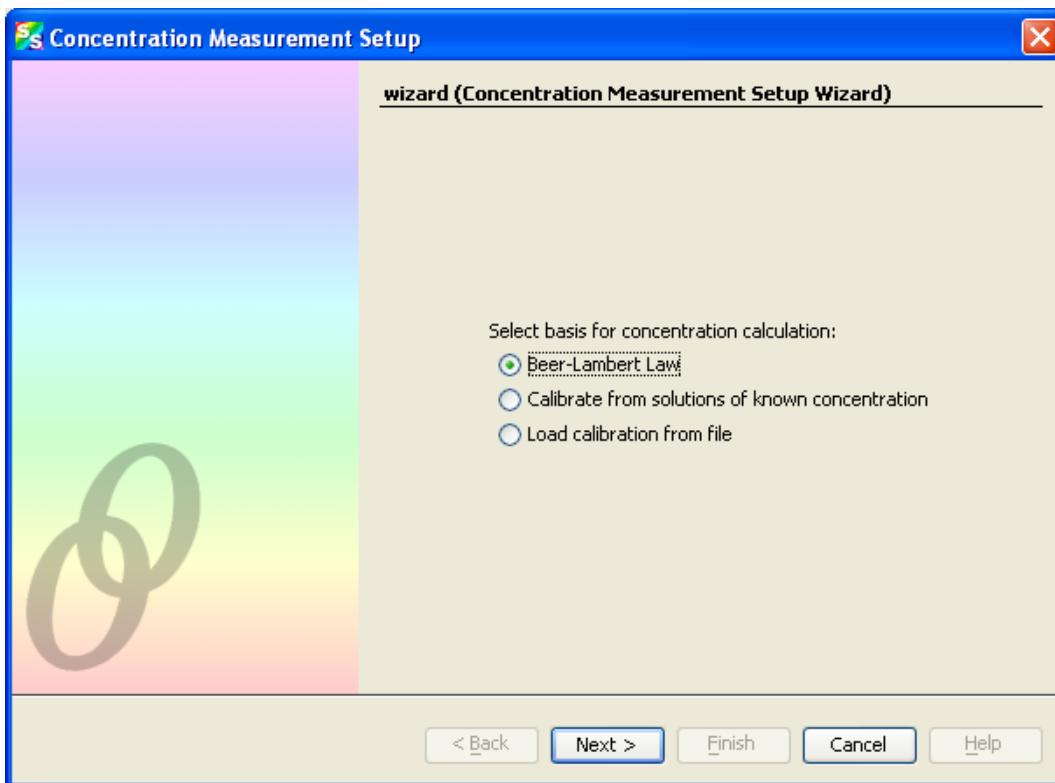
The Concentration Measurement Setup Wizard allows you to choose one of these three methods.

## ► Procedure

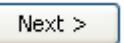
1. Select **File | New | New Concentration Experiment** from the menu to open the Concentration Measurement Setup Wizard.



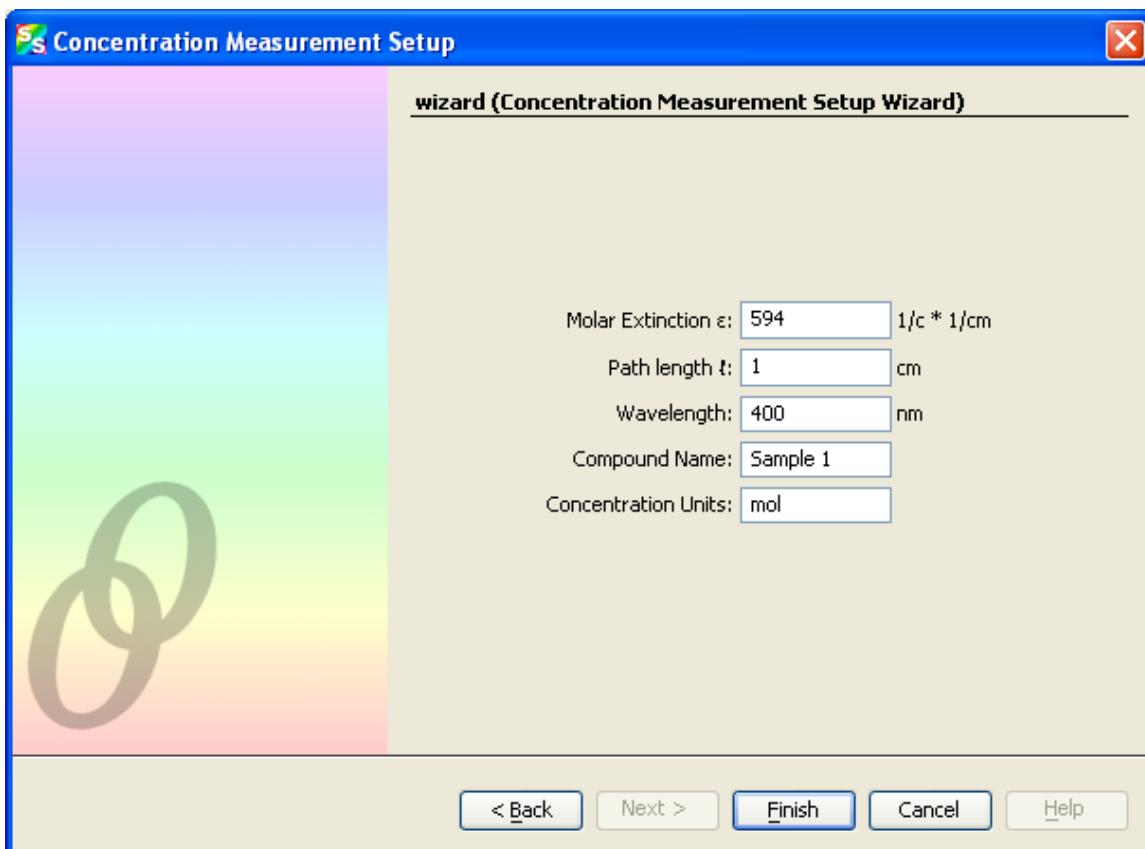
2. Before measuring concentration, you must first take an absorbance measurement. Select your data source, either a new absorbance measurement or an existing measurement and click **Accept**. If you select to take a new absorbance measurement, the Absorbance Measurement wizard appears (see [Absorbance Experiments](#) for instructions).
3. Once you have either selected an existing absorbance measurement or you have completed the steps in the Absorbance Measurement wizard, the Concentration Measurement wizard asks you to select the basis for the concentration calculation.

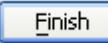


## Calculating Concentration Using Beer's Law

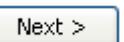
4. Select Beer-Lambert Law to specify the molar extinction constant  $\epsilon$  and a wavelength. Then, Click .

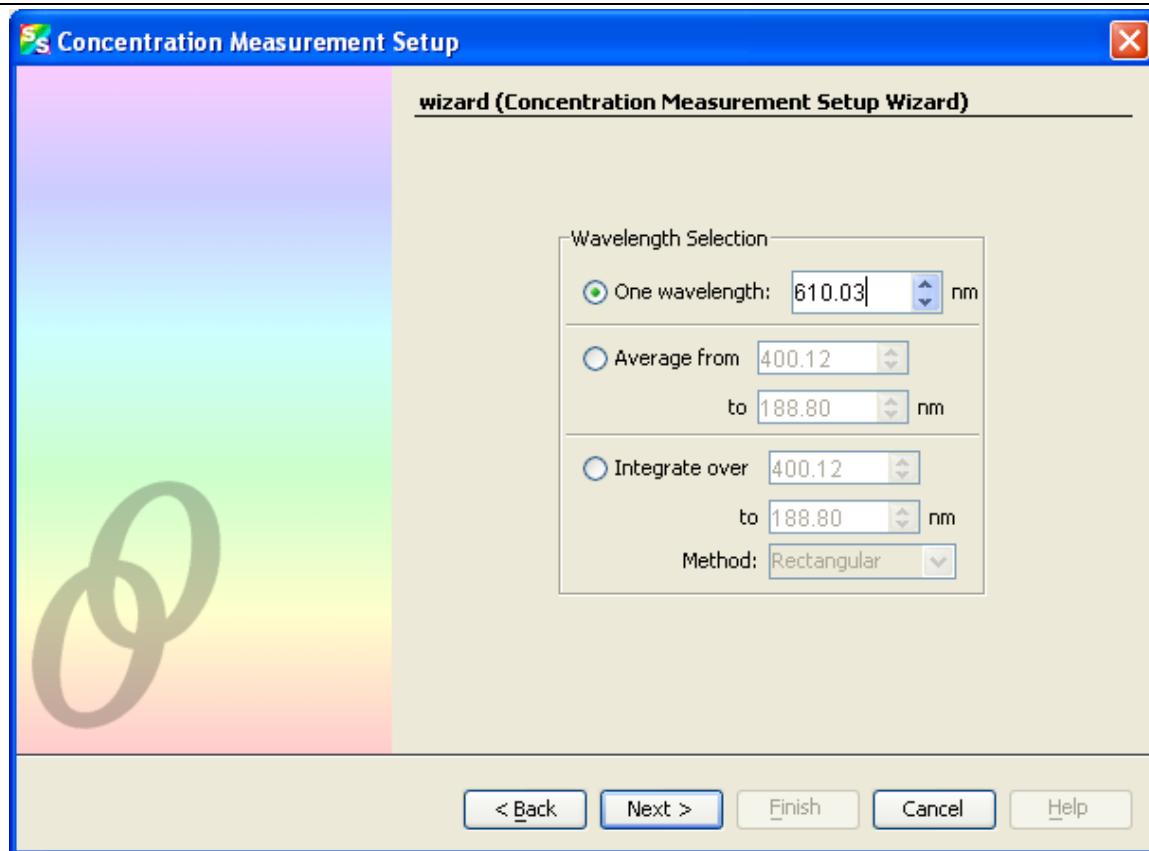
The following window appears:



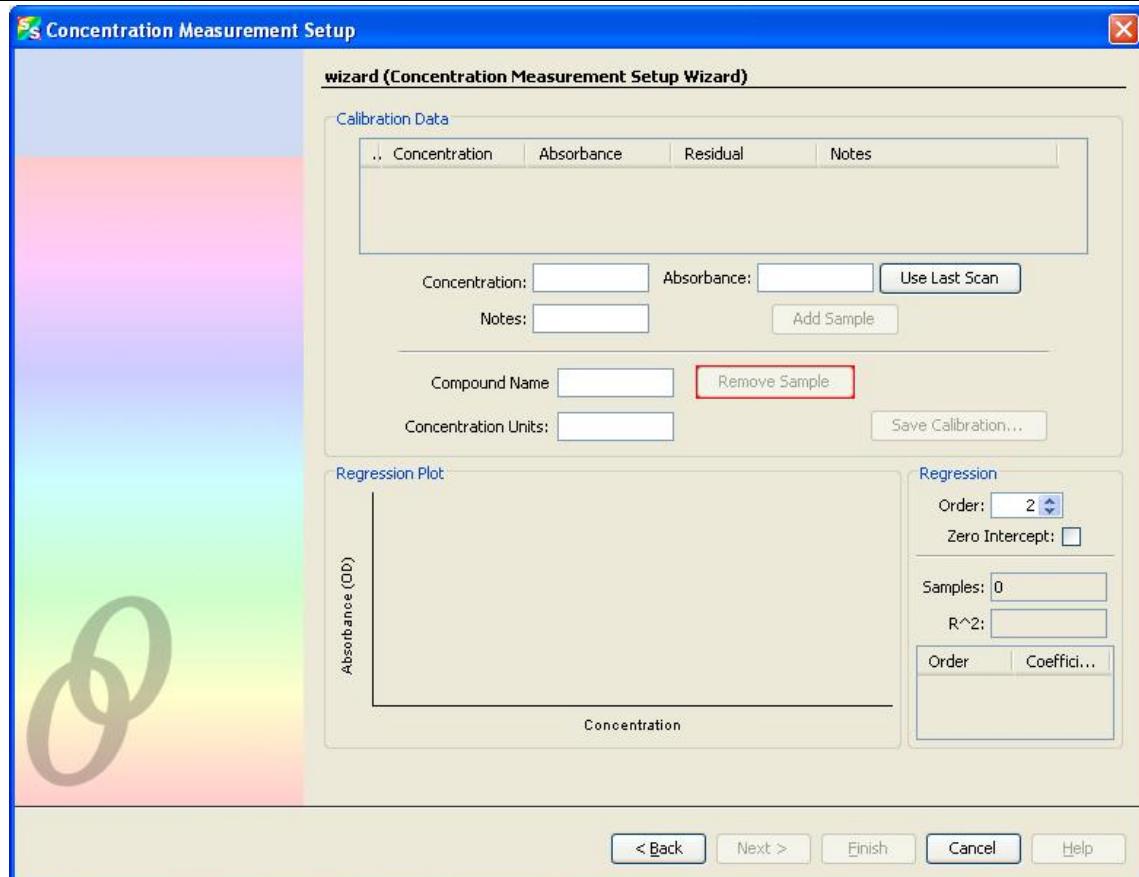
5. Fill in the fields according to the constants appropriate for your sample. The **Compound Name** and **Concentration Units** can be set to anything, and are simply provided for reference. Click  when done.

## Calibrating from Solutions of Known Concentration

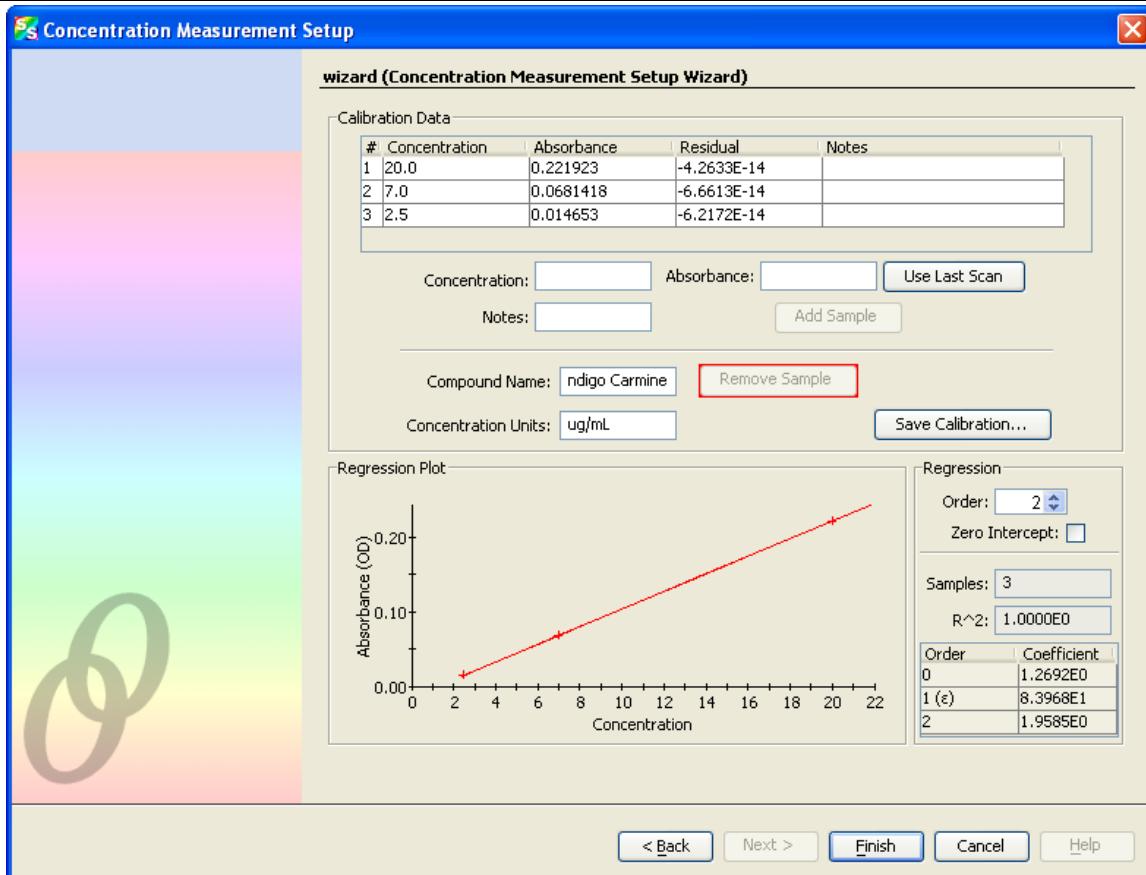
- Insert a sample for which the concentration is known into the spectrometer.
- Select **Calibrate from solutions of known concentration**, insert samples into the spectrometer for which you know the concentration and use that as a basis for computing the concentration of the unknowns. Then, click . The following window appears:



- c. Choose a single wavelength where the absorbance of your compound is greatest. You can also choose an average or integral over a range of wavelengths, which may provide a more robust calibration, since it is not as reliant on the behavior of the compound at one wavelength. Then click **Next >**. The following window appears:



- d. If desired, enter the name and concentration units for their compound in the indicated fields (this step is optional).
- e. To generate a calibration, enter a known concentration in the **Concentration** field, and either manually enter the corresponding **Absorbance** or place the corresponding cuvette into the cuvette holder and click **Use Last Scan** to measure the absorbance directly. Use **Notes** to enter any comments.
- f. Click **Add Sample** to log the concentration vs. absorbance point. It will appear on the Regression plot in the bottom of the window, and in the table at the top.
- g. After entering a few points, a regression line will be computed through the concentration points. This indicates that sufficient points have been sampled for concentrations to be estimated from unknowns.



6. Enter options for how the regression is computed in the lower-right corner of the window:

- Order** – Set the regression order to **1** (straight line fit) or **2** (second order polynomial fit).
- Zero Intercept** – You can force the regression line to pass through the origin (that is, zero concentration and absorbance) by checking this box.

For a first order fit, at least two data points are necessary. For a second order fit, three points are necessary. If **Zero Intercept** is selected, then only one point is required for a first order fit and two points for a second order fit.

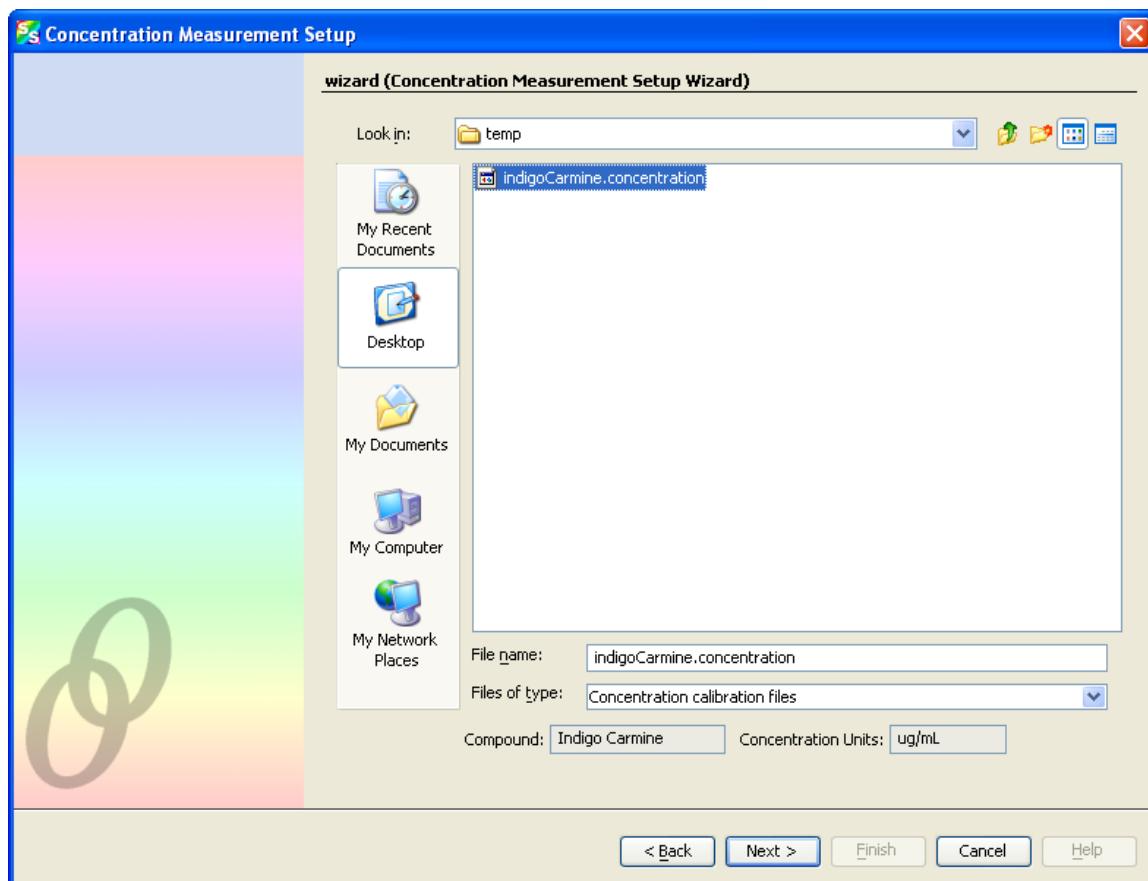
In general, more data points result in a better estimation of the concentration of an unknown. It is recommended that as many calibration points be sampled in this way as is practical. Also, allow your reference lamp to stabilize before attempting a calibration with many points, as any drift in the lamp's emission will introduce error into these samples.

The quality of the regression is shown in the lower right as an **R<sup>2</sup>** value, where 1.0 is a perfect fit (lower numbers indicate a poorer fit). The residual value for each point is also shown in the table at the top of the window; this indicates the difference between the known concentration for a sampled absorbance and the estimated concentration using the regression. In the ideal case, this value will approach zero. Note that very small values (on the order of 10-12 or smaller) are normal even for a good fit; this is due to a rounding error and should have no discernable effect on solution quality.

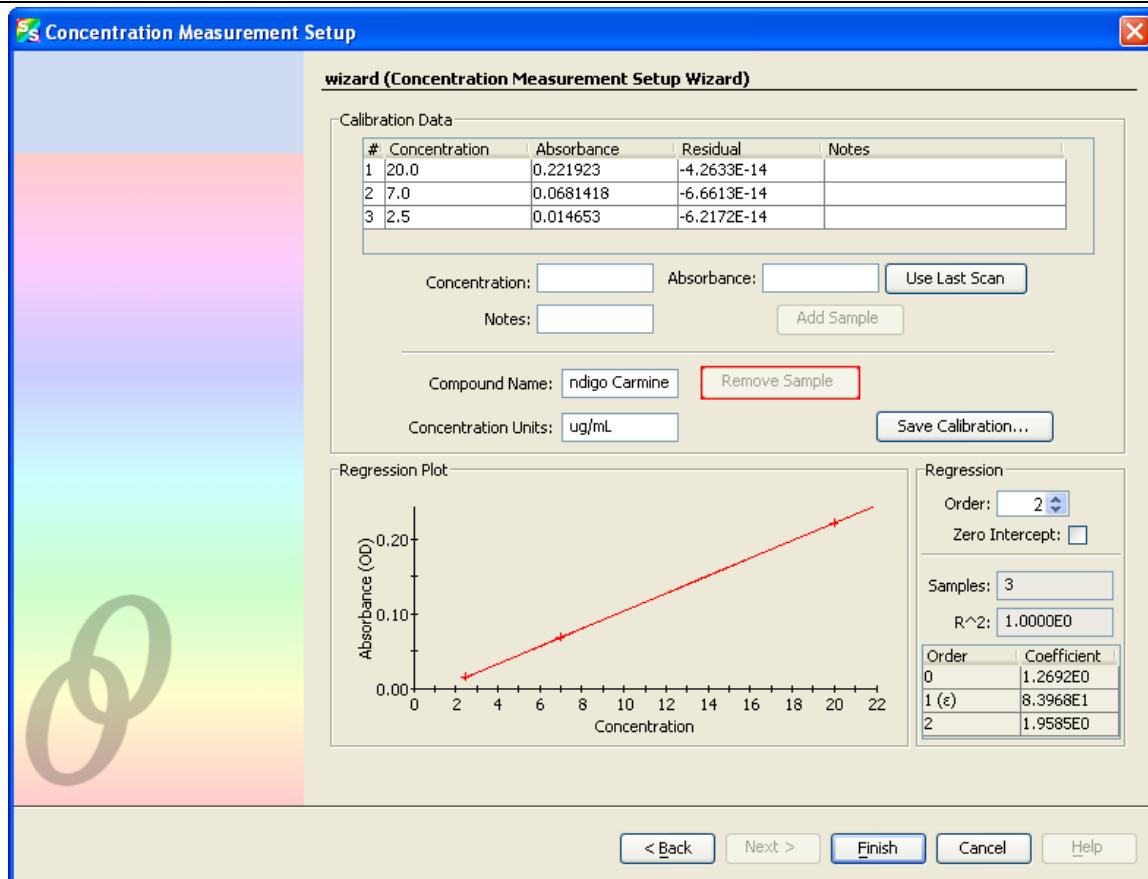
7. At any time, you can select a sample from the table at the top of the window and click **Remove Sample** to discard the point. Once enough points exist to compute a regression, the **Save Calibration...** button will be enabled to allow the current set of samples to be saved to disk for later retrieval.
8. Click **Finish** when you have entered enough points to generate a regression line.

### Loading Calibration from an Existing File

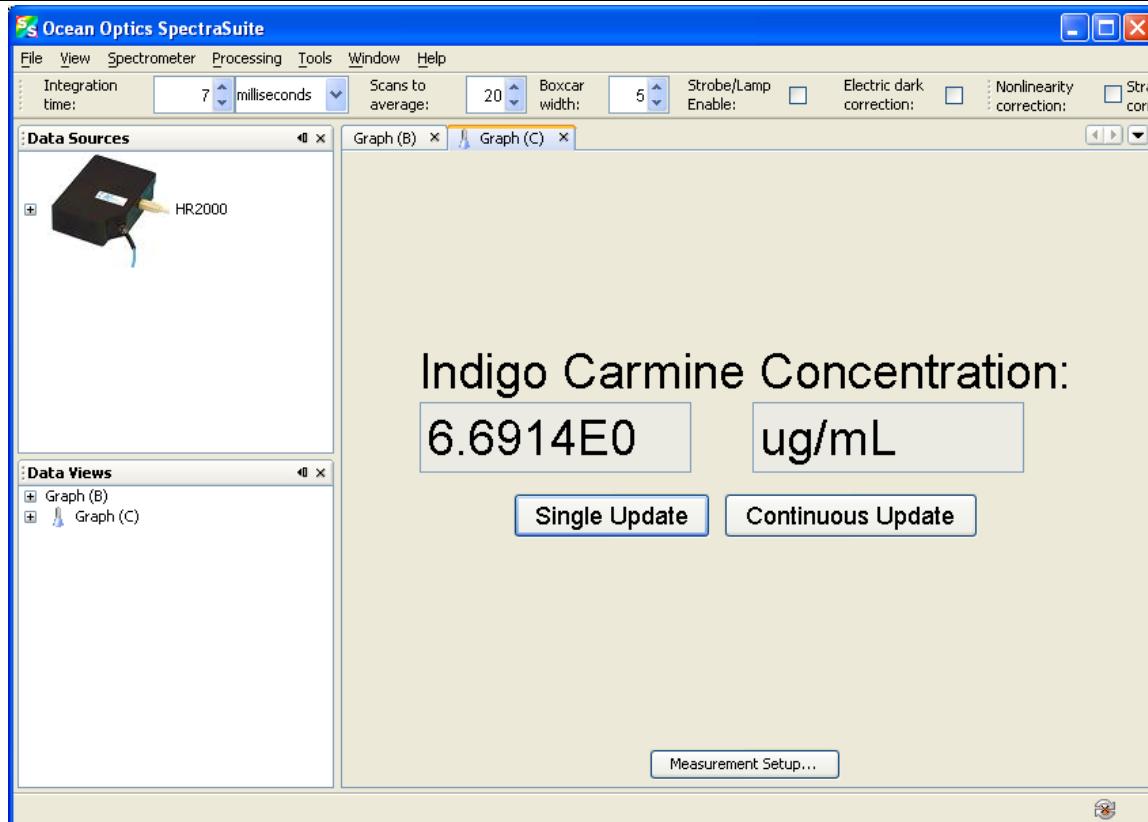
- a. Select **Load calibration from file** to recall a calibration from known solutions that was performed previously. The following window appears (the example below is in Windows XP format):



- b. Select a file that was previously saved with **Save Calibration...** in the **Calibrating from Solutions of Known Concentration** wizard (see [Calibrating from Solutions of Known Concentration](#), Step h.). When an appropriate file is selected, the name of the compound and concentration units appear near the bottom of the window.
- c. Click **Next >**. The resulting window is the same as if you had just entered those values from a known concentration:



9. When the concentration of the sample has been calculated using one of the three available methods, click **Finish**. The Concentration window appears:

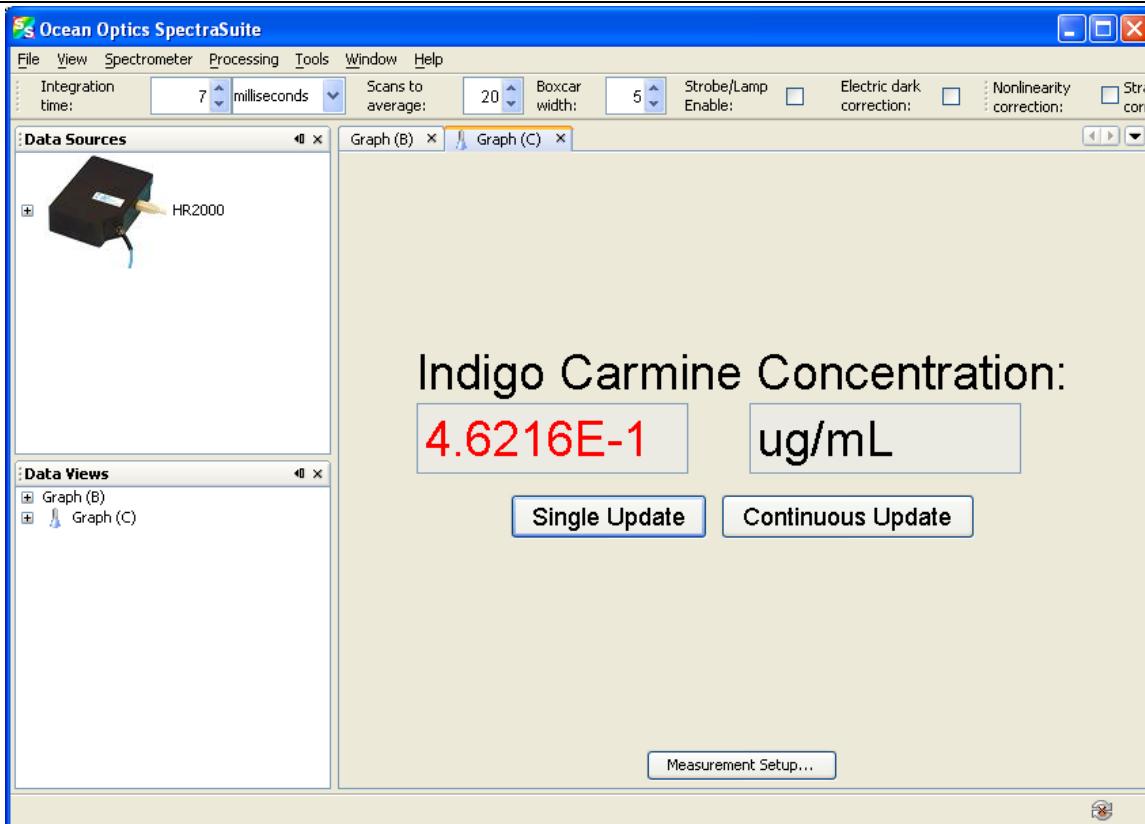


10. By default, the window will not update on its own. Perform a single scan by clicking **Single Update** (for instance, after inserting each cuvette of unknown concentration). Click **Continuous Update** if you want the values to update as quickly as possible.

Note the following on this window:

- The name of the compound and the units you provided are shown.
- The numeric value for the concentration appears in black if the calculation was within the bounds of the measurement setup. If you calculated the concentration using the Beer-Lambert law, the concentration appears in black for any positive measured absorbance. If you calculated the concentration using known samples, the concentration will appear in black only if the measured absorbance is within the range of absorbance sampled by the user. If a sample is introduced that falls outside of this range, the concentration will appear in red to indicate that it is out-of-bounds and may not be accurate, as shown in the following example:

## A: Experiment Tutorials



At any time, you can click [Measurement Setup...](#) to reopen the setup wizard and change the parameters for the concentration measurement.

# Transmission Experiments

Transmission is the percentage of energy passing through a sample relative to the amount that passes through the reference. Transmission mode can also display the portion of light *reflected* from a sample, since transmission and reflection measurements use the same mathematical calculations. We express transmission as a percentage ( $\%T_\lambda$ ) relative to a standard substance (such as air). SpectraSuite calculates  $\%T_\lambda$  (or  $\%R_\lambda$ ) with the following equation.

$$\%T_\lambda = \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \times 100\%$$

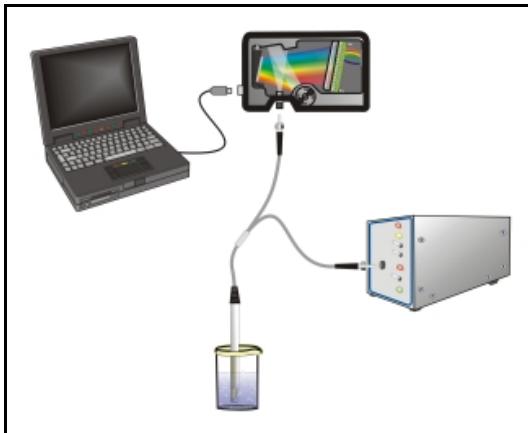
Where:

$S_\lambda$  = Sample intensity at wavelength  $\lambda$

$D_\lambda$  = Dark intensity at wavelength  $\lambda$

$R_\lambda$  = Reference intensity at wavelength  $\lambda$

Typical transmission setup: The light source (far right) sends light via the input leg of a transmission probe into a container (bottom center). The light interacts with the sample. The output leg of the transmission probe carries the information to the spectrometer (top center), which transmits the information to the computer (far left).



Common transmission applications include measuring light through solutions, optical filters, optical coatings, and other optical elements (such as lenses and fibers).

### ► **Procedure**

Perform the following steps to take a transmission measurement using SpectraSuite:

1. Place SpectraSuite in Scope mode by clicking the Scope (S) icon in the Experiment mode toolbar or selecting **Processing | Processing Mode | Scope** from the menu.
2. Ensure that the entire signal is on scale. The intensity of the reference signal's peak differs depending on the device being used. If necessary, adjust the integration time until the intensity is appropriate for your device.
3. If you have not already done so, place a sample of the solvent into a cuvette and take a reference spectrum. You must take a reference spectrum before measuring transmission.

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**Note**

Do not put the sample itself in the path when taking a reference spectrum, only the solvent.

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Click the Store Reference Spectrum () icon on the toolbar or by select **File | Store | Store Reference Spectrum** from the menu bar to store the reference. This command merely stores a reference spectrum in memory. You must click the Save Spectra () icon on the toolbar to permanently save the reference spectrum to disk.

4. If you have not already done so, store a dark spectrum reading. To do this, either block the light path to the spectrometer, uncheck the **Strobe/Lamp Enable** box in the Acquisition toolbar, or turn the light source off. Then, take a dark spectrum by clicking the Store Dark Spectrum () icon on the toolbar or by selecting **File | Store | Store Dark Spectrum** from the menu bar. This command merely stores a dark spectrum in memory. You must click the Save Spectra () icon on the toolbar to permanently save the spectrum to disk.
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**Note**

If possible, do not turn off the light source when taking a dark spectrum. If you must turn off your light source to store a dark spectrum, allow enough time for the lamp to warm up again before continuing your experiment.

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You must take a dark spectrum before measuring transmission.

5. Put the sample in place and ensure that the light path is clear. Then, take a transmission measurement by clicking on the Transmission () icon on the toolbar or selecting **Processing | Processing Mode | Transmission** from the menu. Note the following changes on the screen:
  - The experiment mode listed in the Data Sources and Data Views panes changes to **Transmission Mode**.
  - The units listed on the Graph pane changes to **Transmission (%)**.
6. To permanently save the spectrum to disk, click the Save Spectra () icon on the toolbar.

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**Note**

If you change any sampling variable (integration time, averaging, smoothing, fiber size, etc.), you must store a new reference and dark spectrum.

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## Reflection Experiments

Reflection is the return of radiation by a surface, without a change in wavelength. Reflection can be:

Specular (the angle of incidence is equal to the angle of reflection)

Diffuse (the angle of incidence is not equal to the angle of reflection)

Every surface returns both specular and diffuse reflections. Some surfaces may return mostly specular reflection, while others may return mostly diffuse reflection. Specular reflection increases proportionately with the amount of gloss on a surface.

Reflection is expressed as a percentage ( $\%R_\lambda$ ) relative to the reflection from a standard reference substance:

$$\%R_\lambda = \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \times 100\%$$

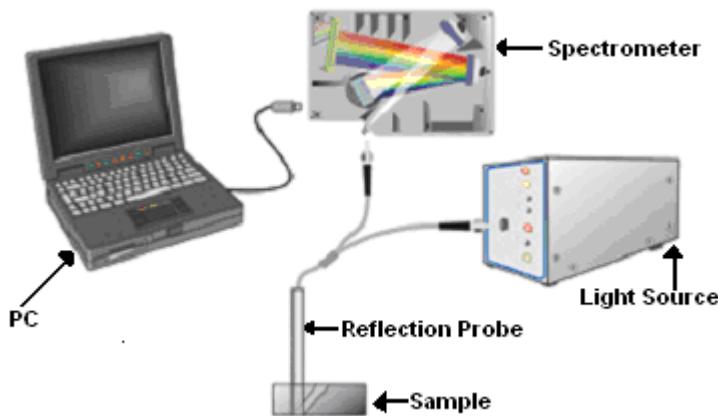
Where:

$S_\lambda$  = the sample intensity at wavelength  $\lambda$

$D_\lambda$  = the dark intensity at wavelength  $\lambda$

$R_\lambda$  = the reference intensity at wavelength  $\lambda$

The following figure shows a typical reflection setup. A light source sends light via the input leg of a reflection probe onto a sample. A reflection probe holder holds the probe in either a 90 or 45-degree angle from the surface. The output leg of the reflection probe carries light from the sample to the spectrometer, which is connected to the computer.



### Typical Reflection Setup

Common reflection applications include measuring the properties of mirrors and coatings. Other applications include measuring the visual properties of the color in paints, plastics, and food products.

#### ► Procedure

Perform the following steps to take reflection measurements using SpectraSuite:

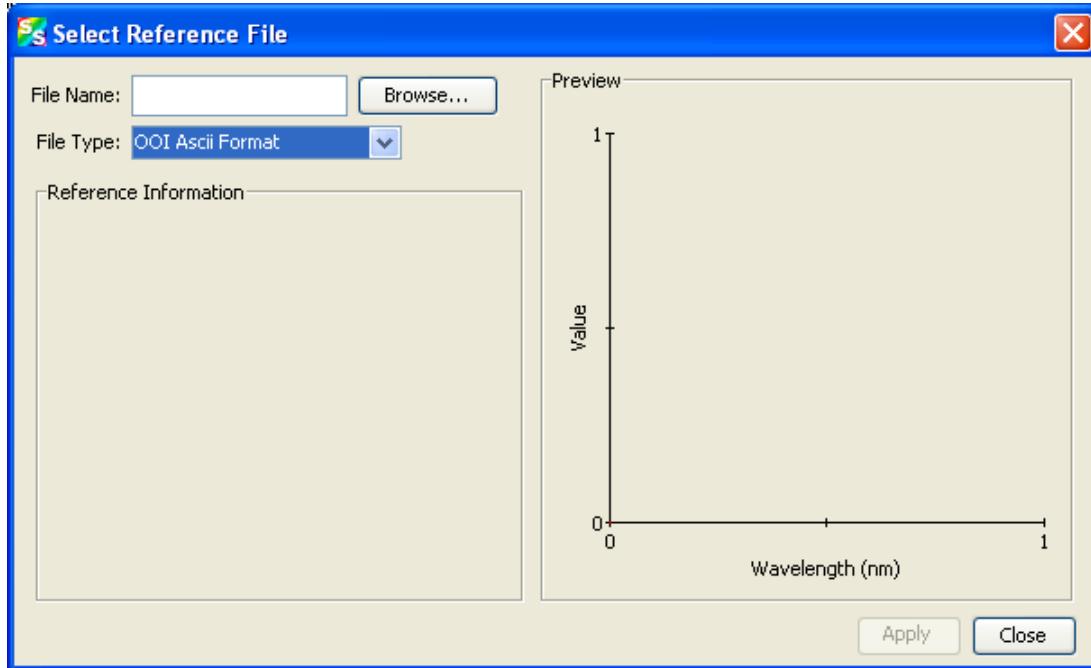
1. Place SpectraSuite in Scope mode by clicking the Scope (  ) icon in the Experiment mode toolbar or selecting **Processing | Processing Mode | Scope** from the menu.
2. Ensure that the entire signal is on scale.
3. Take a reference spectrum with the WS-1 Diffuse Reflectance Standard or the STAN-SSH High-reflectivity Reference Standard. You must take a reference spectrum before measuring reflection.
4. Click the Store Reference Spectrum (  ) icon on the toolbar or by select **File | Store | Store Reference Spectrum** from the menu bar to store the reference. This command merely stores a reference spectrum in memory. You must click the Save Spectra (  ) icon on the toolbar to permanently save the reference spectrum to disk.
5. Either block the light path to the spectrometer, uncheck the **Strobe/Lamp Enable** box in the Acquisition toolbar, or turn the light source off. Then, take a dark spectrum by clicking the Store Dark Spectrum (  ) icon on the toolbar or by selecting **File | Store | Store Dark Spectrum** from the menu bar. This command merely stores a dark spectrum in memory. You must click the Save Spectra (  ) icon on the toolbar to permanently save the spectrum to disk.

### Note

If possible, do not turn off the light source when taking a dark spectrum. If you must turn off your light source to store a dark spectrum, allow enough time for the lamp to warm up again before continuing your experiment.

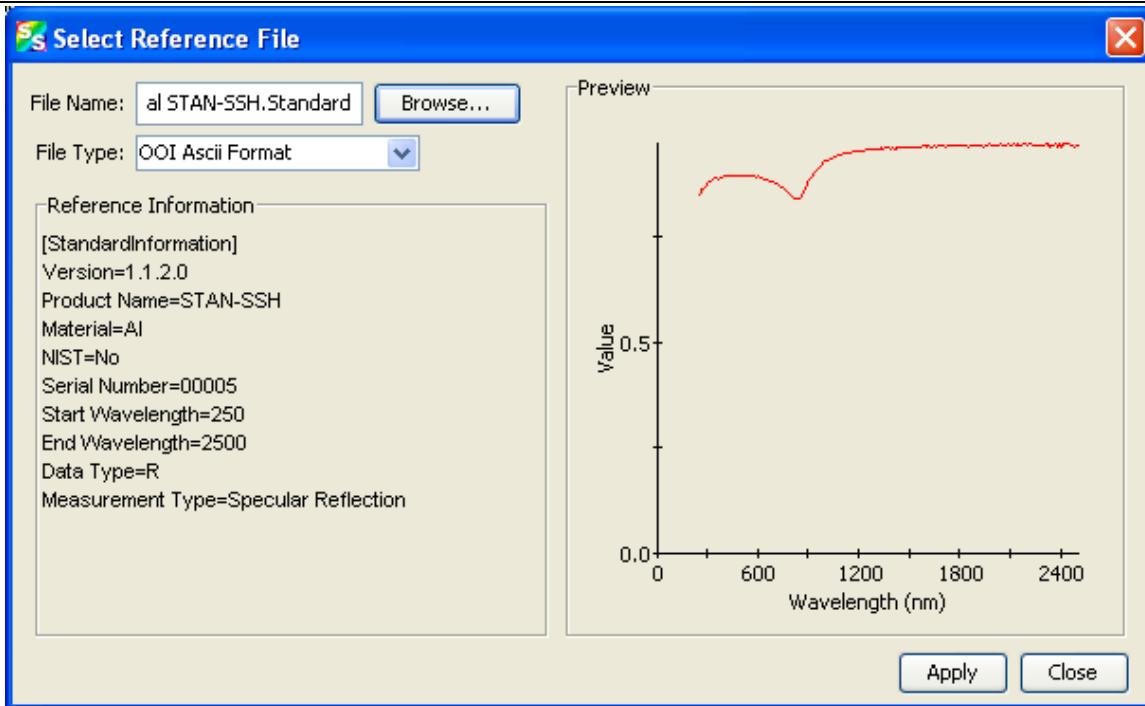
You must take a dark spectrum before measuring reflection.

6. Put the sample in place and ensure that the light path is clear. Then, take a reflection measurement by clicking on the Transmission (T) icon on the toolbar or selecting **Processing | Processing Mode | Transmission** from the menu (since the mathematical calculations used to calculate transmission and reflection are identical).
7. If you received calibration file with your reference standard, click the Non-unity Correction icon ( $\frac{x}{1}$ ) on the toolbar. The **Select Reference File** screen appears.



8. Browse to the location where you stored your reflectivity standard files. Then click the **Apply** button.

The reference information appears on the **Select Reference File** screen.



9. Click  to apply the file data to your graph on the main SpectraSuite screen.
10. To permanently save the spectrum to disk, click the Save Spectra () icon on the toolbar.

### Note

If you change any sampling variable (integration time, averaging, smoothing, angle, temperature, fiber size, etc.), you must store a new reference and dark spectrum.

## Irradiance Experiments

Irradiance is the amount of energy at each wavelength emitted from a radiant sample. Absolute irradiance is the measure of light in absolute terms. Relative irradiance is a comparison of the fraction of energy the sample emits and the energy the sampling system collects from a lamp with a blackbody energy distribution (normalized to 1 at the energy maximum). SpectraSuite calculates relative irradiance with the following equation:

$$I_{\lambda} = B_{\lambda} \left( \frac{S_{\lambda} - D_{\lambda}}{R_{\lambda} - D_{\lambda}} \right)$$

Where:

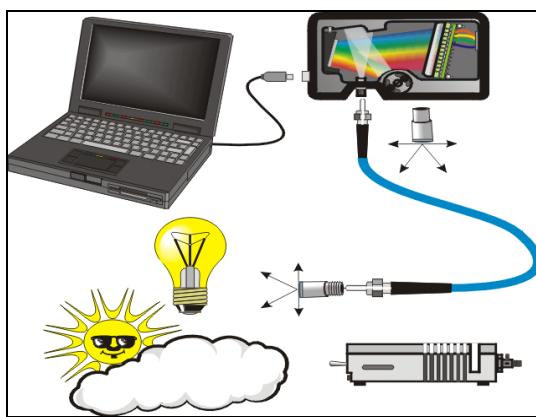
$B_\lambda$  = Relative energy of the reference (calculated from the color temperature) at wavelength  $\lambda$

$S_\lambda$  = Sample intensity at wavelength  $\lambda$

$D_\lambda$  = Dark intensity at wavelength  $\lambda$

$R_\lambda$  = Reference intensity at wavelength  $\lambda$

Typical relative irradiance setup: Use a light source with a known color temperature (such as the LS-1 or LS-1-LL (lower right) to take a reference spectrum. The light to measure (lower left) accumulates through a CC-3 Cosine Corrector (or FOIS integrating sphere) into an input fiber, which carries the light information to the spectrometer. The spectrometer then transmits the information to the computer, which compares the measured spectra against the reference spectrum, thus removing wavelength-dependent instrument response from the measurement.



Common applications include characterizing the light output of LEDs, incandescent lamps, and other radiant energy sources such as sunlight. Relative irradiance measurements also include fluorescence measurements, which measure the energy given off by materials excited by light at shorter wavelengths (see [Fluorescence](#)).

## Absolute Irradiance

Absolute Irradiance uses a lamp of known output (in terms of microwatts per square centimeter per nanometer) to calibrate the spectrometer's response at every pixel. This corrects the shape and magnitude of the spectrum, and the resulting spectrum is in terms of microwatts per square centimeter per nanometer ( $\mu\text{Watt}/\text{cm}^2/\text{nm}$ ). Note that if an integrating sphere is used, then the resulting spectrum is *radiant flux*, in units of microwatts per nanometer ( $\mu\text{Watt}/\text{nm}$ ).

To conduct an absolute irradiance measurement, it is necessary to have the following:

- S:** Sample spectrum (counts per nanometer)
- D:** Dark spectrum (counts per nanometer, with the same integration time, corrections, and smoothing as sample)
- C:** Calibration (micro-Joules per count)
- T:** Integration time (seconds)

## A: Experiment Tutorials

**A:** Collection area (represented in square centimeters) unless the light source is entirely inside an integrating sphere

**dL:** The wavelength spread (how many nanometers a given pixel represents)

Absolute irradiance (**I**) is computed as follows:

$$I_P = (S_P - D_P) * C_P / (T * A * dL_P)$$

Where: the subscript **P** indicates a particular pixel for **I**, **dL**, **S**, **D**, and **C**. Thus, **S<sub>P</sub>** refers to pixel **P** of the sample spectrum.

Note that if the lamp is entirely enclosed within an integrating sphere, then the **A** term is omitted.

**dL** is typically computed as follows:

$$dL = |L(P + 1) - L(P - 1)| / 2$$

Where: **L(P)** refers to the wavelength represented by the center of pixel index **P**.

The collection area for a measurement is usually taken to be the surface area of the optic closest to the light source. For instance, if the light source is being sampled most directly by a fiber optic cable, then the end of the fiber is the active optic and its surface area should be used (which can be computed from the fiber diameter). If a cosine corrector is being used, then the surface area of the cosine corrector provides the collection area. If an integrating sphere is being used but the light source is outside the sphere, then the size of the aperture in the side of the sphere is what determines the collection area.

Although you have the option to do so, you do not need to store reference spectrum first since absolute irradiance is not relative to another measurement. However, you must store a dark spectrum and have a calibration file before you can measure absolute irradiance. Calibration equipment is available from Ocean Optics. Contact an Ocean Optics Application Scientist for more information.

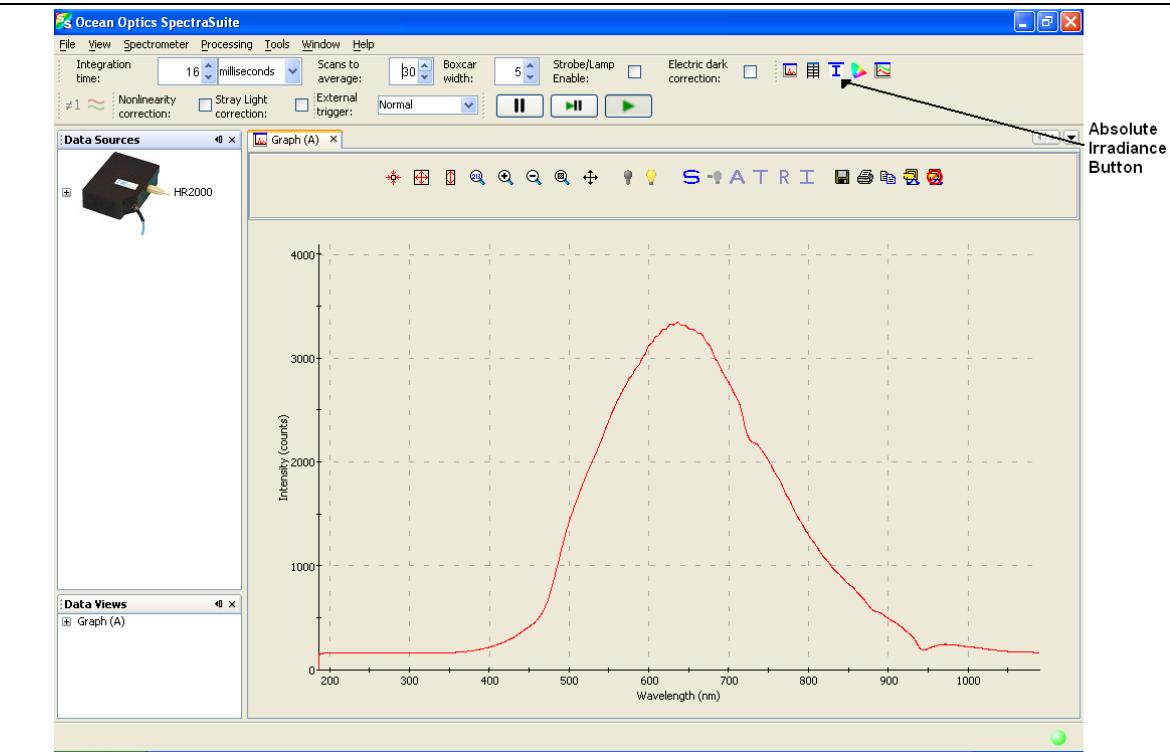
If you select **File** | **New** | **Absolute Irradiance Measurement** or click  on the Irradiance toolbar, the Absolute Irradiance Wizard is activated to guide you through the process. If you select **File** | **New** | **Absolute Irradiance Graph**, the Absolute Irradiance graph in Scope mode appears, and you must work through the various steps required for an Absolute Irradiance measurement on your own.

The following procedure assumes that you are using the Absolute Irradiance Wizard.

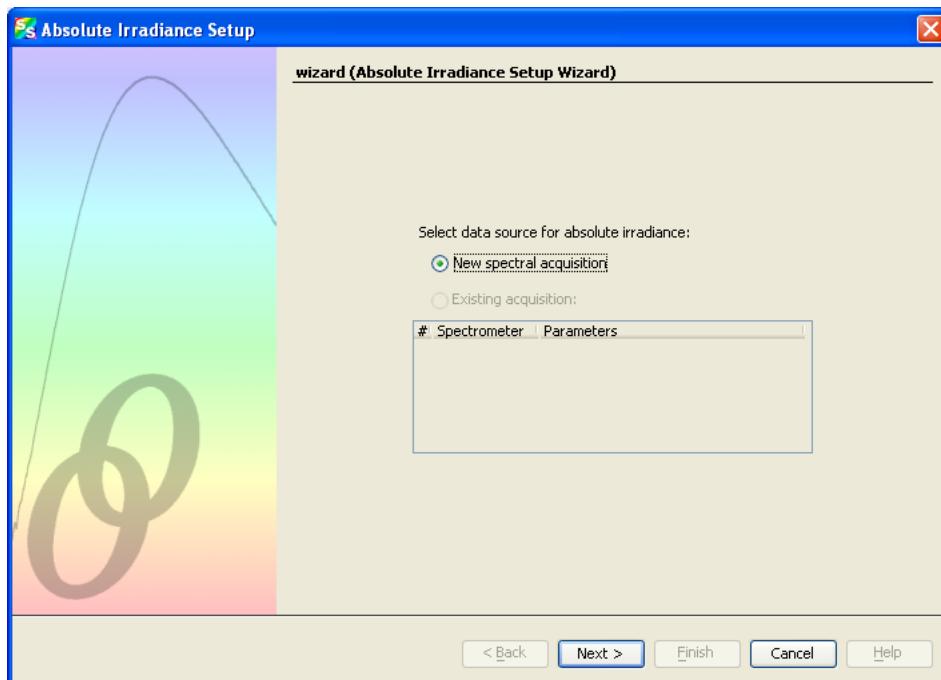
### ► Procedure

Perform the following steps to take an absolute irradiance measurement using SpectraSuite:

1. Select **File** | **New** | **Absolute Irradiance Measurement** from the menu or click  on the Irradiance toolbar to use the wizard to create the Absolute Irradiance graph.

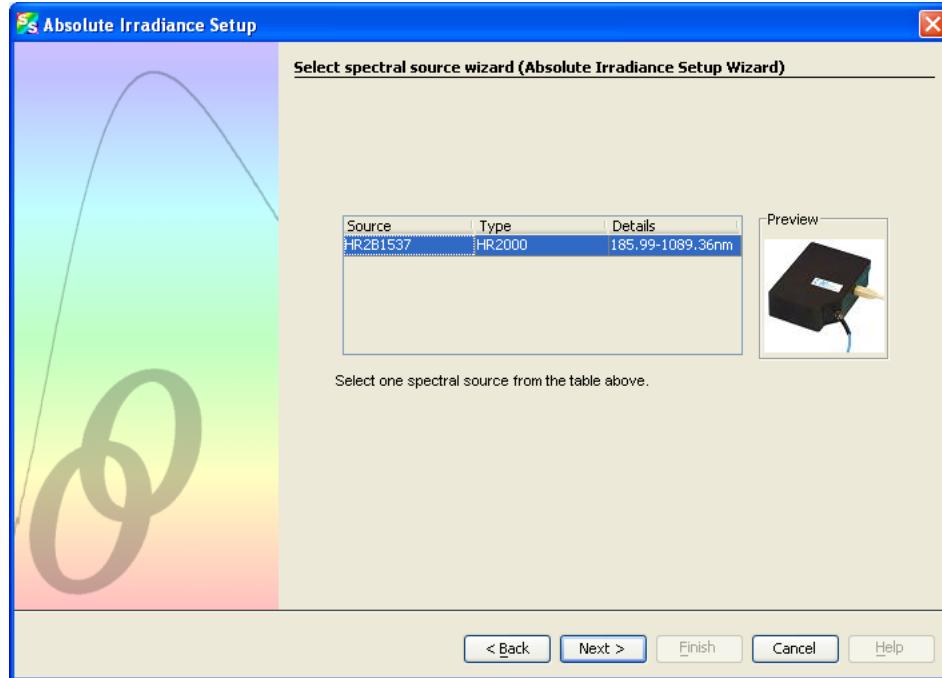


The first page of the Absolute Irradiance Setup Wizard appears.

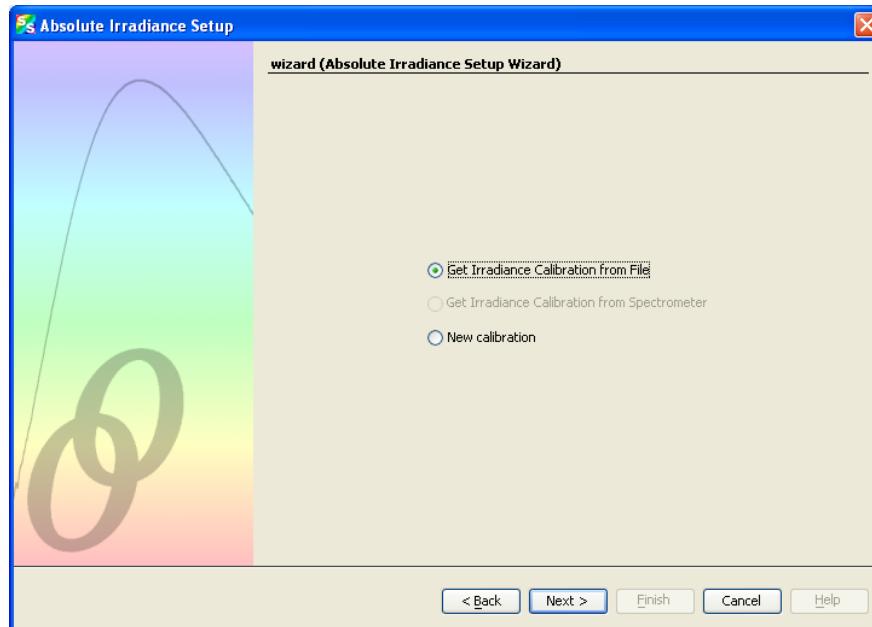


2. Select to measure absolute irradiance from either a new or existing acquisition. Then, click **Next >**. The second page of the Absolute Irradiance Setup Wizard appears.

## A: Experiment Tutorials



3. If you have more than one spectrometer, highlight the one to be used. Then, click [Next >](#). The third page of the Absolute Irradiance Setup Wizard appears.

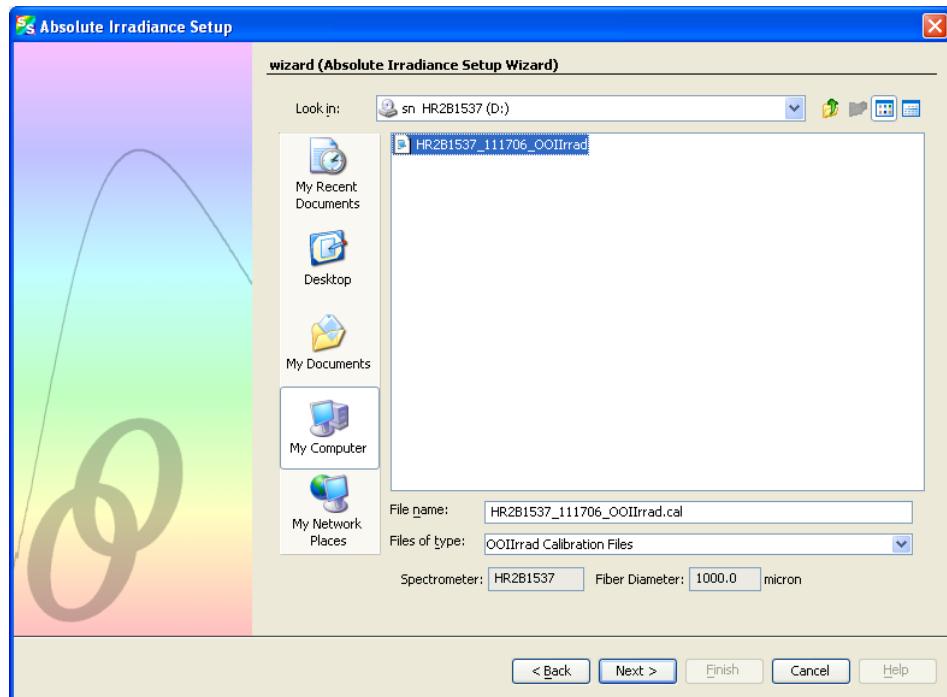


9. Choose one of the following:

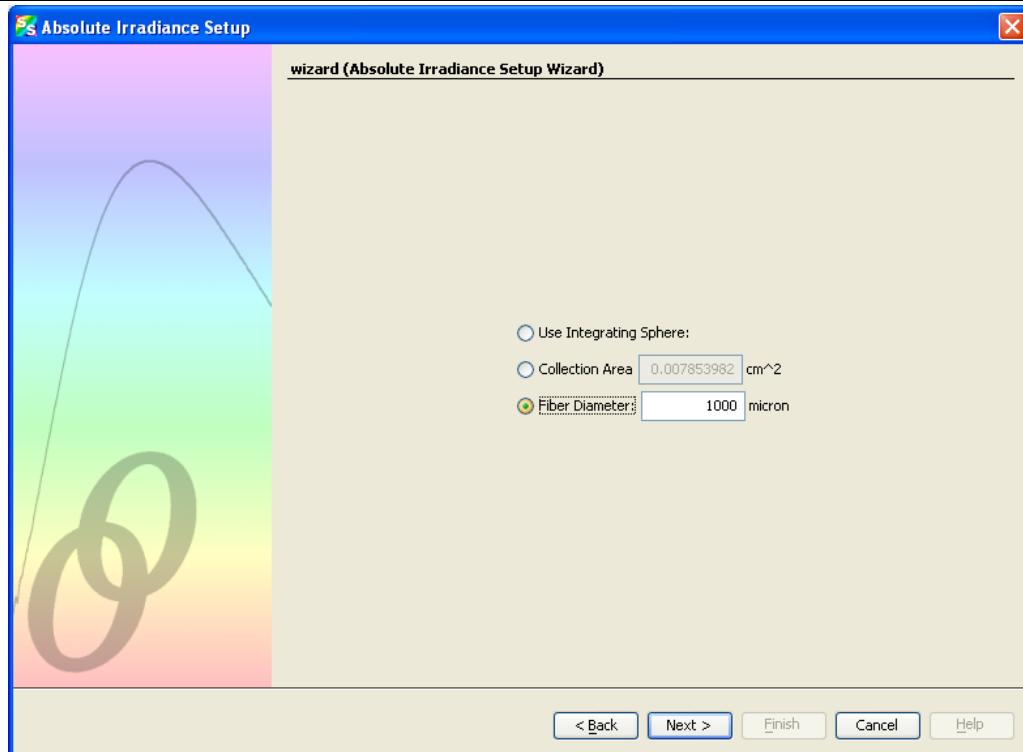
- [Get Irradiance Calibration from File](#)
- [New Calibration](#)

## Get Irradiance Calibration from File

- a. After selecting **Get Irradiance Calibration from File**, browse to the desired calibration file.



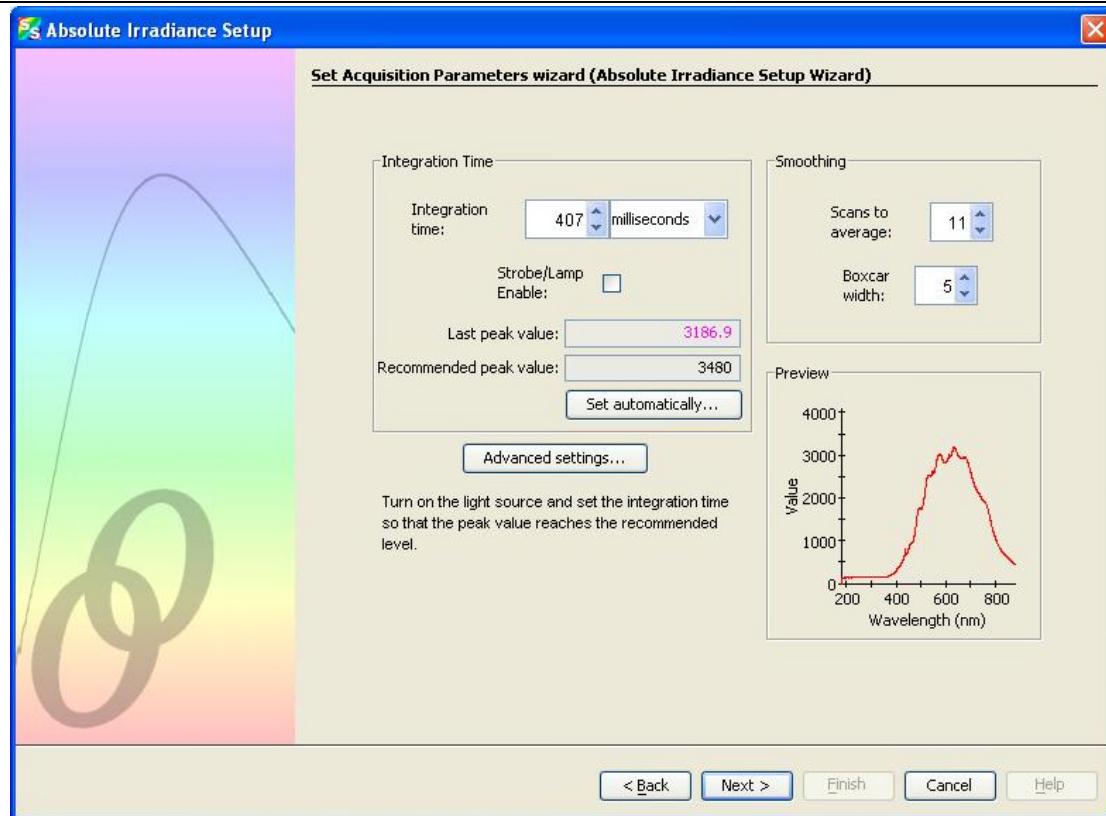
- b. Select the file and click **Next >**.



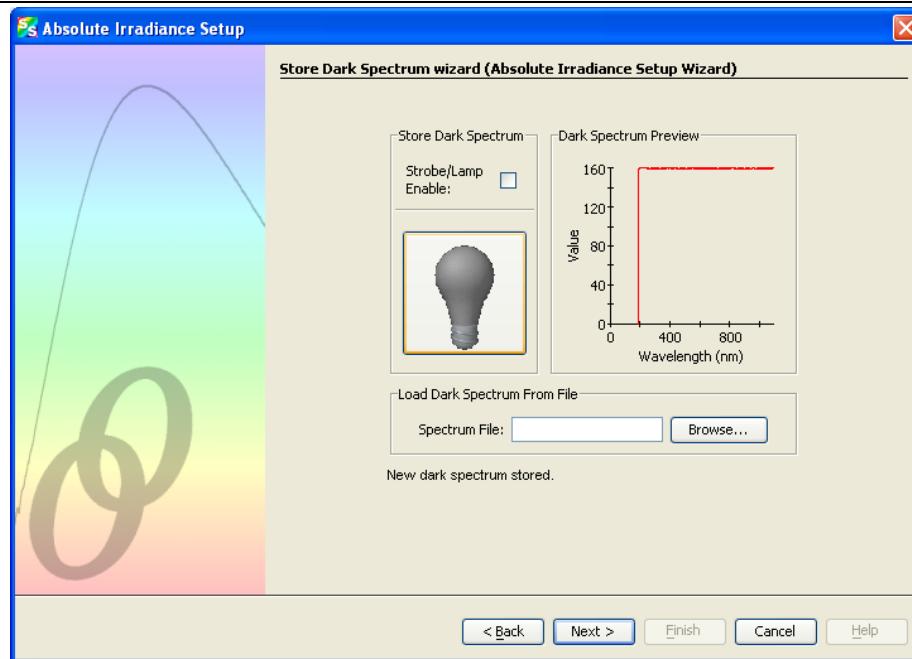
- c. If you are using an integrating sphere, check the **Use Integrating Sphere** option.
- d. If you know the collection area, check Collection Area and enter the value.
- e. If you are using a bare fiber or a cosine corrector, check **Fiber Diameter** and enter the value.
- f. If you are using an Ocean Optics cosine corrector or a direct attach cosine corrector, enter the appropriate value for the Fiber Diameter as follows:

Cosine Corrector	Fiber Diameter
CC-3	3900 microns
CC-3-UV	3900 microns
CC-3-DA	7140 microns

- g. Then click **Next >**. The **Set Acquisition Parameters** screen appears.



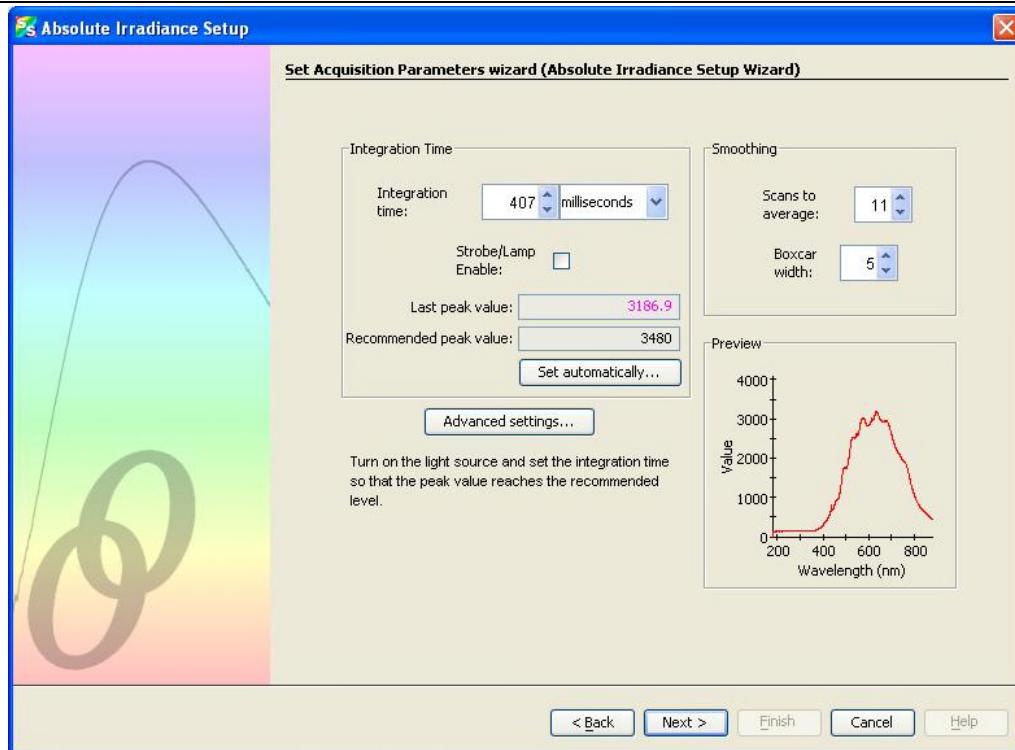
- h. Set your acquisition parameters for your experiment using the **Integration time** and **Boxcar width** so that the **Last peak value** is very close to the **Recommended peak value**. In most cases, clicking **Set Automatically...** should provide the optimum settings for the experiment. Then, click **Next >**. The Dark Spectrum screen appears.



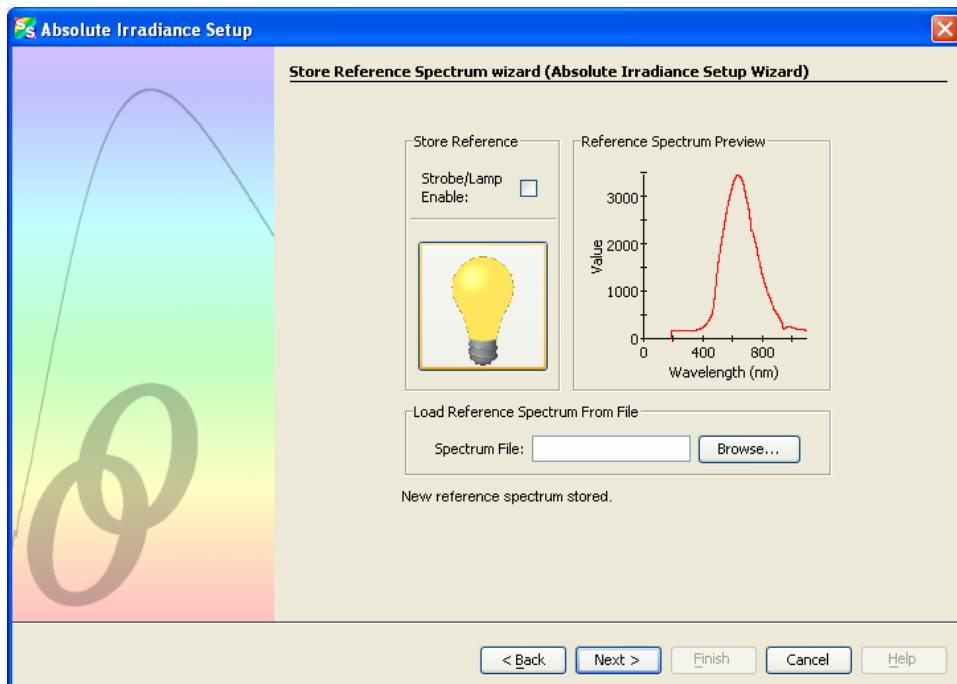
- i. Block the light path or uncheck the **Strobe/Lamp Enable** box, then click  to take a dark spectrum. The graph appears on the right side of the screen. Click .

### New Calibration

- a. After selecting New Calibration, the Set Acquisition Parameters screen appears.

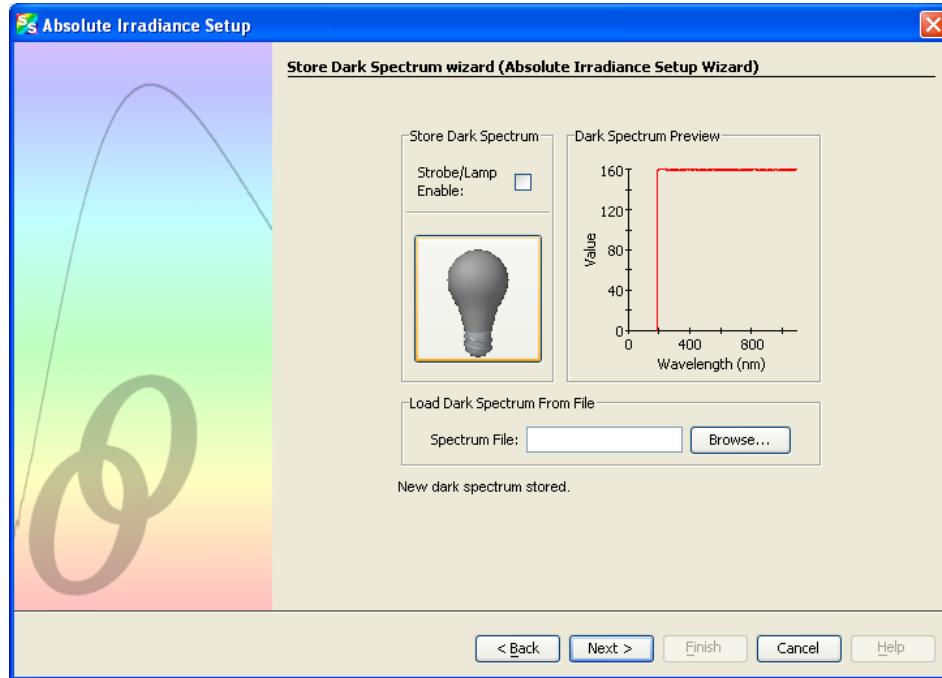


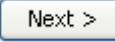
- b. Set your acquisition parameters for your experiment. Then, click **Next >**. The Store Reference screen appears.

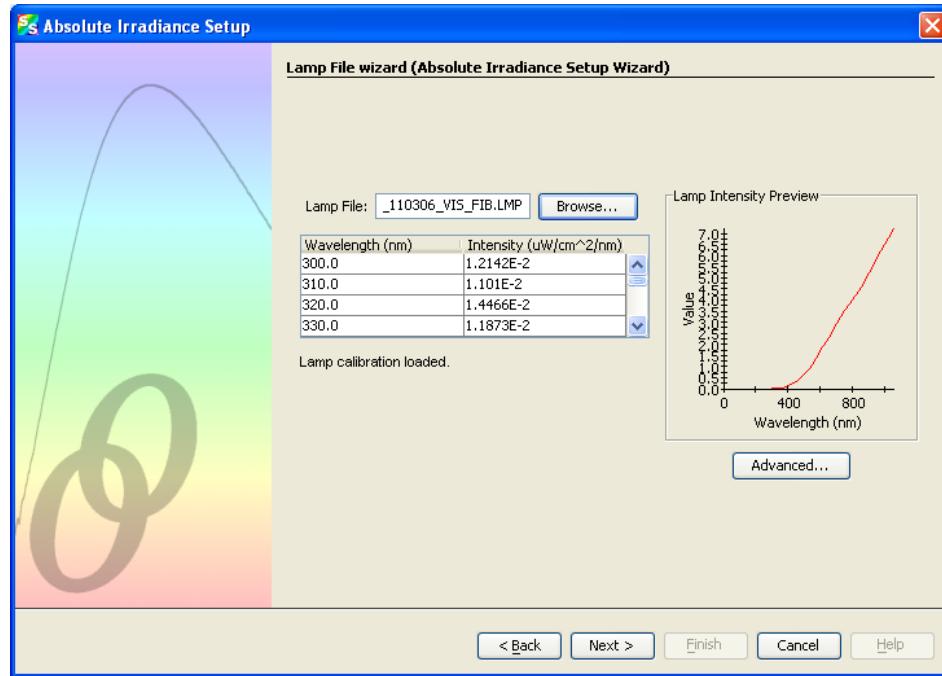


**A: Experiment Tutorials**

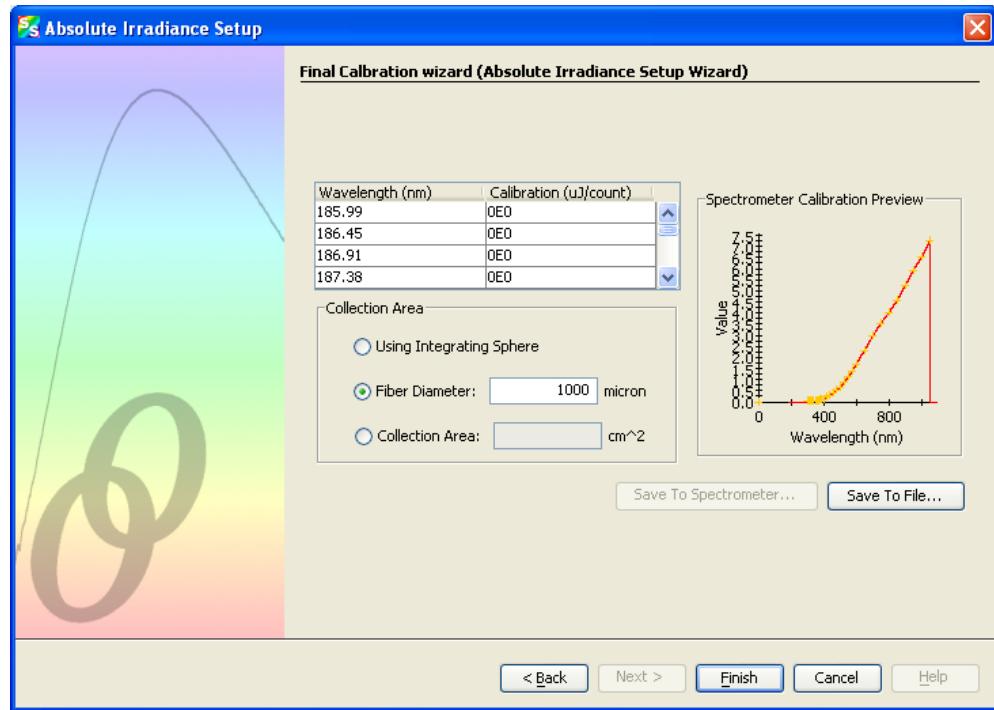
- c. Turn on your light source, then click  to store a reference spectrum. The Dark Spectrum screen appears.



- d. Block the light path or uncheck the Strobe/Lamp Enable box, then click  to take a dark spectrum. The graph appears on the right side of the screen. Click . The Lamp File wizard screen appears.



- e. Enter the name of the lamp file or browse to the desired file to use. The final screen of the calibration wizard appears. Note in the **Spectrometer Calibration Preview** that the lamp file curve (in yellow) is overlaid on the spectrometer's curve (red). Once you apply this calibration, the curves should be exactly the same.



- f. Click **Finish**. The **Absolute Irradiance Calibration** measurement screen appears.

## Relative Irradiance

Relative irradiance is a measurement of light relative to the known color temperature of a blackbody light source. Common applications include characterizing the light output of LEDs, incandescent lamps, and other radiant energy sources such as sunlight. Relative irradiance measurements also include fluorescence measurements, which measure the energy given off by materials excited by light at shorter wavelengths.

Relative Irradiance uses a lamp with a known color temperature (but not necessarily known power output) to correct just the shape of the spectrum but not the magnitude (hence its "relative" identifier). Relative Irradiance allows the user to determine whether there is more light at one wavelength than another (which cannot be determined from Scope mode due to the IRF), though it does not provide any information on how much power there is in absolute terms. This can be useful in some applications, such as measuring fluorescence. You must have stored reference and dark spectra before measuring relative irradiance.

Calculate relative irradiance as follows:

$$I_{L,T} = N * B_{L,T} * (S_L - D_L) / (R_L - D_L)$$

Where:

$I_{L,T}$  = Relative irradiance at wavelength  $L$  and color temperature  $T$  Kelvins

$N$  = Normalizing term to bound  $I_{L,T}$  into the range 0-100

$S_L$  = Sample spectrum at wavelength  $L$

$D_L$  = Dark spectrum at wavelength  $L$

$R_L$  = Reference spectrum at wavelength  $L$

$B_{L,T}$  = Emission of a blackbody radiator at wavelength  $L$  and color temperature  $T$  Kelvins

Compute  $B_{L,T}$  from Planck's law:

$$B_{L,T} = \frac{2 * h * c^2}{L^5} \left( e^{h * c / L * k * T} - 1 \right)$$

Where:

$L$  = Wavelength in meters

$T$  = Temperature of the blackbody in Kelvins

$h$  = Planck's constant (approximately  $6.626 * 10^{-34}$  J\*s)

$k$  = Boltzmann's constant (approximately  $1.38 * 10^{-23}$  J/K)

$c$  = Speed of light (approximately  $3 * 10^8$  m/s)

$e$  = Base of the natural logarithm (approximately 2.718)

Compute  $N$  by first finding the wavelength at which the maximum output for a blackbody of a given temperature occurs. This is done using the Wein displacement law (shown greatly simplified here, with an approximate value):

$$L_{max} = 2898 / T$$

Thus,

$$N = 100 / B_{L_{max},T}$$

### ► Procedure

1. Place SpectraSuite in Scope mode by clicking the Scope () icon in the Experiment mode toolbar or selecting **Processing | Processing Mode | Scope** from the menu.
2. Ensure that the entire signal is on scale. The intensity of the reference signal's peak differs depending on the device being used. If necessary, adjust the integration time until the intensity is appropriate for your device.
3. Take a reference spectrum using a light source with a black body of a known color temperature, such as the LS-1.
4. Click the Store Reference Spectrum () icon on the toolbar or by select **File | Store | Store Reference Spectrum** from the menu bar to store the reference. This command merely stores a reference spectrum in memory. You must click the Save Spectra () icon on the toolbar to permanently save the reference spectrum to disk.

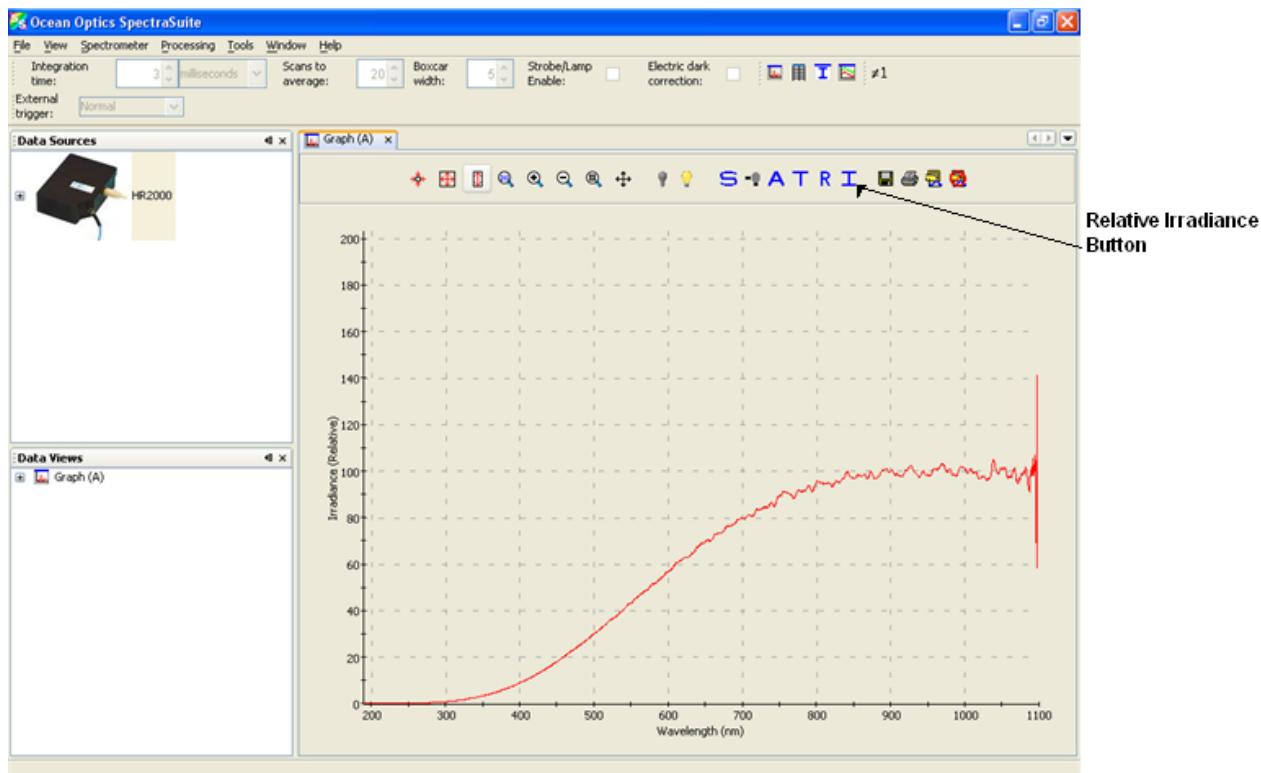
5. If you have not already done so, store a dark spectrum reading. To do this, either block the light path to the spectrometer, uncheck the **Strobe/Lamp Enable** box in the Acquisition toolbar, or turn the light source off. Then, take a dark spectrum by clicking the Store Dark Spectrum ( ) icon on the toolbar or by selecting **File | Store | Store Dark Spectrum** from the menu bar. This command merely stores a dark spectrum in memory. You must click the Save Spectra ( ) icon on the toolbar.

### Note

If possible, do not turn off the light source when taking a dark spectrum. If you must turn off your light source to store a dark spectrum, allow enough time for the lamp to warm up again before continuing your experiment.

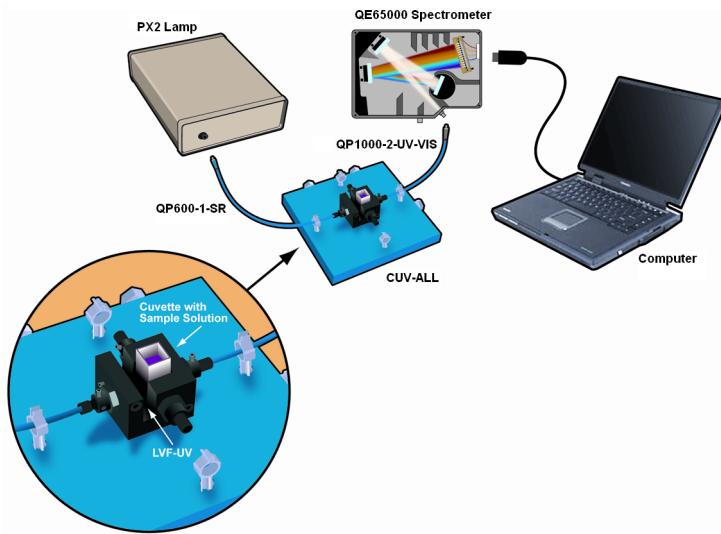
You must take a dark spectrum before measuring relative irradiance.

6. Position the fiber at the light source you want to measure. Then, click  . The Relative Irradiance graph appears.



## Fluorescence

A fluorescence measurement is a type of relative irradiance measurement in which the energy given off by materials excited by light at shorter wavelengths is measured. Advantages of fluorescence include High sensitivity, high speed (intensity changes on the order of picoseconds), and safety (nondestructive to sample and no hazardous by-products). A typical fluorescence set-up is shown below. Note that the fibers for the lamp and the spectrometer must be at a 90° angle to each other (or a CVD-DIFFUSE must be used).

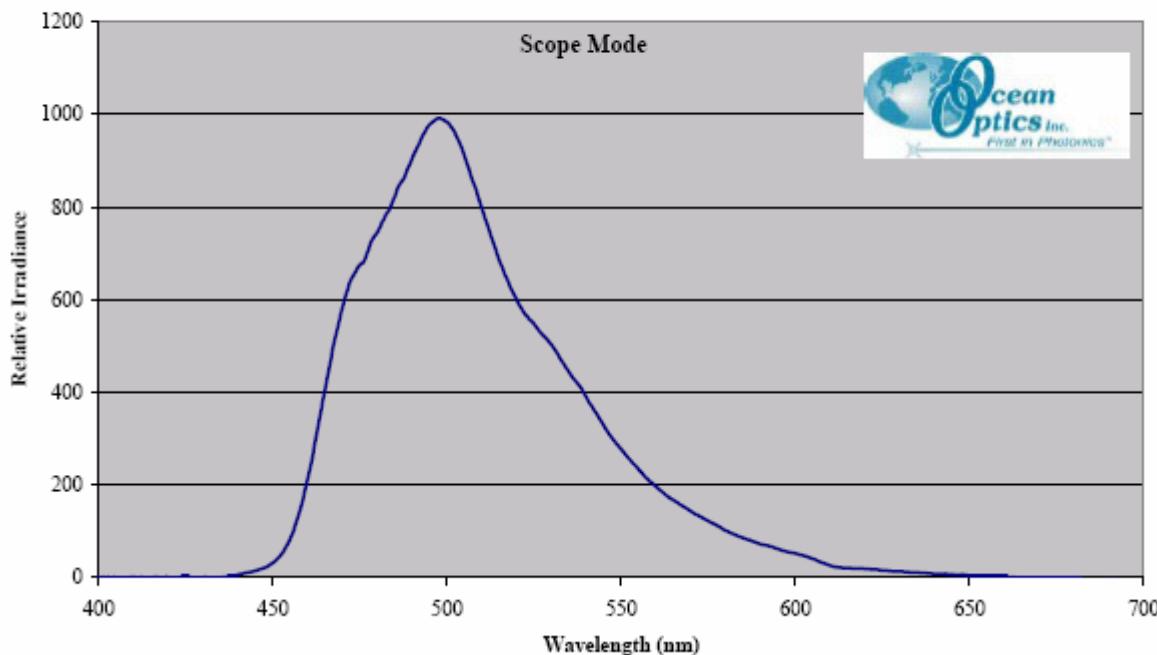


Fluorescence can be measured in the following modes:

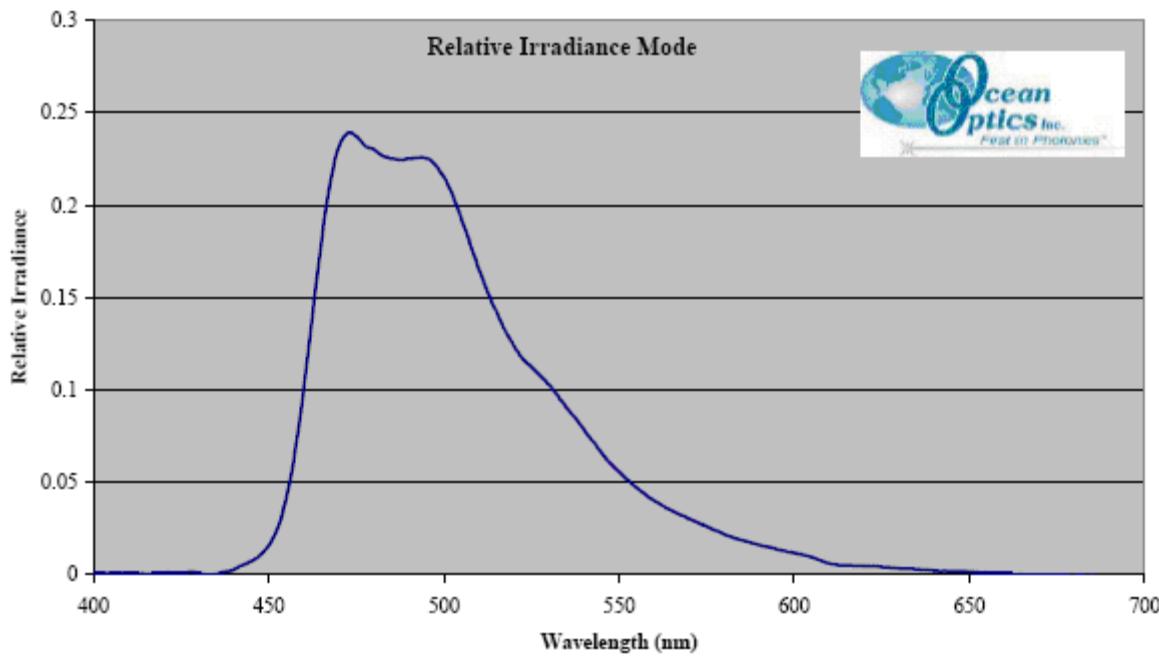
- Scope mode: Scope mode is the preferred mode for configuring your acquisition parameters. The signal graphed in Scope mode is the raw voltage coming out of the A/D converter. This spectral view mode provides complete control of signal processing functions before taking absorbance, transmission, reflection, and relative irradiance measurements. This mode reflects the intensity of the light source, the reflectivity of the grating and mirrors in the spectrometer, the response of the detector, and the spectral characteristics of the sample.
- Relative Irradiance mode: Relative Irradiance mode is the preferred mode for fluorescence experiments. Relative irradiance spectra are a measure of the intensity of a light source relative to a reference emission source. To perform a fluorescence experiment in Relative Irradiance mode, first do a radiometric calibration using a blackbody of known color temperature. See [Relative Irradiance](#) for the experiment procedure.

See the following figures for examples of graphs of relative irradiance in a fluorescence measurement.

PVK sample measured with the USB2000-FL spectrometer, PX2 pulsed xenon light source, CUV-ALL-4-Way cuvette holder, 1000  $\mu\text{m}$  illumination fiber, 600  $\mu\text{m}$  detection fiber  
Sample in disposable cuvette



PVK sample measured with the USB2000-FL spectrometer, PX2 pulsed xenon light source, CUV-ALL-4-Way cuvette holder, 1000  $\mu\text{m}$  illumination fiber, 600  $\mu\text{m}$  detection fiber (LS-1 tungsten halogen light source used for reference) Sample in disposable cuvette



**Note**

If you have a spectrometer with a gated detector (such as the USB2000-FLG), you can initiate a fluorescence measurement with **File | New | New Gated Fluorescence Measurement**.

If you have a Curie UV-VIS Emission Spectrofluorometer (serial number starts with CUR), you can initiate a fluorescence measurement with **File | New | New Curie Fluorescence Measurement**.

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**Application Tips**

If the signal you collect ...	You can ...	By ...
Saturates the spectrometer (peaks are off the scale)	Decrease the light level on scale in Scope mode	<ul style="list-style-type: none"><li>Decreasing the integration time, or</li><li>Incorporating linear variable filters into your experiment</li></ul>
Has too little light	Increase the light level on scale in Scope mode	<ul style="list-style-type: none"><li>Increasing the integration time, or</li><li>Removing linear variable filters from the light path</li></ul>

## Color Experiments

With SpectraSuite, you can obtain photopic data (in either lumens or lux per unit area) based on a CIE standard visibility curve. You can also control the parameters for all system and display functions, such as data acquisition, graph display, and cursor configuration. In addition, you can create a spreadsheet display of lamp output intensity by wavelength, providing an easy way to chart and analyze acquired data. SpectraSuite will compute all color measurements except RGB.

The color data that can be gathered using SpectraSuite include the following:

- Reflective and emissive color
  - Emissive color can use relative or absolute irradiance
- CIE 1931 and CIE 1965 observers
- CIE Illuminants A, B, C, D50, D55, D65, D75, E (unity), F1-F12
- CIE x,y chromaticity diagram with optional Planckian locus
- Color spaces
  - CIE XYZ
  - x,y,z
  - Color Rendering Index (CRI)
    - General CRI Ra

- Special CRI R1-R14
  - Correlated Color Temperature (CCT)
  - Dominant wavelength and purity
  - u'v'w', u,v hue angle, u,v saturation
  - CIE Whiteness and Tint
  - CIELAB (L\*a\*b\*, hue-angle, chroma)
  - CIE 1960 u,v
  - Hunter Lab

The Color Measurement wizard performs color measurement on the following processing modes:

- Absolute Irradiance
- Radiant Flux
- Reflection
- Relative Irradiance
- Transmission

#### ► **Procedure**

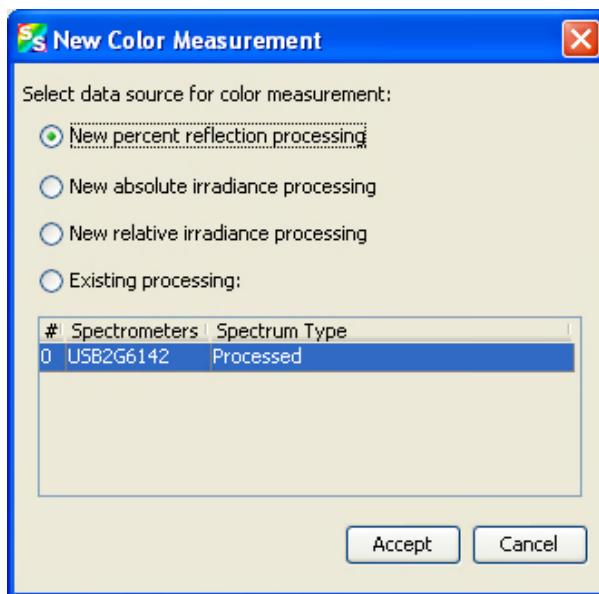
To collect color data,

1. From the main graph, click the Chromaticity icon  on the Processing toolbar

OR

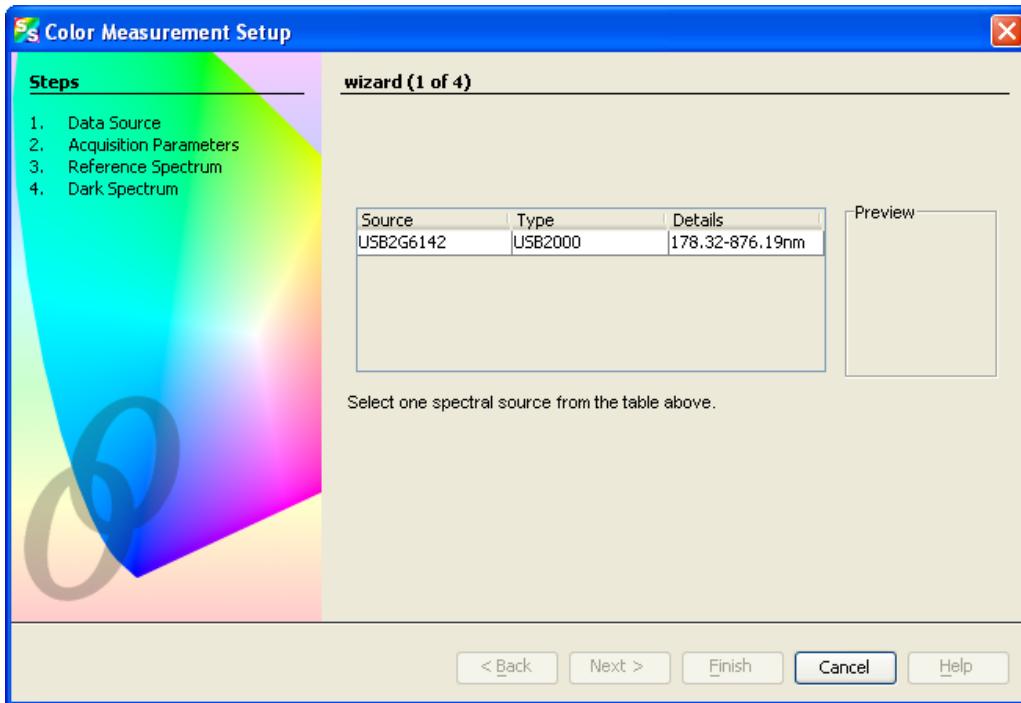
Select **File | New | Color Measurement**.

The **New Color Measurement** dialog box appears.

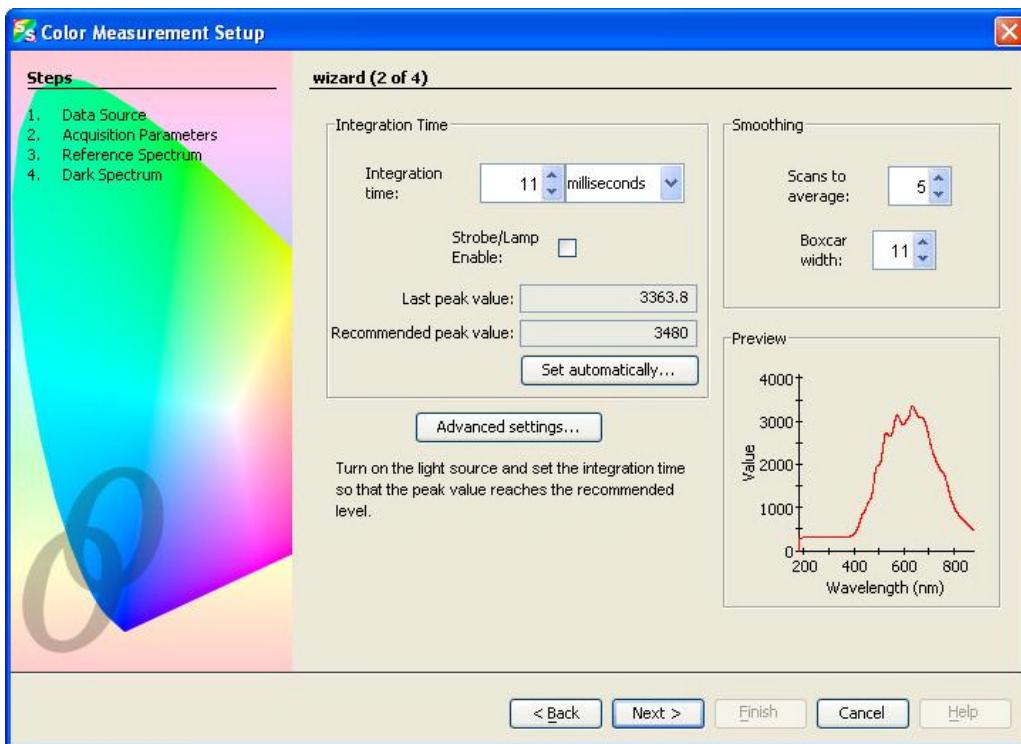


**A: Experiment Tutorials**

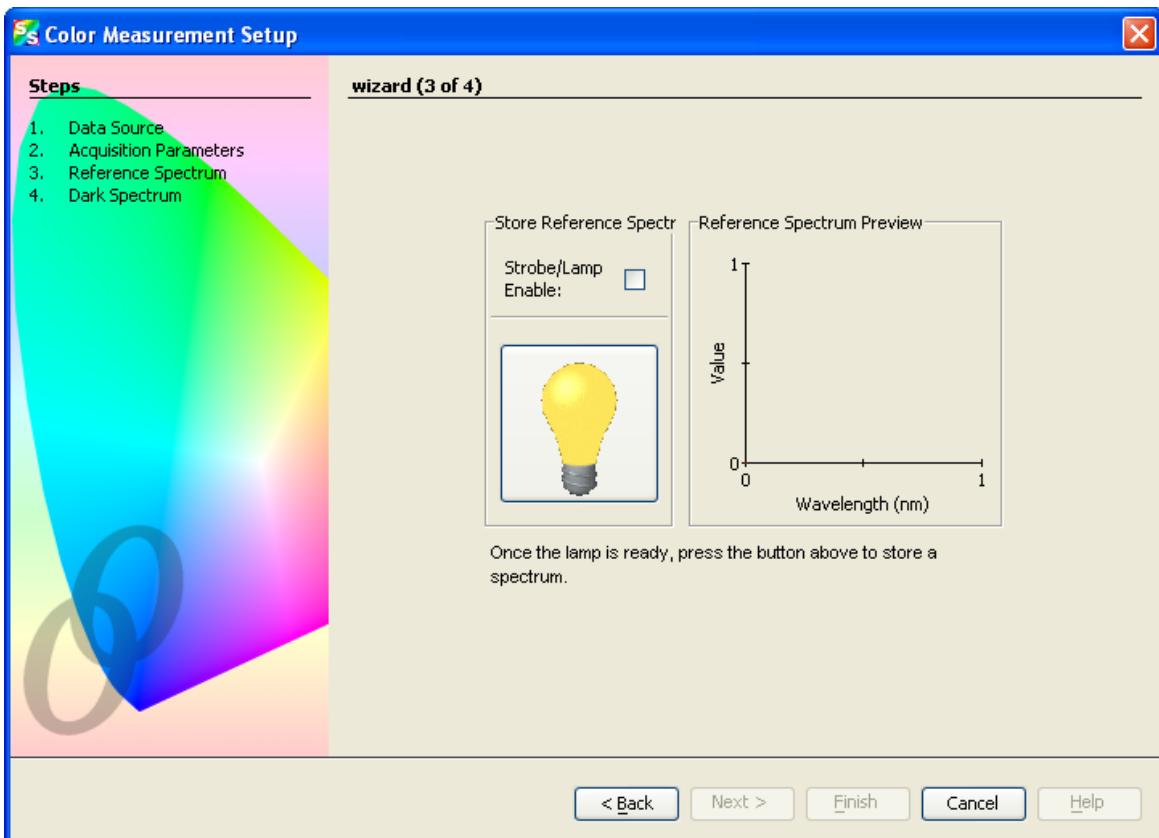
2. Select the data source for the color measurement and click **Accept**. The first Color Measurement Setup wizard screen appears.



3. Highlight the desired spectral source to select it. Then click **Next >**. The second Color Measurement Setup wizard screen appears.



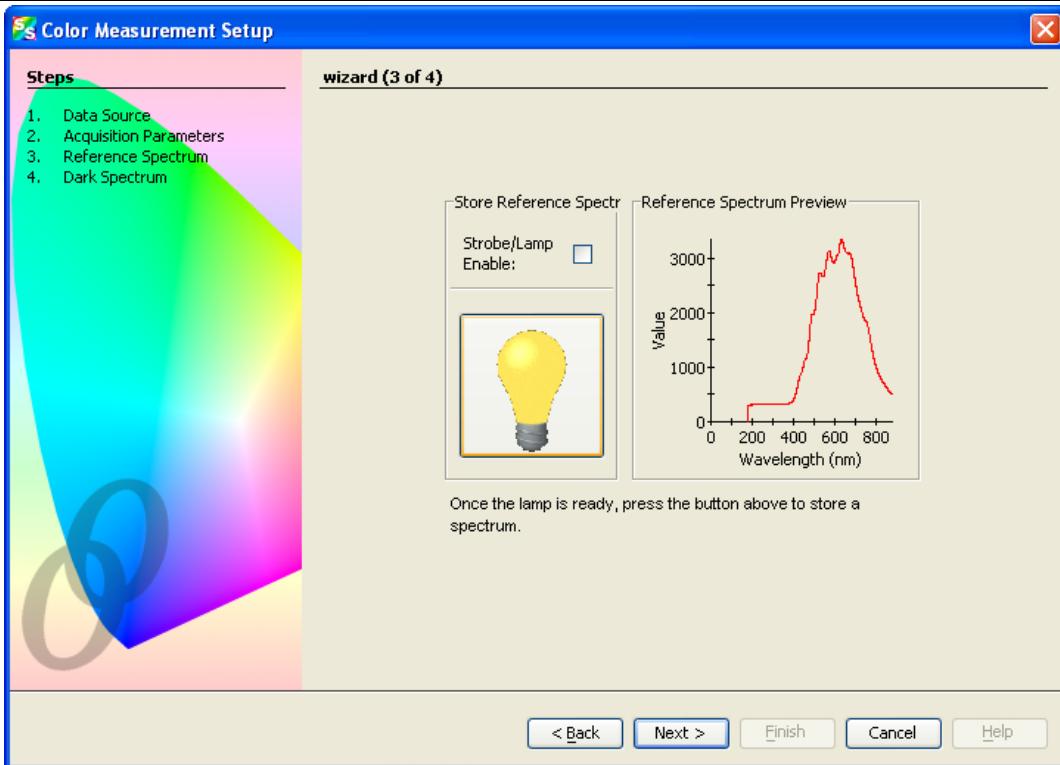
4. Turn on your light source. Adjust the **Integration time**, **Scans to average**, and **Boxcar width** so that the **Last peak value** is within the proper range (near the **Recommended peak value**). When this happens, the **Last peak value** reading changes from pink to black. Then, click **Set Automatically...** should provide the optimum settings for the experiment. Then, click **Next >**. The third Color Measurement Setup wizard screen appears.



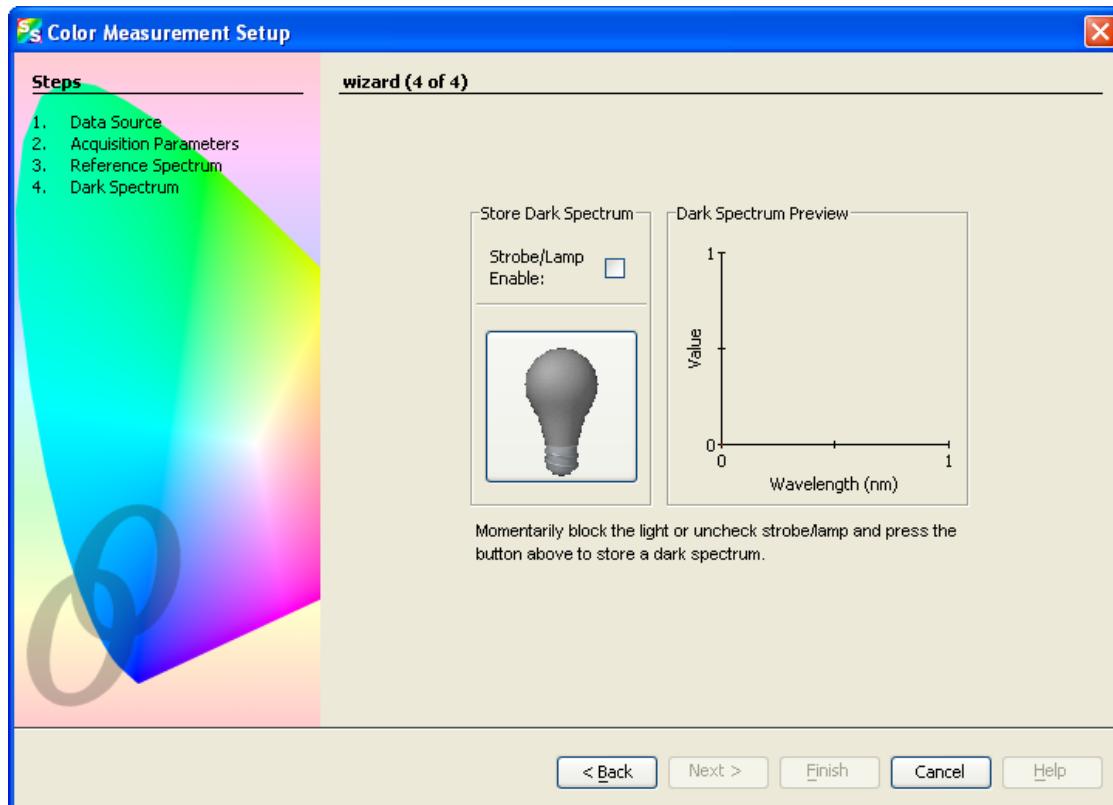
If you are performing an absolute irradiance calibration, go on to Step 6. Otherwise, continue with Step 5.

5. If you have not done so already, check the **Strobe/Lamp Enable** box or physically turn on the lamp. Once the lamp has warmed up, click  to store a reference spectrum. The graph appears in **Reference Spectrum Preview**.

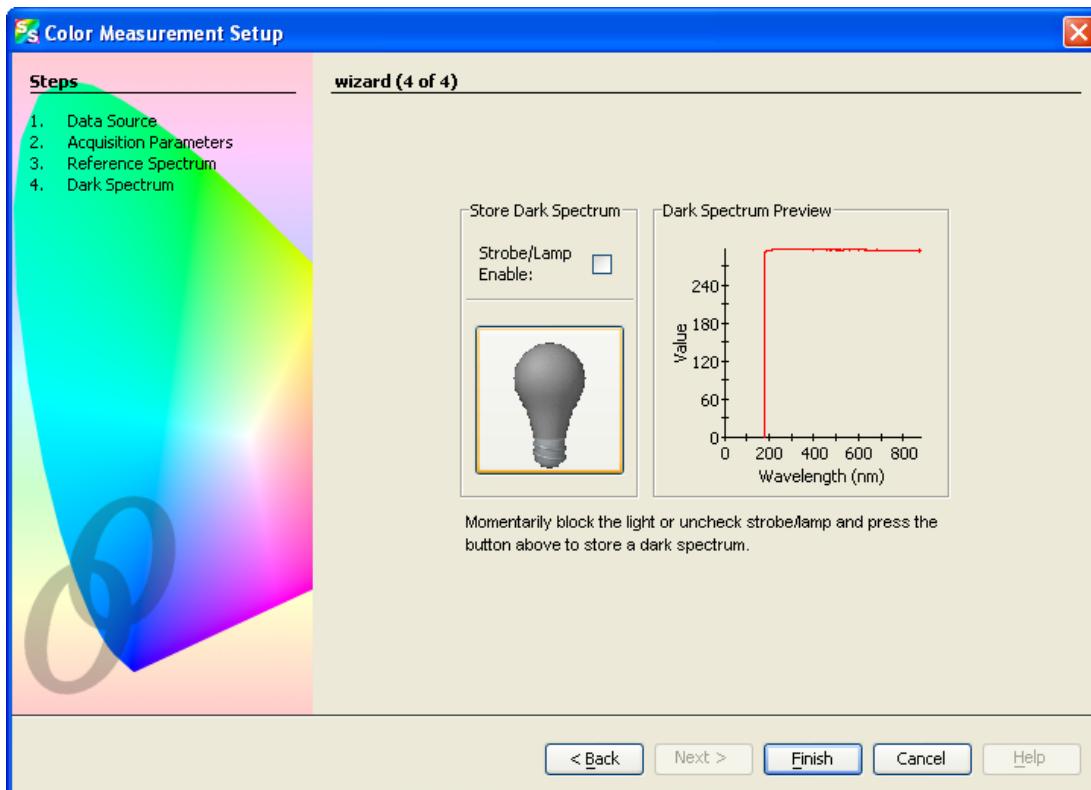
## A: Experiment Tutorials



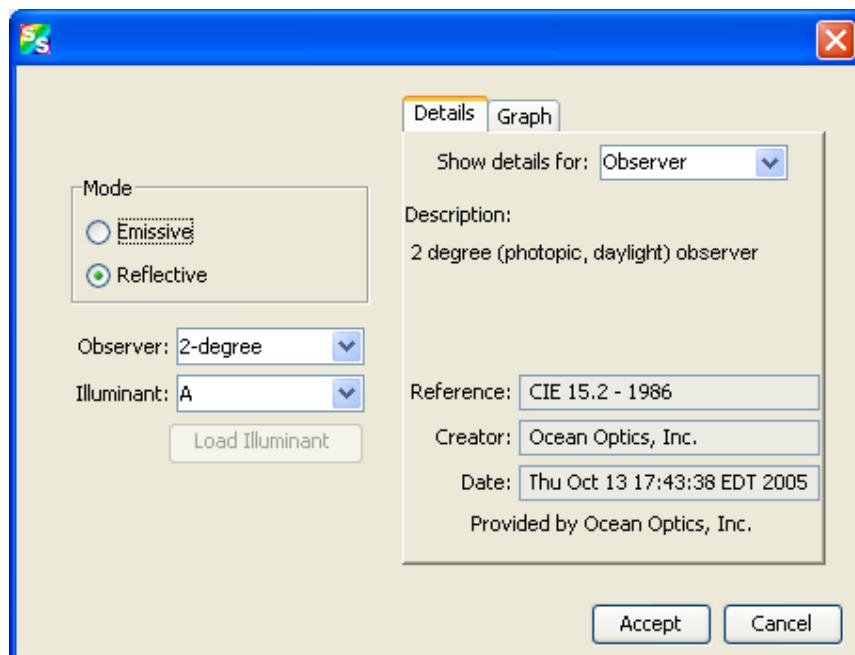
6. Click  . The fourth Color Measurement Setup wizard screen appears.



7. Block the light or uncheck **Strobe/Lamp Enable**. Then click  to store a dark reference spectrum. The graph appears in **Dark Spectrum Preview**.



8. Click . The following screen appears.

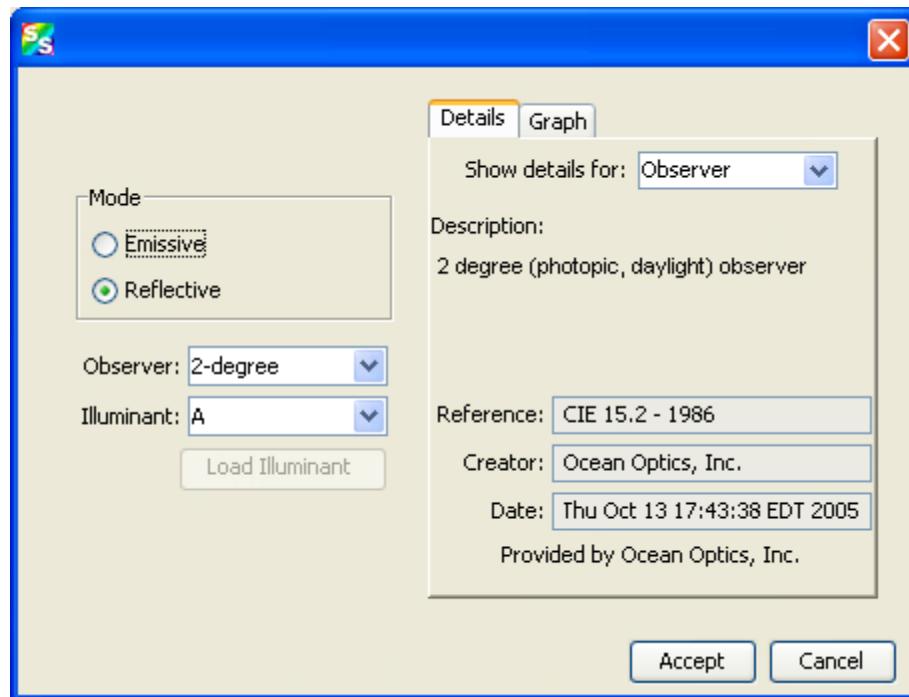


**A: Experiment Tutorials**

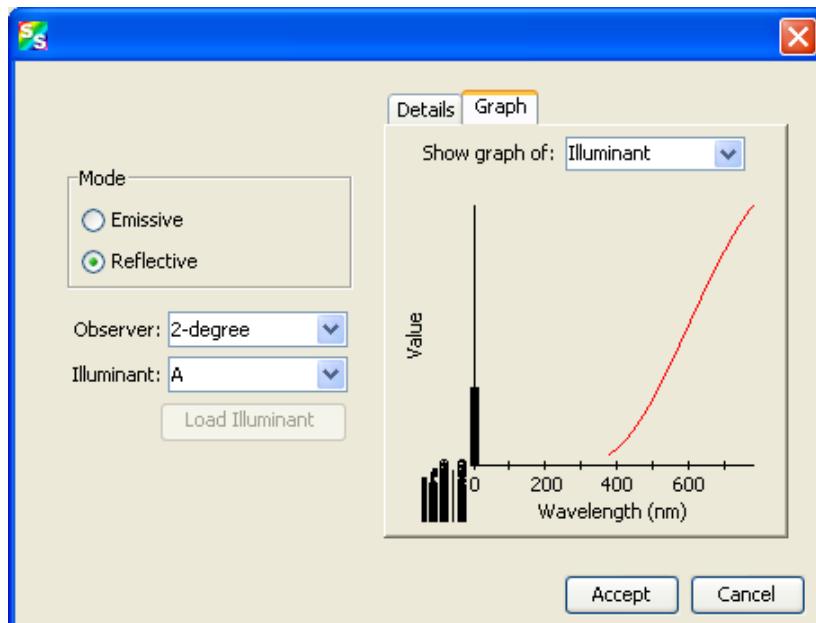
The fields on this screen are described in the following table.

Field	Description
Mode	<p>Either Emissive or Reflective mode is selected, depending on the type of color measurement selected in Step 1. You can change it here:</p> <p><b>Reflective</b> – Color measurement of a surface for a selectable CIE-defined illuminant. For color by transmission, choose Reflective color. The math for reflective and transmissive color is the same. In both cases, it is measuring the percentage of light that is collected after the light interacts with something.</p> <p><b>Emissive</b> - Measurement of the light emitted from an LED or a lamp (emission source).</p>
Observer	<p>Specify the observer (viewing angle) using the drop-down list:</p> <p><b>2° (CIE 1931)</b> – photopic (daylight)</p> <p><b>10° (CIE 1964)</b> – scotopic (dark-adjusted)</p>
Illuminant	<p>If you chose Reflective measurement under <b>Mode</b>, select the desired Illuminant from the drop-down list. This illuminant is theoretical and CIE-defined; it has nothing to do with the actual lamp used in the measurement. The choice of illuminant only matters for some color spaces (especially X, Y, Z and dominant wavelength and purity).</p> <p>In Emissive mode, the X,Y,Z color space is normalized based on the illuminant (X,Y,Z are multiplied by 100/Yref where Yref is the Y value for the illuminant). The E illuminant effectively removes the reference illuminant from the calculation, so if you want to see the unnormalized X,Y,Z values then choose illuminant E.</p> <p>Also, the dominant wavelength depends on the "white point", which is the chromaticity of the illuminant. A change in the illuminant can shift the dominant wavelength about 5nm. The E illuminant places the white point in the center of the x,y chromaticity diagram (at 0.33,0.33,0.33).</p> <p>It is normal to report the illuminant and observer with the measured color, and it is not strictly necessary that the illuminant be the same type of lamp as the test lamp (that is, illuminant A is not just used with tungsten lamps). The two most common illuminants are A and D65. You may want to see how others in your field report their results in terms of the illuminant used.</p>
<input data-bbox="192 1740 404 1782" type="button" value="Load Illuminant"/>	For future use.

9. Your selections are reflected on the right side of the screen. Select to view either illuminant or observer details in the **Show details for** field. An example screen with details for the observer is shown below:

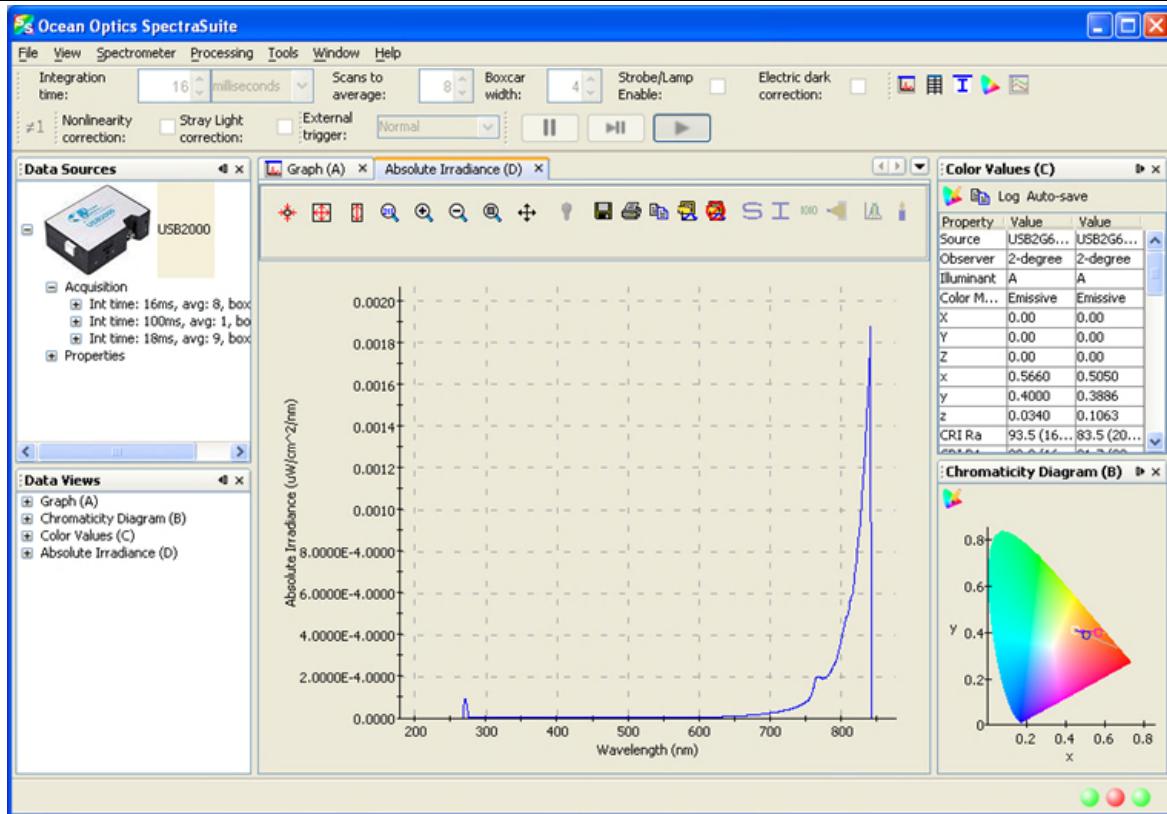


10. Select the Graph tab to view a graph reflecting the selections you have chosen. An example graph of the illuminant is shown below:



11. Click **Accept**. Your color data appears on the main SpectraSuite screen as shown below:

## A: Experiment Tutorials

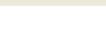


### Tip

To close all three color views (**Graph**, **Color Values**, and **Chromaticity Diagram**) at once, highlight the color acquisition in the **Data Sources** pane, right-click and select **Terminate**.

## Color Measurement Screen Controls

Once you have captured your color data on the Color Measurement screen shown above, you can use the following controls in the Color Values section of the screen:

Control	Action
	Edit Color settings. Use this control to edit the color settings in your graph. See <a href="#">Edit Color Settings</a> for more information.
	Copy Spectral Data to Clipboard.
	Opens a browser for you to select a log file you have created.
	Saves your color data to a file. See below for an example saved in Notepad. See <a href="#">Exporting Processed Data</a> for more information

Source	Observer	Illuminant	Color Mode	X	Y	Z	X	Y	Z	CRI	Ra	CRI
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4849	0.3710	0.1441	84.5	(2096K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4849	0.3710	0.1441	84.5	(2096K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4891	0.3739	0.1371	85.9	(2075K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4891	0.3739	0.1371	85.9	(2075K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4885	0.3720	0.1396	83.3	(2068K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4885	0.3720	0.1396	83.3	(2068K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3755	0.1387	84.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3755	0.1387	84.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3749	0.1397	88.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3749	0.1397	88.9	(2119K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4830	0.3721	0.1449	86.2	(2124K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4830	0.3721	0.1449	86.2	(2124K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4842	0.3703	0.1456	85.6	(2098K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4842	0.3703	0.1456	85.6	(2098K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4887	0.3721	0.1392	85.6	(2066K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4887	0.3721	0.1392	85.6	(2066K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4847	0.3703	0.1449	84.1	(2093K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4847	0.3703	0.1449	84.1	(2093K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4886	0.3760	0.1354	87.0	(2095K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4886	0.3760	0.1354	87.0	(2095K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3725	0.1431	85.9	(2113K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3725	0.1431	85.9	(2113K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3720	0.1437	87.7	(2110K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3720	0.1437	87.7	(2110K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4806	0.3699	0.1494	84.2	(2132K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4806	0.3699	0.1494	84.2	(2132K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4812	0.3724	0.1464	82.9	(2144K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4812	0.3724	0.1464	82.9	(2144K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4856	0.3688	0.1456	83.4	(2073K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4856	0.3688	0.1456	83.4	(2073K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3731	0.1410	84.9	(2101K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4859	0.3731	0.1410	84.9	(2101K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4866	0.3731	0.1403	83.5	(2094K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4866	0.3731	0.1403	83.5	(2094K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4918	0.3691	0.1391	85.0	(2016K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4918	0.3691	0.1391	85.0	(2016K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3747	0.1410	86.8	(2130K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4843	0.3747	0.1410	86.8	(2130K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4790	0.3748	0.1461	84.7	(2186K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4790	0.3748	0.1461	84.7	(2186K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4841	0.3740	0.1419	85.9	(2127K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4841	0.3740	0.1419	85.9	(2127K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3704	0.1442	83.8	(2087K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4854	0.3704	0.1442	83.8	(2087K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4864	0.3761	0.1375	85.1	(2118K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4864	0.3761	0.1375	85.1	(2118K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4851	0.3750	0.1400	88.1	(2123K)	
USB2G6142	2-degree	A	Emissive	-0.00	-0.00	-0.00	0.4851	0.3750	0.1400	88.1	(2123K)	



---

## Appendix B

# Troubleshooting

The following table lists common problems and their possible solutions.

Problem	Possible Cause(s)	Recommended Solution(s)
Password does not unlock the installer	Need the current SpectraSuite password	SpectraSuite's password was changed in version 2.0.140 06/25/2009.
SpectraSuite installs, but will not run.	1. For Windows OS: low RAM 2. For Mac OS X 10.6 (Snow Leopard): Need an older version of the Apple JVM	Use Notepad to open the SpectraSUiteWindows.bat file located in C:\Program Files\Ocean Optics\SpectraSuite\spectrasuite.bin. Edit Java Heap size from 1024 to 512 or 256. See <a href="#">Running SpectraSuite on Snow Leopard</a>
SpectraSuite starts, but does not show my spectrometer	1. The spectrometer is not plugged into the computer. 2. The attached spectrometer is not supported by SpectraSuite. 3. The device is not detected or identified. 4. Spectrometer needs to be reset.	1. Plug one end of the USB cable into the spectrometer, and the other end into the USB port of your computer. 2. See <a href="#">USB Spectrometer and Device Control</a> for a list of spectrometers supported by SpectraSuite. 3. Disconnect any lamps or plug-ins that may be attached to the spectrometer, disconnect and reconnect the spectrometer, wait 10 seconds, and try again. If the spectrometer is detected, repeat with the lamp or plug-in connected. This may indicate a problem with an attached device. Under Windows and Linux, it is also possible that the spectrometer model may be newer than the driver file that informs the operating system about the spectrometer. The SpectraSuite update center does not yet update these system files, so it may be necessary to reinstall with the latest SpectraSuite installer to get the correct files. 4. Unplug the spectrometer's USB cord, then plug it back in.

**B: Troubleshooting**

Problem	Possible Cause(s)	Recommended Solution(s)
	5. The device driver is not installed correctly.  6. The spectrometer has old firmware.	5. Reinstall the device driver.  6. Contact Ocean Optics for updated firmware.
SpectraSuite's splash window opens, but never finishes loading.	1. You are using a USB2000 Spectrometer has firmware older than 2.41.0.  2. The spectrometer needs to be reset.	1. Use the <a href="#">USB Programmer</a> and verify that the USB2000 has firmware version 2.41.0 or newer. The USB Programmer will also let you program newer firmware if necessary.  2. Unplug the spectrometer's USB cord before loading SpectraSuite, then plug it back in after loading SpectraSuite.
The SpectraSuite layout is backwards or otherwise incorrect after updating to a newer version.	Need to delete a user directory.	Delete user directory userdir_v2-<Username> located in C:\Documents and Settings\<Username>\ and restart SpectraSuite.
When the spectrometer is attached, a "cannot find driver" error is received.	For Windows 64-bit OS: 32-bit version of SpectraSuite has been installed.	Install the 64-bit version of SpectraSuite.
Some of the menu and toolbar items are grayed out (inactive).	Some menu and toolbar items require some action to be taken before they can be used.	1. Acquisition parameters, storing reference/dark spectra, and the Strip Chart require an unambiguous selection of an acquisition. If no acquisitions are running, try starting one. If more than one acquisition is started, try clicking on the desired trend in the graph to select the correct target. Similarly, try expanding the tree under the icon of the spectrometer and see how the controls respond to selecting each item. Right-click these items (or Control-click in MacOSX) to see additional actions for each.  - Minus dark requires a dark spectrum to be stored.  - A, T, R, and I (relative irradiance) require a reference and dark spectrum to be stored.  - Absolute Irradiance mode (I) requires a calibration and a stored dark spectrum.  Photometry and energy/power/photons measurements require an active absolute irradiance calculation.

Problem	Possible Cause(s)	Recommended Solution(s)
It took longer than expected to get a spectrum on the graph.	The host computer requested some change in the spectrometer's acquisition parameters (integration time, status of the strobe/lamp enable, etc.).	<p>SpectraSuite discards the next spectrum it acquires after making changes to acquisition parameters. This extra discarded <i>stability scan</i> causes the next single-shot acquisition to take longer than normal because it is really acquiring two scans.</p> <p>For the same reason, a second external hardware trigger pulse may be required if the <i>Normal</i> free-running trigger mode is not being used. When preparing to do single-shot acquisitions or external triggering, it is recommended that all of the acquisition parameters be set in the continuously acquiring free-running mode to minimize this effect.</p> <p>If SpectraSuite is taking turns acquiring spectra with different acquisition parameters from the same spectrometer, it may be doing a stability scan before every sample scan. Also, as above, the number of scans to average is multiplied by the integration time.</p>
Can't access Absolute Irradiance mode	A spectrometer calibration and a Dark spectrum have not been stored.	Go to <b>File   New   New Absolute Irradiance Measurement</b> to open a wizard to guide you through the process. Absolute irradiance requires a spectrometer calibration (either loaded from disk or generated using a calibrated lamp) and a stored dark spectrum. The most typical reason for not being able to access absolute irradiance mode is that you must store a dark spectrum after loading a calibration.
The graph window shows a broken pattern of dots instead of a spectrum line.	On Microsoft Windows systems, ATI video cards are known to have problems displaying the graph properly.	Right-click the desktop, choose Properties, then select the Settings tab and click the <b>Advanced...</b> button. There should be a tab for the device that allows you to change the hardware acceleration. Set the hardware acceleration to about half and press <b>Apply</b> . That should immediately correct the problem. If not, try lowering the acceleration further.



# Index

## A

### Absolute Irradiance

conversions, 88  
Experiments, 153  
graph, 45, 64  
measurement, 46  
mode, 88, 89

### Absorbance

Experiments, 132  
measurement, 44  
mode, 86

### acquisition

controls, 27, 63  
pause, 70  
terminate, 70  
toolbar, 62

### add new external library

annotations, 58  
application tips, 168

## B

### Beer's Law

boxcar width, 62

## C

### calibration

combine files, 90

### chart

close all documents, 119

close window, 120

### collection area

### color

Experiments, 168  
measurement, 47  
settings, 81  
temperature, 97

### Concentration

Experiments, 137  
measurement, 46

### configure new trigger

### controls

acquisition, 27  
graph, 19

### conversions

Convert Spectra, 55

### correction toolbar

Create a new spectral window, 34

### Curie Fluorescence

measurement, 45

### cursor

custom external libraries, 103

### custom libraries

add external, 106

### Customize Toolbars

## D

### Dark

dark spectra, 131

### data display toolbar

device control, 1

### document

audience, vii

purpose, vii

summary, vii

### documentation

Documents, 119

### draw

## E

### Edit Menu

Edit Result Colors, 101

electric dark correction, 63

### Exit

### Experiments

Absolute Irradiance, 153

Absorbance, 132

Color, 168

Concentration, 137

Fluorescence, 166

Irradiance, 152

Preparing, 129

Reflection, 149

**Index**

Relative Irradiance, 163  
Transmission, 146  
exporting data, 98  
external library  
    add, 105  
    configure, 106  
    remove, 108  
external library configuration  
    load, 107  
    remove, 108  
    save, 107

**F**

features, 2  
File Menu Functions, 33  
    Configure Export, 53  
    Convert Spectra, 55  
    Exit, 56  
    Open, 51  
        Dark, 51  
        Experiment, 53  
        Reference, 51  
    Save, 53  
        Dark, 54  
        Reference, 55  
    Save Spectrum, 53  
    Stop Export, 53  
    Store, 54  
Fluorescence  
    measurement, 44, 45  
Fluorescence Experiments, 166  
Functions  
    Edit Menu, 57  
    File Menu, 33  
    Overlay Menu, 81  
    Spectrometer Menu, 69  
spectroscopic, 2

**G**

Gated Fluorescence  
    measurement, 44  
graph controls, 19  
Graph Layer options, 57

**H**

high-speed data acquisition, 37  
3-D chart, 41  
capturing data, 38

using data, 42

**I**

IDE configuration, 111  
image, 59  
indicators, 29  
    status, 29  
installation, 5  
    device drivers, 9  
    device drivers on Windows 7 64-bit systems, 9  
    device drivers on Windows Vista 64-bit systems, 13  
    Linux, 8  
    Macintosh, 7  
    via CD, 5  
    via ftp, 6  
    Windows, 6  
integration time, 62  
Irradiance Experiments, 152

**L**

lamp enable, 63  
layer tools, 25  
legend, 61  
library triggers, 108  
Linux platform installation, 8

**M**

Macintosh platform installation, 7  
measurement  
    absorbance, 44  
    color, 47  
    concentration, 46  
    Curie fluorescence, 45  
    gated fluorescence, 44  
    new absolute irradiance, 46  
    reflection, 44  
    relative irradiance, 44  
    transmission, 44  
memory toolbar, 64  
Mikropack device  
    new, 110  
    remove, 110  
minimize window, 120  
MMS Raman spectrometer, 74, 76  
Module Manager, 112

## N

new, 33  
New Energy, Power, Photons, 91  
new Mikropack device, 110  
nonlinearity correction, 63  
non-uniform, 83  
nonunity correction, 64, 82, 151

## O

Open, 51  
options, 110  
Output, 120  
overlay, 60  
Overlay Menu, 81  
overlay spectral data, 24

## P

pause acquisition, 70  
peak finding, 27  
peaks, 59  
photometry, New Photometry Measurement, 93  
preprocessing, 82  
  toolbar, 64  
processed spectrum  
  load stored spectrum, 51  
Processing  
  mode, 85  
  tools, 23  
product description, 1  
Progress Bar, 31

## R

Raman, 101  
Reference, 51, 55  
  monitor, 83  
  spectra, 131  
Reflection  
  measurement, 44  
  mode, 87  
Reflection Experiments, 149  
Relative Irradiance  
  Experiments, 163  
  measurement, 44  
  mode, 88  
remove a trigger, 109  
remove Mikropack device, 110

remove preprocessor, 82  
rescan devices, 80  
restore window, 120  
resume acquisition, 70

## S

Save  
  Spectra Collection, 53  
  Spectrum, 53  
scale, 57  
scale graph height to fill window, 21  
scale graph to fill window, 20  
scans to average, 62  
Scope Minus Dark, 86  
Scope mode, 86, 88  
screen capture, 55  
SeaChanger module, 64  
Set Laser Wavelength, 101  
show devices, 71  
small toolbar icons, 68  
spectra  
  dark, 131  
  reference, 131  
spectra collection  
  remove, 80  
SpectraSuite settings, 111  
spectrometer  
  features, 71  
Spectrometer Menu, 69  
spectrum  
  graph, 34, 63  
  IO tools, 24  
  range, 60  
  storage tools, 23  
  table, 36, 64  
status indicators, 29  
Store, 54  
strip chart, 47, 64  
  controls, 128  
  creating, 123  
  saving, 128  
  saving data, 128  
strip chart table, 51  
strobe enable, 63  
strobe gate delay  
  toolbar, 68

**T**

Template Manager, 111  
terminate acquisition, 70  
testing toolbar, 68  
toggle graph pane, 22  
Tool menu, 103  
toolbar, 61  
    acquisition, 62  
    correction, 63  
    customize, 68  
    data display, 63  
    memory, 64  
    preprocessing, 64  
    strobe gate delay, 68  
    testing, 68  
    trigger, 68  
Transmission  
    Experiments, 146  
    measurement, 44  
    mode, 87  
trendline, 59  
trigger  
    configure new, 108  
    remove, 109  
    view, 109  
trigger toolbar, 68  
triggers, 108  
troubleshooting, 179  
Tutorials, 129

**U**

uniform, 83  
update available, 30  
Update Center, 3, 113  
updates, 3  
upgrades, ix

**V**

view triggers, 109  
visible spectrum, 60

**W**

what's new, vii  
Window menu, 119  
Windows 7 device driver installation, 9  
Windows platform installation, 6  
Windows Vista device driver installation, 13

**X**

x-axis units, 96

**Z**

zoom  
    in, 21  
    out, 22  
    out maximum, 20  
    region, 22  
    set numeric ranges, 21  
    tools, 20, 23