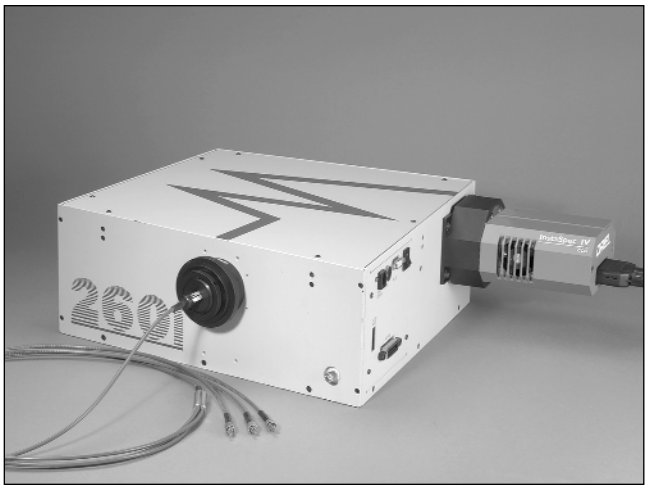


InstaSpec™ IV CCD Detector Heads.

- **Spectroscopic systems**
- **Slow scan scientific grade imaging systems**
- **Air cooling to -55 °C**
- **High speed data acquisition, up to 1 MHz**
- **True 16-bit dynamic range**

InstaSpec™ IV is our family of imaging and large area spectroscopic CCD systems. We offer sealed and evacuated detector heads which reach temperatures of -55 °C without water cooling! Dark current is an impressive <0.1 e^-/pixel/s @ -55 °C. InstaSpec™ IV CCD systems offer the sensitivity of photomultiplier tubes with the advantage of simultaneous capture of an entire UV-NIR spectrum.

Since introducing the original InstaSpec™ IV over 8 years ago, we have placed hundreds of systems in government laboratories, manufacturing facilities and universities, worldwide. Because we offer the mating spectrographs and a full line of complementary optical components (fiber optics, shutters, filters) we're able to offer the complete solution.

COMPONENTS OF AN INSTASPEC™ IV CCD SYSTEM

Each system comes with a CCD detector head, a PC plug-in controller board and the powerful InstaSpec™ software.

Detector Head

These compact CCD heads are TE cooled to either -40 °C or -55 °C on single stage evacuated systems, and -55 °C on multi-stage evacuated systems. The sensor area is large and there are no dead regions between elements.

We offer two types of detector heads: square format for imaging applications and rectangular format (4:1 aspect ratio or higher) for spectroscopic applications.

Imaging Detector Heads

These use 512 x 512 or 385 x 578 pixel, slow scan scientific grade front illuminated sensors. Front illuminated sensors have good UV response down to 180 nm (see Fig. 3 on the following page). Full image readouts to 16-bit accuracy are possible, with frame rates as high as 4.5 Hz. Note, when imaging with a continuous light source, a shutter is required.

To realize the full benefits of these CCDs, choose an imaging spectrograph or couple a lens directly to the detector. See Table 2 on page 6-116 for a selection.

Fig.1 Image of fluorescing currency and relative intensity contour.

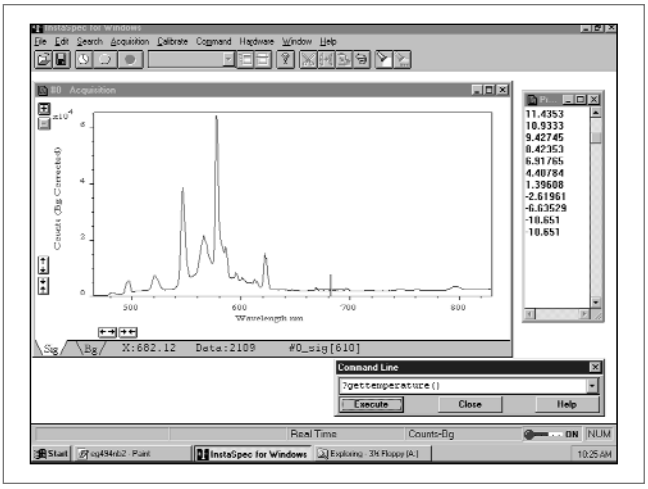


Fig. 2 Spectra of typical fluorescent room light.

Spectroscopy Detector Heads

The CCD chips in the detector heads are ~1 inch long to match the flat focal plane produced by most spectrographs. The readout register is along the long (dispersion) axis allowing use of the most efficient readout method, commonly referred to as Full Vertical Binning. This binning scheme eliminates the need for any shutter and offers sustained spectral acquisition rates up to 250 spectra per second with a 1024 pixel array, or as high as ~800 spectra per second with a 385 pixel array. Faster acquisition rates are achievable in Fast Kinetics Mode, or in CROPPED mode (we talk about Fast Kinetics Mode on the following page; for details on CROPPED mode, contact an Applications Engineer).

PC Plug-in Controller Card

The controller is a 32-bit RISC microcontroller on board a 3/4 length PC card. PCI format is standard, however, ISA is available. Please contact an Applications Engineer for details.

Powerful Software

Don't be fooled by the simplicity of the InstaSpec™ Software; it is a powerful and rugged Windows™ based application. It controls the hardware, including Oriel's Spectrograph and Shutter, and acquires, manipulates and displays both spectral and image data in real time. For those who wish to write routines or customize the software, we provide a simple to learn programming language. See page 6-124 for details on the InstaSpec™ Software.

WHY INSTASPEC™ IV?

We offer two families of CCD systems; the LineSpec™ family described on the previous pages and the family talked about here, called InstaSpec™ IV. InstaSpec™ IV CCDs use larger chips, have much lower dark current, and have greater dynamic range.

Table 1 LineSpec™ CCDs vs InstaSpec™ IV CCDs

CCD Family	Pixel Size W x H	Dark Current (e^-/pixel/s)	Read-out Rate	Dynamic Range
LineSpec™ (Model 78850)	14 x 200 µm	218	1.25 MHz*	1150:1
-40 °C InstaSpec™ IV CCD (Model 78451)	26 x 26 µm	<0.2	62 kHz**	65,536:1
-55 °C InstaSpec™ IV CCD (Model 78437)	26 x 26 µm	<0.1	1 MHz**	65,536:1

*** 12 bit**
**** 16 bit**

DLL DEVICE DRIVERS

For those who wish to integrate an InstaSpec™ Detection System with other LabView™, VisualBasic, or C controlled instruments, we offer the 78452 Device Drivers. The 78452 allows for complete control of all InstaSpec™ acquisition functions from within your custom application through the DLLs.

QUANTUM EFFICIENCY

The CCD sensors offered in the InstaSpec™ IV systems have several spectral response options. These offer various trade-offs of quantum efficiency, spectral coverage, and cost. We talk about the differences in detail, starting on page 6-99.

Front Illuminated Sensors

- Moderate quantum efficiencies from 180 to 1100 nm (with UV phosphor)
- Most economical

These sensors come standard with and without a vacuum UV coating. For those working above 400 nm, front illuminated sensors without this coating provided increased quantum efficiency in the 450 to 650 nm range. See page 6-117 for available chip listings.

Open Electrode Sensors

- Significantly higher QE in the UV

If you are working in the UV, these sensors offer the best performance to cost ratio. If your measurement covers a wide range of UV and VIS, please review performance implications starting on page 6-99.

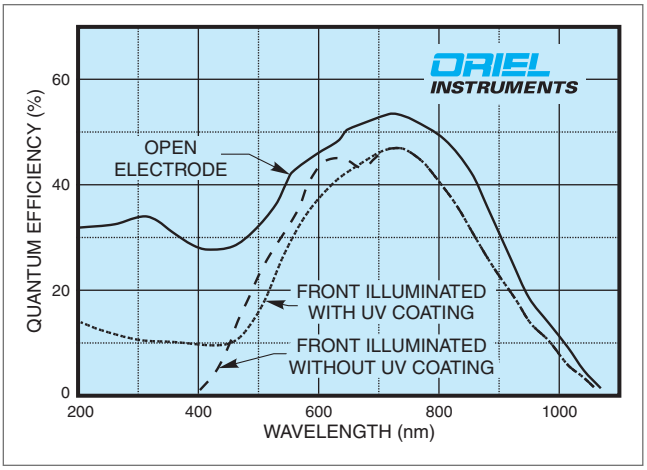


Fig. 3 Quantum efficiencies of various InstaSpec™ IV CCD sensors.

TECH NOTES

DARK CURRENT

InstaSpec™ IV CCDs control the exposure time to allow "on chip" integration. This is a powerful method of enhancing weak signals such as those encountered in Raman and weak luminescence measurements. However, due to dark current in the CCD, the exposure time cannot be increased arbitrarily; the limit is not the dark current itself but the shot noise associated with it. In any case, it is desirable to keep the dark current to a minimum. All CCDs have inherent dark current that can be reduced by Multi-Phase Pinned (MPP) operation and by cooling. Our InstaSpec™ IV CCDs use "Advanced MPP" CCD sensors. These provide the lowest dark currents of any devices available today, without the compromise in well depth which other devices exhibit.

COOLING

For low signal measurements, we offer CCDs cooled to -55 °C, achieved without traditional water or liquid nitrogen cooling. A new design and manufacturing process ensures that your detector maintains a vacuum and will not suffer from condensation effects. No additional windows, which degrade overall performance, are required to protect the CCD chip. Low temperature operations allow long exposure times for both imaging and spectroscopy applications. The hermetic seal is a unique and better design leading to a more compact and simple-to-use system. There is no need for dry gas flushing during operation or periodic pumping of the detector head.

FOR MAC USERS ...

For those with Macintosh Computers or GPIB Systems, we offer software (model 78112). The InstaSpec™ controller board (provided with the system) must be installed in a Windows™ `95 486 DX or higher, 32 MB CPU (not provided), and the 78112 Software installed. The software will then allow access to all National Instruments protocol. In addition, the PC host computer and master computer in your system must have NI GPIB boards installed. The master computer will then treat the InstaSpec™ host PC as a standard GPIB slaved device.

FAST KINETICS MODES

By illuminating only a small strip along the top of the CCD sensor and using the rest of it as a temporary storage area, spectral acquisition rates of up to ~6,000 spectra per second can be achieved in short bursts.

Alternatively, by illuminating only the bottom portion of the CCD sensor and reading out at maximum speed, sustained spectral acquisition rates up to ~800 spectra per second are possible. We call these modes of operation, Fast Kinetics. You illuminate only the needed part of the CCD sensor by using a Fast Kinetics Fiber Optic Adapter on an Oriel Imaging Spectrograph.

Fast Kinetics Adapters

Our Fast Kinetics Adapters let you do time resolved measurements of reactions in slices as short as 160 µs with any InstaSpec™ IV CCD. The adapter positions the input from a single fiber on the top portion of the CCD sensor, only. Once the spectrum is acquired, it is shifted down onto the dark portion of the sensor and temporarily stored on the CCD itself. Once the sensor is full, you can read each time slice and display it.

Alternatively, for support of sustained acquisition in fast kinetics, please contact an Applications Engineer.

MULTI-TRACK SPECTROSCOPY

With any InstaSpec™ IV CCD, an imaging spectrograph and a multi-track fiber optic, you can acquire multiple spectra simultaneously. This is called Multi-track Spectroscopy. The InstaSpec™ Software divides the CCD into tracks which are up to 1024 elements long. Each track corresponds to the output of an individual fiber. The number of tracks, track height and track position (binning scheme) are controlled from the software. Data from each track can then be displayed as either discreet spectra or a single image (in either grey scale or false color map).

We offer dual, 2, 3, 5 and 9 track fiber bundles on page 8-21. An imaging spectrograph is required and these are listed as the first four items in Table 2.

TECH NOTE

A WORD ON MAGNIFICATION

InstaSpec™ IV CCDs are 3.3 or 6.6 mm tall. If you are using our CCD on another manufacturer's spectrograph, take into account the magnification and aberrations of the spectrograph before choosing a multi-track fiber.

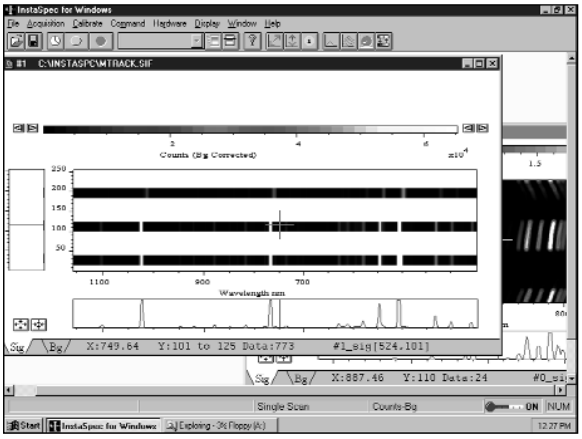


Fig. 4 Using a full resolution image to locate tracks and select appropriate binning pattern increases readout rates. Multiple independent spectra can be easily and quickly compared.

SPECTROGRAPHS

The table below summarizes the spectrographs best suited for InstaSpec™ IV CCDs. Throughput is high, stray light is negligible and imaging qualities are superior.

MOUNTING

A flange is required to mount an InstaSpec™ IV detector head to the output of some Oriel Spectrographs (see following page for appropriate flanges). To couple these detectors to other manufacturers' spectrographs, contact an Oriel Applications Engineer for special flanges.

SHUTTERS

You need a shutter with these CCDs unless you are operating in full vertical binning (FVB) mode. The shutter prevents image smearing as tracks are sequentially read out when performing multi-track spectroscopy or imaging, with CW sources. TTL signals to control the shutter are supplied by the CCD's controller card, and are accessed through the 76161 I/O Accessory.

The MS257™, MS260i™ FICS™ and MS127i™ Spectrographs have internal shutters. If you are using a spectrograph without shutter, choose from one of the shutter assemblies described on pages 6-132 and 6-134.

Table 2 Recommended Oriel Spectrographs for Use With InstaSpec™ IV CCDs

Spectrograph	F/#	Resolution (nm)	Array Bandpass (nm)	No. of Tracks Which can be Resolved	No. of Gratings Supported Simultaneously	Features	Detail Page
MS257™	F/3.9	0.25*	81*	9	4	Fully automated, two flat field output ports; excellent spatial and spectral resolution	4-32
MS260i™	F/3.9	0.30*	81*	9	3	Automatic grating interchange; more economical than MS257™	4-88
MS127i™	F/3.7	0.4*	165*	5	1	Good resolution, stray light and throughput, manual instrument	4-83
FICS™	F/2.1	2 or 3.5**	435, 610 430, 700**	5	1, fixed	Very compact, fixed grating instrument; ideal for OEM integration	4-74
MS125™	F/3.7	0.4*	168*	N/A	1	Excellent research instrument with small aspect ratio, for non-imaging applications	4-79

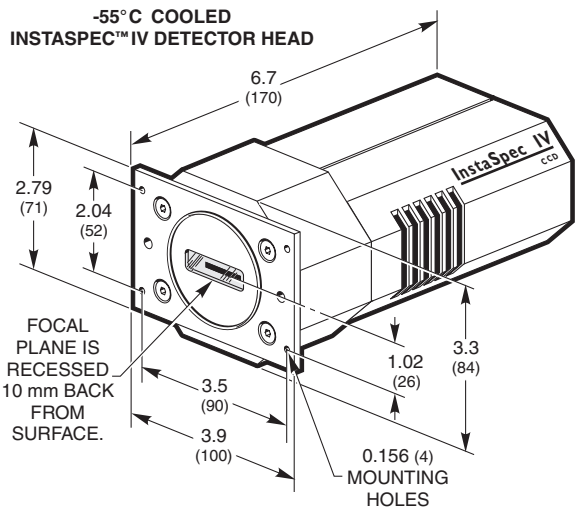
*** With 1200 l/mm grating blazed at 250 nm, 25 µm x 3 mm slit, and 26 x 26 µm pixel size array.**
**** Various models available.**

MULTIPLE I/O ACCESSORY

The 76161 connects directly to the CCD controller board and has seven BNC connectors. It facilitates communication between InstaSpec™ IV and external instruments such as shutters, pulsed sources, and any other device in your lab accepting or generating a TTL pulse.

COMMON SPECIFICATIONS

	Spectroscopy CCDs	Imaging CCDs
Pixel size:	26 x 26 µm	24 x 24 µm (512 x 512) 22 x 22 µm (385 x 578)
Read noise:	10 electrons	10 electrons
Dynamic range:	65,536:1	16,383:1 (512 x 512) 65,536:1 (385 x 578)
Computer requirements:	100 MHz Pentium in 386 enhanced mode, 16 MB RAM 4 MB disk space. Video: 256 colors, 800 x 600 or higher resolution.	100 MHz Pentium in 386 enhanced mode, 16 MB RAM 4 MB disk space Video: 256 colors 800 x 600 or higher resolution.



Dimensions in inches (mm)

Fig. 5 Dimensional diagram of InstaSpec™ IV CCD Detector Heads.

ORDERING INFORMATION

Mounting Flanges

For This Spectrograph	Model No.	Price
77700 MS257™	**77786**	
77702 MS257™	**77787**	
MS125™	**77439**	
MS260i™ (For axial port)	**Not Required**	
MS260i™ (For lateral port)	**77462**	
MS127i™	**Not Required**	
FICS™	**Not Required**	

Fast Kinetics Adapters

For This Spectrograph	Model No.	Price
MS257™	**77205**	
MS260i™, MS127i™, FICS™	**77504**	

Accessories

78452 InstaSpec™ IV DLLs
78112 GPIB Software
76161 Multiple I/O Accessory

InstaSpec™ IV CCD Systems

Detector Type	Sensor Type	Pixel Format (µ)	Readout Rate	Max. Spectra Rate* (Hz)	Max. Image Rate (Hz)	Min Temp (°C)	Dark Current (@ min. temp.)	Model No.	Price
Spectroscopy	Front Illuminated	1024 x 256	62 kHz	48	0.2	-55	<0.1 e^-/pixel/s	**78434**	
		1024 x 256	1 MHz	167	3.3	-55	<0.1 e^-/pixel/s	**78435**	
		1024 x 256	62 kHz	48	0.2	-40	<0.15 e^-/pixel/s	**78465**	
		1024 x 256	1 MHz	167	3.3	-40	<0.15 e^-/pixel/s	**78468**	
		1024 x 128	62 kHz	52	0.5	-40	<0.2 e^-/pixel/s	**78453**	
		1024 x 128	1 MHz	250	6	-40	<0.2 e^-/pixel/s	**78455**	
	Open Electrode	1024 x 256	62 kHz	48	0.2	-55	<0.1 e^-/pixel/s	**78436**	
		1024 x 256	1 MHz	167	3.3	-55	<0.1 e^-/pixel/s	**78437**	
		1024 x 256	62 kHz	48	0.2	-40	<0.15 e^-/pixel/s	**78466**	
		1024 x 256	1 MHz	167	3.3	-40	<0.15 e^-/pixel/s	**78469**	
	UV Coated	1024 x 128	62 kHz	52	0.5	-40	<0.2 e^-/pixel/s	**78451**	
		1024 x 128	1 MHz	250	6	-40	<0.2 e^-/pixel/s	**78454**	
		1024 x 256	62 kHz	48	0.2	-40	<0.15 e^-/pixel/s	**78464**	
		1024 x 256	1 MHz	167	3.3	-40	<0.15 e^-/pixel/s	**78467**	
Imaging	Front Illuminated	512 x 512	1 MHz	111	3.2	-55	<0.1 e^-/pixel/s	**78438**	
		385 x 578	1 MHz	100	3.5	-55	<0.75 e^-/pixel/s	**78439**	

*** Maximum spectra rate is the minimum exposure time plus the necessary delay between scans.**

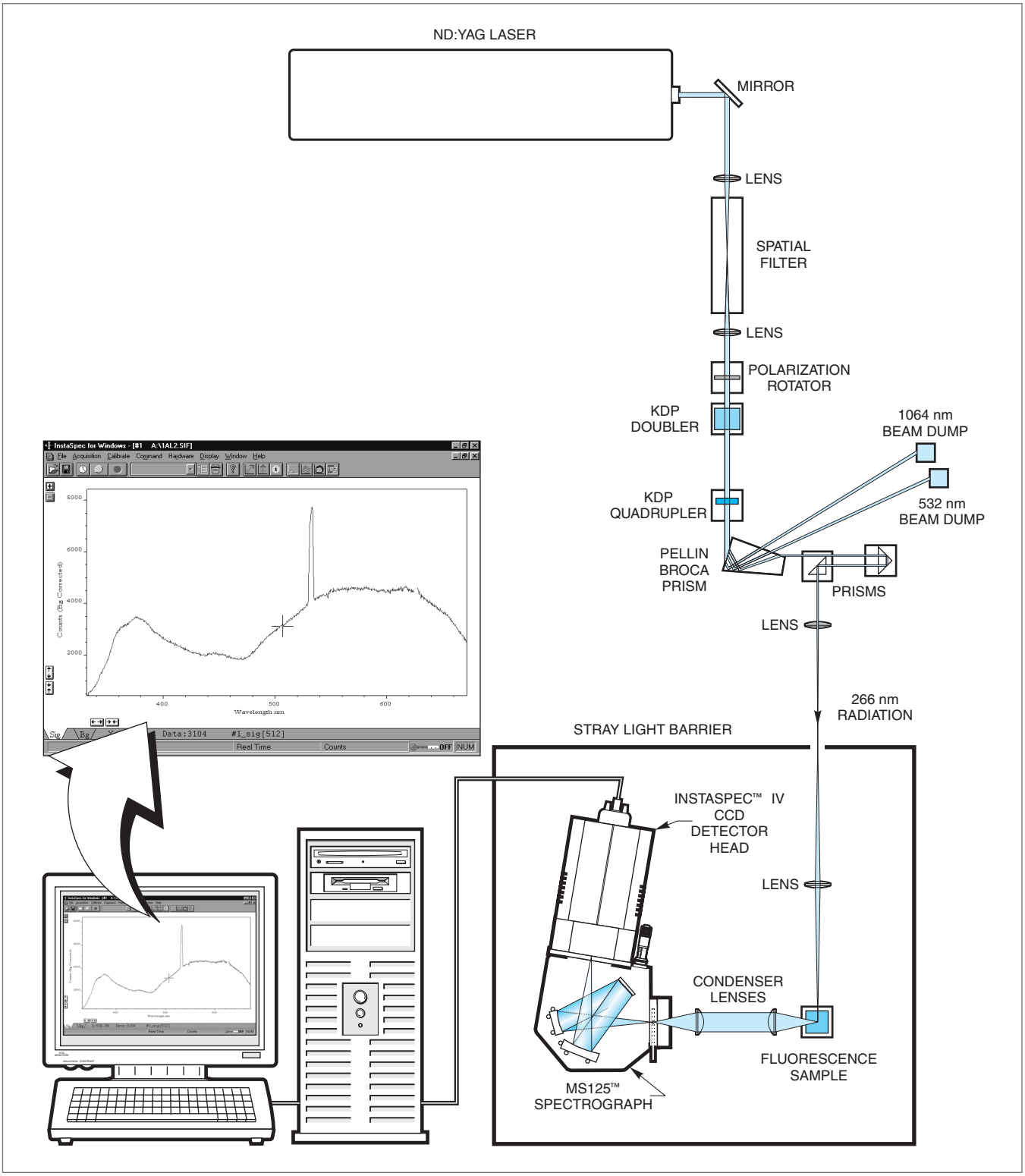


Fig. 6 Setup using an InstaSpec™ IV CCD and MS125™ 1/8 m Spectrograph to measure the emission from crystals under UV irradiation. This experiment tests for correlation between crystal emission and crystal damage thresholds in large fusion lasers. ***Data courtesy of Dr. Eugene Arthurs, Daniel Krause, and Jeffrey Bohn, Cleveland Crystals Inc., Cleveland, Ohio.***

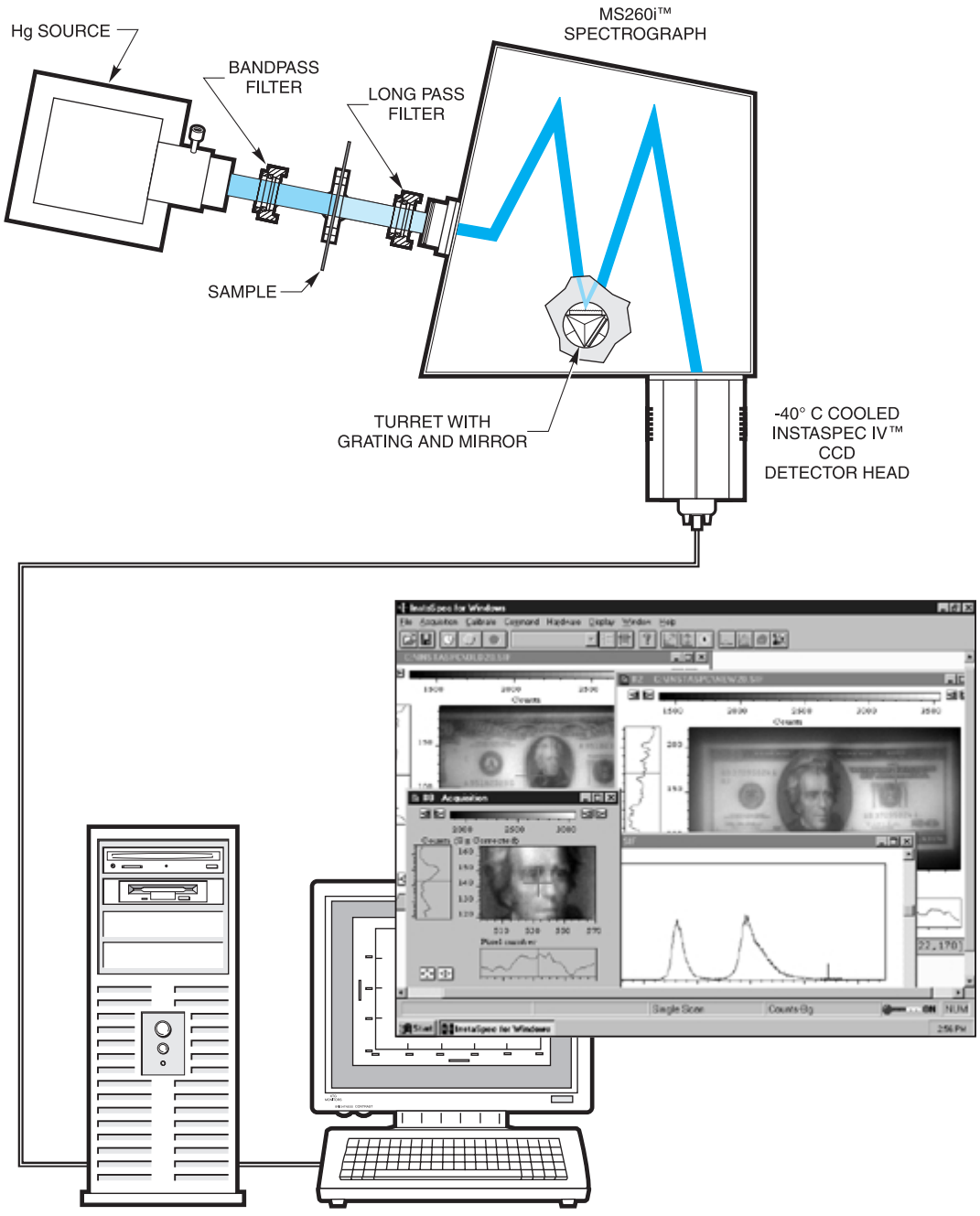


Fig. 7 UV source used to stimulate currency, yields a fluorescence spectrum. The long pass filter leaks the stimulation wavelength but attenuates sufficiently such that the dynamic range does not suffer. Data shown is overlaid fluorescent image and saved spectrum.