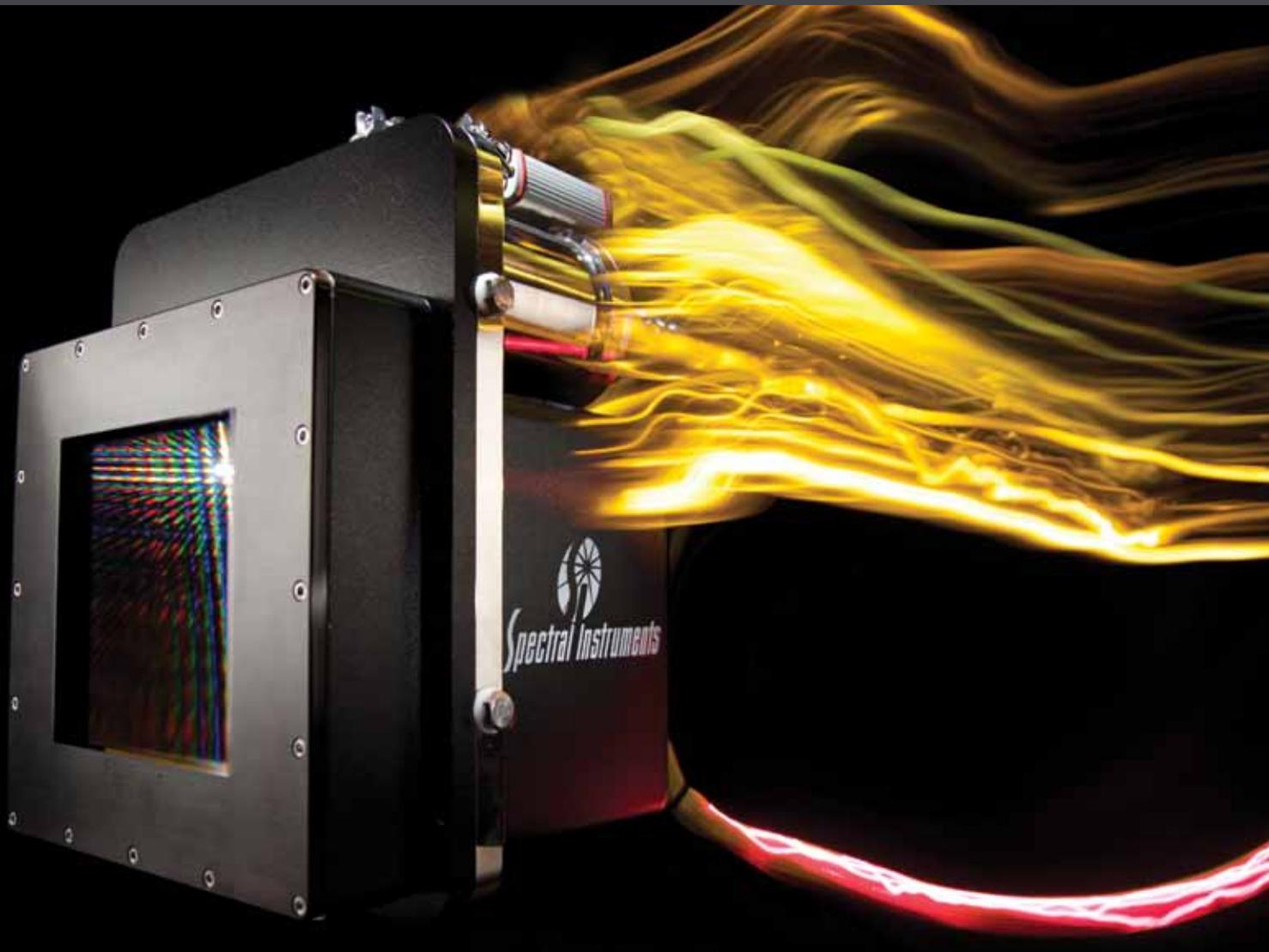




Scientific Cameras

A History of Innovation

Spectral Instruments has 20+ years' experience customizing the design of and manufacturing cameras for high end imaging applications. The design of each camera is configured and hand tuned to get the most out of that top of the line CCD appropriate for your application. Thermoelectric and cryo-cooling technology is utilized to lower the temperature of the CCD to remove dark current from your images -resulting in an optimal instrument for detecting low photon flux. No other company is as well positioned to offer a cost effective custom solution for your scientific imaging and OEM needs.

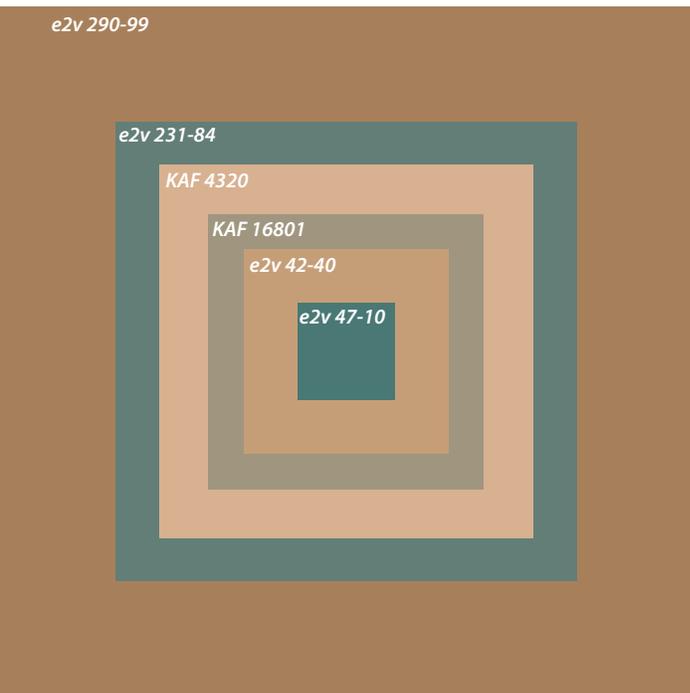


SI Cameras

SI produces a number of camera product lines each of which can be customized with all scientific CCDs available today. The advantage to doing business with SI is you can select a CCD which suits your application for merits such as pixel size, physical size, number of ports or speed. The next step in determining an ideal camera is to select the camera model based primarily on cooling depth required for your application or selected CCD. Contact SI directly for quotes.

CCDs

The CCDs shown on the following page are a list of the most commonly used sensors available in our cameras. This is not a complete list, and only serves as a starting point for a customer to begin a dialog with us to find their optimal solution. Theoretically any CCD available can be installed into our cameras.



*actual CCD size

Optical wavelength detection applications

Any CCD in this table will provide high performance for imaging visible light photons. The best sensitivity will be found with those CCDs which can be had with backside illumination (all those listed with BI as an option).

Near Infrared detection

All silicon based sensors have trouble with wavelengths longer than $1\mu\text{m}$, and one way CCD manufacturers have developed to get around this problem is to make the silicon thicker (thick epitaxial layer) and increase the absorption length for photons. CCDs with this feature are called 'Deep Depletion' devices (DD in our table) and are always found back illuminated. The process used to manufacture these devices requires them to be made as 'non-MPP' devices and thus have a large amount of dark current. SI has only installed these deep depletion devices into our coldest TE cameras (850S) or our cryo cameras (1110S) and we recommend this to prevent dark current from becoming a problem in your imaging.

UV detection

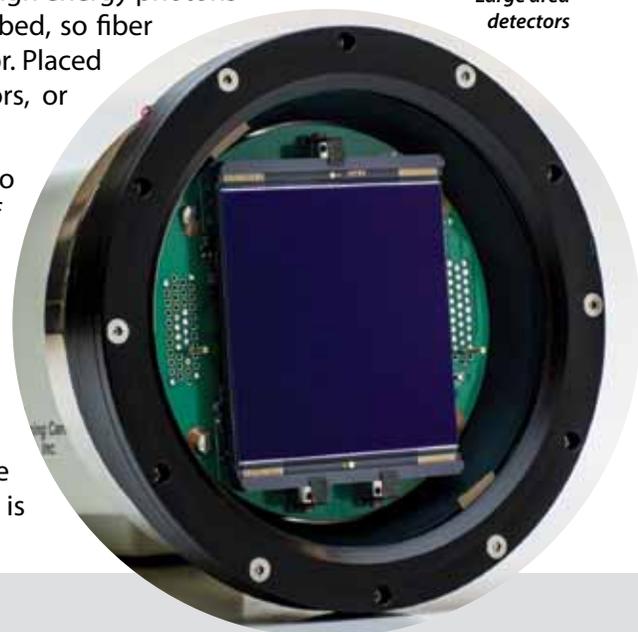
When applicable, SI can coat your sensor with a phosphor to 'down convert' your UV photons (down to 100nm) into visible light at the CCD. Talk with SI to find out if this strategy is right for your application.

High energy detection

SI has specialized in these cameras for many years by offering customized CCDs with no AR coating as well to bond fiber optics directly to the CCD itself. Some high energy photons and particles will permanently damage CCDs when they are absorbed, so fiber optics are used to prevent the absorption of this energy in the sensor. Placed at the interface of the fiber optic are down converting phosphors, or scintillators to create visible light detectible by the sensor directly.

- *Fiber optics* – tapers or faceplates are bound directly to the CCD to absorb damaging radiation in the glass rather than the CCD. One of our key innovations is in providing deeply cooled sensors bonded to fiber optics with little to no sacrifice in imaging resolution. Photon energy greater than 10keV is best suited to a camera with a phosphor or scintillator at the input to a fiber optic.
- *Direct detection* – energies less than 1keV are typically suited to backside CCDs with no AR coating and can also be used up to 10keV . Frontside CCDs are better suited for 1keV to 10keV , although damage to either type of CCDs occurs at all energies higher than 1keV so it is always best to use a fiber optic if possible.

Large area detectors



Industry Leaders

CCDs

Name	Ports	Pixel Size (µm)	Vertical	Horizontal	Megapixels	Size V (mm)	Size H (mm)	Cooling	Optimized for	Options
e2v 290-99	16	10	9232	9216	85	92.32	92.16	Cryo	MS	PG, BI, DD
e2v 231-C6	4	15	6160	6144	37.8	92.4	92.2	Cryo	MS	PG, BI, DD
e2v 231-84	4	15	4112	4096	16.8	61.7	61.4	Cryo	MS	PG, BI, DD
STA 1600	16	9	10580	10560	111.7	95.2	95.1	Cryo, TE	MS	PG, BI, DD
STA 4150	4	15	4096	4096	16.8	61.4	61.4	Cryo, TE	MS	PG, BI, DD
e2v 230-84	4	15	4112	4096	16.8	61.7	61.4	Cryo, TE	HS	BI, DD
KAF 16801	1	9	4096	4096	16.8	36.88	36.88	TE	HS	
STA 3700	16	16	1920	1920	3.7	30.7	30.7	Cryo, TE	HS	SpTr
KAF 4320	4	24	2085	2084	4.3	50	50	TE	HS	
e2v 231-42	4	15	2064	2048	4.2	31	30.7	Cryo	MS	PG, BI, DD
e2v 230-42	4	15	2064	2048	4.2	31	30.7	Cryo, TE	HS	BI, DD
e2v 42-40	2	13.5	2048	2048	4.2	27.6	27.6	Cryo, TE	MS	BI, DD
e2v 47-20	2	13	1024	1024	1	13.3	13.3	Cryo, TE	HS	BI, DD, FTr
e2v 47-10	2	13	1024	1024	1	13.3	13.3	Cryo, TE	HS	BI, DD



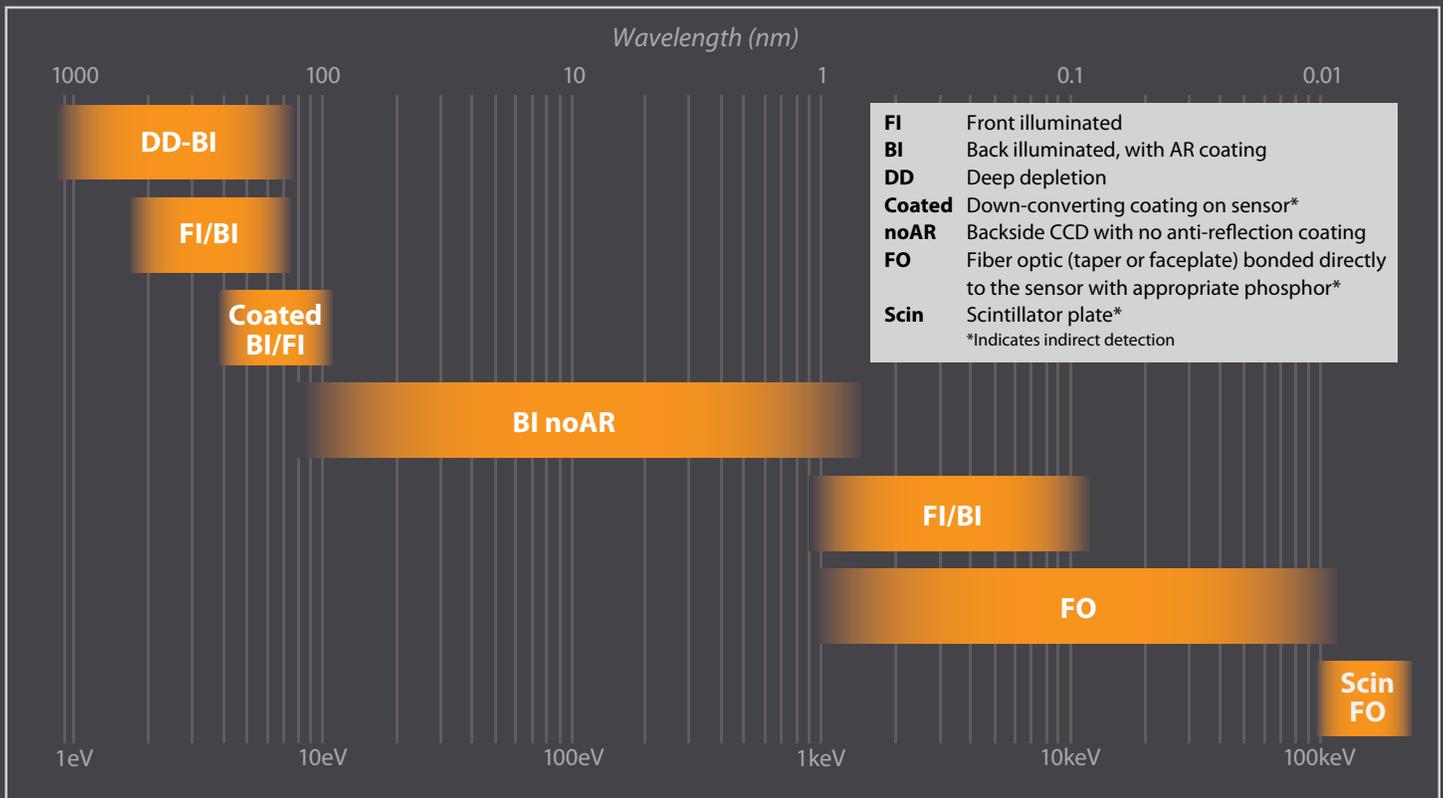
PG Package options, see SI
BI Back-illuminated CCDs with custom AR coating
DD Deep depletion silicon available
SpTr Split frame transfer CCD
FTr Frame transfer CCD
MS Mid speed
HS High speed

Camera table

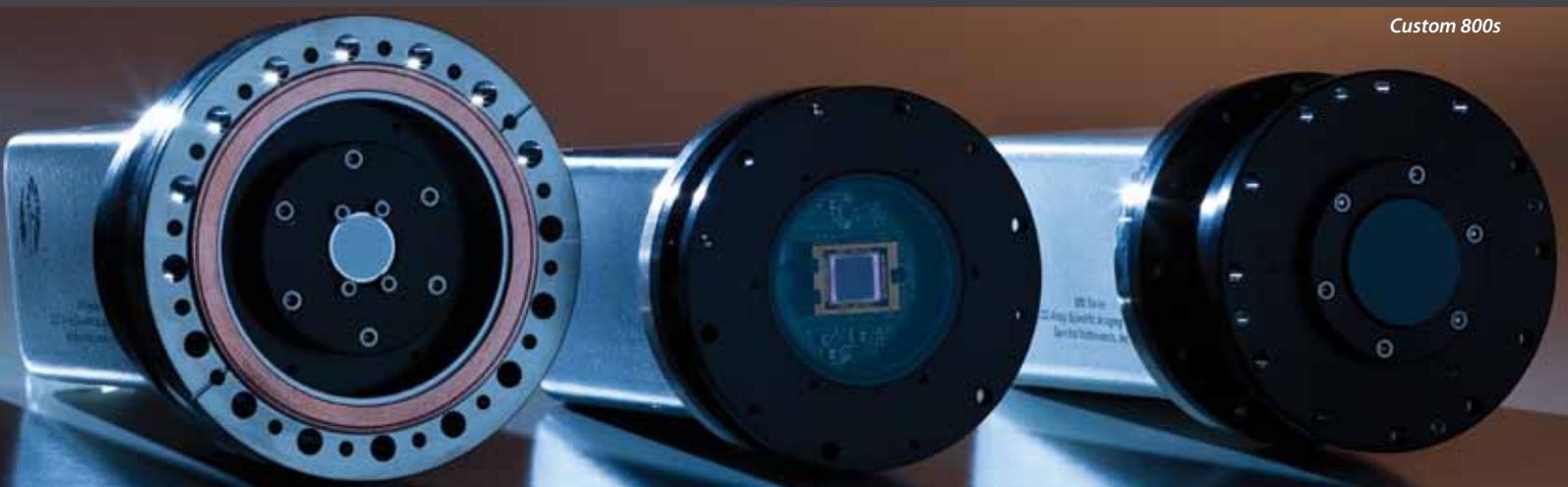
SI Model	Cooling	Max Cooling °C	Typical Sensor Size	Interface	Max Ports
1110	Cryo	-110	XL-M	F, CL, E	16
1100	TE	-60	XL-M	F, CL, E*	4
850	TE	-90	L-S	F, E*	2
800	TE	-40	L-S	F, E*	4
1000	TE	-40	M-S	F, E*	1
900	Cryo	-110	XL-L	F	>16
1200	TE*	-30	M-S	F, E	2

XL 70+mm
L 50-70mm
M 20-50mm
S <20mm
F Proprietary FO
CL Camera link
E Native Ethernet
E* Ethernet with adapter
TE Thermoelectric water cooled
Cryo Cryotiger
TE* Thermoelectric air cooled





The table above demonstrates the energy and wavelength ranges best suited for each type of imaging solution offered by SI. All of our cameras can be configured for any of these ranges.



OEM capabilities

SI offers an unprecedented flexibility that our competitors do not. A precisely designed, manufactured and tuned camera from SI will give you an edge over your competition you cannot obtain anywhere else. No other company can provide this design capability at the low cost we can offer. Please contact us to see how our prompt support, leading edge design, and manufacturing capabilities can push your product development to new heights in performance and profitability.

New sensor development

Even as CMOS seems to be the "future" of high performance imaging, there are many other imaging domains and Spectral Instruments is actively pursuing those having satisfactory performance parameters for a variety of applications. From high-energy to very low as in X-Ray to Infra-red Spectral has on-going sensor research and development as a major company focus.