Frequently Asked Questions and Answers

Cathodoluminescence Products

MonoCL3 including XiCLone
PanaCL
MiniCL
Cold Stages
(updated Dec02)

Questions and Answers

Question	Answer
What is cathodoluminescence	Cathodoluminescence (CL) is the light emitted by specimens as a result of electron bombardment in the approximate wavelength range 160-2000nm. 400-800nm is the visible regime. Wavelengths shorter than this are in the UV, and longer than this in the infra red. CL is emitted from a generation volume after any optical absorption and internal reflection processes have taken place. It is only one of the processes by which the energy of the interaction is dissipated. X rays are much higher energy and of a characteristic value which provides a finger print of the elements present. CL is associated with much lower energy transitions. For this reason, CL is not governed by elements present and is not used as an elemental analysis technique. Rather CL is governed by other factors such as physical chemistry, opto-electronic properties, temperature, crystal structure, strain etc.
Will my specimens give CL?	It is quite possible! A great many non metallic specimens give CL.
Is CL possible using equipment other than electron microscopes.	Yes, using optical microscopes with electron flood gun attachments. However, Gatan does not make equipment for flood gun based systems. These are usually dedicated to taking colour pictures of geological specimens, and are normally much less sensitive and lower resolution than than scanning EMs using equipment from Gatan.
Will a simple diode in the microscope detect CL	It is possible, but the sensitivity is usually extremely low so that imaging results can only be achieved with very bright specimens, and high injection conditions. Futhermore, spectroscopy is not possible. CL has progressed as an advanced imaging and spectroscopic technique due to high signal collection and the sensitivity of detectors in CL systems from Gatan.
Doesn't Oxford Instruments manufacture MonoCL and CL systems.	The whole cathodoluminescence product range (+ cryogenic/hot/tensile stages, cryotransfer system and TEM holders) and the support of installed products was taken over by Gatan in 2000. This product range continues to be developed, manufactured and supported by GatanUK.
What is MonoCL3?	MonoCL3 is the third generation, premium cathodoluminescence system for high resolution imaging and spectroscopy. With adequate port access, it is suitable for all SEMs, most microprobes, and some TEMs. With MonoCL3 cathodoluminescence is collected, dispersed (if chosen), and detected in the form of images and spectra in a highly efficient and user friendly way.
What is MonoCL3+	MonoCL3+ is includes Digiscan digital beam control together with a Peltier cooled High Sensitivity PMT as standard.
What is ParaCL	ParaCL is an option for MonoCL3 (+). Standard MonoCL3 functionality gives panchromatic and monochromatic imaging and spectroscopy in serial mode. ParaCL provides the option of fast CL spectroscopy in parallel using a CCD camera.
What is XiCLone	XiCLone is an option for MonoCL3 that gives spectrum imaging, i.e. the full spectral data set at every pixel position. XiCLone is a new premium product based on the combination of MonoCL3, ParaCL, Digiscan, and Spectrum Imaging Software. The software shows a CL image from any chosen wavelength or band pass of wavelengths, but due to the time required for a large pixel density data map, the CCD does not replace the PMT for imaging, or the serial spectral acquisition functionality

	which is standard on MonoCL3 systems.
What is PanaCL?	PanaCL uses the same high efficiency collection and multiple detector options as MonoCL3 , but the light is not dispersed. As there is no integral monochromator, CL images are acquired with no need for software computer control or photon counting electronics. PanaCL is a CL system, rather than just collection optics. CL is focused onto a photomultiplier tube, or alternative detector, and a desktop controller is used to control the detector, and signal amplification for imaging. Like MonoCL3, PanaCL is suitable for all SEMs, most microprobes, and some TEMs. PanaCLF allows optically filtered light to be imaged.
What is MiniCL?	MiniCL is a cost effective entry level CL detector. There is no collection optics, but the high sensitivity photomultiplier tube can be inserted close to the specimen, ensuring good performance, with the added benefit of excellent low magnification use.
Can you supply a MiniCL to work over different wavelength regimes, or band pass facility.	Sorry, no. The MiniCL is an entry level, cost effective CL solution. For more advanced CL imaging applications please consider the PanaCL or MonoCL3.
Will the equipment fit on my microscope.	If you (or the vendor) provide us with full details of your microscope, or the one you intend to purchase, together with details of all other detectors installed or to be installed, then we can help make that decision. MonoCL3 and PanaCL systems require a free port close to the level of the pole piece. MiniCL requires either a similar port, or one at a higher elevation in the chamber. If these ports are occupied then it still may be possible by relocating some detectors. It is important that we receive such information, otherwise we cannot accept the order. Furthermore manufacture cannot start until correct information is received.
This will be a general purpose microscope. Will this cause problems.	For standard CL systems this should not be a problem. The standard retraction distance of MonoCL3/PanaCL system is 75mm. For MonoCL3, an LED indicates whether the mirror is in place, or fully retracted. This doesn’t exist on PanaCL or MiniCL systems. For MonoCL3 and PanaCL systems, the mirror can be detached, so there is no protusion into the chamber. There is an option for extended retraction (~165mm) for microscopes with large chambers where venting the microscope to detach the mirror for high tilt operation is not favoured. This is offered for a premium. The MonoCL3/PanaCL should not cause any degradation in normal SEM performance, and this is checked at installation. Chamberscopes are perhaps the best way of ensuring safety with multi user microscopes. The CF302 liquid Helium cold stage will not affect general usage, because this stage and front door is swapped for the SEM stage when CL experiments are performed. For CF302M helium module, and C1000 series liquid nitrogen cold modules, some work may be required to restore the microscope back to standard microscopy with the default SEM specimen holder. Alternatively, microscopy can be performed using the modules as default specimen holders, in which case Gatan dovetail specimens are required.
What is the purpose of CL spectroscopy?	For some users, CL spectroscopy is the “icing on the cake” whilst for others, it is key information. CL is light emitted by (non-metallic) specimens in the wavelength regime

	160-2000nm. CL is not analogous to EDS or PEELs because in most cases it doesn't provide quantitative elemental information. Rather CL is determined by chemistry, crystal structure and defects, opto-electronic, strain and tempertature effects. Hence, an understanding of the nature of the CL emission via spectroscopy, together with imaging distribution is often very important.
Do I get a spectrum from every pixel in the image?	This is now possible with the XiCLone product. The XiCLone software is extremely powerful and can be used to display any chosen wavelength, band pass, or retrieve the spectrum from any point or area on the specimen. It is possible to upgrade XiCLone from MonoCL2 or MonoCL3 systems. Standard MonoCL3 functionality provides serial spectroscopy only. The ParaCL product can be used to obtain fast CL spectrum from chosen positions but this information does not form an image. As PanaCL and MiniCL are imaging only product there is no spectroscopy.
Can I integrate my own monochromator with Gatan's CL systems?	Sorry, but this is not possible. MonoCL3 and PanaCL are sold as CL systems, rather than components. With a CL system as a product, Gatan or your vendor takes responsibility for the system working. This is not possible with components. The other reason is that the direct optical coupling to the chamber mounted monochromator is key to the MonoCL3. Other forms of coupling are very inefficient Gatan wants to be associated with premium performance products. It is also not possible to integrate our monochromator with any other collection optics system.
MonoCL3 has "panchromatic" and "monochromatic" modes. Please explain.	MonoCL3 employs high performance mirrors to direct the emission along different light paths. In panchromatic mode, all the light is directed at the detector. This is the same configuration as using a PanaCL system. This allows the combined intensity of all CL wavelengths within the response of the detector to be imaged. In monochromatic mode, all the light is coupled into the monochromator. Monochromatic mode is used for recorded photon counting spectra in serial mode , for imaging with just one wavelength bandpass, or for spectroscopy and imaging in parallel mode with the ParaCL and XiCLone options.
What is the difference between MonoCL3 and MonoCL2	MonoCL2 has been a world leading product in this field for many years. Its main strengths have been optical performance and reliability in the field. MonoCL3 runs on the Digital Micrograph platform and is fully integrated into the Gatan Microscopy suite. The changes in MonoCL3 have been requested by customers, service and microscope manufacturers. They have focused on enhanced user friendliness, optical and electron optical performance, auto-calibration, sensitivity of detectors, and enhanced configuration opportunities for your application. The MRU is standard on MonoCL3. The XiCLone and ParaCL products are options for MonoCL3 systems only, so any upgrade to these products will require upgrading to the Digital Micrograph platform (MonoCL2UP).
Can you explain the auto-calibration features of MonoCL3	No user input is required in terms of software configuration other than starting the software. Once the software is started the system autocalibrates. The calibration parameters are defined at the testing stage and may be installed at test or installation.

How accurate is the spectral calibration?	This depends on the dispersion of the grating chosen. The calibration is accurate to the resolution at which the spectral lines correction calibration is performed (at testing). This is typically a fraction of a nm for a standard dispersion grating. The spectral calibration should not be confused with the spectral response, (quantum efficiency as a function of wavelength).
Can I check the spectral calibration?	An in-line spectral lamp is now available for checking the spectral calibration without venting the SEM chamber. This lamp is an option on MonoCL3 systems, but is included as standard on ParaCL and XiCLone systems. The in-line spectral lamp produces very sharp emission lines at know positions and is inserted into a replacement lower back panel. When not in use, this is removed and a light tight plug is put in place. For systems without an in line spectral calibration lamp, a spectrum can be recorded either from overhead fluorescent lamps, (which produce sharp lines in similar positions to the in line lamp) when the chamber is vented and the mirror inserted. Alternatively a mercury, or other lamp with sharp known emission lines can be employed.
Is the spectral response calibrated?	The spectral response for all MonoCL3 products are not quantified as standard. The software provides a simple routine for applying spectral response correction curves for different detectors and blaze gratings but these are provided as a first order approximation only. At the extremity of these curves, errors can be larger. A quantitative spectral response will only be measured at time of manufacture and is an additionally quoted option.
How do I know I'm getting the best performance?	The critical alignment is carried out in the factory at testing prior to shipping. This is checked again at installation. The CL working distance is discussed at the enquiry stage. A shorter working distance is normally preferred for FE SEM, and may be essential due to space limitations in microprobes. After installation, the one critical aspect which the user needs to understand is the working distance of the specimen with respect to the CL mirror. The collection efficiency of the mirror is strongly dependent on the relative position of the sample, (1mm below bottom surface). Longer working distances than this may give better low magnification performance with more uniform, but lower collection efficiency. However, for high resolution spectroscopy purposes where the top performance is required, then then the working distance needs to be accurate. For some specimens, this can be judged by imaging the signal in monochromatic mode at the wavelength of a peak emission, or zero order. Alternatively, it is possible to use a predetermined working distance read from the microscope, or stage controls, or to use a chamber scope.
What are the slits for?	These are the entrance and exit slits of the monochromator. They do not affect the central wavelength chosen λ, but only $\Delta\lambda$, the width of the bandpass and hence the amount of light coupled through the system. The optical coupling of MonoCL3 is precisely designed so that the maximum amount of light can be coupled with narrow slits. This ensures high signal to noise ratio, even with high spectral resolution settings, thus restricting uneccesary electron beam injection conditions.
What is the spectral resolution?	The spectral resolution ($\sim\Delta\lambda$) is determined by the grating choice and the chosen slit width. The best way to understand this is to consider the simple dispersion equation. $\Delta\lambda$ (nm per mm slit width)=1.8 x 1800 / dispersion (l/mm). A standard 1200l/mm grating therefore gives 1.2nm resolution with 0.5mm slit widths. A high dispersion grating gives high spectral resolution (low $\Delta\lambda$), and a low dispersion

	grating, low spectral resolution. However, the slits can always be narrowed using the micrometer screws giving higher resolution. Thus for many applications, the highest possible dispersion is not always the most flexible. When using the CCD camera (where the pixel size is predetermined), the spectral resolution depends on the width of the entrance slit and the dispersion of the grating. For high spectral resolution results a high dispersion grating should be used. A low dispersion grating is supplied as standard with a CCD camera to give a wide spectral coverage with medium spectral resolution.
Are there any different types of focal length monochromator?	Sorry, no. The chamber mounted monochromator is standard at F4.2 and 300mm focal length. The optical coupling, micrometer slits, wide choice of gratings, and sensitive detectors ensure that CL microscopists are not limited by the spectral resolution. Experiments have shown that a bench top high dispersion monochromator gives worse performance due to the light lost. A CCD camera will normally give a higher spectral response, but this is limited to the sensitivity range of the CCD, 200-1100nm. Furthermore, for semiconductor applications, a specimen temperature of much less than 5K would be required before the MonoCL3 system could not satisfy the spectral dispersion.
Is there a high resolution monochromator option which gives a smaller minimum step size?	This is not a standard product.
The MonoCL3 brochure mentions filter housing and filters. Is this necessary if there is already a monochromator?	The filter housing / filters are an option on MonoCL3. They are more commonly supplied with the PanaCL system (as PanaCLF) in which case their use is more obvious. The filter housing is located between the exit of the MonoCL, and the detector. The filter housing takes standard optical filters and has four positions. The main application is for users who wish to have a wider bandpass than that offered by the standard MonoCL3 functionality, e.g. sample blue light, or only light less than 500nm, rather than a narrow band pass of +-1-30nm. The filter housing takes standard circular 1inch diameter filters.
What is the parabolloidal mirror for?	The parabolloidal mirror is a key component to the MonoCL3 and PanaCL systems. It is a true precision piece of optical equipment, being diamond turned out of a piece of aluminium. It is not coated. The precision of the turning ensures its optical performance. The mirror has a hole directly above the focal point of the mirror for the electron beam. When the specimen is at the focal point, CL generated by the specimen is collected in a very efficient manner and collimated along one axis of the mirror, at right angles to the incident electron beam. The mirror is earthed to the SEM chamber to ensure no charging occurs. With MonoCL3 and PanaCL there are several versions of the mirror, standard, multi signal, and TEM. The multi signal mirror is an optional extra and is recommended for geological applications where simultaneous CL, BS, SE, and X ray microanalysis may be required. The TEM mirror is suitable for widegap STEM polepieces, or for SEM applications where a very short working distance is required. With the TEM mirror the field of view and spectral resolution may be limited compared to the standard mirror.

What is the collection efficiency?	Extensive modelling and tests have been carried out to show that the precise off-axis, diamond turned Al parabolloidal mirror is the best and most efficient collection method for CL. This is due to the angle subtended by the mirror, the optical perfection and high reflectivity of Al, the nature of the focal point, and the collimation of the exit beam. Furthermore, this design ensures optimum coupling of the light through the monochromator to the detectors. There is little benefit in designing a mirror to collect the maximum amount of light, if little of it reaches the detectors. CL collection losses are due to light which escapes up the electron beam hole, a necessary feature! For a true lambertian source (CL from flat surface), the 1mm diameter hole in the standard mirror leads to ~20% losses. Any calculation or estimation which avoid this fact is misleading.
What are the advantages of the multi-signal mirror?	The multi-signal mirror is optional, and supplied in addition to the standard mirror. There is no multi-signal short working distance option. The multi-signal mirror has the front section cut away. This sacrifices some of the CL collection, but this collection efficiency still remains relatively high, e.g. 40%. The cut away section allows other signals to be detected simultaneously without moving the mirror, e.g. enhanced SE, BS, and EDS. EDS requires the detector to be facing the CL mirror. The multi-signal mirror is coated to avoid spurious Al X ray signals interfering with the micro-analysis. Please note, quantitative X ray microanalysis is not possible.
What is the spectral transmission of MonoCL3 and PanaCL?	The collection optics, mirrors, and fused silica lenses have little deviation from uniformity over the detection range of the detectors. The spectral transmission is therefore determined primarily by the blaze of the grating, whilst the spectral detection is determined by the spectral sensitivity of the detectors. For users wishing to further reduce any atmospheric absoprtion losses a nitrogen gas purge option is available for the MonoCL3. For customers wishing to perform CL into the far IR, CaF lenses and windows are available as options.
Please explain the rectraction mechanisms of the CL systems.	MonoCL3 and PanaCL share the same sophisticated retraction mechanism. The chamber vacuum extends inside this mechanism, and this, together with the interface flange is Helium leak tested to a high vacuum in the factory. The retraction mechanism is housed in the MonoCL3 or PanaCL body. This whole body together with the collection optics has fine Y and Z adjustment on a sliding seal with respect to the chamber. The retraction mechanism provides the required precision movement required to repeatedly move the mirror in and out of the correct position without further adjustment. MonoCL3 and PanaCL are suitable for the high vacuum environment of FE SEMs. In contrast, MiniCL is a simple sliding seal. The MiniCL is only suitable for FE SEMs if precautions are taken to isolate the column vacuum prior to insertion or retraction. The rectaction distance is either 75mm or 165mm from the pole piece. The retraction mechanism is different for TEM CL systems and MonoCL3 systems for UHV chambers employs bellows. The retraction distance can normally be engineered to suit the requirement. Both the standard and extended retraction mechanisms on the MonoCL3 system have an LED indicator which changes from red to green when the mirror is fully retracted
What is the light guide for?	The light guide is attached to the retraction mechanism and holds the parabolloidal mirror in place. When the specimen is correctly positioned at the CL working distance, the light is collimated and is therefore not “guided”. When the specimen is not at the

	working distance the light guide increases transmission in panchromatic mode.
Why are the lights guides detachable?	The light guide which hold the parabolloidal mirror beneath the pole piece is detachable as standard on MonoCL3 / PanaCL systems. This detachment may be required for large chamber microscopes where 75mm retraction does not allow full tilt operation of the stage. In addition, this allows the user to quickly remove the mirror on venting the microscope, for example for safe keeping, or to exchange the mirror with another from Gatan's range.
If the mirror gets dirty. Can I clean it?	The inside hole of the mirror should be free from any particles, as these can cause astigmatism. If any debris exists, this can normally be cleaned with pressurized gas, passing a thread through the hole. Long periods of use, at high beam currents, or in oily vacuums can lead to yellowing of the mirror as hydrocarbons are cracked and deposited on the surface. This leads to reduced performance, and possible charging effects. It is not possible to clean such mirrors back to their original state, and it is recommended a replacement is purchased.
What maintenance is required?	The MonoCL3 system is designed to be very low maintenance. This also applies to the PanaCL / MiniCL systems. With MonoCL3, the calibration does not change as a function of time, and the electronics are normally very stable. The PMTs are protected from exposure to very bright lights, especially because the trip mechanism activates when too much light is sensed. The internal optics do not require cleaning or maintenance, and this should not be attempted. The most common source of problems are associated with users altering the configuration of the computer system, installing new software or hardware not associated with the MonoCL3 system. The PMT cooler has a limited lifetime and it is best to turn this off when not in use. The Ge detector requires occaisional pumping out to a high vacuum. With a CF302 or CF302M, the Helium transfer arm may also requires occaisional pumping out to a high vacuum. MonoCL3 is generally very reliable. Extended warranty, and formal service contracts are available on request.
Do I have to work with the lights off?	Cathodoluminescence systems from Gatan are light tight and room lights should not make any difference.
What about interference from other signals?	The CL systems will detect light from IR chamber scopes and these should be turned off. It is also possible that a MiniCL system or MonoCL3/PanaCL with a multi signal mirror will detect light from the luminescence of an Everhart-Thornley SE detector, or from an EBSP phosphor screen. For light from an SE detector, the CL image may have some SE component to it. Some users find this an added benefit. With a MiniCL this can be avoided using a collection hood or alternatively removing the bias voltage from the SE detector.
Can I get a MonoCL3 / PanaCL / cold stage for my UHV microscope.	We would like to hear from you to discuss this request as special design engineering work will be required to provide a system to satisfy your needs. The PanaCL or MonoCL3 system can be engineered to be UHV compatible. In such cases the monochromator and detectors are dismounted from the light guide and bellows to allow bake out.
Can the monochromator take three gratings?	Sorry, no. The MonoCL3 system is designed to take a maximum of two gratings at a time on a turrent. It is possible to change between more than two gratings by removing the back

	cover. However, with this procedure, some care needs to be excercised regarding the calibration. If more than 2 gratings are specified at time of purchase, then the other gratings can be calibrated to a first approximation at time of installation.
Will my CL system detect Back Scattered electrons.	No back scattered electrons are detected using any CL system from Gatan. The MSM option will allow detection of BSE by a suitable detector.
Do I need specimen cooling?	Quite often the answer is yes, and Gatan can supply a range of cryogenic cooling options. However, the answer really depends on your application, as well as budget. Specimen cooling increases spectral discrimination and provides more meaning to the physics of the light emission processes when semiconductor specimens are cold. Some direct band gap semiconductors give adequate CL at room temperature. However, the information that is contained in the CL emission may be blurred by thermal processes. Also, certain transitions may not be activated at low injection conditions unless the specimen is cold. This can be critical in achieving the mix of spatial resolution and spectral resolution from your sample. For most specimens, Helium cooling is preferable, but nitrogen can be adequate. For indirect band gap semiconductors, Helium cooling is usually essential. Some geological materials also give enhanced CL emission by an order of magnitude when the specimen is cooled to ~-100C. Liquid Helium cooling is not applicable. Other geological specimens, and ceramics materials where the luminescence is due to trace amounts of rare earth impurities, the temperature makes no difference and cooling is not required. The Helium cold stage and cold module product range has recently been upgraded to allow the use of liquid nitrogen as a cryogen. This is the most cost effective way of proceeding as one cold stage or module can be used to achieve liquid helium or liquid nitrogen temperatures with very little alteration to the configuration. The product is called CF302DF and all existing CF302 and CF302M systems are upgradeable.
Is there a manual?	The MonoCL3 product manual covers the equipment, principals of operation, and explains what happens during testing and installation. There is a separate manual for the software operation.
Which computer platforms are suitable?	MonoCL3 software is designed for Windows 2000 on a PC only. The product is not available on a Macintosh computer. MonoCL3 uses only serial A / COM1 using RS232 communication protocol. The standard product is supplied with a computer flat screen LCD monitor. It is possible to run standard MonoCL3 from another computer (if Windows 2000 and COM1 s free) although any negotiations concerning a discount for Gatan not supplying a computer need to take place before the order is placed. ParaCL requires a free PCI slot. Digiscan employs a PCI based firewire card. XiCLone computers are supplied by Gatan with extra RAM for enhanced performance with large data sets.
What is involved in a MonoCL2UP?	MonoCL2UP gives MonoCL3 functionality* on Digital Micrograph, and provides an upgrade platform to a modern ParaCL and XiCLone system but using some of the existing hardware of the MonoCL2 system. This is a cost effective route. The missing functionality includes the LED status of the retraction mechanism. Also please note the MonoCL2 systems were sold when the group was part of Oxford Instruments and hence the system may have been incorporated into the Link ISIS Digital Beam control platform. The MonoCL2UP route loses this integration and Digital Micrograph runs from a new PC with no communication with an Oxford Instruments

	program. If new Gatan Digital Beam control is desired, this should be purchased additionally and is not included in the standard MonoCL2UP package.
Which parts of a MonoCL (first generation) or MonoCL2 system can I upgrade to a MonoCL3?	Unfortunately very little of a MonoCL1 generation system can be recycled. The upgrade path MonoCL2UP to give MonoCL3 functionality and software is only suitable for MonoCL2 era systems. This requires dialogue with GatanUK.
Do I need an HSPMT?	The Peltier cooled HSPMT provides exceptional performance due to the higher quantum efficiency, spectral range (165-930nm), and superior signal to noise. The HSPMT is recommended for work using FE SEMs, and other applications where high performance in this spectral regime is required, e.g. for low injection conditions. The HSPMT is supplied with an integral low noise pre-amplifier. The power supply for the Peltier cooler has intelligent temperature and shuts down automatically with visual warnings if the water coolant supply is insufficient. One alternative to the HSPMT is the ERPMT. This provides a slightly lower spectral response, but covers a wider spectral regime of 250-1060nm.
Which is better for Infra Red CL, the IRPMT or the Ge detector?	There is no simple answer as both have strong points. Ge detector is sensitive, gives good signal to noise with spectroscopy using a lock-in amplifier, and has a wide spectral range extending to 1800nm. Also, it is easier to cool, a single dewar fill lasts several hours. However, it is less stable (e.g. sensitive to cosmic rays), requires occasional pumping out to a high vacuum, and is more difficult to image with because of its slow response compared to PMTs. The IRPMT is also sensitive and fast, and uses photon counting in an identical way to visible PMTs. It does not require lock-in techniques and doesn't require pumping out to a high vacuum. However, it is more difficult and takes longer to cool, requiring a nitrogen gas source and dewar. It is generally easier to use because of its fast response and ease of photon counting. The IRPMT may give rise to a small vibration in the microscope due to the nature of the coolant flow and physical attachments.
Can I upgrade to IRPMT, or a Ge detector for Infra Red CL?	Yes. This should not require any return to the factory. However, it is best to inform GatanUK of possible upgrade intentions.
What are the advantages of ParaCL and XiCLone?	ParaCL and XiCLone open new doors to CL analysis, throughput, and applications simply because of the speed with which a CL spectrum can be acquired and the power of the spectrum imaging software. ParaCL is therefore ideal for beam sensitive specimens, for rapid spot analysis from different parts of a specimen, for electrically insulating specimens, and for situations where rapid analysis is imperative. XiCLone revolutionizes spectral CL as a technique due to the power of obtaining the full CL data set in one simple experiment. Furthermore, advanced non linear least squares fitting tools for (multiple) Gaussian curves can be applied to whole data sets, either in nm or eV mode. With such analysis it is simple to turn a spectrum image into a spectral shift map, or a spectral peak width map, or to create two new spectrum images, one based on the fitted signal, and one based on the residual signal. This latter approach helps extract small extrinsic luminescence features (e.g. shoulders on peaks) from larger instrinsic features.
Which CCD is better, back illuminated or front illumianted.?	The back illuminated camera has a higher quantum efficiency, but suffers from etaloning. This is multiple internal reflections which cause an high frequency (~3nm) interference pattern. This is only noticeable for light >750nm and is only pronounced if there is a sharp peak in the range 750-1100nm.

	As an alternative a wider array front illuminated camera can be supplied. This detects more light due to it's size, but the quantum efficiency is slightly lower. This camera does not suffer from etaloning. The front illuminated camera is the best choice for users wishing to cover the whole spectral range of the CCD camera.
Can I upgrade to XiCLone?	Yes. This is simple for MonoCL3 systems, but MonoCL2 system will require upgrading to MonoCL2UP. This requires a return to the factory. However with careful scheduling the work required minimize any downtime. XiCLone requires Digiscan digital beam control, for which an external scan interface is required on the microscope. Note, the CCD camera is not designed for simultaneous mounting with a Ge detector.
Is a thermal FE SEM suitable for CL?	Yes. Many CL sales are now for thermal FE SEM. They provide the high performance of FE microscopes with a high maximum beam current.
Is a cold FE SEM suitable for CL?	Yes. However, this depends on the application. For examples for studies with direct band gap semiconductors with a cold stage, the majority of CL studies will be performance at a beam current of less than 1nA and this is typically within the range of currents possible. However, for some applications where high injection densities are critical, then an cold FE SEM may not be the best solution.
Can I buy a MonoCL2 system?	From March 2001, MonoCL3 and MonoCL3+ has superceded MonoCL2, MonoCL2/ISIS and EMCL2 systems.
Are any microscopes, microprobes or TEMs unsuitable for CL systems.	It is best to ask Gatan for advice. For many microscopes there are many different possible configurations, including the sharing of ports for multi-user environments. With care, it is not difficult to add and remove detectors.
If I remove the MonoCL3 monochromator from the microscope, will it need recalibrating when attached once more?	If done carefully, then the answer is no.
Who do I buy the products from?	Gatan has offices in the UK, US, Germany, France and Singapore. Sales of equipment for attaching to new electron microscopes, often occur through the EM manufacturer. In addition other coutries sales and service is from an extensive network of distributors. For more information email info@gatanuk.com

Configuration Chart.

	Mono**CL3**	Mono**CL3+**	ParaCL Option for Mono**CL3**(+)	Xi**CL***one* Option for Mono**CL3**(+)	Notes
Panchromatic imaging	Yes	Yes	Yes	Yes	PMT visible, IR optional
Monochromatic imaging	Yes	Yes	Yes	Yes	PMT visible, IR optional
Filter imaging	*	*	*	*	* requires MonoCLF
HSPMT detector	Optional	Yes	Optional	Optional	
Serial image on SEM	Required	Optional			Requires input on SEM
Solid state IR detector.	Optional	Optional	Optional %	Optional %	% May not be compatible for simultaneous mounting with CCD camera.
Digiscan Digital Beam control	No #	Yes	Not required (Yes for **3**+)	Required (Yes for **3**+)	# Other DBC unit may be in use

Digital Micrograph software on Windows 2000 PC.	Yes	Yes	Yes	Yes	
Automatic monochromator calibration	Yes	Yes	Yes	Yes	
In-line spectral calibration lamp	Optional	Optional	Yes	Yes	
Automatic dark noise removal with internal shutter	No	No	*	*	* depends on array width
CCD spectrum acquisition	No	No	Yes	Yes	
Spectrum imaging from line and area.	No	No	No	Yes	
NLLS analysis	Yes	Yes	Yes	Includes advanced features	
Slice tool.	No	No	No	Yes	
Spectrum grabber.	No	No	No	Yes	
Mirror options, standard, MSM, TEM.	Yes	Yes	Yes	Yes	