

Stereoscan

Stereoscan 430: Operator Manual

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Stereoscan 430 Operator Manual

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Chapter 1 - Getting Started

Getting Started

1.1. Introduction

Components of the Stereoscan 430

The *Stereoscan 430* is a software-controlled digital scanning electron microscope.



Figure 1.1

1.1.1. The Column and Chamber

The *Stereoscan 430* gun and column is used to generate and focus a fine beam of electrons onto the surface of a specimen mounted in the specimen chamber. The electron gun has a thermionic emitter as a source of electrons - the normal source is a tungsten hairpin filament. Three electromagnetic lenses beneath the gun, focus and shape the electron beam before it strikes the specimen in a scanned, or rastered, fashion. The energy of the electron beam is adjustable from 300 volts to 30 kilovolts in 10 volt steps and the electron probe current is continuously adjustable from 1 pico-amp to 1 micro-amp to suit the type of examination required.

The specimen chamber of the *Stereoscan 430* holds the specimen to be viewed in such a way that it may be freely manoeuvred during examination. The specimen stage which holds the specimen is attached to the door of the chamber and is of the

manual cartesian type. The stage may be opened for examination once the vacuum within the chamber has been vented.

1.1.2. The Vacuum System

The operation of the electron optical column and specimen scanning is dependent not only on the presence of a vacuum, but also the degree of vacuum, i.e. the system is safely interlocked so that it is not possible to switch on any of the high voltages until an adequate vacuum is reached.

The vacuum system is simple and efficient. A turbomolecular pump, backed by a rotary pump, is mounted on the lower face of the specimen chamber and commences pumping when the system is being evacuated and comes to rest during system venting. The electron gun and column are pumped through the tube running from the chamber up to the gun section. The only valve in this system is the air-admittance valve attached to the rear of the chamber, which automatically opens when venting is requested. Normal operating vacuum should be in the range to 10^{-4} to 10^{-6} torr. No water cooling is required.

1.1.3. The Control Console

Complete software control of the *Stereoscan 430* means that operation of the instrument is rather like operating a desktop computer - all operations are controlled through the mouse and keyboard. Within the console of the microscope, the computer is used to communicate your operations and commands into actions by the SEM. The PC environment used is Microsoft® WindowsTM 3.1 and the SEM control application (LEO) runs within this well known and easy to use system. Section 1.2 provides an introduction to WindowsTM and how to use the system of Help provided. If you are unfamiliar with WindowsTM, the WindowsTM tutorial (selected from Program Manager Help) is strongly recommended.

The right hand side of the console contains the standard internal hard disk drive (80 megabytes capacity or 105 megabytes optionally) and the standard floppy disk drive just beneath the Leica logo. The floppy disk drive is used to read in or store data files - such as images, microscope condition files or any of the files associated with WindowsTM applications - as well as for loading system software or software options. If any of the optional mass storage drives are fitted (WORM or Bernoulli, for example), they will be mounted just below the floppy disk drive in the console and are accessed just as any other disk drive within the user interface.

1.2. WindowsTM and How to Use Help

The LEO software is a normal WindowsTM application running under WindowsTM Version 3.1. and therefore obeys all the usual rules of WindowsTM applications. If

you are familiar with WindowsTM, you already know the essential terms and operations and are ready to learn how to use the Microscope.

If you are unfamiliar with WindowsTM, you should read at least Chapters 1 and 2 of the 'WindowsTM User's Guide' which is supplied with your system.

Obtaining Help

Comprehensive on-line Help for the LEO software is provided and may be accessed in several ways:-

- Selected by function key
- Selected from a menu
- Selected by a button
- Context sensitive help

Function Key Selection of Help

The following function keys are used to obtain help:-

- F1 - Displays general help for the microscope, giving overviews and providing a starting point for more detailed interrogation of the help information
- <shift> F1 - Selects context sensitive help mode - see below
- F9 - Displays help on the use of special keys and key combinations
- <shift> F10 - Displays how to use the Help system

Selecting Help from a Menu

Where **Help** is displayed in a menu (e.g. at the extreme right of the LEO top window) selecting it will display the index to help relating to that window.

Selecting Help from a Button

Where a button labelled Help appears in a dialog box selecting it will display an index of help relating to the dialog box functions.

Context Sensitive Help

This is frequently the most useful method of using Help.

To select this mode press the shift key and while holding it down press special function key F1.

While in Context sensitive help mode the cursor will be displayed as



wherever help information is provided. In this mode mouse selections do not perform their normal operations but display help on the specific item selected.

Some examples of what may be selected are:-

- A menu item - describes its function
- A window background - describes the function of the window
- A displayed parameter - describes the parameter, and under what conditions it is enabled (useful to discover why a parameter is greyed out)
- A toolbar Icon - describes it's function
- A Panel Background - describes its use and components

To switch off Context help mode press the <Esc> key while the context help cursor is displayed.

1.3. The User Interface

Overview

The user interface is used to control the *Stereoscan 430* and is a normal Windows[™] application. The minimum that may be on display is the Top Window within which appears the Image Window. Other components may be called up as required, either explicitly (e.g. by menu selection) or implicitly as an implied response to some action or event. When the system is started up, you will also usually have the Toolbar displayed.

1.3.1. The Mouse

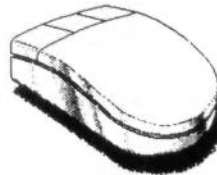


Figure 1.2

The mouse is the primary adjustment and selection control of the microscope. As such there are carefully defined conventions governing its use:-

1. Selection and Dragging

The normal WindowsTM convention of pointing and clicking with the **left** mouse button is used for menu selection, dragging and sizing of objects.

For example, the status window can be selected from the **View** menu by clicking with the **left** mouse button on **View** in the menu bar and then clicking on the status entry. The position of the status menu can then be altered by clicking on the title bar of the status window and moving the mouse with the **left** mouse button held down.

2. Icon Selections

The **left** mouse button is also used to select icons. Selecting an icon will either assign the adjustment parameters (displayed in the top right corner of the toolbar), or cause the icon to execute immediately.

Examples of parameter assignment icons include the kV/Probe Current icon, the Signal Level icon and the Mag/Focus icon. Immediate action icons include Scan Rate + and - icons and the Run Up icon.

3. Parameter Adjustment

The **left** and **middle** mouse buttons are used for parameter adjustment when the cursor is over the image window while adjust mode is selected. To adjust the parameter displayed in the toolbar:-

- Move the cursor over the image area
- Select the **left** mouse button for the left toolbar parameter, or
- Select the **middle** mouse button for the right toolbar parameter
- Move the mouse to the left (while holding down the mouse button) to decrease the parameter, or to the right to increase the parameter



*There are two speeds of adjustment available, coarse and fine. The selected speed is displayed to the left of the adjustment parameters in the toolbar, with (< >) for fine and (<< >>) for coarse. The speed can be toggled by pressing the **tab** key.*

For example, to adjust the magnification, select the Mag/Focus icon. This assigns magnification control to the **left** mouse button. Now move the cursor over the image and press the **left** mouse button. By holding the button down and moving the mouse to the left, the magnification can be decreased. A movement to the right will increase the magnification.

Some parameters such as Beam Shift and Stigmation provide adjustment in both the X and Y directions. This is indicated by the appearance of the adjustment icon in the bottom left corner of the image.

4. **Pop-up Menus**

The **right** mouse button is used to display a pop-up menu while over the image. Once the pop-up menu has been displayed, all selections on it are made with the **left** mouse button.



*The image is not the only interface component which has a pop-up menu associated with it. Most objects which do not have their own menu have a pop-up menu which is displayed with the **right** mouse button.*

5. **Panel Selection**

There is one other use for the **right** mouse button which is to bring up the control panel associated with each icon. This is done by putting the cursor over the icon and selecting the **right** mouse button.



The control panels are not unique to the icon, so more than one icon may bring up any given control panel.

Once the control panel has been displayed selections can be made with the **left** mouse button.

With the mouse pointer positioned over the image, the right mouse button obtains a pop-up menu allowing further mode selection, e.g. Annotation.

A little practice will be required to gain familiarity with the three button mouse. However, it is an extremely quick and convenient method of SEM control.

1.3.2. **The Keyboard**

In addition to mouse control of parameters, many keyboard keys have been assigned special functions and these can sometimes be a valuable aid to instrument operation. The keys have been designated (also to be found by pressing F9 - keys Help) as follows:-

F1 Help (see 1.2)

F1 + Shift Context sensitive Help (see 1.2)

F2 Performs a lens hysteresis correction for all column lenses. This has the effect of improving the accuracy of both the Probe current indication and

the magnification, which in turn improves the accuracy of on-screen measurement.

F2 + Shift Toggles the toolbar at the top of the screen on and off.

F3 Closes all additional Windows other than the toolbar and status window. This also closes any currently iconised Windows.

F3 + Shift Toggles the PC-plane (i.e. the Windows plane) on and off. When the PC plane is off, the space bar can be used to switch it back on. This is particularly useful for viewing the full size image without obstruction by any menus which might need to be kept open.



All keyboard commands remain active.

F4 is used to step through each entry in the magnification table (**Tools - Mag Table**). Selection of a mag-table entry does not lock out normal operation of the instrument.

F4 + Shift exits from mag-table mode. Re-entry into mag-table mode then re-commences at the first entry.

F5,F6,F7,F8 (with or without shift) Executes the installed macro (if it exists). If the macro does not exist, a 'beep' is given.

F9 Help on key usage

F10 Menu

F11 Selects the Annotate/Measure function and toggles between Move and Edit modes.

F11 + Shift Toggles the Datazone overlay on and off.

Tab Toggles coarse and fine adjustment mode (<> to <<>>)

Esc Aborts the currently executing auto function or macro.

Pause Pauses/resumes execution of a macro.

A Performs an auto-stigmation routine. This may be aborted by pressing the Esc key.

B If B is pressed, the arrow keys may be used to control Beam Shift, or fine image movement.

F starts an autofocus routine. This may be aborted by pressing the Esc key. Note also that the area used for autofocus, a reduced area at the centre of the screen, may be moved after obtaining the image pop-up menu and selecting Focus Area.

I If I is pressed the arrow keys may be used to adjust the two parameters currently displayed in the image window. The left/right keys decrease and increase the left parameter and the up/down keys increase and decrease the right parameter. If the arrow keys are temporarily allocated to any other parameter (e.g. by pressing B,M,S or Z), the keys may be returned to the default mode by pressing I.

M If M is pressed the arrow keys are temporarily assigned to control magnification and focus. The left/right keys increase and decrease the magnification whilst the up/down keys increase and decrease the focus.



If Optibeam is switched on, focus means Working Distance. If Optibeam is off, focus means C3 lens current.

+ is used to increment through the available scanning rates.

- is used to decrement through the available scanning rates.

Space is used to reveal the PC plane if hidden by shift-F3.

Alt followed by arrow key movements allow navigation of the pull-down menus of the **currently selected** (highlighted in the title bar) window.



*These key designations are in addition to the keys already designated for WindowsTM operation - consult WindowsTM Help for a list of these keys. One particularly useful keyboard shortcut is **Alt/Tab** which enables fast switching from one WindowsTM application to another. To use, hold down the **Alt** key and repeatedly press **Tab** until the title of the required application is shown and then release the **Alt** key. The selected application then becomes the current application.*

1.3.3. The Top Window

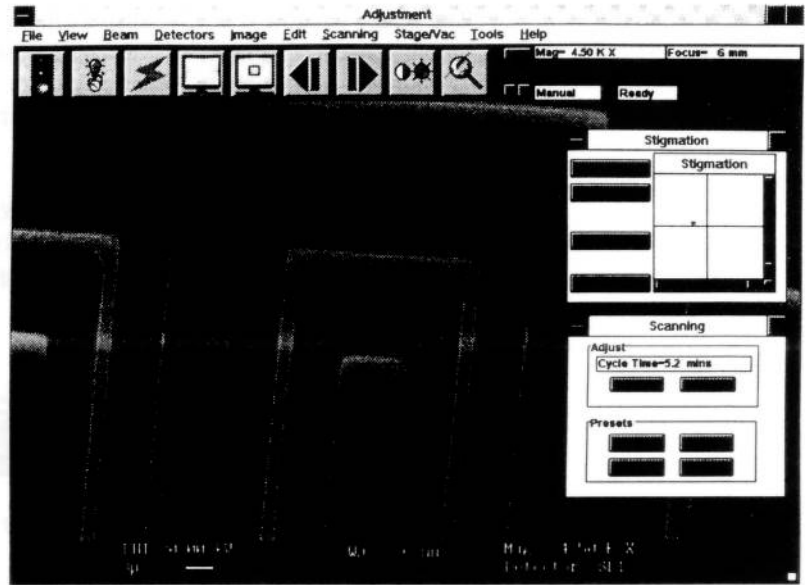


Figure 1.3

The top window provides the environment within which the other Windows reside. It contains:-

- The caption bar, which displays the Version number of the LEO software in use together with the release date. In some circumstances, the caption bar displays messages to the user.
- The System button permitting the system to be shutdown or put into Standby mode.
- The minimise button which enables the user interface to be iconised while leaving the SEM operational.
- The reduce/full size button allows you to work with the Top Window at a reduced size or at full screen size by alternate clicks.
- The top level menu from which all system operations may be selected. Help may also be selected from this level. Context sensitive Help (shift-F1) may be used to obtain help on each function.

1.3.4. The Image Window

The image window is used to display the live image, and may either occupy the whole screen or a quarter of the screen as selected by the top menu selection View->Full screen image. When in quarter screen mode it may be moved with the mouse by dragging the caption bar. The caption bar indicates the current mode and implies how the mouse is to be used.

Quarter screen mode is especially useful when other Windows such as profile or status etc are to be displayed simultaneously. They can be moved and sized separately to give the required screen arrangement.

1.3.5. The Toolbar

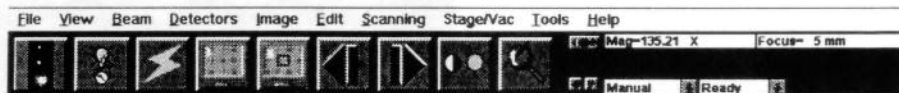


Figure 1.4

The toolbar is displayed at the top of the main window and provides access to commonly used functions. The toolbar consists of a fixed portion and a variable portion. The fixed portion makes up the right half of the toolbar and displays the current mouse adjustment parameters (e.g. Mag and Focus), the state of the vacuum system (e.g. Ready, Venting or Pumping), the state of the EHT system (e.g. Manual, Shutdown, Beam On etc.), coarse/fine adjustment icon (< > for fine, << >> for coarse) and the identity of any currently executing macro function.

The variable portion contains icons which may be selected with left or right mouse buttons to perform required operations. A standard set of icons is provided, although different sets of icons may be loaded according to the application requirements and operator skill level, i.e. Novice or Expert. Novice mode provides two rows of large icons whilst Expert mode provides three rows of small icons.

The operational convention adopted is that the left mouse button initiates an action or adjustment mode, the right button displays a panel associated with the selected function which may be used for more detailed setting up or control.

The toolbar itself may be disabled from the top menu View->Toolbar.

1.3.6. Other Components

As a result of menu actions or other events, various other interface components may be displayed. These are:-

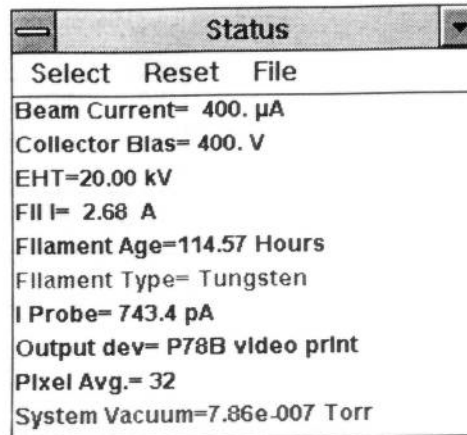


Figure 1.5

Status Window

This displays a user selected group of instrument parameters which are continuously updated.

Individual items can be selected or deselected from within the status menu select window. In addition files of status menu selections can be saved and loaded from within the Status File Menu.

Datazone

The datazone displays information concerning the current state of the system, and since it is a form of annotation (displayed in the overlay plane), it may therefore be included in exported and hard-copied images etc.

The datazone is only displayed in full screen image mode. Its contents and position is user definable from within the annotation plane control pop-up menu.

The datazone may be switched on and off from the main window menu selection **View->Datazone**.

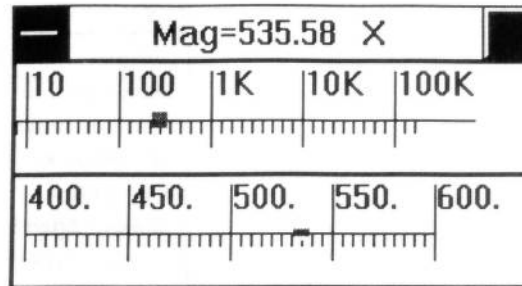


Figure 1.6

Magnification Control Window

This window may be invoked from the top menu **Image->Mag/Foc** function and is used to set the base magnification of the instrument to a specific value. The use of the magnification control window is fully described in Section 2.3.4 *Setting Focus and Magnification*.

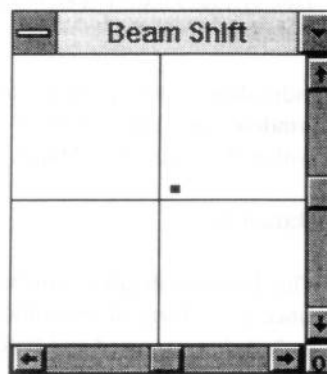


Figure 1.7

Navigation Box - (Top menu selection **View->Nav box**).

The navigation box provides visual indication of the range and current value of one and two dimensional parameters. Any variable may be selected to the Navbox by selecting the parameter within the status window or toolbar, however not every parameter is well suited to this type of control (e.g. parameters with non-linear control characteristics such as magnification and probe current).

The edges of the box represent the limits of the variable range (e.g. - 100%, + 100%) and cross hairs indicate the centre of the box, not necessarily the centre of the range. The current parameter value is indicated by a red marker. The parameter

value may be adjusted by dragging the marker to the required position. Alternatively the X and Y values may be individually adjusted using the scrollbars and the parameters set to zero using the origin button (labelled with **O**) at the junction of the X and Y scrollbars. If this button is selected the current parameters are set to zero.

This method of adjustment is also to be found within control panels such as Stigmation.

1.3.7. Starting Up and Closing Down the Stereoscan 430

Starting up and closing down the *Stereoscan 430* is very simple, however it is important to follow the routines described here:-

Starting Up from Cold

The Standby button above the disk drive will be illuminated. Press the On button, the system automatically loads up to Program Manager in Windows - this takes about a minute, during which time the DOS loading messages will be seen. Note also that when the program manager first appears, an icon showing traffic lights will be seen at the lower left of the screen. This indicates that SEM initialisation is taking place and finishes when the green light is displayed. This icon will remain until LEO is started.

Locate the LEO UIF icon and double-click it. This starts the user interface loading during which a loading message is displayed and a dialog box appears to prompt for the user directory to start in.

After complete loading of the user interface (the hourglass icon disappears) imaging may be started by pressing the Start icon (provided that the vacuum status is Ready). At this point it would be a good idea to optimise the gun and imaging conditions (see Chapter 2 *Operation*).

Starting Up from Standby

Locate the LEO standby icon and double-click it. The system will be restored to the state it was in when last used.

Shutting Down

When a working session on the microscope has finished and the microscope is to be left overnight, over the weekend or longer, there are two ways to close down the system:-

Standby

This is the recommended state to leave the system in overnight and is again selected from the system button at the top left of the screen. Note that this is a software standby, not to be confused with the standby button above the disk drive which switches off power to the computer. Having selected SEM Standby, the software puts the SEM into standby mode. This includes setting the EHT, Lens currents, HRRU (if fitted), imaging and overlay planes to standby conditions. This is indicated by the user interface iconising with the text SEM Standby.

Shutdown

This is the recommended state to leave it for two days or longer. Click on the system button at the top left of the screen and select **SEM Shutdown**. You will be asked if you wish to save the current operating conditions - if you choose yes, then the conditions are stored in a file called Restore.Leo, which is a macro and can be used to restart the system later. The software then goes through a controlled shutdown, during which important files are written to disk - on no account press the Standby button or power off at this point. When the Program Manager can again be seen, close this down in the same way i.e. from the system button, then press the Standby button. Starting up again is then as described in Section 1.4.1 *To Obtain an Image* later in this Chapter.



It is quite a good idea either to switch off the viewing monitor or switch on a screen-saver (such as provided in the Program Manager/Main/Control Panel/Desktop menu) to prevent any burning of the screen.

1.3.8. Some Important Do's and Don'ts

DO

- Use the software routines provided for shutting down and standby mode
- Check filament saturation, as described, after the first runup of a new session
- Create user directories as necessary and keep all user data within them
- Read the Help provided. It is there for your guidance
- Try to keep a note of any important error messages for diagnostic purposes
- Call your local Leica customer care office in the event of problems
- Keep the chamber door and gun "O" rings clean

DON'T

- Fill the hard disk with images, use floppies where possible or use a mass storage disk

- Try to edit or alter, in any way, the system files. This **will** cause operational problems
- Try to install any peripheral without first seeking advice from Leica Cambridge

1.4. Common Operating Routines

1.4.1. To Obtain an Image

Before commencing to turn on the filament there should be a sample inside the chamber and there should be a satisfactory vacuum, i.e. **Vacuum Ready** displayed. The vacuum status and operating status are displayed towards the right of the toolbar.

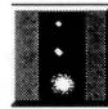
If the vacuum is satisfactory **Ready** will be displayed, and the operating status will display **Shutdown**. If the operating status displays **Beam Off**, this indicates that a run-up file has been loaded but the filament has subsequently been turned off.

After loading the control program the image area may be displayed at 1/4 full screen size. The operator may, at any time, change the displayed image to full screen size. This can be done by selecting **View** (with the left button) from the top row of the toolbar and then selecting **Full Screen Image** from the drop down menu. Similarly the datazone can be displayed by selecting **Datazone** from this same drop down menu.



The datazone will not be displayed while the image area is displayed at 1/4 full screen size, and while this mode is set the option of displaying the datazone is greyed out, so that it cannot be selected.

Clicking with the left button over the **Run Up** icon



will cause a macro called RESTORE.LEO to be loaded and executed. This macro holds all the operating conditions of the SEM and corresponds to the last set of operating conditions that were saved when the microscope was shutdown.

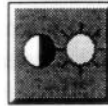
Should the operator require other specific operating conditions please refer to *Saving and Loading Conditions* in Section 2.7.2.

This operation will take several seconds, during which time the macro will appear and then be executed. When the macro has been removed and MANUAL displayed in the toolbar the SEM is ready to use. Normally there will be some form of recognisable image displayed on the screen, at worst it may show only as a change in signal brightness.

The following steps should provide the operator with an image of the sample with which to work.

Adjust the Image Brightness to a Suitable Level

Set the mouse control to Brightness and Contrast control by clicking with the LEFT button over the icon



With the mouse pointer over the image hold down the LEFT button and slide the mouse either left or right to decrease or increase the image brightness to a satisfactory level.

Select a Very Low Magnification, i.e. about 20X

Set the mouse control to Magnification and Focus by clicking with the LEFT button over the Mag/Focus icon. Then, with the mouse pointer over the image hold down the LEFT button and slide the mouse to the left to reduce the magnification. The value of the magnification will decrease while this operation is continued, or repeated, until the minimum value is attained.

Focus the Image

Unless already selected, set the mouse control to Magnification and Focus control, by clicking with the **Left** button the Mag/Foc icon. Place the mouse pointer over the image and hold down the CENTRE button and then slide the mouse to the left or right until the image becomes more recognisable and into focus.

If difficulty is experienced, note the value of the focus displayed in the toolbar. Most samples will usually be in focus somewhere within the range 5mm to 30mm. If the sample is out of the field of view altogether, then an image of part of the stage mechanism or even of the mesh covering the turbo-molecular pump, may be produced, to do this a focus distance greater than about 30mm is required. If this is the case, the sample will have to be moved into the field of view by manually moving the stage X and Y controls mounted on the door of the chamber. The simplest thing is to move the controls until both X and Y position counters indicate

approximately 0500. This will place the stage at the centre of its travel and, if a single stub is mounted in the chamber this will now be under the beam, or if the carousel is present, the centre of this will be under the beam. Repeat the above focusing operation to achieve a recognisable image.

Optimisation of Settings

Once a recognisable image has been obtained the operator can optimise the conditions prior to examining the sample in detail. The following procedures should be done at the start of a session, but any part of the following can be repeated subsequently, should the operator feel it necessary.

Setting kV and Probe Current

The accelerating voltage to be used will depend greatly upon the sample being examined, and will require some experimentation by the operator to achieve the best results. As a rough guide, uncoated non-conductive samples should be examined using between 1 and 3 kV, non-conductive but coated samples should be examined using between 5 and 15 kV and conductive samples can be examined using between 10 and 25 kV.

It is recommended that inexperienced users start with a conductive sample and set the accelerating voltage to 15 kV and the probe current to 200 pA.

To Adjust the kV

Set the mouse control to kV and probe current control by clicking with the **Left** button over the icon



The current values of the kV and probe will be displayed in the toolbar. Then with the mouse pointer over the image, hold down the **Centre** button and slowly move the mouse to the left or right to decrease or increase the kV to the desired value.

To Adjust the Probe Current

If not already active, set the mouse control for kV and probe adjustment by clicking on the icon with the **Left** button. With the mouse pointer over the image hold down the **Left** button and slowly slide the mouse to the left or right decrease or increase

the probe current to the desired value. It may then be necessary to adjust the brightness of the image as described above.

The value of the probe current chosen will affect the signal to noise level within the displayed image, and also the achievable resolution. A large probe current will produce a good noise free image, but it will not be possible to obtain good resolution at higher magnifications, and conversely a low probe current will enable high resolution images to be obtained but the image will become progressively more noisy as the probe current is decreased. Inexperienced operators may choose to run in the Auto-probe mode when the magnitude of the probe current is varied as the magnification is changed, see Section 2.3.2 *Setting EHT and Probe Current*.



Any parameter assigned to mouse control may be set directly by double clicking on that parameter display in the toolbar. A number entry box appears allowing the value to be typed in.

Setting the Filament Current and Beam Alignment

Filament Setting

The setting of the filament current will have a large effect of the brightness and stability of the image, as well as influencing the lifetime of the filament. As the filament current is increased the brightness of the signal increases until a small plateau is reached, this is known as the "first peak" (see Figure 1.8), increasing the filament further will again cause the signal brightness to increase until another plateau is reached, further increase of the filament current will not improve the signal brightness, this is referred to as the fully saturated condition. The lifetime of the filament decreases as the filament current increases, there is no advantage in increasing the filament current above the just saturated condition.

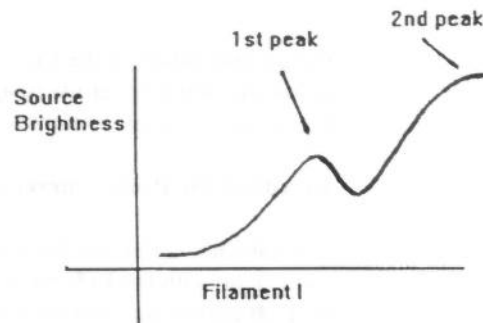


Figure 1.8

The filament should be operated at one of two conditions, either at the first peak setting or where the filament has become just fully saturated. These two positions will provide conditions for stable brightness operation. Operating at the first peak setting will give a long filament life, but is not satisfactory for high resolution imaging, while the fully saturated condition will give the brightest signal and allow the best resolution images to be obtained, but the lifetime of the filament will be reduced.

The above conditions can be achieved by selecting the **Filament Current** icon and slowly increasing filament current (having selected **manual** brightness control) while observing the points at which maximum brightness occurs. The two peaks of maximum brightness correspond to the two saturation peaks.

The filament current may be varied by using the associated scroll bar within the Gun Alignment panel, either by SLOWLY dragging the slider in the appropriate direction, or by clicking over the arrow at the appropriate end of the scroll bar.

Alignment

For the best performance of the microscope the electron beam should pass down the column along the electron optical axis, and any aperture in use should also be centred about this axis. As no column can be perfect, various adjustments are provided to compensate for this.

Final Aperture Alignment

The centring of the final aperture can easily be checked by having a recognisable feature at the centre of screen and then taking the focus through focus and back again. When aligned, the image will only rotate and not shift laterally. If the aperture is mis-aligned the image will move backwards and forwards across the screen in a slight arc. If the aperture is mis-aligned it will be necessary to move the position of the aperture using the X and Y controls on the side of the column until the image ceases to shift laterally.

Focus Wobble

To facilitate setting the optimum aperture position the operator may find it helpful to select Focus Wobble. This may be selected from the Gun Align panel or directly from the drop down menus under Beam.

When selected, this automatically sweeps the objective lens backwards and forwards through focus, the speed and amplitude of the sweep can be altered from the Wobble panel. Selecting or de-selecting Fast will change the speed from fast to slow, and using the Amplitude scroll bar will enable a suitable excursion of the

sweep to be set. Selecting reduced raster and a fast scan speed will also facilitate this operation.

Adjust the X and Y aperture micrometers carefully until the images ceases to shift laterally and only rotates. The Focus wobble can then be de-selected by selecting **Off** from within the Focus Wobble panel.

Beam Alignment

The beam is correctly aligned down the column when the brightness level of the signal cannot be increased any further (ensuring the system is switched to **MANUAL** brightness control) by any adjustment of the gun align screws. These are moved as opposite pairs where one is slackened and the other screwed in. Both pairs should be adjusted against each other until the signal brightness is at a maximum. This adjustment should be carried out in conjunction with the filament current adjustment, if the optimum settings are to be achieved.