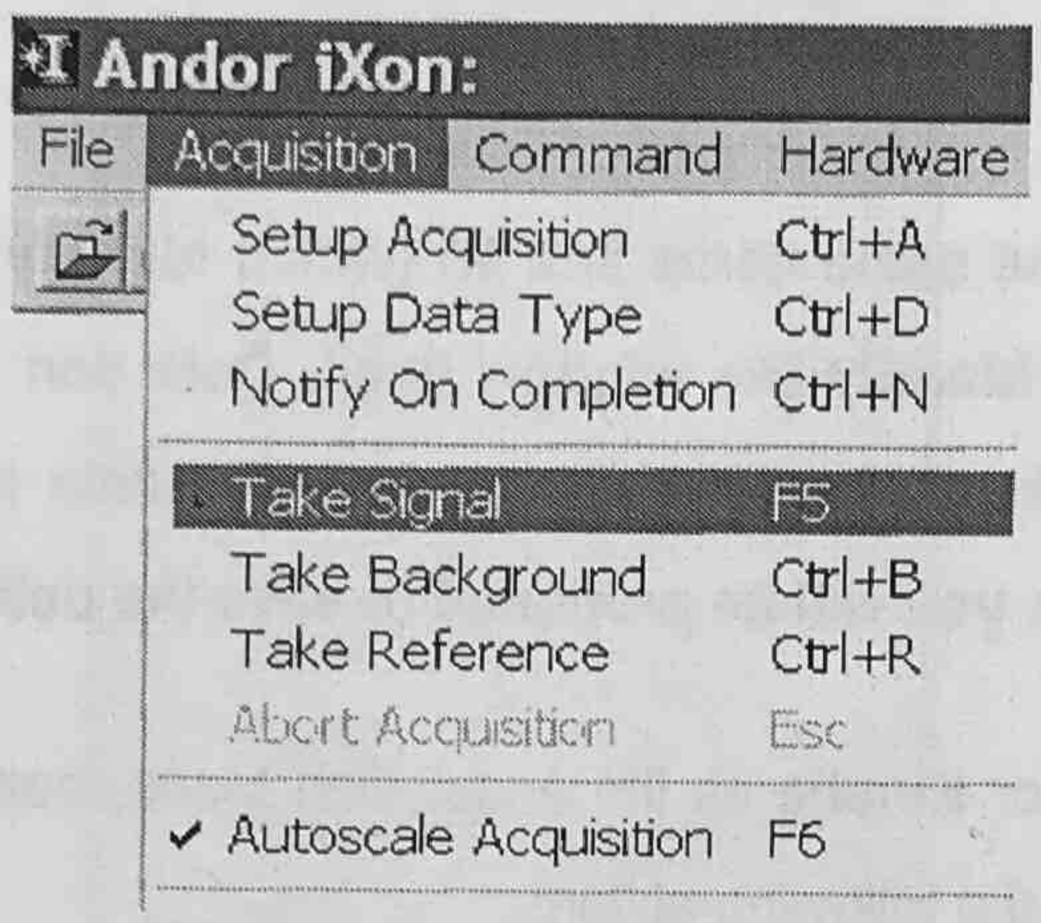
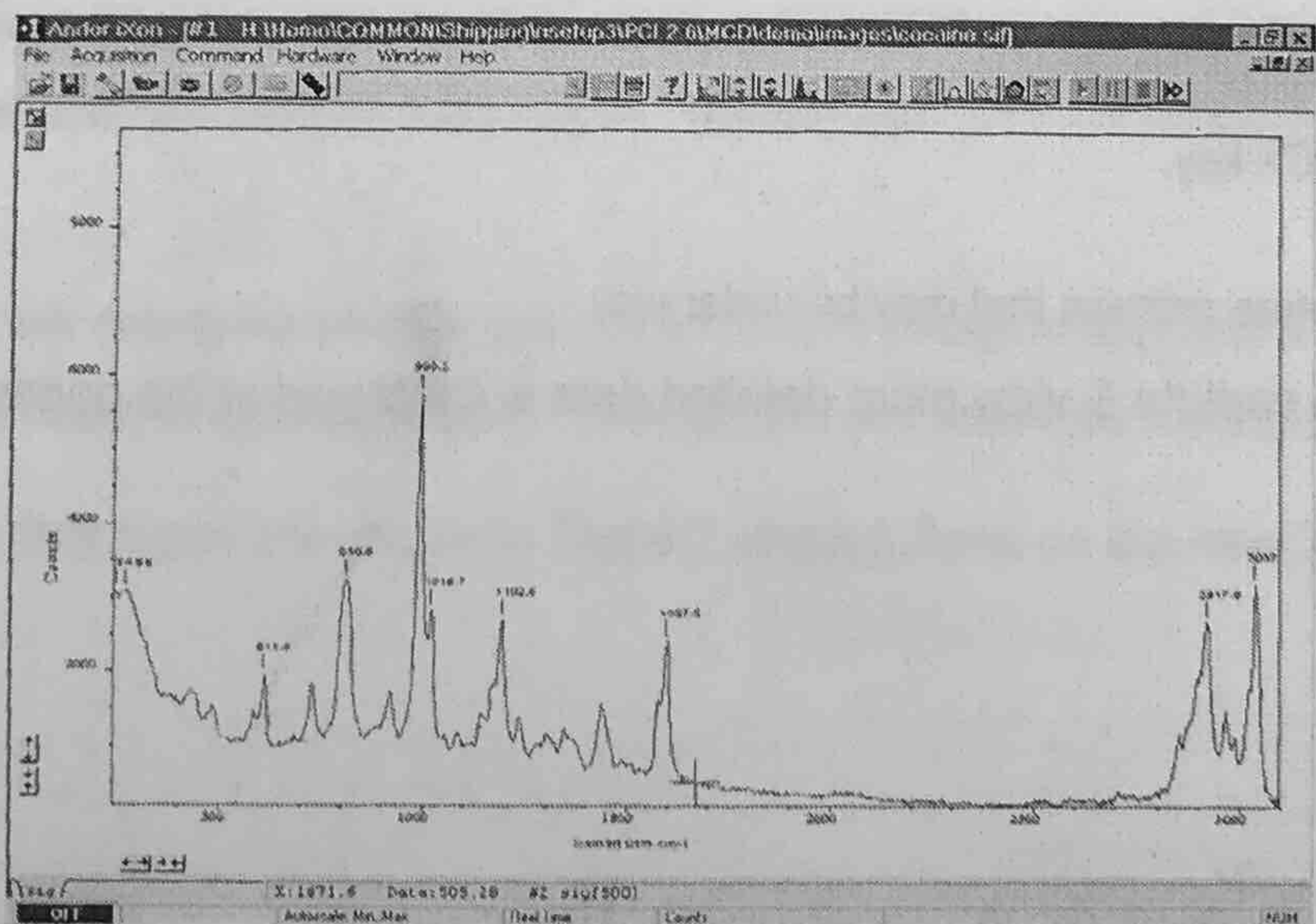
To start an initial data acquisition you can either:

- Click the button on the Main Window,
- Press **F5** on the keyboard
- Select the **Take Signal** option from the **Acquisition** drop-down menu as shown:



The **Data Window** opens, (labeled **#0 Acquisition)** and displays the acquired data, according to the parameters selected on the **Setup Acquisition** Dialog box. e.g.:



When you acquire data, by reading out a scan or a series of scans of the CCD-chip at the heart of the detector, the data are stored together in a Data Set, which exists in your computer's Random Access Memory (RAM) or on its Hard Disk. You can also create a data set via the Andor Basic programming language.

#n uniquely identifies the data set while the data set is being displayed and is temporary. It ceases to be associated with the data set once you close all data windows bearing the same #n. It is often referred to as an **Acquisition Window.**

NOTE: Each Data Window has the same name and #n (which identify the data set), but a unique number, following the data set name, to identify the window itself. Data can be modified only in a Data Window labeled with the name and the #n of the data set to which the data belong. If you modify a data set and attempt to close the data window, you will be prompted to save the data set to file.

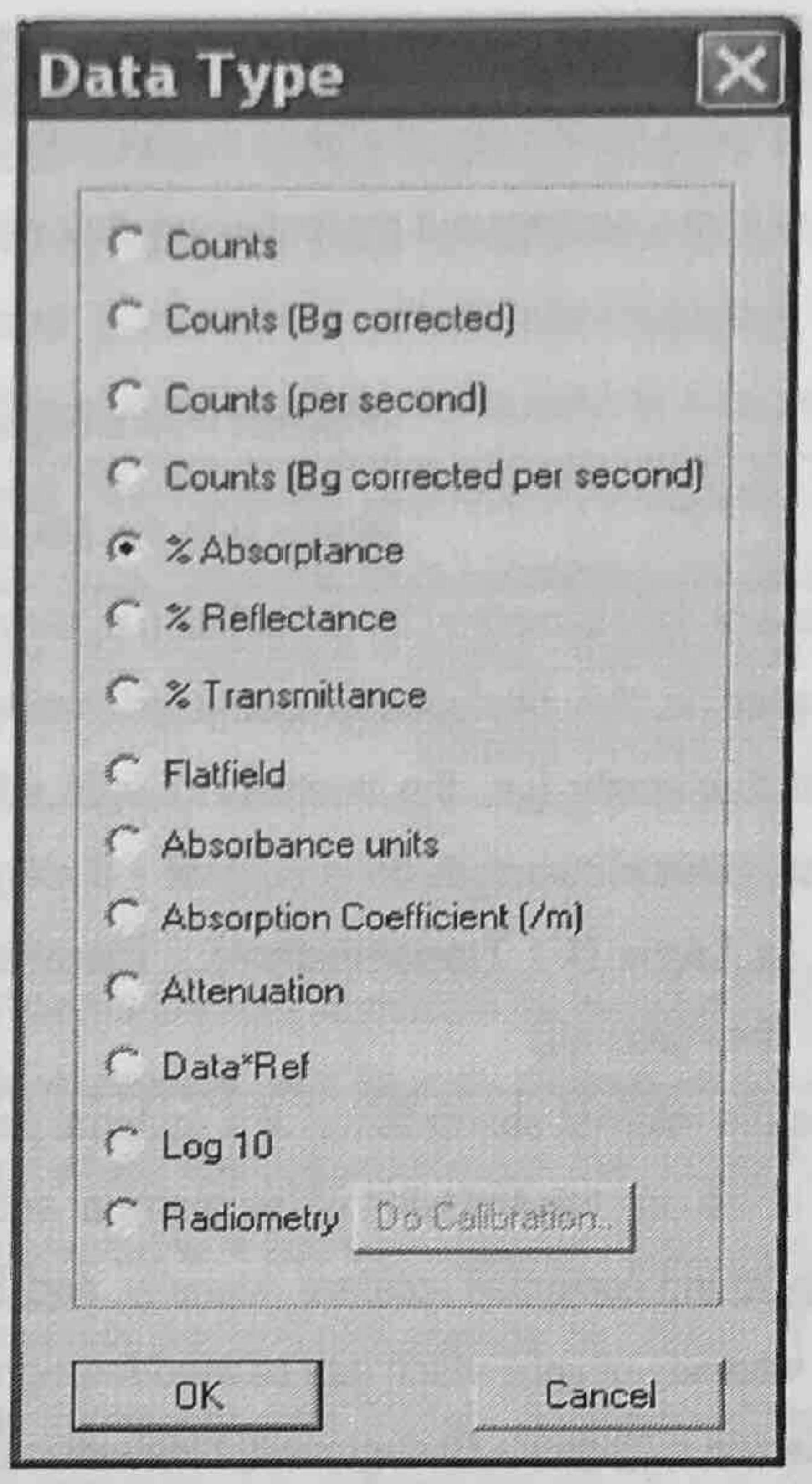
If you have selected **Accumulate** or **Kinetic** as the Acquisition Mode, new data will continue to be acquired and displayed until you carry out one of the following actions:

- Select **Abort Acquisition** from the Acquisition drop-down menu.
- Click the Abort Acquisition button
- Press the **<ESC>** key.

This stops any data capture process that may be under way.
Information on how to capture & view more detailed data is contained in the pages that follow.

DATA TYPE SELECTION

When the **Setup Data Type** option of the Acquisition drop-down menu is selected, the **Data Type** dialog box opens:



From the dialog box you can select the type of information (e.g. **%Absorptance**) that you want the system to compute and display whenever you perform Take Signal. The acquired data are presented under the **Sig** tab of an Acquired Data Window.

The data type you select will determine whether you need to take a background and/or a reference scan using the **Take Background** and/or **Take Reference** options. These options are described in more detail later in this section.

The descriptions of the data types are shown in **Table 7** which follows on the next 2 pages.

TABLE 7: DATA TYPES

OPTION	FUNCTION
Flatfield	Flatfield is used to remove any pixel-to-pixel variations that are inherent in the CCD sensor. If Reference is the background corrected incident intensity, the Signal is divided by the Reference so: Flatfield = **M** x **Signal / Reference** Where **M** is the **Mean of Reference**.
Absorbance units	A measure of light absorbed by an object (i.e. they represent the object's Optical Density (OD)). If Reference is the background corrected incident intensity, and Signal - Background the transmitted intensity (i.e. the intensity of light which has passed through the material being examined), then Transmission = (Signal - Background) / Reference. Absorbance Units are defined as **Log_{10} (1 / Transmission)**. Therefore: Absorbance Units = Log_{10} (Reference / (Signal - Background)).
Absorption Coefficient (/m)	Indicates the internal absorptance of a material per unit distance (m). It is calculated as **$-log_e$ t**, where **t** is the unit transmission of the material and **log_e** is the natural logarithm. If Reference is the background corrected incident intensity, and Signal - Background the transmitted intensity (i.e. the intensity of light which has passed through the material being examined), then: Transmission = (Signal - Background) / Reference, and: Absorption Coefficient = $-log_e$ ((Signal - Background) / Reference)
Attenuation	A measurement, in decibels, of light absorbed due to transmission through a material - decibels are often used to indicate light loss in fiber optic cables, for instance. If Reference is the background corrected incident intensity, and Signal - Background the transmitted intensity (i.e. the intensity of light which has passed through the material being examined), then: Attenuation = 10 x log_{10} ((Signal - Background) / Reference)
Data*Ref	Allows you to 'custom modify' the background corrected signal: Data x Ref = (Signal - Background) x Reference Store Value See the Andor Basic Programming Manual for similar operations.
Log 10	Calculates the logarithm to the base 10 of the background corrected signal counts. Log Base 10 = log_{10} (Signal - Background)
Radiometry (OPTIONAL EXTRA)	Allows you to calculate values for radiance or irradiance. The system requires that you supply calibration details. This option must be ordered separately. This option must be ordered separately.

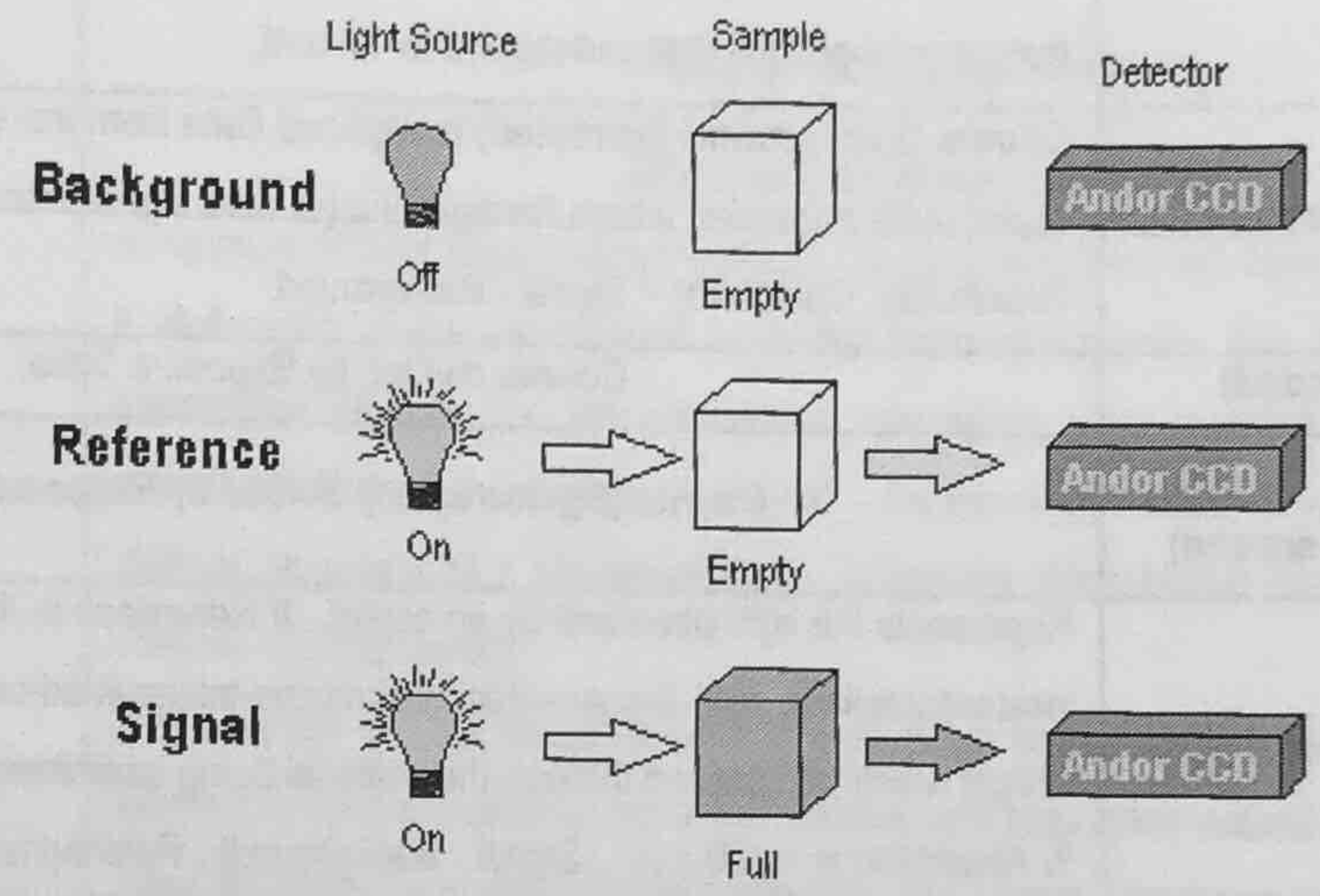
TABLE 7: DATA TYPES (CONTINUED)

OPTION	FUNCTION
Counts	**Counts** represents raw, digitized data (i.e. no calculations have been performed on the data) from the CCD detector's analog to digital (A/D) converter. Refer to the detailed performance sheet accompanying your particular CCD detector for the number of electrons that correspond to 1 count.
Counts (Bg corrected)	**Counts (Background Corrected)** is digitized Data from the CCD detector's analog to digital (A/D) converter, where Background (or dark signal) has been removed. Counts (Bg. Corrected) = Signal - Background
Counts (per second)	**Counts** divided by Exposure Time.
Count (Bg corrected per second)	**Counts (Bg corrected)** divided by Exposure Time.
%Absorptance	Represents the light absorbed by an object. If Reference is the background corrected incident intensity, and Signal - Background the transmitted intensity (i.e. the intensity of light which has passed through the material being examined), then: % Absorptance = 100 x (1 - (Signal - Background) / Reference)
%Reflectance	Represents the light reflected by an object. If Reference is the background corrected incident intensity, and Signal - Background the reflected intensity (i.e. the intensity of light which has been reflected from the material being examined), then: % Reflectance = 100 x (Signal - Background) / Reference
%Transmittance	Represents the light transmitted by an object. If Reference is the background corrected incident intensity, and Signal - Background the transmitted intensity (i.e. the intensity of light which has been transmitted through the material being examined), then: % Transmittance = 100 x (Signal - Background) / Reference

As an example, the system will compute % Absorptance as:

100 x (1 - (Signal - Background) / Reference).

The illustration below shows a typical use of Background, Reference and Signal for computations such as **%Absorptance** or **%Transmittance**:



USE OF BACKGROUND, REFERENCE & SIGNAL

Example: % Transmittance, % Absorptance

The default data type (used when you capture data and have not explicitly made a selection from the Data Type dialog box) is **Counts.**

If you select background corrected counts as your data type - **Counts (Bg Corrected)** - you will have to perform **Take Background** before you perform **Take Signal.**

If you select any data type **other than** Counts or Counts (Bg Corrected) you will have to perform Take Background and Take Reference (in that order) before performing Take Signal.

The calculations for the various data types assume the following definitions:

- **Signal:** Data in uncorrected Counts, acquired via Take Signal.
- **Background:** Data in uncorrected Counts, acquired in darkness, via Take Background.
- **Reference:** Background corrected data, acquired (usually for the purpose of computing a material's reflection, transmission or absorption characteristics) via Take Reference. Reference data are normally acquired from the light source, without the light having been reflected from or having passed though the material being studied.

If you require raw or background corrected data pertaining to the light source itself, Signal will be data acquired directly from the source.

If you intend to compute the reflection, transmission or absorption characteristics of a material, Signal will be data acquired from light that has passed through or has been reflected from the material being studied.

NOTES:

1. **'Signal', as used in the definitions of the calculations, refers to 'raw' data from the CCD and should not be confused with the possibly 'processed' data to be found under the Sig tab of the Data Window.**
2. **Functionality for displaying and manipulating data is only available if a Data File has been opened, if data have been newly acquired, or if you are using the Andor Basic programming language to create a new window in which to display data. In each case data are displayed in a data window.**

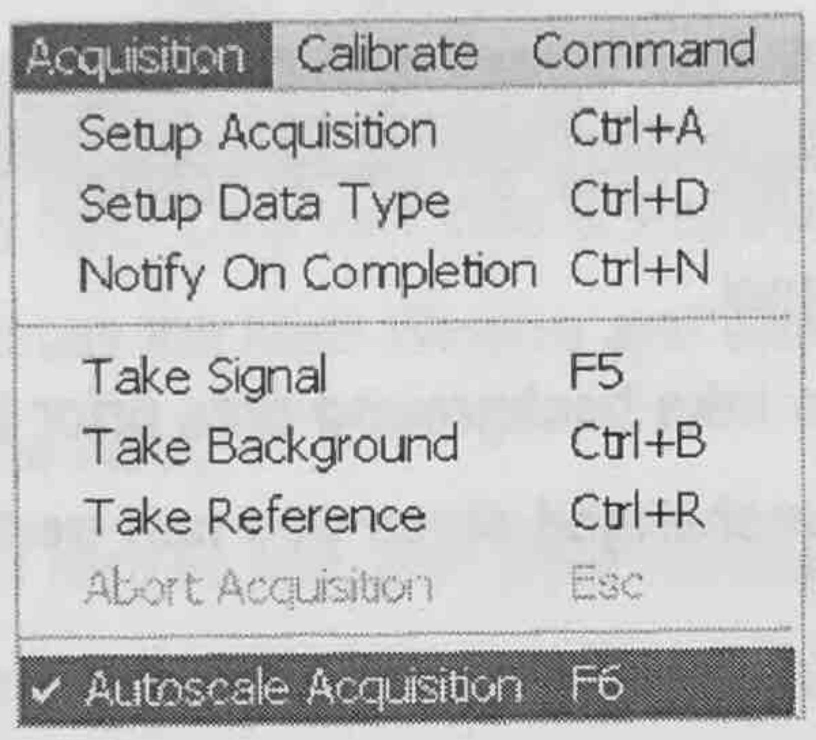
From the **Acquisition** drop-down menu on the Main Window, you can make the following data acquisition selections:

- **Take Signal**
- **Take Background**
- **Take Reference**

Provided you do not change the acquisition parameters, the scans you take for background and reference are automatically used for subsequent data acquisitions whenever you perform Take Signal.

Take Signal (Autoscale Acquisition OFF)

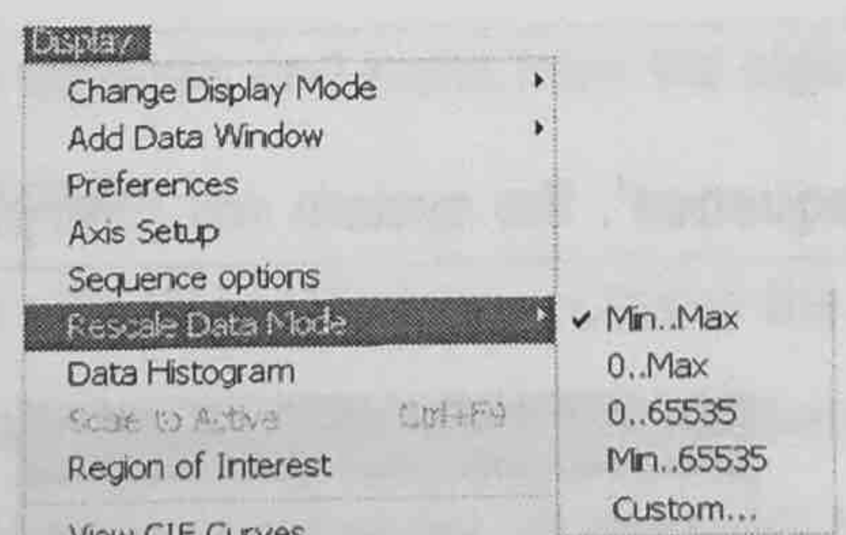
Autoscale Acquisition can be selected from the Acquisition drop-down menu as shown (or press F6 on the keyboard):



With Autoscale Acquisition deselected, the display will remain the same size regardless of brightness settings, etc. When selected off, the button appears (click this button to switch back on).

Take Signal (Autoscale Acquisition ON)

With Autoscale Acquisition selected, the system will configure the Acquisition Window (if necessary adjusting its scales in real time) so that all data values are displayed as they are acquired. The button appears when selected on. The data are displayed in accordance with the selection made on the **Rescale Data Mode** on the **Display** Menu:



You can choose to display values between the following parameters:

Minimum & maximum **(Min..Max)**

Zero & maximum **(0..Max)**

Zero & 65535 **(0..65535)**

Minimum & 65535 **(Min..65535)**

Custom setting as required.

For further information on **Rescale**, please refer to **page 114**.

Take Background

The **Take Background** option of the Acquisition drop-down menu instructs the system to acquire raw background data.

These are as counts of the Acquisition Window. No calculations are performed on these data.

The data type you select via Setup Data Type on the Acquisition Menu may require you to perform Take Background before you perform Take Signal.

NOTE: You do not necessarily have to take background data prior to each acquisition of signal data. If the data acquisition parameters remain unchanged since you last performed Take Background, then no <u>new</u> background data are required.

Take Reference

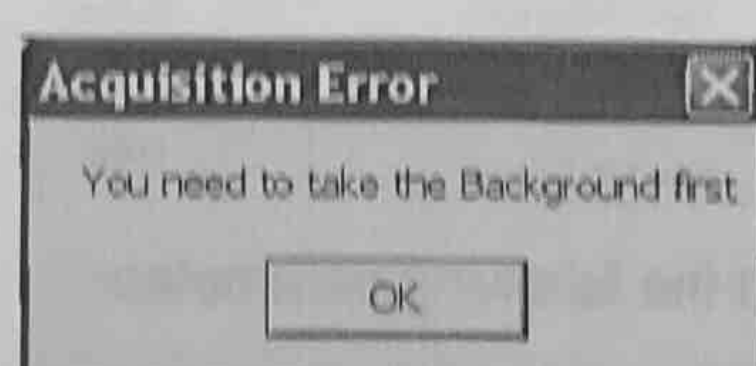
The **Take Reference** option of the Acquisition drop-down menu instructs the system to acquire background corrected data that will be used subsequently in calculations that require a reference value. Before executing this function you must therefore perform a **Take Background**.

The data you acquire using Take Reference are displayed as counts minus background under the **Ref** tab of the Acquisition Window.

NOTE: The data type you select via Setup Data Type on the Acquisition Menu may require you to perform Take Reference before you perform Take Signal.

Acquisition Errors

If you perform an operation '**out of sequence**', the system will prompt you by launching an **Acquisition Error** message, e.g.



The **Window** menu offers a number of options which help you manage the data windows or icons that you have created while working with the system. Table 8 below explains the available options.

TABLE 8: WINDOW OPTIONS

OPTION	DESCRIPTION
CASCADE	Arranges any open Data Windows or Program Editor Windows) into a stack which runs diagonally across the Main Window and allows you to see the title bars of each of the windows in the stack.
TILE HORIZONTAL	Arranges and resizes any open Data Windows or Program Editor Windows so that all run the full width of, and are fully visible within, the Main Window. Any icons that have been created within the system will be arranged into a row starting at the bottom left of the screen.
TILE VERTICAL	Arranges and resizes any open Data Windows or Program Editor Windows so that all run the full height of, and are fully visible within, the Main Window. Any icons that have been created within the system will be arranged into a row starting at the bottom left of the screen.
ARRANGE ICONS	Places in a row (starting at the bottom left of the screen) any icons that have been created within the system.
CLOSE ALL	Removes all windows and icons from the Main Window. You will be prompted to save any unsaved data.
COPY TO CLIPBOARD	For use only with Data Windows - Copies the contents of the active Data Window into the Windows clipboard. Data which have been copied to the clipboard can be pasted into other Windows applications, where it will be treated as a picture or 'bitmap'.

In addition to the window-handling options described, the Window Menu displays a list below the Copy to Clipboard option of any open Data Windows or Program Editor Windows or are currently iconized within the system. When the name of the window or icon in the list is selected, the corresponding window or will be brought to the front of the Main Window (if the Data Window or Program Editor Window was iconized it will now be opened as well).

ACQUISITION MODES & TIMINGS

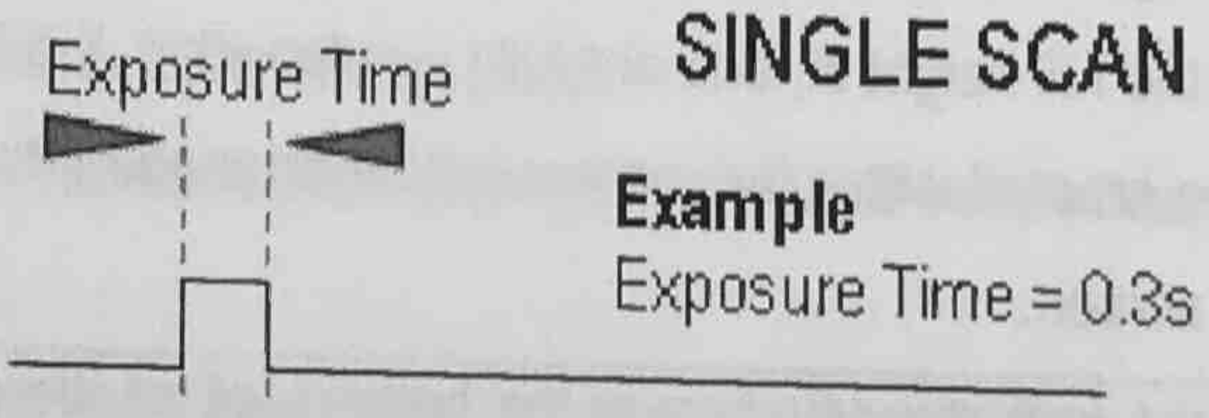
An acquisition is taken to be the complete data capture process that is executed whenever you select Take Signal, Take Background, or Take Reference from the Acquisition Menu or whenever you click the Take Signal button.

By contrast, a scan (an **'Acquired Scan'** in the definitions that follow) is **1x readout** of data from the CCD-chip. Several scans may be involved in a complete data acquisition.

The minimum time required for an acquisition is dependent on a number of factors, including the **Exposure Time (i.e. the time in seconds during which the EMCCD collects light prior to readout.)** and the **Triggering** mode. Triggering modes are described in more detail later in this section.

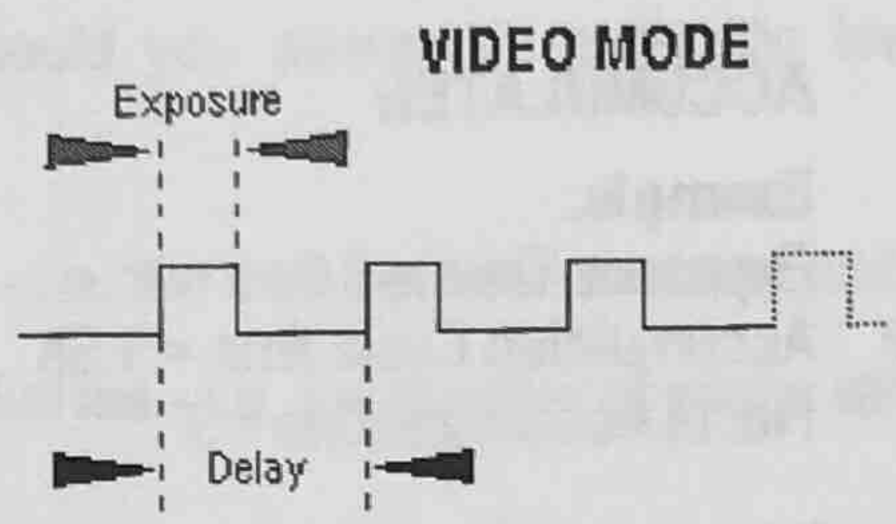
Single

Single scan is the simplest acquisition mode, in which the system performs one scan of the CCD.



NOTE: Should you attempt to enter too low a value, the system will default to a minimum Exposure Time.

If you click the [button] button, the system repeatedly performs a single scan and updates the data display.

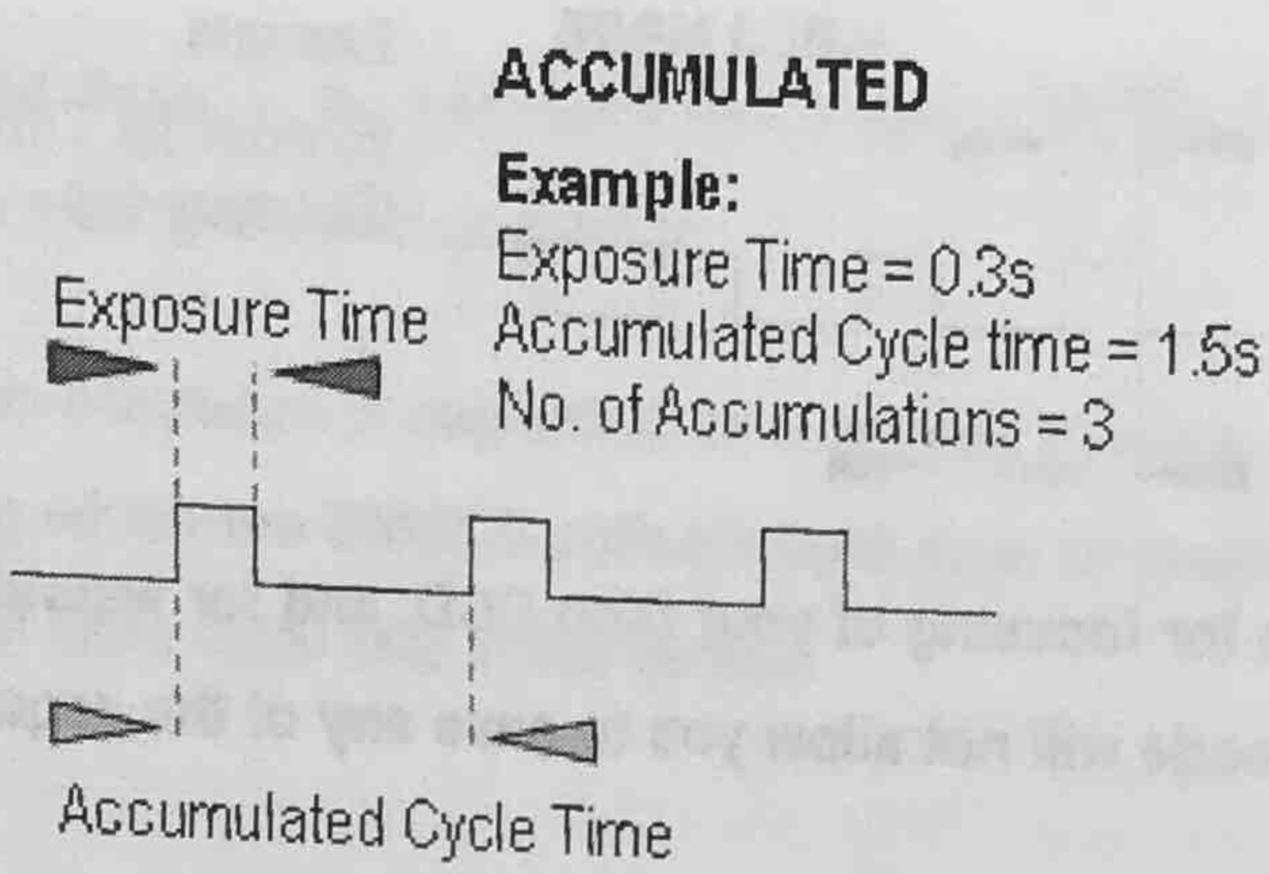


Example

Exposure Time = 0.3
Delay = 1 s

NOTE: This is a useful mode for focusing of your iXon CCD, and for watching experimental events happening in real time. However, this mode will not allow you to save any of the acquired images or data, except for the last frame of the sequence.

Accumulate mode allows you to add together in computer memory the data from a number of scans to create an **'Accumulated Scan'** e.g.:



You can select the following parameters in the Setup Acquisition dialog box:

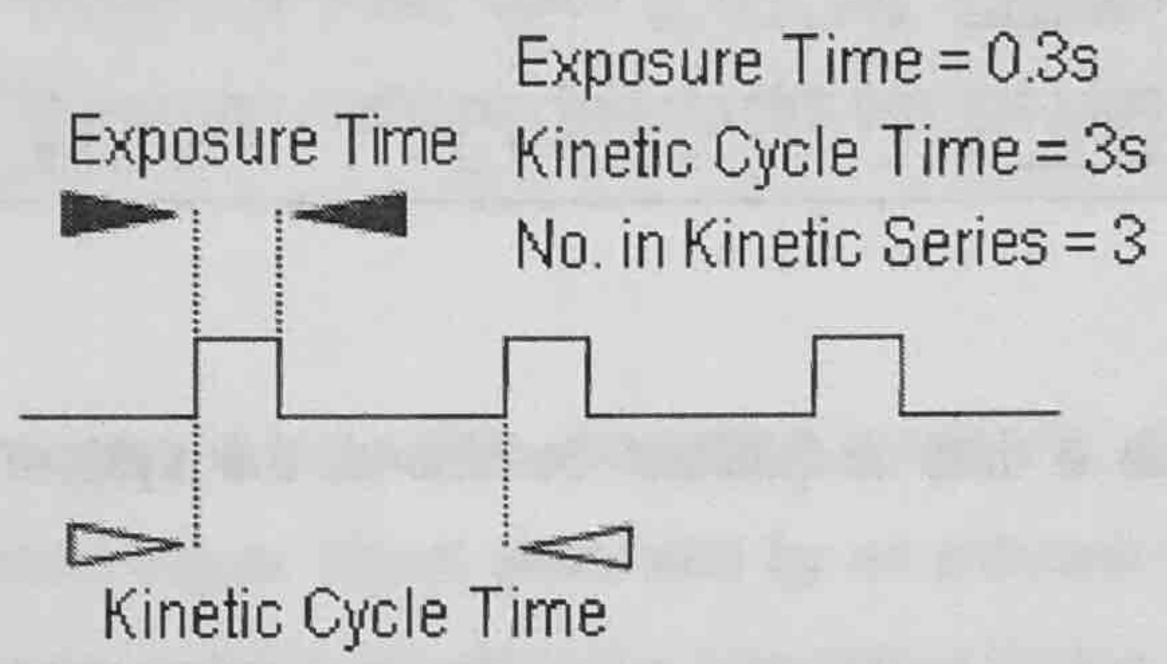
- **Exposure Time**
- **Accumulated Cycle Time** - i.e. the period in seconds between each scan. This parameter is only available if you have selected **Internal triggering** (please refer to **Triggering Modes** later in this section.)
- **No. of Accumulations -** i.e. the number of scans you want to add together.

NOTE: This mode is used to improve the signal to noise ratio.

In the Setup Acquisition dialog box you can key in the following parameters:

- **Exposure Time** (should you attempt to enter too low a value, the system will default to a minimum Exposure Time).
- **Kinetic Cycle Time** - i.e. the time between the start and finish of each kinetic scan.
- **Number in Kinetic Series** - i.e. the number of scans taken in the kinetic series.

KINETIC SERIES



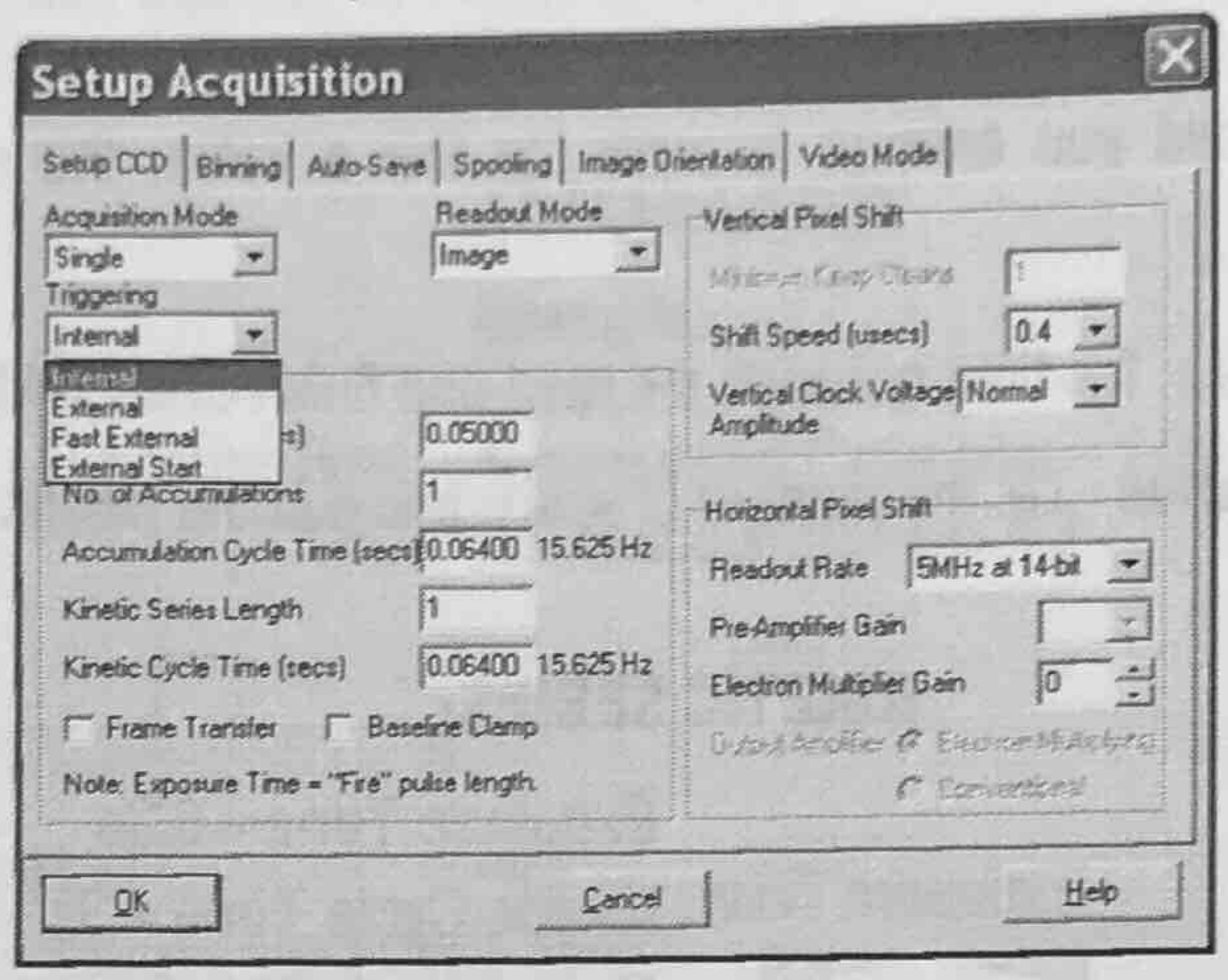
NOTE: This mode is particularly well suited to recording the temporal evolution of a process.

FRAME RATES

The **Kinetic Cycle Time** can also be act as a useful guide to the Frame Rate your camera is operating at. Depending on the Acquisition parameters you set, i.e. **Vertical Shift Speed**, **Binning or Sub Image Patterns**, **Cycle Time** and whether **External Trigger** is being used, the **Kinetic Cycle** Dialog box will display a Hz figure. As a guide 1 Hz equals 1 frame per second.

If **External trigger** is selected the **Kinetic Cycle** dialog box will indicate the maximum achievable frame rate.

The **Triggering** modes are selected from a drop-down list on the Setup Acquisition dialog box:



Internal

In **Internal** mode, once you issue a data acquisition command, the system determines when data acquisition begins.

You can use Internal mode when you are able to send a trigger signal or '**Fire Pulse**' to a short-duration, pulsed source (e.g. a laser). In this case starting data acquisition also signals the pulsed source to fire. The **Fire Pulse** is fed from the **Fire** SMB connector on the detector.

Internal Trigger Mode is also used with '**C**ontinuous **W**ave' (**CW**) sources (e.g. an ordinary room light) where incoming data, for the purposes of your observation, are steady and unbroken. This means that acquisitions can be taken at will.

External

In **External** mode once you issue a data acquisition command, data will not be acquired until your system has received an External Trigger signal generated by an external device (e.g. a laser). The External Triggering signal is fed to the **Ext Trig** SMB connector on the rear of the detector.

NOTE: If you have a shutter connected, and are using External Triggering, you must ensure that the shutter is open before the optical signal you want to measure occurs.

Fast External

Normally, when using **External Trigger** the system will only enable the triggering of the system after a complete **Keep Clean** Cycle has been performed. This is to ensure that the CCD is always in the same known state before it is triggered. This is particularly important when the system is in Accumulation or Kinetics mode. In cases were repetition rate is paramount, and slight variation in the base background level is less important, it is possible to remove this restriction by using **Fast External** triggering. **The Keep Clean process is continuous on the iXon and any delay is negligible**.

NOTE: If you need Maximum Repetition Rate, have a shutter connected and are using Fast External triggering, you must ensure that the shutter is open before the optical signal you want to measure occurs.

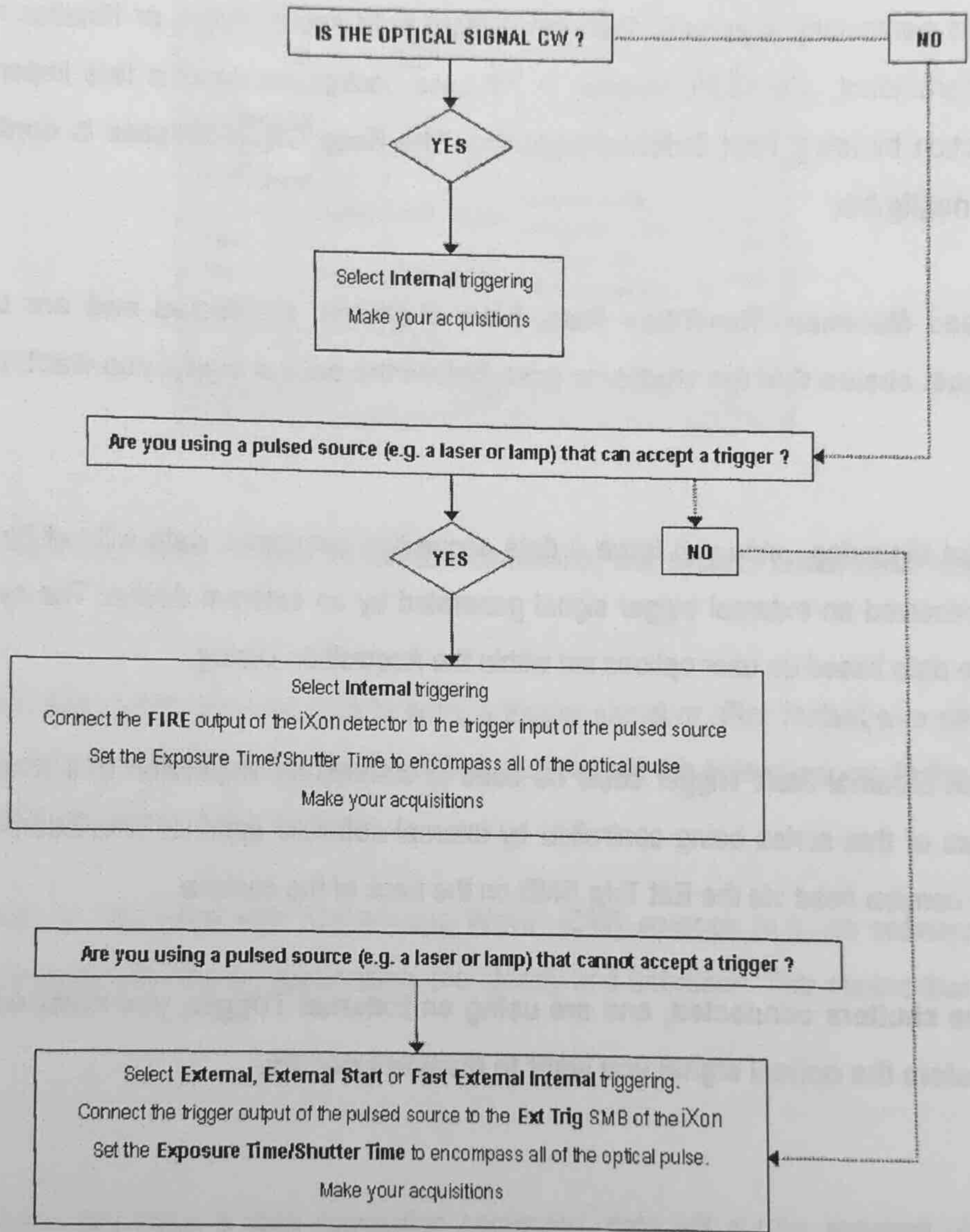
External Start

With **External Start** triggering, once you issue a data acquisition command, data will not be acquired until your system has received an external trigger signal generated by an external device. The system will then continue to acquire data based on user options set within the Acquisition Dialog.

This means that an External Start Trigger could be used to commence acquisition of a Kinetic series, but with the parameters of that series being controlled by internal software options. The External Start trigger signal is fed to the camera head via the **Ext Trig** SMB on the back of the camera.

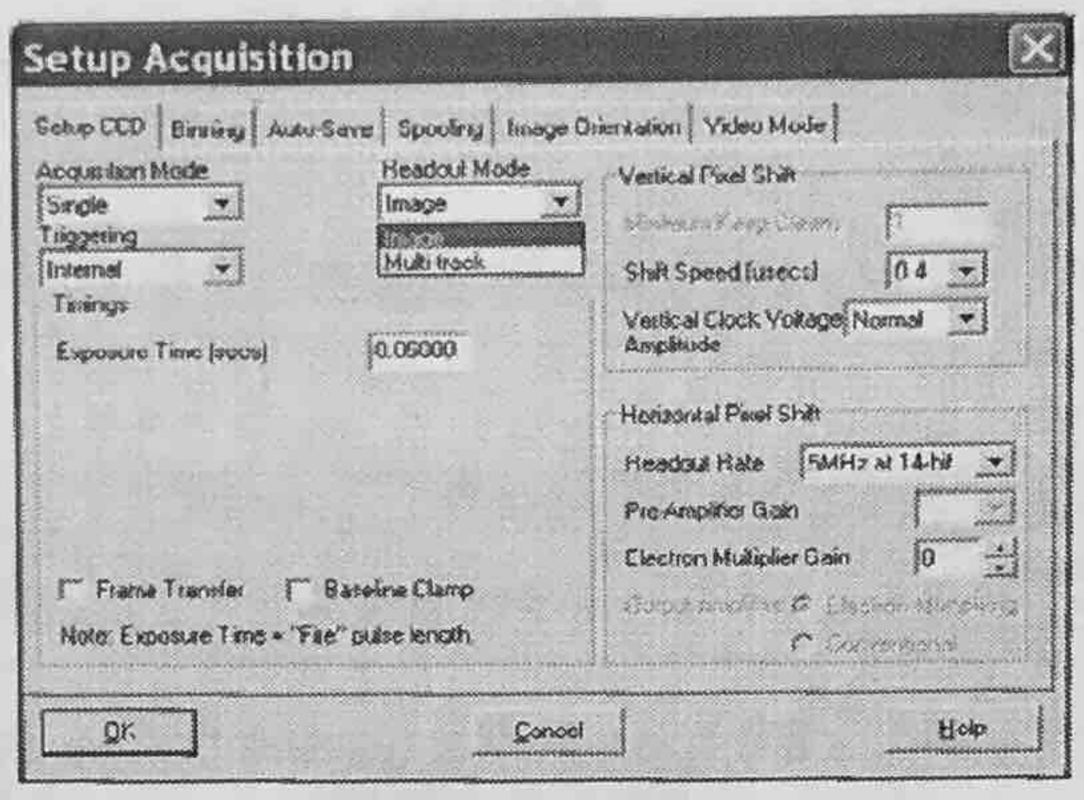
NOTE: If you have shutters connected, and are using an External Trigger, you must ensure that the shutter is open before the optical signal you want to measure occurs.

The following flowchart will help you decide whether you should use **Internal**, **External**, **External Start** or **Fast External** triggering.

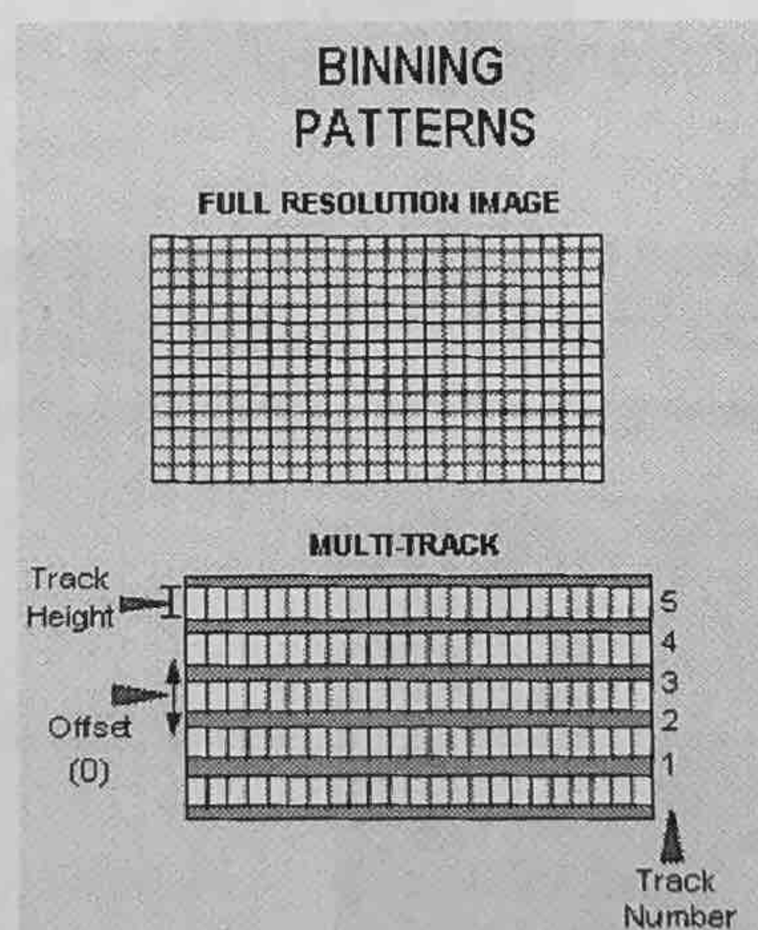


The **Readout Modes** available from the Setup Acquisition dialog box let you use the CCD chip at the heart of the detector to collect/readout data. The options available are as follows:

- Image
- Multitrack



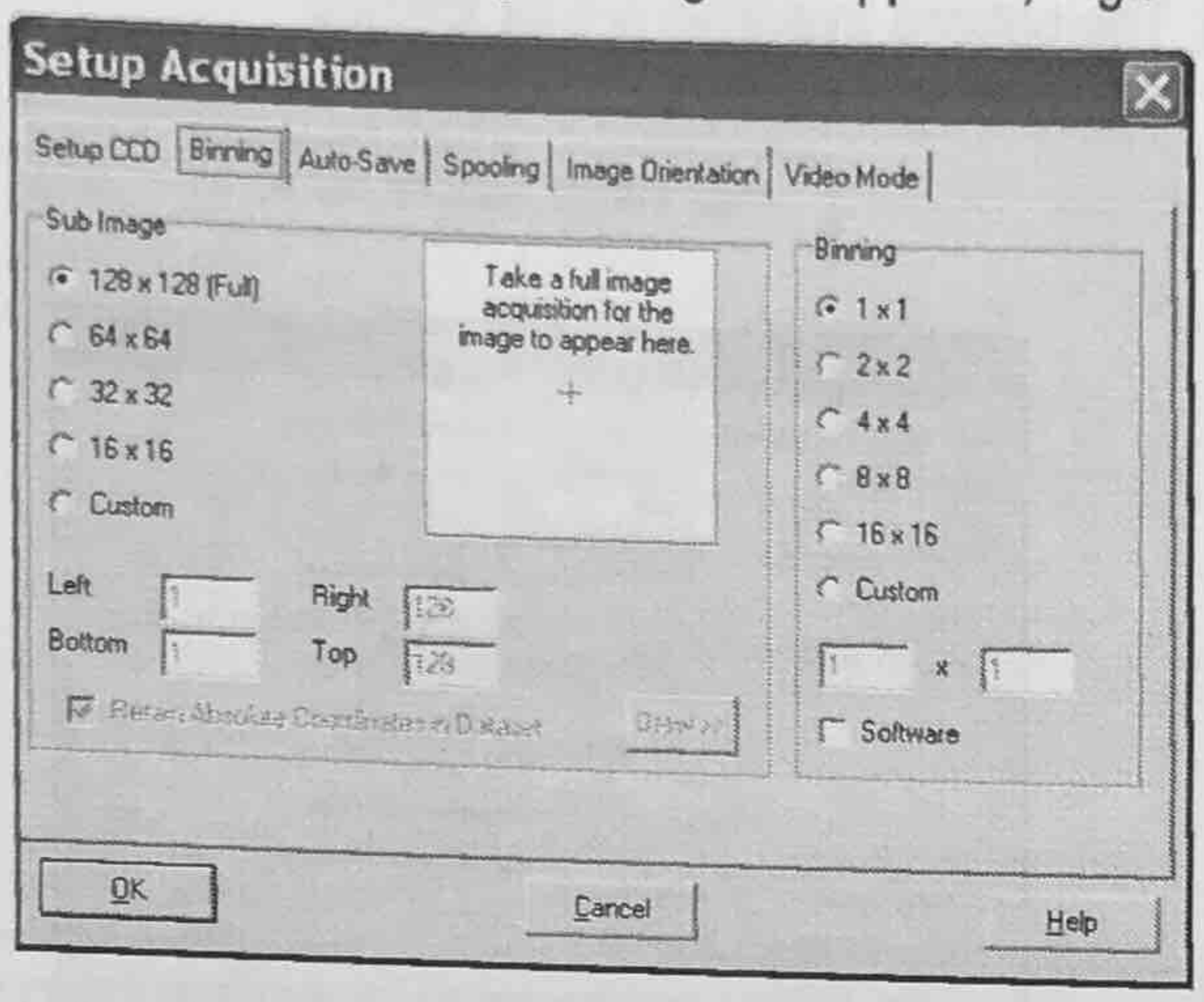
The **Binning** patterns used in each readout mode are as follows:



Binning is a process that allows charge from two or more pixels to be combined on the CCD-chip prior to readout. For a full explanation of binning please go to **page 179**.

NOTE: The examples given in this manual to illustrate the use of binning patterns are based on a 30-11 chip with 1024 x 256 pixels, each pixel measuring 26 μm².

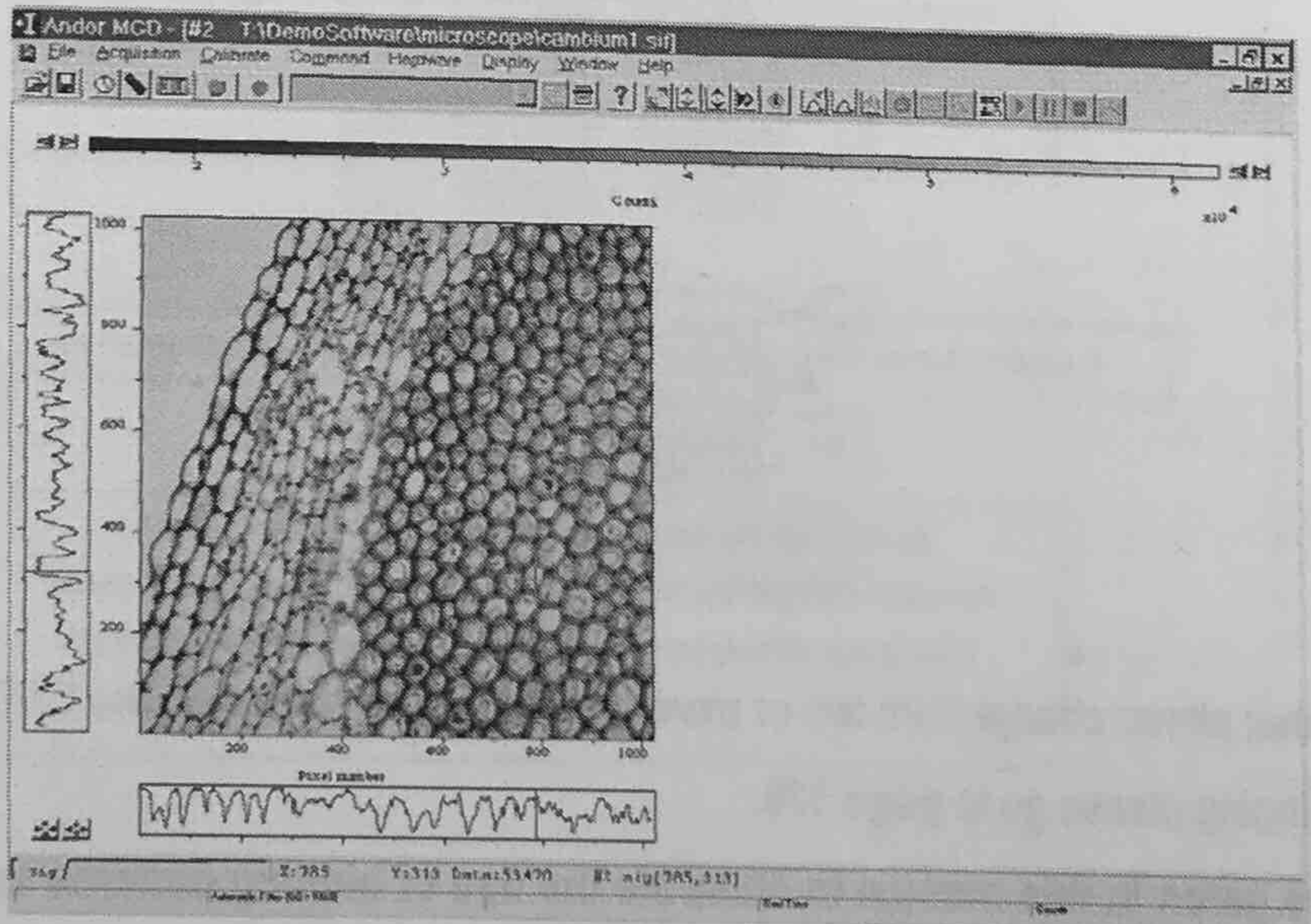
When the **Setup Image** tab is clicked, the **Setup Image** dialog box appears, e.g.:

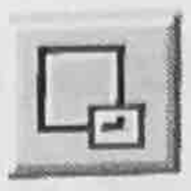


The user can then to set and control various **Binning Patterns** and define **Sub Images** of the iXon CCD.

By default, taking an Acquisition supplies you with a count from each pixel on the CCD, in effect allowing you to take a picture of the light pattern falling on the pixel matrix of the EMCCD.

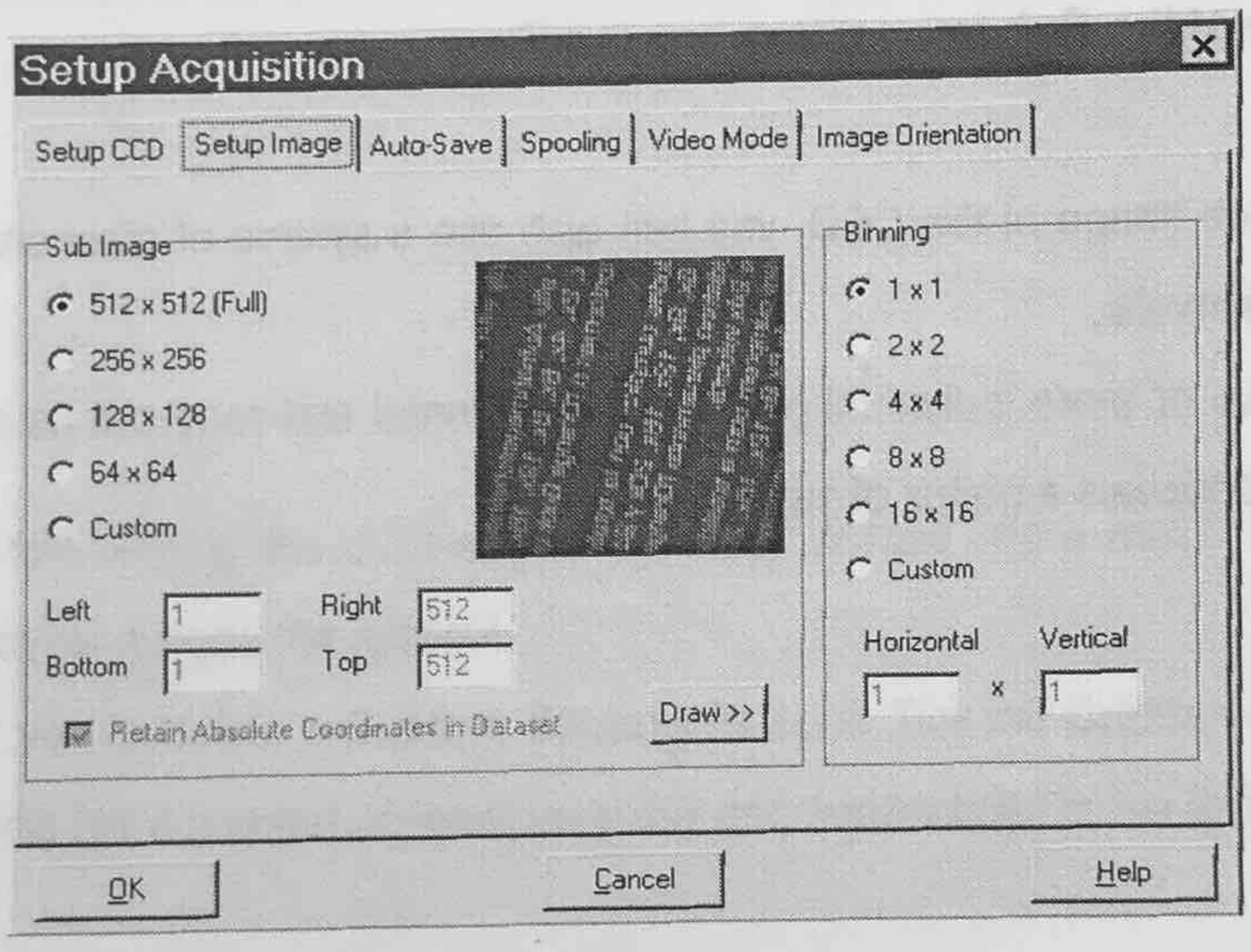
This default is referred to as a **Full Resolution Image**. The image may be viewed in grayscale or false color, or it may be displayed as 2D or 3D traces, e.g.:



For the purpose of initial focusing and alignment of the camera, or to increase the readout speed, you may use the software to select a **Sub Image** of the chip. To select Sub Image mode, click on the  button

When the iXon is running in Sub Image mode, only data from the selected pixels will be readout. Data from the remaining pixels will be discarded.

To read out data from a selected area, or **Sub Image**, of the CCD use the radio buttons to select the resolution, which you require, e.g.:



The software offers a choice of three defined sub images:

- 256 x 256 pixels
- 128 x 128 pixels
- 64 x 64 pixels.

There is also an option for you to define a **Custom** Sub Image. This function allows you to set the Sub Image to any size and location on the CCD chip. To define a Custom Sub Image tick the **Custom** button, then use the co-ordinate entry dialogue boxes to select the size and location of your sub image.

DRAW

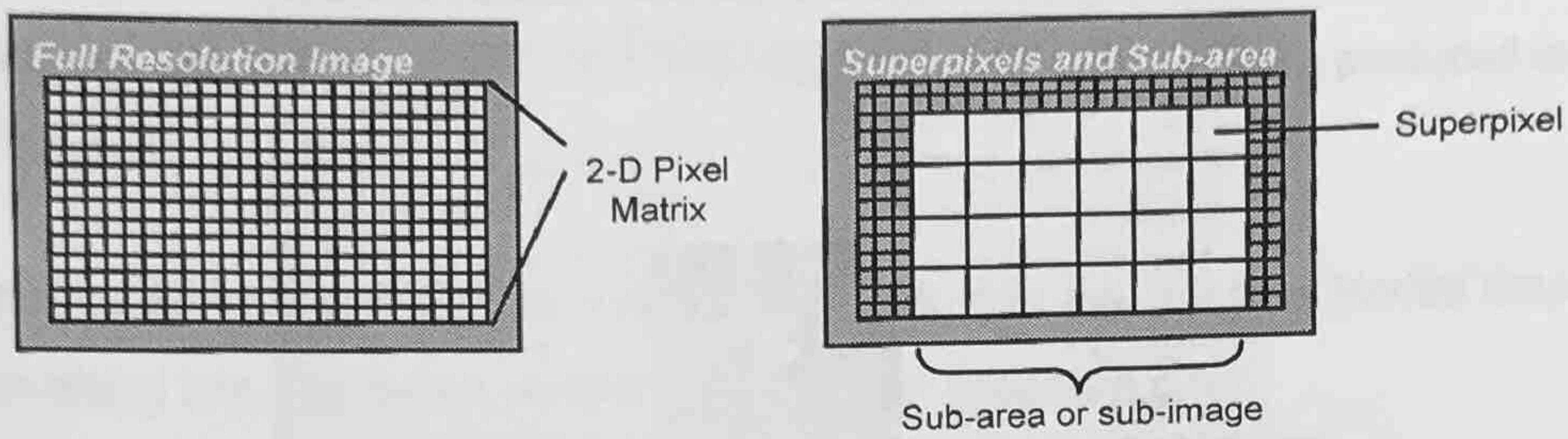
In addition to the previous methods of defining a Sub Image on the CCD, you can also use the Draw Option to select the size and location of your Sub Image. In order to use the Draw Option, you must first acquire a full resolution image. This will be the template on which you will draw your Sub Image.

Click on the [Draw >>] button then use the Draw tool to select the size and position of your Sub Image by dragging rulers form the X and Y-axis.
Alternatively, a Sub Image can be drawn on the template by positioning your cursor on the image, and dragging out the shape of the Sub Image area you require.

SUPERPIXELS

As well as selecting a Sub Image of the CCD, you can also use a system of pixel charge aggregation, known as **Binning**, to create **Superpixels**.
Superpixels consist of two or more individual pixels that are binned and read out as one large pixel: the CCD, or your selected sub-area, becomes a matrix of superpixels.

The horizontal and vertical **Binning** parameters determine the dimensions of any **superpixels** you may choose to create.



The software presents a selection of five of the most common binning patterns:

- 1x1 pixels
- 2x2 pixels
- 4x4 pixels
- 8x8 pixels
- 16x16 pixels.

For example, if you enter 4x4 binning the CCD-chip is notionally divided into a matrix of superpixels which each measure 4x4 pixels and provide a signal for readout.

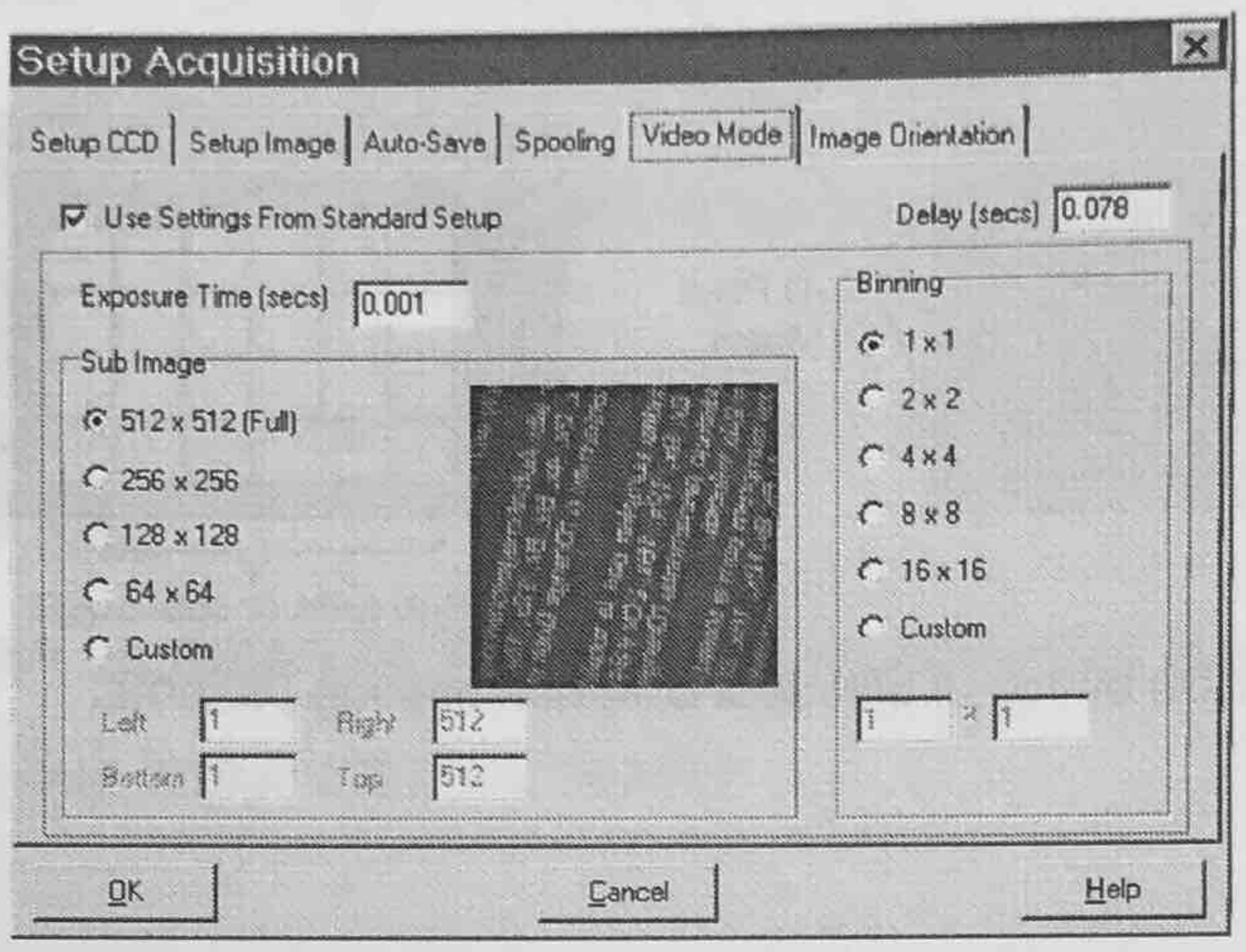
There is also an option for you to define a **Custom Binning Pattern.** Tick the **Custom** radio button and enter the dimensions of the superpixels (as a number of pixels vertically and horizontally) in the text boxes.

Working with Superpixels

By a process of binning charge vertically into the shift register from several rows at a time (4 rows in the above example, representing the height of your superpixels) and then binning charge horizontally from several columns of the shift register at a time (4 columns in the example, representing the width of the superpixels), the system is effectively reading out charge from a matrix of superpixels which each measure 4x4.

The result is a more coarsely defined image, but faster processing speed, lower storage requirements, and potentially a better **signal to noise ratio** (since for each element or superpixel in the resultant image, the combined charge from several pixels is being binned and read out, rather than the possibly weak charge from an individual pixel).

When the **Video Mode** tab on the Setup Acquisition dialog box is clicked , the Video Mode dialog box opens, e.g.:



When the **Use Settings From Standard Setup** option is selected, the following parameters can be adjusted :

- **Exposure Time**
- **Delay (i.e. the time you require between scans).** If you attempt to enter too low a value, the system will default to a minimum delay.
- **Resolution (Sub-image area)**
- **Binning pattern**

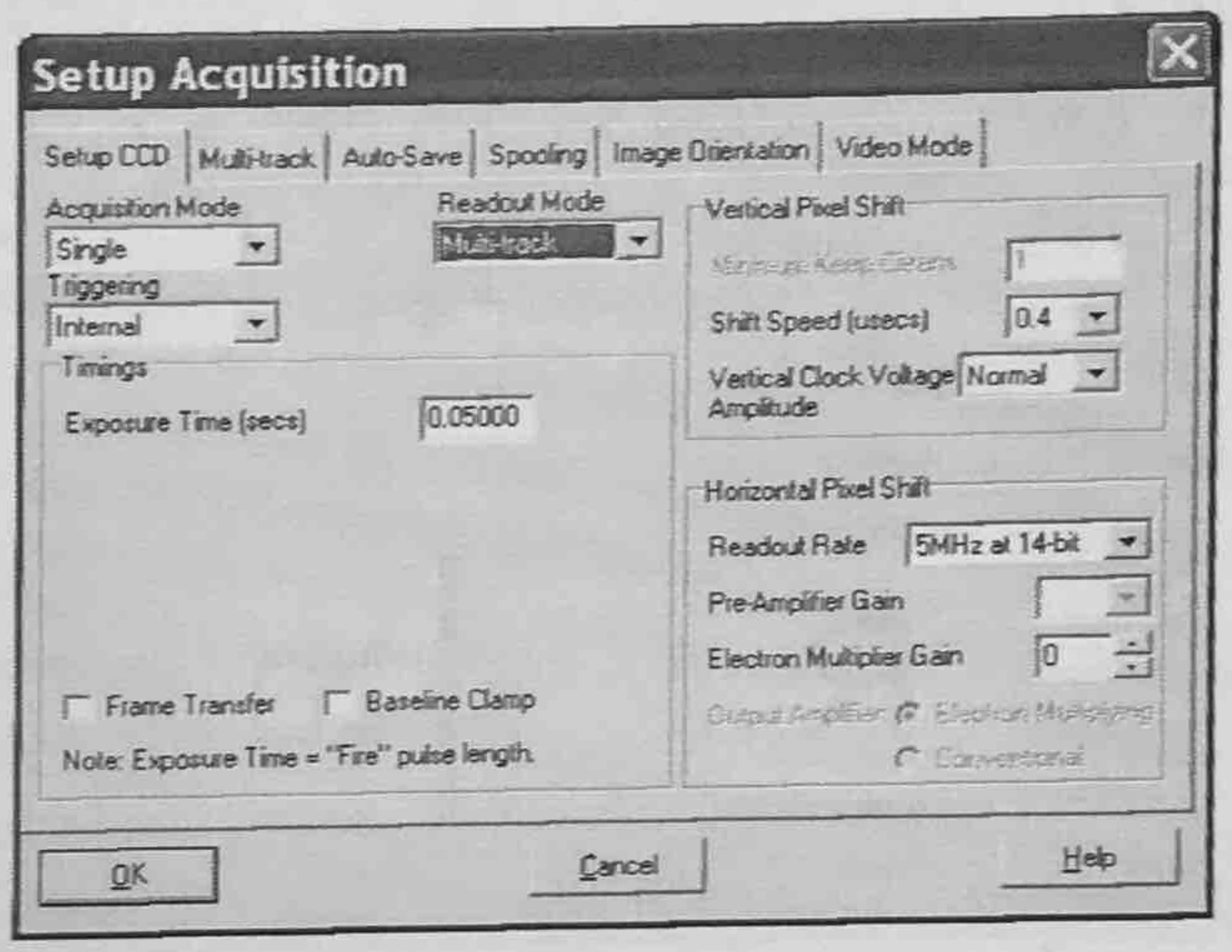
The system will acquire data only as quickly as the data can be displayed. If you perform Take Background or Take Reference in video Mode, the system will perform one scan only rather than repeatedly performing a scan at the delay indicated. New data will continue to be acquired and displayed until you either :

- Select **Abort Acquisition** from the **Acquisition** Menu .
- Click the button
- Press the **<ESC>** key.

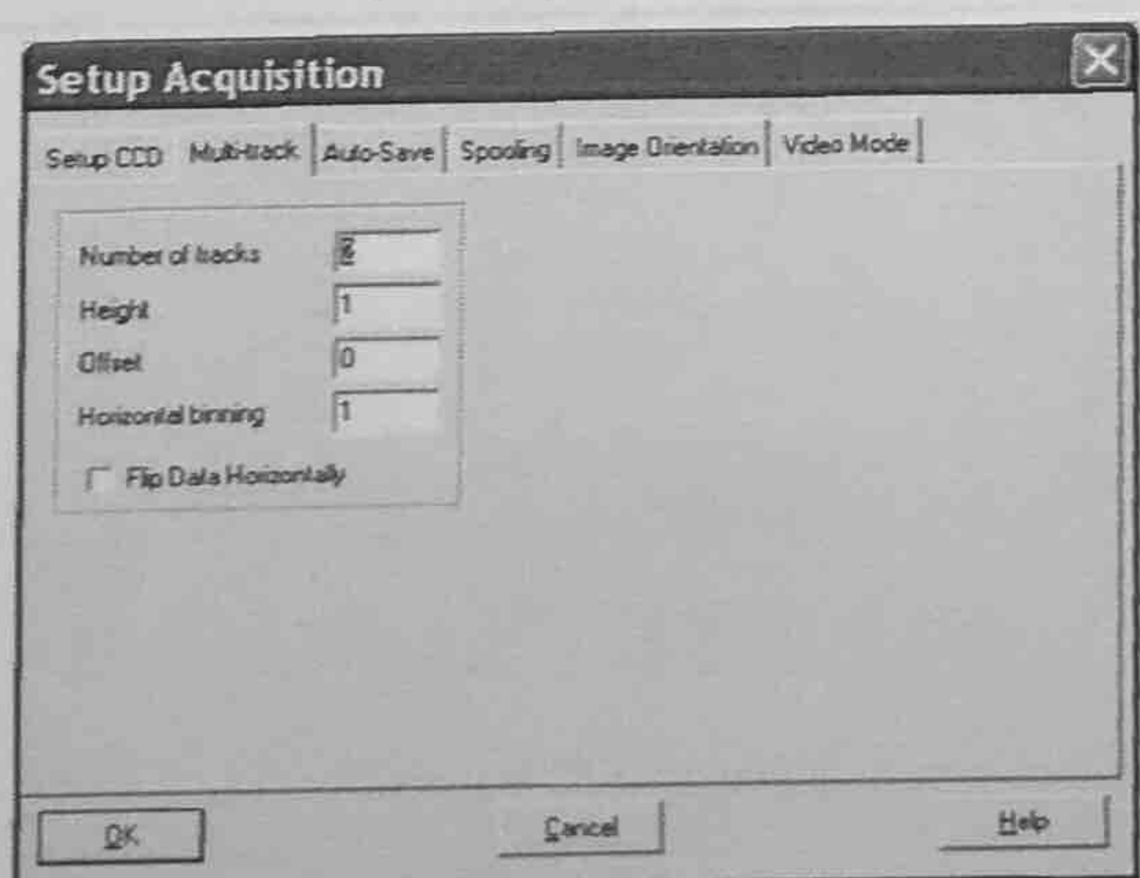
This stops any data capture process that may be under way.

Multi-Track mode allows you to create one or more tracks. You can define (in rows) the height of each track, and the offset, which in effect 'raises' or 'lowers' on the CCD-chip the pattern of tracks from which you will readout charge. In this way you can adjust the position of the tracks to match a light pattern produced on the CCD-chip by a fiber bundle, for example.

To define multiple tracks on the CCD-chip, select **Multi-track** from the Readout Modes drop-down menu in the Setup Acquisition dialog box. The **Setup Multi-track** dialog box appears e.g.:



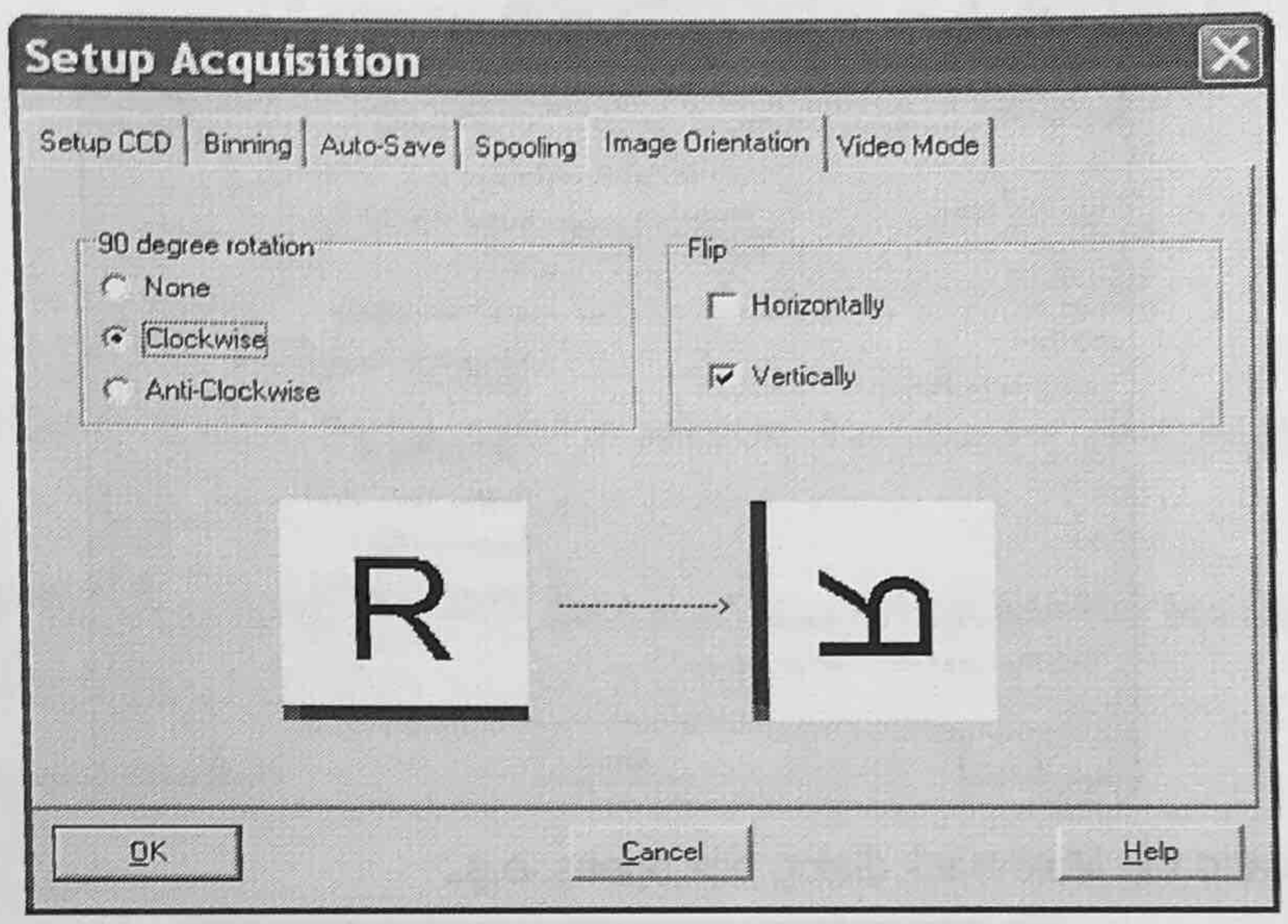
Click the **Multi-track** tab and the Multi-track dialog box opens, e.g.:



Type in the required parameters then click **OK.**

In **Image** mode, the data can also be orientated as they are acquired. This is particularly useful if the CCD-chip has a readout register along its short, vertical edge. Without rotation, images would by default appear sideways on screen.

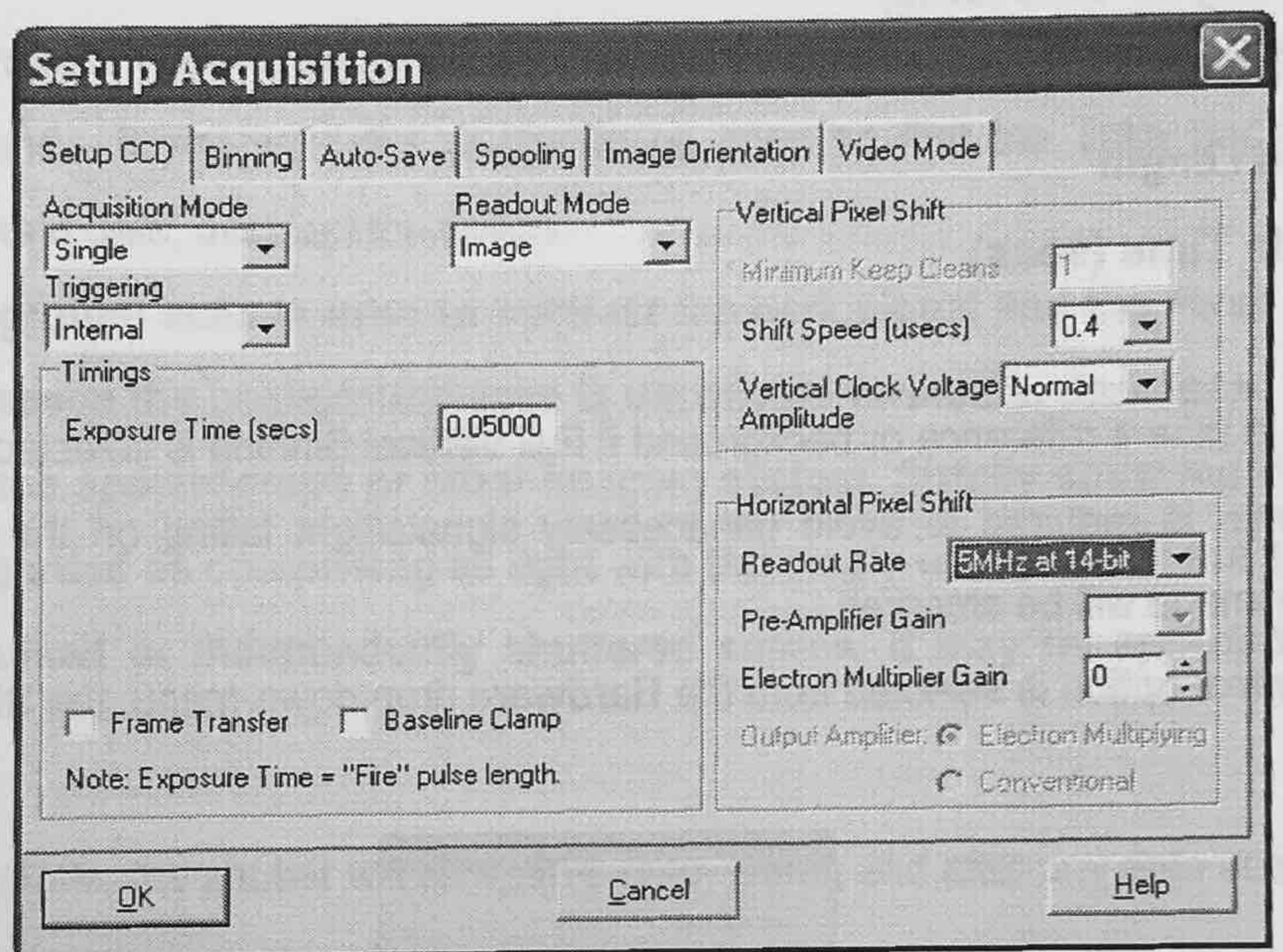
To orientate the image data, click the **ImageSpectral Orientation** tab on the Setup Acquisition dialog box, then select the required parameters with the appropriate check buttons, e.g.:



READOUT RATE

The Horizontal Pixel Shift Readout Rate defines the rate at which pixels are read from the shift register. The faster the Horizontal Readout Rate the higher the frame rate that can be achieved. Slower readout rates will generate less noise in the data as it is read out.

The rate can be selected from a drop-down list on the Setup Acquisition dialog box:



TIMING PARAMETER

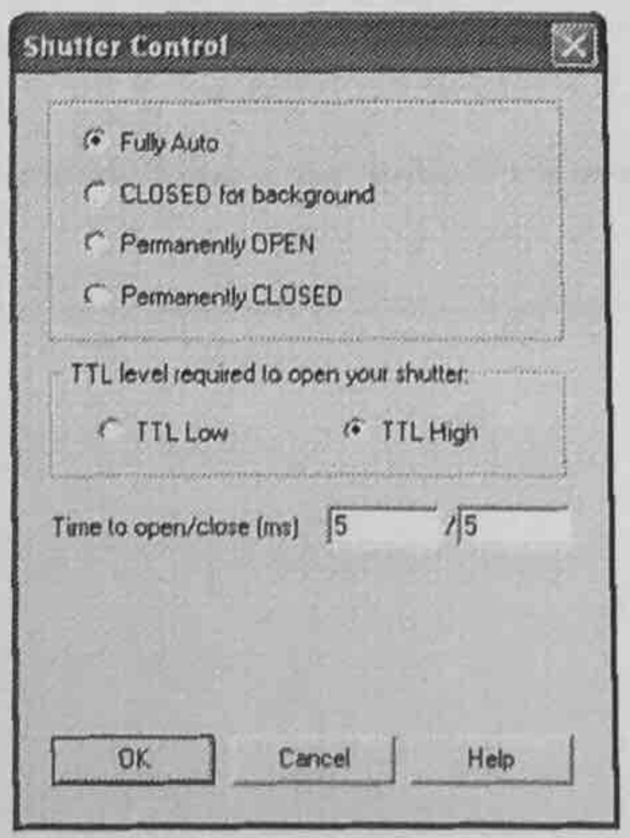
Depending on which combination of Acquisition, Readout & Triggering modes is selected, various timing parameters are available as follow:

- **Exposure Time (secs)**
- **No. of Accumulations**
- **Accumulation Cycle Time (secs)**
- **Cosmic Ray Removal**
- **Kinetic Series Length**
- **Kinetic Cycle Time (secs)**

SHUTTER

A shutter can be used to take a reference or background if Full Vertical Binning is selected. For either Multi-Track or Image mode, the shutter is required to avoid unnecessary signals/light falling on the CCD during the readout process; otherwise the image will be smeared.

When the **Shutter Control** option is selected from the **Hardware** drop-down-menu, the **Shutter Control** dialog box opens e.g.:



You can use this to indicate when and how a hardware shutter should be used. With a CCD, the shutter is used for background shuttering.

Certain settings (e.g. **Permanently OPEN** & **Permanently CLOSED)** take effect as soon as you close the Shutter Control dialog box. Other settings will be applied whenever you acquire data.

Fully Auto is the simplest shutter mode, as it leaves all shuttering decisions to the system. When you perform **Take Signal** the shutter opens for the duration of the **Exposure Time** you have entered in the Setup Acquisition dialog box.

NOTE: This option will automatically provide suitable shuttering for the majority of data acquisitions. The shutter will be closed for background data acquisitions and will be opened for all other data acquisitions.

If **CLOSED for background** mode is selected, any shutter driven from the Shutter output will be closed as you perform Take Background. If you want the shutter to be open so that the Take Background function records genuine optical background data, deselect the option.

NOTE: Usually a background scan is used to subtract the dark signal and the Fixed Pattern Noise (FPN) of the sensor. For this reason the background scan is usually performed in darkness. A shutter may be used to stop light entering the spectrograph or other imaging system. Strictly speaking though, the background acquisition may be regarded as comprising all light with the single exception of the source. Thus, when you are working with a pulsed or independently shuttered source, it may be appropriate to have the mode deselected.

In **Permanently OPEN** mode, the shutter will be open before, during and after any data acquisition.

Permanently CLOSED mode can be useful if you want to take a series of acquisitions in darkness and do not require the shutter to open between acquisitions. You might, for example, wish to capture a sequence of background values. The shutter remains closed before, during and after any data acquisition.

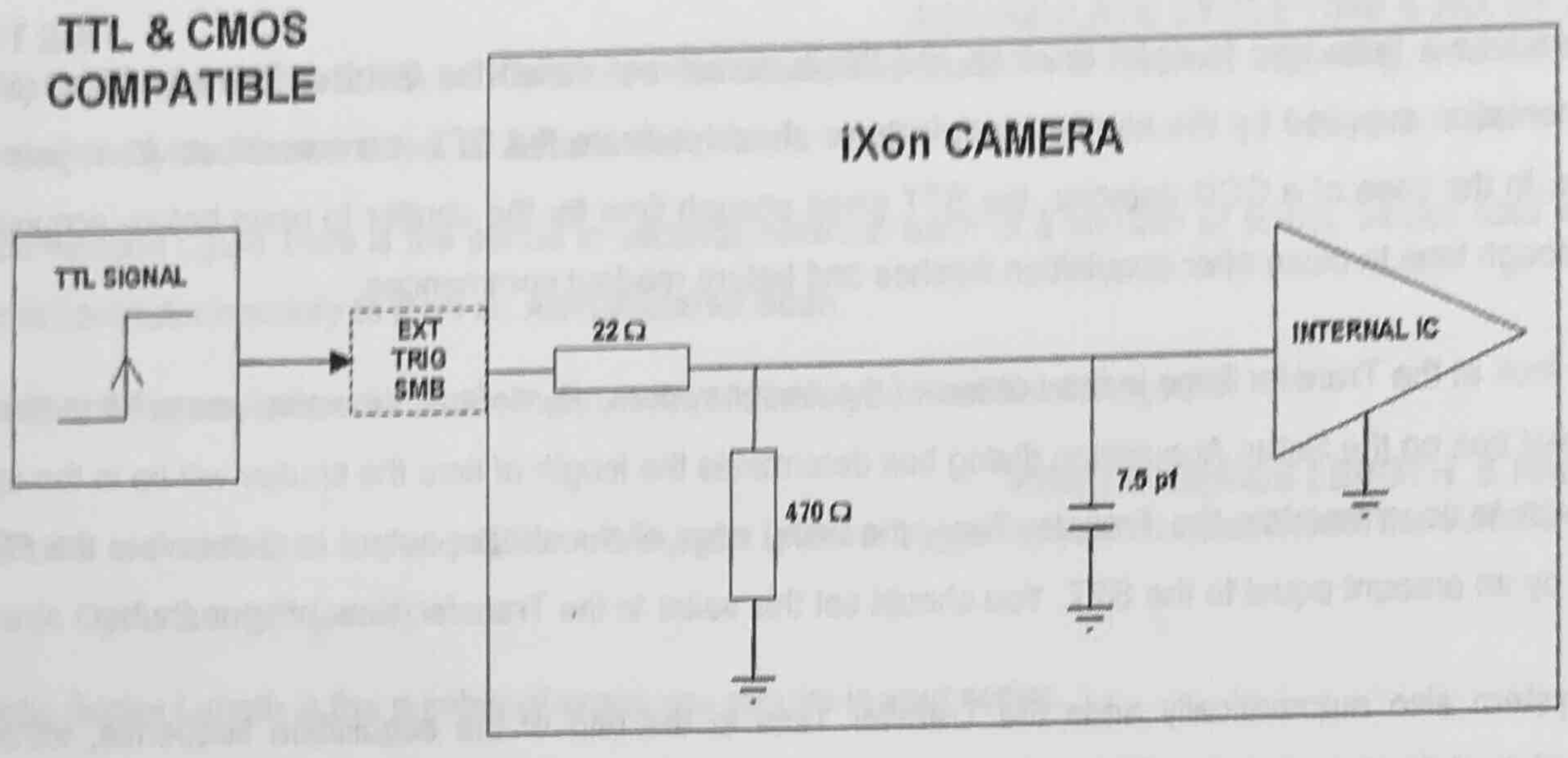
The **TTL** (Transistor-Transistor **Logic**) buttons, **TTL Low** & **TTL High,** let you instruct the system as to how it should control the opening and closing of the shutter.

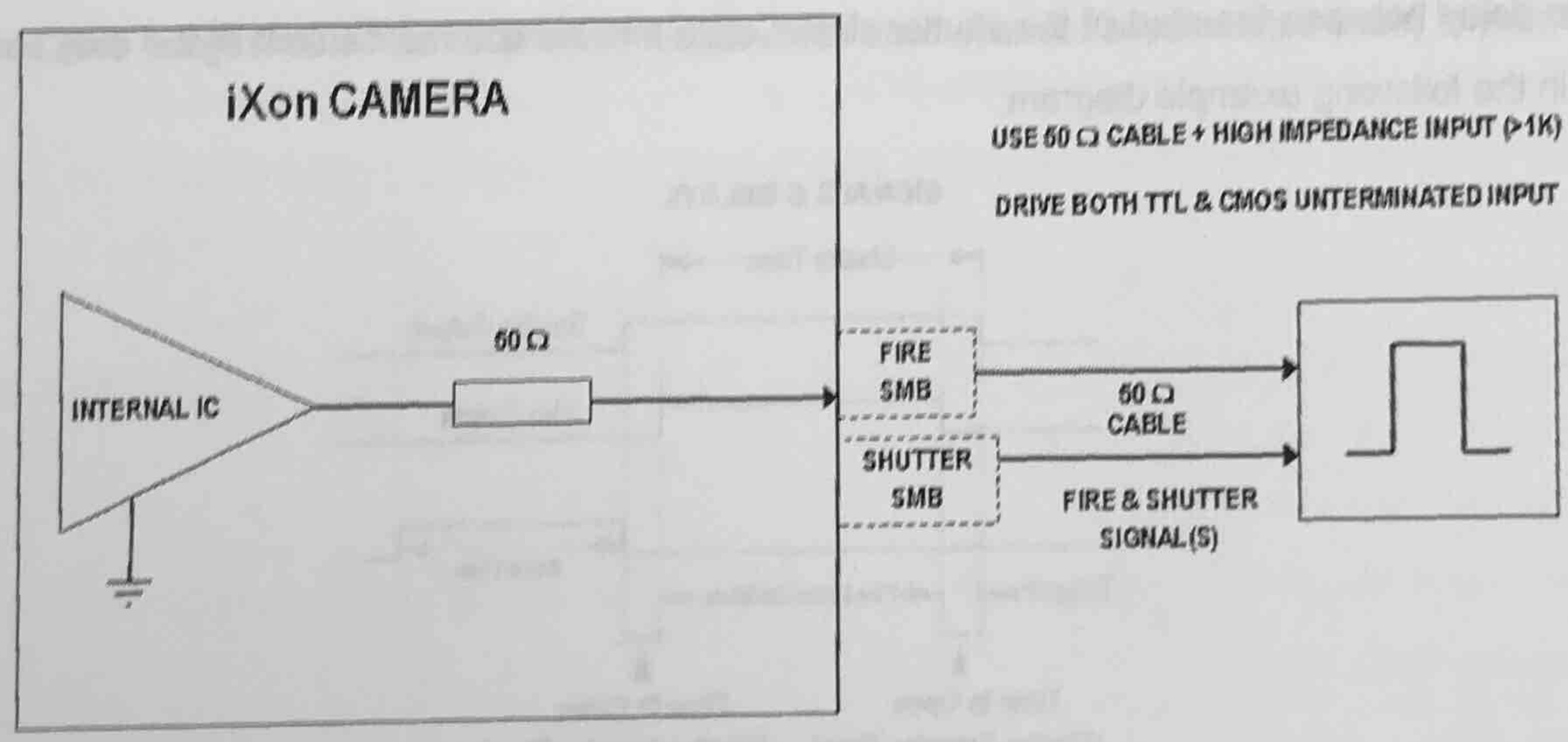
If you select **TTL Low,** the system will cause the output voltage from the iXon to go 'low' to open the shutter.

If you select TTL **High**, the system will cause the output voltage from the iXon to go 'high' to open the shutter. The documentation supplied by the shutter manufacturer will show whether your shutter opens at a high or a low TTL level.

NOTES:

1. **The iXon contains a Frame Transfer CCD device, so a shutter may not be required for most applications. If a shutter is fitted but not required for the experiment, then set it to permanently open, and Time to 0. This will allow the system to operate at its optimum rate. If a Background is required then close the shutter using Permanently Closed, take Background, and reopen.**
2. **The shutter pulse is not capable of driving a shutter. It is only a 5V pulse designed to trigger TTL & CMOS compatible shutter drivers. Also there is no shutter pulse during the Take Signal and Take Reference data acquisitions.**





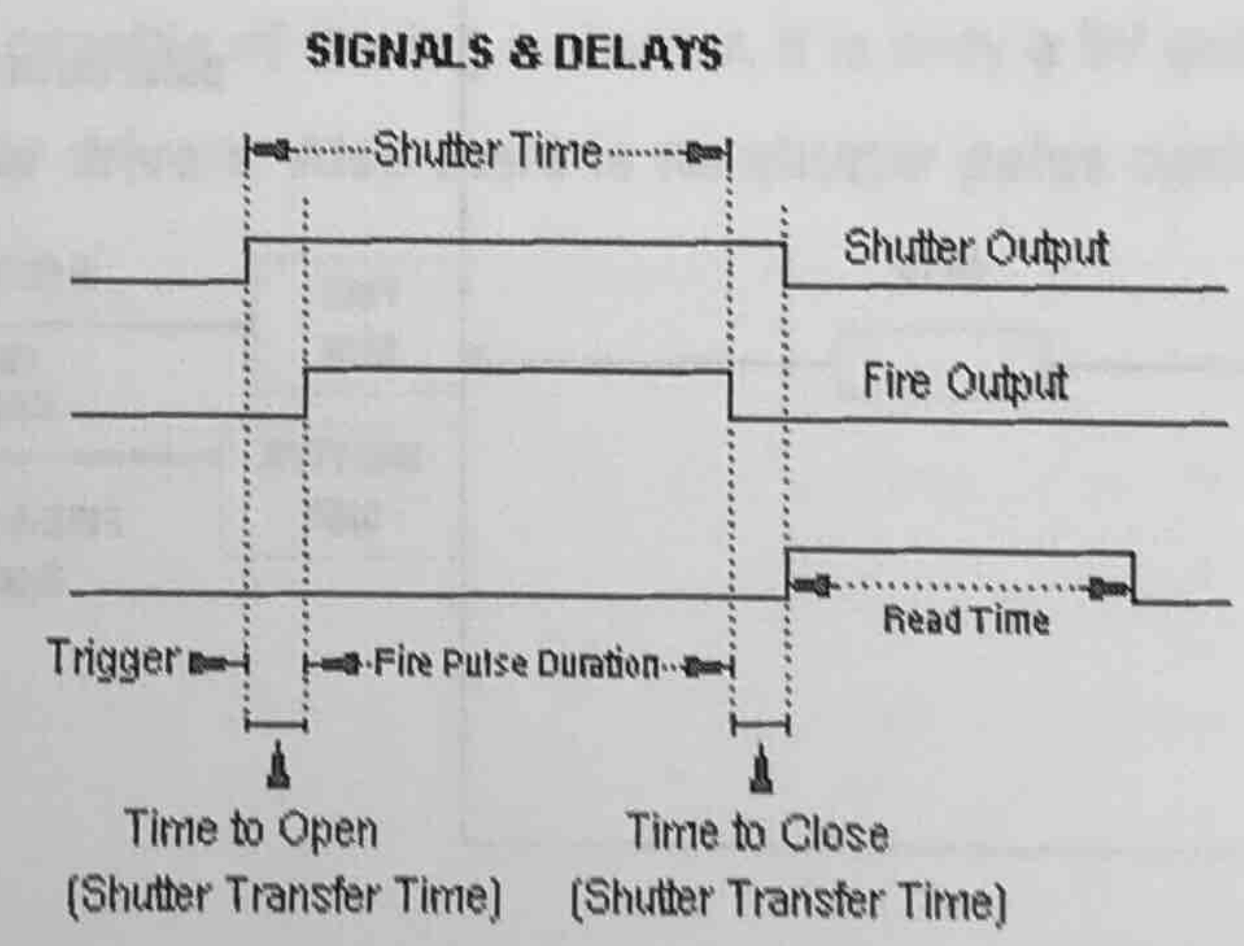
NOTE: The shutter pulse is fed from the Shutter out pin on the back of the camera.

TIME TO OPEN OR CLOSE

Shutters take a finite time to open or close and this is sometimes called the **Shutter Transfer Time** (STT). The documentation supplied by the shutter manufacturer should indicate the STT you can expect from your particular shutter. In the case of a CCD detector, the STT gives enough time for the shutter to open before acquisition starts and enough time to close after acquisition finishes and before readout commences.

Let us look at the Transfer Time in the context of the Andor system. By default, the value you enter in the Exposure Time text box on the Setup Acquisition dialog box determines the length of time the shutter will be in the open state. However, to accommodate the Transfer Time, the rising edge of the shutter output is sent before the FIRE output signal by an amount equal to the STT. You should set this value to the Transfer Time of your shutter.

The system also automatically adds the Transfer Time to the end of the acquisition sequence, introducing an appropriate delay between the start of the shutter closed state and the commencement of the data being read out as shown in the following example diagram:



If you do not have a shutter connected, set the Time to open or close to 0. Setting the Time to open or close to any other value will insert extra delays into cycle time calculations.

ACCUMULATE CYCLE TIME & NO. OF ACCUMULATIONS

If you have selected **Accumulate** or **Kinetic** as the acquisition mode, with **Internal** triggering, you can also select the **Accumulation Cycle Time** and **No. of Accumulations.**

The Accumulation Cycle Time is the period in seconds between each of a number of scans, whose data are to be added together in computer memory to form an **Accumulated Scan**.

The Number of Accumulations indicates the number of scans you want to add together.

KINETIC SERIES LENGTH & KINETIC CYCLE TIME

When **Kinetic** is selected as the acquisition mode, with **Internal** triggering you can also select the **Kinetic Series Length** and **Kinetic Cycle Length (secs).**

The Kinetic Series Length is the number of scans you require in your series.

The Kinetic Cycle Length is the interval (in seconds) at which each scan (or accumulated scan) in your series begins.

Fast Kinetics allows exposure times on a microsecond timescale. Use Fast Kinetics when you need an exposure time that is smaller than the minimum Kinetic Cycle Time in a standard Kinetic Series.

In Fast Kinetics the image to be recorded is imaged across a certain section of the CCD. The unilluminated part of the CCD is used for storage of image before readout. You must ensure that light does not fall on this storage part of the CCD by using, for example, an imaging spectrograph.

By way of explanation, take the example of an illuminated sub-area of height 8 rows. A CW spectrum is imaged along this sub-area and the resulting image is then shifted down 8 rows into the unilluminated area, thus sampling the image in time. In this way the image is temporarily stored on the CCD itself, rather than in the computer. The process is repeated until the frame of the CCD is filled with time-sampled images or until the number of images you have specified for your series has been acquired.

Next each image is transferred into the shift register in turn, and read out in the normal way.

With a CCD-chip of height 512 pixels and a sub-area height of 8 rows, 63 discrete images can be stored on the CCD (not 64 images, since the top 8 rows of the CCD constitute the illuminated sub-area, which cannot be used for storage.)

From the Setup Acquisition dialog box, you can change the following parameters:

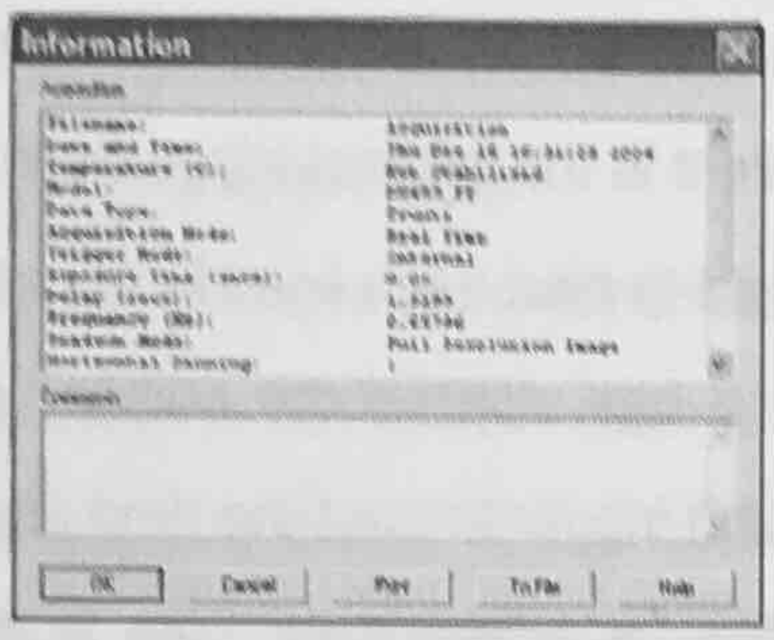
- **Exposure Time**. The Exposure Time also represents the cycle time of the Fast Kinetics series. There is no separate parameter for a Fast Kinetics cycle time
- **Sub Area Height in rows**
- **Number in Series** (the number of time-sampled images you want to acquire), and the in microseconds.
- **Binning** of the images
- **Offset** of the active area from the bottom of the detector can also be specified.

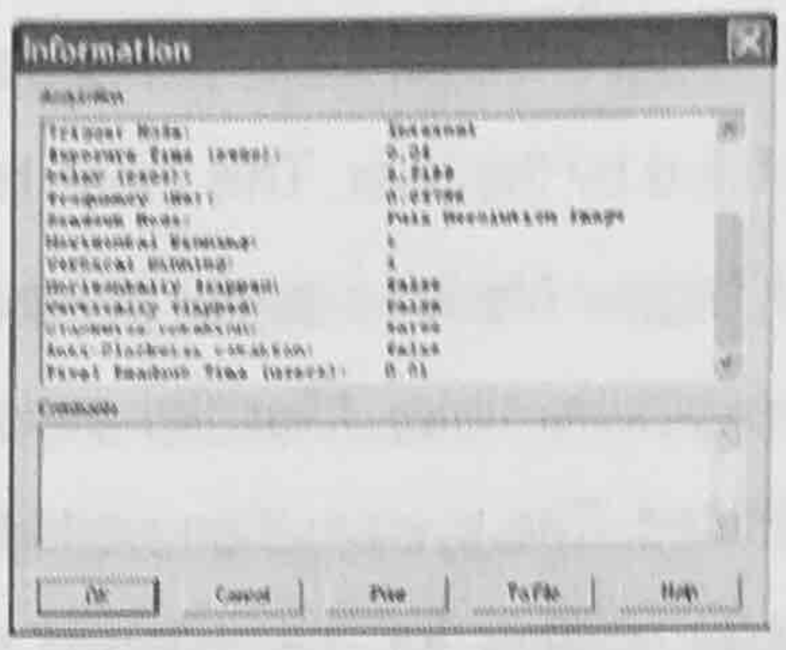
The data from each of the spectra in the Fast Kinetics series is stored as an image. Select Image from the Readout Mode drop down list on the Setup Acquisition Window. Fast kinetics is not available in multi-track mode.

With Fast Kinetics you may use the following Trigger Modes: Internal, External, Fast External and External Start.

- In Internal Trigger Mode, the system determines when the acquisition begins, and then uses the acquisition settings defined by the user. This mode is equivalent to the internal triggering mode for Single Scan etc.
- In External Trigger Mode, a trigger pulse is required to start each scan in the series. The rising edge of the trigger starts the exposure time. After the exposure time has elapsed the number of rows specified by the user are vertically shifted. The system then waits for the next trigger to start the next scan. As there is no keep clean cycle running while waiting for the external trigger the "real "exposure time is the time between each trigger. A consequence of this is that if your experiment has a constant background signal but your trigger period is not fixed you may see different background levels in your signal.
- In External Start Trigger mode, data will not be acquired until the system receives an initial external trigger signal from an external device, like a laser. From that point on, the system alone determines when data are acquired based on the user settings, as in the case of Internal Trigger. As the system changes from an external trigger mode to internal trigger mode on receipt of the initial trigger signal the exposure time of the first scan in the series will not be the same as the subsequent scans. The exposure time is defined as the time between vertical shifts.

Details of the Acquisition selection can be viewed by clicking the File Information button on the Main Window which opens the **Information** dialog box (you can enter your own notes in the Comments box):





The table below details the type of information contained in the dialog box.

TABLE 9: INFORMATION DIALOG BOX

Filename	The filename associated with the active Data Window. If the data has not yet been saved this will default to Acquisition
Date and time	The date & time at which the acquisition was made.
Temperature (C)	The temperature to which the detector had been cooled.
Model	The model number of the detector.
Data Type	Data Type – Counts, % Transmittance, etc.
Acquisition Mode	Single, Accumulate or Kinetic
Trigger Mode	Internal, External or Fast External
Exposure Time (secs)	"Fire" pulse length
Delay (secs)	Value in microseconds
Horizontal Binning	**Always = 1**
Vertical Binning	Minimum = 1, Maximum = 256
Horizontally flipped	True or False
Vertically flipped	True or False
Clockwise rotation	True or False
Anti-clockwise rotation	True or False
Pixel Readout Time (µsecs)	Value in microseconds