

TERX detection system

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Contents

A. User Instructions	2
A.A. Use of this Instruction Manual	2
A.B. Warning Signs and Hazard Icons	2
A.C. Symbols Used	3
A.D. Abbreviations Used	3
A.E. Structure of the Safety Notices	4
B. Safety Information	5
B.A. Proper Use	5
B.B. Use of these Operating Instructions	5
1. Hardware System Components	6
1.1. Energy dispersive X-ray Detector	6
1.2. TERX System	6
2. The TERX Software	8
2.1. The ESPRIT Software	8
2.2. Time resolved X-ray Measurement	8
2.3. Electron energy resolved X-ray Measurement	11

A. User Instructions

A.A. Use of this Instruction Manual










This important product information guide contains safety and handling, regulatory and warranty information for the TERX detection system.

To avoid injury and damage, read all operating instructions and safety information in this guide. If this instruction manual is lost, a replacement manual can be ordered from DREEBIT GmbH.

Please see www.dreebit.com for more detailed contact information.

A.B. Warning Signs and Hazard Icons

Table 1: Overview of warning signs used in this instruction manual

	This symbol indicates a generic warning.
	This symbol indicates the presence of a high voltage hazard.
	This is the warning symbol indicating the presence of a magnetic field.
	This is a warning symbol indicating a hot surface.
	This is a warning symbol indicating an ionizing and radiation hazard.
	This is a warning symbol indicating a crushing hazard.
	This is a warning symbol indicating a heavy item.

A.C. Symbols Used

Table 2: Overview of used symbols in this instruction manual

Notation	Meaning
>	You are requested to perform one action.
1.	Perform these actions in the sequence described.
2.	
•	List item

A.D. Abbreviations Used




Table 3: Overview of used symbols in this instruction manual

Abbreviation	Written
BNC	Bayonet Naval Connectors
EBIS-A	Electron Beam Ion Source - Advanced
EPC	EBIS-A Power Control
ESI	EBIS-A Signal Interface
GND	Ground
HV	High voltage
IIF-L	Ion Irradiation Facility L
SIG	Measurement signal
UHV	Ultra high vacuum

A.E. Structure of the Safety Notices

The following safety notices indicate the different danger levels.

Safety Notes

	DANGER DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
	NOTICE Notice indicates a property damage message.
	NOTE! For general requirements, which must be adhered to.

B. Safety Information

B.A. Proper Use

The TERX detection system is designed for research and development applications.

Any application exceeding the bounds of these specifications is considered improper use, and can lead to serious personal injury or material damage. DREEBIT will not be held responsible for any damages resulting in such a case.

Further requirements of proper use are that you:
Read and adhere to these operating instructions.

B.B. Use of these Operating Instructions

This instruction manual contains the information required for the proper operation of the TERX detection system. The Operating Instructions are delivered with the TERX detection system and are an essential part of the product. They must be kept in an accessible, visible place next to the TERX detection system.

Product life phases

The Operating Instructions and the Maintenance Instructions describe all product life phases of the TERX detection system. They consist of the system conditions and applications that follow manufacturing: transport, installation, commissioning, operation, maintenance, service, storage and final disposal. Each related chapter can be found easily via the table of contents in the instruction manuals.

Supplier documentation

The delivery of the TERX detection system includes separate operating instructions for individual system components. They include important safety information and are essential parts of the system documentation. The safety instructions contained therein must be strictly adhered to. The information contained in the supplier documentation is required in particular for the maintenance and service of the respective components.

1. Hardware System Components

1.1. Energy dispersive X-ray Detector

The TERX System can be used with any X-Ray detector that provides the measured X-ray events on a digital output. The delivered X-Ray detector is described in a separate manual.

1.2. TERX System

The TERX System for time and energy resolved X-ray spectroscopy is used for the measurement of the X-ray emitted by a DRESDEN EBIT. The X-ray is measured in dependence on the electron energy or the ionization time. The measured data can be plotted and saved for further investigations.

The trap time of the ion source is controlled by TERX system in the time resolved operation mode. The measured X-ray photons are detected in dependence on the X-ray energy and the ionization time and stored in the TERX system. The events are transferred to the measurement computer, stored in a X-ray-energy-time-matrix and displayed in a scatter plot.



DANGER

While the TERX System is installed the beamline potential can not be switched on

The X-Ray detector and the TERX System are mounted on ground potential. The TERX System has to be connected to the Signal Interface Box on beamline potential. When the TERX System is connected to the Signal Interface Box the beamline potential has to be set on ground potential. Switching on the beamline potential is avoided by an interlock signal.

To enable the beamline potential the connection D-Sub connection plug of the Signal Interface Box has to be removed from the Signal Interface Box and plunged into the TERX System.

In the energy resolved operation mode not only the ionization time but also the trap potential is varied by the TERX system. X-ray photons are detected in dependence on the X-ray energy and the trap potential. The events are transferred to the measurement computer, stored in a trap-potential-X-ray-energy-matrix and displayed in a scatter plot.

Setup of the TERX System

The TERX System includes the following hardware components:

- TERX Control System
- Signal Interface Box
- connection cable between the Signal Interface Box and the Drift Tube Potential
- connection cable between the Signal Interface Box and the TERX control system
- interlock cable between the TERX control system and the Power and Pressure control unit

The TERX Control System has to be mounted near the Signal Processing Unit of the X-Ray detector. First connect the potential equalization contact between the TERX Control System, the Signal Processing Unit and the equipotential bonding terminal. The door interlock of the Power and Pressure Control Unit has to be removed and connected to the interlock input of the TERX Control System. The interlock output of the TERX Control System has to be connected to the door interlock of the Power and Pressure Control Unit. The TERX Control System has to be connected to the Signal Processing Unit by the delivered ribbon cable.

NOTICE

Take care that the potential equalization contact is connected between the TERX Control System, the Signal Processing Unit and the equipotential bonding terminal. Otherwise the TERX System can be damaged.

The Signal Interface Box has to be mounted in the control rack on beamline potential. The original control cable of the Drift Tube Potential unit is released from the Drift Tube Potential unit and is mounted at the Signal Interface Box. The Signal Interface Box is connected with the delivered connection cable to the Drift Tube Potential unit. The Signal Interface Box can be stay in control rack when the TERX System is not used.

NOTICE

Take care that the potential equalization contact is connected between the Drift Tube Potential unit, the equipotential bonding terminal in the high voltage rack and the equipotential bonding terminal equipotential bonding terminal in the ground rack. Otherwise the TERX System can be damaged.

At last connect the TERX Control system with the Signal Interface Box. This connection has to be released and the 9-pin D-sub connector has to be mounted on the TERX Control System when the TERX System is not used and the beamline should be used in the high voltage mode.

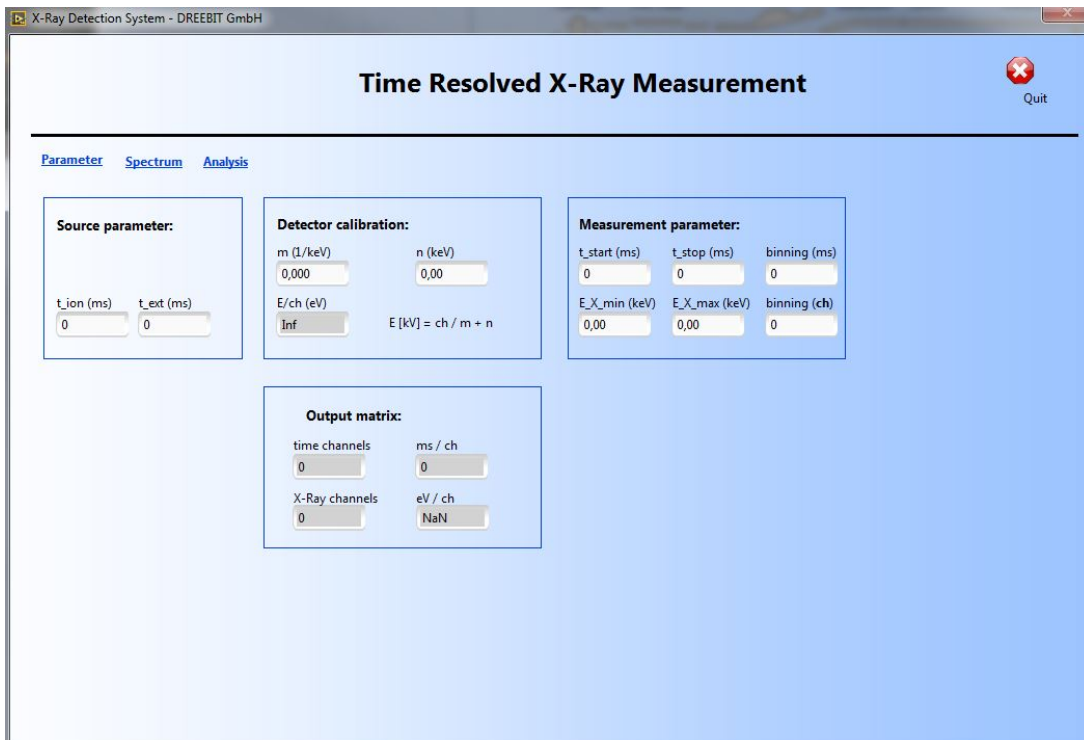
2. The TERX Software

2.1. The ESPRIT Software

The X-ray detector has to be started before the time or energy resolved X-ray measurement can be started. Please read the ESPRIT Software manual to bring the X-ray detector in operation. A manual measurement has to be started. After the measurement is started press “CTRL + F2” to open a command window in the ESPRIT software. Then type “NP 1000” and press “RUN” to reduce the zero peak generation. This is necessary for using the TERX detection system.

2.2. Time resolved X-ray Measurement

To start the time resolved X-ray measurement the press “X-Ray Time” button in the EBIT Control Center. The measurement parameters has be set in the first page as it is shown in Figure 1.



Time Resolved X-Ray Measurement

Parameter Spectrum Analysis

Source parameter:

t_{ion} (ms) t_{ext} (ms)
0 0

Detector calibration:

m (1/keV) n (keV)
0,000 0,00

E/ch (eV)
Inf E [kV] = ch / m + n

Measurement parameter:

t _{start} (ms)	t _{stop} (ms)	binning (ms)
0	0	0
E _{X_min} (keV)	E _{X_max} (keV)	binning (ch)
0,00	0,00	0

Output matrix:

time channels	ms / ch
0	0
X-Ray channels	eV / ch
0	NaN

Figure 1: Parameter window for the time resolved X-ray spectroscopy

NOTICE

Because of the Terx System controlling the trap potential it is important to take care that the heating current of the chathode is set on an uncritical value before the TERX System is started.

The following relevant parameters has to be set:

Source parameter

- t_ion (ms) ionization time of the DRESDEN EBIT
- t_ext (ms) extraction time of the DRESDEN EBIT

Detector calibration

- m (1/keV) slope of the linear fit of the detector calibration
- n (keV) offset of the linear fit of the detector calibration

Measurement parameter

- t_start (ms) start time of the X-ray measurement during a trap cycle
- t_stop (ms) stop time of the X-ray measurement during a trap cycle
- binning (ms) time resolution of the X-ray measurement (if the computer becomes slowly increase this number)
- E_K_min (keV) minimum of the detected X-ray energy
- E_K_max (keV) maximum of the detected X-ray energy
- binning (chs) number of X-ray channels to be summarized (if the computer becomes slowly increase this number)

The measurement is stored in a time-X-ray-energy matrix. The size of this matrix is shown the *Output matrix* field. The matrix should be smaller than 1000x1000 values.

The measurement will be started on the *Spectrum* page as it is shown in Figure 2. It can be chosen if a continuous measurement or a measurement with a preset measurement time should be started. The measurement is started by the green button.

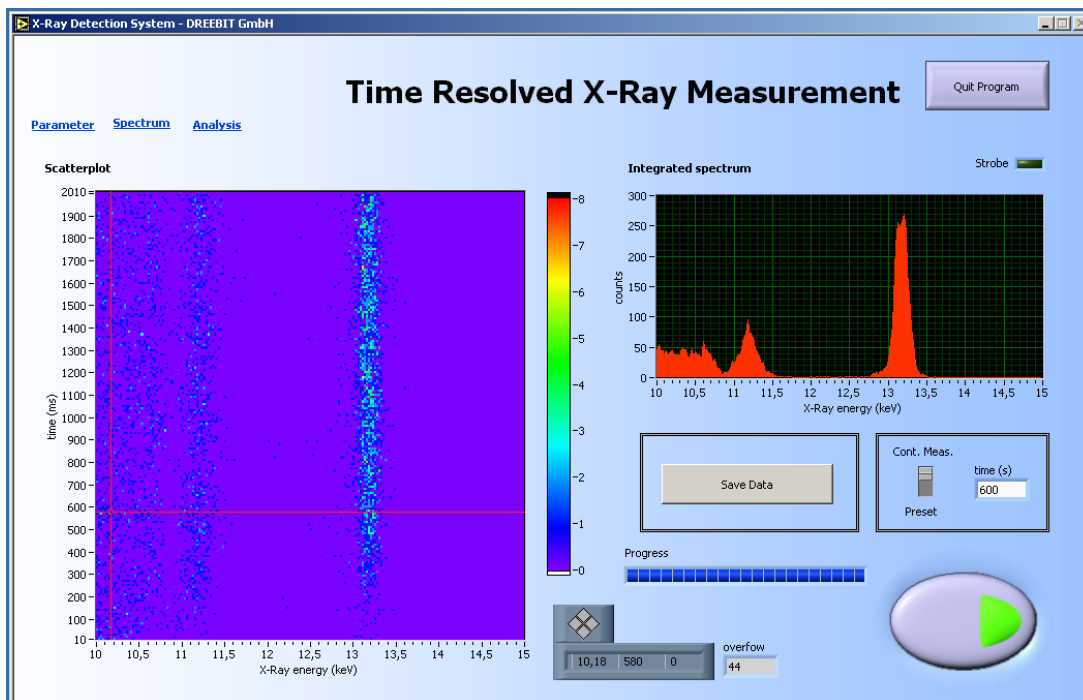


Figure 2: Measurement window for the time resolved X-ray spectroscopy

The time and energy dependent X-ray events are shown in the left picture (scatter plot). The spectrum is integrated over the measurement time in the upper picture. When the measurement is finished it can be saved by pressing the *Save* button. Chose a folder where to save and type the file name including the appendix (name.txt or name.dat). A second file (name.par) is generated including the lower limit and the step size of the X-ray energy and the time. The *Strobe* LED indicates the registering of X-ray events. The scatter plot is actualized and scaled every second. The x-, y- and z-axis can also be scaled manually. Therefor the automatic scaling has to be disabled by pressing the right mouse button on the relevant axis and disabling *Autoscale*. X-ray events that are lost and not counted by the TERX system are shown in the *overflow* field. If the number increases relative to the absolute number of X-rays the count rate has to be reduced by lowering the electron current or increasing the distance between X-ray detector and DRESDEN EBIT.

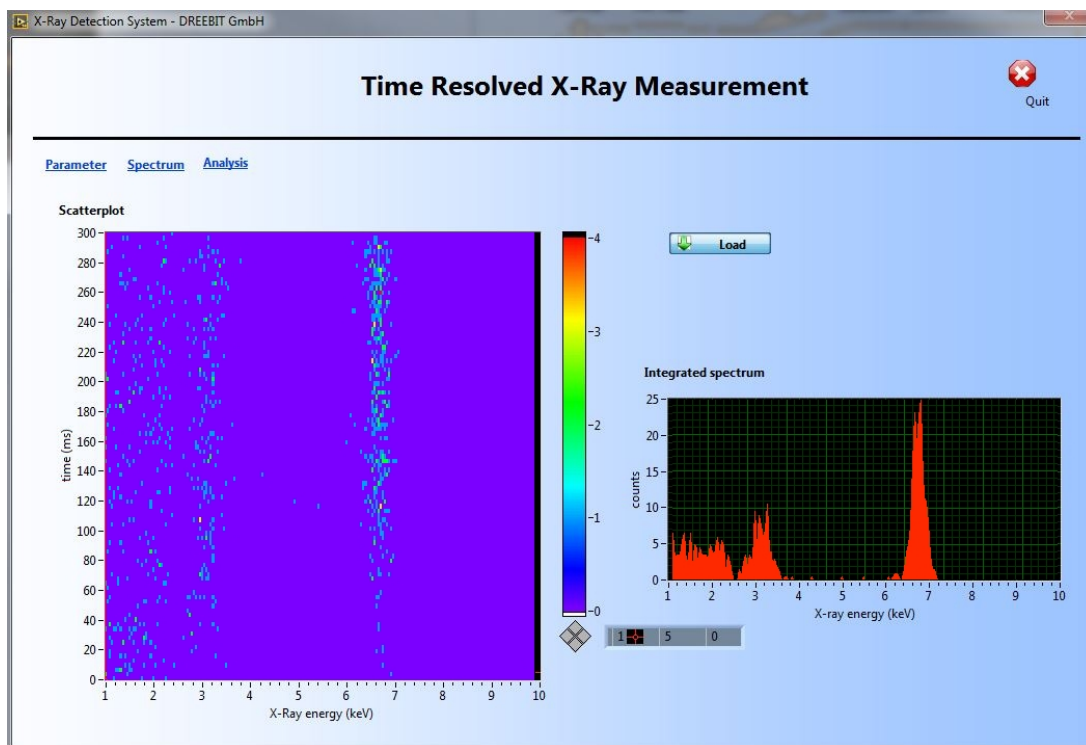


Figure 3: Analysis window for the time resolved X-ray spectroscopy

Stored spectra can be plotted in the *Analysis* page as it is shown in Figure 3. Press the load button and choose the file to open. The corresponding *.par file has to be stored in the same folder. The time and energy dependent X-ray events are shown in the left picture (scatter plot). The spectrum is integrated over the measurement time in the upper picture. The x-, y- and z-axis can also be scaled manually. Therefor the automatic scaling has to be disabled by pressing the right mouse button on the relevant axis and disabling *Autoscale*.

2.3. Electron energy resolved X-ray Measurement

To start the time resolved X-ray measurement the press “X-Ray Energy” button in the EBIT Control Center The measurement parameters has be set in the first page as it is shown in Figure 4.

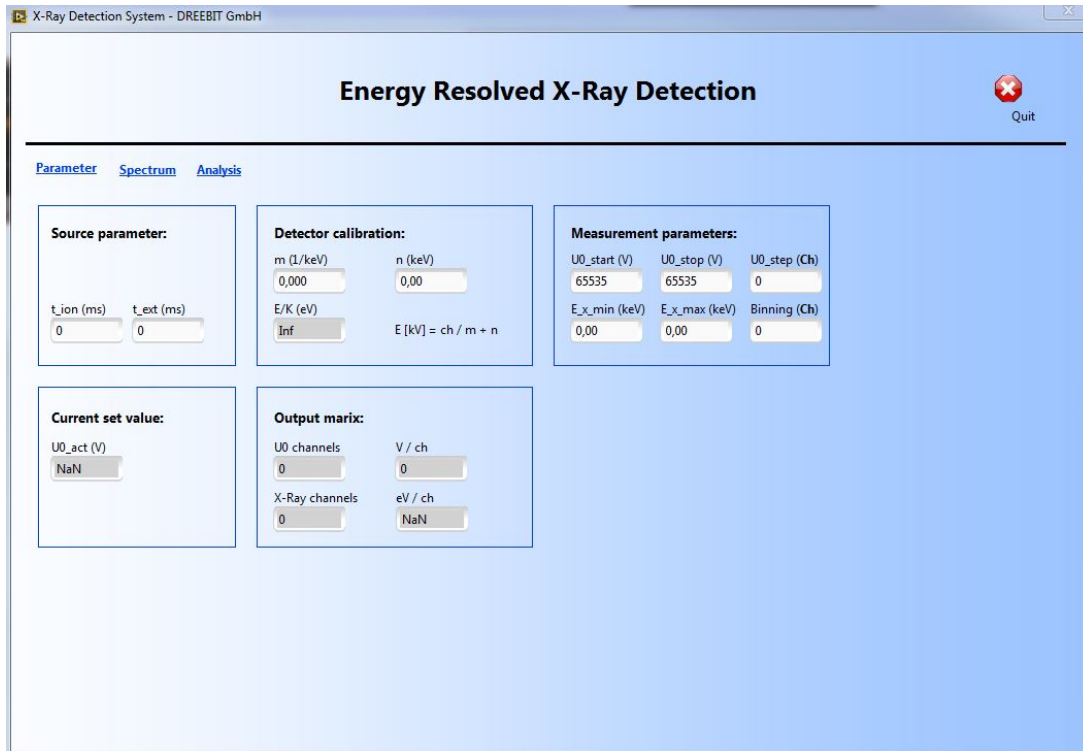


Figure 4: Parameter window for the energy resolved X-ray spectroscopy

NOTICE

Because of the Terx System controlling the trap potential it is important to take care that the heating current of the chathode is set on an uncritical value before the TERX System is started.

The following relevant parameters has to be set:

Source parameter

- U0 (V) drift tube potential of the DRESDEN EBIT
- t_ion (ms) ionization time of the DRESDEN EBIT
- t_ext (ms) extraction time of the DRESDEN EBIT

Detector calibration

- m (1/keV) slope of the linear fit of the detector calibration
- n (keV) offset of the linear fit of the detector calibration

Measurement parameter

U0_start (V)	minimum trap potential to count the detected X-ray
U0_stop (V)	maximum trap potential to count the detected X-ray
U0_step (Ch)	step size to increase the trap potential (if the computer becomes slowly increase this number)
E_K_min (keV)	minimum of the detected X-ray energy
E_K_max (keV)	maximum of the detected X-ray energy
binning (chs)	number of X-ray channels to be summarized (if the computer becomes slowly increase this number)

The measurement is stored in a trap-potential-X-ray-energy matrix. The size of this matrix is shown the *Output matrix* field. The matrix should be smaller than 1000x1000 values.

The measurement will be started on the *Spectrum* page as it is shown in Figure 5. It can be chosen if a continuous measurement or a measurement with a preset measurement time should be started. The measurement is started by the green button.

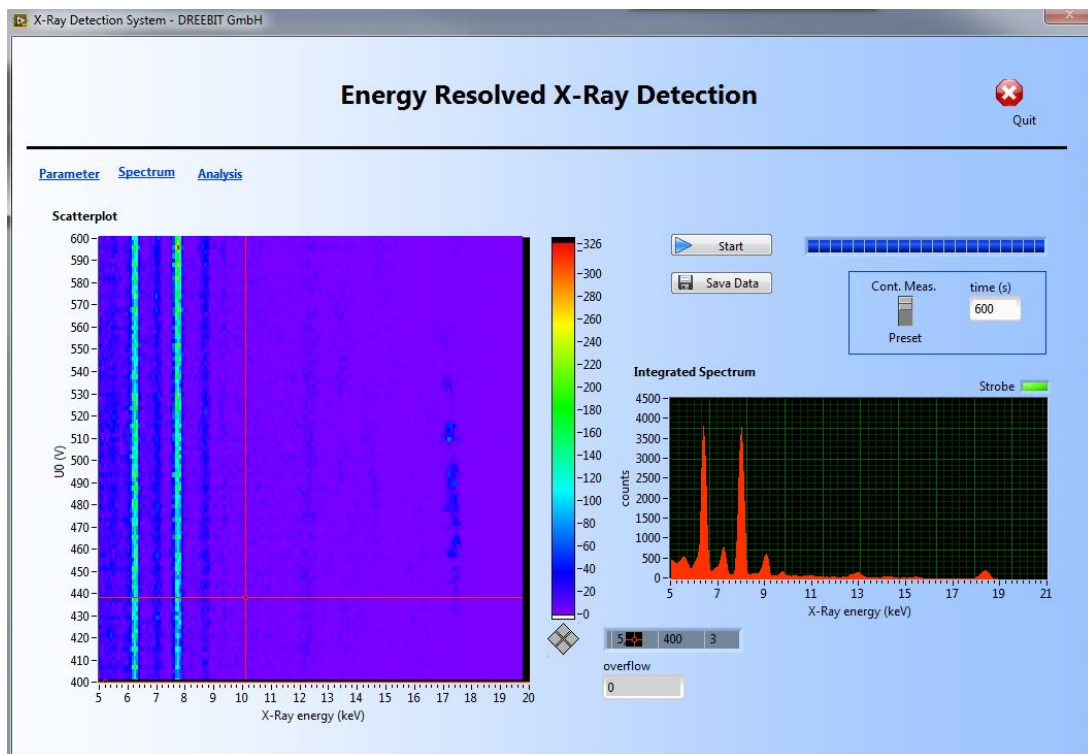


Figure 5: Measurement window for the energy resolved X-ray spectroscopy

The trap potential and X-ray energy dependent X-ray events are shown in the left picture (scatter plot). The spectrum is integrated over the trap potential in the upper picture. When the measurement is finished it can be saved by pressing the *Save* button. Chose a folder where to save and type the file name including the appendix (name.txt or name.dat). A second file (name.par) is generated including the lower limit and the step size of the X-ray energy and the trap potential.

The *Strobe* LED indicates the registering of X-ray events. The scatter plot is actualized and scaled every second. The x-, y- and z-axis can also be scaled manually. Therefor the automatic scaling has to be disabled by pressing the right mouse button on the relevant axis and disabling *Autoscale*. X-ray events that are lost and not counted by the TERX system are shown in the *overflow* field. If the number increases relative to the absolute number of X-rays the count rate has to be reduced by lowering the electron current or increasing the distance between X-ray detector and DRESDEN EBIT.

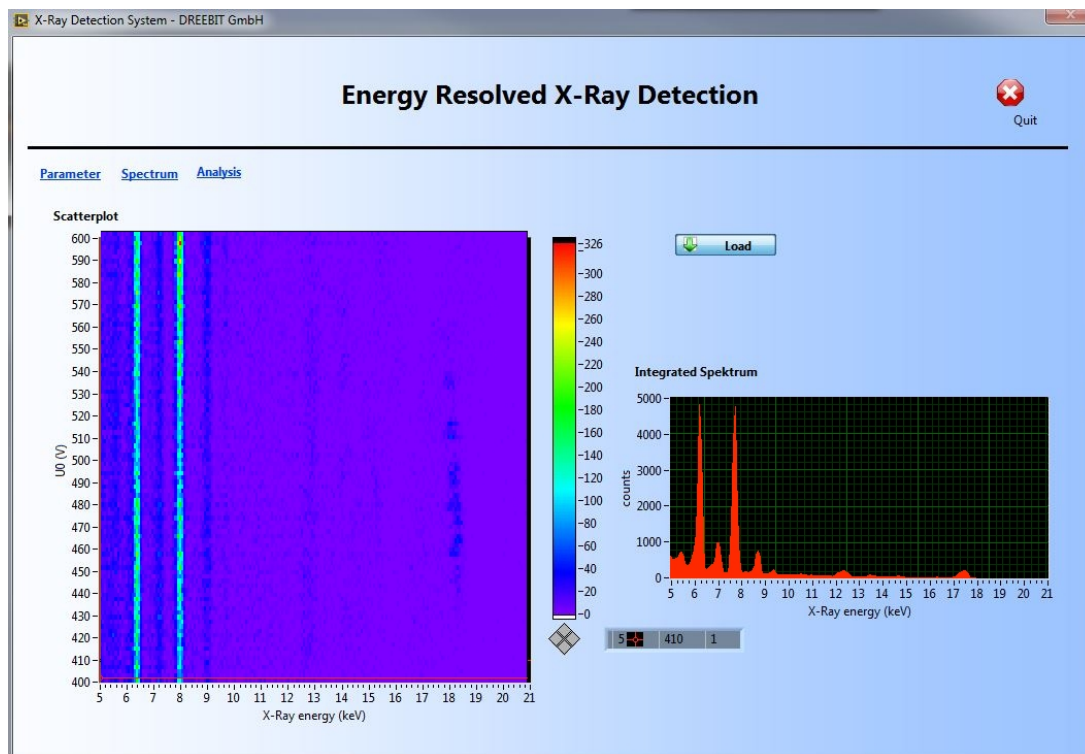


Figure 6: Analysis window for the energy resolved X-ray spectroscopy

Stored spectra can be plotted in the *Analysis* page as it is shown in Figure 6. Press the load button and choose the file to open. The corresponding *.par file has to be stored in the same folder. The trap potential and X-ray energy dependent X-ray events are shown in the left picture (scatter plot). The spectrum is integrated over the trap potential in the upper picture. The x-, y- and z-axis can also be scaled manually. Therefore the automatic scaling has to be disabled by pressing the right mouse button on the relevant axis and disabling *Autoscale*.