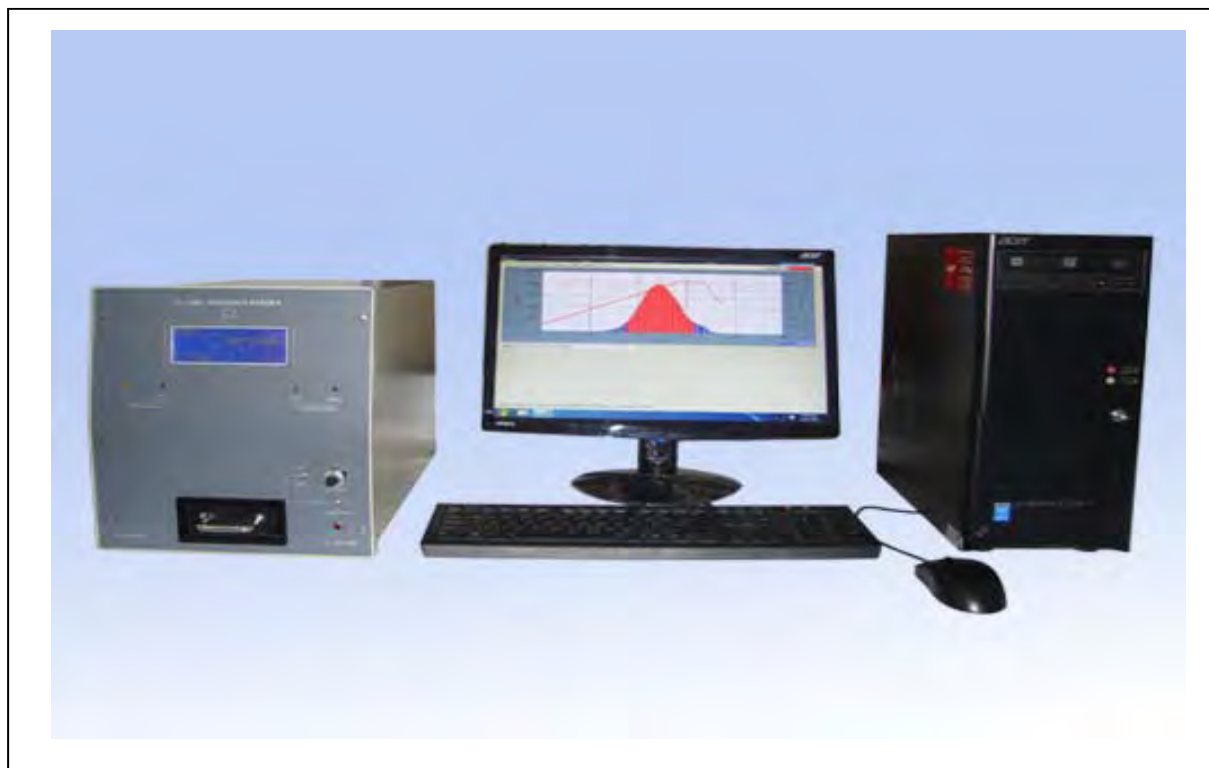


## **PC CONTROLLED TL / OSL RESEARCH READER**



**TYPE –TL/OSL 1008 - Modified**

**NUCLEONIX SYSTEMS PRIVATE LIMITED**

**Plot No: 162 A & B, Phase II, I.D.A. Cherlapally, Hyderabad - 500 051.**

**Phone: 040-29706483 / 84 / 85, Mobile No: 7331104481 / 82**

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**FILE\_NAME : NSPL/DOC / MAN / TL/OSL-1008/ 01**

**VER\_20170824**



## **Note to Users**

Users are advised to refer to SYSTEM HARDWARE REFERENCE/Part for understanding of the system, its constituent units, system integration and its functioning.

Also by referring to this manual, user will know how to unpack, assemble, inter connect/integrate the complete system, for use and operation.

SYSTEM SOFTWARE COMMANDS REFERENCE/Part (Chapter VIII) is to be referred for using and operating the system under P.C .controlled mode, which is also part of this user manual. Also for TL/OSL glow curve acquisition, analysis and processing, this chapter is to be referred.

## **Important Notes**

System performance is guaranteed only if a good 2KVA servo stabilizer is used. A highly stable, supply 230V, 50HZ AC is essential. Do not use the system without servo stabilizer. Also good earthing is to be ensured. Also A.C. room with dust free environment is preferred.



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## UNPACKING

Please read the following lines and observe precautions, while unpacking the system. Unpack each box gently, avoid hammering & hard hitting.

1. Usually the system is packed in cardboard/wooden boxes / Plywood boxes.

### 2. Equipment Packed                      Quantity

#### Usually

- |    |  |         |   |
|----|--|---------|---|
| a. | CPU Unit of Personal Computer(Optional)  | OneBox  | (Units (a), (b) &(c) are supplied, only if the order is placed, for personal computer system Plywood box. |
| b. | TFT Monitor with Keyboard(Optional)  | One Box |   |
| c. | Printer (Optional)   | One Box |   |
| d. | Integral TL/ OSL Reader unit TL/OSL 1008.  | One Box |   |
| e. | Annealing oven up to 350 / 400 degree C (optionally supplied). Annealing oven is to be placed separately in another room on the floor.   |         |   |
| f. | Nitrogen gas cylinder with regulator (optional) if you want to cool the LED clusters by flushing Nitrogen at 1 to 2 lpm flow rate or as required. Place it on the floor next to the TL/OSL Reader unit.<br>Since each of the 3w LED is mounted on a heat sink Nitrogen flushing <b>may not be required</b> . |         |   |

3. Unpack these items (a, b, c, d) gently & place the items on the table.

**Note:** If user has PC already, then item no. (a), (b), & (c) will not be supplied, (If PC is not ordered).







Fig: PC based TL/OSL Research Reader after unpacking.

4. Now either keep cap of the Nitrogen flushing nozzles (Inlet & outlet) in closed condition always, when gas is not connected or connect it through a flexible pipe from Nitrogen cylindrical to allow Nitrogen gas. (Optional). Since it is a single sample TL/OSL Research Reader, Nitrogen Flushing not required.
5. Now make Interconnections as given in the table in CHAPTER IV, including A.C. Mains Cord for PC, Printer and Integral TL Reader.



## CHAPTER -I

### INTRODUCTION

**Luminescence** arises upon stimulation either thermally (TL) or optically (OSL) of minerals and other phosphors that have been previously exposed to ionizing radiation. During exposure, radiation energy accumulated and stored in the crystal lattice and metastable states are created. During the stimulation trapped charges recombine with opposite charges as a result luminescence (TL/OSL) occurs.

A versatile PC CONTROLLED TL/OSL RESEARCH READER, has been developed to meet the requirement of researchers to study both TL & OSL of samples, in a single system and also to meet the following objectives.

- To facilitate study of both TL/OSL materials by researcher, using single equipment.
- Choice of stimulation by multiple LED sources (GREEN, BLUE and optionally IR LED sources)
- To facilitate study of TL materials in different forms such as pellets, powders, discs, micro-rods, chips etc.
- System to facilitate programmable levels of stimulation intensities, to shine on to the sample in OSL mode.
- Single board electronics PCB with microcontroller and embedded code makes it more compact & reliable.
- User friendly software and GUI to facilitate the researchers to be more comfortable in using the system.
- Minimal controls on front & rear panels for userconvenience.
- Ease of temperature calibration through software, in TLmode.
- User configurable features facilitate one, to program for desired heating profile in TL mode & select required acquisition parameters in OSLmode.

# **Data Sheet of Photodetector Module**

photodetector module

PDM9107-CP-USB data sheet (provisional)

1 description

The PDM9107-CP-USB is a plug-and-play photon counting module incorporating a high sensitivity, low noise, 29mm diameter photomultiplier, fast counting electronics and a low-power high voltage supply. The counting electronics consist of an amplifier/discriminator with an adjustable threshold and a multi-channel scaler/counter timer which records and stores data as a function of time. There is a choice of three software configurable counting modes: pre-set number of channels, pre-set total measurement period, or continuous. HV level and data retrieval are controlled by dedicated application software.

The spectral range of the PDM9107-CP-USB is 280-630nm. Other versions are available with a wider range, for example the PDM9107Q-CP-USB, which extends the UV sensitivity to 160 nm.

The combination of an effective photosensitive diameter of 25mm, and a dark count of typically 100cps at 20°C, results in a unique detection capability. The module is also very easy to use, the only additional requirement being a PC or laptop with a free USB port.

A positive-polarity high-voltage supply is used for maximum count-rate stability at very low light levels and a mumetal\* cylindrical housing provides a high degree of immunity to external magnetic fields.

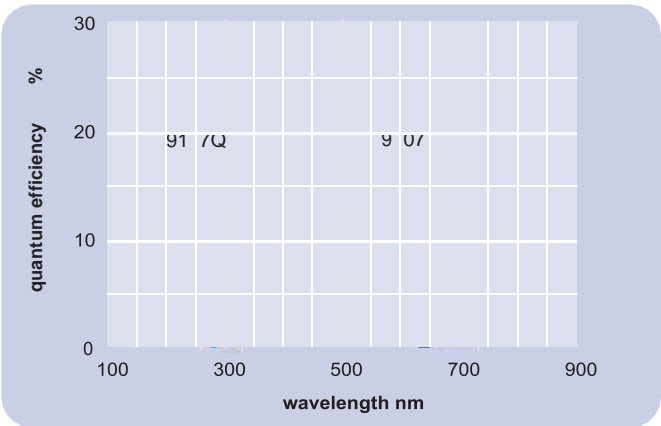
2 applications

The PDM9107-CP-USB is suitable for all applications involving photon-counting mode light detection down to single photons. Typical uses are time-resolved fluorescence, luminescence and similar investigations.

3 features

- easy plug-and-play operation
- wide dynamic range
- no external power supply required
- magnetic and electrostatic shielding
- spectral range options
- 25mm diameter detection area
- low noise

4 photocathode spectral response



5 characteristics

	unit	min	typ	max
photocathode: biakali				
active diameter	mm		25	
spectral response range	nm	280		630
quantum efficiency (peak)			28	
output:				
interface type			USB 2.0 or higher	
connector type			USB type A	
signal:				
pulse width	ns		17	
pulse rise and fall time	ns		1.2	
pulse-pair resolution	ns		25	
dead time	ns		25	
count rate:				
without dead-time correction	cps		30M	
with dead-time correction	cps		100M	
channel width		0.2ms		999hrs
channel width jitter	µs		200	
dead-time between channels:			none	
number of channels		1		65535
counts per channel				10 <sup>8</sup>
discriminator level (adjustable)	mV	2		8
dark count rate at 20°C	cps		100	200
supply (from USB connection)				
voltage	V	4.5		5.5
current:				
no signal	mA		40	
signal = 100Mcps	mA		120	
control voltage (1:1000)	V	0.1		2.0*
warm-up time	s		1	
temperature (operating)	°C	5		55
temperature (storage)	°C	-40		60
weight	g		220	

\*subject to not exceeding maximum rated gain of the pmt

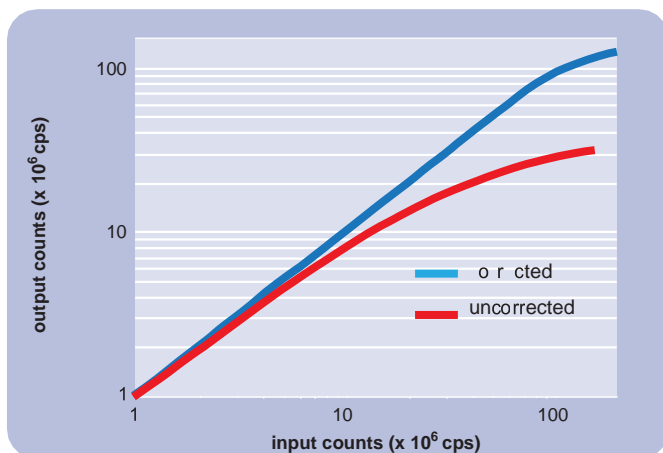
## 6 dynamic range

Extended dynamic range can be obtained by dead time correction to compensate for departure from linearity at high count rates due to pulse pile-up. Dead time may be corrected for, as follows:

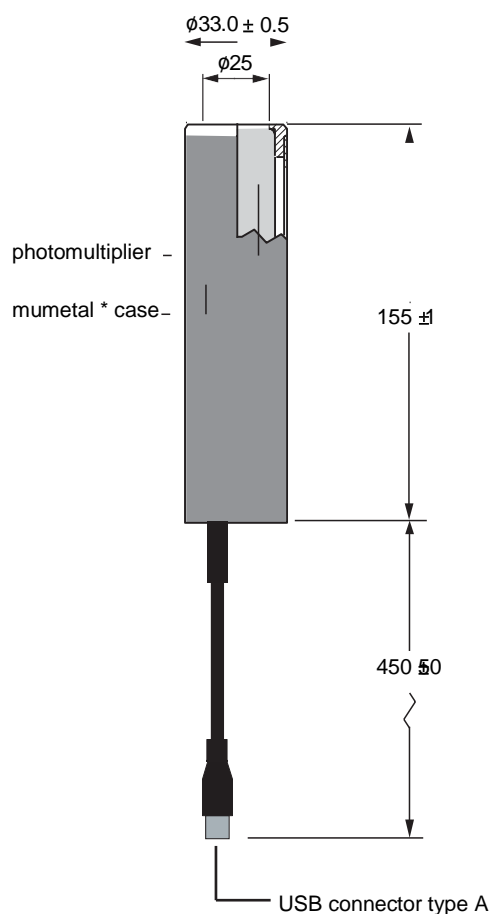
$$N = n/(1-nT)$$

where: N is the true count rate (cps),  
n is the measured count rate (cps),  
T is the count rate correction factor ( $25 \times 10^{-9}$ s),

Using this correction, deviation from linearity is typically within  $\pm 5\%$  at 100Mcps.



## 8 outline drawing mm



\*mumetal is a registered trademark of Magnetic Shield Corporation

## 7 installation and operation

Each module is supplied with test data. Wherever possible, installation should be carried out in subdued light. Exposure to strong lights, particularly those containing a high UV content, can result in a temporary increase in dark counts during subsequent operation.

Remove the protective cap or cover from the package. If necessary, the photomultiplier window can be cleaned using a lens tissue moistened with alcohol. Do not use any other solvent.

Mount the module in a light-tight enclosure with the light source to be measured and install the application software by downloading from the ET Enterprises Limited website ([www.et-enterprises.com](http://www.et-enterprises.com)). Connect the USB cable to the PC or laptop and run the application. Further details are given in the user manual which can also be downloaded from the ET Enterprises website.

## 9 ordering information

<b>PDM9107-CP-USB</b>	visible range (280-630nm)
<b>PDM9107Q-CP-USB</b>	extended UV (160-630nm)

## 10 warning

No attempt must be made to repair or dismantle this product. High voltage used within the module may present an electric shock hazard.

### ET Enterprises Limited

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Uxbridge UB8 2YF  
United Kingdom  
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fax: +44 (0) 1895 270873  
e-mail: [sales@et-enterprises.com](mailto:sales@et-enterprises.com)  
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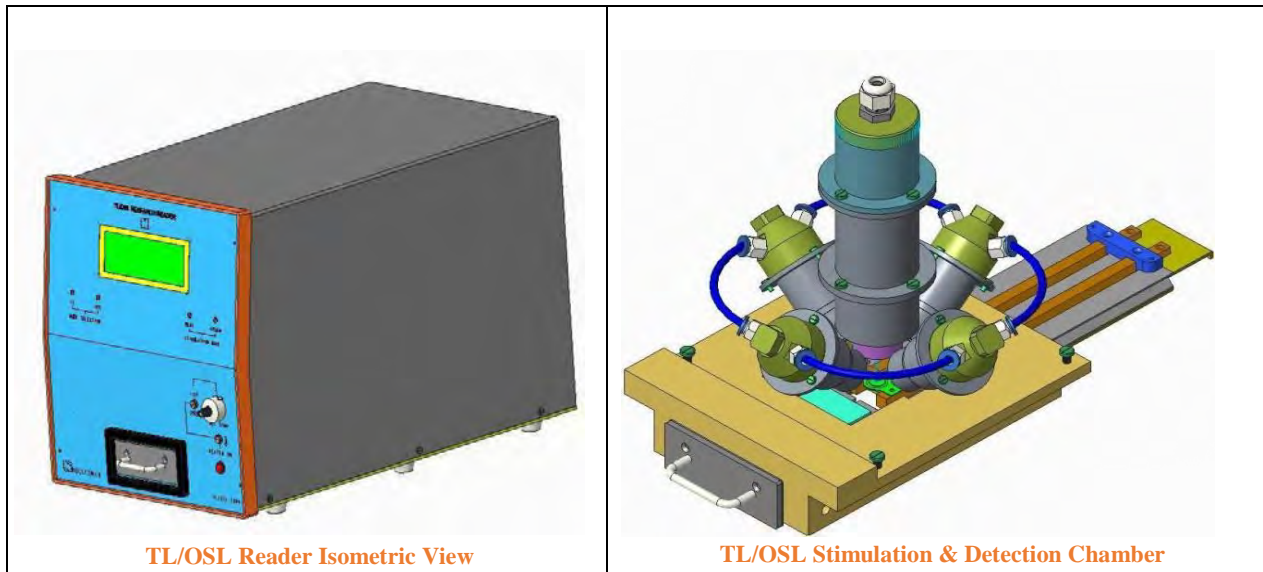
© ET Enterprises Ltd, 2015  
DS\_ PDM9107-CP-USB Issue 1 (29/07/15)

## CHAPTER -II

### SPECIFICATIONS

#### PC CONTROLLED TL / OSL READER TL/OSL-1008

##### Technical Data



**PC Controlled TL/OSL Reader TL/OSL 1008** manufactured by Nucleonix systems is a compact integral unit, designed primarily to meet the requirements of TL/OSL research community in R&D labs & universities who are engaged in luminescence studies of TL/OSL materials. The drawer & sample holder of this system facilitates, single sample TL/OSL acquisition & analysis, at a time.

System has precisely designed stimulation & detection opto- electronics & photon counting module with appropriate filters, focusing lenses & sample drawer assembly with heating arrangement all enclosed in a single mechanical chamber. System facilitates loading of the TL/OSL samples on to Kanthal strip. For OSL samples separate cups/ planchet can be provided.

TL/OSL data acquisition & analysis is controlled by PC software. In case of OSL, optical stimulation by BLUE & GREEN LEDs provided is also controlled by PC software and electronic circuits & embedded code in the microcontroller. System can be operated in TL or OSL or TL-OSL modes as required by the user. Photon counting module acquires luminous intensity data -for both TL & OSL samples. Two modes of OSL stimulation have been provided in this system namely. CW - OSL (Continuous wave OSL) and LM – OSL (Linearly modulated OSL).

## Specifications

### I. TL / OSL Stimulation & Detection chamber

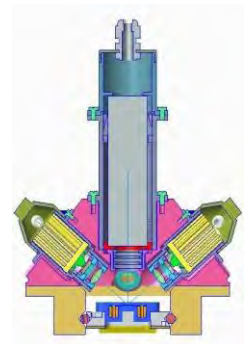
It is a light leakage free, precisely fabricated mechanical assembly, houses photon counting module with detection filter basket, LED stimulation assemblies (four) diagonally placed around photon counting module cylindrical enclosure. TL/OSL sample holders with Kanthal heater strip & drawer arrangement are also built-into this chamber.

### II. Optical Stimulation Assembly

**Optical Stimulation System** consists of BLUE & GREEN LED cluster(s) with, each LED of 3 watt power. Either BLUE or GREEN LED cluster(s) each cluster containing two LEDs can be stimulated. These LEDs are placed diagonally 180° opposite, with suitable lens arrangement, provides uniform luminous intensity onto the sample area.

#### Light Source (s):

- (i). Blue LEDs cluster, each of 3 watt output placed 180° degrees opposite gives stimulation output with peak wavelength emission of 465nm, having Luminous flux radiometric power of 30mW @ 700mA & emission wave length band is (460-470)nm.
- (ii). Two Green LEDs cluster has peak wavelength emission of 525nm and gives 99mW radiometric power @ 700mA. Emission wavelength band is (520 -535) nm.



**Fig: Stimulation and detection chamber**

#### Constant Current Driver:

Electronic circuits built-in provide Constant current drive to each of the LED clusters with dimming control, to vary the luminous intensity.

#### Stimulation Filter:

Each of the LEDs assembly is provided with a long pass, stimulation filter of 420nm of 12.5mm dia. This prevents the scattering light below 420nm, entering the PMT directly.

#### Focusing Lenses:

A suitable focusing Plano-concave lens is provided in front of the LEDs to focus the light on to the OSL samples placed in the planchet.

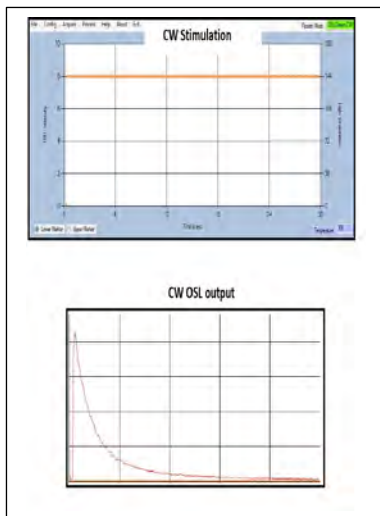
**Heat Sink:** Each of the LED assembly has been provided with a specially designed Heat sink (cylindrical) to keep the LED at lower temperature to obtain uniform illumination, onto the sample holder.



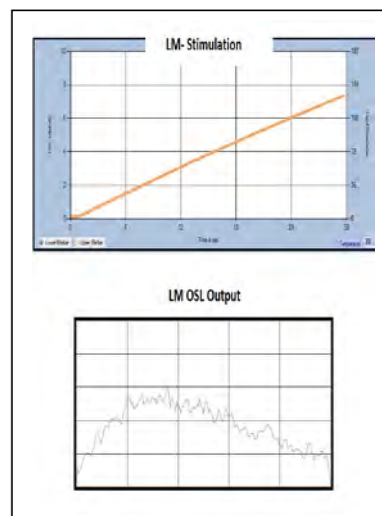
### Photo Diode / Photo sensor:

A suitable photo diode, with appropriate electronics reads stimulation intensity & proportionately plots on Y-axis in the software through ADC.

### Stimulation modes provided:



(i) CW-OSL-continuous wave OSL



ii) LM-OSL linearly modulated

### III. TL-OSL READER-Light Detection System/Photon Counting Module

Photon counting module, is an integral part of the TL-OSL Reader. Photon counts received from the luminescence emission from the TL / OSL materials are counted in this module & the data counts are transferred to PC, thru RS232 interface. This module essentially is plug-and play photo detector package, comprises of selected 25mm diameter end window PMT, a positive high voltage power supply, high speed amplifier- discriminator, counter & a microcontroller. All these are encapsulated with in a cylindrical mumetal case providing a high level of external magnetic shielding.

PMT: 25 mm PMT with ultra-low dark counts.

Count rate capacity: 100 MHz

High Voltage: Built in & set to optimum value.

PC Interface: RS 232 serial port or serial USB port.



#### **IV. TL Heating System**

##### **Heating Element: (Heater Strip)**

Kanthal strip (72% Fe, 23% Al and 2% Cr or Nichrome) is used as a heating element. Kanthal Strip has a circular depression of 14mm to hold discs and powder samples. Additionally flat heater strips also can be provided on request.

##### **Sample Heating Process:**

Sample heating can be done in two modes:

"PROG MODE" of Temp. Control through personal computer program.

"ISO MODE" (Internal mode) of Temperature Control, by varying the ten turn dial.

##### **Temperature range / Programmed plateau heating:**

From room temperature up to 500<sup>0</sup> C linear & plateau heating (Single / Two / Three plateau heating are possible).

##### **Heating Rates:**

Heater strip can be programmed to heat the sample from 1<sup>0</sup> C/sec up to 40<sup>0</sup> C/sec and a max set temperature allowed is 500<sup>0</sup> C.

##### **Nitrogen Flushing Nozzle:**

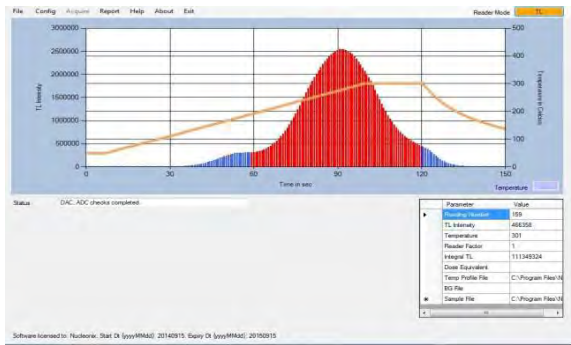
Nitrogen gas flushing nozzle, to suppress spurious luminescence from oxidation effects & also for cooling has been provided, on the rear panel.

#### **V. PC Configuration**

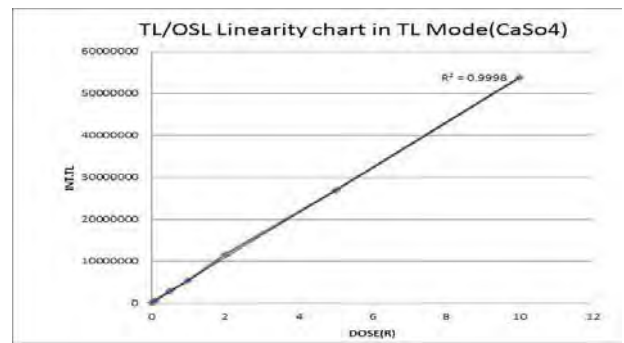
Branded computer system with Intel Core i3 @ 3.06Ghz, 2GB DDR2 RAM, 500GB SATA, DVD R/W, Keyboard and Internal ready Optical scroll, 19" TFT Monitor, Laser jet printer, Windows licensed OS- Windows 7.0.

#### **VI. Software features**

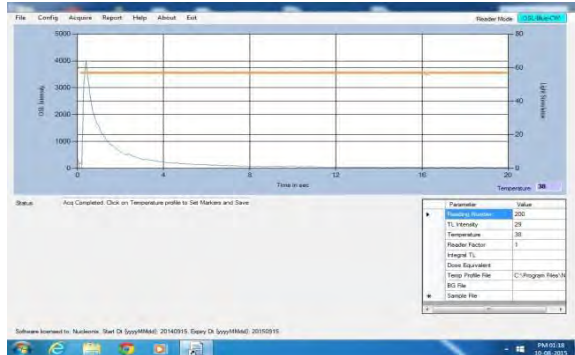
TL / OSL reader system operates thru PC controlled user friendly software. Software performs Self diagnostics of the system & reports faults. Software facilitates one to choose TL or OSL mode for sample data acquisition, allows the user to configure for the required heating profile in TL mode & other parameters as required in OSL mode. Once data is acquired, acquired data can be saved or further processed depending upon the requirement.



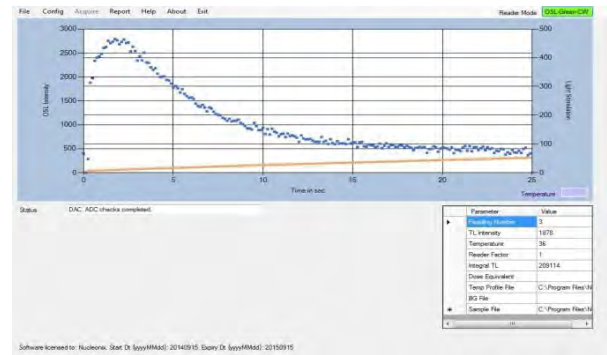
TL Glow curve of CaSO<sub>4</sub> using photon counting module



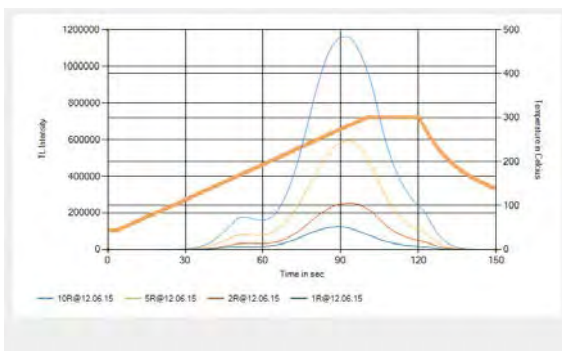
TL-OSL Linearity chart in TL Mode



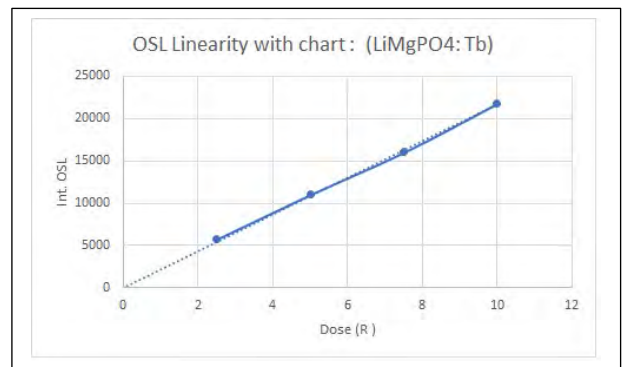
LiMgPo<sub>4</sub>:Tb, B Glow curve acquisition CW-OSL Mode



LiMgPo<sub>4</sub>:Tb, B Glow curve acquisition LM-OSL Mode



TL Glow Curves in Overlap Mode with Same Heating Profile



CW-OSL Performance study

### Software Key features:

- **Mode Selection:** TL / OSL Green / OSL Blue. In OSL, Continuous Wave (CW) & Linear Modulated (LM) modes are available.
- **Heating profiles in TL mode:** Various Heating profiles can be configured – Linear, Single & Multi-plateau.
- **Temperature Calibration:** The software provides an easy & user friendly method for Temperature calibration.
- **Light Stimulation Profile:** Light stimulation profile can be configured for CW or LM modes.

- **Acquisition:** Data is acquired based on the selected Mode & Profile. Background spectrum / Sample data can be acquired.
- **Background Subtraction:** There is a provision to do background subtraction automatically during acquisition.
- **Export Spectrum data to Excel:** Software allows the spectrum data to be exported to Excel, which gives the convenience to the user for further processing.
- **Spectrum overlap:** Multiple spectra can be overlapped (up to 10) for comparative studies.
- **Spectrum subtraction:** 2 spectra can be mutually subtracted & resulting spectrum can be saved.
- **Help:** Software manual is provided which gives installation & usage instructions clearly.

### Applications:

TL Phosphor Characterization, Medical Dosimeter, Personal Monitoring Research, Archeology dating, Environmental Radiation Monitoring, Medicine, Biology, Neutron Dosimetry, Reactor Engineering, High Level Photon Dosimetry with TL materials, standardization and inter comparison of TL dosimeters used in personnel monitoring etc.

**Applications in radiation oncology:** Therapy machine calibration checks & inter-comparison studies with other centers, treatment planning accuracy verification using phantoms, patient specific dosimetry, studies in Brach therapy physics, in X-ray diagnostics to determine absorbed doses to patients & in research etc.

### **Optional accessories :**

#### **A.TL Materials & Phosphors`**

(i) TL Phosphor  $\text{CaSO}_4$ : Dy Powder

(ii) TL Discs  $\text{CaSO}_4$ : Dy discs with Teflon base 13.3mm dia X 0.8mm thick.

(iii) LiF; Mg, Ti square chips (3.2mm x 3.2mm x 0.9mm)

(iv) Vacuum Tweezers

(v) Powder dispenser blocks

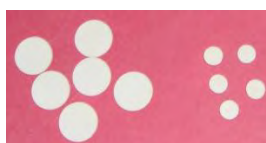
(vi) Neutral density filters.



(i)



(ii & (iii)



(iii)



(iv)



(v)



(vi)

## B. Annealing Oven

Internal Dimensions 14 X 14 X 14 (inches)

Temp Range : up to 400<sup>0</sup>c

Temp Indication: Digital

No. of trays: 2 nos.

Heating: High grade Nichrome wire placed in the ribs of sides and bottom for uniformity.

Power requirement: Single phase 220/230VAC supply.

Accuracy : +/-1<sup>0</sup> or better



## C.CCD Spectrometer (USB 2000+):

This is an optional attachment, which will facilitates one to record TL intensity Vs wave length in the range of 200-1100nm.

This CCD spectrometer is a compact portable unit roughly the size of portable hard drive. It is provided with fiber optical patch cable with SMA connectors, high speed USB cable, software, etc. Software provides graphical user interface and can display spectra (color spectra) of TL intensity Vs wave length.



### Important specifications of ccd spectrometer:

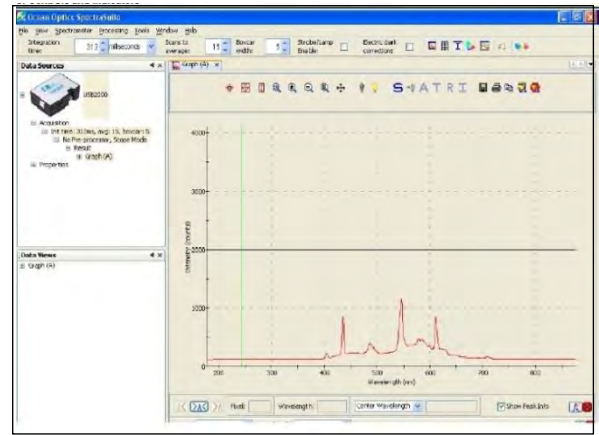
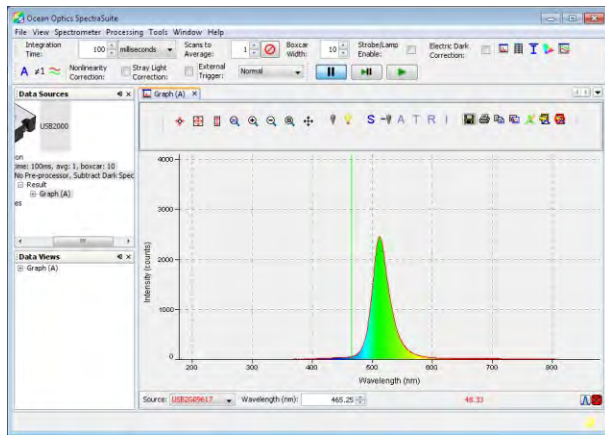
Linear Silicon CCD array detector type SONY ILX511B 2048 PI

Wavelength response: 200-1100 nm

Data transfer speed: Full scans to memory every 3 ms w/USB

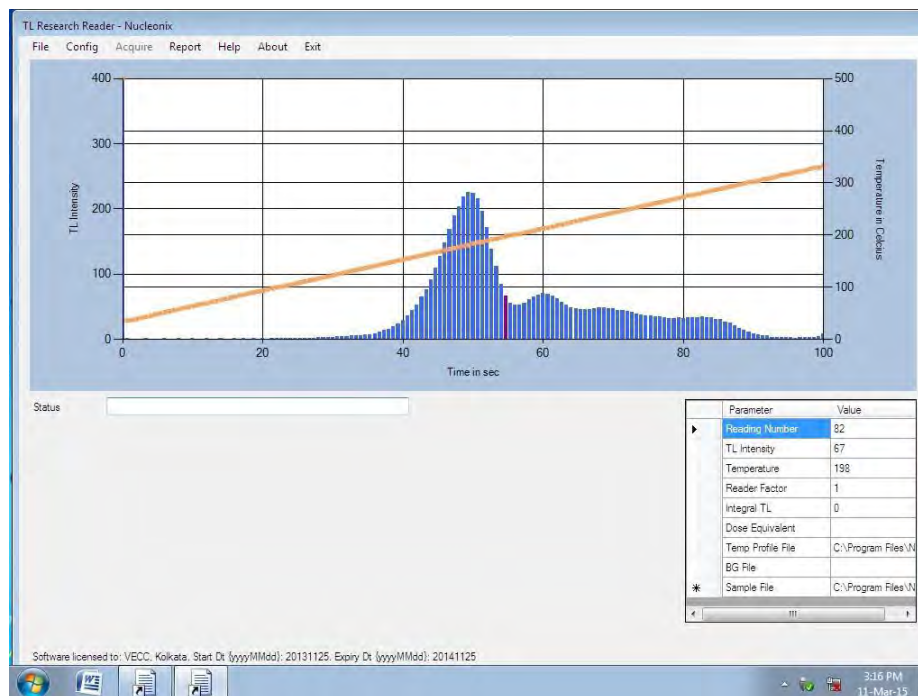
Dynamic range:  $8.5 \times 10^8$ (system): 1300:1 for a single acquisi

SNR(Single to Noise Ratio): 250:1 at full signal



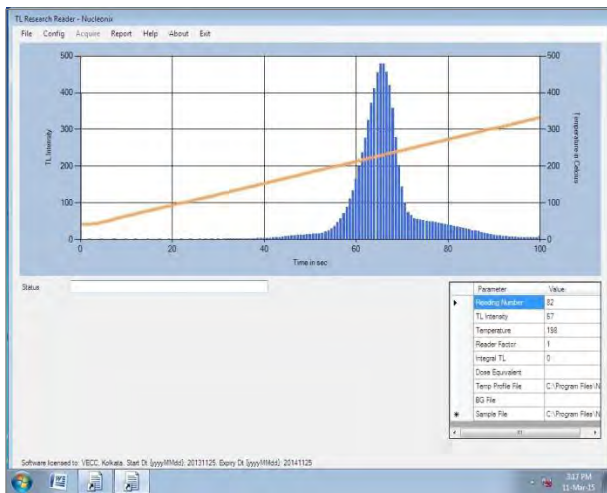
I. CCD spectrometer-Intensity Vs Wavelength record

II. LiF- Glow Curve [LiF-N (Mg,Ti)]

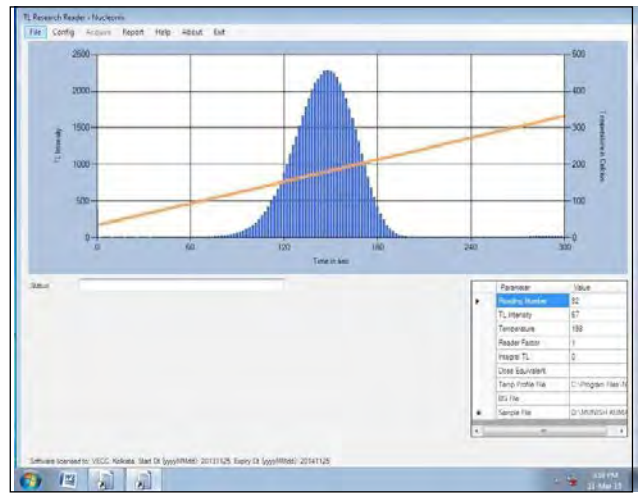


II. LiF- Glow Curve [LiF-N (Mg, Ti)]





III. a) Glow Curve of LiF – Mg, Cu, P



b) Glow Curve of Al<sub>2</sub>O<sub>3</sub> (ALUMINA)

## CHAPTER-III

### SYSTEM INTERCONNECTION DETAILS

System unpacking, installing PMT & mounting all the units on a table etc. have been covered under unpacking. Below table gives the details of interconnections between various units and sub-systems.

S.NO	Instrument/Unit (Name of the signal)	Connection from	Connection to	Type of Cable
1	A.C. power to unit	A.C Mains socket (230V A.C)	TO TL/OSL 1008 on Rear panel MS-socket (3 pin)	3 pin MS connector with Three core mains cable to Three pin A.C plug
2	Profile configure signal (PC to $\mu$ C board)	CPU Rear panel	TL/OSL Rear panel	USB-A to USB-B Cable
3	Photon Counting unit output to CPU (USB or RS232)	TL/OSL Rear panel	CPU Rear panel USB/RS232 Socket	Serial Cable or USB-A to B cable, RS232 Cable (9 pin D type)
4	(Printing command)	CPU Rear panel/Front panel	Printer	USB-A to USB-B Cable
5	Nitrogen cylinder (optional)	Nitrogen cylinder	To TL/OSL 1008 rear panel Nitrogen gas inlet nozzle	Flexible Gas pipe
6	VGA Signal	Monitor (rear panel)	P.C Video connection	15-pin VGA cable
7	AC power supply	A.C Mains 230V, A.C.	Monitor (rear panel)	AC  Mains cord



## CHAPTER –IV

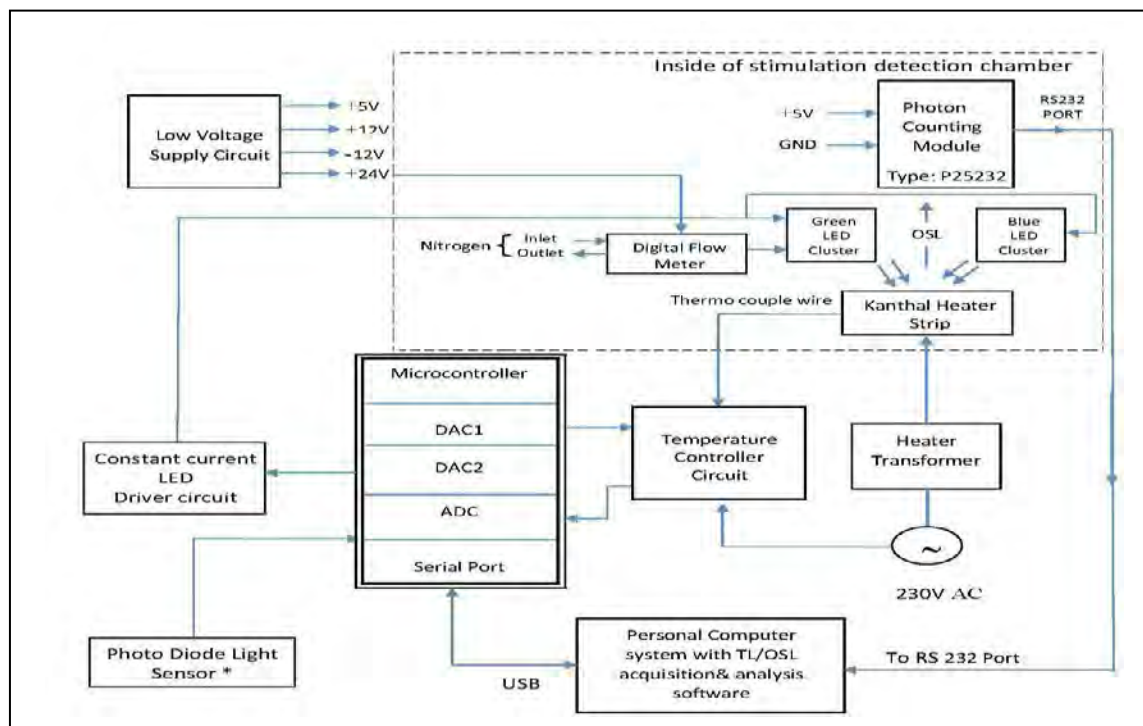
### BLOCK DIAGRAM DESCRIPTION

#### i) Block Diagram Description of TL/OSL ReaderUnit:

Entire system electronics in the form of functional block diagram is shown fig (1). This in conjunction with PC system and software, works, as the PC CONTROLLED TL/OSL RESEARCH READER.

Figure1 consists of the following blocks, namely:

- Low Voltage Supply Circuits (to generate +5V, +/- 12V, +24V)
- Stimulation-detection chamber with green & blue LED's and photon counting module
- Electronics PCB consisting of Microcontroller with embedded code, peripheral devices such ADC, DAC1&2, Temperature controller, constant current LED driver, serial port, etc.
- Photo diode sensor
- Digital flow meter
- Personal computer system and
- Data acquisition and analysis software



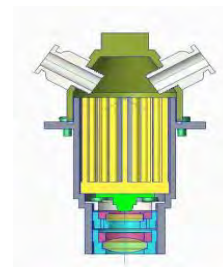
**Fig: Block diagram of TL/OSL Research Reader**

Low Voltage Supplies: LV supplies namely +5V, +/-12V and +24V required by the system are generated using conventional power supply circuits and DC to DC converter.

## ii) Optical Stimulation & Detection chamber

### Optical Stimulation Assembly (Refer to Fig-2& 3)

It is a light leakage free, precisely machined fabricated mechanical assembly, houses photon counting module with detection filter basket, LED stimulation assemblies (four) diagonally placed around photon counting module cylindrical enclosure. TL / OSL sample holder with (Kanthal heater strip) & drawer arrangement are also built-into this chamber.



**Fig: LED Light Stimulation Cylindrical enclosure with Heat sink focusing lens**

Optical Stimulation System consists of BLUE & GREEN LED cluster(s) with, each LED of 3 watt power. Either BLUE or GREEN LED cluster(s) each cluster containing two LEDs can be stimulated. These LEDs are placed diagonally 180° opposite, with suitable lens arrangement, provide uniform luminous intensity onto the sample area.

### iii) Light Source (s):

- (i). Two Blue LEDs cluster, each of 3 watt output gives stimulation output with peak wavelength emission of 465nm, having Luminous flux radiometric power of 30mW @ 700ma & emission wave length band is (460-470)nm.
- (ii). Two Green LEDs cluster, each of 3 watt has peak wavelength emission of 525nm, and gives 99mW radiometric power @ 700mA. Emission wavelength band is (520 -535) nm.

### iv) Constant Current Driver:

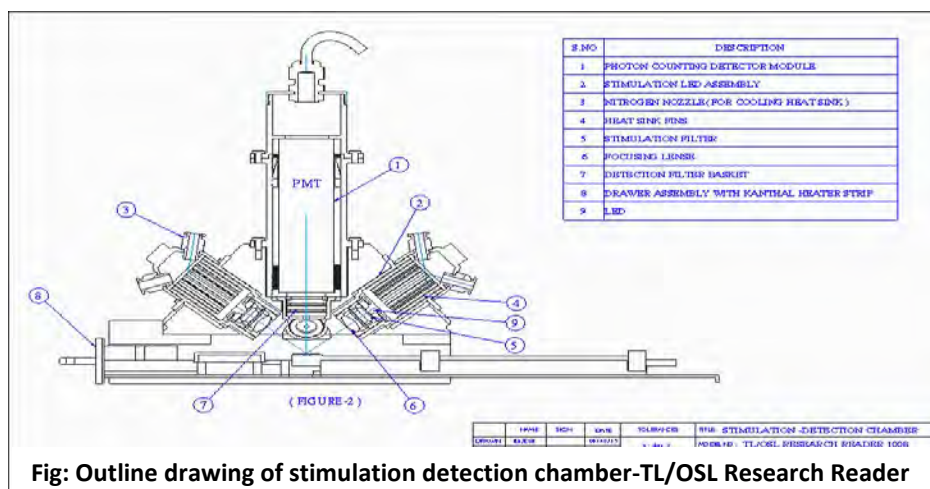
Electronic circuits built-in provide Constant current drive to each of the LED clusters with dimming control, to vary the luminous intensity. Stimulation intensity control is achieved through DAC2 which provides analog voltage proportional to the intensity level, which intern drives the current, both in LM&CW-OSL modes.

Each of the LEDs assembly is provided with a long pass, stimulation filter of 420nm of 12.5mm dia. This prevents the scattering light below 420nm, entering the PMT directly.

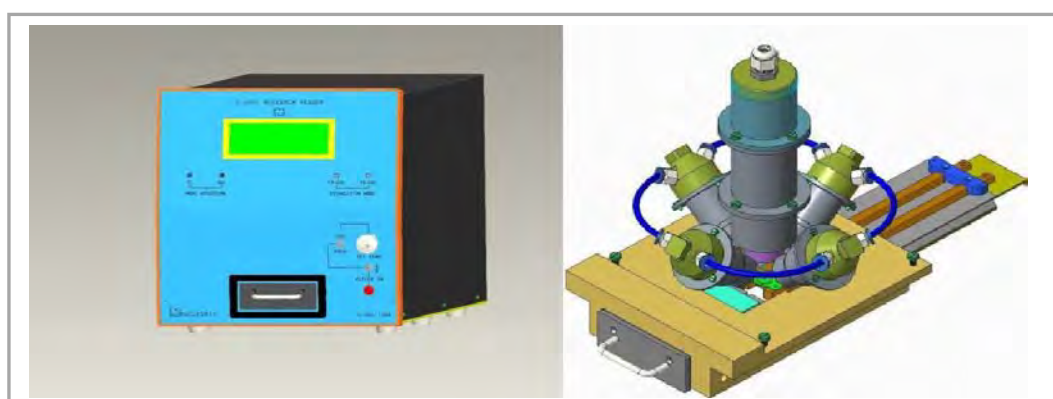
A suitable focusing Plano-concave lens is provided in front of the LEDs to focus the light on to the OSL samples placed in the Planchet / Kanthal heater strip.

Each of the LED assembly has been mounted on a specially designed cylindrical Heat sink, with cooling fins to keep the LED function at lower temperature so as to obtain uniform stimulation, onto the sample holder.

Additionally Nitrogen gas flushing arrangement through a digital rotameter with flow rate control has been provided for cooling the fins of the LED heat sinks. Flow/Rate of 1 lpm to 2 lpm or as desired can be set for cooling the heat sink fins. A circular tubular path from gas inlet connects sequentially to all the four LEDs (two pairs of Green & Blue LEDs) & the gas is sent to outlet on the rear panel of the system.



**Fig: Outline drawing of stimulation detection chamber-TL/OSL Research Reader**



**Fig: TL/OSL Reader Isometric View**

**Fig: TL/OSL Stimulation & Detection Chamber**

#### **v) Photo Diode / Photo sensor:**

A suitable photo diode, with built in amplifier placed close to the Kanthal sample heater strip, senses the part of the stimulation intensity, (proportional to that falling on to the sample) and is read by ADC of the microcontroller board, which in turn, plots 'stimulation intensity signal' on Y2 axis, in both LM and CW modes of OSL acquisition.

#### vi) TL-OSL READER-Light Detection System / Photon Counting Module:

The light detection system consists of a plug-and-play photo detector package (ref to fig 7) configured for photon counting. It comprises of a selected 25mm diameter end window photomultiplier tube. Positive high voltage power supply, high speed amplifier-discriminator, counter and micro-controller. All are encapsulated within a cylindrical mu-metal case, providing a high level of immunity from the effects of external magnetic fields. Low voltage and signal output connections to these packages are by flying leads.

Three options from Electron Tubes range of 25mm end window photomultipliers are offered to cover the spectral range from UV to IR spectral response curves.

P25232: Selected bi-alkali photomultiplier with high blue sensitivity and ultra-low dark counts.



**Fig: Photon Counting Module**

**Photon counting module** provides a fast, accurate light measurement via an RS232 interface to a host PC. Some of the important features are-

Simplicity of operation, Minimal set up time, Compact cylindrical assembly, Electrostatic and magnetic shielding, RS 232 interface, UV window option, 100 MHz count rate capability, Automatic dead time correction, Operates from +5V supply, Pre-set discriminator level and HV are factory set for optimal performance.

#### vi) TL Acquisition Mode:

In this mode of operation user has to set the following conditions for TL acquisition. The filter basket has to have heat absorbing glass/ IR filter combination. In the software menu select the TL mode. Followed by this, three point temperature calibrations is to be carried out. Set ISO/PROG switch to PROG mode place the heater ON/OFF switch to ON position. Now user can load the TL sample on to the Kanthal heater strip. One can configure for the required heating profile and carry out the TL acquisition. TL intensity is acquired and plotted on the y1 axis by the photon counting module. On y2 axis temperature is plotted.

#### Vii) TL Heating System:

##### Heating Element: (Heater Strip)

Kanthal strip (72% Fe, 23% Al and 2% Cr or Nichrome) is used as a heating element.

Kanthal Strip has a circular depression of 14mm to hold discs and powder samples. Additionally flat heater strips also can be provided on request.

##### Sample Heating Process:

Sample heating can be done in two modes:

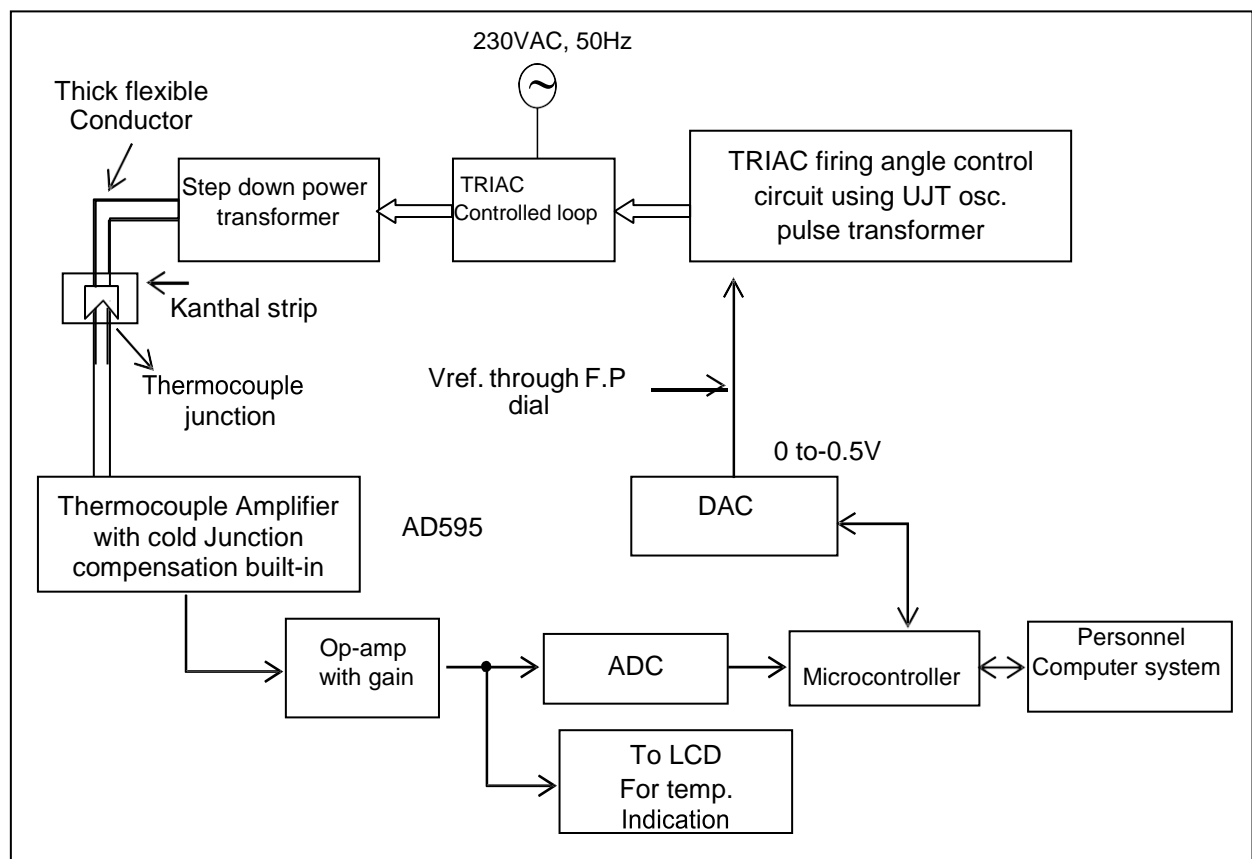
"PROG MODE" of Temp. Control through personal computer program. "ISO MODE" (Internal mode) of Temperature Control, by varying the ten-turn dial.

From room temperature up to 500<sup>0</sup> C linear & plateau heating (Single / Two / Three plateau heating are possible).

viii) Temperature controller circuit

Below Figure is the temperature controller & sample heating system. Thermocouple 'mv' output received from the Kanthal heater strip is, fed to a monolithic thermocouple amplifier with cold junction compensation. Output from this is fed to an op. amp. And it goes to ADC chip whose value is read by microcontroller & interpreted in terms of temperature through PC program, subsequently. Programmable heating of Kanthal heater strip is achieved, by firing a TRIAC & controlling the conduction angle of 230V, A.C power. Conduction angle control loop circuit essentially has a UJT oscillator synchronized with 50Hz A.C. power. UJT oscillator generates a trigger pulse through pulse

Transformer which controls the conduction angle of TRIAC. This enables 230V AC primary loop of a power transformer which is stepped down to 2.5V@ 40 ampere. Secondary of this transformer heats up Kanthal strip. The control of conduction angle is by a D.C control voltage 0 to-500 mV which heats from room temperature up to 500<sup>0</sup>C. This control voltage is fed from a ten-turn dial in ISO mode & from DAC1 which is programmed through microcontroller to generate various heating rates from 2<sup>0</sup> C / sec to 40<sup>0</sup> C / sec & also various heating profile(s) such as single / multiple plateaus.



**Fig: Temperature controller part of the circuit, for sample heating on Kanthal strip**

## CHAPTER -V

### DEFAULT SETTINGS

After making all the connections user may set the switches and knobs to default values before proceeding with glow curve acquisition.

Default settings on the instrument:

- |  |   |
|--|---|
| * ISO/PROG Toggle Switch<br>Check                | - Keep the Toggle switch to 'ISO' mode initially to<br>The working of the reader by heating in ISO mode.<br>Then to "PROG" mode, for normal acquisition of a<br>glow curve.   |
| * SET TEMPERATURE (DIAL)                         | - Not Applicable in PROG mode.<br><br>Applicable only in ISO mode .However it can be<br>left at minimum position. When operated in ISO<br>mode approx. every two turns correspond to<br>100 <sup>0</sup> c.   |
| * HEATER ON/OFF Switch                           | - Initially OFF position, when the equipment is<br>switch ON. Then change to ON position before<br>ensuring that Temp in TC display should indicate<br>room temperature or ambient temperature of<br>Kanthal strip. If temperature indication shown is<br>near to 'zero 'or -ve, then the thermocouple could<br>be in broken condition/open condition. If found,<br>so it should be rectified/replaced before switching<br>ON the heater ON switch. |
| *A.C. Mains<br>ON / OFF switch on (Rear panel) - | F.P control store fault settings<br>And ensuring connections between<br>PC and TL/OSL 1008, switch ON the<br>A.C. mains switch on Rear panel to<br>Power the instrument.  |

## CHAPTER –VI

### HOW TO Make the System Operational / Functional to get the Accurate TL / OSL Measurements

- Unpack the unit and check for the physical damage( If found please contact product specialist through Nucleonix Customer Support Executive)
- By default, system is sent with “TL filter basket”, prompting the user to operate in TL mode.
- Make all system interconnections and keep the unit in switch off condition.
- Put off the “Heater ON” switch and keep temperature Knob at minimum position.
- Keep the ISO/PROG heating mode switch in ISO mode, initially.
- Switch on the AC-Supply and switch ON the unit through (Rear Panel Rocker switch).
- LCD display shows ambient temperature as sensed by thermocouple, spot welded at the bottom of the Kanthal strip. (If not, check the thermo-couple connections and spot welding under Kanthal strips).
- Put ON the “Heater ON” switch and slowly increase the set temperature Knob and such that for each turn, the temperature increases by around 50<sup>0</sup>C (approximately).
- Check the temperature up to 500<sup>0</sup>C in LCD for 10 Turns of the Set Temperature knob
- Minimize the Set temperature knob and change the Heating mode switch into PROG, mode allow the Kanthal strip to cool and temperature indication to reach, to 45 degrees (approx.).
- Load and Install the TL/OSL Research Reader application software from CD. (Refer the software instruction Manual). Your PC, if supplied by Nucleonix will have TL/OSL application software, installed already.
- Run the TL/OSL Research Reader application software in the PC and check if the proper COM Port is entered or not. Go through **software instructions/commands**, thoroughly before operating further.
- Select Mode to “**TL option**” from the commands provided.
- Do the “**temperature calibration**” as described in the instruction manual (Page no : 62 )
- Go through, already configured & recommended temperature profiles for various types of TL phosphors. Always remember to configure a temperature profile, to have minimum IR & max TL extraction (output) so that residual TL when acquired shall be less than 10% of the original TL glow curve.

- Create some Standard ( or desired) temperature profiles for different TL Phosphors or Samples (optional)
- Try to use recommended profiles, if it meets your requirement
- For natural crystal chips, discs and powder samples, **Linear Heating with Natural cooling profile** is desired. Clamping may not be required.
- For Teflon based, pellets and discs samples, **Linear heating with some clamping time and natural cooling profiles** are advisable.
- Acquire a dummy glow curve by loading no sample on the Sample holder (KanthalStrip)
- Run the background glow curve (If user wants to subtract the BG, save and select this file as Background file in Acquire menu)
- Now the System is ready to do the sample acquisition & analysis in TL-Mode.
- Refer to procedure & command instruction / sequence for TL glow curve acquisition as described at the end of this chapter.
- To operate the Reader in OSL Mode, select the reader mode (either CW-OSL or LM-OSL)
- Now create standard or required stimulation profile
- Acquire a dummy spectrum in OSL mode
- Run the BG spectrum (If user wants to subtract the BG, save and select this file as Background file in Acquire menu)
- Now the system is ready to do the sample acquisition & analysis in OSL mode
- Refer to the procedure and command instructions/sequence for OSL Glow curve acquisition as described at the end of this chapter.
- Then choose 'Main Screen' after configuration. (Refer to TL /OSL Software user manual for details on configuration and TL /OSL glow curve acquisition). Load the TL /OSL material in disc, pellet, crystal, chips or powder for under study on to the Kanthal strip after weighing accurately in case of powders and close the drawer.
  - a. Before making any measurements or acquiring a glow curve for a TL sample, read the instruction manual on "How to make TL measurements more accurately &correctly".
  - b. Before making any measurements or acquiring a glow curve for an OSL sample, read the instruction manual on "How to make OSL measurements more accurately &correctly". Read the complete procedure for TL measurements or OSL measurements chapter then go to 4.1.7 point for acquisition. Start acquisition by clicking on 'ACQUIRE' icon.
- Acquisition will go on from ambient temperature/ambient light to set temperature/light

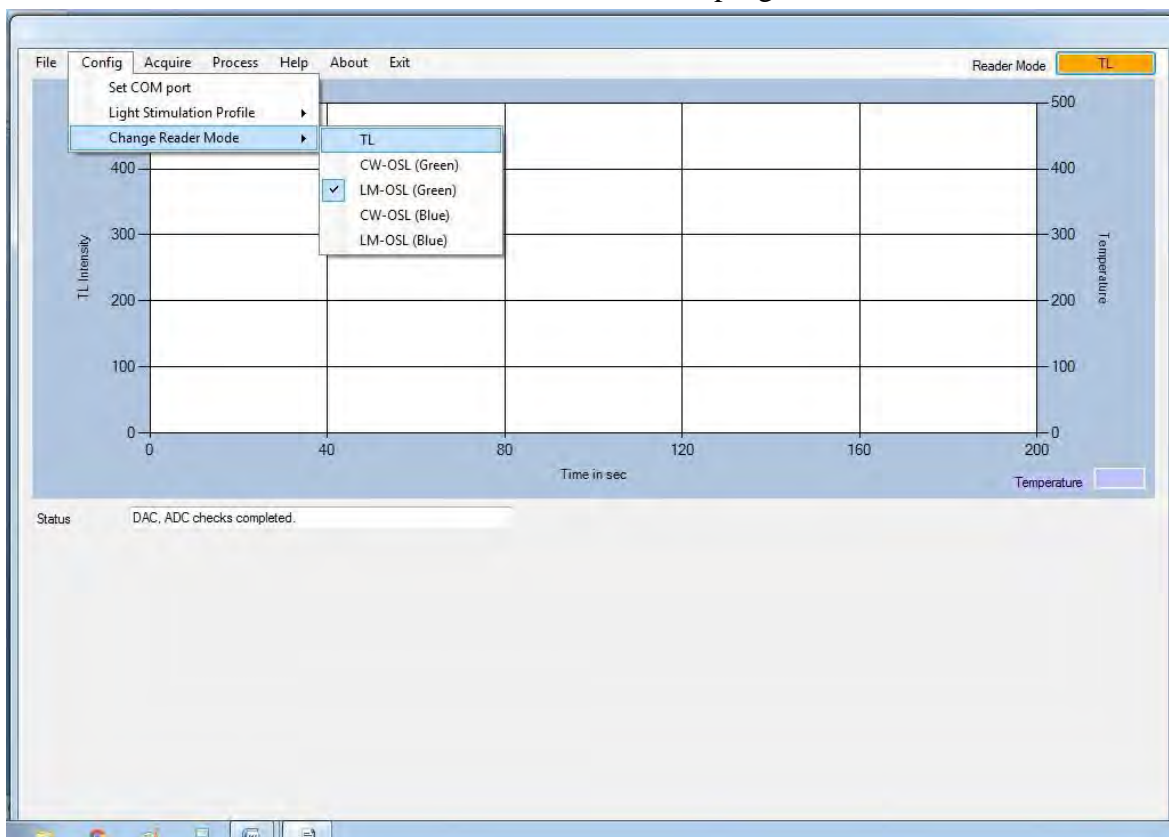


intensity as per the selected heating profile/light stimulation profile. PC display will present digitized GLOW CURVE for acquisition channel indicating TL/OSL intensity Vs Time and Temperature /Light intensity.

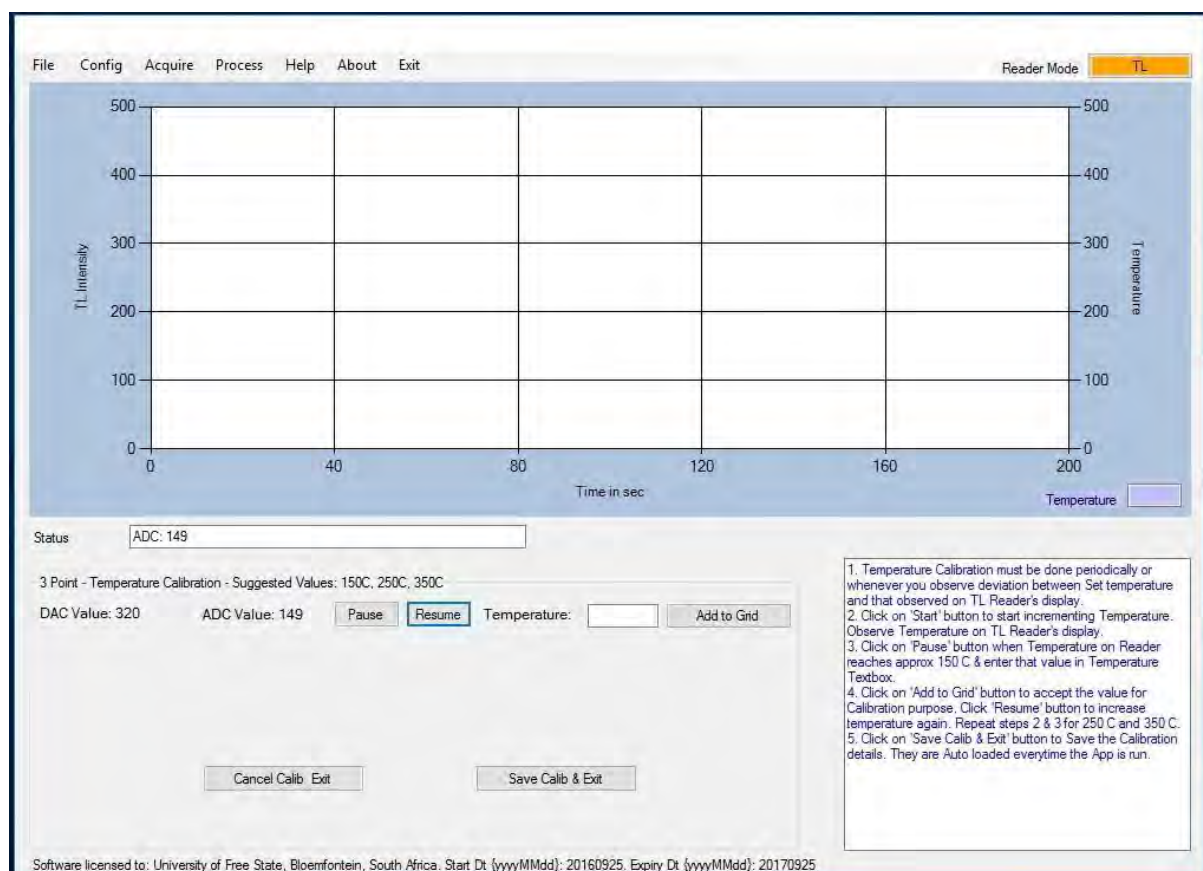
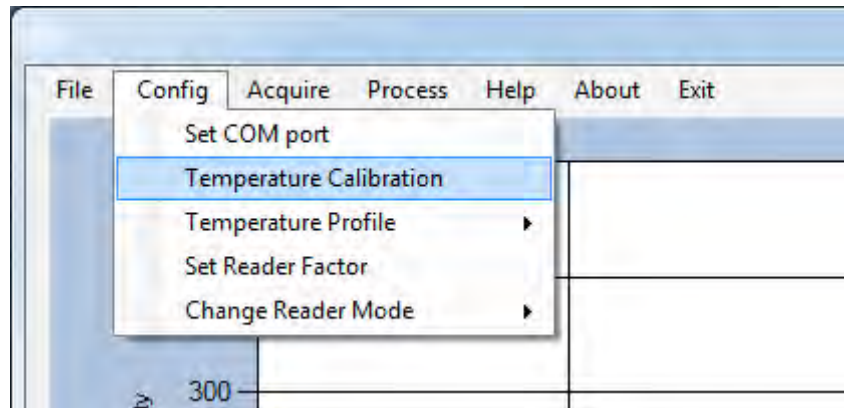
- Acquired glow curve can be saved as file with time, light intensity and temperature parameters apart from TL / OSL intensity. As per software features user can analyze, print, plot and do other functions as desired.
- Before you load another sample, rerun & acquire for back ground with the same sample & save it as a BG file.
- Brush out the powder (or take out the disc) in to bottom collection tray & reuse.
- Allow it to cool to at least 40<sup>0</sup>C (in TL mode) before next sample can be loaded & run.

### Procedure for TL glow curve acquisition and analysis

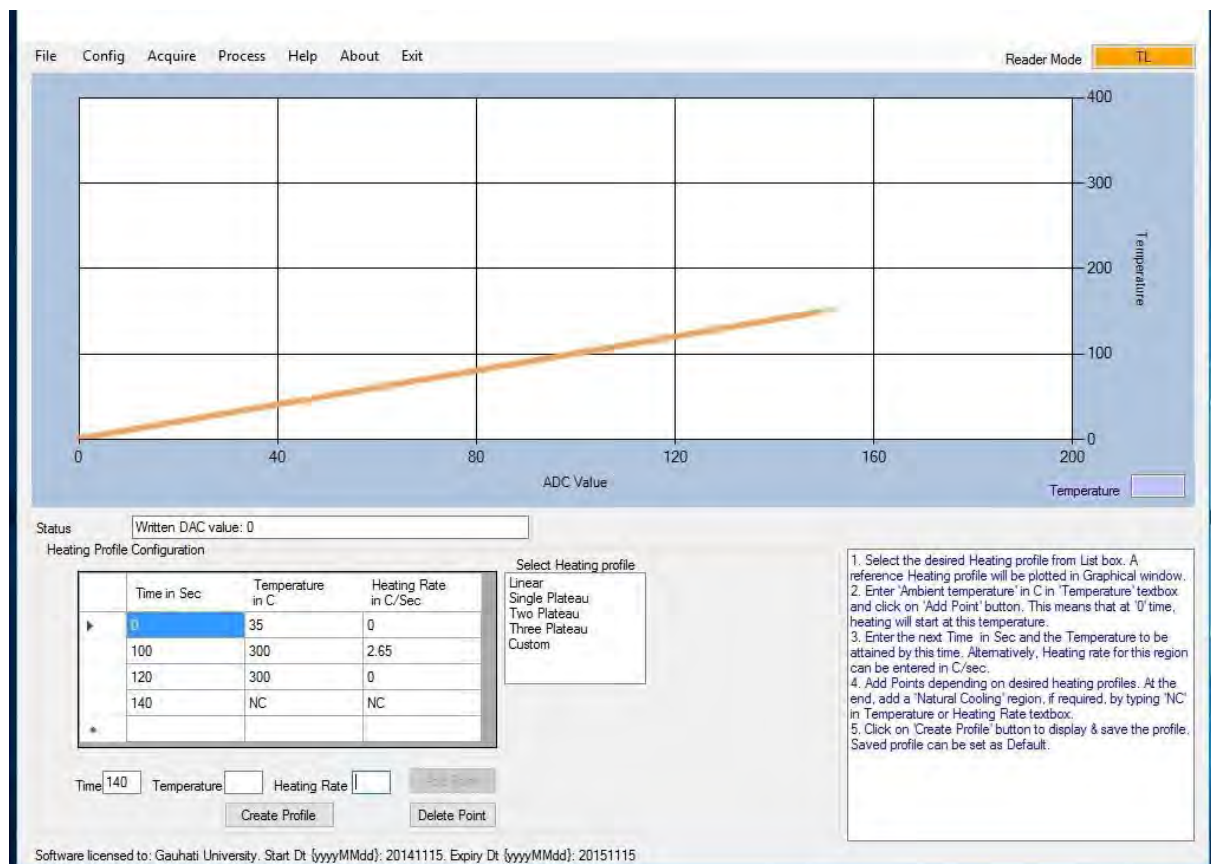
- Keep the temperature in PROG mode and Put ON the “Heater ON” switch
- Make sure that **TL filter Basket** insertion in the Dark (Detection and Stimulation) chamber (To change the filter Basket Refer the Instruction Manual Page No. 54)
- Switch ON the Reader, by using ‘Rocker switch’ on the Rear panel.
- Open the TL Research Reader application Software.
- Select the Change Reader Mode to TL, if other mode is running (Default it is in TLMode, when the Reader is powered up) as shown in fig.
- Mode will be shown in the GUI screen on the top right extreme corner as **Reader Mode**



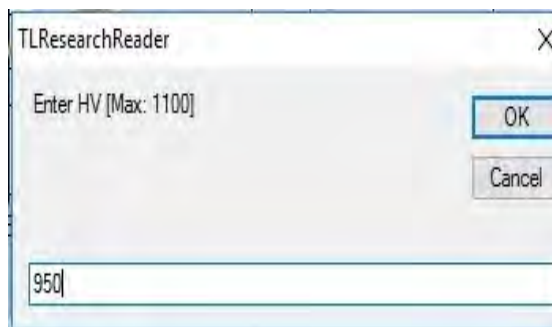
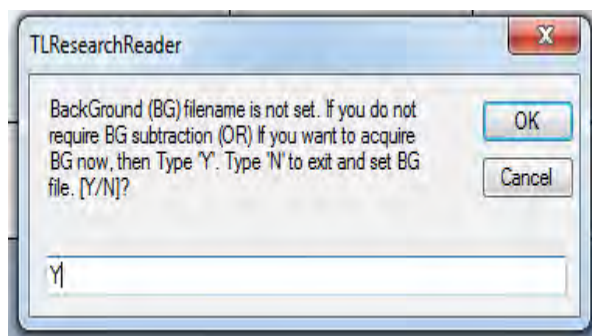
- Do the Temperature Calibration as described in the Software Manual (It is recommended to do the Temperature Calibration once in fortnight (15Days))



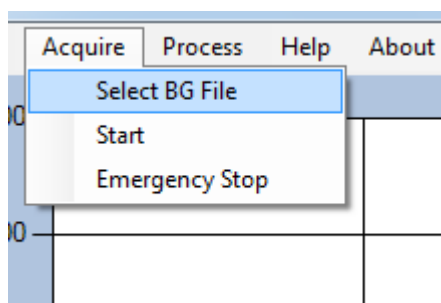
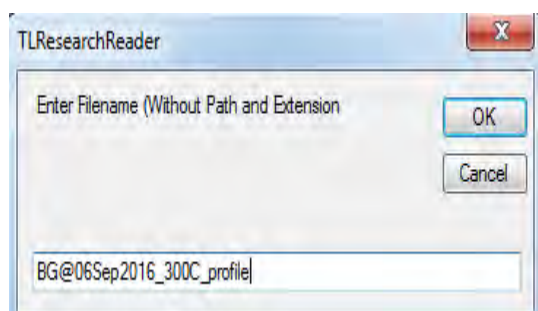
- Now Create a Temperature Profile to get the maximum Illumination from with min. IR.



- Acquire the Background by placing **NO** sample on the Kanthal Strip by clicking acquire menu → start
- (If user interested to subtract the background. Otherwise we can skip this one)

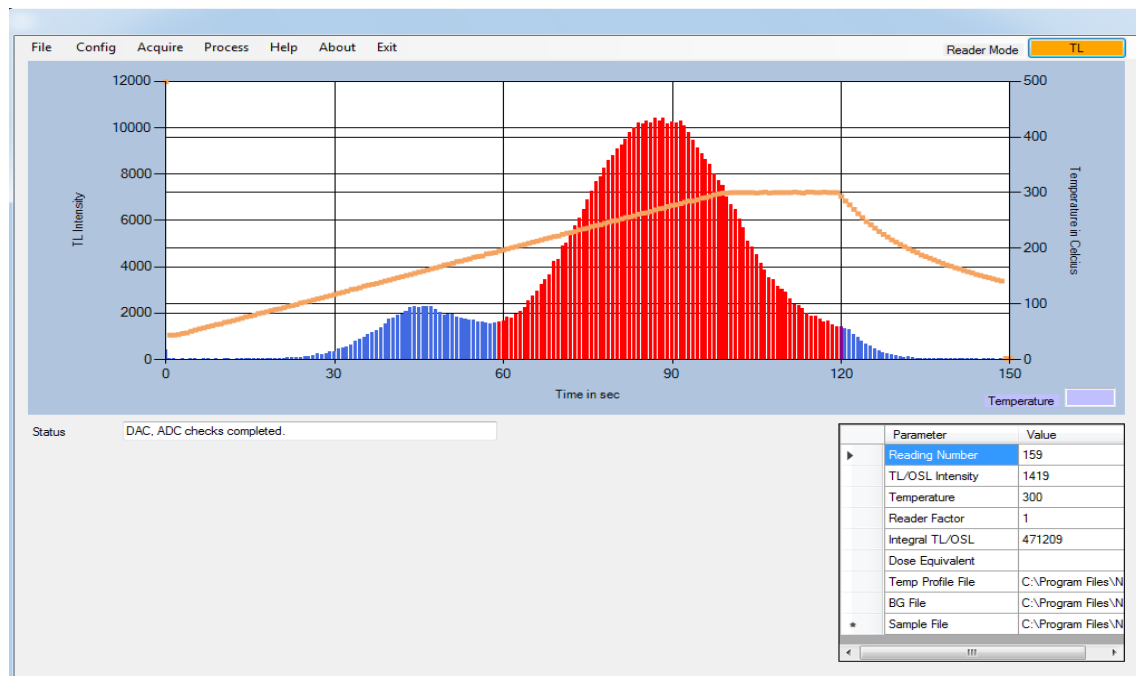


- Save the background glow curve and select the same file to subtract automatically from the sample data

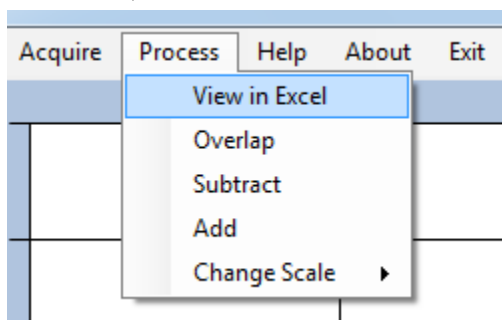


- Now place the irradiated sample on the Kanthal at middle.
- Acquire the glow curve and save the file.

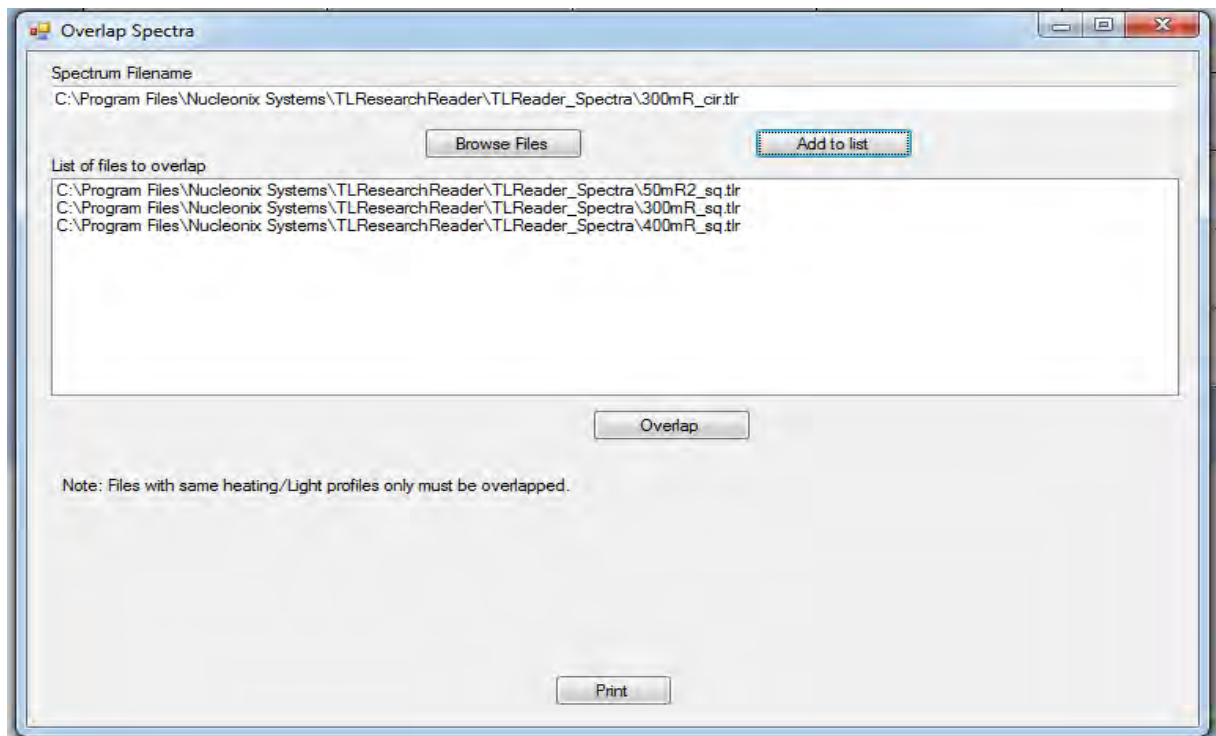
- User can select the Region of Interest (ROI) by clicking the required extreme points on the glow curve. Integral TL will be displayed in Table on the right bottom of application Software



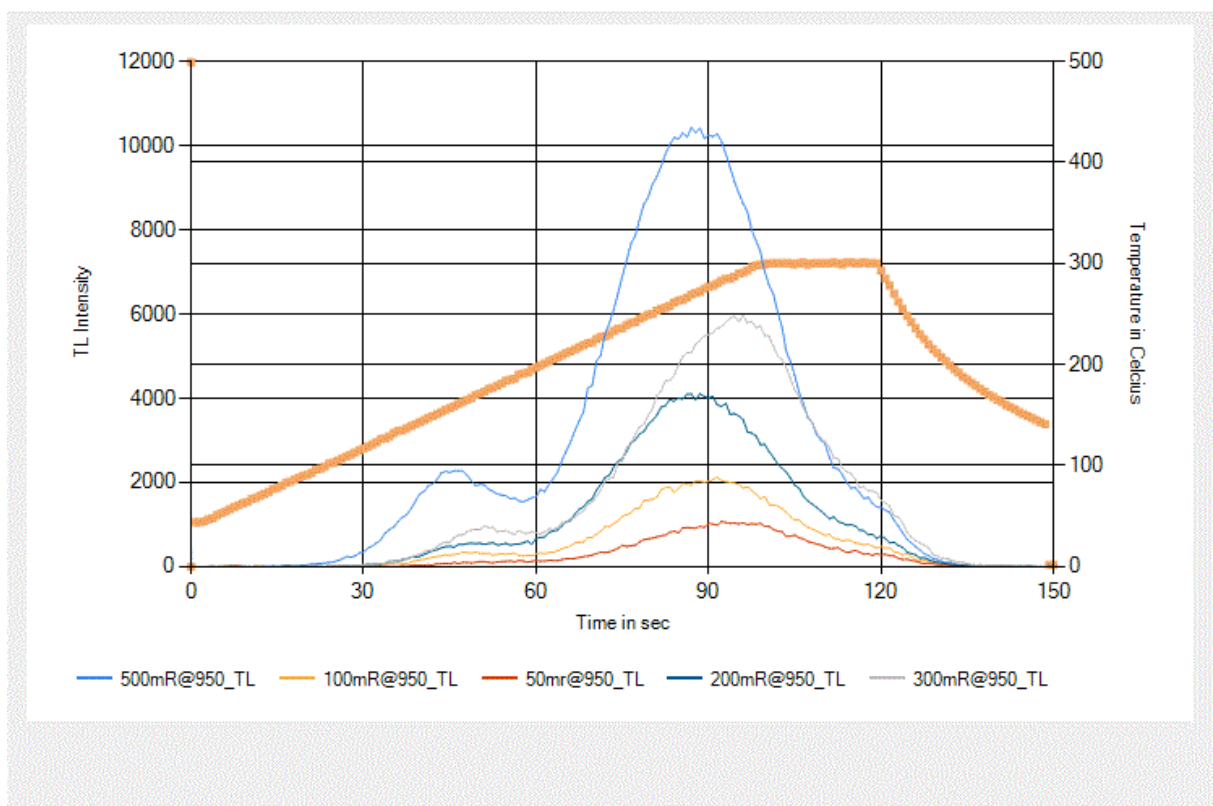
- One can open the previous glow curves from the File menu → Open → select the desired file.
- We can process or utilize the raw data (Temperature, Illumination Intensity) by viewing in excel format (Process menu → View in Excel → select the desired file)



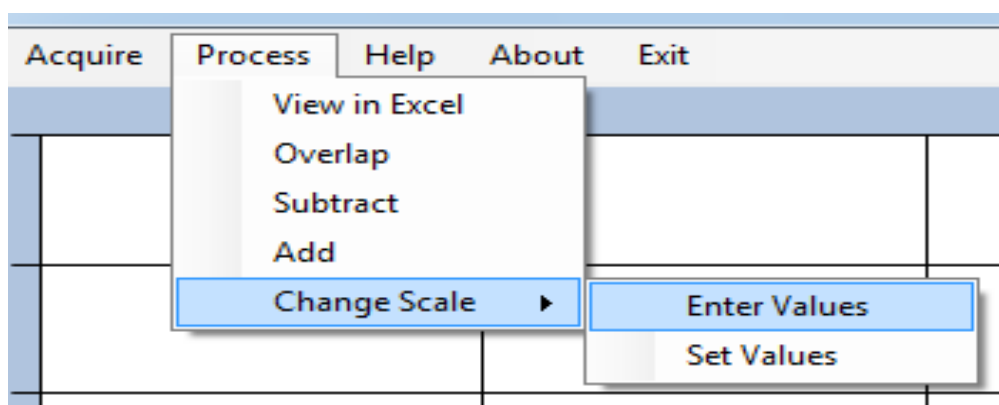
- In order to do comparative studies one can overlap different glow curves (With same temperature Profiles)
- Go to process menu → Overlap → browse the required files and add to list one by one



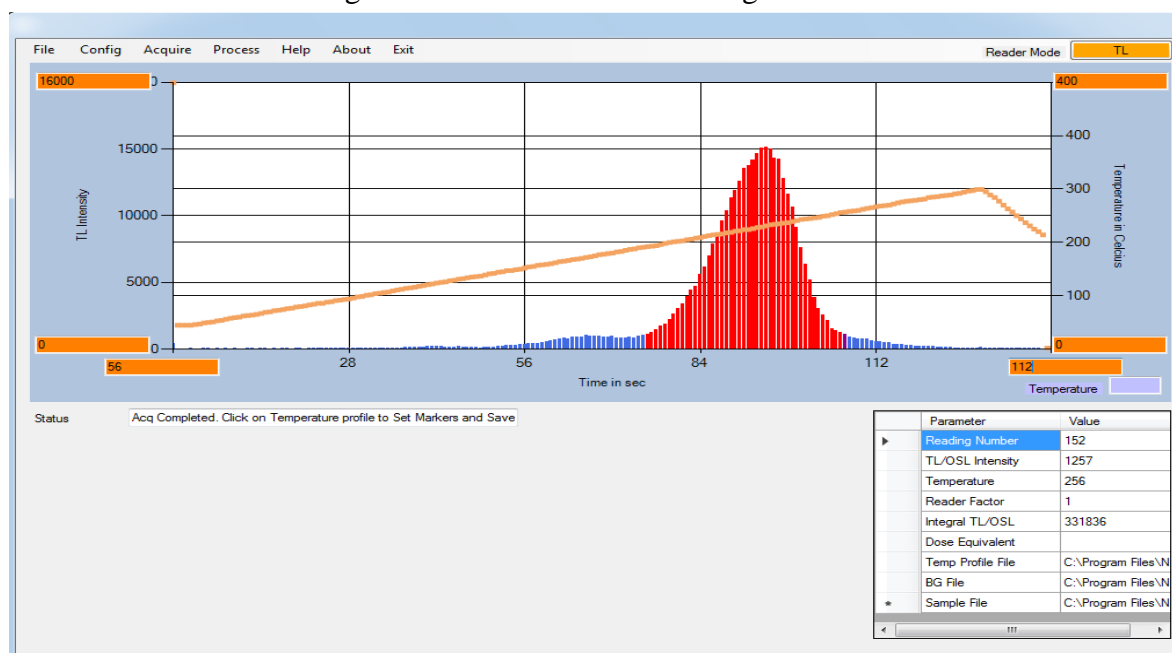
- Now click Overlap and save the file at desired destination
- Typical overlap file will be as shown in figure



- If user want to observe particular region interest of glow curve then click on Process ➔ Change Scale ➔ Enter values



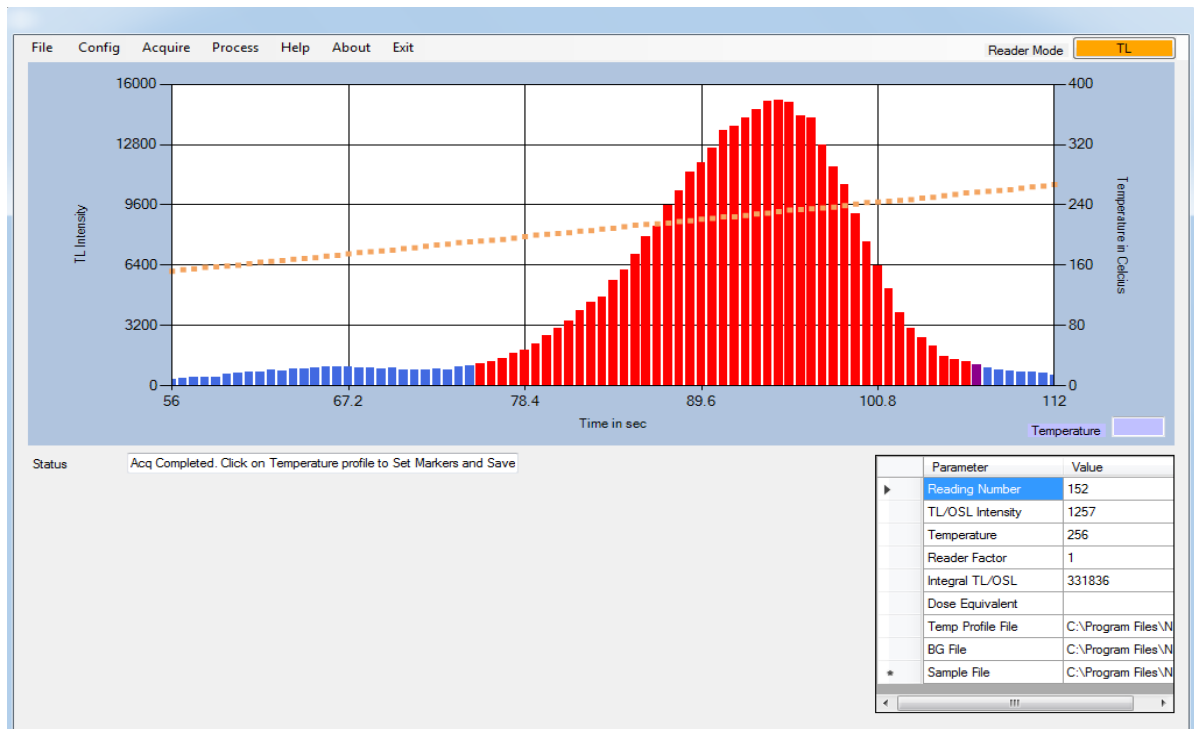
- Enter the min and max range of interest as shown in the figure



- Click on Process Menu → Change Scale → Set Values ( to apply these settings to the glow curve)



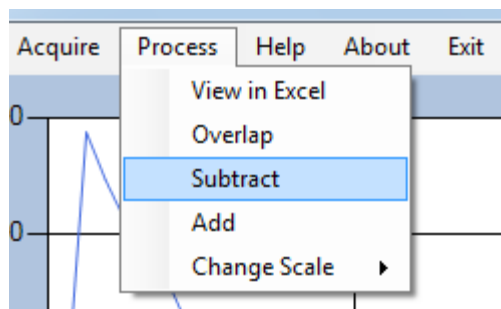
- Hence Glow Curve will be transformed (or zoomed in) as shown in figure



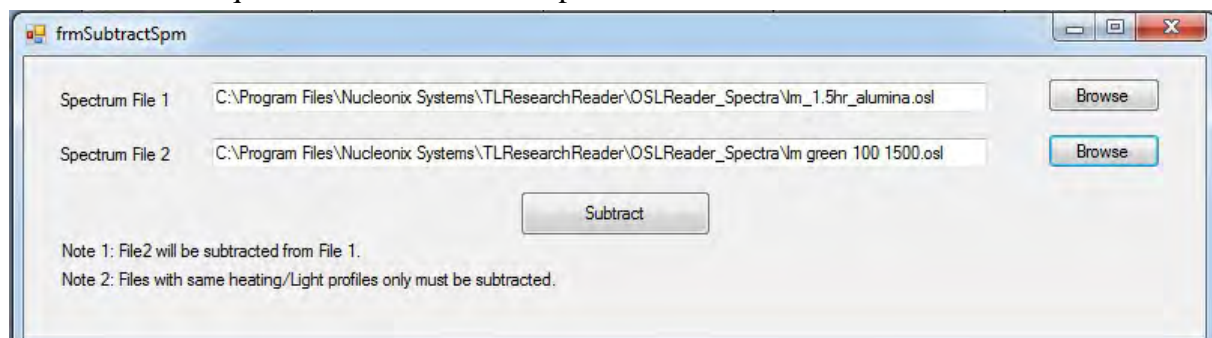
- These settings will be saved permanently until the software is re-opened.

### Subtraction/Addition of two spectra (Glow Curves)

- Arithmetic operation like Addition or subtraction of two spectra can be done, depends upon the requirement of user
- For that click in Process Menu → Subtract (or Add)



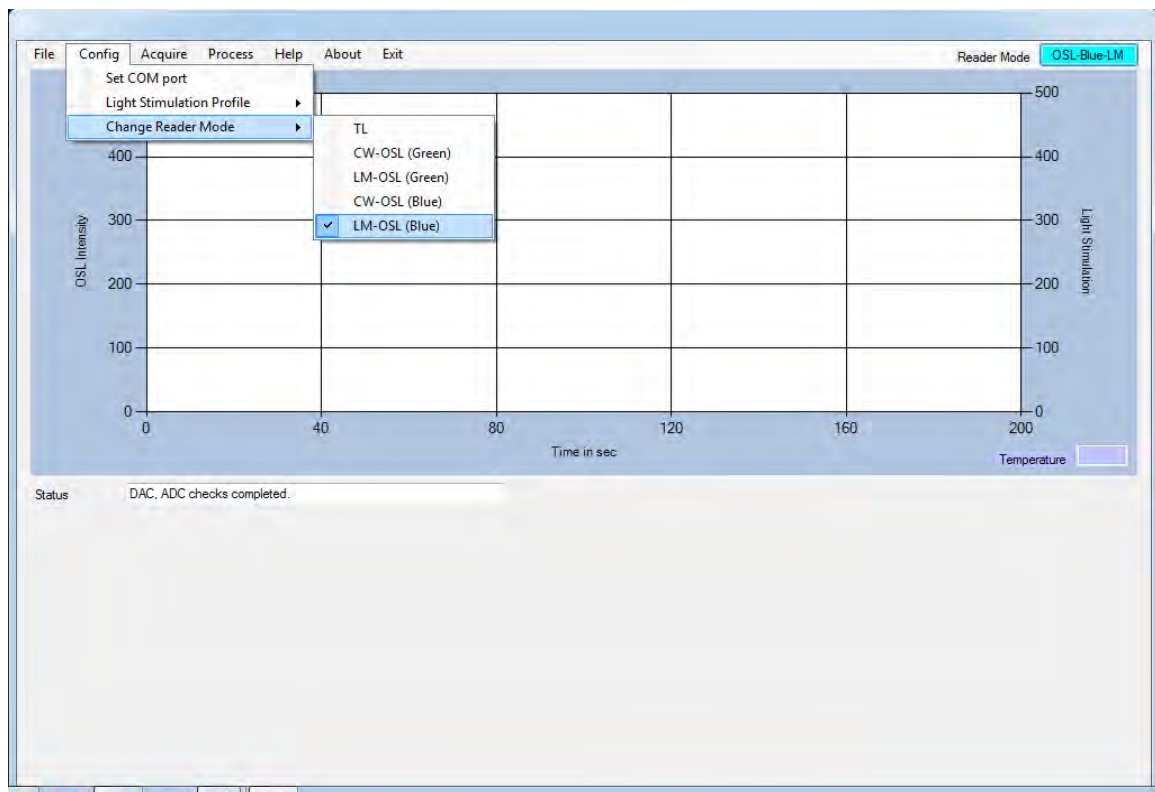
- Select the files required for the arithmetic operation



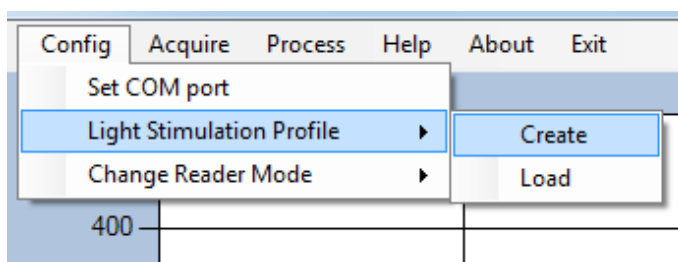
- Save the resultant file for the analysis (if,required)

## Procedure for OSL Glow Curve acquisition and analysis

- Keep the temperature in PROG mode and Put OFF the “Heater ON” switch
- Make sure that OSL filter Basket like U-340, UG-1 (U1) insertion in the Dark chamber (To change the filter Basket Refer the Instruction Manual Page No. 54 )
- The ambient light should be subdued or Dim (otherwise sample may lose the stored irradiated dose)
- Switch ON the Reader, by using ‘Rocker switch’ on the Rearpanel
- Open the TL Research Reader application Software
- Select the Change Reader Mode to Required OSL mode, if other mode is running (Default it is in TL Mode, when the Reader is powered up) as shown in fig.

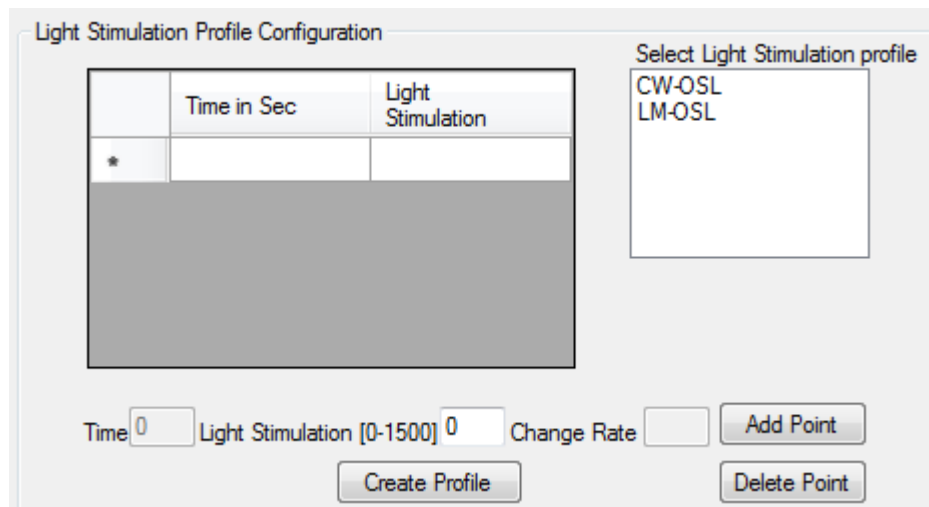


- Create or Load the stimulation profile by clicking Config Menu → Light Stimulation Profile → Create (Or Load if already Created)

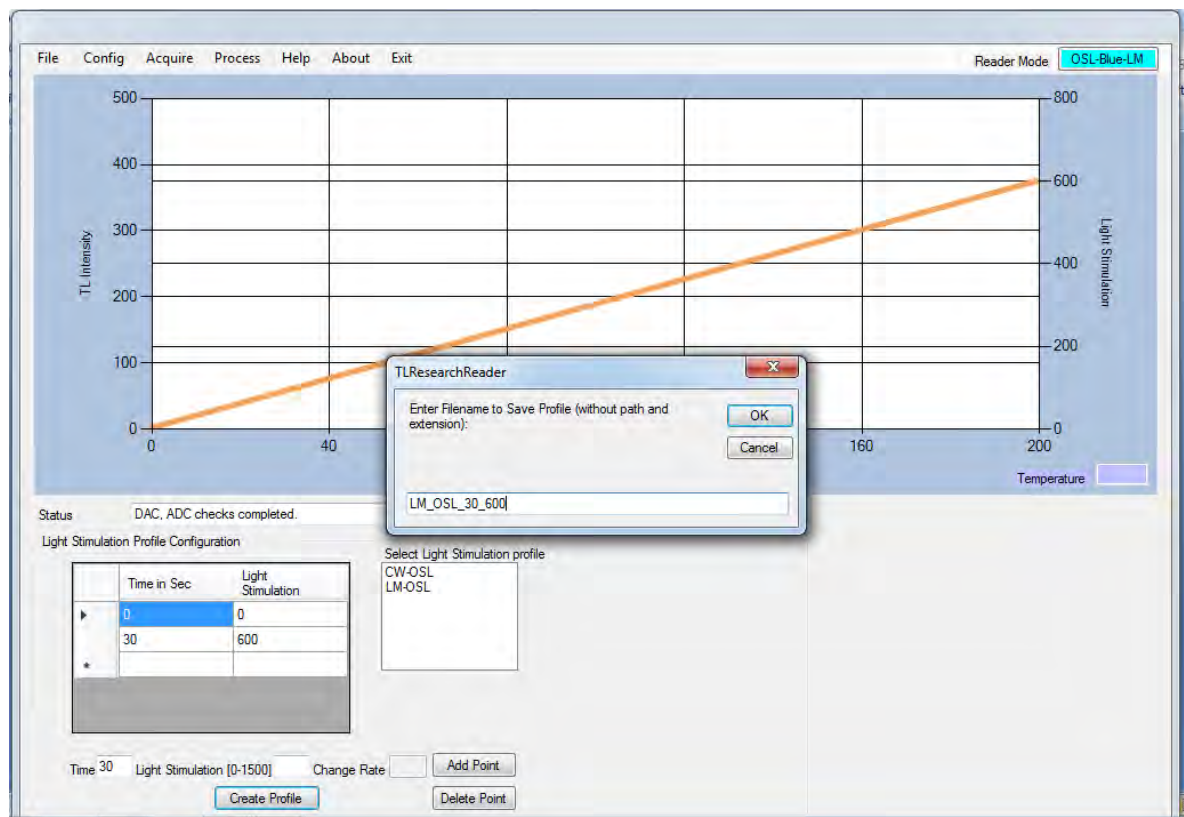


- If user wants run the sample with LM-OSL mode, he has to configure starting Light stimulation (typically zero) intensity at zero time, add that point and enter the runtime, required Light stimulation and add the point

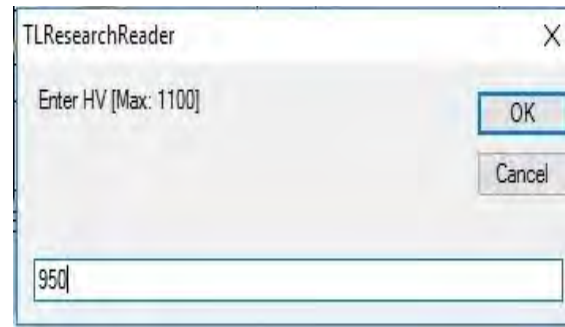
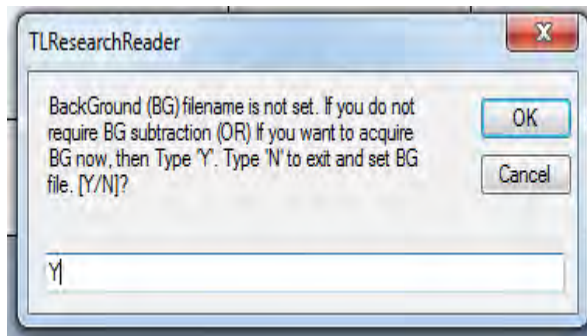




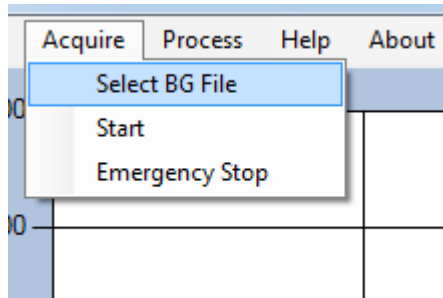
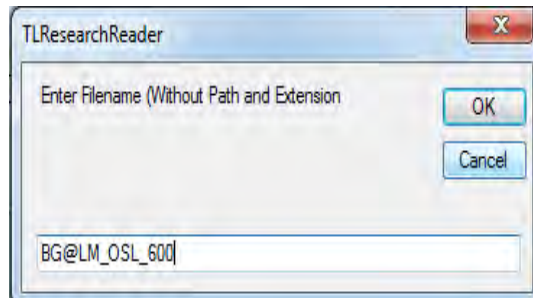
- Now Create and save the profile



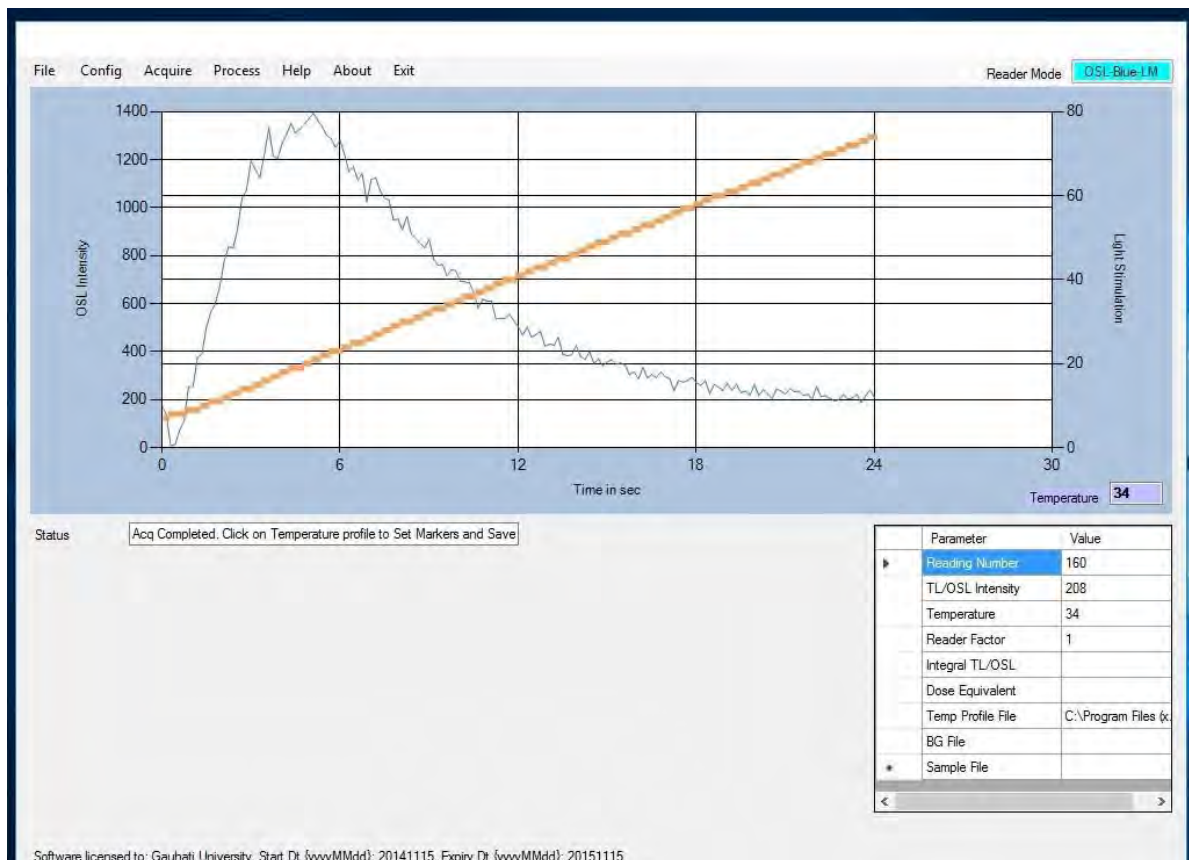
- If user wants run the sample with CW-OSL mode, he has to configure a Light stimulation intensity at zero time, add that point and enter the run time & same Light stimulation and add the point
- Acquire the Background by placing **NO** sample on the Kanthal Strip by clicking acquire menu → start
- (If user interested to subtract the background. Otherwise we can skip this one)



- Save the background glow curve and select the same file to subtract automatically from the sample data

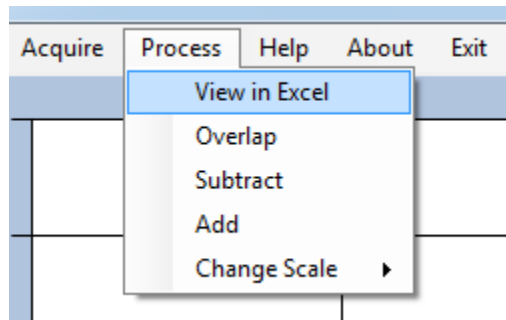


- Now place the irradiated sample on the Kanthal at middle.
- Acquire the glow curve and save the file.

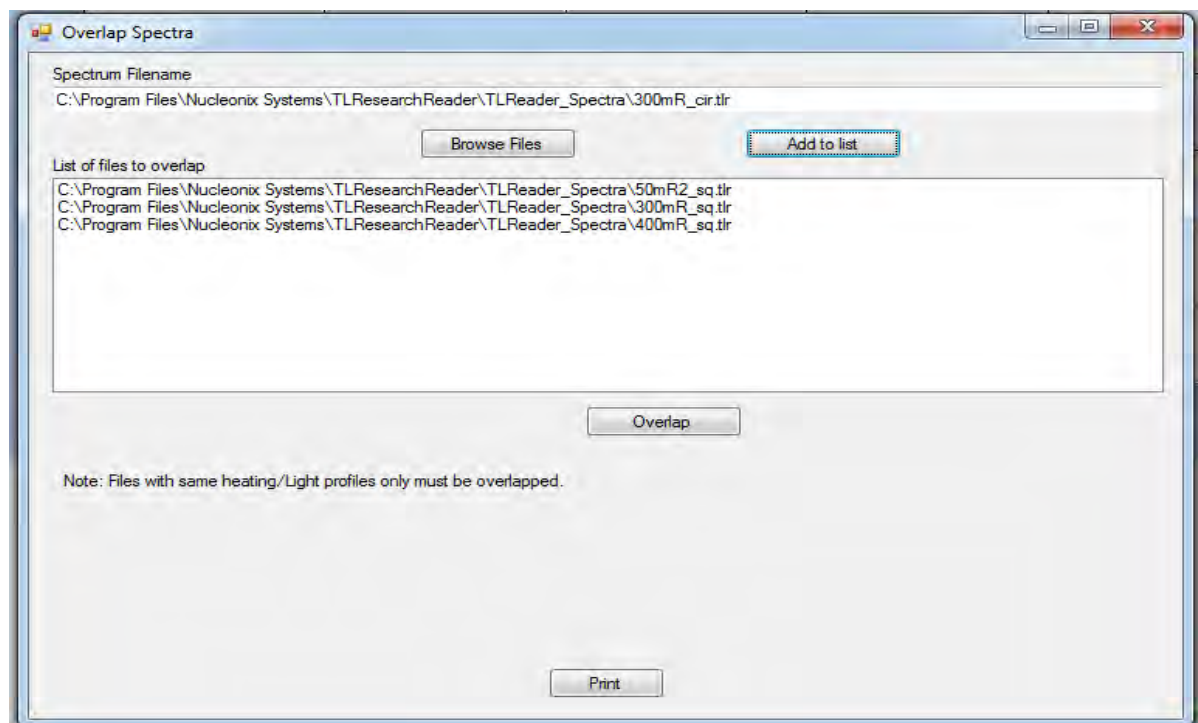


- User can select the Region of Interest (ROI) by clicking the required extreme points on the glow curve. Integral OSL will be displayed in Table on the right bottom of application Software
- One can open the previous glow curves from the File menu → Open → select the desired file.

- We can process or utilize the raw data (Stimulation, Illumination output Intensity) by viewing in excel format (Process menu → View in Excel → select the desired file)

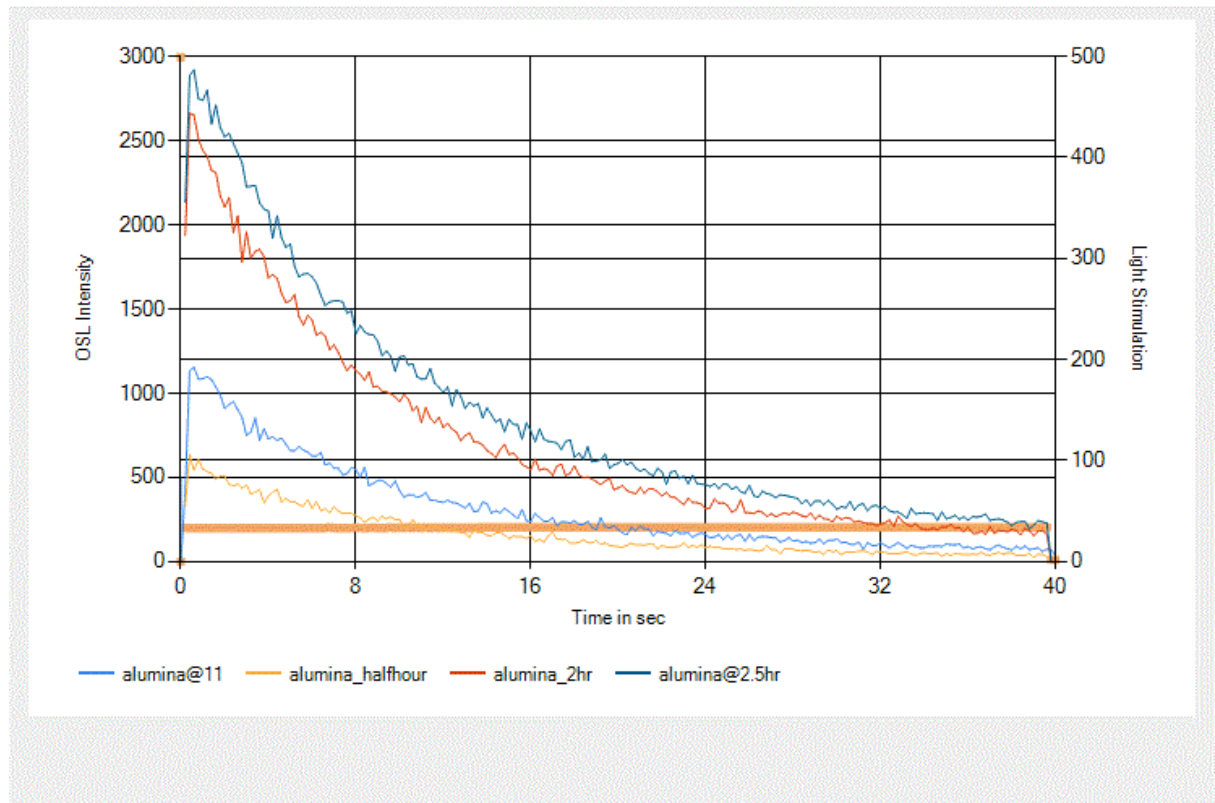


- In order to do comparative studies one can overlap different glow curves (With same temperature Profiles)
- Go to process menu → Overlap → browse the required files and add to list one by one

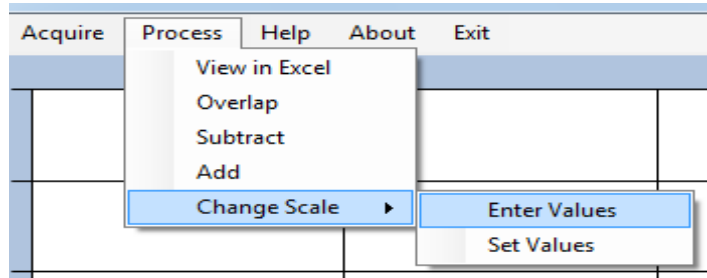


- Now click Overlap and save the file at desired destination

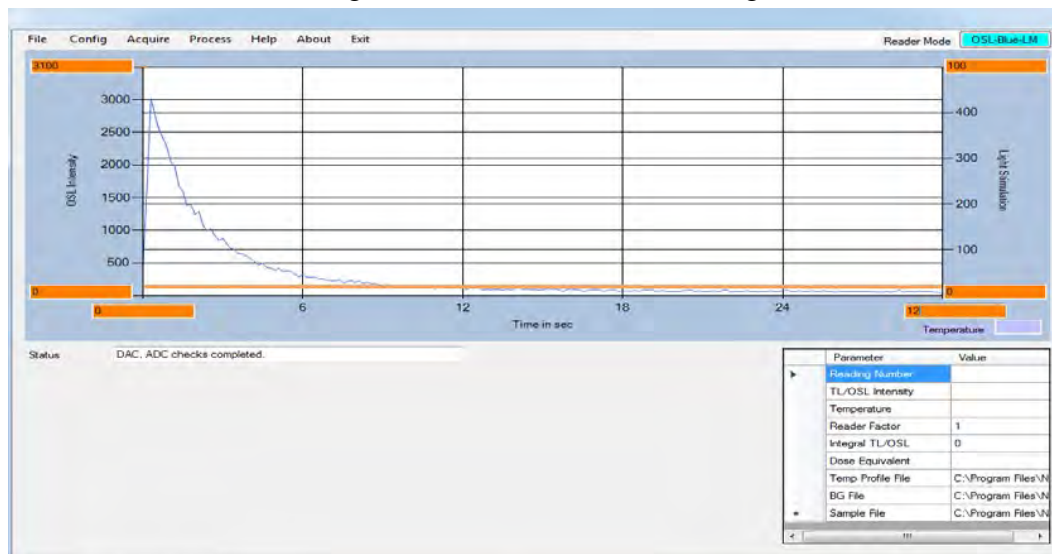
Typical Overlap file will be as shown in figure



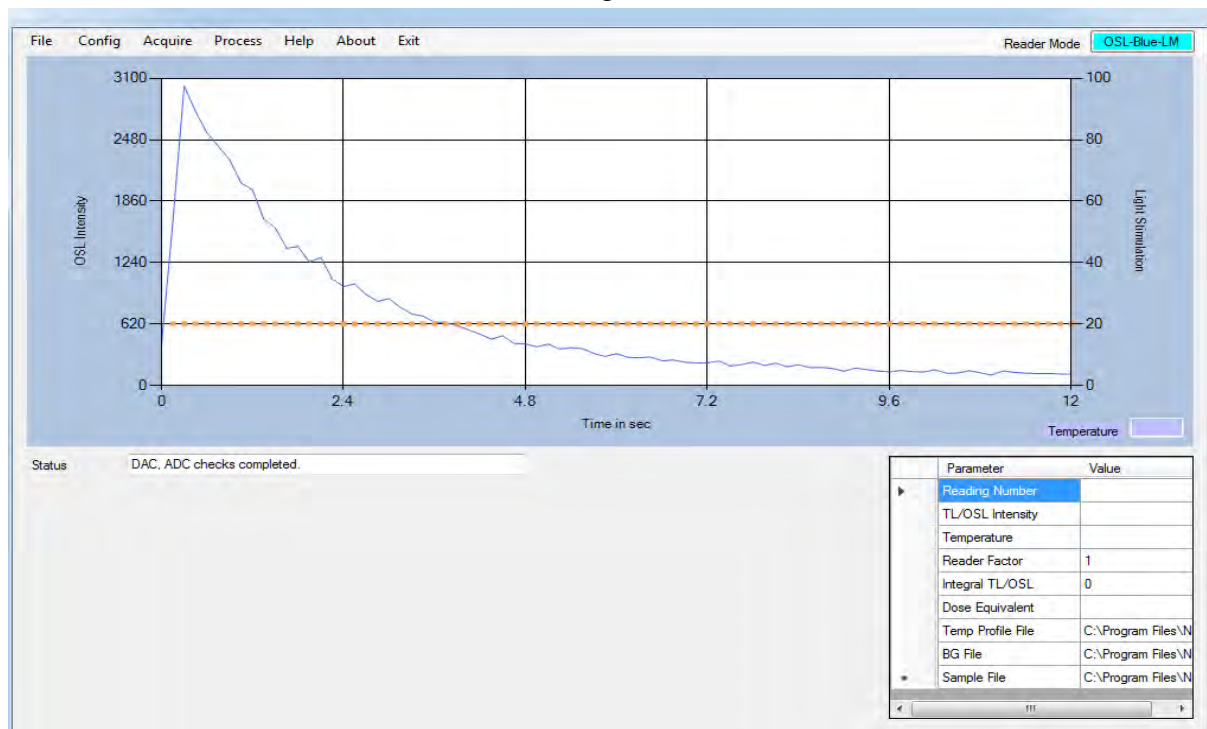
- If user want to observe particular region interest of glow curve then click on Process → Change Scale → Enter values



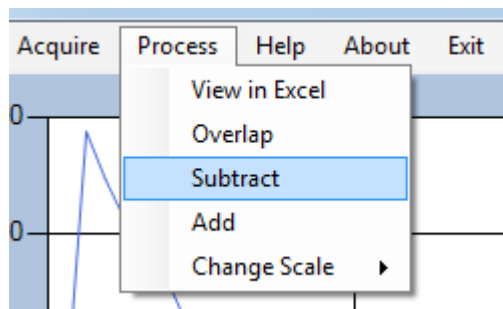
- Enter the min and max range of interest as shown in the figure



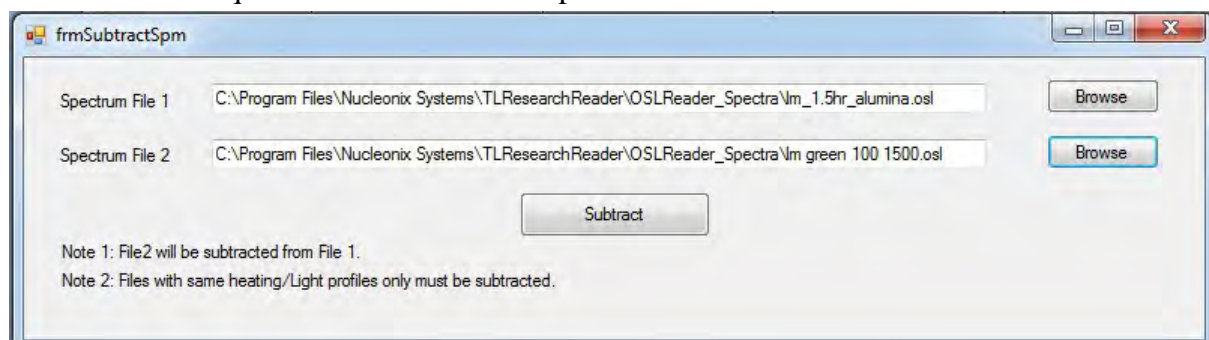
- Click on Process Menu → Change Scale → Set Values ( to apply these settings to the glow curve)
- Hence Glow Curve will be seen as shown in figure



- These settings will be saved permanently until the software is re-opened.
- **Subtraction/Addition of two spectra (Glow Curves)**
- Arithmetic operation like Addition or subtraction of two spectra can be done, depends upon the requirement of user
- For that click in Process Menu → Subtract (or Add)



- Select the files required for the arithmetic operation



- Save the resultant file for the analysis (if, required)



## CHAPTER -VII

### PRECAUTIONS /OBSERVATIONS/LABORATORY RECOMMENDATIONS

#### (A) In TL Mode:

- a. Before the power is switched ON ensure all proper connections & default control settings are made.
- b. See that the 20X4 LCD display is working and is indicating the ambient temperature at as seen by spot welded thermocouple at the bottom of Kanthal strip. If LCD display indicates temperature value as near zero or -ve value then thermocouple connection may be opened. (Keep the temperature switch in ISO Mode and switch ON the HEATER ON switch and slightly increase the SET TEMP. knob by two turns, if temperature is not increased then check or replace Kanthal strip welded with thermocouples)
- c. After switching ON the equipment allow ten minutes warm up time before useful measurements are taken up.
- d. Ensure 'HEATER ON' toggle switch to OFF position, each time before switching on the power to equipment.
- e. Ensure ISO / PROG toggle switch to 'ISO' position and 'SET TEMP' dial to minimum on before switching ON, the instrument.
- f. Whenever a new Kanthal strip with thermocouple spot welded is changed ensure proper thermocouple output polarity signal to temperature controller circuit. In case Kanthal strip burns off or temperature reading is not proper, then replace the damaged Kanthal Strip with thermocouple wires by a new one (as per the detailed procedure given in Chapter IX) and go through 3 point temperature calibration.
- g. To Quit the TL / OSL software, it is recommended to use exit menu.
- h. It is recommended to do the **temperature calibration** once or twice in a fortnight (15 days).
- i. Ensure that filter basket meant for '**TL mode**' only is loaded.

#### (B) In OSL Mode:

- a. Load appropriate filter basket Green/Blue depending upon the stimulation mode selected. Improper filter basket can damage photon counting module.
- b. Each time photon counting module is removed, for placing the filter basket, it should be removed in standard dark room condition (only after unplugging the RS232/USB circular port).

- c. Once photon counting module is replaced and the equipment, is switched on for measurements, it is advised that warm up & stabilization time of 10 to 15 minutes is allowed before making measurements.
- d. Always ensure that instrument top cover & other mechanical fitments are in proper place & there is no light leakage into the system.
- e. Allow Nitrogen inlet at the rate of 2 to 3 lpm, if you feel cooling of LED cluster is essential for continuous measurement of OSL samples. Since it is a single sample TL/OSL reader, Nitrogen flushing to cool the heat sink of LED cluster may not be required.

**(C) Laboratory recommendations:**

- a. **Power requirements:** System is designed to work at 220V  $\pm$  10% A.C. @ 50 HZ frequency. Operating the system at any other voltage or frequency is strictly not advised & it may mal- function. A good servo stabilizer is recommended to provide stable supply.

- b. **PC requirement:**

Branded computer system with Intel Core i3 @ 3.06Ghz, 2GB DDR2 RAM, 500GB SATA, DVD R/W, Keyboard and Internal ready Optical scroll, 19" TFT Monitor, Laser jet printer, Windows licensed OS-Windows 7.0 or Higher and MS-Office.

- c. **Temp & humidity:** AC room at 25°C to 30°C & RH below 75% with dust free environment is recommended.

- d. **Laboratory Lighting conditions for TL/OSL measurements:**

- i. It is highly desirable to operate the system, when it is in OSL mode in subtle or subdued red/orange light during sample handling. Standard dark room lighting can be adapted.
- ii. For changing the 'filter basket' or for making CCD spectrometer measurements, it becomes necessary to disconnect & remove photon counting module. During this time also one has to do this in subtle light condition. Unplug the USB Cable from RS232/USB port (circular). And, after opening the top cover of the instrument, disconnect USB cable connector of the photon counting module from inside of Rear Panel (RP) & gently remove the circular fixture of the photon counting module to displace it from the detection-stimulation chamber, then replace required filter basket (Refer the chapter: changing of detection filters) & restore photon counting module, including its connection onto Rear Panel USB. Close top cover, fasten the captive screws as required & switch on the unit and operate as required.
- e. **Nitrogen gas requirement:** Nitrogen gas flow arrangement is basically provided for cooling the heat sinks provided for 3W LED clusters. However, this TL/OSL Research reader is designed to study single sample at a time & as heat sinks provided are good enough, there is no need of Nitrogen gas flushing requirement. One can avoid using this. It is highly essential **NOT** to remove black PVC covers for the IN/OUT nozzles on rear panel provided to let Nitrogen IN/OUT.

However, for TL measurements, for very low level dose rate measurements & when heating to higher temperatures, only to eliminate spurious counts due to oxidation effects on Kanthal strip, one may flush with Nitrogen gas at very low flow rates, if required. Care should be taken while using powder samples. It is also advised to clean the Kanthal strip surface with a soft tissue or Acetone gently (periodically, if required).

f. Placement of TL/OSL samples on Kanthal strip for measurements:

(i) **TL samples/phosphors:** TL materials under study which are in different physical form such as discs, micro-rods, chips, crystals etc. of equal weight and size/shape can be placed directly in contact with the Kanthal heater strip surface. Ensure to keep it at the center, each time, you make measurements. If you are using powder samples, use powder dispenser block and fill the powder into the hole, make it flat by taking off extra powder from the dispenser block surface or one can use precision balance to weight the powder samples. After each measurement, brush out the powder completely from the Kanthal surface.

(ii) **OSL phosphors:** These materials are usually in disc form or in chips form. Place the OSL disc/chip which is exposed to Gamma/Beta/X-Radiation, at the center of the Kanthal strip. Ensure that heater ON switch is kept in 'OFF' position.

(iii) Now choose CW-OSL or LM-OSL mode & acquire the OSL glow curve as per the procedure.

**(D) In Emission spectra mode (with CCD SPECTROMETER)**

- i. Swap the photon Detection Module (PDM) with optical filter mount as described in the forthcoming chapter
- ii. Wrap the PDM in black cloth or keep it in dark chamber.
- iii. Insert the corresponding filter basket for the sample under the emission study of TL or OSL mode as explained in the forthcoming chapters



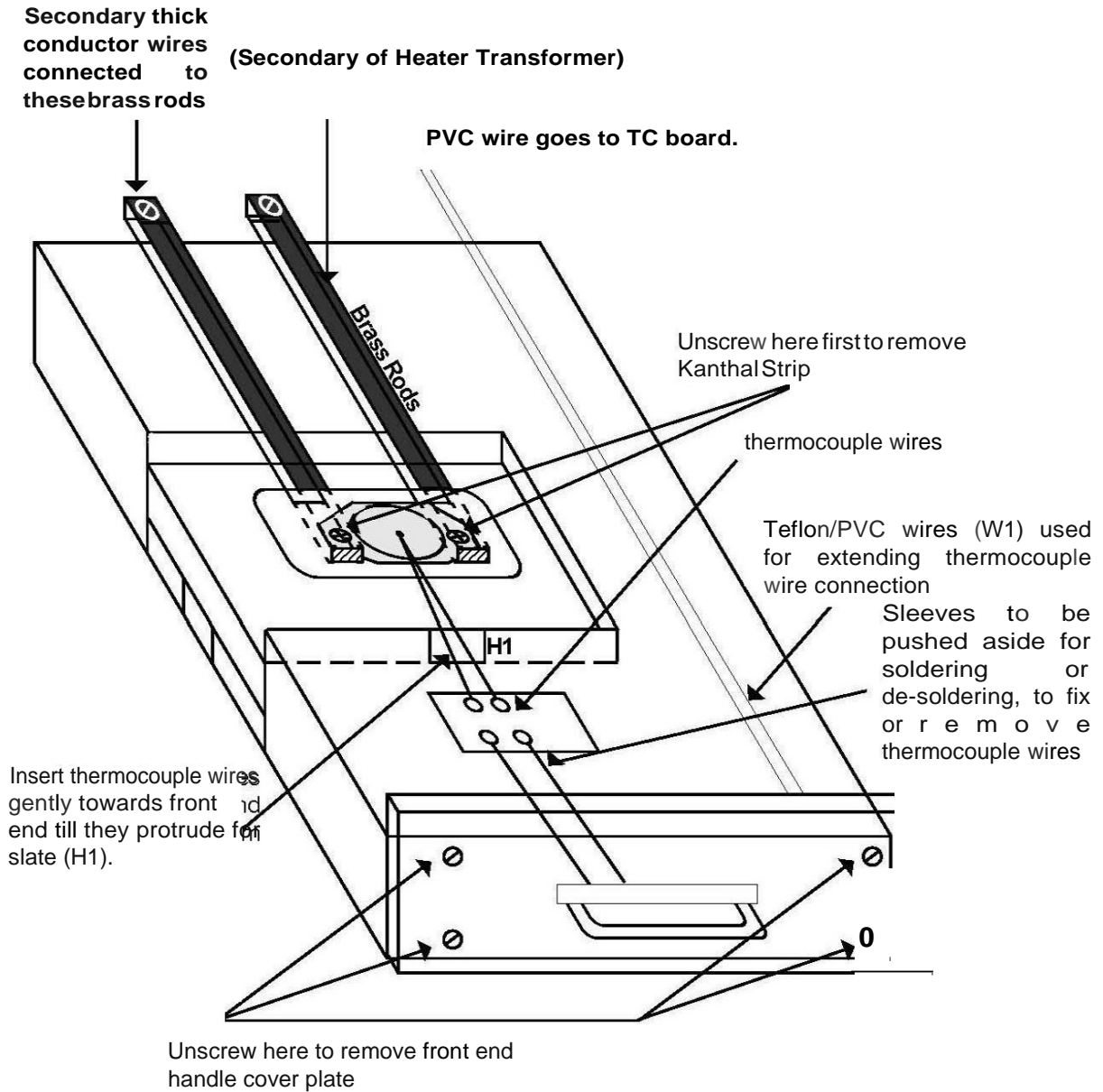
## CHAPTER -VIII

### PROCEDURE FOR REPLACING THE DAMAGED KANTHAL STRIP

- Once it is identified that either a thermocouple wire is broken, damaged or Kanthal strip is burnt, then one can proceed with dismantling operation as detailed in following steps.
- Unscrew & remove the Cap near the Kanthal.
- Take a star/flat screw driver of appropriate size and unscrew the Kanthal strip, from top of the brass rods, in the drawer assembly.
- Lift the front flap, below which thermocouple is soldered to long wires.
- Move the sleeves on wires a side and de-solder thermocouple wire and de-solder thermocouple ends if there is terminal block. Now hold the burnout Kanthal Strip and gently remove it out.
- Hold the thermocouple such that thermocouple wires should be your side.
- Land the Kanthal Strip on the Brass rail bars & screw it up loosely.
- Now insert the thermos-couples wire in the Slot provided (H1 Slot)
- Solder the Thermocouple wires on the one side Bridge such that the color of sleeves should match on the other side.
- Now, tightly fix the Kanthal on the Brass Bars.
- Now, **Put OFF** the TEMP ON Switch & Power up the TL Research Reader.
- The Display Should Show room Temperature.
- Touch the Kanthal Strip with Solder rod, then the Temp on the LCD Should Increase.
- Increase not reverse polarity the thermocouple Wires/ Teflon Wires.
- Now we can say that the Polarity of thermocouple is Correct.
- Turn OFF the Unit & fix the Cap over the Bridge & Screw it up.

After this, the heater ON switch on heater ON switch can be made ON and check heating in ISO mode by slowly increasing the dial by one turn and observe the temperature to be 50<sup>0</sup>C (100<sup>0</sup> in old design). For two turn's approx. 100<sup>0</sup> C and for three turns 150<sup>0</sup> C etc. and reduce the dial and switch OFF the unit. Now the unit is ready for use.

## THERMOCOUPLE WIREROUTING IN PMT HOUSING



## CHAPTER -IX

### HOW TO MAKE TL MEASUREMENTS MORE ACCURATE USING NUCLEONIX PC BASED TL/OSL READER SYSTEM, in TL Mode.

#### Precautions to be observed for measurements and screening of dosimeters. (Chips, Micro-rods, discs, mini discs etc.)

If you are working with Teflon coated discs,

- a. Choose a set of discs from the same batch production from your supplier.
- b. Preserve them in clean conditions.
- c. Do not allow dust, dirt, scratches on disc.
- d. Do not handle with bare hands. Better to use forceps and place them gently on to the Kanthal strip.
- e. Discard buckled or wrapped discs if you find them either initially or after few measurements.
- f. Disc should make total contact onto the Kanthal strip.
- g. Each disc isotope screened before being accepted for doing meaningful measurements.
- h. Expose a set of discs from the same batch for a known dose and acquire for TL glow curve for each disc at least 3/5 times.

For each disc and each compute the average area and deviations from the Average area. These deviations shall be in close limits (limits can be decided by the user), then Accept them and use for measurements (Say, the deviation is within 10% to 13% as per user's Choice). If any disc is found to give inconsistent / large variations, and then discard such dosimeters from using for measurements permanently.

- i. Out of the screened discs you may find a few of them giving excellent reproducibility. Such discs could be put separately and can used for calibration and evaluation of reader factor in a particular range. These are called "**calibration dosimeters**". The rest of dosimeters which have fairly good, reproducibility within acceptable limits (deviation within 10% or 15% as set by user) can be called as field dosimeters (In medical dosimetry they are called patient dosimeters).

All the above points mentioned hold good for micro rods and chips also. The advantage of using these discs, mini discs, micro rods and chips is that one need not weigh them, as they are supposed to be of equal weight.

## Precautions to be observed for measurements with TL materials in powder form

- j. It is very important to measure the powder accurately and place it on to the Kanthal strip.
- k. Accuracy depends mainly on the accurate weight measurement.
- l. Powder should not be placed on the Kanthal strip as a heap but should be spread uniformly.

This ensures that while heating takes place all the particles in the powder get heated up to the same temperature.

- m. While disposing from the Kanthal strip, it should be gently brushed aside, so that powder particles fall onto the collection tray.

- n. Any particles left out may contribute to the next measurement as residual TL/OSL adding to the next sample.

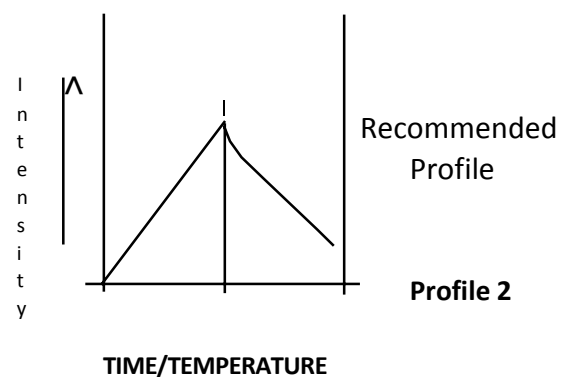
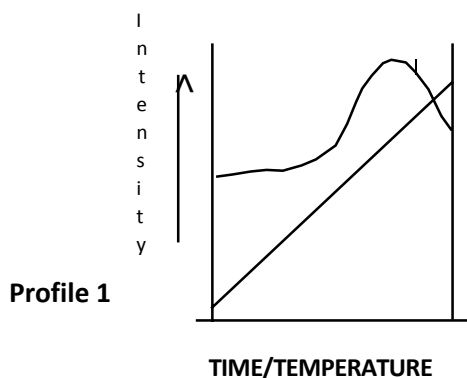
## Choosing Appropriate Heating Profile

- o. Depending on the type of TL material ( $\text{CaSO}_4$ , LiF or other material) and the form in which (disc, rod, chip, powder crystals, pellets etc.) The heating profile is to be chosen.
- p. The purpose of choosing most appropriate heating profile is primarily to maximize TL Output and leave minimum residual TL in it. Also to minimize the contributions due to the Thermal & I Remissions.
- q. Most commonly used heating profiles are

- i. Linear

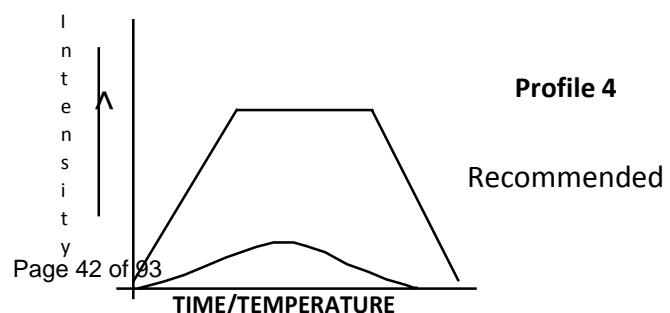
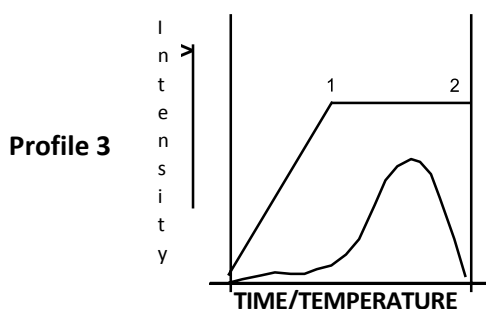
Linear with cooling region included in total run Time

- ii.



- iii. Linear clamped (Single Plateau)

- iv. Linear clamped with cooling region included in run time



r. For Teflon coated disc, it is desirable to choose either linear clamped or linear clamped with Cooling region. Longer clamping duration may be required to ensure that TL emissions

Complete and residual TL is completely removed.

s. Clamping temperature around 300<sup>0</sup> C is more than enough in majority of cases for normal TL Materials (other than pottery, sand and geological samples).

t. Thermal emission starts above 300 C on wards hence it is important that we restrict Heating to set temperature up to a maximum of 300<sup>0</sup> C. Up to 350<sup>0</sup> C in some cases provided There is good IR cut-off filtering done.

u. For low level TL measurements nitrogen flushing is strongly advised. In fact for all Measurements if it is provided it helps in any spurious signal due to oxidation and other effects.

v. For low level TL measurements, it is better to choose a heating profile of “Linear clamped with cooling region included”. Because some TL curve may extend into this region. Also, restrict clamping to 300<sup>0</sup> C to restrict thermal contribution.

w. The most recommended heating profiles are “profile 2” & “profile 4” as shown fig. for powders such as CaSo4 and micro rods etc. Typical heating rate may be 5<sup>0</sup>C /sec. (i.e., Time to be selected for profile region (0-1) will be approx. 60sec. Profile region.

(1-2) will be “0 (zero)” sec and total run time can be selected as 75 sec (this makes the cooling region to be approx. 15sec. enabling glow curve acquisition to be recorded in this regional so). If user wants to select other heating rate, say 10<sup>0</sup> C /sec, then select profile region time between (0-1) as 30 sec., between (1-2) as zero & run time as 45 or 50 sec.. This is linear profile with cooling included, but without clamped region.

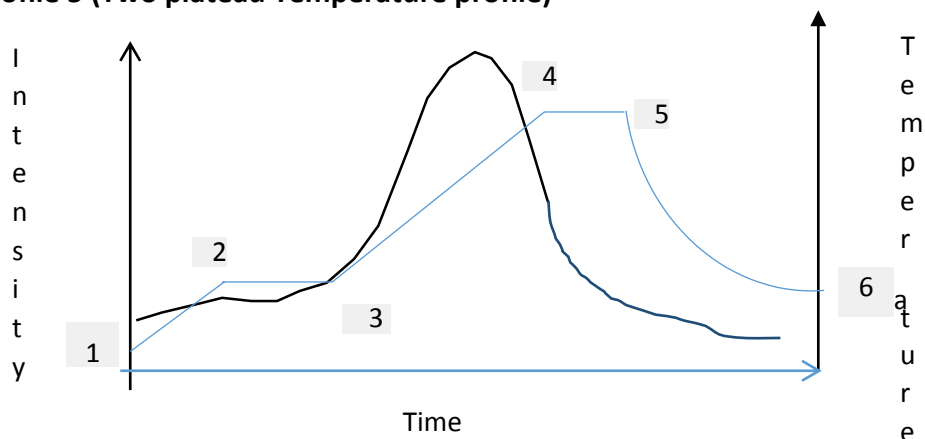
Sometimes it may be better to clamp at 300<sup>0</sup> C for certain time say 5 to 10 sec or even more to ensure that no residual TL is left. In which choose profile “profile 4”. For powders clamping for 5 to 10 sec. maybe enough.

After first time TL acquisition, if your reunite same sample, you will get back ground profile, which will also indicate if there is some residual TL.

For Teflon embedded /coated discs, recommended profile is “profile 4”and it is essential to clamp it for longer duration of the order of 40 to 60 sec. (Profile region {1-2}). Linear heating region (0-1) may be about 60 sec and total run time can be about 150 sec. to include some cooling region.

Typical profiles, glow curves & print outs obtained on this system have been enclosed for ready information and reference for user convenience.

#### Profile 5 (Two plateau Temperature profile)



This Profile consists of following regions of temperatures

1. (1-2) Linear Heating (Pre-Heating)
2. (2-3) Clamping Temperature (To Eliminate Low/ Unwanted temperature Peaks)
3. (3-4) Linear Heating (Read Cycle)
4. (4-5) Second clamping temperature To get the desired glow curve)
5. (5-6) Natural cooling

Note: user can configure more than 2 plateau temperatures provided that the maximum temperature is not exceeding 500 °C

Earlier, users used to run a Temperature profile to eliminate the low temperature peak and then they had to Re-read the sample to get the Glow curve which is under stable meta-stable.

Now, in this software user can configure a temperature profile with one plateau temperature to eliminate lower Temperature Glow curve Peak or unwanted glow curve. And other plateau to get the actual (desired) glow curve So that we can easily capture the ROI from the Glow Curve

#### Annealing of TL phosphors (power or disc or crystals etc.):

Proper annealing the TL phosphors in a Hot air circulating Annealing oven is essential, each time TL is read. Powder can be placed in a SS pan and discs, micro-rods etc. on a SS tray inside the oven.

Temperature of the order of 240 to 280°C (Typically for CaSO<sub>4</sub>: Dy disc samples) or slightly higher temp. May be adequate for most of the TL Phosphors. Time of annealing can be suitably chosen by the experimentalist. If the annealing is not complete, then it will give rise to Residual TL emission. For any TL laboratory annealing oven is must, without which TL measurements cannot be carried out.

## Computing Reader Factor and Range correlation factors and other observation to be made for accurate measurements.

x. **Reader Factor (RF):** It is the ratio of the “Total dose” (absorbed by the dosimeter in mR or R etc.). By the “Net TL glow curve area under the markers” (after background subtraction).  
Say,

$$R.F = \frac{\text{Total Dose}}{\text{Net area of glow curve}}$$

**Note:** i. for computing R.F use screened dosimeters.

ii. Also this is valid for a set of same class of dosimeters of same weight or size and TL material.

y. Once R.F. is computed, the system remembers it and for all other measurements it computes and reports the dose equivalent.

## Calibration of Dosimeters for Your Application & Measurement

Your application could be a kind of measurement involving X-rays and gamma radiation etc., either using machines directly or indirect measurements such as scattered radiation or through phantoms or other attenuating media. Application can be personal dosimetry, medical dosimetry, TL material characterization, environmental radiation measurement etc., for every kind of measurement to obtain the dose absorbed (equivalent) in terms of mR, R, we need to go through the calibration process.

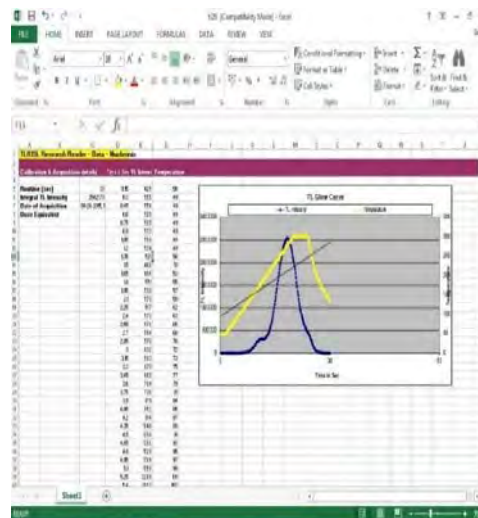
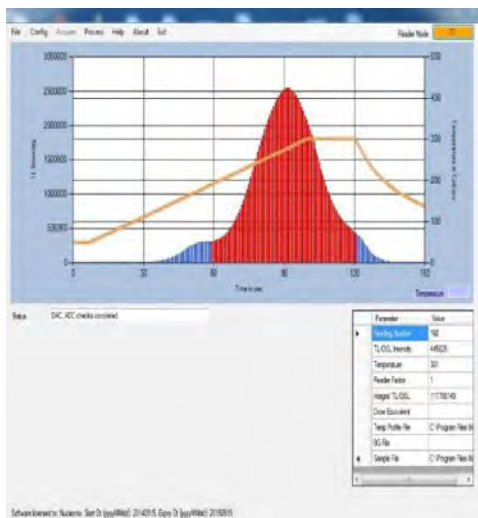
The best way is to choose calibration dosimeters after screening and expose them under a cobalt machine for known dose. Then read it using our PC based TL/OSL Reader and acquire glow curve and obtain Reader Factor (RF), as explained.

Then put the dosimeter (same) after annealing to the actual application, where the radiation, its energy and conditions may be different and make a measurement.

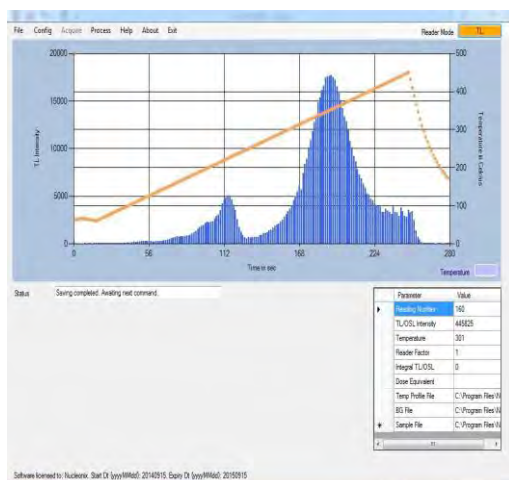
After acquiring the glow curve one can obtain the dose equivalent, by the following computation, which is built into the software.

Dose Equivalent = (Area obtained) X RF (for dosimeter under measurement)

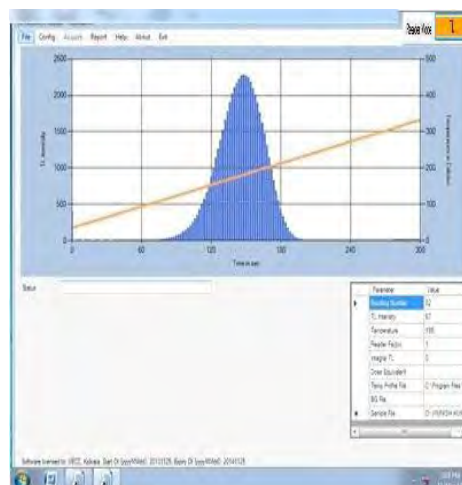
For better accuracy it is advised to make a few iterative measurements and average the obtained results.



**CaSO<sub>4</sub>: Dy Glow curve & it's excel graph**

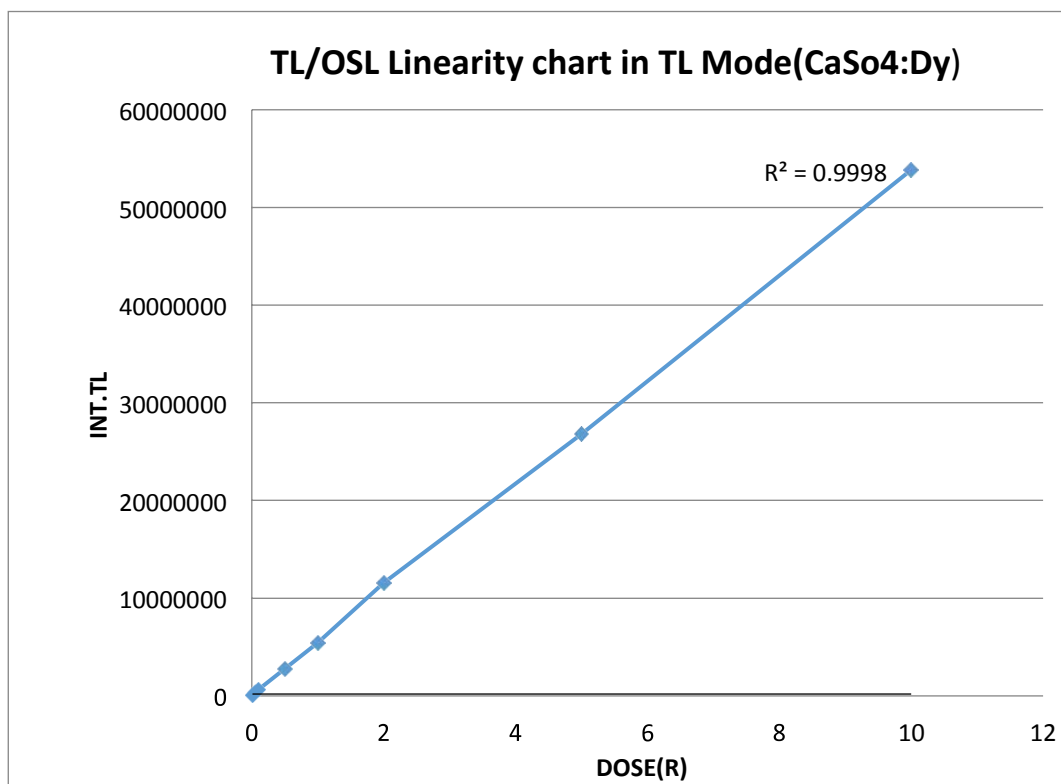


**LiF: Mg, Ti (MTS, equivalent TLD-100) Glow curve**

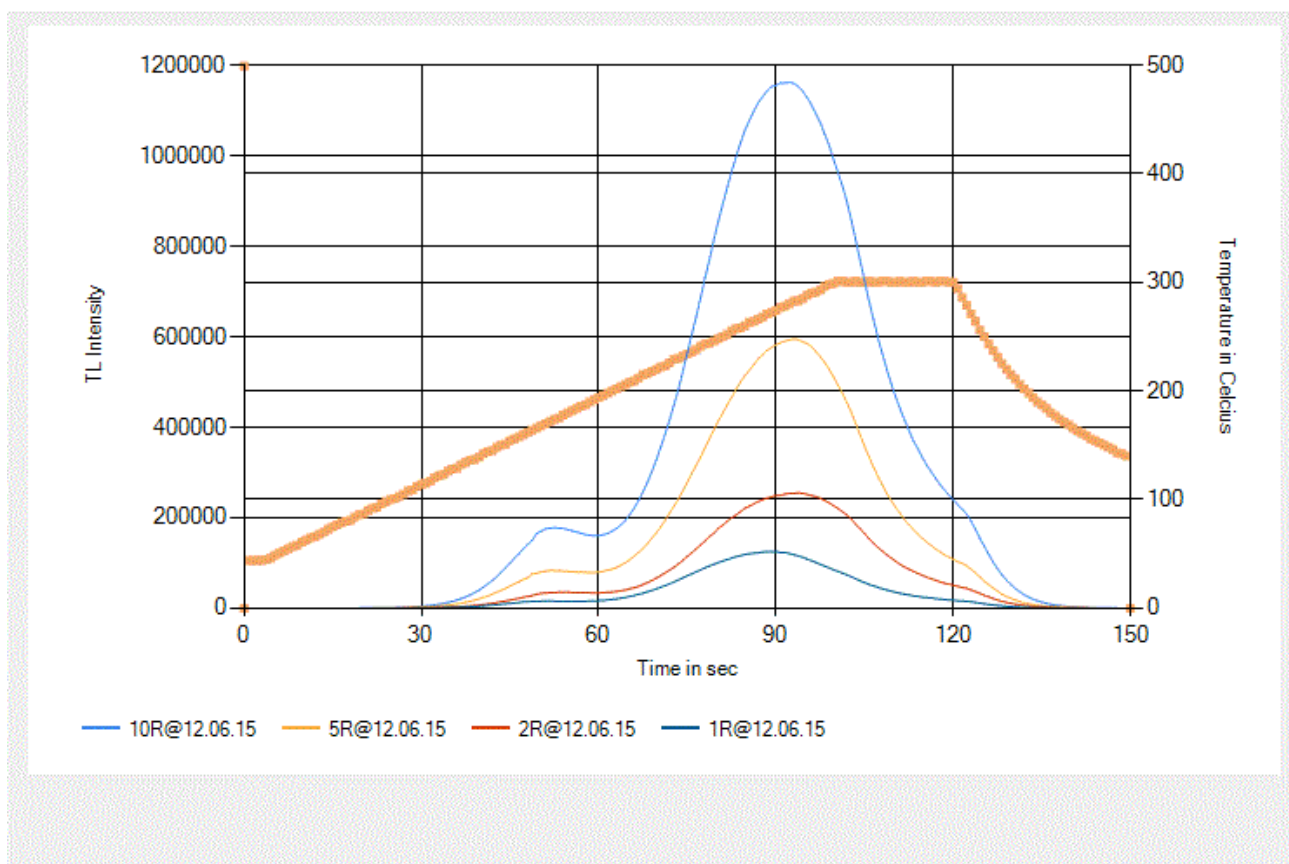


**Glow curve of Al<sub>2</sub>O<sub>3</sub>: C**





**Typical TL Linearity Chart**



**Typical TL Over lap**

## CHAPTER - X

### Choosing Optical filters for your material

Optical filters must be judiciously chosen to prevent stimulation light from reaching the photo detector module and to optimize the signal-to-noise ratio. The choice must be based on a combination of factors, such as OSL emission wavelengths of interest, optimum stimulation wavelength, choice of stimulation modality, required sensitivity and so on. There is no unique answer for a particular problem, but some filter combinations have been popularly adopted by different research groups and in different equipments. Table (1) on the following page lists some of the filter combinations reported in the literature and the materials with which these combinations have been used.

It can be seen from the table (1) that for Green stimulation centered at 525 nm, stimulation filter used is GG495 and the detection filter used is Hoya-340 (7.5mm) with a transmission window of ( 270 nm 340 nm) with the OSL reader, operated in CW-OSL mode for sample under study being Al<sub>2</sub>O<sub>3</sub>:C. This is what is used in Risø readers (Bøtter- Jensen, Thomsen and Jain, 2010). With the same Green stimulation, and for the same OSL Phosphor i.e. Al<sub>2</sub>O<sub>3</sub>: C, in respect of In Light readers (Jursinic, 2007), stimulation filter used is Schott OG-515 and the detection filter used is Hoya-B 370 with a transmission window of (300-450 nm). From another reference (Yukihara et al., 2009), it can be seen from the table (1) that stimulation filter used is GG-495 and the detection filter used is Corning 5-58 with a transmission window of (340- 480 nm) for the same Al<sub>2</sub>O<sub>3</sub>:C material, of course the system is operated in POSL mode.

With Blue LED emission centered at 470 nm, the filter combination used is Schott GG-420 for Stimulation and Hoya U-340, for detection in the Risø TL/OSL readers. This combination is used to read OSL emission from materials such as Quartz and Feldspar. The Schott GG-420 filter is used in front of the LEDs to cut the tail of the LED emission extending into the detection region. Bandpass filters such as Hoya U-340 and Schott UG-1 transmit in the IR region (>700 nm). To solve this problem, some filters are coated with a metal oxide layer (e.g., Schott DUG11X) or are used in combination with another bandpass filter (e.g., Schott BG-39) to block the IR component.

‘Nucleonix systems’ can supply filter combinations as required by the users/researchers. By default, we are supplying filters as given in this user manual. However, we may alter or keep adding other combination of filters from time to time to meet and achieve better performance.

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### Examples of light sources and optical filters used for OSL measurements

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Stimulation	Stimulation filters	Detection filters	Transmission window	Stimulation mode	Suitable material	Available instruments/Reference
Green LEDs (525 nm)	Schott GG-495	Hoya U-340 (7.5 mm)	270–380 nm	CW-OSL	Al <sub>2</sub> O <sub>3</sub> :C	Risø readers (Bøtter-Jensen, Thomsen and Jain, 2010)
	Schott OG-515	Hoya B-370	300–450 nm	CW-OSL	Al <sub>2</sub> O <sub>3</sub> :C	InLight readers (Jursinic, 2007)
	Schott GG-495	Corning 5-58	340–480 nm	POSL	Al <sub>2</sub> O <sub>3</sub> :C	(Yukihara et al., 2009)
Blue LEDs (470 nm)	Schott GG-455	Hoya U-340 (7.5 mm)	270–380 nm	CW-OSL	Quartz, feldspars,	Risø reader (Bøtter-Jensen, Thomsen and Jain, 2010)
	Schott GG-455	Schott UG-1 + Schott BG-39	330–410 nm	CW-OSL	Al <sub>2</sub> O <sub>3</sub> :C	(Smetana et al., 2008)

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## NOTE:

1. Filter designations are mostly based on published literature, but equivalent filters are sometimes available from different manufacturers. For example, Kopp 5113 filters have similar characteristic to Corning 5-58.
2. The lower and upper transmission wavelengths were approximated based on the wavelength corresponding to 5% of the maximum transmission.
3. "POSL" indicates the filter combinations in which background can be high if used in CW-OSL mode. For filter combinations indicated as CW-OSL, pulsed stimulation is sometimes used for time-resolved discrimination between the OSL from different materials or luminescence centers.
4. This column indicates most used OSL materials that have been used with the particular stimulation source and filter combination. It does not mean that other materials cannot be used with satisfactory performance, depending on the intended application.
5. When using Hoya U-340 filters with Al<sub>2</sub>O<sub>3</sub>: C, most of the signal is from the main luminescence centers (F-centers), which consists of a broad centered at 415 nm. However, a UV emission band centered at 335 nm is also detected.

## CHAPTER XI

### Overview of OSL Materials

OSL is observed in a wide variety of natural and artificial materials. Well-known OSL materials include quartz, feldspar and carbon-doped aluminum oxide, but OSL has also been observed in topaz, ceramics, dental enamel, common salt, washing powder, water softener, monocrystalline silicon carbide and a variety of doped and undoped materials such as magnesium silicate, spinel, glasses and so on. In spite of the wide variety of material exhibiting OSL, just a few of them have been widely used in OSL applications. In fact, the availability of materials has been one of the disadvantages of the OSL technique when compared to the TL technique.

In this section we will describe some of the general properties of OSL materials of interest for the applications discussed. In particular, we discuss the OSL stimulation and emission spectra, luminescence lifetime, OSL mechanisms and relationship with TL. Table (2) summarizes some of the material properties discussed in subsequent sections. Properties relevant to particular applications will be discussed in the respective chapters. A more detailed material description organized by type of material can be found in Bøtter-Jensen, McKeever and Wintle (2003), and an excellent overview on the properties of various OSL materials can be found in Pradhan, Lee and Kim (2008). TL properties of some of these materials can also be found in McKeever, Moscovitch and Townsend (1995).

#### **Artificial Materials:**

Carbon-doped aluminum oxide ( $\text{Al}_2\text{O}_3\text{:C}$ ) is the most widely used OSL material in X-ray, gamma and beta radiation dosimetry applications as the basis for the Luxel and InLight dosimetry systems (Landauer Inc., USA). OSL measurements are typically carried out with green stimulation, and detection of the main emission band is in the blue region of the spectrum, centered at 415 nm

Al<sub>2</sub>O<sub>3</sub>:C was introduced in the 1990s as a high sensitivity TL material with a reported sensitivity 40–60 times that of LiF: Mg, Ti TL detectors (Akselrod et al., 1990; Akselrod and Kortov, 1990; Akselrod, Kortov and Gorelova, 1993). The crystal is grown in a reducing atmosphere in the presence of carbon to increase the concentration of oxygen vacancies responsible for the main emission band centered at 415 nm. It has been suggested that the substitution of O<sup>2-</sup> by C<sup>4-</sup> promotes the formation of oxygen vacancies by providing charge compensation (Yang et al., 2008). The material was then developed for OSL applications (Akselrod et al., 1998a; Akselrod and McKeever, 1999; Markey, Colyott and McKeever, 1995; Markey et al., 1996b; McKeever et al., 1996). The detector response is linear for several orders of magnitude, up to ~10 Gy.

Al<sub>2</sub>O<sub>3</sub>:C is also used as a probe in optical fiber dosimetry systems for medical and environmental applications (see Chapters 5 and 6). In addition, Al<sub>2</sub>O<sub>3</sub>:C-based dosimeters were recently made sensitive to neutrons with the addition of neutron converters in the dosimeter formulation. Al<sub>2</sub>O<sub>3</sub> doped with carbon and magnesium (Al<sub>2</sub>O<sub>3</sub>: C, Mg) has been recently developed for volumetric optical memory storage and nuclear track detection (Akselrod et al., 2003; Akselrod and Akselrod, 2006) and is currently being investigated for OSL applications

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Summary of OSL materials, relevant properties and key references

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OSL material	Application or potential application	Optimum stimulation wavelength	Emission bands and lifetimes	Z <sub>eff</sub>	References
Al <sub>2</sub> O <sub>3</sub> :C	Personal, environmental, medical and space dosimetry	525 nm (green)	335 nm (<7 ns), 420 nm (35 ms)	11.3	(Akselrod and McKeever, 1999; McKeever and Akselrod, 1999)
BeO	Personal dosimetry	435 nm (blue)	335 nm (TL), 380 nm(OSL)	7.2	(Bulur and Go'ksu, 1998; Sommer and Henniger, 2006; Sommer, Freudenberg and Henniger, 2007; Sommer, Jahn and Henniger, 2008) (Bos, Prokic' and Brouwer, 2006)
MgO:Tb	Personal dosimetry	500–570 nm (green)	350–700 nm (Tb <sup>3+</sup> lines)	10.8	
BaFX: Eu <sup>2+</sup> (X = Br, Cl, I)	X-ray imaging	495 nm, 590 nm	490 nm (750 ns)	~50	(Rowlands, 2002; Sonoda et al., 1983; von Seggern, 1999)

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## Summary of OSL materials, relevant properties and key references

OSL material	Application or potential application	Optimum stimulation wavelength	Emission bands and lifetimes	Zeff	References
Cu <sup>+</sup> -doped fused quartz	Optical fiber dosimetry	790 nm (red)	540 nm	11.8	(Justus et al., 1999a; Justus et al., 1999b)
Quartz	Luminescence dating, retrospective	Blue	365 nm (~30-40 μs)	11.8	(Denby et al., 2006; Krbetschek et al., 1997)
Feldspar	Luminescence dating, retrospective	IR	Visible (Schott BG-39)	11.5(albite) 13.7 (Kfeldspar)	(Clark and Bailiff, 1998)
MgS:Ce,Sm SrS:Ce, Sm CaS:Ce,Sm	Optical fiber dosimetry, integrated sensor	IR	490 nm (36 ns, 165 ns)	14.6(Mgs)) 34.6(SrS) 18.5(CaS)	(Dusseau et al., 2000; Lapraz et al., 2006; Ravotti et al., 2007)
KCl:Eu and KBr:Eu	X-ray imaging, optical fiber dosimetry	560 nm (KCl) and 620 nm (KBr)	420 nm (~1 μs)	18.1(KCL) 31.5(KBr)	(Douguchi et al., 1999; Gaza and McKeever, 2006; Klein and McKeever, 2008; Merckle, Powell and Wilson, 1978; Nanto et al., 1993)



## Summary of OSL materials, relevant properties and key references

OSL material	Application or potential application	Optimum stimulation wavelength	Emission bands and lifetimes	Zeff	References
YSO Porcelain	Near-real time detection  Retrospective dosimetry	Green  Green	320-475 nm  410 nm	33.6	(Hazelton et al., 2010) (Bøtter-Jensen et al., 1996; Poolton, Bøtter-Jensen and Jungner, 1995)
Common salt, washing powder, water softener	Retrospective (accident) dosimetry	Blue	UV (Hoya U-340)		(Larsson et al., 2005; Thomsen, Bøtter-Jensen and Murray, 2002)
Electronic components and substrates	Retrospective (accident) dosimetry	IR and blue	Visible (Schott BG-39) Or UV (Hoya U-340)		(Godfrey-Smith, 2006; Go"ksu, 2003; Inrig, Godfrey-Smith and Khanna, 2008; Inrig, Godfrey-Smith and Larsson, 2010; Larsson et al., 2005; Mathur et al., 2007; Woda and Spö"ttl, 2009; Woda, Greilich and Beerten, 2010))  (DeWitt et al., 2010; Godfrey-Smith and Pass, 1997; Godfrey-Smith, 2008; Yuki-hara et al., 2007)
Dental enamel	Retrospective (accident) dosimetry	IR and green	Visible (Schott BG-39) or UV (Hoya U-340)	15.6 (Shimano et al., 1989)	(Bailiff et al., 2002; Veronese et al., 2010)
Dental ceramics	Retrospective (accident) dosimetry	IR (140 °C) and blue	Visible (Schott BG-38) or UV (Hoya U-340)		

## CHAPTER XII

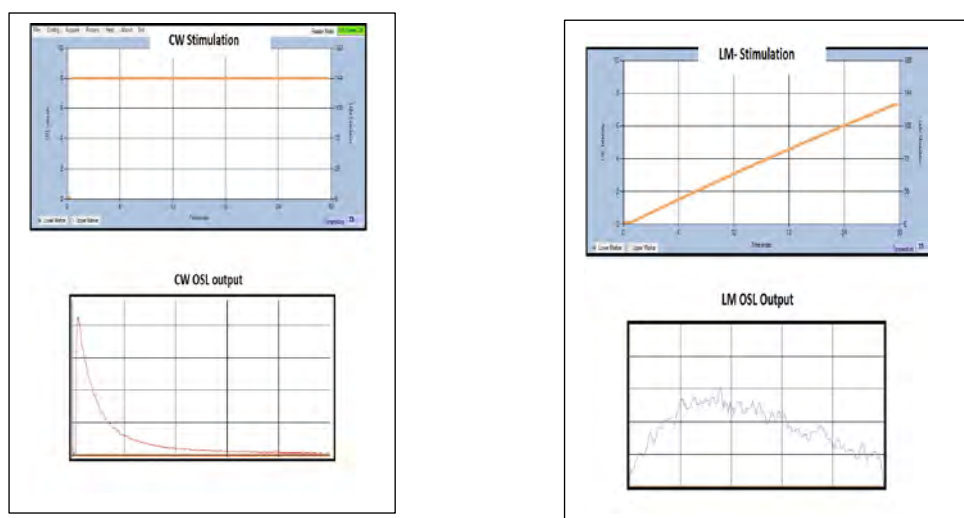
### HOW TO MAKE OSL MEASUREMENTS

The different operating modes present in this pc based TL/OSL research reader are I). CW-OSL (Green) ii). LM-OSL (Green) iii). CW-OSL (Blue) IV). LM-OSL (Blue). User can select the desired mode of operation through the software application.

For example if the user wants to use CW-OSL (Green), then user has to configure the operating mode of the unit as CW-OSL (Green).

After configuration of the unit to desired mode, user can create a new light stimulation profile which consists of initial and final light intensity values. For CW-OSL mode user has to enter the same light power or (DAC Values) in initial and final run times. For LM-OSL mode user has to give starting and final light power or (DAC Values).

The two different stimulation modes CW-OSL & LM-OSL look as follows.



**Fig: CW-OSL and LM-OSL stimulation modes**

After selecting the desired mode of operation and light intensity profile, now the unit is ready for acquiring OSL sample data.

**The main important note in acquiring OSL data is that user has to take care of the filter basket (which is used in stimulation and detection chamber).** To get the information about the filter basket read the chapter about “Changing detection filters”.

User has to load the sample in the Kanthal strip for acquisition of OSL data, after loading of the sample user can initiate the acquisition through by clicking on ‘start’ button which is under acquire menu of TL/OSL Research reader software.

**Note:** All the readings should be carried under ambient light conditions; user has to take care of the TL/OSL laboratory conditions, which consists of ambient conditions (dark room).

Below are the images which earlier acquired glow curves of different OSL samples. Save the glow curve by clicking “Save” in file menu.

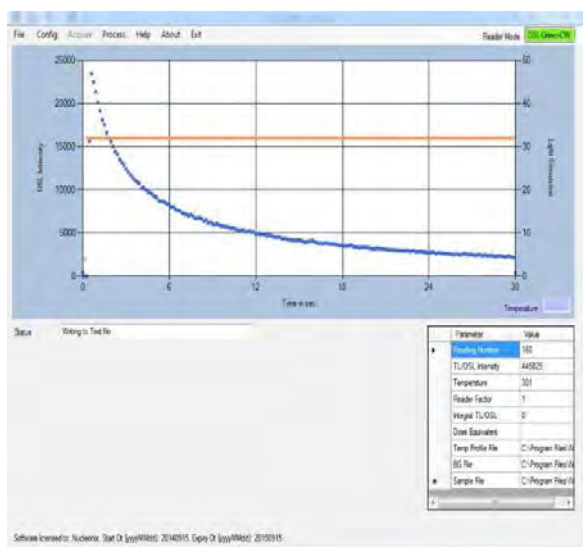


Fig: CW-OSL glow curve of  $\text{Al}_2\text{O}_3$ : C sample

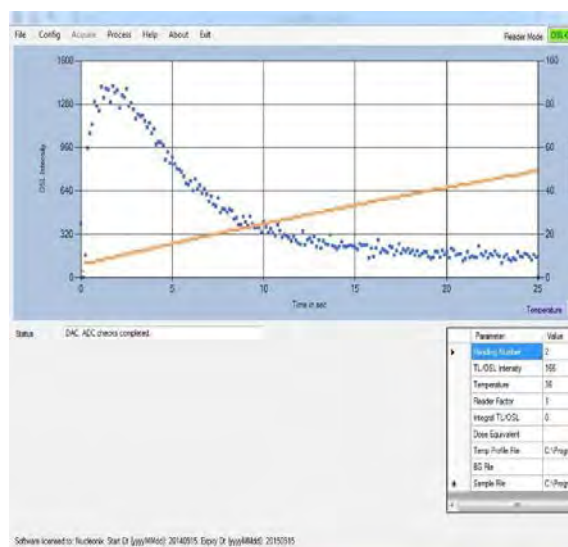


Fig: LM-OSL glow curve of  $\text{LiMgPO}_4$ : Tb, B

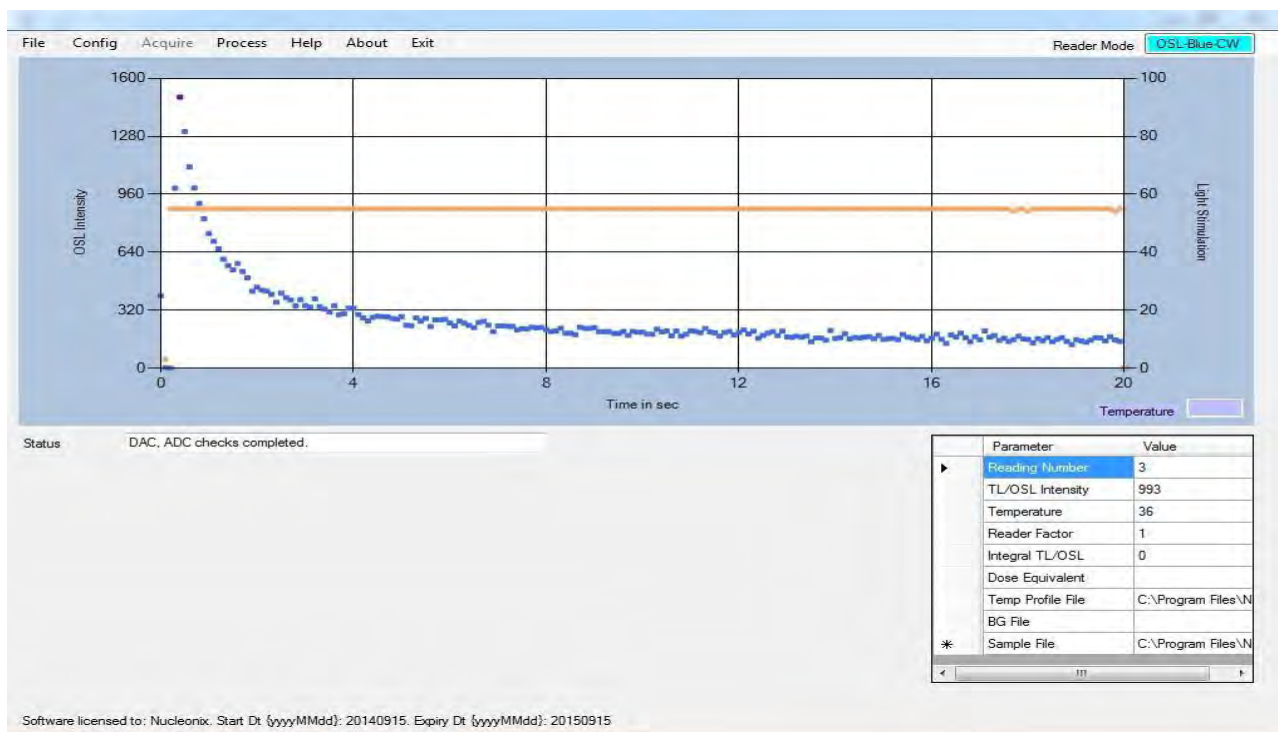
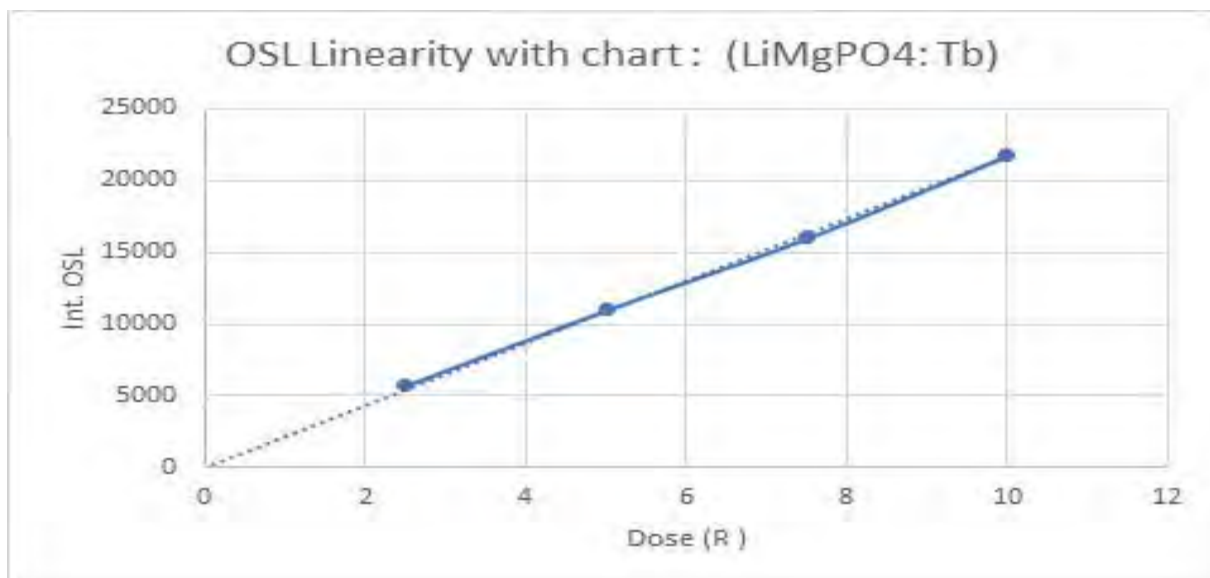
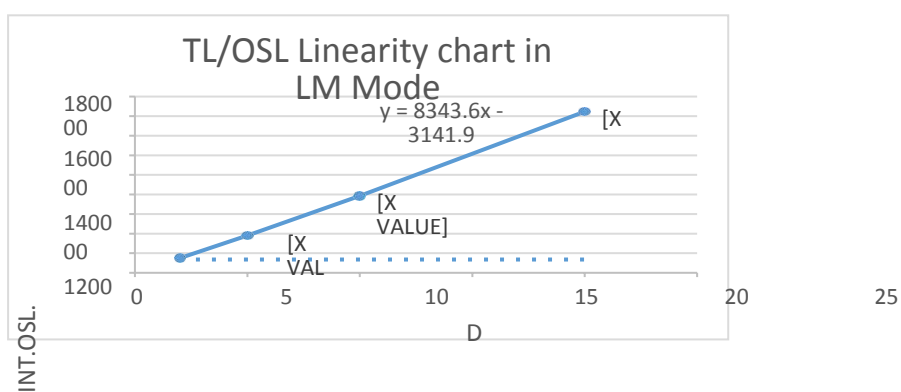


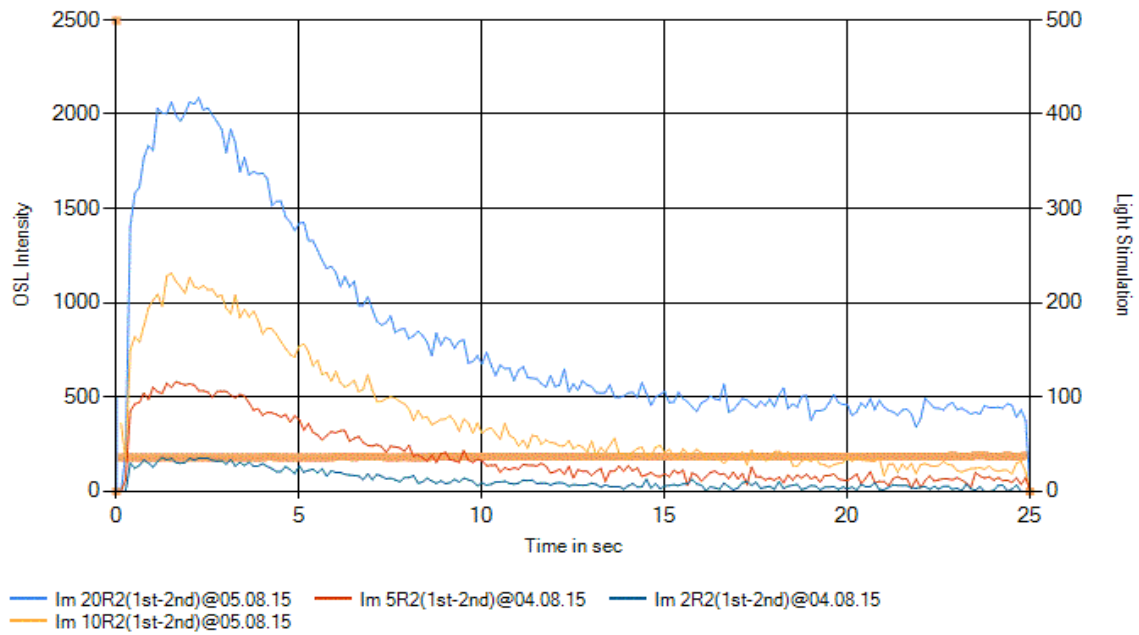
Fig: CW-OSL glow curve of  $\text{LiMgPO}_4$ : Tb, B



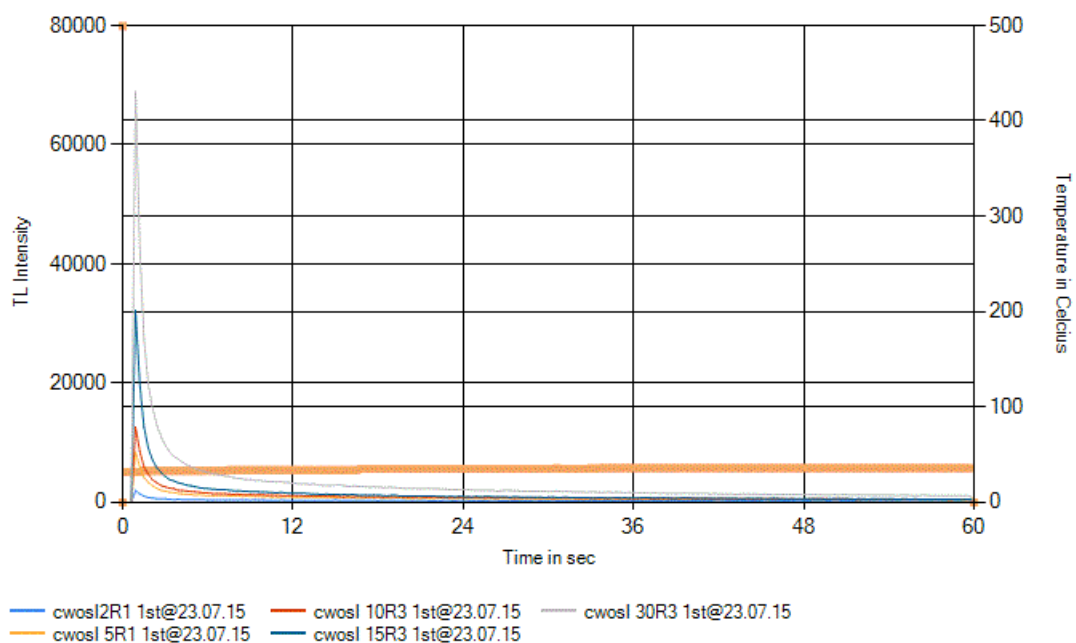
### LiMgPo4 linearity



## LM Mode Linearity



## LM-OSL OVERLAP



## CW-OSL OVERLAP

## CHAPTER XIII

### CHANGING DETECTION FILTERS & MOUNTING FIBER OPTIC ARRANGEMENT IN DARK CHAMBER

The following procedure describes how the filters are replaced; this can be done by the following steps.

1. Filter basket (selection)
2. Dismantling of the electronic unit (mechanical parts)
3. Remove photon counting module
4. Replace the previously existing filter basket with desired filter basket
5. Mount the photon counting module
6. Assembling of electronic unit (mechanical parts)
7. Check for light leakage

#### 1. Filter basket (selection):

The various filter baskets supplied to the user are shown in the below image.

They are as follows

- TL Filter Basket (TL)
- OSL Filter baskets
  - U-340 filter basket (U-340)
  - UG-1 filter Basket (U 1)



**Fig: Various filter baskets**

The filters baskets used for various modes of operation are i. TL mode basket ii. OSL-Green mode basket iii. OSL-Blue mode basket

- j. **Basket for TL mode:** It consists of a heat absorbing glass and IR cut-off filter combination which is placed one over other. To arrange these filters first put an O-ring after that heat

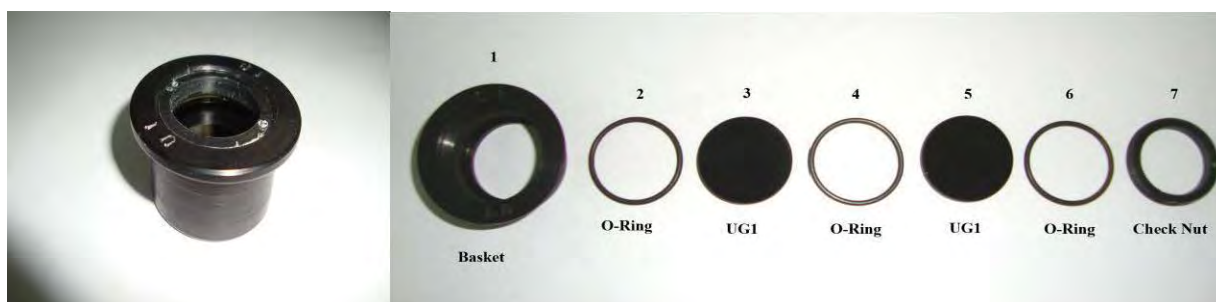


absorbing glass, next put another O-ring then put IR cut-off filter on it and put an O-ring on it after that tighten the filter basket through by the use of chuck nut. The nut should be sufficiently tight to prevent the filters from moving. Be careful not to crush the detection filters (glass).



**Fig: TL filter basket and its arrangement**

**ii. Basket for OSL-Green mode:** It consists of detection filter combination which is UG1 with a thickness of 6.0mm (6.0mm thickness can be achieved by the use of two UG1 filters, each of 3mm thick). These filters can be arranged in the filter basket as first make an O-ring in the basket then put detection filter next put an O-ring after that detection filter and then O-ring. Secure the detection filters through by tightening of the chuck nut. The nut should be sufficiently tight to prevent the filters from moving. Be careful not to crush the detection filters(glass).



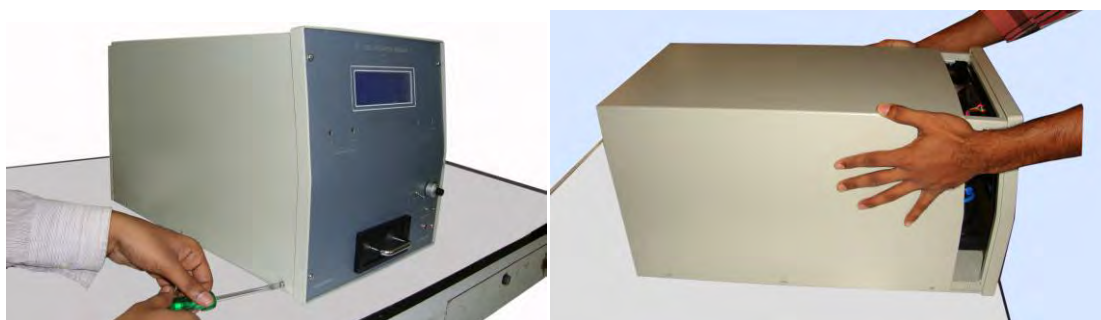
**Fig: Filter basket for Green stimulation and its arrangement**

**iii. Basket for OSL-Blue mode:** It consists of single detection filter which is U-340 with a thickness of 7.5mm (7.5mm thickness can be achieved by the use of three U-340 filters). These filters can be arranged in the filter basket as first put an O-ring in the basket then put detection filter next put an O-ring after that detection filter and then O-ring. Secure the detection filters through by tightening of the chuck nut. The nut should be sufficiently tight to prevent the filters from moving. Be careful not to crush the detection filters (glass).

#### **Dismantling of electronic unit (mechanical parts):**

Disconnect the USB cable from the Rear Panel Circular USB port. To dismantle the electronic unit, initially user has to turn off the power supply (230V A.C) connection to the TL/OSL research reader, remove the nitrogen gas connections (if any) and all the communication cables. User has to open the top cover of the unit through by the use of screw driver, gently remove the top cover and place it aside. With this dismantling of electronic unit is completed.

**Below are the images showing dismantling procedure of electronic unit.**



**Fig: Dismantling of electronic**

**Note: The steps 2,3,4,5 & 6 are to be done in ambient light conditions.**

#### **2. Remove photon counting module:**

Always use subdued light when removing/mounting the photon counting module. Never expose photon counting module directly to white light. And then disconnect the USB cable from USB port inside the Rear Panel. Then gently remove the circular chuck nut which is fixed at the bottom side of the photon counting module. After that take out the photon counting module



(Photon Detection Module) from the stimulation chamber, use the bottom locker to the module to avoid light exposure. User can place the photon counting module in the box which is provided, to avoid any damages to the module. Below figures are showing the procedure for photon counting module dismantling.



**Fig: Dismantling of Photon Counting Module**

Power connector for Photon counting module inside of the Rare Panel

### 3. Replacing the filter basket:

Remove the previously existing inserted filter basket from the stimulation and detection chamber; insert the desired filter basket in the stimulation and detection chamber. Please ensure that O-ring between the filters before inserting the new filter basket. If this O-ring is missing a light leak has been introduced into system.



**Fig: Replacing of filter**

### 4. Mount the photon counting module:

The photon counting module is remounted using the chuck nut which is earlier removed, use that chuck nut to tighten the module on the stimulation and detection chamber. Before remounting the module ensure that proper O-ring and filter combination are used the filter basket. Then connect the communication cable of photon counting module to the connector provided (9-pin D-type connector).

## 5. Assembling of electronic unit:

Now close the outer cover of the electronic which is earlier removed and tighten the outer cover with the screws which are earlier used. Now give all connections to the unit, if you have any doubts regarding connections of the unit once go through to the system interconnection details of chapter iii.

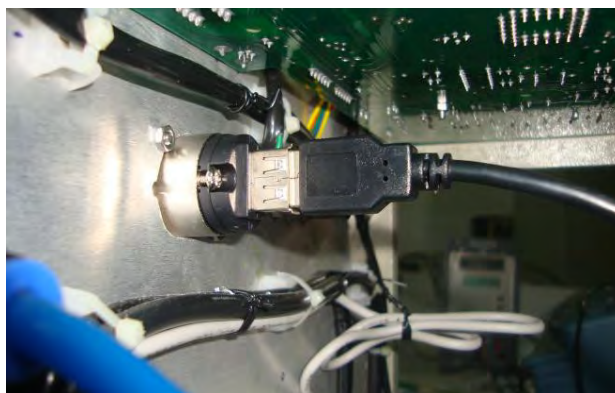
## 6. Check for light leakage

After changing of the filter basket and assembling of photon counting module it is advisable to ensure that there is no light leakage. This checking can be done by a test run of the unit either in TL/OSL mode.

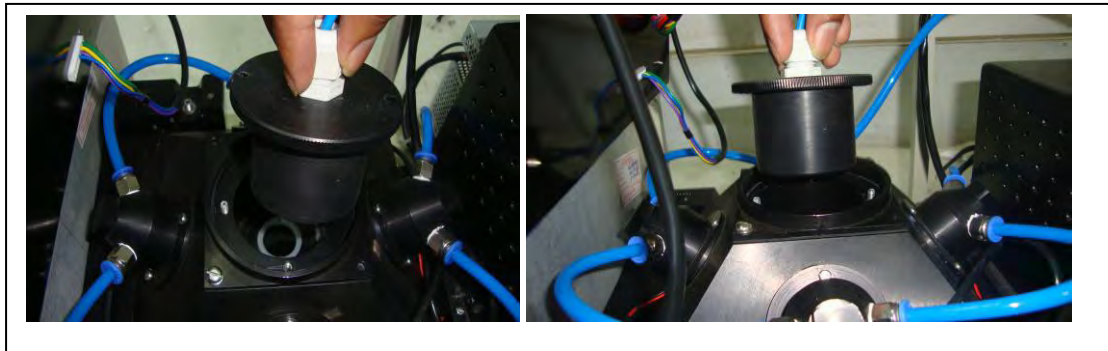
1. Open the application software
2. Change the mode to desired one
3. Load any/ default profile as per mode of operation
4. Switch off the lights
5. Click “start” in acquisition menu note down the darkcounts.
6. Switch on the white room light and note down the dark counts for the same profile.  
If the numbers of detected counts are higher when room light is on compared to when it is off, a light leak has been introduced. This light leak must be eliminated before it is advisable to use the reader.
7. Click on “Emergency stop” for any malfunction of the unit

## 7) How to Swap the PDM with optical fiber mount

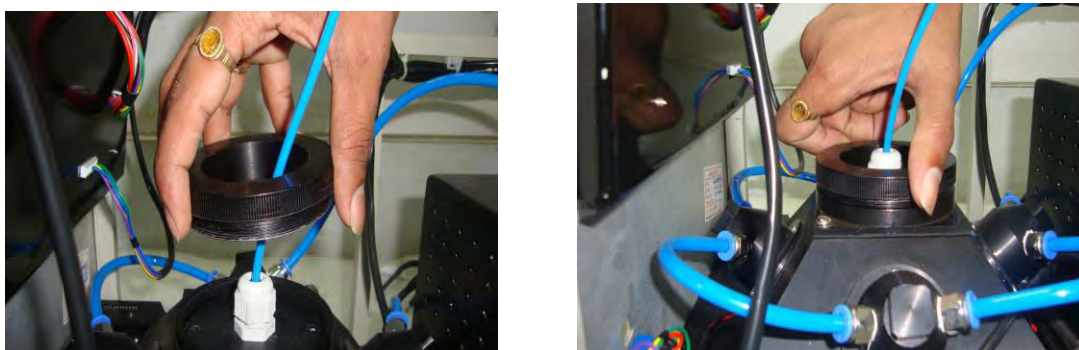
- a. Put OFF the TL-OSL Research Reader
- b. Disconnect the RS232/USB Port (Circular) from the rear panel.
- c. Open the top cover and unplug the USB cable from the USB port inside the rear panel.



- d. Remove the circular fixture and remove PDM from Dark Chamber
- e. Insert the required filter basket (depending upon TL/OSL Research Reader mode)
- f. Take the optical fiber mount and insert in the dark chamber.



- g. Run the circular fixture over the optical fiber and tight it up.



- h. Connect the other end of optical fiber to the CCD Spectrometer attachment as shown figure



- i. Close the top cover over the TL OSL Research Reader and fix it up with captive screws
- j. Connect the USB cable to the USB port on the Front Panel of the Reader to the PC
- k. Run the SpectraSuite software and do the emission spectra analysis in the PC
- l. The procedure in obtaining emission spectra from the sample under the study is as described in the Chapter-V in the Experimental Manual (Page No. 24 )

## CHAPTER –XIV

### FIRST LEVEL OF PREVENTIVE MAINTENANCE AND ATTENDING TO SERVICE OF TL/OSL READER

Once the software is installed and working satisfactorily for every day measurement, whenever the unit is switched ON, user can follow the following sequence

Put all the controls in default settings.

1. Put the heater ON switch to 'OFF' position. After initial warm-up time of 5min. load light source. Put the ISO / Program switch at program Position and set temperature to 0 c.
2. Through acquisition button run for acquisition cycle. Note the counts for the channel.
3. Repeat this every day if you make measurements. It should give same measurements.
4. In acquisition, you can see a band with constant light source counts.
5. Without light source, run for a profile without any sample, the background should be very Low.

The movements you switch on you look at the temperature display. It should show close to Ambient temperature, as sensed at the thermocouple. If by chance thermocouple connection Broken, the display show very near to zero or small negative display. Then check for the thermocouple breakage or any other connector breakage up to the TC board. If Kanthal strip is burnt or TC may be broken same will be replaced.

In case instrument not displays anything check Rear panel low voltage supplies and report the problem accordingly.

Each day before you start the experiment, you go through the temperature calibration after warm-up time. When you are using light source you should keep the heater ON/OFF switch to 'OFF' position

#### RECOMENDED HEATING PROFILES

##### A. POWDER SAMPLE

For power samples & also for Natural crystals / micro-rods / discs etc., low heating rate is recommended .The Normal profile to get accurate output is

Heating Rate = Typical (2<sup>0</sup>c/sec)  
(range permitted is 0.5<sup>0</sup>c/sec to 40<sup>0</sup>c/sec)

Set Temp	=	300 c(typical)
Rise Time	=	100sec
Clamp Time	=	20sec
Natural cooling Time	=	20sec

- B. DISCS (Fixed wt.) with Teflon base material for fixed samples say caso4:Dy discs, ` 2<sup>0</sup> c/sec to 5<sup>0</sup> c/sec is recommended HeatingRate=10<sup>0</sup> c/sec(typical)=5<sup>0</sup>c/sec

Set Temp	=	300°c
Rise Time	=	60sec
Clamp Time	=	30sec
Natural Cooling time	=	20sec

## CHAPTER XV

### SOFTWARE USER MANUAL

#### SYSTEM REQUIREMENTS:

PC (Minimum configuration): Intel i3 CPU or better, 2 GB RAM, 160 GB HDD.

OS: Windows 7. (Windows Vista / XP is not supported)

Antivirus: Norton / Quick heal / Kaspersky

Internet connectivity & Team viewer/Skype software: For remote trouble-shooting

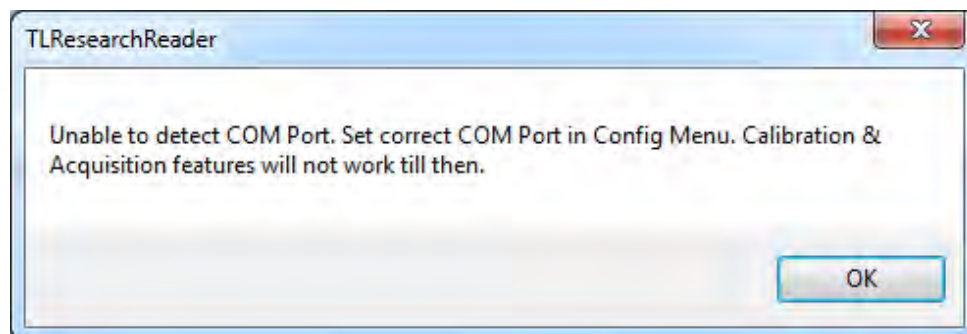
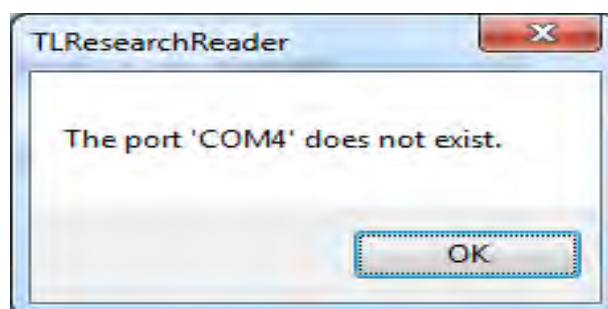
Serial Port (9-pin D-type) for connecting PMT to PC, COM Port (USB) for connecting Electronic unit to PC.

#### MAKING CONNECTIONS AND IDENTIFYING COM PORT:

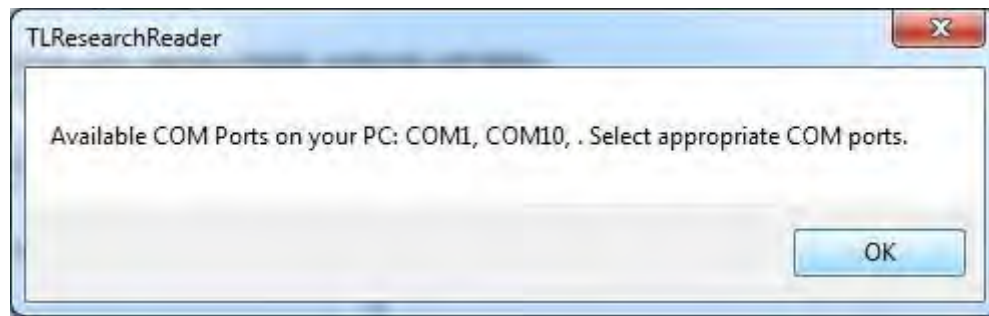
Prepare the Reader as per Hardware user manual. Connect the Serial cable(USB A-B) from TL/OSL Research Reader Electronic Unit to PC COM port and connect the RS-232 cable from electronic unit to PC serial port. After making connections, the COM port numbers must be identified. For the first run of TL/OSL application the software itself gives the com port numbers connected to the pc. Alternatively the user can know the com port numbers for that, Right click on "My computer" icon on Desktop. Select Properties -> Device Manager -> Ports. You will find the COM port numbers. For eg. If you find "COM3", it means that COM port number is 3.

#### SOFTWARE OPERATION AND FEATURES:

If COM port settings are incorrect, then following windows appear.

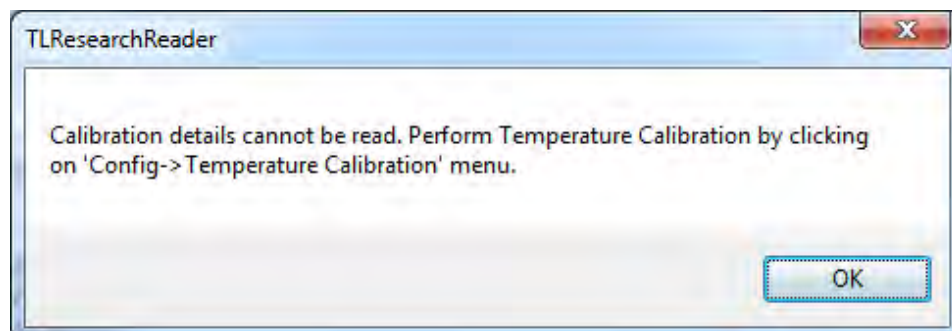
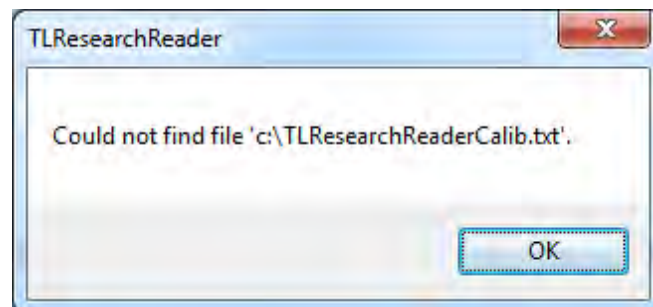




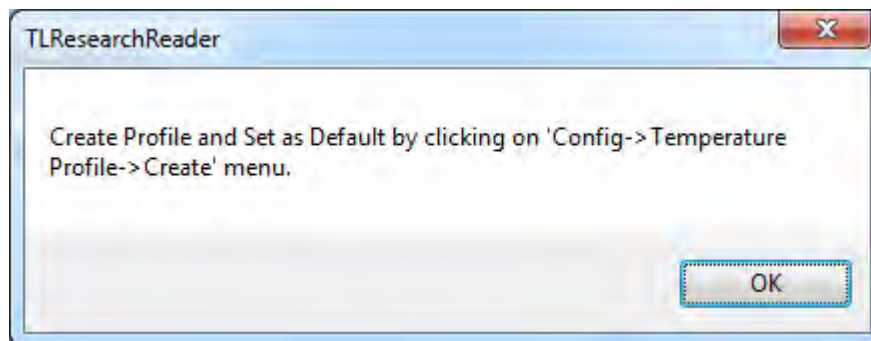
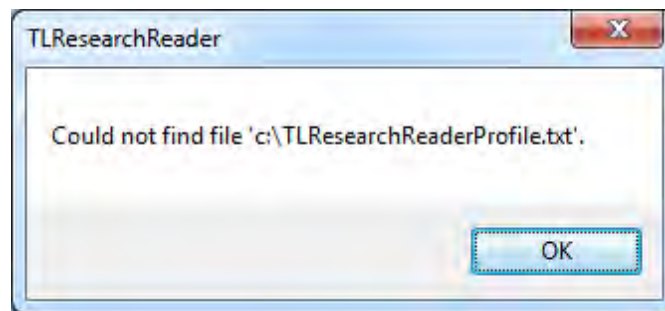


Recheck the COM port numbers and enter the correct COM port numbers in "Config-> Set COM Port" menu.

The very first time the application is executed, the below message appears.

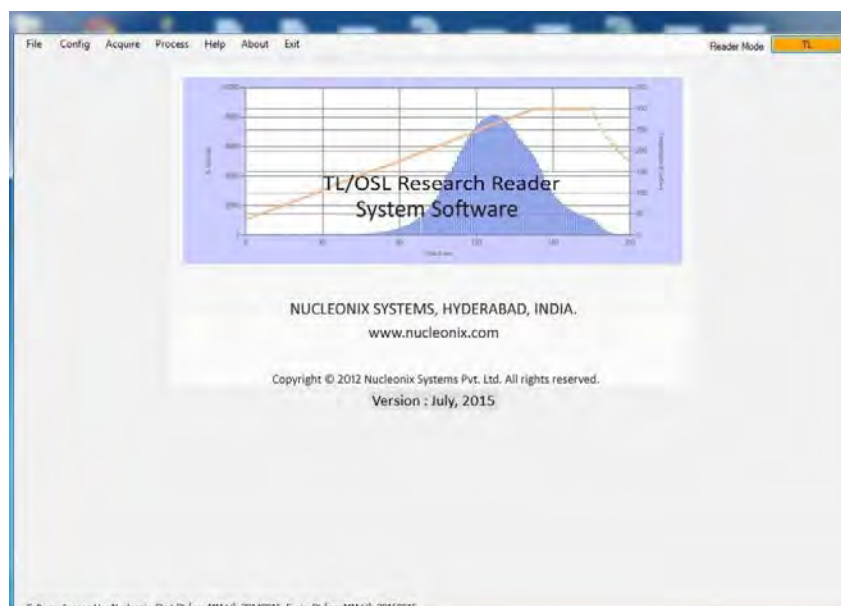


This means that no previous Temperature Calibration file exists and hence Temperature Calibration is to be performed.



This means that no previous Temperature Profile file exists and hence Temperature Profile is to be created. Click on “Ok”.

The main screen of TL/OSL Research Reader appears as below:





## **Config Menu:**

### **Setting the COM Port**

To set COM port, select Config menu and click on “Set COM port”. In the window that pops up, enter the COM port numbers and click Ok. The application is terminated for the new settings to take effect. Now Rerun the application.

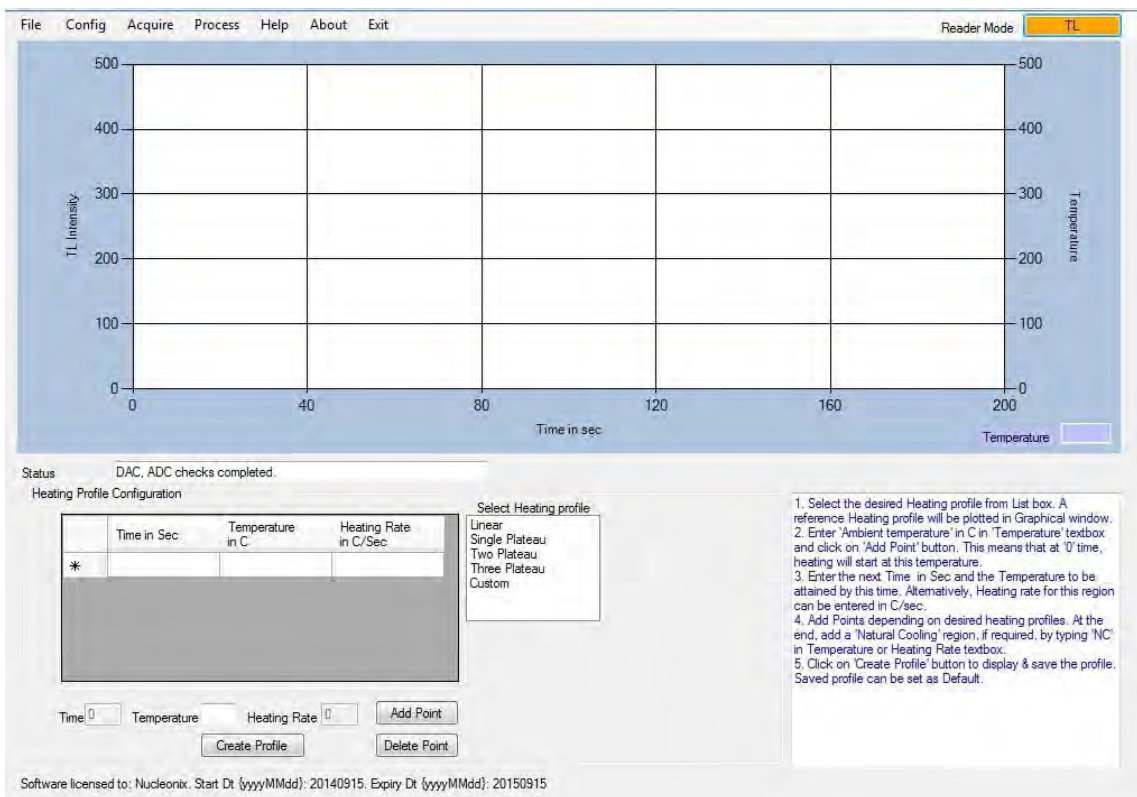
### **Temperature Calibration**

- a. Temperature Calibration must be done for the very first time the Software is executed. Also, it is to be done periodically or whenever you observe deviation between set temperature and that observed on TL Reader's display. To do this, select Config menu and click on Temperature Calibration.
- b. Click on Start button to start incrementing Temperature. Observe the temperature on TL/OSL Reader's display.
- c. Click on 'Pause' button when Temperature on Reader reaches approx. 150<sup>0</sup> C & enter that value in Temperature Textbox.
- d. Click on 'Add to Grid' button to accept the value for Calibration purpose.
- e. Click 'Resume' button to increase temperature again. Repeat steps (c) & (d) for 250 C and 350C.
- f. Click on 'Save Calib & Exit' button to Save the Calibration details. They are Auto loaded every time the App is run.

### **Configuring the Heating Profile**

User can **create** a new Heating Profile of the following types: Linear, Single Plateau, Two Plateau, Three Plateau and Custom and Save the Profile for re-use.

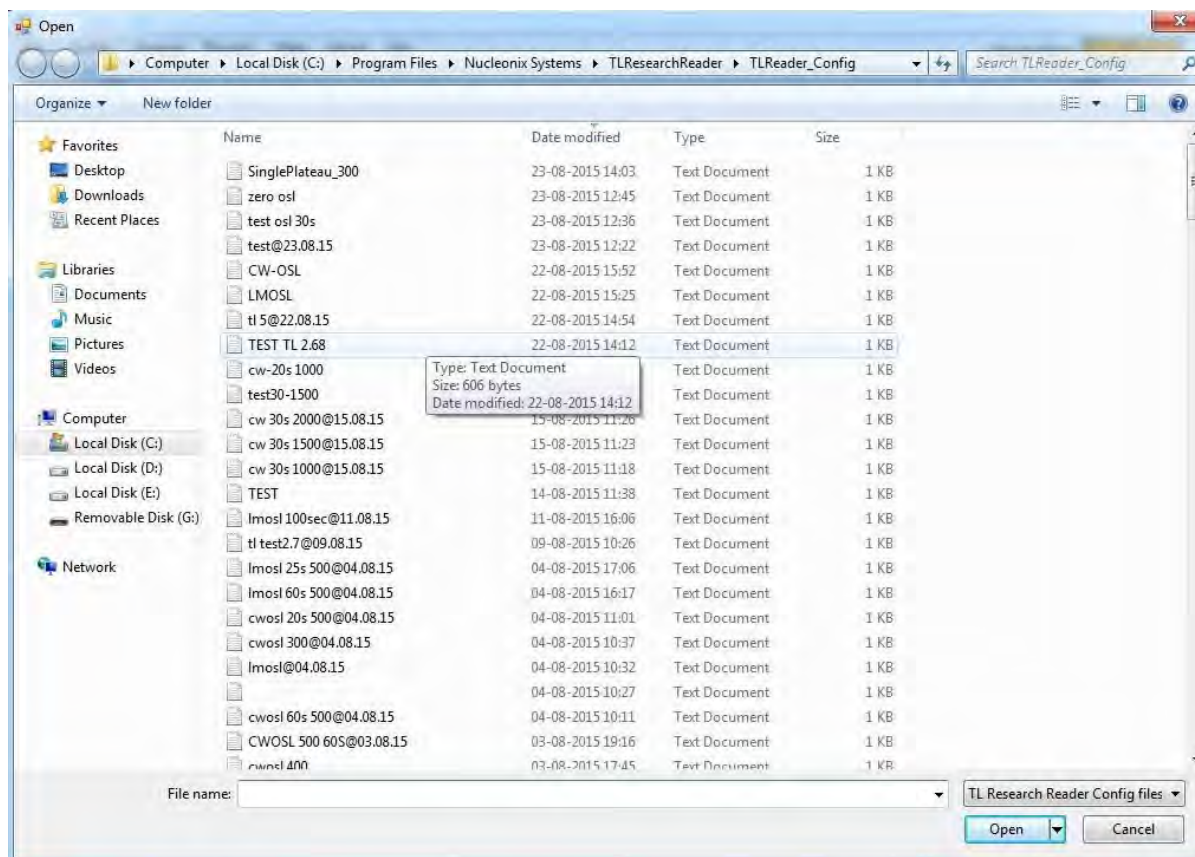
This can be done by clicking on Config Menu, “Temperature Profile” and “Create”. The screen looks like below:



### The below steps can be followed to configure:

- Select the desired Heating profile from List box. A reference heating profile will be plotted in Graphical window.
- Enter 'Ambient temperature' in C in 'Temperature' textbox and click on 'Add Point' button. This means that at '0' time, heating will start at this temperature.
- Enter the next Time in Sec and the Temperature (maximum is 500C) to be attained by this time. Alternatively, Heating rate for this region can be entered in C/sec (maximum is 40C/sec).
- Add Points depending on desired heating profiles. At the end, add a 'Natural Cooling' region, if required, by typing 'NC' in Temperature or Heating Rate text box.
- Click on 'Create Profile' button to display & save the profile. User must give an appropriate name to the Profile for easy identification. For eg., a linear heating profile with 300 sec run time can be given the name "LinearProfile\_300". Saved profile can be set as Default, so that every time the application is executed, the default profile is automatically loaded and this profile will be used for Acquisition.

To **Load** a specific Heating Profile other than the default one, click on Config Menu, "Temperature Profile" and "Load". A dialog box opens as shown below:



It shows the filenames of heating profiles. Select the desired one and click open. A message appears to confirm that heating profile is loaded.

Now, we are ready to acquire the TL spectrum.

### Setting Reader Factor to obtain 'Dose Equivalent'

Setting Reader Factor enables us to get the Dose Equivalent in „Integral TL“ computation.

### Change Reader Mode:

Provided Operating modes of the TL/OSL research reader are:

TL

CW-OSL (Green)

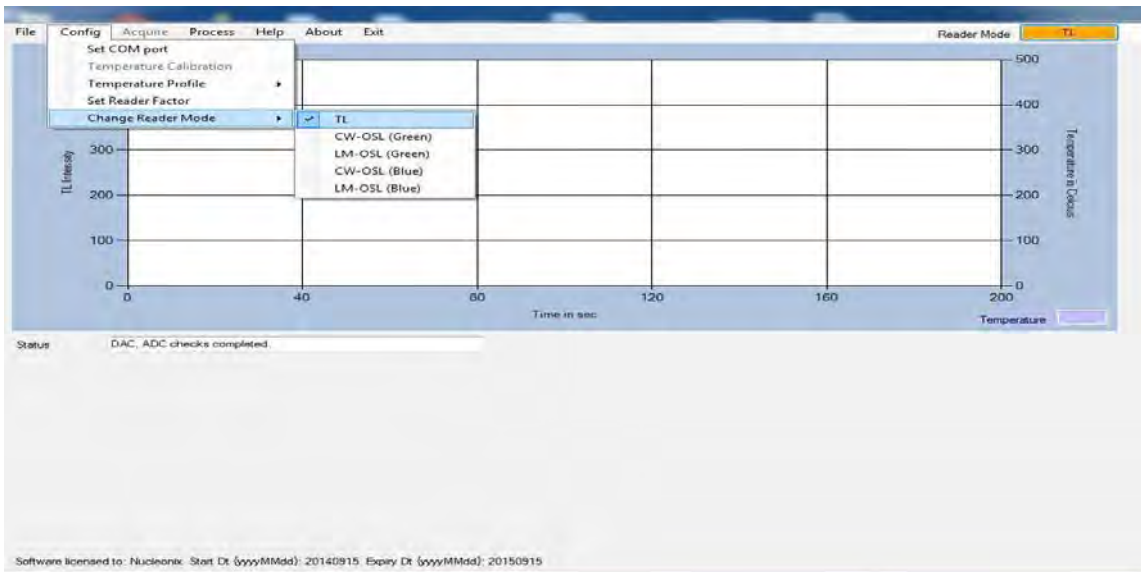
LM-OSL (Green)

CW-OSL (Blue)

LM-OSL (Blue)

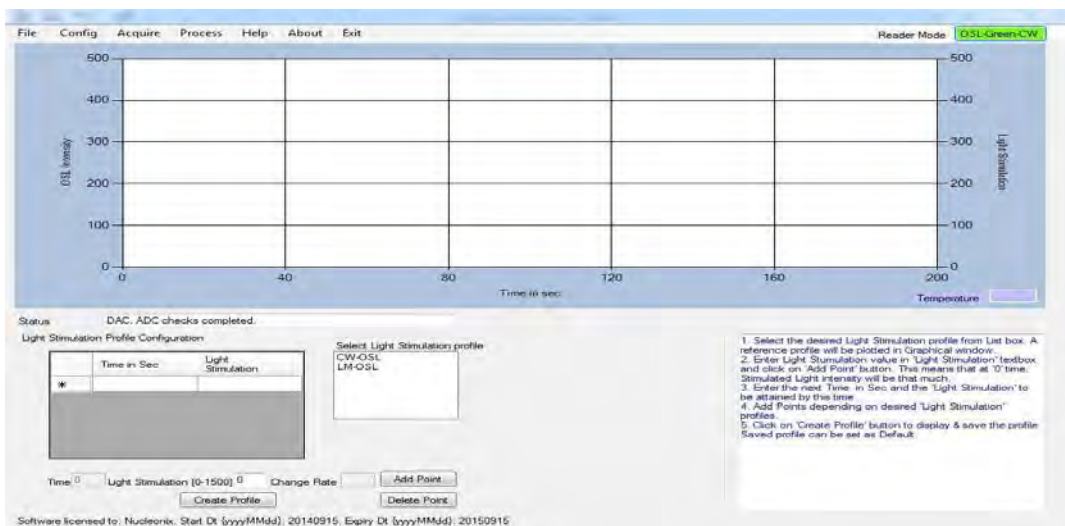
Initially the reader is in TL mode (Power on condition).

User can change to the desired operating mode of the reader by using this change reader mode option. By clicking on this change reader mode it will give the options for the user which is shown in below figure.



User has to select the desired operating mode before going to acquisition. By selecting the desired operating mode it gives a pop-up window that showing “calibration values saved”. Click on ok button.

**Light Stimulation Profile:** User can **create** a new Light Stimulation Profile of the following types: CW-OSL and LM-OSL. This can be done by clicking on Config Menu, “Light Stimulation Profile” and “Create”. The screen looks like below:



The below steps can be followed to configure:

- Select the desired Light Stimulation profile from List box. A reference profile will be plotted in Graphical window.
- Enter 'Ambient Light' (DAC Profile) in 'Light Stimulation (0-1500)' textbox and click on 'Add Point' button. This means that at '0' time, LED's will start lit with this reference DAC value.
- Enter the next Time in Sec and the 'Light Stimulation (0-1500)' maximum DAC value is 1500 to be attained by this time. Click on 'Add Point' button.

d. Click on 'Create Profile' button to display & save the profile. User must give an appropriate name to the Profile for easy identification. For eg, a LM-OSL with 30 sec runtime can be given the name “LM-OSL\_30”. Saved profile can be set as Default, so that every time the application is executed, the default profile is automatically loaded and this profile will be used for Acquisition.

To **Load** a specific Light Stimulation Profile other than the default one, click on Config Menu, “Light Stimulation Profile” and “Load”. A dialog box opens all the saved profiles, select the desired profile and click open button then it gives a pop-up window showing that Light stimulation profile is loaded.

#### **Acquire Menu:**

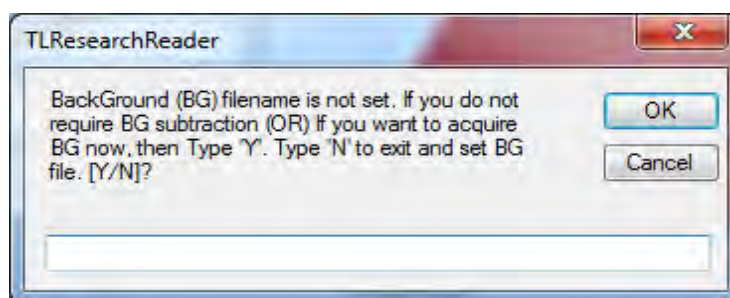
**If the reader is in TL mode:** After Temperature Calibration (if executing for the first time) and creating / loading desired Heating Profile, we are ready to acquire the spectrum. Ensure that Heater switch is ON and appropriate filter basket in the stimulation chamber.

**If the reader is in OSL mode:** After selecting the desired stimulation mode (BLUE OR GREEN) and creating / Loading the required Light stimulation profile, we are ready to acquire the spectrum. Ensure that appropriate filter basket is loaded in the stimulation chamber.

#### **Acquiring Background Spectrum**

A background spectrum must be acquired before loading the sample. This can be done by clicking on “Acquire Menu” and “Start”.

A window pops up as given below:



Select “Y” as we are acquiring the Background spectrum.

Save this file by clicking on “File Menu” and “Save”. A Window pops up in which the User must enter a filename. Enter an appropriate name like “BG\_Aug182015”. The user can save this file in his desired location by choosing “Save As” option in the file menu.

#### **Setting BG Filename for Auto subtraction**

Before acquiring Sample spectrum, we must set the Background filename to the most recently acquired background spectrum filename.

This is done by clicking on “Acquire Menu” and “Select BG File”.

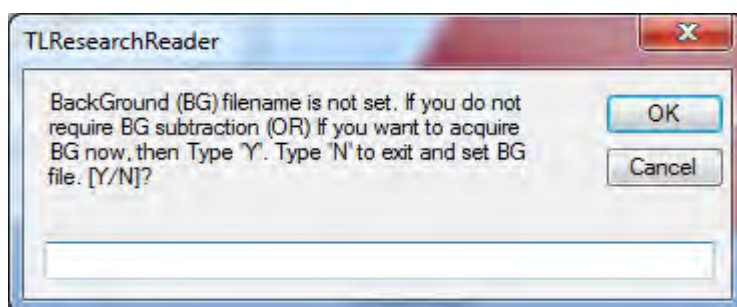
Once this is done, background data will automatically be subtracted from all the acquired samples.

If Background data is not required to be subtracted from sample data, then this step is to be skipped.

### Acquiring Sample data

Load the sample in the sample holder and close the drawer tightly. To acquire spectrum for a Sample, click “Acquire Menu” and “Start”.

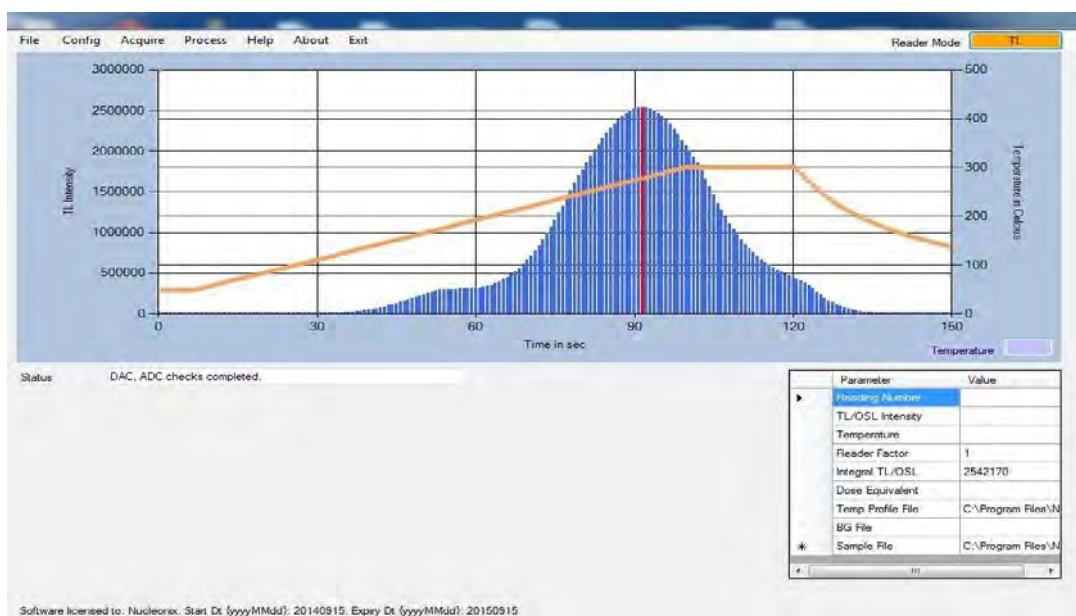
The below message pops up if you have forgotten to set the BG filename.



If you choose to acquire sample data without BG subtraction, type “Y”. Otherwise type “N” to set BG file name and return later.

### If the reader is in TL mode:

Live acquisition and plotting of TL glow curve and Temperature profile starts as per the selected Heating profile. A typical profile after acquisition would look like below:

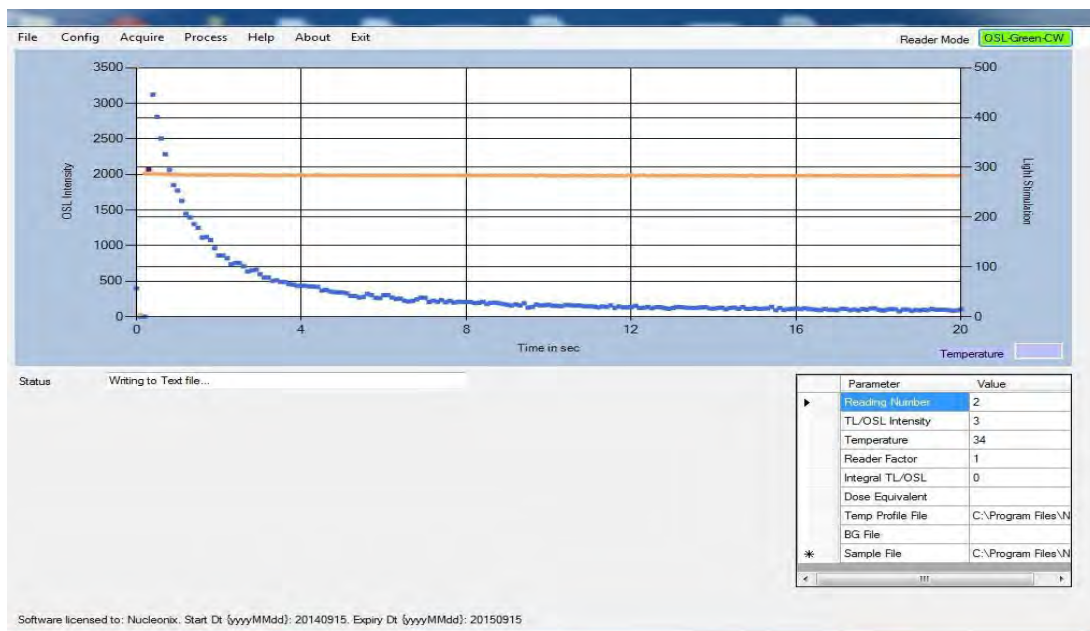


Notice the grid on bottom right. During acquisition, Reading Number, TL/OSL Intensity and Temperature are updated for every data point that is acquired.



### If the reader is in OSL mode:

Live acquisition and plotting of OSL glow curve and Light Stimulation profile starts as per the selected Light Stimulation profile. A typical profile after acquisition would look like below:



Notice the grid on bottom right. During acquisition, Reading Number, TL/OSL Intensity and Temperature are updated for every data point that is acquired.

### Setting the Region of Interest (ROI) and calculation of Dose Equivalent

User can now click on the spectrum to set the Region of Interest (ROI). ROI's colour changes to Red. Integral TL/OSL Intensity is calculated for the selected ROI and displayed in the Grid. Dose Equivalent (in mR or R) is calculated by multiplying Integral TL/OSL Intensity and Reader Factor. Also find that Temperature Profile file name, BG File name and Sample file name is listed in the grid.

### Saving the acquired spectrum

To save the acquired spectrum, click on File Menu and save. User is asked to enter the filename without path and Extension. The spectrum data is saved in a text file and also exported to Excel. These files are located in c:\Program Files\Nucleonix Systems\TLResearchReader\TL Reader Spectra and TL Reader Reports (For OSL glow curve OSL Reader Spectra) folders respectively.

## Stopping Acquisition before completion

User can choose to stop the acquisition, turn off heating / Lighting and stop by clicking on “Acquire Menu” and “Emergency Stop”. The acquisition process will be stopped.

## Viewing Saved Spectra

Saved Spectra can be viewed in TL/OSL Research Reader application or in Excel. To view in application, click on “File” Menu and “Open”. Select the filename to open and click ok.

The spectrum is retrieved and plotted. The Grid parameters including Dose Equivalent are updated. Also, Region of Interest is highlighted in Red Color.

To view the file in MS Excel, click on “Process” menu and “View in Excel” Further processing of data, if required, can be done in MS Excel.

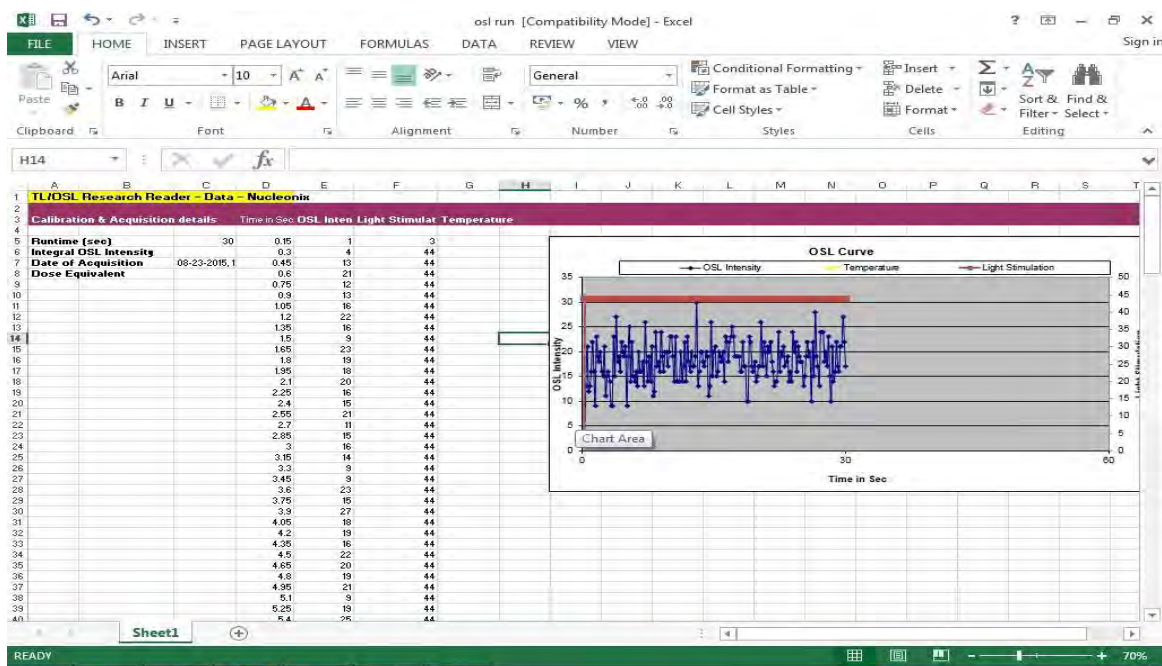
### Process Menu:

With this menu user can do the desired manipulations to the saved spectrum file.

### View in Excel

This function gives the user to open spectrum file in MS-EXCEL sheet. User can use this data for further processing's.

A sample OSL spectrum file in Excel sheet looks as follows.



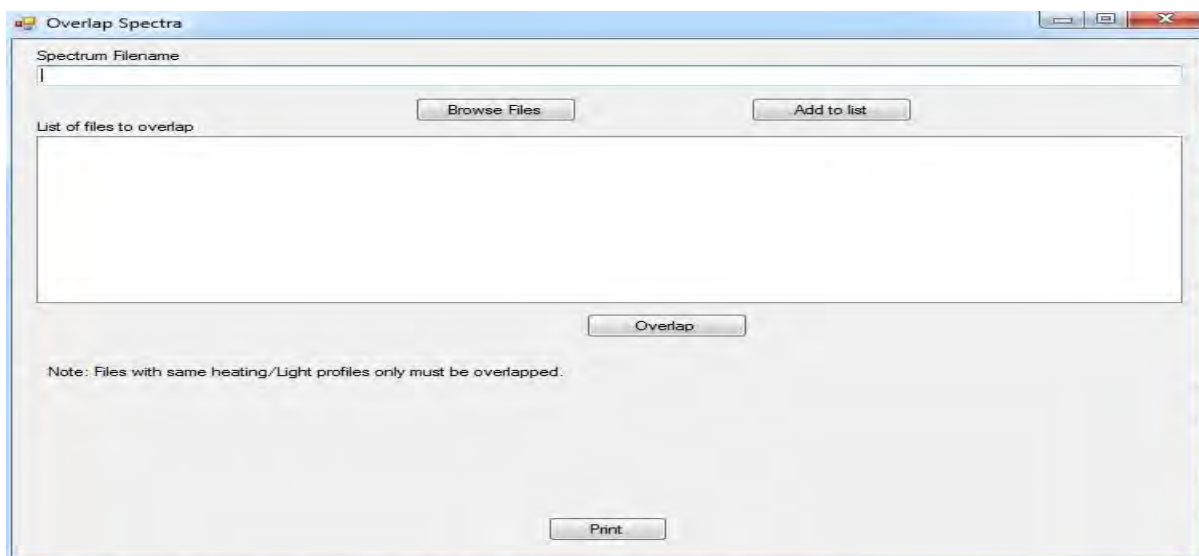


## Overlapping up to 10 Spectra

This is a powerful feature that can be used to overlap spectra acquired using same Heating profile.

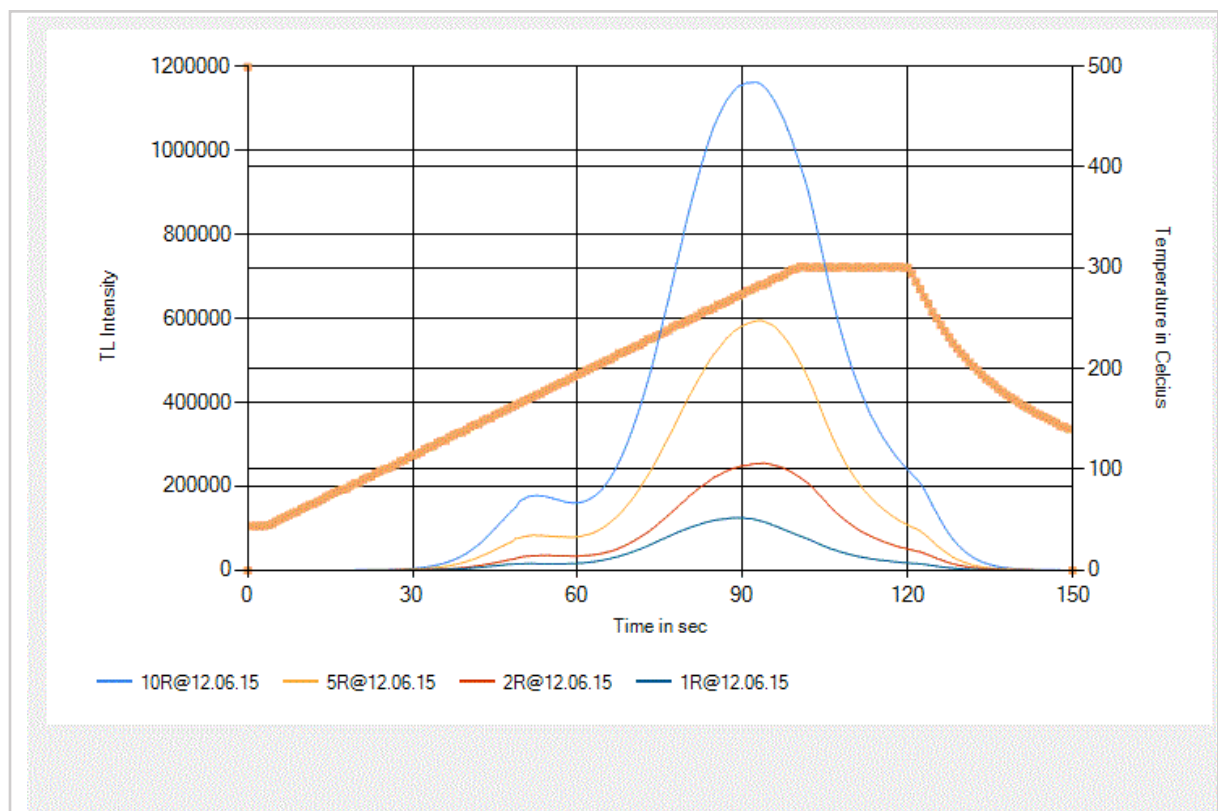
User can visually compare and print the overlapped spectra.

To overlap spectra, User must click on „Report“ menu and „Overlap“. It shows the below screen:

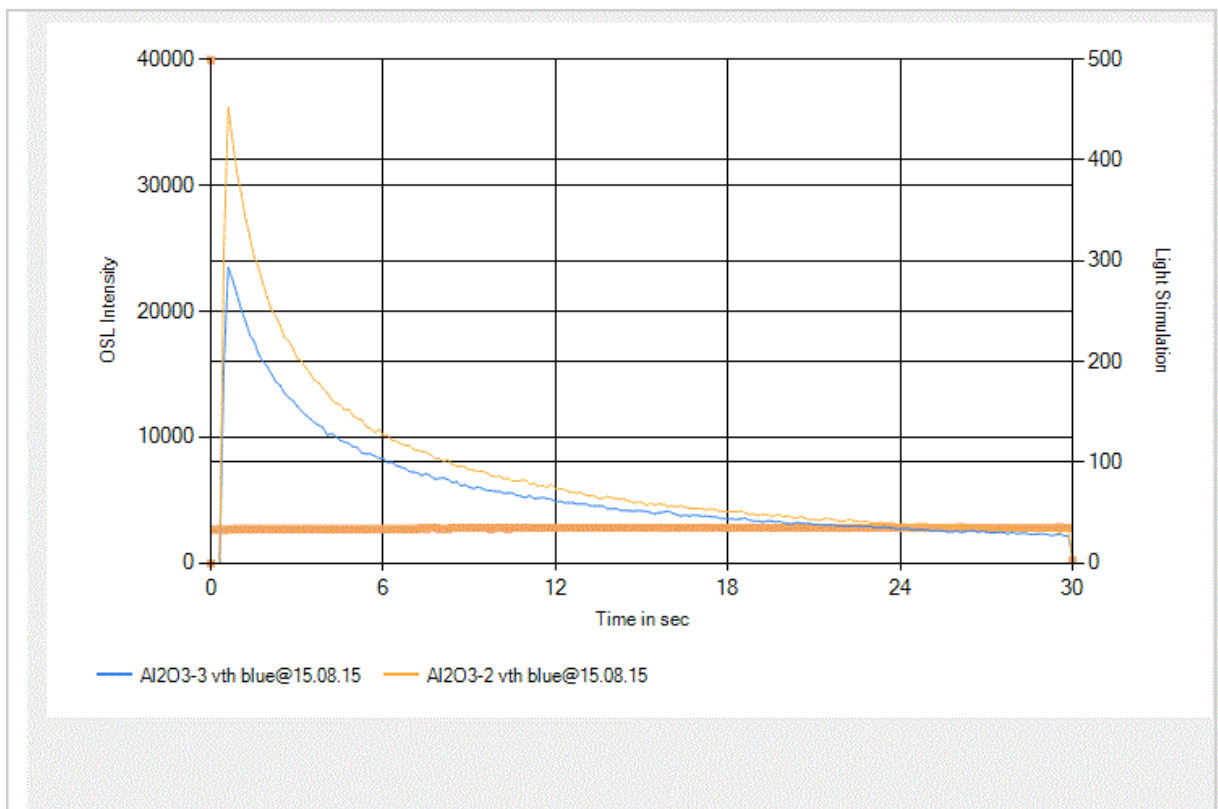


Here, User must browse and select the file to be overlapped by clicking „Browse Files“ button. Then, the file should be added to list by clicking on „Add to list“ button. Up to 10 files can be added to the list. Then, click on Overlap button. Given below is an overlap image of 4 files (TL mode), which is saved as

D:\File name\TL Research Reader Overlapfile.gif



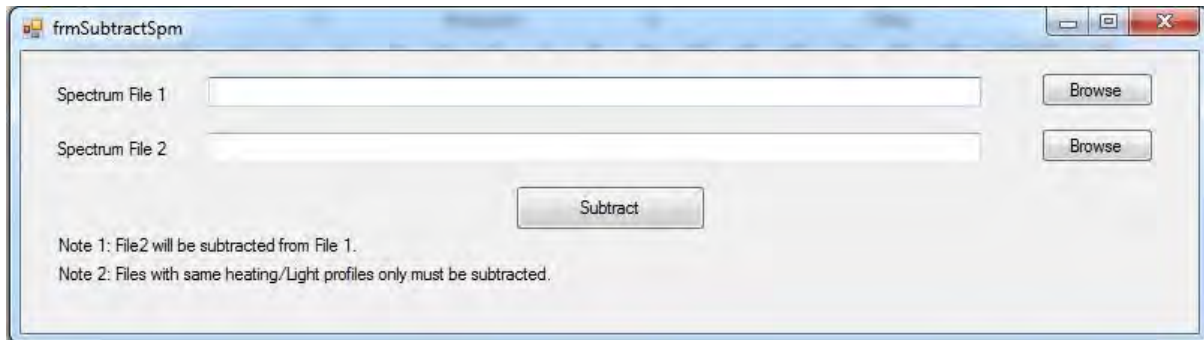
In OSL mode the overlap file is given as follows:



## Subtract function

User can subtract the two spectrum files by using this subtract function. In this spectrum file2 will be subtracted from the file1 and the result will be plotted, user can save this subtracted plot with new file name.

By clicking on the subtract function it opens a window which looks as follows.

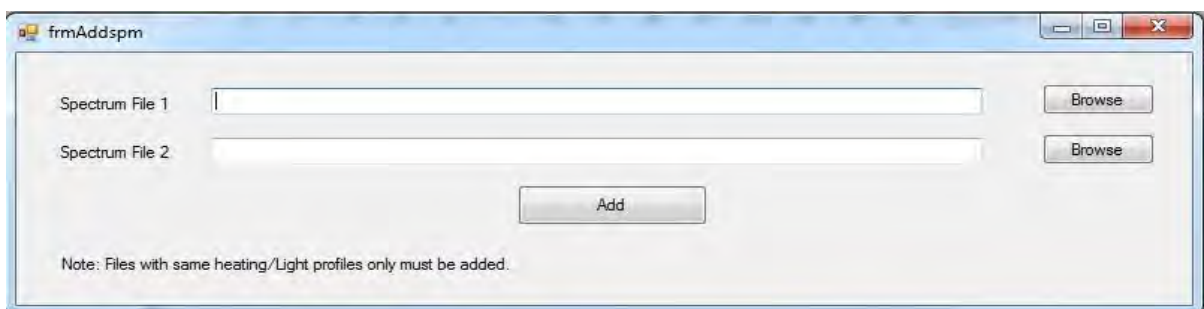


Here the spectrum files which have the same heating/Light profiles only must be subtracted. If the user gives spectrum files with two different Light/heating profiles then it gives a message that “only the spectrum files with same heating/light profiles will be subtracted.”

## Add Function

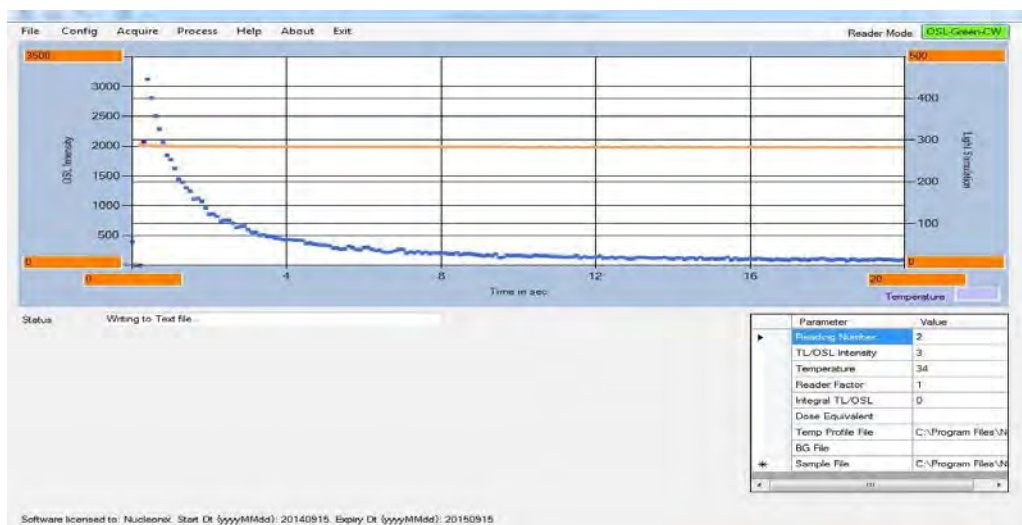
User can add two spectrum files by choosing this add function. In this spectrum file1 and spectrum file2 are added and the result is spectrum output will be plotted. User can save this new spectrum file under file menu.

By clicking on the add function it opens a window which looks as follows.



## Change Scale

By using this user can configure the scales such as x, y and y1 axis to the desired values, for that user has to click on “Change Scale”, “Enter Values” function. By clicking that function it opens a window which looks as follows.



It open boxes for each axis user has to give the minimum and maximum limit values in that corresponding box. After that to effect these new settings to the spectrum file user has click on “Process” menu in that “Change Scale”, “Set Values”. With this new settings are adopted to the all the axis(x, y and y1).

### File Menu:

The various functions under file menu are briefly given as follows.

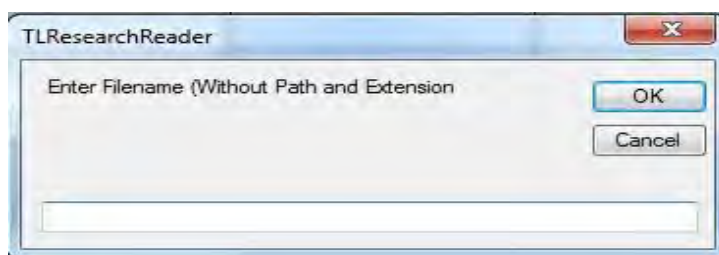
#### Open

This function gives the user to open the earlier saved spectrum files. By clicking this it pop-up a window which gives a message that “Current glow curve data. If any, will be lost unless it is saved. Proceed anyway(Y/N)”. By giving ‘Y’ to that window as acknowledgement then it open a list of files which are earlier acquired and saved spectrum files.

**Note:** If the reader is in TL mode then in “open” menu it only shows the files corresponding to TL spectrum. To open the files corresponding to OSL spectrum user has to change the operating mode of the unit.

#### Save

To save the presently acquired spectrum, user has to click on “File” menu “save” option with this it opens a pop-up window which looks as follows.



User has to give name to that spectrum file without any path and extension. After that click on “OK” button with this presently acquired spectrum is saved with given file name.

### Save As

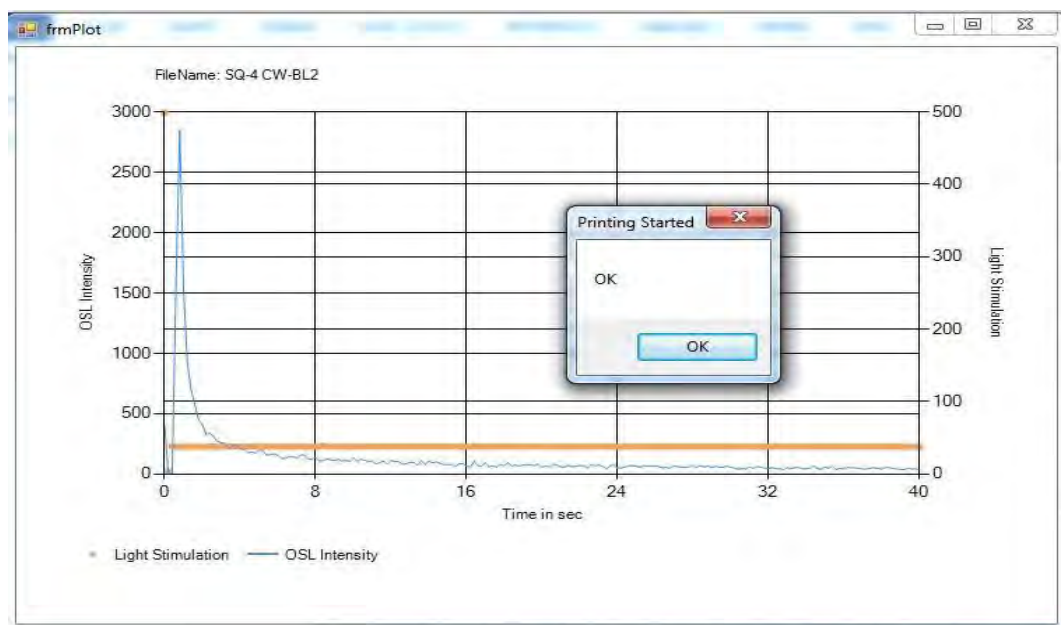
To save the presently acquired spectrum to the desired memory location, user has to click on “File” menu “Save As” option with this it opens window user can select the desired memory partition to save the spectrum after that click on save button, with this the files is successfully saved to the desired memory lo0action.

### Plot

To print the any file user has to click on “File” menu “plot” function, with this it open a window which looks as follows.



In that window click on “open file & plot” button with that it open all the saved spectra files. User has to select the file for print and click on open. After that it just shows the spectra file and gives a window that printing started which looks as follow.



**Erase**

To clear the main application window screen or earlier spectrum file glow curve, user has to click on “file” menu “Erase” option with that the main application screen will be cleared.

**Help:**

By clicking this help option it gives a window shows the path for software user manual.

**About this Software**

The version number of this software is displayed when “About” menu is clicked. Please check with Nucleonix for the latest upgrades.

## CHAPTER –XVI

### EQUIPMENT MAINTENANCE SERVICES AND WARRANTY C L A U S E

#### General

As per the warranty clause of the company we provide one year warranty during which period we provide free service at our works. Hence in case of any mal-function in our instruments you are requested to send the unit back to our works by RPP / COURIER / SPEED POST PARCEL / GATI / XPS / door delivery. We shall arrange immediate rectification / replacement within two weeks from the date of receipt of the equipment at our place. Please note that the equipment will be serviced at our works only. **There is no warranty for the photon counting module and filter baskets because photon counting module is a light sensitive device, due to any mishandlings of the module or improper filter basket selection will affect the working of photon counting module.**

#### **The equipment is to be sent to:**

**The Servicing Department**

**NUCLEONIX SYSTEMS PRIVATE LIMITED**

**Plot No: 162A&B, PHASEII, I.D.A.Cherlapally,**

**Hyderabad-500051 Ph: 040-68888777,**

**E-mail:info@nucleonix.com www.nucleonix.com**

For all the Radiation monitoring equipment, detectors built-in or external probes will not have one-year warranty, only inspection warranty at the time of supply is provided. Since detectors will / may have fragile glass construction we do not provide warranty. In case of failure of these components at cost price as per Nucleonix price list user has to buy.

**Note:** In respect of all types of portable radiation monitors, it may be necessary to check up and recalibrate the equipment once a year at our works.

#### **Equipment Repairs /Servicing Policy (With In India)**

## During Warranty

The following procedure is to be followed by the customers with in India for availing services / repairing facility during warrantee period.

- Equipment's are to be sent to our works for availing free repair services during warrantee, after the customer receives approval from the customer support division, by sending an e-mail.
- For all equipment's, costing less than 6.0 lakhs one year warrantee & free service is offered, when the equipment's are sent to our works only. For larger systems such as installed systems, networked systems, specialized systems, costing more than 6.0 lakhs during one year warrantee, free service is offered at site. Field service Engineer will be deputed subject to warrantee terms & conditions.
- This does not include personal computer related problems, for which local computer service provider of the PC vendor is to be contacted. Also for software related problems online support will be provided. Software support doesn't include cleaning of virus problems etc.
- When the equipment's are sent to our works for warrantee services, they are to be properly packed with adequate cushion top prevent any transportation damages. Nucleonix Systems is not responsible for damages or loss during transportation.
- Packing / Freight charge is to be borne by customer when he sends the equipment to our works. However when we return after servicing packing will be Nucleonix responsibility & Freight charges will be to your account. Only services are free.
- 
- Please indicate in your correspondence equipment model & serial number.
- All the equipment's are to be sent to our works only on door delivery basis.
- For Door Delivery Transportation contact XPS/GATI cargo in your city / town or a reliable courier service to pick the consignment from your place. For their nearest local address & phone no's look into their websites. Transit insurance if the customer feels is necessary it is to be covered.
- Nucleonix Systems will not receive the equipment's sent by other modes of transportation, such as Rail / Road.
- After servicing, equipment's will be sent back by same mode of transport such as XPS



/GATI /COURIER / RPP

- All types of Radiation detectors, glass ware (filter baskets), PMTs etc. Which are fragile are not covered in warrantee, if the failure is due to physical damage, external or internal due to shock, dropping, miss-handling etc. If the failure is due to a natural fault then only it is covered under warrantee for a limited period of three months. However complete electronics is covered for 1 year warrantee.
- You can also send the equipment personally to our works for repairs either during or after warrantee, after fixing up with our service dept. (Customer Support Division) .If possible we may repair on same day or your person can stay for a day or two & get it repaired & or calibrated.

### After Warranty Services

- On expiry of 1yr warrantee if you like to send the equipment (low cost less than 6.0 lakhs) for repairs to our works, you may please observe the following procedure.
- Send an e-mail with details mentioning that you agree to pay service charges which includes: Basic service charges per unit / module in the range of Rs : 2500 to Rs : 10,000 depending on the sophistication of the unit calibration charges ( if applicable for your equipment) + cost of components + packing charges + Return Freight charges @actual.
- Once our customer support department responds & requests you to dispatch the equipment to our works for repairs, you may do so by following the steps given below.
- Followed by this you can send the equipment straight away if it is within 5yr sold. If the equipment is beyond 5yrs. old, then also you can send it for repairs, however only after you receive confirmation from Customer Support Division, that it is repairable & is not an obsolete model. If the design is obsolete then customer support division (CSD) may give you 'buy back' offer to replace with new model or upgrade it with electronic circuit boards & enclosure.
- For all installed equipment's costing above Rs: 6.0 lakhs which are larger in size & for which field servicing only is recommended, you can obtain a quotation with relevant details by sending an e-mail & avail the services accordingly.
- For all field servicing jobs, since we need to depute engineers, it is likely, to take time & also it will cost more which includes Engineer's TA & DA etc., apart from basic service charges + cost of spares etc. Please note that basic service charges will be different for different products depending upon sophistication.

- Also in some cases it may not be possible to fix-up the problems in the field itself, in such cases we may advise you to send them to our works.
- For all jobs to be serviced in the field, customer is requested to provide adequate details on the nature of problems, to enable our engineer to come prepared with Adequate Spares
- For any additional information send an e-mail to [info@nucleonix.com](mailto:info@nucleonix.com), attention: Customer support division.

### **Equipment Repairs / Servicing Policy (For Exports)**

Equipment's, manufactured & exported are subjected to a well-defined quality assurance (QA) plan & Factory acceptance tests (FAT) .Nucleonix systems has the following policy to provide maintenance support to overseas customers either directly or through international dealers/distributors.

#### **During & after warranty:**

- Form in or problems, which can be handled by customers, servicing tips have been provided in the user manual/ servicing manual.
- Also most of the equipment's have built-in fault diagnostic features which will indicate to the user nature of problem in the equipment. Based on the visual indication in the instrument Display, user can take corrective action or contact Nucleonix systems by email for help.
- Nucleonixsystems will guide in localizing the defective part/module or sub-system by interacting with the customer if required. Skype will be used for communication.
- During warranty free replacement of sub-system or board (PCB) will be done. However customer has to send defective sub-system back to Nucleonix system with-in 15 days on arranging replacement.
- During & after warranty, any Freight charges & customs clearance charges are to be borne by customers, both ways.
- If it is a manufacturing defect, then Nucleonix system will bear the replacement cost of sub-system / unit. However any Freight charges & customs clearance charges in their country are to be borne by customer.
- After warranty, services will be similar to that of services during warranty. However, customer will have to pay for cost of parts replaced freight charges both ways & customs clearance charges in both the countries. Nucleonix systems plan to introduce audio visuals on web or on CDs to facilitate product demonstration, installation & minor maintenance very soon.

## CHAPTER – XVII

### CONTACT US FOR AVAILING SERVICES

#### Postal/Mailing Address (Phone / Fax / Email)

Nucleonix Systems Pvt. Ltd.

Plot No. 162 A&B, Phase II, I.D.A.,

Cherlapally, Hyderabad - 500 051, Telangana, India.

Phone: + 91-720734546,

Mobile: 7331104481, 7331104482 .

Email : [info@nucleonix.com](mailto:info@nucleonix.com)

**For any information, Contact by email is always appreciated. (This will help us to respond to you quickly)**

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#### Marketing Department:

##### a) Sales / Commercial Information / Field installation and servicing

For any Commercial, Price information, Product information, customer coordination & quotation of our products customer related commercial services, please contact front office marketing staff through the listed Email Ids or Phone Nos. given below

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#### Whom to Contact:

Business Executives:	Contact Numbers	Contact by E-mail ID
1.R. Maniram (Sr. Business Executive)	Mob:7331104481, 7207034546	info@nucleonix.com
2. Ch. Gayatri (Business Executive)	Mob:7331104481, 7207034546	info@nucleonix.com
3. K. Swapna (Business Executive)	Mob:7331104481, 7207034546	info@nucleonix.com

**Note:** Our business executives will also connect you to concerned Engineer or General Manager for any technical clarifications if required

#### **b) Factory Services**

for **Servicing and Calibration** factory services & follow up on the above jobs including dispatch related/payment related issues of serviced & calibrated items please contact

**Ms .K. Sarika**  
**(Executive services)**

**Mob:**7331104482

**E-mail:** info@nucleonix.com

She will also connect you to concerned engineer or general manager if required, for any clarifications & deficiencies in services

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#### **c) Dispatch Related Issues (Production Items)**

For dispatch related issues of your ordered equipments, including delays, purchase order related document deficiencies, payment proofs, dispatch docket details and bills etc,.contact

**Ms. V. Anusha / Renuka**  
**Devi (Executive Dispatch)**

**E-mail:** info@nucleonix.com

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#### **d) Product Technical Information / Clarifications**

##### **Whom To Contact:**

Contact any front office "Business Executive"- He / She will take your details and connect you to concerned product engineer for any technical clarifications. Best thing is to email your technical queries and obtain the reply, rather than on telephone.

You can also contact General Manager or Director (Tech) if required.

#### **e) Marketing Manager**

On business matters for all your marketing services / techno commercial requirements about Nucleonix Products contact:

**Bhaskara I.V.**  
**Mob:**8019662500  
**Email:** info@nucleonix.com

#### **f) General Manager**

**Dr.M.S.R.Murthy PhD (Nuclear physics)**  
**Email:** info@nucleonix.com

Contact General Manager for all sales / servicing and technical information including customer support

related issues, on the delays, gaps & lapses by our staff. Contact G.M. regarding field installations & field servicing jobs schedule etc.

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**g) HR -Incharge**

Contact her regarding, job vacancies, sending resume for employment, H.R. related issues etc. contact

**Shanthi Sri P**

**Mob:**7331104480

**Email:**recruit@nucleonix.com

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**h) Director -Technical**

**Mr. J. Dheeraj Reddy**

**Email:** jdreddy@nucleonix.com

**Mobile No.** +91-7674009005

Contact him for, any Technical Information and clarifications on products, which cannot be answered by General Manager / Customer support executives.

For any technical deficiencies in products, related issues & suggestions on product improvements you may contact by email or telephone. This will help the company to improve the product & serve you better.

Dealer's complaints, on commercials, lapses by our commercial staff, or any other discrepancy, or you like to give any feedback on any Nucleonix staff doing any wrong thing against cleaner / ethical business principles / practices can be complained to any of the directors or managing director.

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**i) Director - IT**

**Mr. J. Nishanth Reddy**

**Email:** nishureddy@yahoo.com; info@nucleonix.com

**Mobile No.** +91-9966691000

For any deficiencies in product software's, related issues, & any suggestions or improvisations in software's can be contact by email or telephone. This will help the company to improve the product & serve you better.

**j) Managing Director**

**Shri. J.Narender Reddy (Managing Director)**

**Email: [jnreddy@nucleonix.com](mailto:jnreddy@nucleonix.com); [info@nucleonix.com](mailto:info@nucleonix.com)**

**Contact Managing Director for,** Foreign relations, International Business co-operation, Joint ventures, Exports, Dealership in other countries, Policy matters, Technology tie-ups etc.

**k) Dealers Complaints:**

Dealers complaints, on commercials, lapses by our commercial staff, or any other discrepancy, or you like to give any feedback on any Nucleonix staff doing any wrong thing against cleaner / ethical business principles / practices can be complained to any of the directors or managing director.

**An innovative company working towards excellence  
in the field of Nuclear Instrumentation**



**NUCLEONIX SYSTEMS PVT. LTD.**

Plot No.162 A & B, Phase-II, IDA, Cherlapally, Hyderabad-500051 INDIA.

Ph: 91-40-27263701, 040-27262146, 68888777, Fax: 040-27262146

E-mail: [info@nucleonix.com](mailto:info@nucleonix.com) website : [www.nucleonix.com](http://www.nucleonix.com)