

# iRIXS Operation Manual:

**NOTE:** If you are familiar with iRIXS and only need the spectrograph parameters “**A Routine Procedure to Start RIXS experiments in iRIXS**” is provided on **page 8** of this document.

**NOTE:** Please check the “**Important end-of-run operations**” on **page 9**.

## **(Typical) Beamline mirrors and sample positions for iRIXS**

### **V11 mirror:**

- V11 bend up (axis-2): 4.86 mm
- V11 bend down (axis-3): 4.03 mm
- V11 translation: 0 mm / motor counts
  - Pull out **V11 Translation=10000 counts** for **rollup** experiments!

### **H1 switch yard horizontal mirror:**

- H1 bend up (axis-2): 198.9 mi
- H1 bend down (axis-3): 240.987 mi
- H1 tilt angle (axis-1): 8.49641 mm
- H1 translation: 0.38 on scale

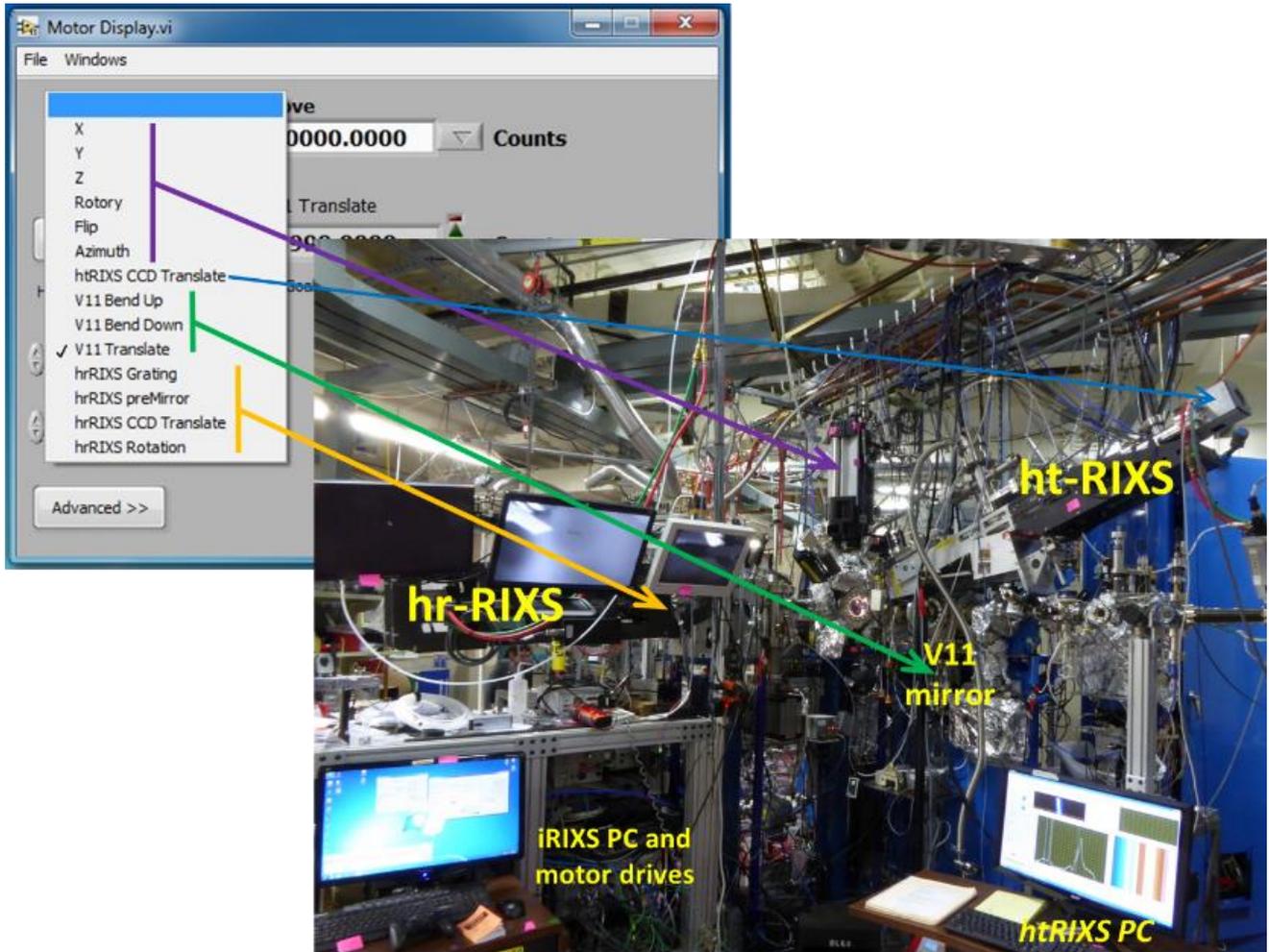
### **[Example!] Sample positions of both spectrographs:**

**Note:** This is for a **Carbon Tape, Upper Stage, Center of sample holder**

- X = 0
- Y = 0
- Z = 0
- Rotation = 90° of Manipulator Rotation (45° to beam)

**NOTE:** The values above are settings of beamline optics for obtaining a focused beam with size of about 20um (vertical) X 100um (horizontal) in iRIXS.

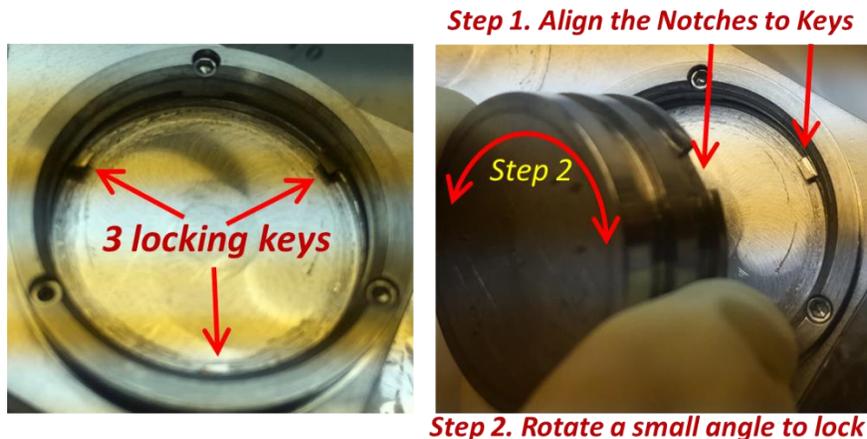
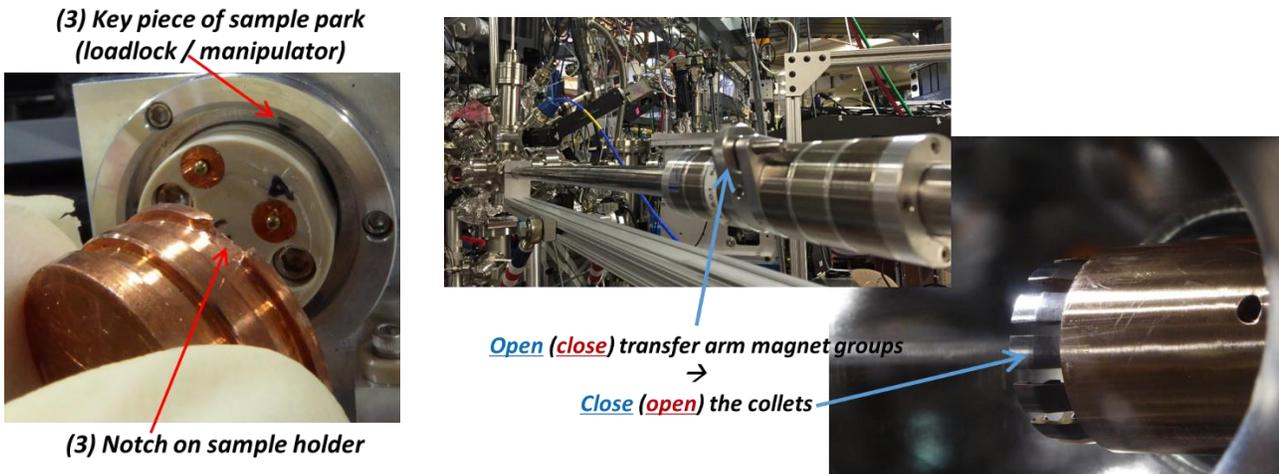
## Locations and definitions



**Figure 1:** motor names in the iRIXS BCS software on the iRIXS main control PC, corresponding to the endstation components

## Sample transfer

Check out a high-definition video demonstration of sample transfer at <http://bl8.lbl.gov/>

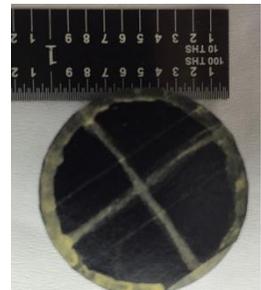


- The sample holder is locked into the sample parks in loadlock and manipulator by matching the 3 notches on the sample holder with the 3 pressing keys of the sample park, press the holder in and rotate a small angle (about 10 degrees), the sample holder will be locked in place tightly.
- **Open/close** the transfer arm magnet groups will **close/open** the collets of the transfer arm to **grab/release** the sample holder. This is done by rotating the center wheel between the two magnet groups of the transfer arm.

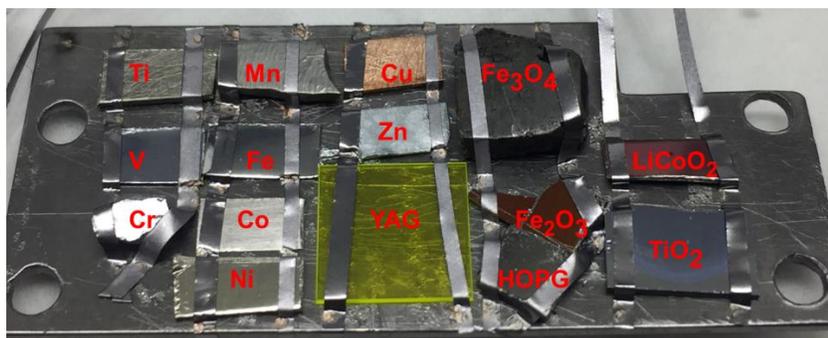
**Note:** Please do NOT take away the sample holder from beamline

**Note:** Do not over-tighten(close)temporary the transfer arm collets

**Note:** Sample holders are of 1 inch diameter, but **leave about 2mm edge** area for the grabber collets. See image, attach samples ONLY to the black area or on the round plate if used!



**Reference samples on iRIXS manipulator:**



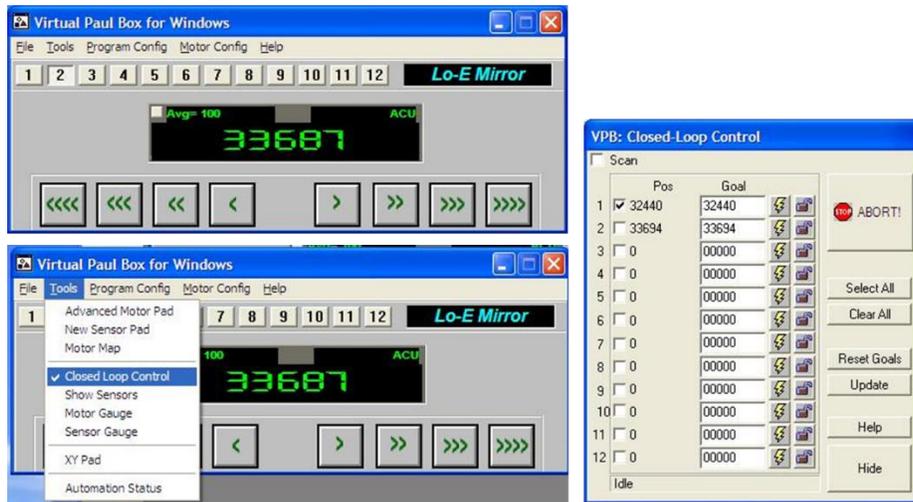
**Note:** Fe<sub>3</sub>O<sub>4</sub> is replaced by **Au** & **CdS** films in April 2016

## High-throughput RIXS (ht-RIXS) spectrograph

The motorized items of ht-RIXS as of 2/22/2016:

**Note:** For a general user, the **ONLY use of the LVDT software below is to watch the grating angles (Channel 3)**, which is needed **ONLY** for switching between low-E and high-E.

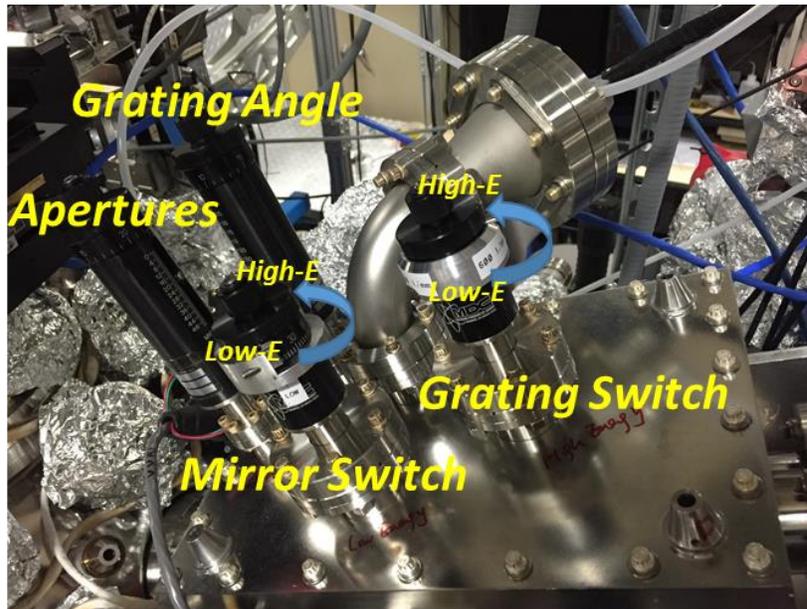
- Low energy Mirror (in-vacuum picomotor) - VPB software in htRIXS PC
- High energy Mirror (in-vacuum picomotor) - VPB software in htRIXS PC
- Andor CCD translation stage (in/out) – iRIXS PC (see figure 1)



- All the LVDT read out and the (2) mirror in-vacuum motor controls are through the “VPB software” installed on the htRIXS PC right underneath the htRIXS spectrograph:
  - Channel 1 – high-energy premirror
  - Channel 2 – low-energy premirror
  - Channel 3 – Grating (both) – Note the grating rotation is not motorized
- Click the lightning button on the *VPB: closed-loop control* panel to move the motor!

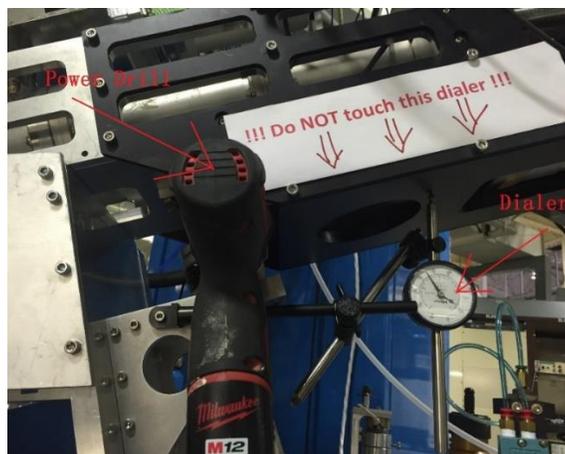
**Note:** In order to display the LVDT readings on the main VPB panel, motor motion has to be stopped by clicking the lightning button again!

The un-motorized items of ht-RIXS as of 2/22/2016:



**Figure 2:** Manual adjustments of the optics in ht-RIXS spectrograph

- A plate with a series of **apertures** is installed upstream of the spectrometer's optical table. The apertures are for alignment purpose. *But for blocking visible light, one may need to move the plate up/down by adjusting the Aperture-LMT.*
- **Grating angle** is adjusted manually by turning the grating LMT and watching LVDT reading on "Channel 3" in the "VPB software" installed on the htRIXS PC (above).
- **Switch** between low-energy and high-energy optics is done by manually rotating the rotatable feedthrough shown in Figure 2. GENTLY rotate BOTH the feedthroughs until they reach the CW/CCW hardware limits for using the Low-Energy/High-Energy optics.
- Andor CCD arm rotation:



As of 2016/03/02, the CCD arm rotation of htRIXS spectrograph is operated through the hand drill, and the dial indicator touching the bottom of the Dialer (see image above)

**Important NOTE:** No-body touches the dial indicator! Otherwise, all the numbers for the focusing position bellow needs to be recalibrated and reset!

### **A Routine Procedure to Start RIXS experiments in iRIXS:**

- a. Move the sample to the marked positions on the *FrontDown* and *RearDown* camera screens (the 2 right side hanging screens in Figure 1).
- b. Set the the calibrated parameters – values shown *in purple* below.
- c. Turn off lightening, cover all viewports, Open the valve to the spectrometer.
  - i. For htRIXS, move **Y-axis** to optimize the peak intensity.
  - ii. For hrRIXS, [Optional!] Check 0<sup>th</sup> order peak for the very 1<sup>st</sup> sample
- d. Start RIXS measurements!

**NOTE:** The CCD arm & grating angles determine the energy window & peak position.

**Below is the operation parameters** (check the values *in purple*):

#### High-throughput RIXS (ht-RIXS) spectrograph

- (Fixed) htRIXS Andor CCD translation: -10 ~ -11mm
- (Fixed) Optical lid angle: ~ 20.8° (**do NOT adjust any spectrometer struts!**)

#### **Low Energy Optics:**

**LEG LVDT reading: 30545** (manual adjustment, Figure 2)

**LEM LVDT reading: 33200**

0<sup>th</sup> order: CCD Arm Angle (angle meter): about **24°**

1<sup>st</sup> order: CCD Arm Angle (angle meter): about **20.8°**

[Just an **Example!**] CCD arm Dialer at 1.900", C-1s (2<sup>nd</sup>) to O-1s (3<sup>rd</sup>) in the same energy window (180 eV (MEG) elastic peak is around *CCD channel 492.5*).

#### **High Energy Optics:**

**HEG LVDT reading: 7500** (manual adjustment, Figure 2)

**HEM LVDT reading: 20000**

1<sup>st</sup> order: CCD arm angle (angle meter): about **21°**

0<sup>th</sup> order: CCD arm angle (angle miter): about **22.8°**

(CCD arm Dialer **0.406"**; 0<sup>th</sup> order peak centered around # **1034.7** pixel)

[Just an **Example!**] CCD arm Dialer at 1.900", O-K to Ni-L in the same energy window (900 eV elastic peak *CCD channel 520*).

**NOTE:** Once see signal, move Y-axis slowly to optimize the intensity/sharpness of elastic peak and/or signals!

## High-resolution RIXS (hr-RIXS) spectrograph

**Note:** 0<sup>th</sup> order peak width adjustment is recommended for the very 1<sup>st</sup> sample. But just maximizing the signal intensity is also good enough.

### 0<sup>th</sup> order *alignment* positions (centered on CCD):

- | • Elements        | Encoder counts    |
|-------------------|-------------------|
| • Grating         | 8540              |
| • Premirror       | 0                 |
| • Spec rotation   | -430000           |
| • CCD translation | 0 (non-sensitive) |
| • Lower aperture  | 25 – 18 (half) mm |
| • Upper aperture  | 0 – 9 (half) mm   |

Note: A focused 0<sup>th</sup> order peak width is about 4-5 pixels, with curvature adjustment.

### 1<sup>st</sup> order *measurement* positions:

- **Grating** 0
  - **Premirror** 0
- [Examples:]
- **Spec rotation** -245000 (with Fe-L and O-K range centered)
  - Spec rotation -230358 (600 eV at 955 channel)
  - Spec rotation -270988 (*O-K to Ni-L on screen*)
    - O-K fluorescence peak around #159 channel here
  - Spec rotation -80000 (C-K on screen)

## Important End-of-run Operations!!

- In Andor CCD software, TURN OFF the cooling of CCD and “SAVE”!
- Close the valve(s) to the spectrograph
- Exit the VPB software for picomotor/LVDT controls
- + Other typical end-of-run practices, e.g., close valves to beamline, etc.

## Spectrograph Operation Software

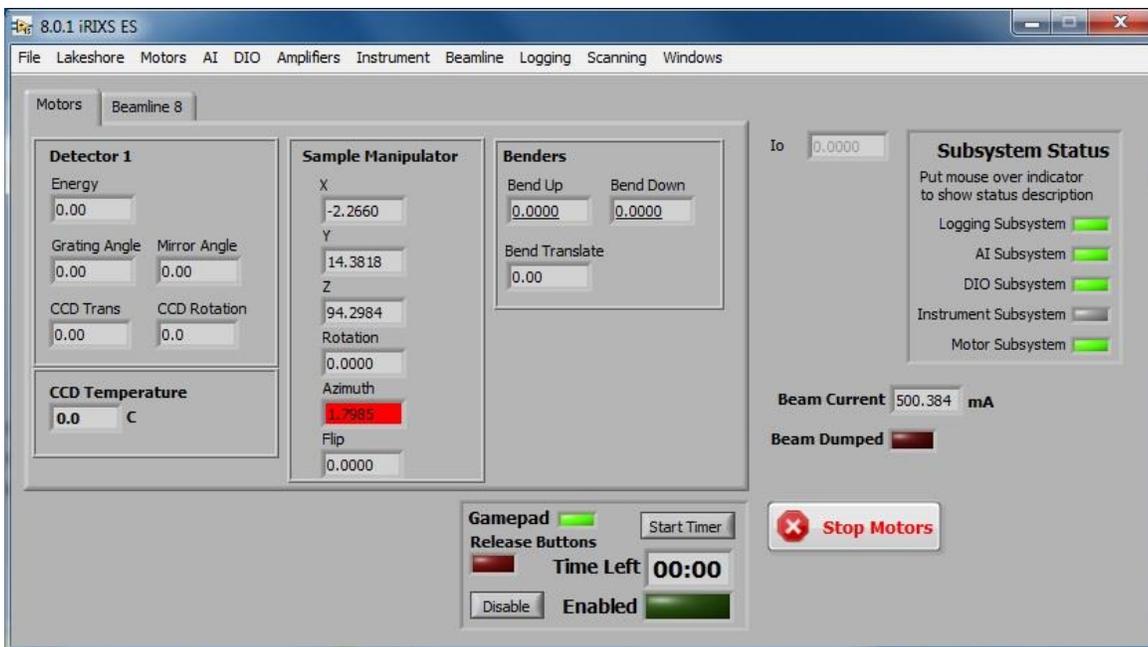
**Update:** As of “May the Fourth (be with you)”, general users ONLY run the ALS labview software package developed by the ALS software group, mainly by Brian Smith.

There are 3 software packages for collecting the data through Andor CCD:

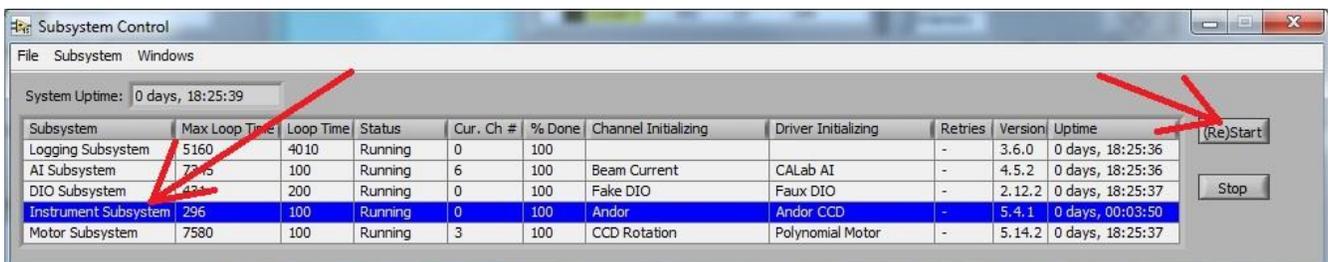
1. **(for users) The ALS Labview software, fully optimized and integrated with BCS!**
2. The Andor Solis camera software from Andor – for troubleshooting only
3. The software package developed by Prof. Clemens Heske, Dr. Oliver Fuchs, Dr. Lothar Weinhardt, Dr. Monika Blum and other members in their group. (Runs with 32 bits Labview for SALSA spectrometer)

## Operation Procedures of the ALS Labview control software:

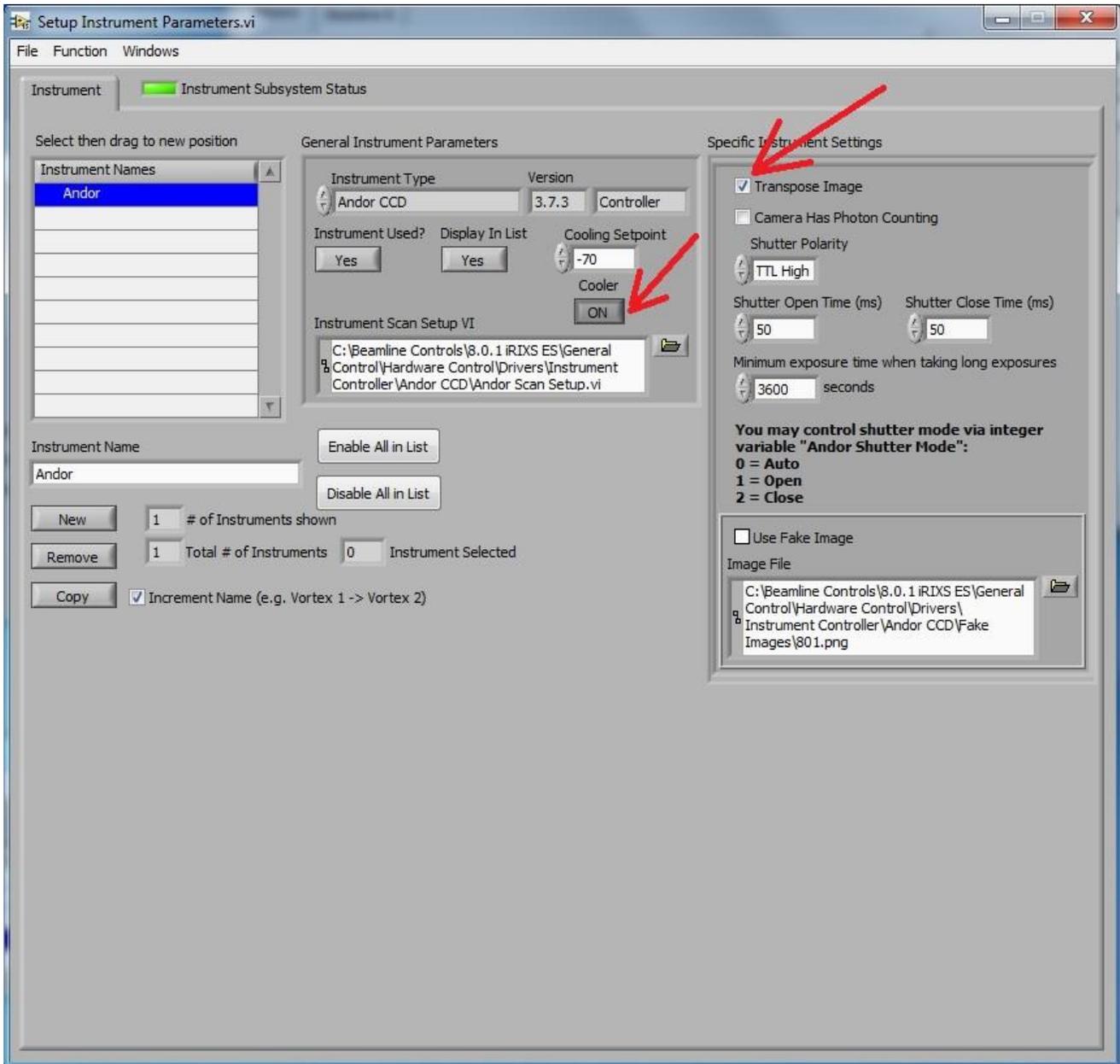
- On iRIXS PC (see Figure 1), run the main iRIXS BCS software. You will see the standard ALS control interface window:



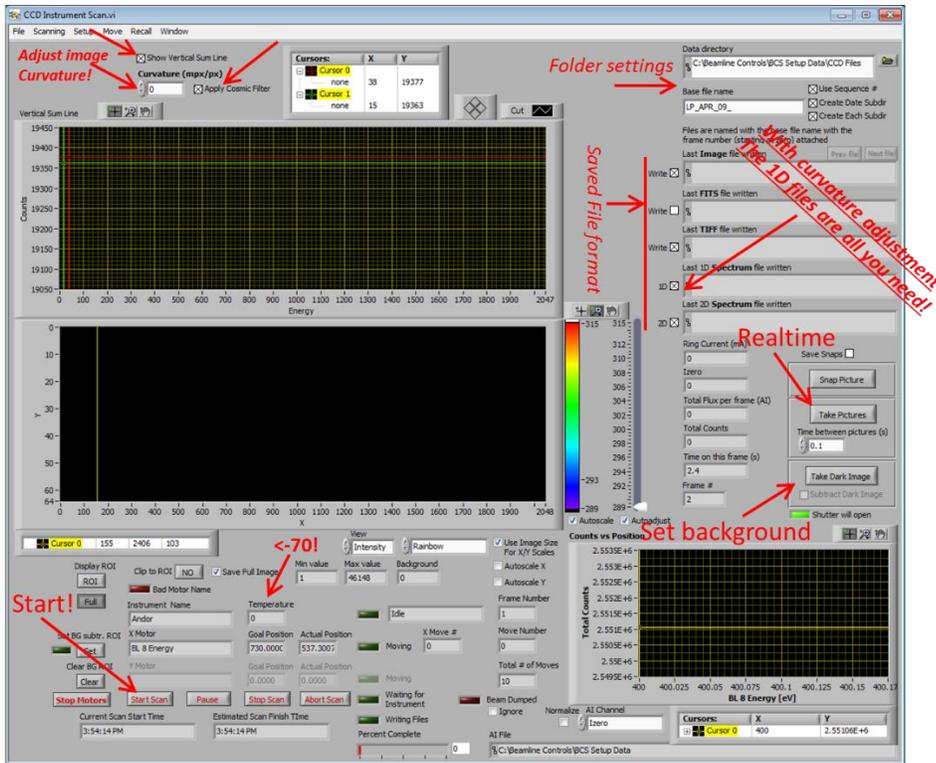
- “Beamline” – “Subsystem Control” : Enable/restart the “Instrument Subsystem:



- Select “Instrument” – “Set Parameters”. The window below pops up:
- “Transpose Image” should be selected
- Make sure the CCD Cooler is “ON”
- Save the setting changes by “Function” – “Save” !



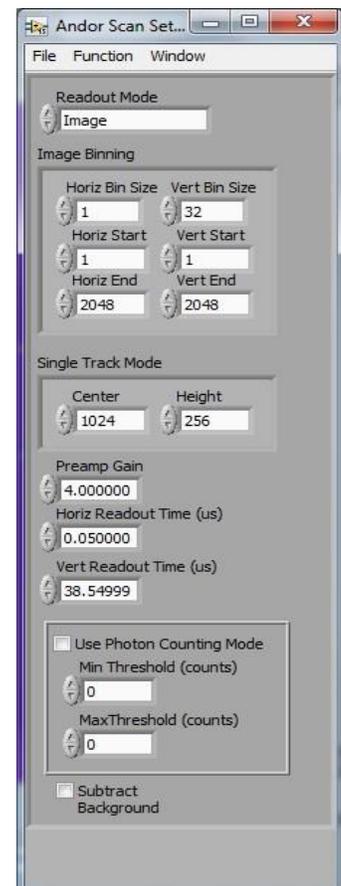
- In the main iRIXS BCS control panel, and select “Scanning” – “CCD instrument Scan”. Two panels will pop up as below, the main **CCD image/spectrum** window, & the **scan setup** window that could also be opened through “setup” – “scan setup” from the main image window.



- Wait until the “temperature” of the CCD shows -70 or lower on the main image window.

**Note:** Try not to turn on the CCD until the temperature is low, except for occasional checking. If the CCD shows high background when it is cooled down, it may need to be warm up and cooled down again.

- Preliminary check: Click “Take Pictures” button, the image and spectrum will be updated real time with the time scale as shown in the “Exposure Time (s)” in the Scan Setup window
- Click “Take Pictures” button again to turn it off.
- Set the desired “Exposure Time (s)” in the scan setup window, then click “Take Dark Image” – the background image will be saved automatically.
- Click to enable “Subtract dark Image” for background reduction.
- Optimize the signal intensity and select energy window (or check 0<sup>th</sup> order peak)
- Set “**curvature**” value so the same energy line is along the same CCD vertical channel on the image screen.



- Click on the “**setup instrument**” of the scan setup window. Set the parameters as in the image here, especially on the *gain* and *readout time*.
- “**Function**” – “**save**” all the changes made! Close the window.
- In the “**scan setup**” panel, set your scan parameters – this is a standard ALS BCS scan interface that is the same as a typical XAS scan.
- If you have changed your “Exposure Time (s)”, redo the “Take Dark Image” to reset the background.
- Click “Start Scan” and wait for your beautiful data jumping out! 😊