# Current Capabilities:

### Hardware Controls:

**Basler Cameras:**

Two Basler cameras are used to view the target from different angles and get shadowgraph images. Controls for the cameras are exposure time, gain, taking an image (at a certain frequency and as an on demand command), and setting a region of interest (in software, not on the camera).

**Spectral Instruments X-ray Camera:**

There is one X-ray camera used to view the fill level of a target. Controls for the camera are exposure time (integration time), gain and digital gain, taking an image, images to average (takes X images and averages them into one image), and setting a region of interest (in software, not on the camera).

**Gardasoft Illuminator:**

One illuminator is used with two channels, one for each Basler camera, to provide enough light to capture a shadowgraph image. The controls for the illuminator are set brightness, set pulse duration, save a setting as high or low, change to the saved high or low setting. Each channel on the illuminator has its own set of controls.

**Navitar Controller:**

There are two Navitar controllers, one attached to each camera, and they are used for zoom and focus on a target. The controls for each Navitar are (for zoom and focus) go to home (go to zero zoom or focus), go to limit (go to the max zoom or focus), go to a specific zoom or focus, +/- 1, and +/- 10.

**MCM (Lakeshore temperature controller, valve control, tritium monitor):**

The MCM is a piece of hardware that gives different programs control over hardware at different times. Cryoview 2 connects to the MCM to gain access to the Lakeshore for getting and setting temperatures of the Cold Finger Extension and the Layering Sphere. The MCM also grants Cryoview 2 control over three valves used for filling targets with DT and has a register that can be read from to detect if there is a leak in the target during the fill process. Controls for the MCM are get/set temperature (of either the CFE or LS), acquire control over valves, relinquish control over valves, open/close a valve, and get statues of valves/control status/leak detection.

### Functions:

**HDF4 (In Progress):**

Data about the target is saved to HDF files using HDF4 format. Data includes images from all three cameras, dates, fill information, and layer information. The functionality to create HDF files and save images to datasets has been completed but the other information to save has not been completed.

**Database Communications (In Progress):**

The database is used to connect to the hardware, acquire target information (such as target ID), acquire layering configurations, and save data about the target. The hardware connections have been implemented but the rest is in progress.

**Target Filling (In progress):**

Target filling is done to fill the target to a specified fill level with DT. The process uses the MCM controls over valves to scrub the target of residual H then fill the target with the DT. The X-ray camera is used to determine the fill level so adjustments can be made to reach the desired fill level. MCM controls over temperature are used to increase or decrease the fill level (by changing the pressure inside the target) and to freeze the ice plug that holds the DT in the target once filled. The algorithm for scrubbing and filling the target has been developed but it has not been tested with the MCM or been approved by the rest of the team.

### Other:

**Pop-out Views:**

A separate window is opened for each camera to allow the user to have a larger image of any view for analysis. There is also a window that will open during the fill process that shows the state of each valve and if there is a leak in the target.

**Monitor Network Connection:**

If connection to the network is lost the user is notified. The status of the network connection is displayed on the GUI at all times.

**Monitor temperatures:**

The user can monitor that temperatures are staying within range of allowable temperatures to ensure target viability.

# Planned Capabilities:

### Hardware Controls:

**X-ray Source**

The X-ray source is needed to produce x-ray images with the x-ray camera. There will also be certain safety interlocks in place that will need to be checked before an image can be taken.

### Functions:

**Target Layering**

Once a target is filled the target needs to have a uniform ice layer formed. Temperature ramps will be stored in the database and the user will have the ability to select the correct one for the target. The two optical views of the target will be used to measure the uniformity of the ice layer and determine if the layer formed correctly. Layering will be done in three stages. First the user will control the temperature to melt away the ice until there is one single crystal, then the temperature will be reduced again to “catch” that crystal. The layering is then done by using the temperature curve to slowly lower the temperature to grow a uniform ice layer out of the crystal. Finally if there is a P1 defect, the temperatures are changed again to remove it. Both forming the ice layer and removing the P1 defect are automated processes.

# Nice To Have: