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EPICS Control of Sample Environment

R. R. Porter, Argonne National Laboratory

The Experimental Physics and Industrial Control System (EPICS) was initially chosen for sample environment control at Argonne National Laboratory's, Intense Pulsed Neutron Source (IPNS) to leverage existing knowledge and for compatibility with our data acquisition system (DAS). Having converted seven beam lines to EPICS control, the system is well integrated and conversion of instrumentation and support for new devices is straightforward. Options exist for control and/or monitoring of cryogenic systems, high temperature furnaces, high pressure generators, magnetic fields, sample position and orientation, and sample reaction environments. This support is presently being converted to run with the latest version of EPICS, which will allow for operation from multiple operating systems.

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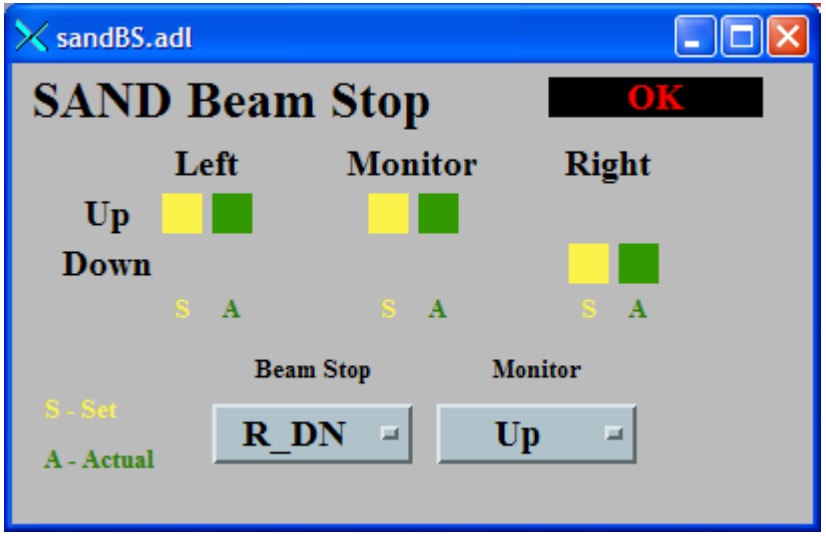
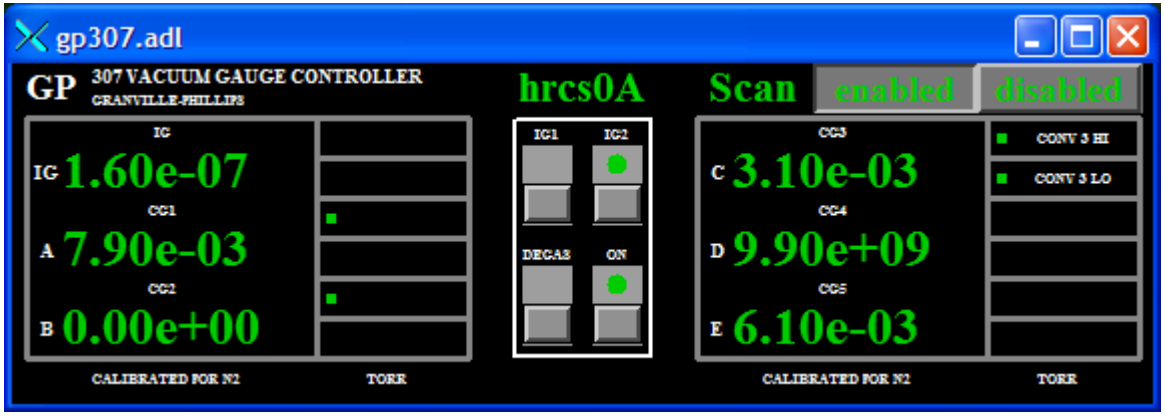
Introduction

- EPICS
- Data Acquisition System Interface
- Cryogenic Systems
- High Temperature Furnaces
- Sample Positioning and Orienting
- Magnetic Fields and High Pressure Generators
- Sample Reaction Environments
- Data Monitoring





EPICS

"EPICS is a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as a particle accelerators, telescopes and other large scientific experiments."[1]

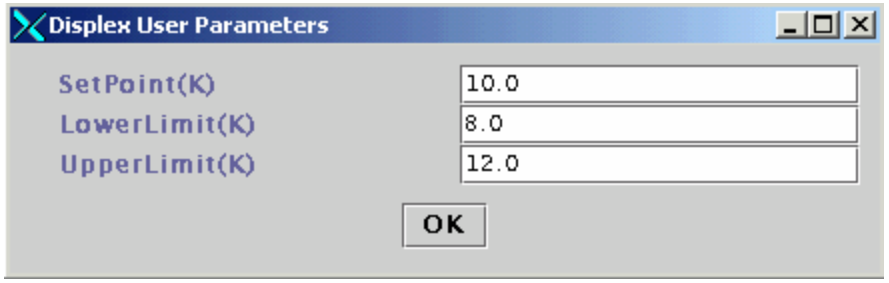
- SynApps – Advanced Photon Source, Beamline Controls and Data Acquisition Group
  - **"synApps** is a collection of software tools that help to create a control system for beamlines. It contains beamline-control and data-acquisition components for an EPICS based control system."[2]

- StreamDevice – Dirk Zimoch, Paul Scherrer Instutuet
  - *"StreamDevice* is a generic EPICS device support for devices with a "byte stream" based communication interface. That means devices that can be controlled by sending and receiving strings (in the broadest sense, including non-printable characters and even null-bytes). Examples for this type of communication interface are serial line (RS-232, RS-485, ...), IEEE-488 (also known as GPIB or HP-IB), and TCP/IP. *StreamDevice* comes with an interface to *asynDriver*, which implements the low-level support for those communication interfaces. But it can be extended to support other bus drivers."[3]

1. http://www.aps.anl.gov/epics/
2. http://www.aps.anl.gov/aod/bcda/synApps/
3. http://epics.web.psi.ch/software/streamdevice/

Data Acquisition System Interface

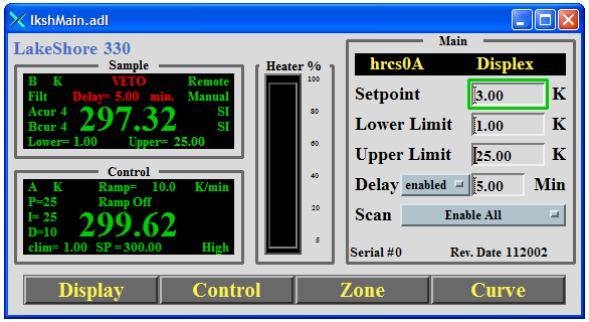
```
deviceName=Displex
deviceNameDbSignal=veto.DESC
controllerName=LakeShore 330
dbDevice=lksh_0
ancIoc=A
vetoSignal=veto
#User Parameters
numUserParameters=3
UserParameterName1=SetPoint (K)
UserParameter1=10.0
UserParameterDbSignal1=parsetp
UserParameterName2=LowerLimit(K)
UserParameter2=8.0
UserParameterDbSignal2=parlower
UserParameterName3=UpperLimit(K)
UserParameter3=12.0
UserParameterDbSignal3=parupper

#Inst Parameters
numInstParameters=0
```



- **Device file read by setup script to create user prompts**
- **Copy of parameters stored in run file**
- **Runtime software links device veto to system veto**

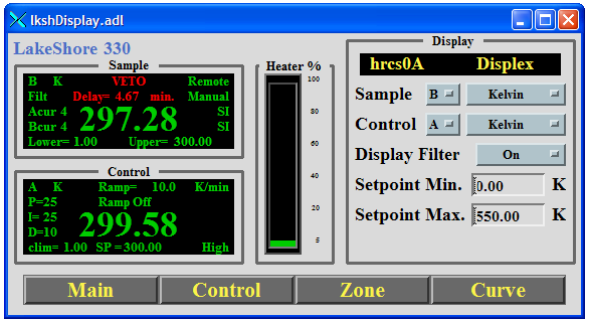
Cryogenic Systems

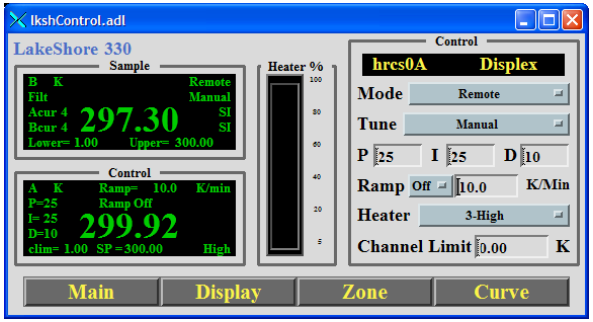
- LakeShore 330, 332, 340
- They type of LakeShore controller is automatically detected when the serial cable is plugged into the port server, with code and displays changing appropriately.

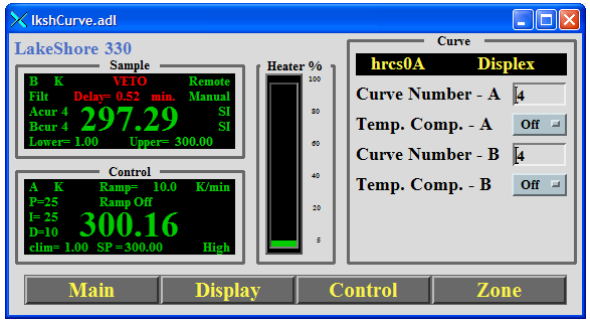


Delay

The delay allows a sample to come to equilibrium, with the out of range veto continuing for the time requested. The delay is reset if the temperature goes out of the accepted range during the delay time. Once the delay has completed, data will be vetoed if the temperature goes out of the accepted range, but the delay will only be repeated if the temperature exceeds the limits by more than the delay offsets.

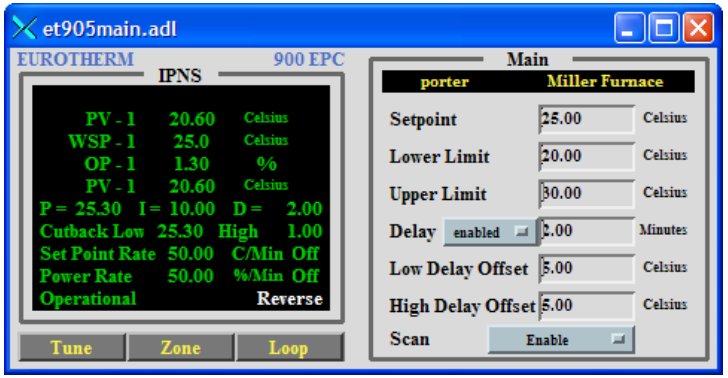


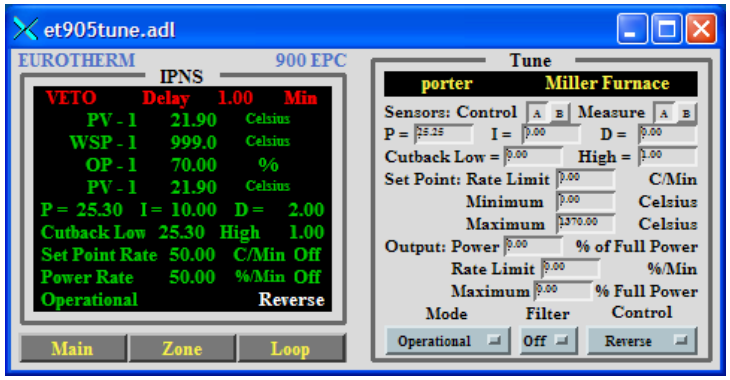


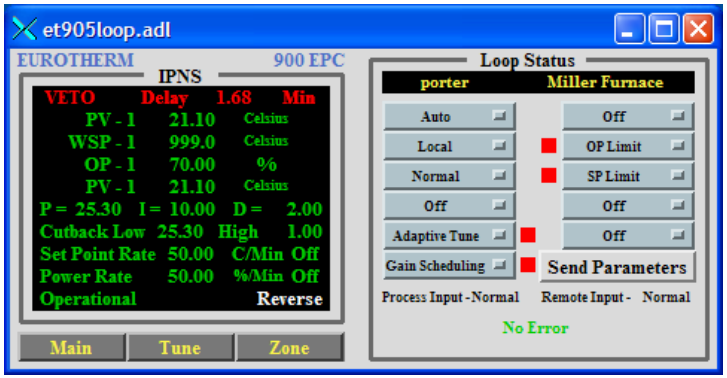


High Temperature Furnaces (Eurotherm 905)

- Main Screen
  - User parameters (Set Point, Upper and Lower Level Limits)
  - Delay (As described under Cryogenic Systems)
- Tune Screen
  - The Control and Measure set the sensors to be used for temperature control and vetoing, respectively, with the control loop, and all associated displays, being controlled by the Control value.
  - PID values are set from this screen
  - Set Point and Output minimum, maximum and ramp rates are set from this screen.
- Loop Screen
  - The Eurotherm 905 allows a number of features to be enabled/disabled for each control loop. The red box indicates that the selection is different than the value in the controller. The Send Parameters button downloads the new parameters, and the error display monitors the status.
- Zone Screen (not pictured)
  - For future implementation of a software zone feature similar to that on the lakeshore.

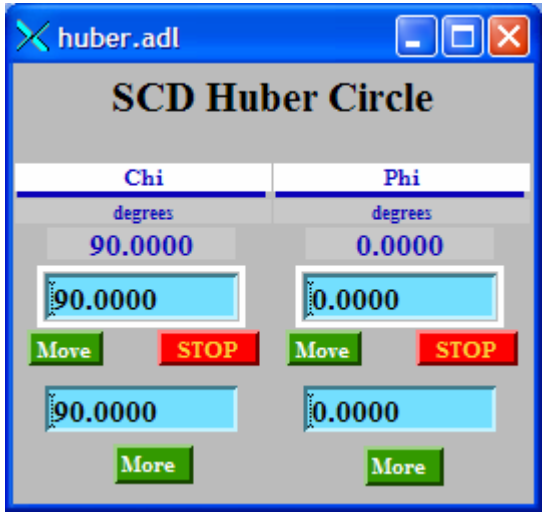


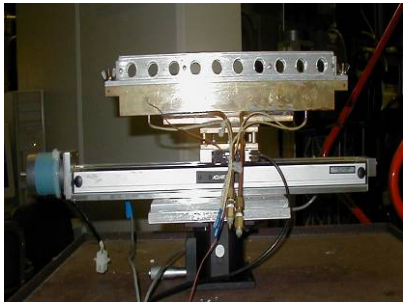


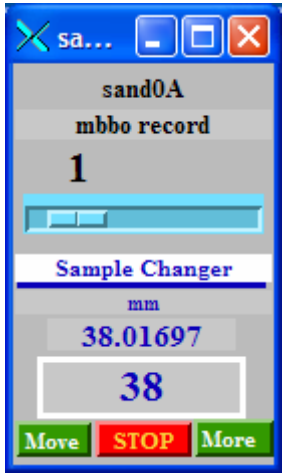


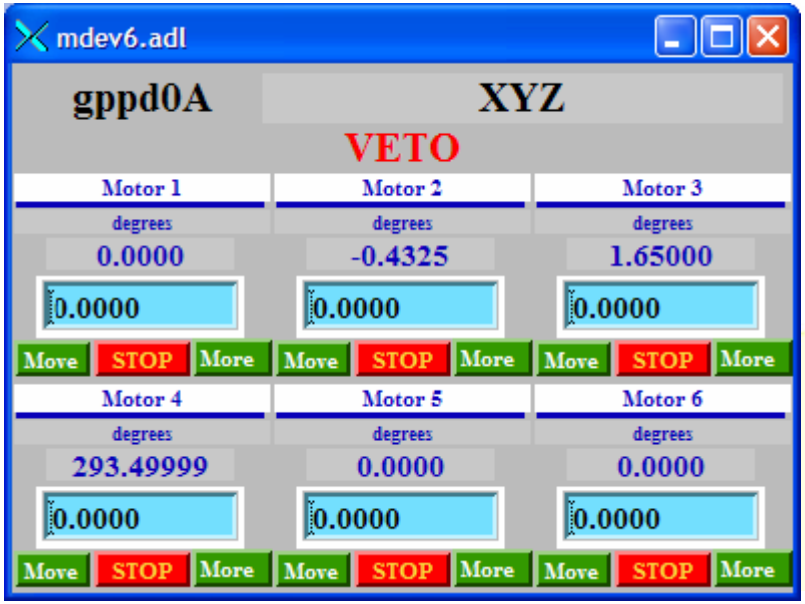
Sample Positioning and Orienting

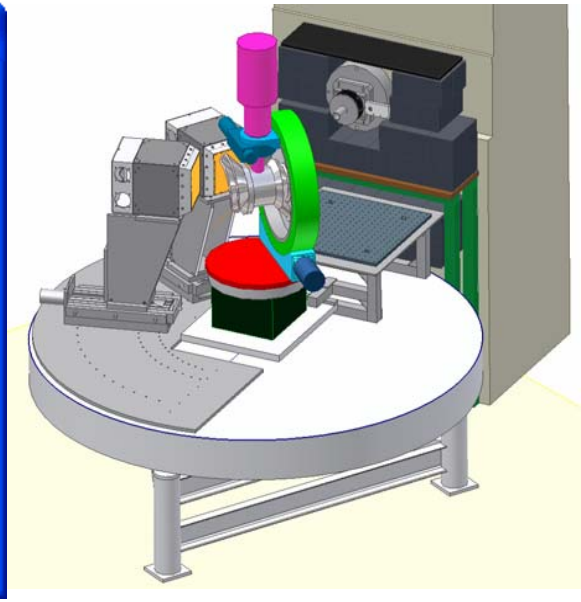
- IPNS has a wide range of motor devices and generic controls for single and groups of motors.
- The “More” button gives access to the underlying EPICS motor record configuration screens, which allow for configuration and calibration of the motor.





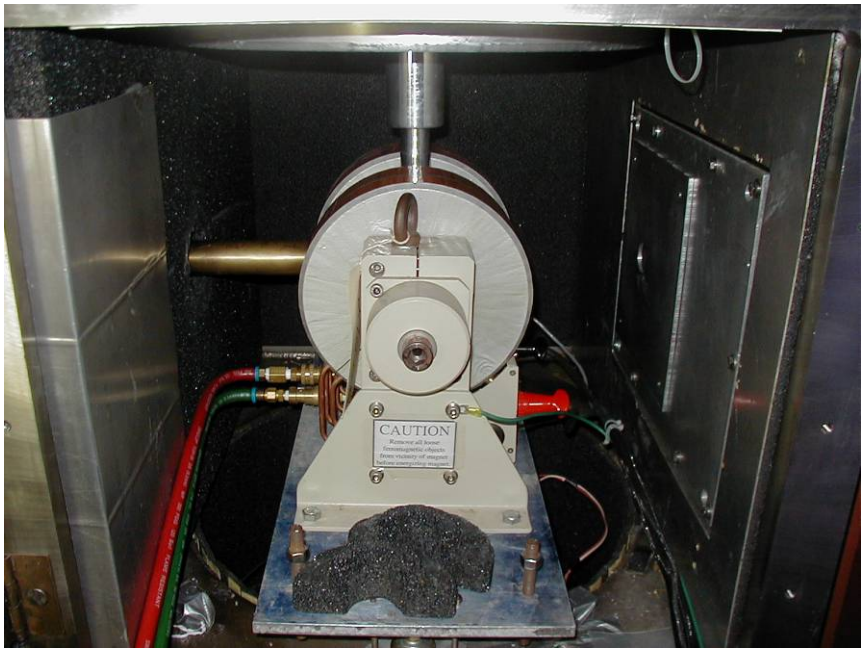






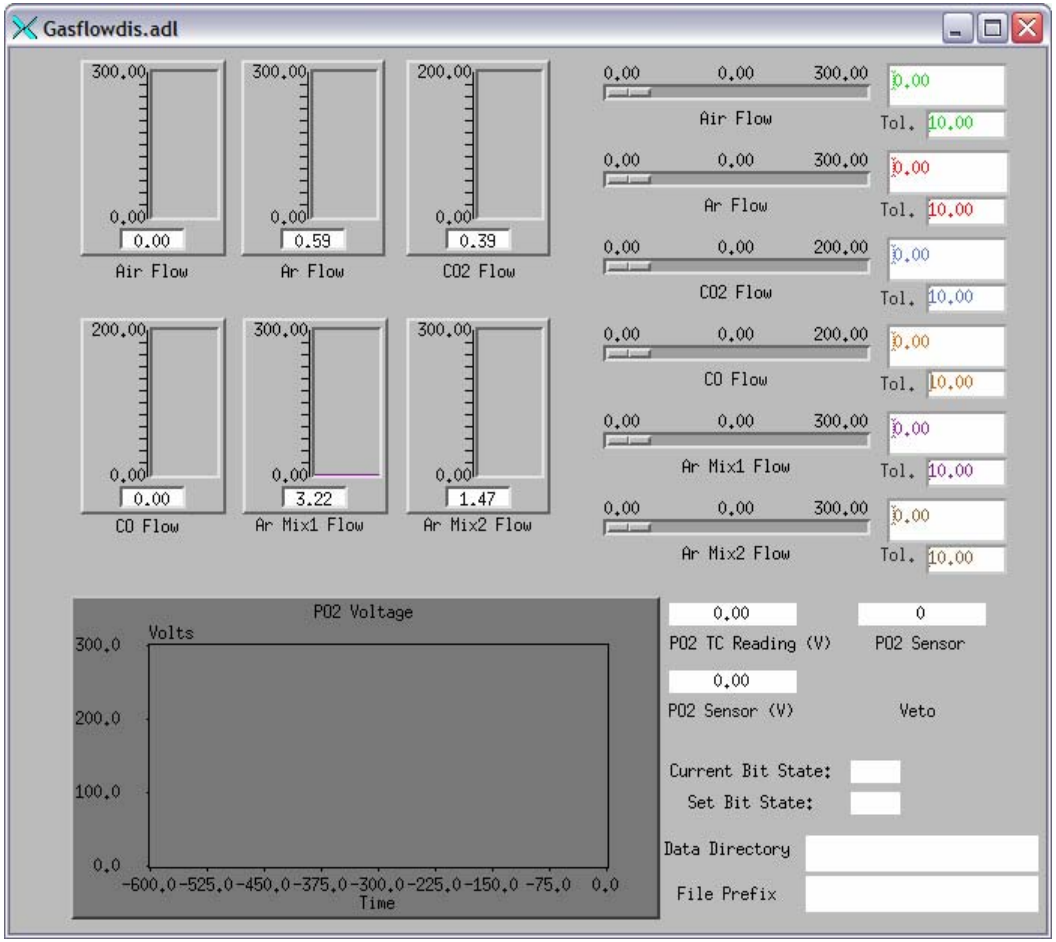
Magnetic Fields & High Pressure Generators

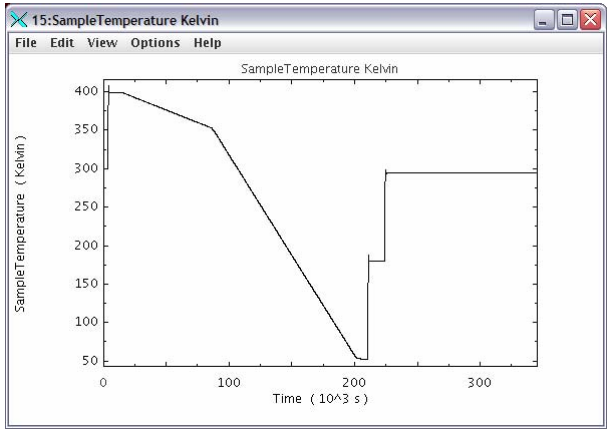
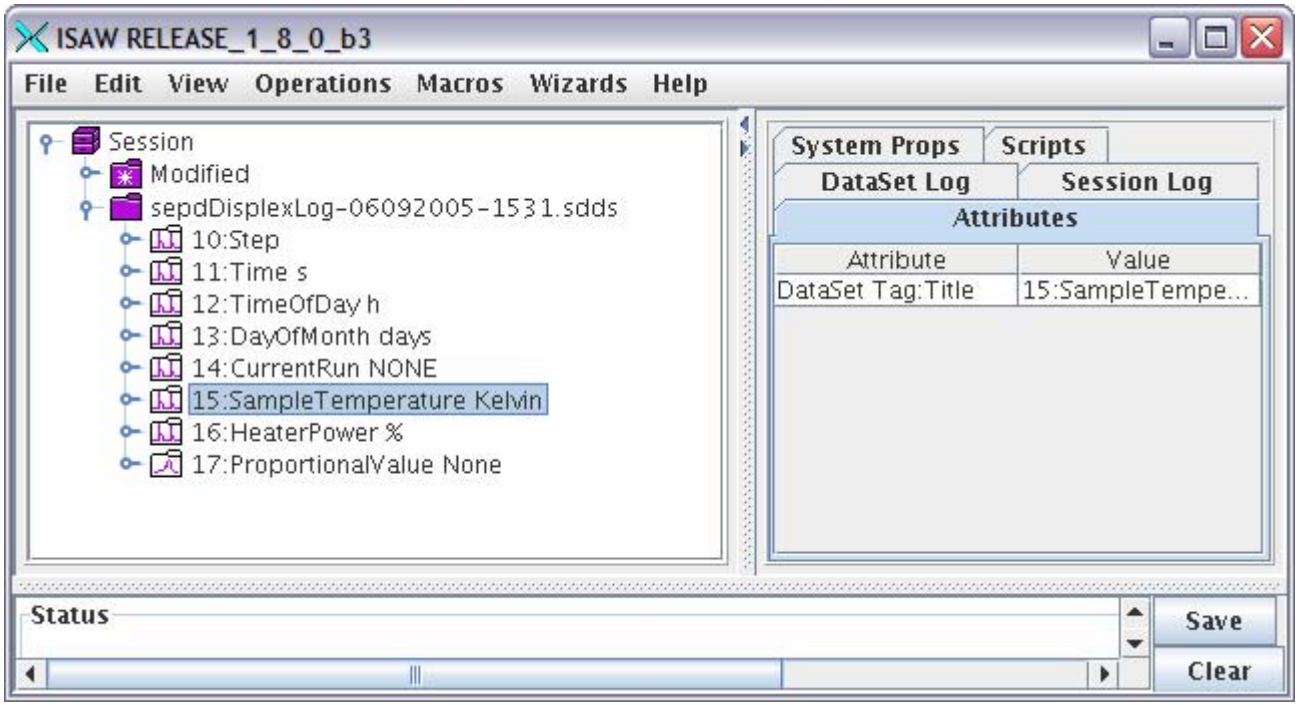
- **Magnet Controllers**
  - Cryomagnetics CS-4 (in development)
  - EMS Power Supply
  - Oxford IPS, ITC, ILM
- **High Pressure Monitors**
  - Analog Value
  - Sensotec SC200



Sample Reaction Environments

- GPPD Gas Control allows custom mixtures of gasses.



Data Monitoring

Data logging is provided in the EPICS toolkit and ISAW, our data analysis package can open and plot the data.