Implementation of the EPICS Software Feedback Loop at BioCARS

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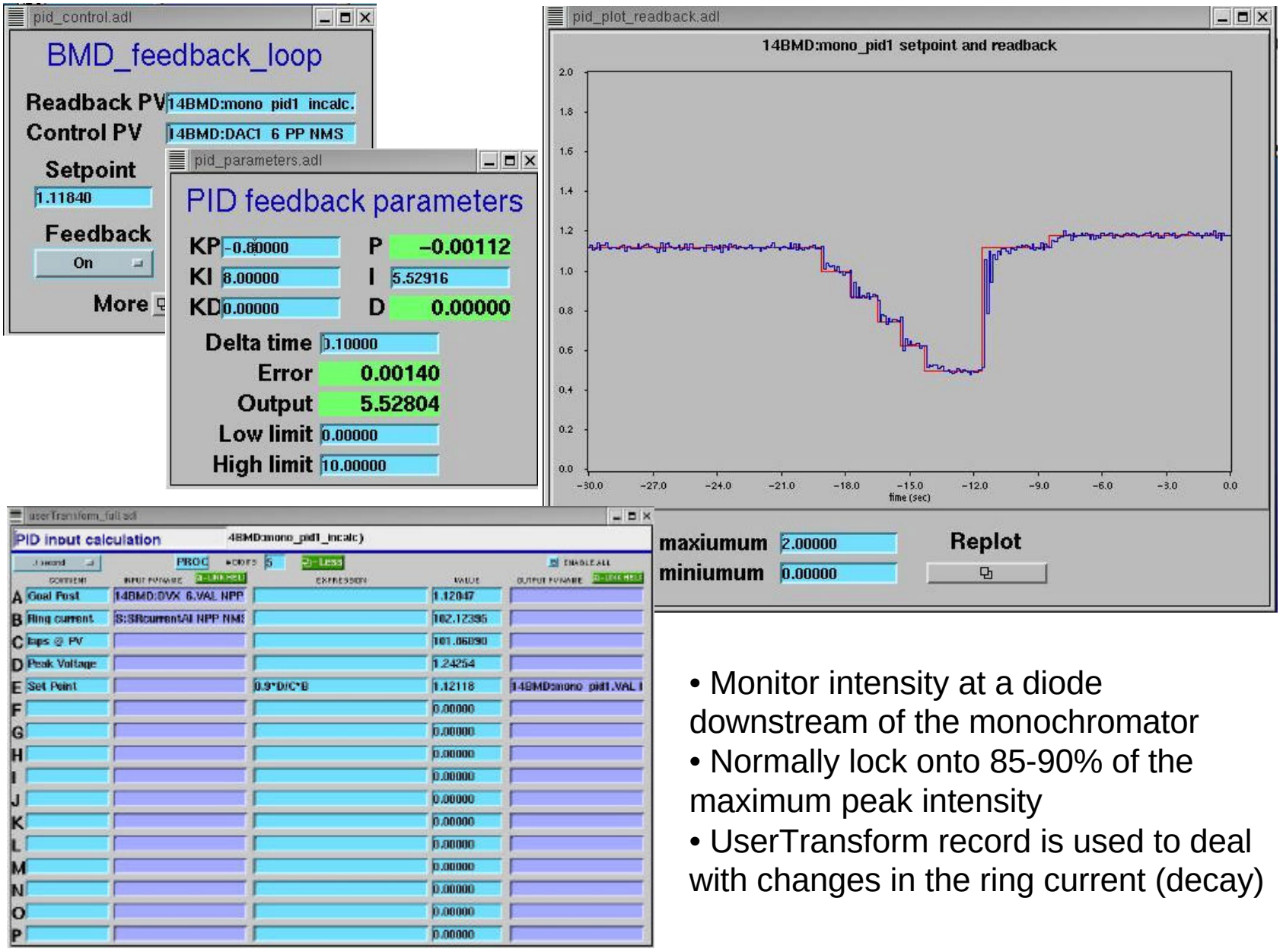
- Needed feedback systems for BM and ID double crystal monochromators
  - Beam stability during experiment
  - Speed up energy scans
- Relative humidity experiments

Options?

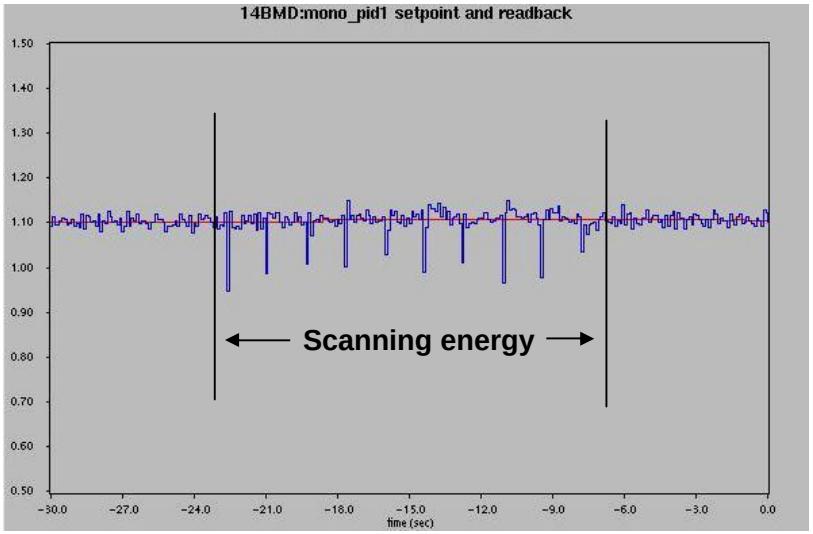
- Hardware solutions
  - Commercial PID controllers
  - MOSTAB
- Software
  - Enhanced PID record (EPICS, Mark Rivers)
    - Analogic DVX 2503 (ADC)
    - Acromag 9210 (DAC)

EPID could do everything we needed without the need to buy additional equipment!!!
Save money, time, and provided a more flexible system.

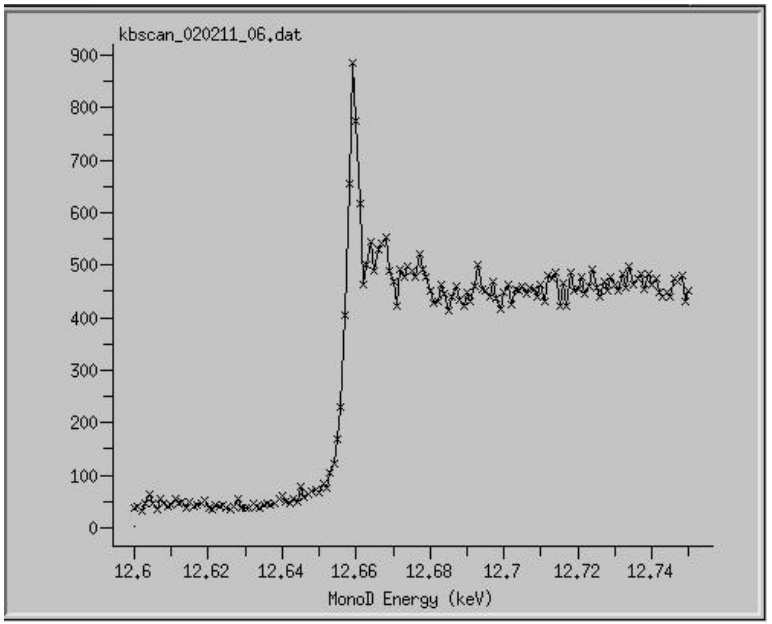


- Monitor intensity at a diode downstream of the monochromator
- Normally lock onto 85-90% of the maximum peak intensity
- UserTransform record is used to deal with changes in the ring current (decay)

Results….Great!



Plot of peak intensity over time



Selenium edge scan

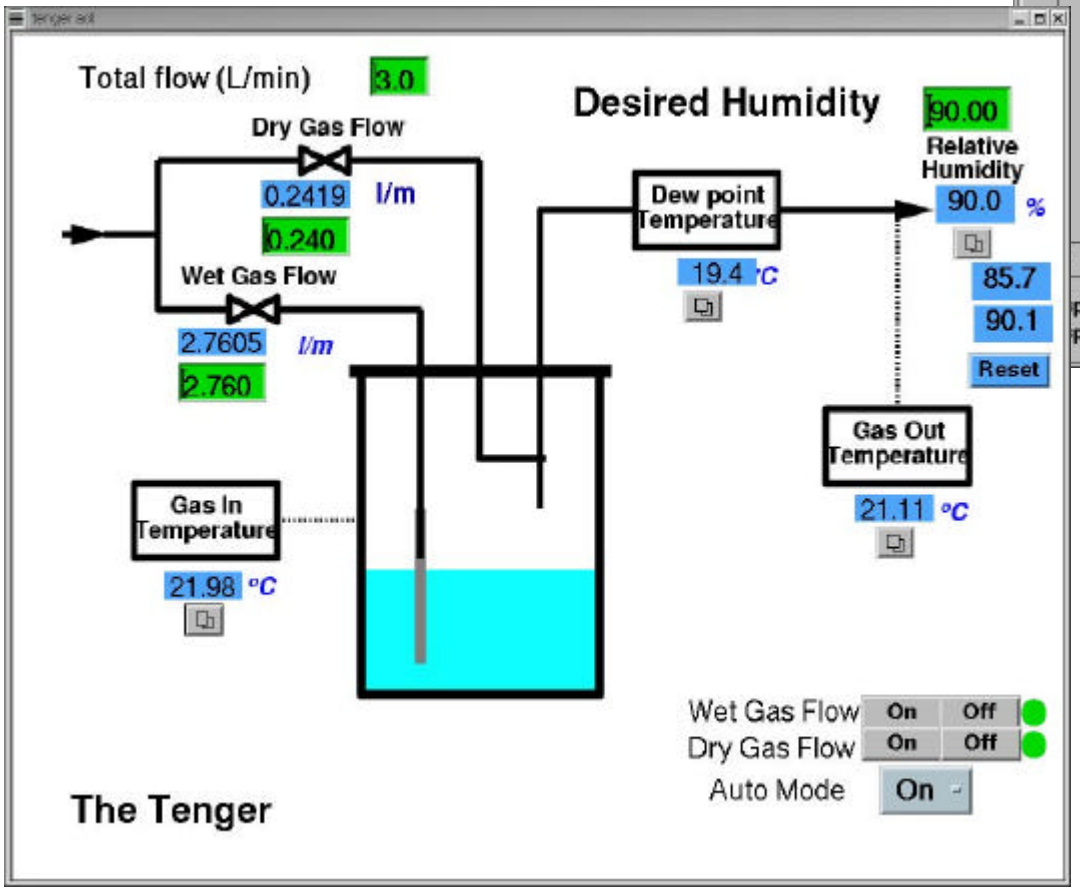
- No more drift in beam intensity
- Reduced time to do an edge scan from ~20 min. down to ~3 min.
- Currently using “Slow” feedback
  - Limited response time of 10 Hz
- Could implement “Fast” feedback
  - Up to 10 kHz

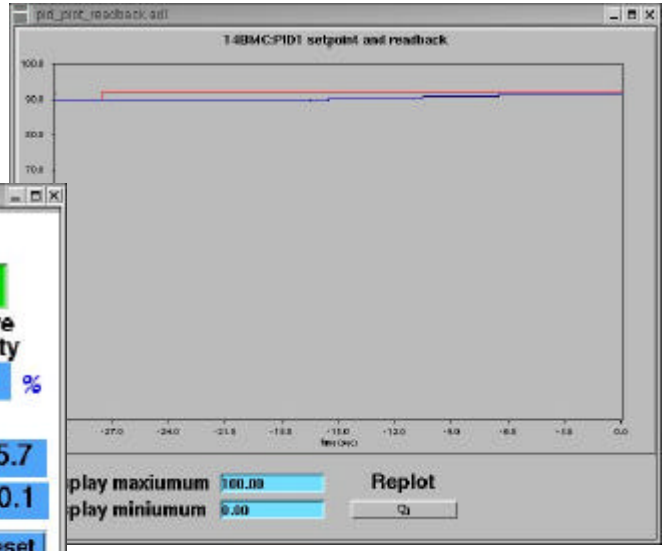
Relative Humidity Experiments

- Wanted to improve crystal quality
- Needed to control the humidity around a sample during a data collection
- Wanted to have everything under computer control

Relative Humidity Experiments

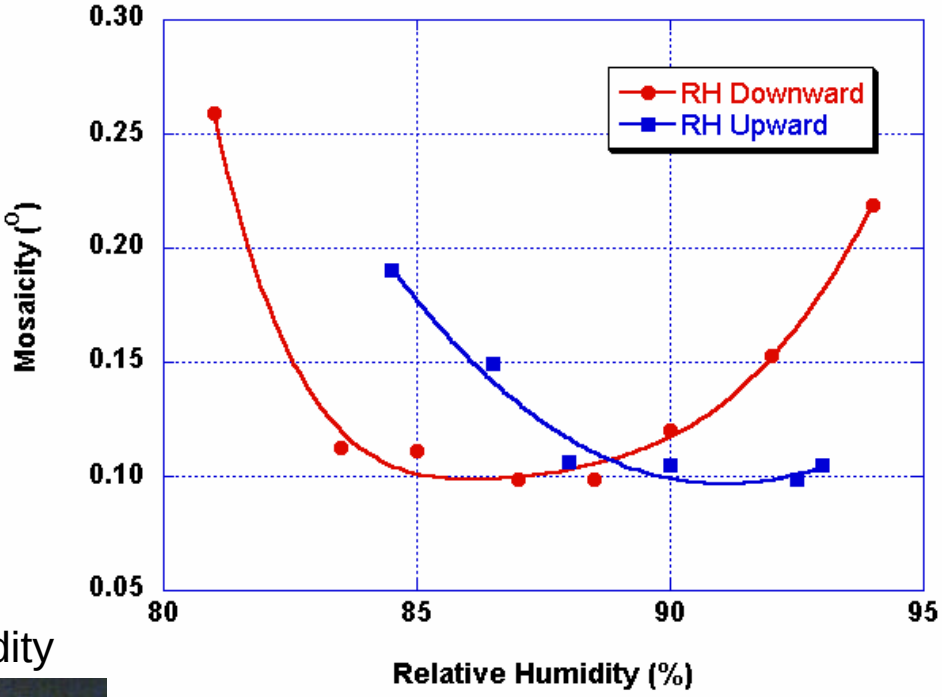
MEDM interface



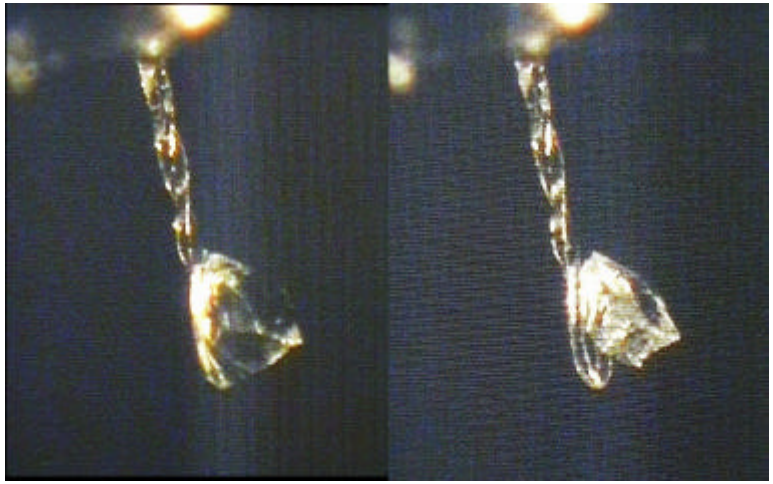


- MKS Instruments MASS-FLO controller (RS232)
- NesLab water bath RTE-221 (RS232)
- EdgeTech dew point meter (DAC/ADC)
- LakeShore temperature controller (GPIB)

Lysozyme Crystal



High humidity Low humidity



- Hysteresis
- Higher mosaicity at high and low relative humidity's

Work done by T.-Y. Teng, CARS

GSECARS Applications of EPID record

- Monochromator second crystal feedback:
  - Feedback on beam position on 13-ID, using photo-diodes in-vacuum slits, measuring scattered radiation from in-vacuum slits
  - Feedback on beam intensity on 13-BM, using table-top ion chamber.
  - Recovers gracefully from beam dumps. PV available to indicate "feedback locked", which data acquisition programs can wait for.
- Furnace temperature control in the large-volume press in 13-BM-D and 13-ID-D. Safety checks to limit voltage, current, and power.
- Pressure control in the large-volume press, via hydraulic pump, in 13-BM-D. Can ramp pressure up and down using scan record to control setpoint
- Temperature stabilization via laser power control in the laser-heated diamond-anvil cell in 13-ID-D.