Cheap thrills for monochromatic beam position stabilization.

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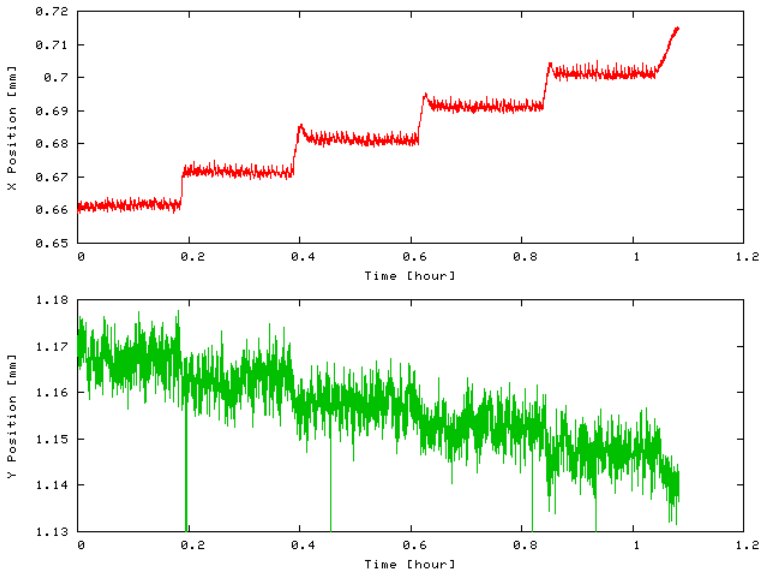
Background

- The first crystal of our double crystal Si (111) cryogenically cooled High Heat Load monochromator is slightly sensitive to pressure variation in the cryogenic lines.
- Pressure variations during a LN2 cryocooler fill every 4 hours move the beam slightly (tens of microns). Pressure variations due to the Oxford cryocooler closed loop pressure control with the heater stick (0.3 PSI) move the beam by 5 microns every 15 seconds.

Beam position versus coolant pressure



Four 1 PSI steps in the buffer Pressure (dx/dP=10 um/PSI, dy/dP=5 μm/PSI)

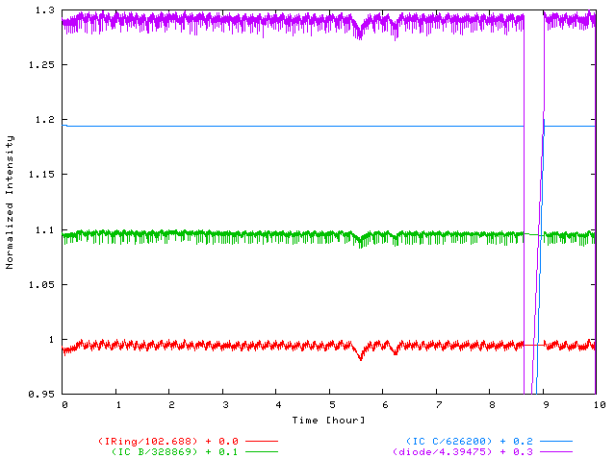
Using a tiltsensor, and air to pressurize the lines during installation, we found $d\theta_B/dP$ = 0.2 μrad/PSI so 19m from mono, one expects 2*19m*0.2 μrad/PSI=7.6 μm/PSI

New pressure regulating valve

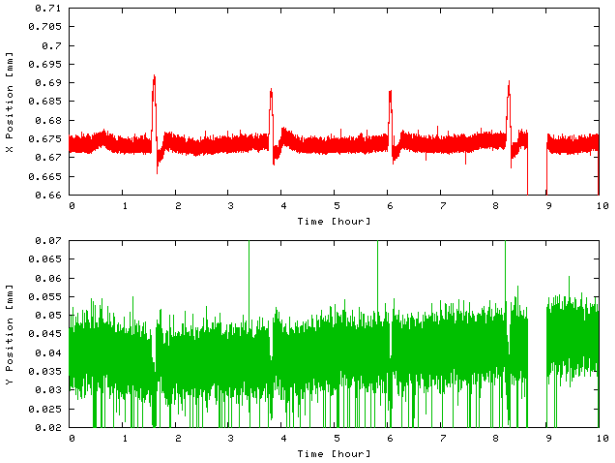
Dry N2 gas pressurizing cryocooler HP buffer, regulated (<0.1 PSI) by Omega PRG101-60.

Credits: first implemented on 11 and 12ID. Copy of 6ID system.

Beam before stabilization circuit



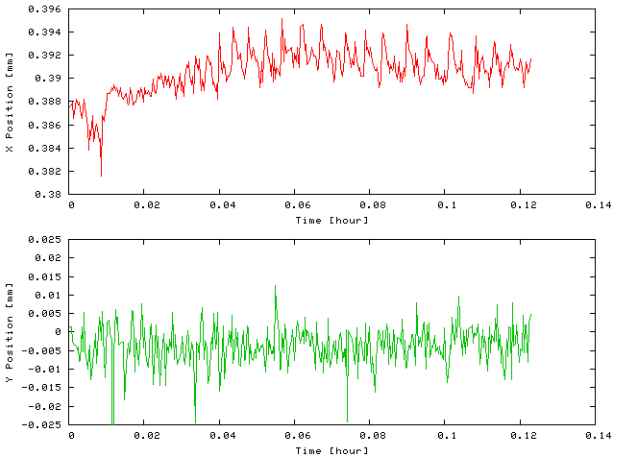
Intensity plots
On 3/21/04



Beam position

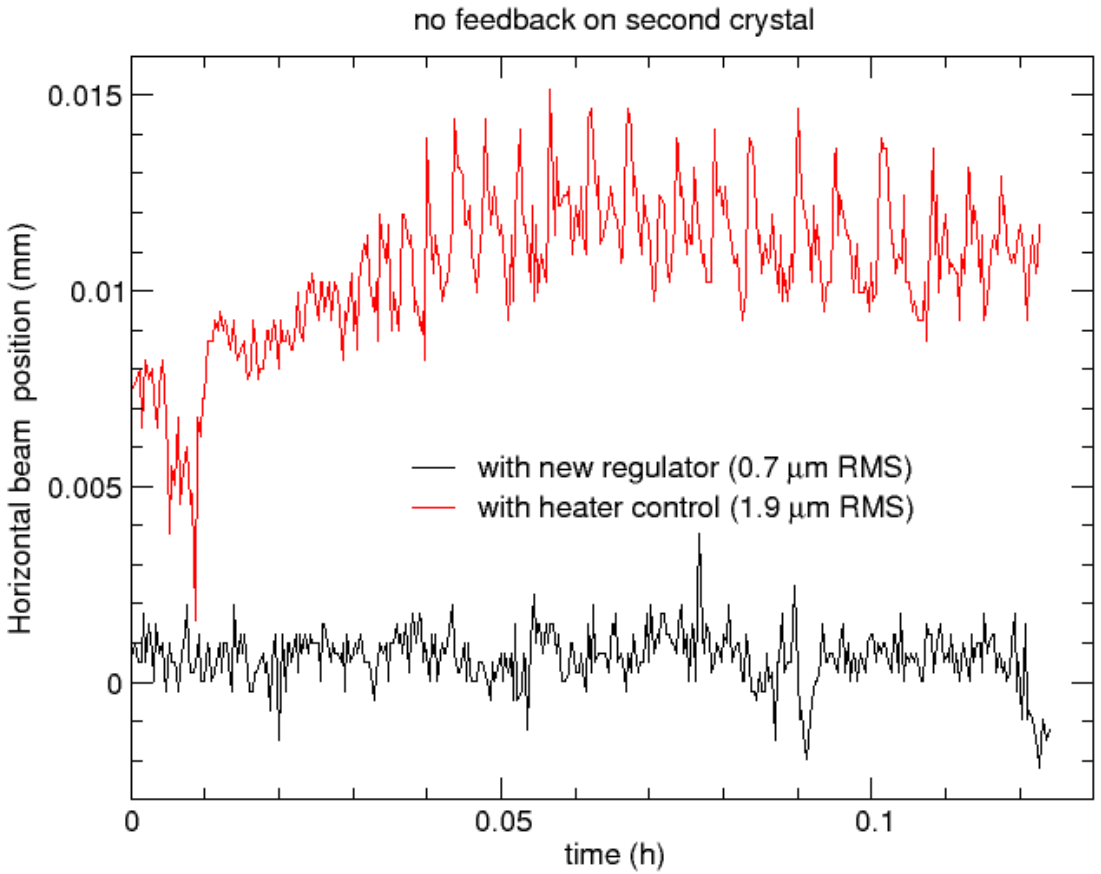
On 3/21/04.

3 hours period beam motion correlate with cryocooler fill.

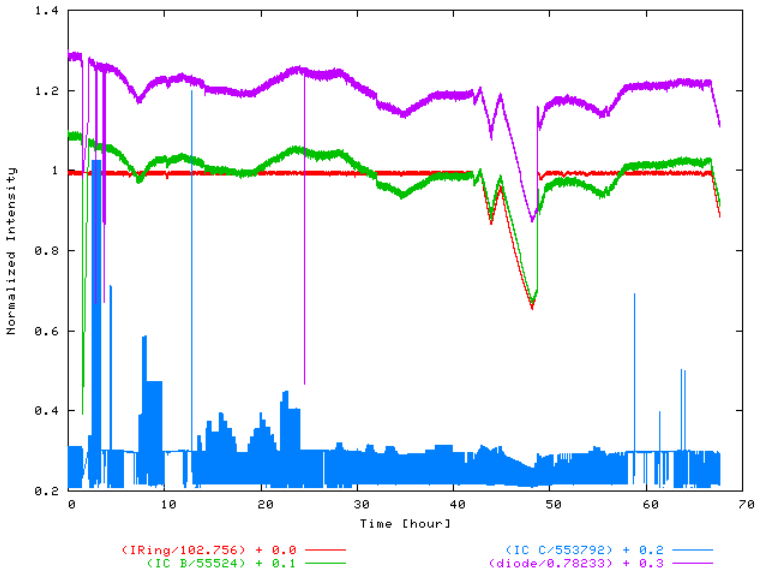


Short time scale Fluctuation, 5 um horizontal motion due to closed loop heater turning on/off.

Short time stability comparison

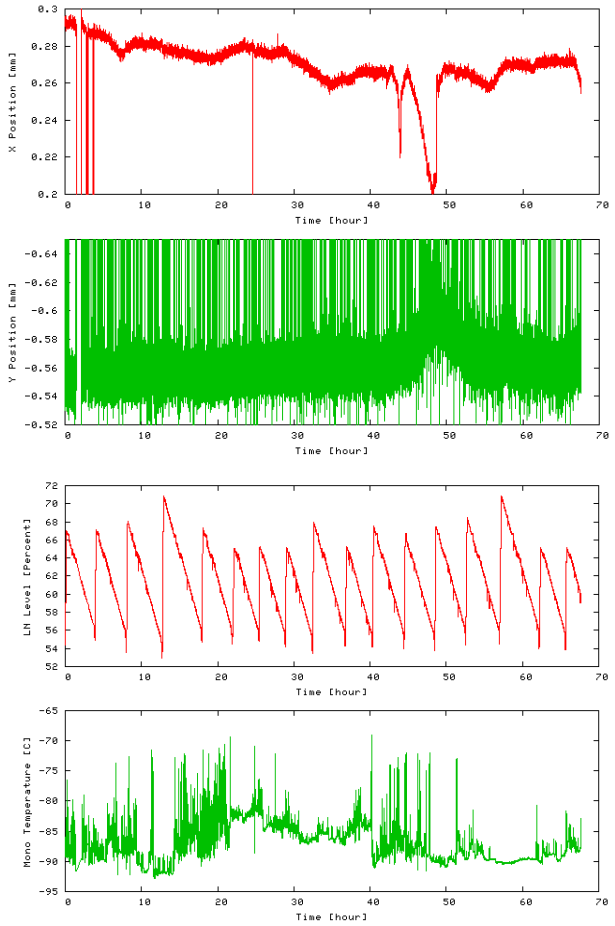


Beam stabilized by constant pressure circuit



Intensities on week of 4/1/04 for 2.8 days. Note top-up failure Near t = 42hrs.

Beam position data week of 04/01. Note beam motion when top-up fails.



Cryocooler Level sensor data

Anecdotal evidence on low pressure fill modification

- In 2003, our Oxford cryocooler was modified with the so-called “low pressure modification” which introduced a phase-separator on the liquid N2 input lines of the low pressure vessel.
- We found that the pressure variation during the fill were more abrupt, causing a bigger pressure difference, and lasting longer than before (in 2002).
- In 2004, we restored the unit to its original design and are more satisfied.

Future plans, conclusions

- Install a regulator with a smaller range and thus more sensitive control.
- Take the cryocooler outside of the 7ID-A hutch so that the low pressure vessel can vent out to the experimental hall. This should reduce the pressure bump during the fill.
- The inexpensive regulator has improved the beam stability, reducing the amplitude of the pressure variations by < 0.1 PSI.

Additional cheap thrills from S7

OMS Stepper card limit polarity inverter(note manual switches). Allow immediate change between NO/NC limit switches.

New BCDA breakout module(BC-035)

Useful to breakout signals from BC-005 transition module to other Stepper motor drivers than ACS Step Pak. Here it is shown with IDC Next Step drivers.