Fast Orbit Correction at the Canadian Light Source

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Outline

- CLS Orbit Control History
  - Design Limitations of Existing System
- Hardware Overview
- Description of Fast Implementation
  - Key advantages over slow system
- Preliminary Results
- Conclusion

History

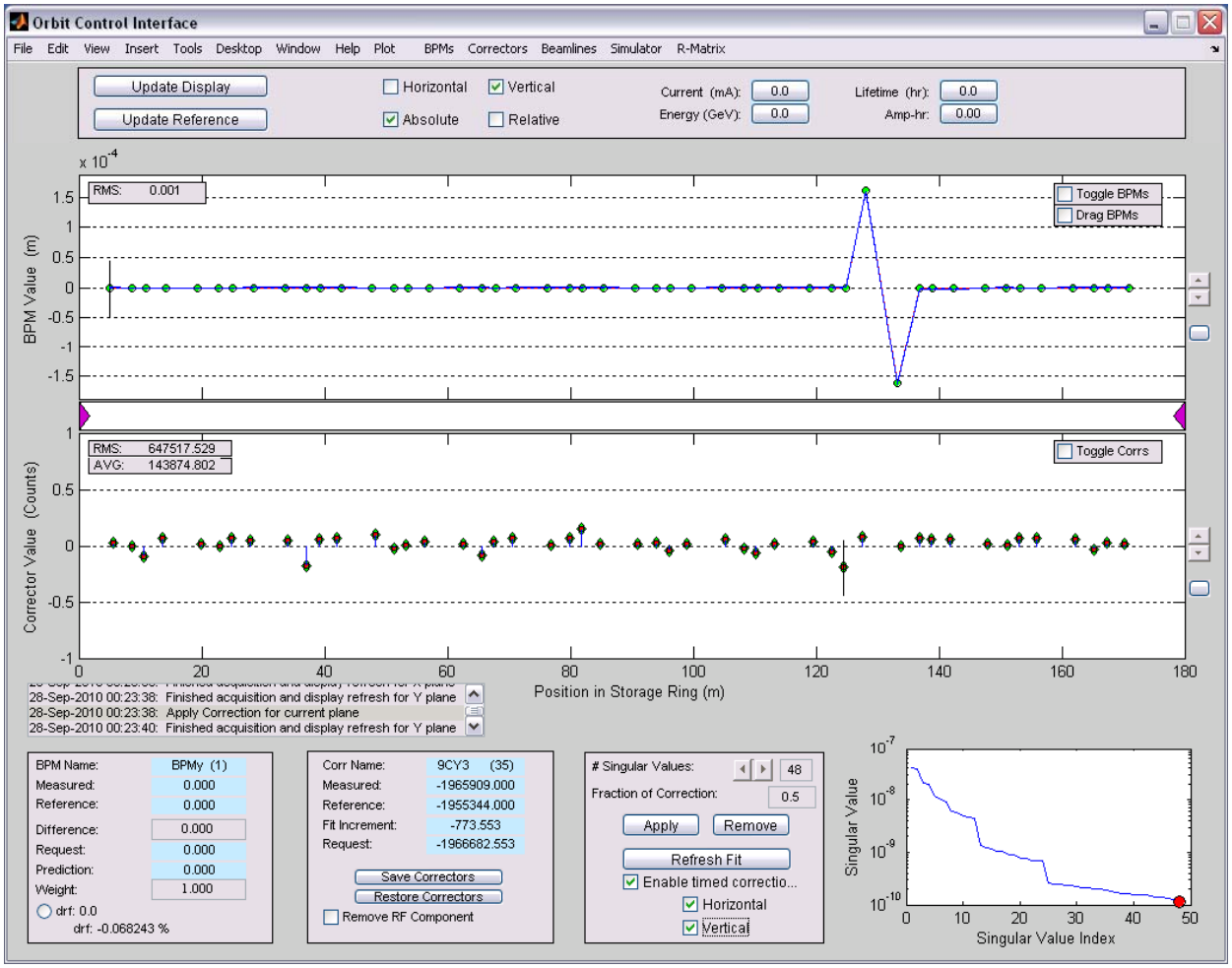
- Present orbit control in use at CLS is CLSORB
  - CLSORB is a Matlab program developed at SLAC and modified for use at the CLS
  - Corrections are calculated by Matlab and sent to low level PS control (mix of RTEMS and Linux IOCs) via EPICS (***slow*** and non-deterministic)
  - Application of corrections done in a ***serial*** fashion
  - Both of the above lead to unintended orbit perturbations – ***noise***
  - Update rate limited to the order of **0.1Hz**

History (2)

Currently we operate in an intermediate step between the slow and fast systems

- Technically, the system still corrects orbit at the slow rate
- However BPM data acquisition has been updated
- Software is in place to enable fast correction once all hardware is in place (described below)

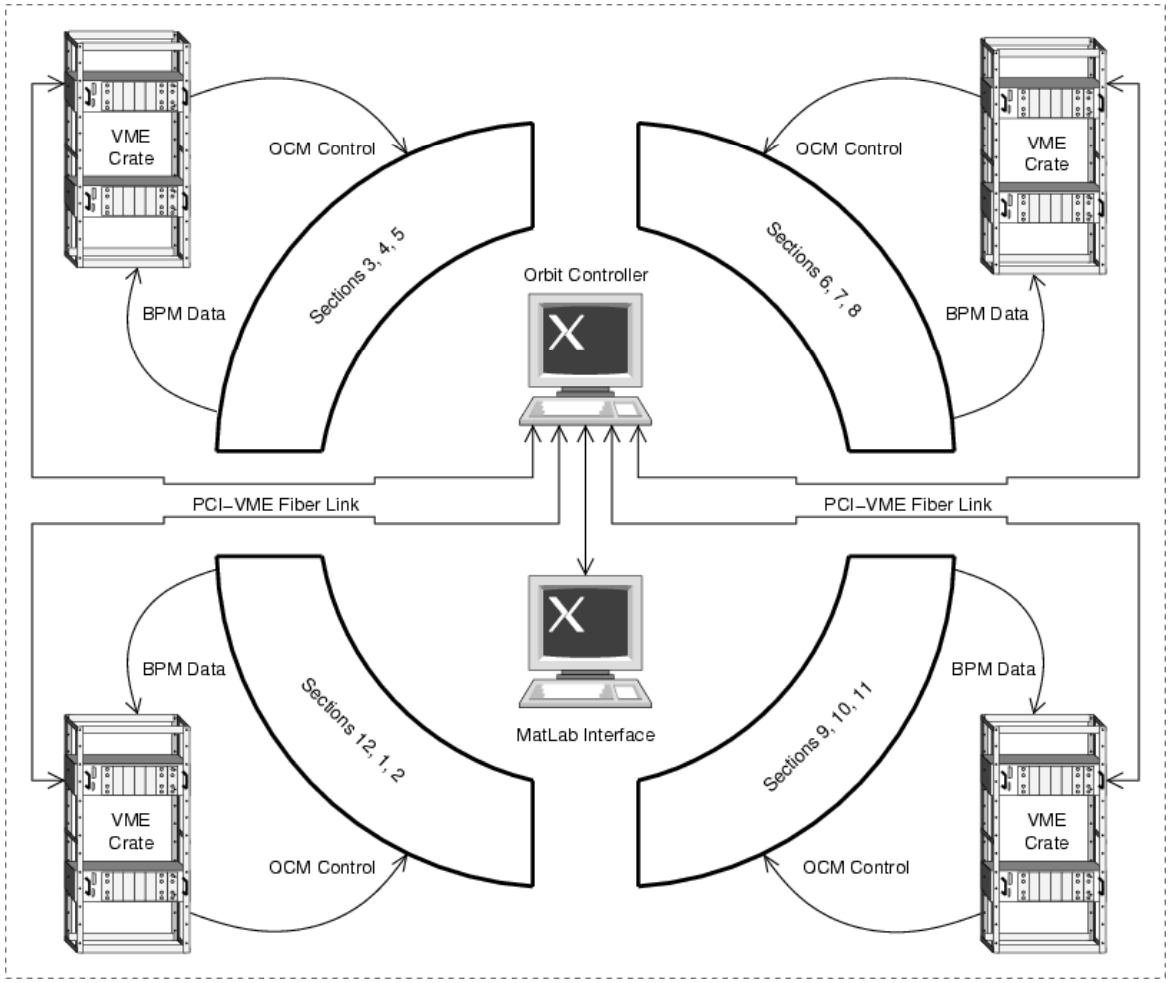
CLSORB User Interface



Hardware Overview

- The Heart of the system is an Industrial 3GHz x86 PC IOC with 1GB or RAM running RTEMS
- I/O to 4 VME Crates with
  - Four (4) SIS PCI/VME 1100/3100 fibre cards for connectivity
  - Four (4) ADC VME cards (ICS-110BL) for BPM data acquisition
  - Eight (8) VMIC 2536 DI/O, 2 per crate for corrector setpoint control

Hardware Layout



Additional Hardware

- Beam Position Monitors (BPMs)
- Bergoz BPM Modules
- OCM Power Supply Controllers, interfaced with the OCM power supplies via VME DIO
  - It should be noted that although setpoints are via the VME interface, feedback is exclusively via a serial interface, currently using Linux IOCs
- Magnets of course

Fast Implementation

Many improvements over previous version

- Update rate improvement, up to 100Hz possible
- BPM data improvements
  - Concurrent acquisition ensures correlation of data and improves noise level (factor of 4)
  - Threaded acquisition improves dead time (factor of 16)
- Localization of calculations/setpoint applications
  - Once the response matrix is transferred the RTEMS system can run independently indefinitely
  - Network latency no longer an issue

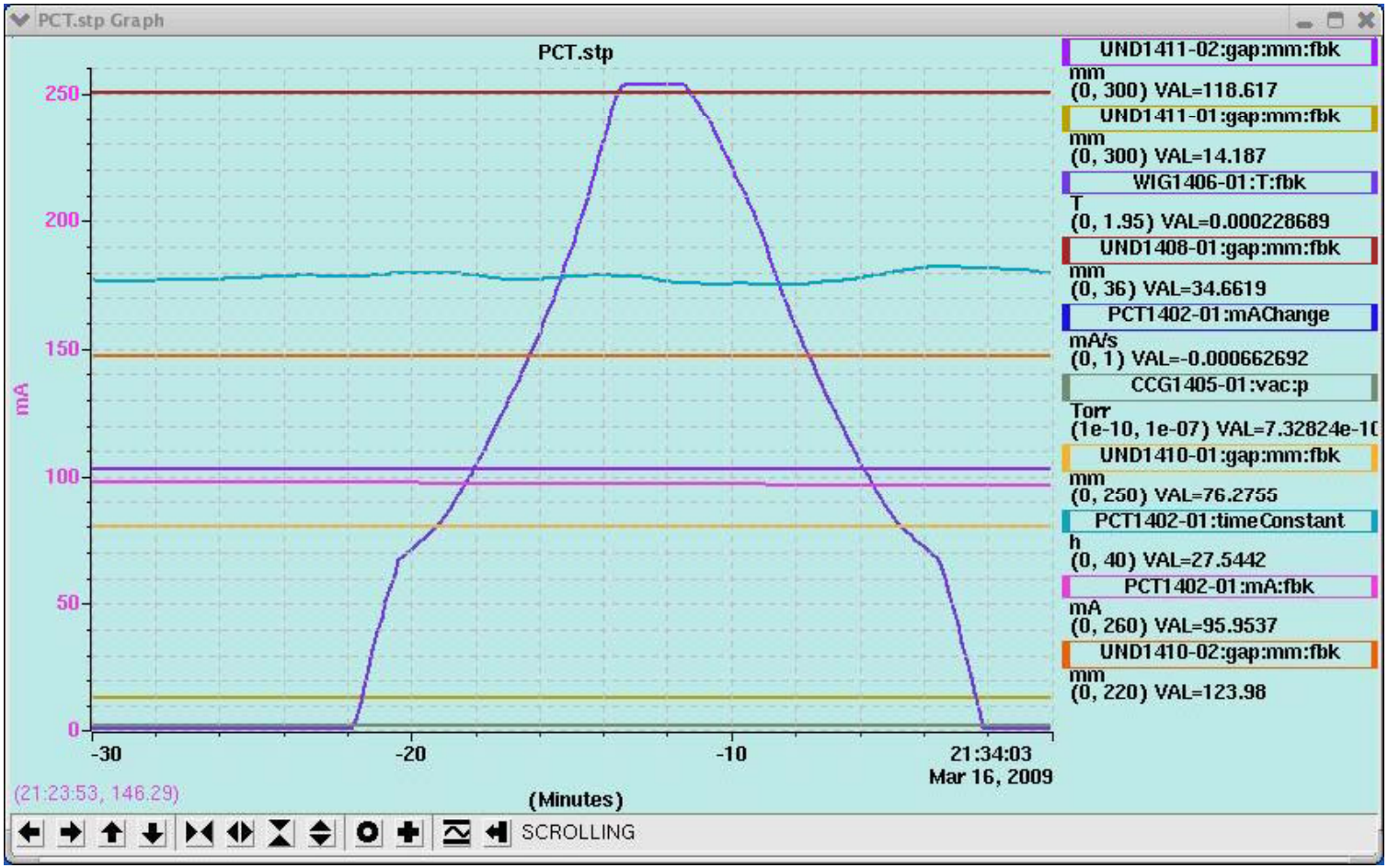
Fast Implementation (2)

- Concurrent setpoint application
  - All corrector setpoints can be loaded and then simultaneously activated
- Multiple Operating Modes including
  - Assisted – BPM data updated @ 20Hz, CLSORB calculates/applies setpoints, presently in use
  - Autonomous – BPM updates as in Assisted but RTEMS IOC calculates/applies setpoints
  - Timed – Updates as Autonomous, but BPM updates are timer driven allowing faster rates
- EPICS interface to Orbit Control Parameters

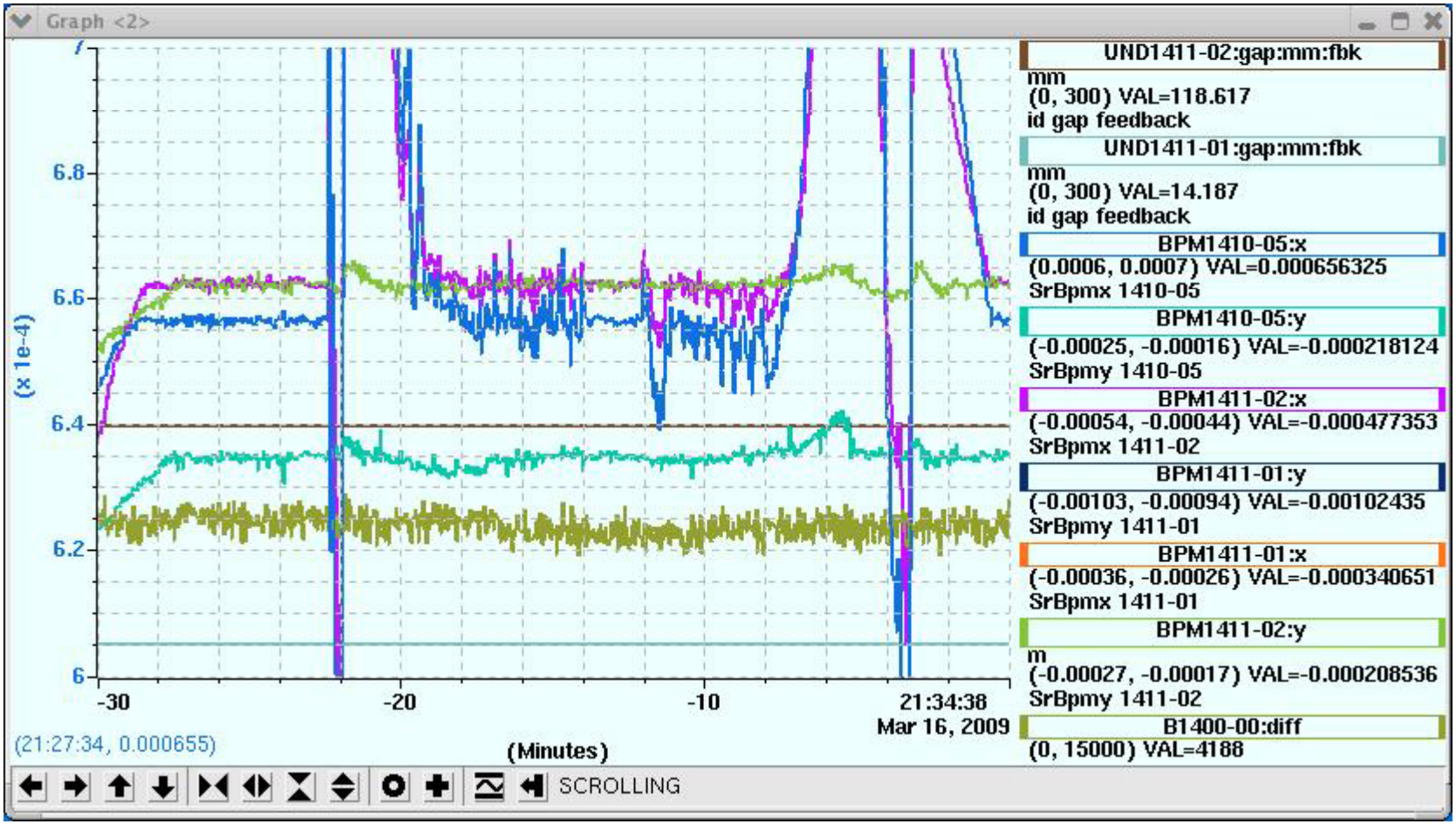
Prelimniary Results

- Simple test performed
  - Ramp insertion device (HXMA Wiggler), close then open gap
  - Observe the expected orbit perturbation
  - Repeat for various operating modes

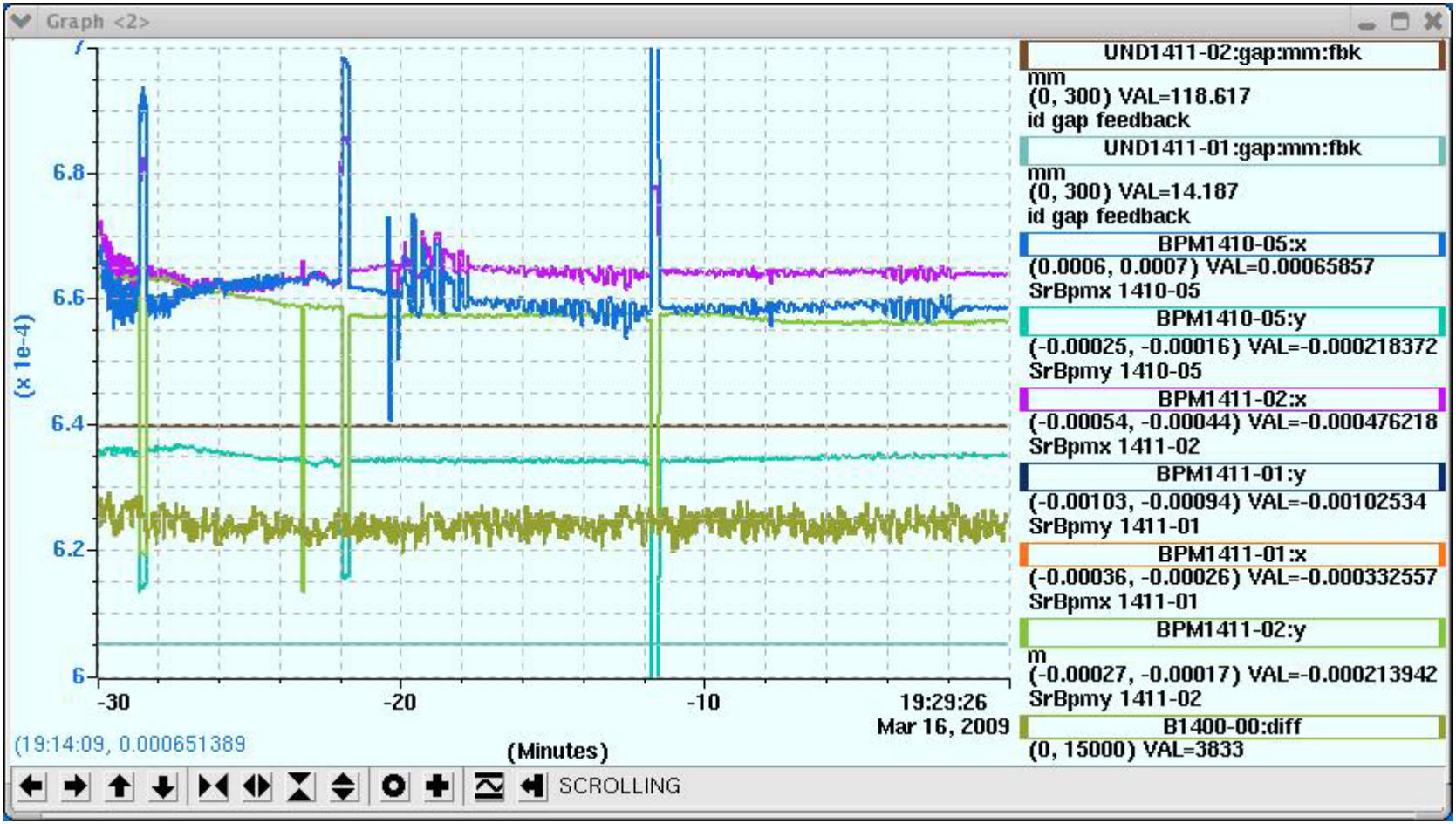
Gap/Field Profile



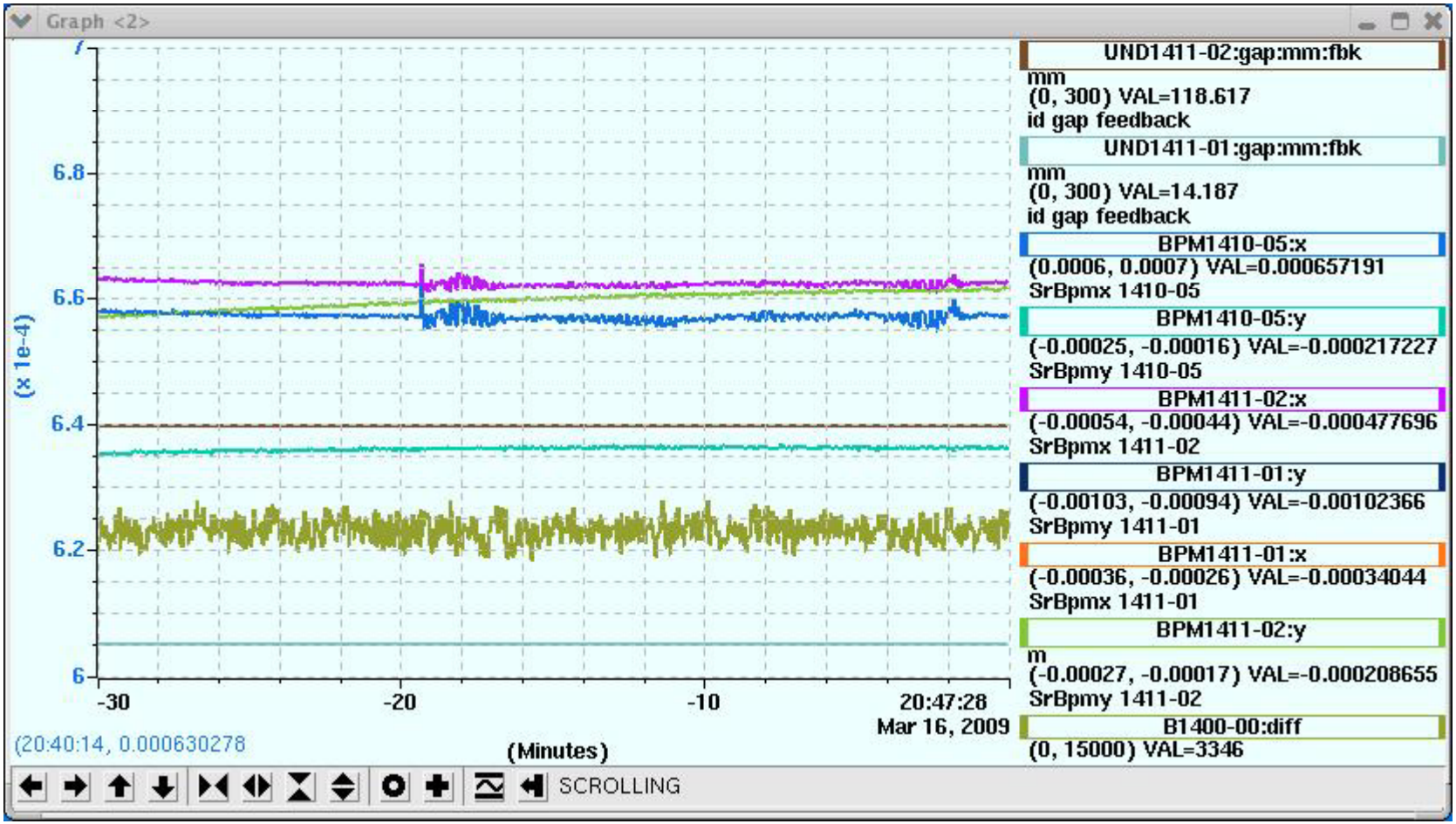
Assisted (Slow) Control



Autonomous Control (20Hz)



Timed Mode (65Hz)



Conclusion

- CLSORB has served the CLS well for several years
- There is however room for improvement
  - Routine operations become transparent to users
  - Low frequency noise can be reduced
- Limiting factor recently has been hardware availability, we are hopeful to complete roll out in late 2010

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