Members of the SLS Beam Dynamics Group

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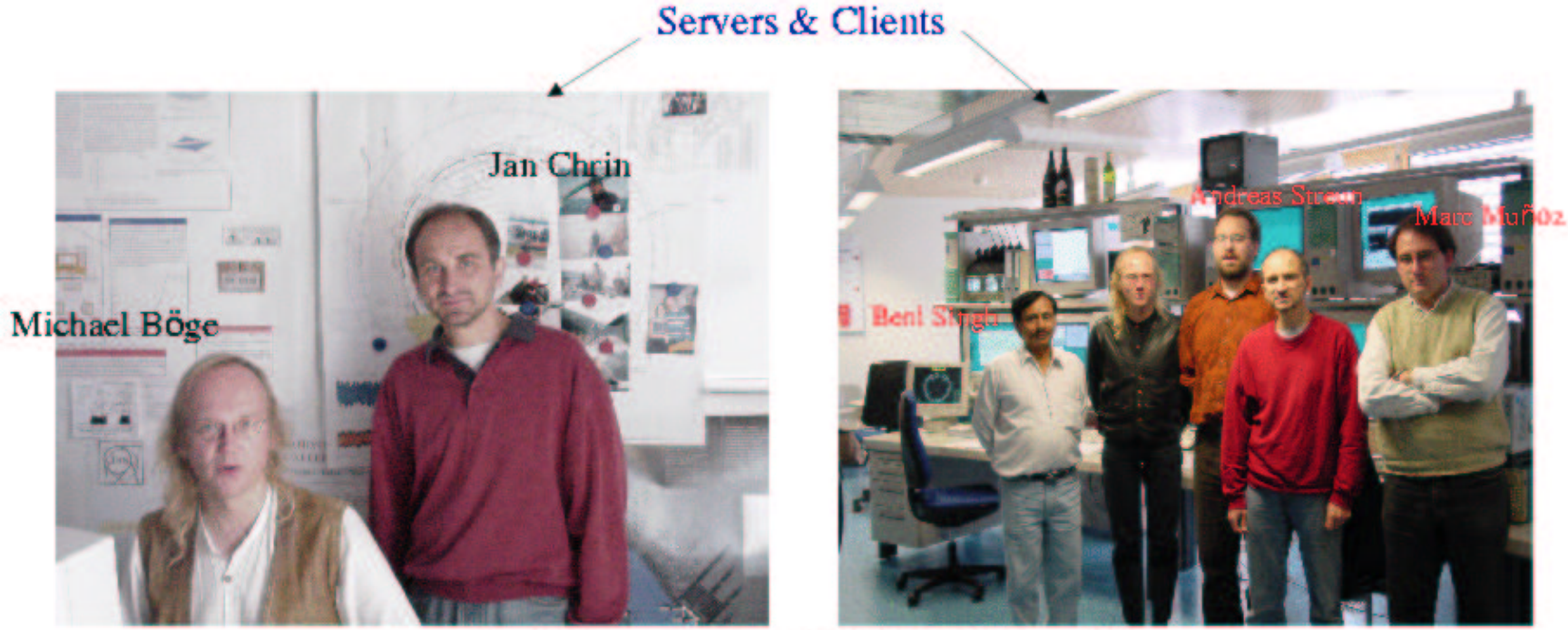

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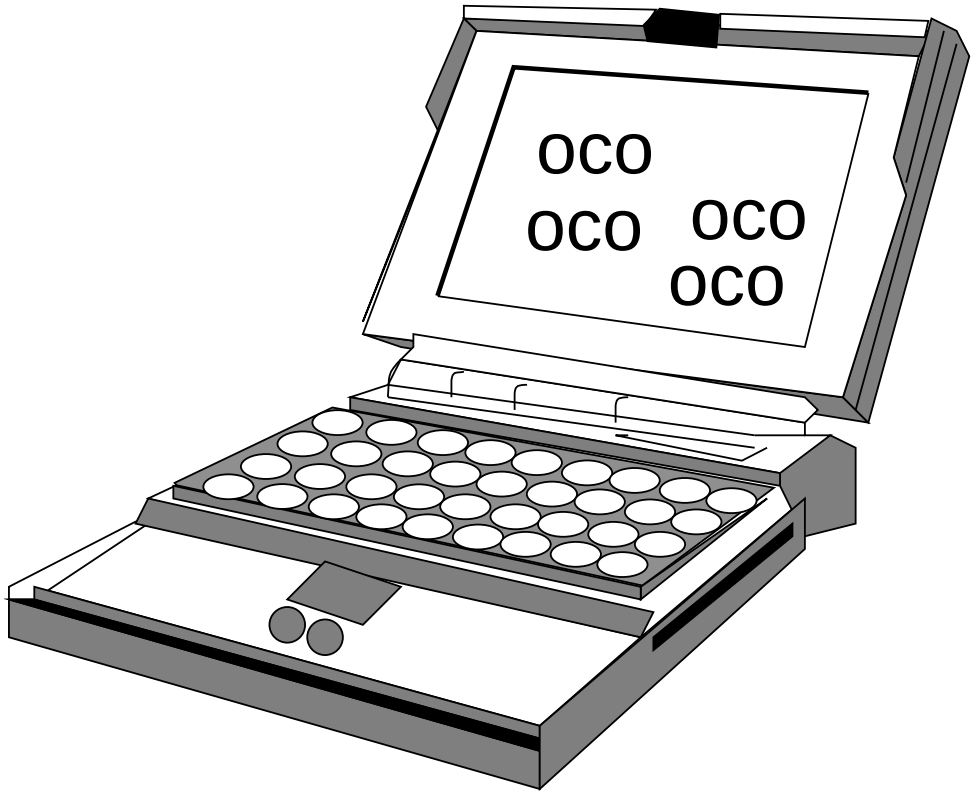
Overview

- Architectural Model for CORBA based Beam Dynamics Applications
- CORBA based Servers/Management
- "CORBA/Model Server" Hardware/Integration into the Control System
- CORBA based Clients
  - Orbit Display
  - Orbit Correction
  - Local Bumps
  - Tune Measurement
  - Lifetime
  - Phase Space Display
  - Transferline Twiss Parameters
- Slow Orbit Feedback

Overview (cont.)

- Slow Orbit Correction Demo ;-)



Introduction

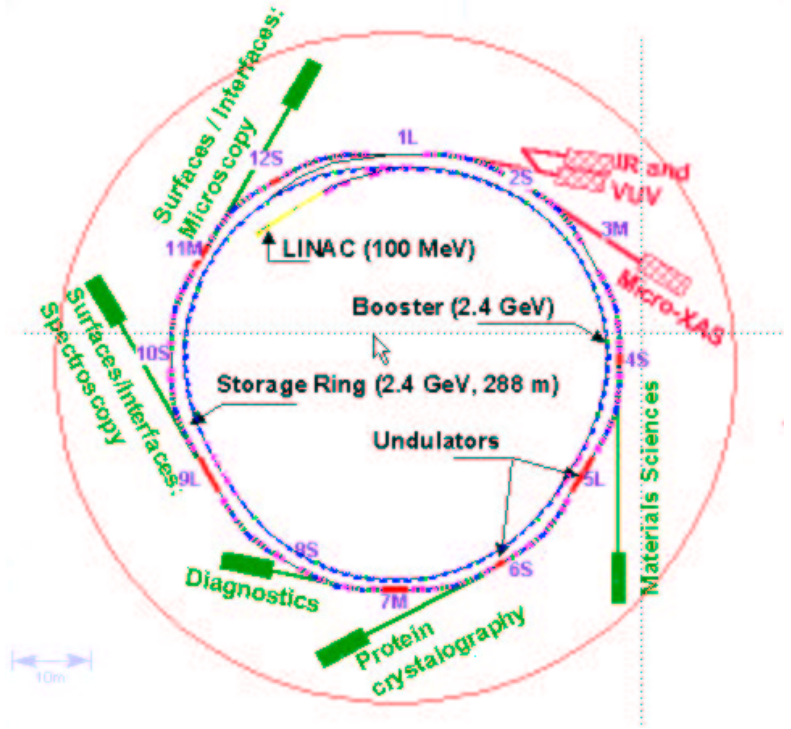
- SLS (Swiss Light Source) 2.4 GeV electron storage @ the Paul Scherrer Institute, Switzerland
- Full energy injector booster synchrotron
- 100 MeV linac
- Operation since August 2001 (70% of beam time for users)

Large number of high-level beam dynamics applications, generic tasks:

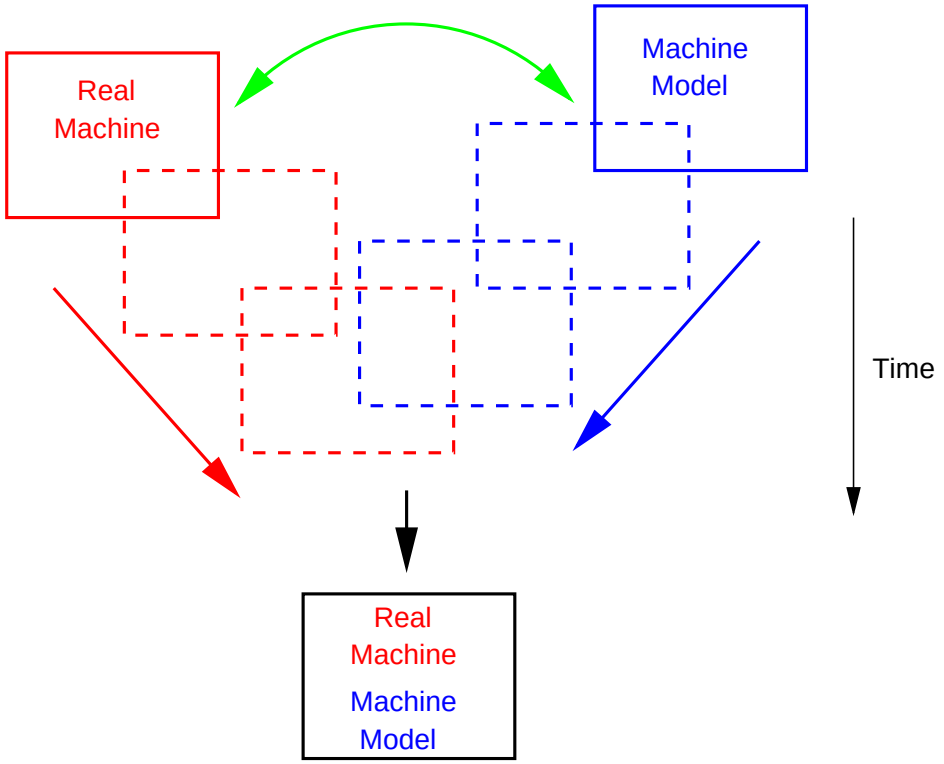
- access to an accelerator physics package
- accelerator device control
- database access and management
- logging of messages and alarms

SLS Layout

- Pre-Injector Linac
  - 100 MeV
- Booster Synchrotron
  - 100 MeV to 2.7 GeV @ 3 Hz
  - ϵ_x = 9 nm rad
- Storage Ring
  - 2.4 (2.7) GeV, 400 mA
  - ϵ_x = 5 nm rad
- Initial Four Beamlines:
  MS – 4S, PX – 6S,
  SIS – 9L, SIM – 11M



"Machine Model" and "Real Machine"



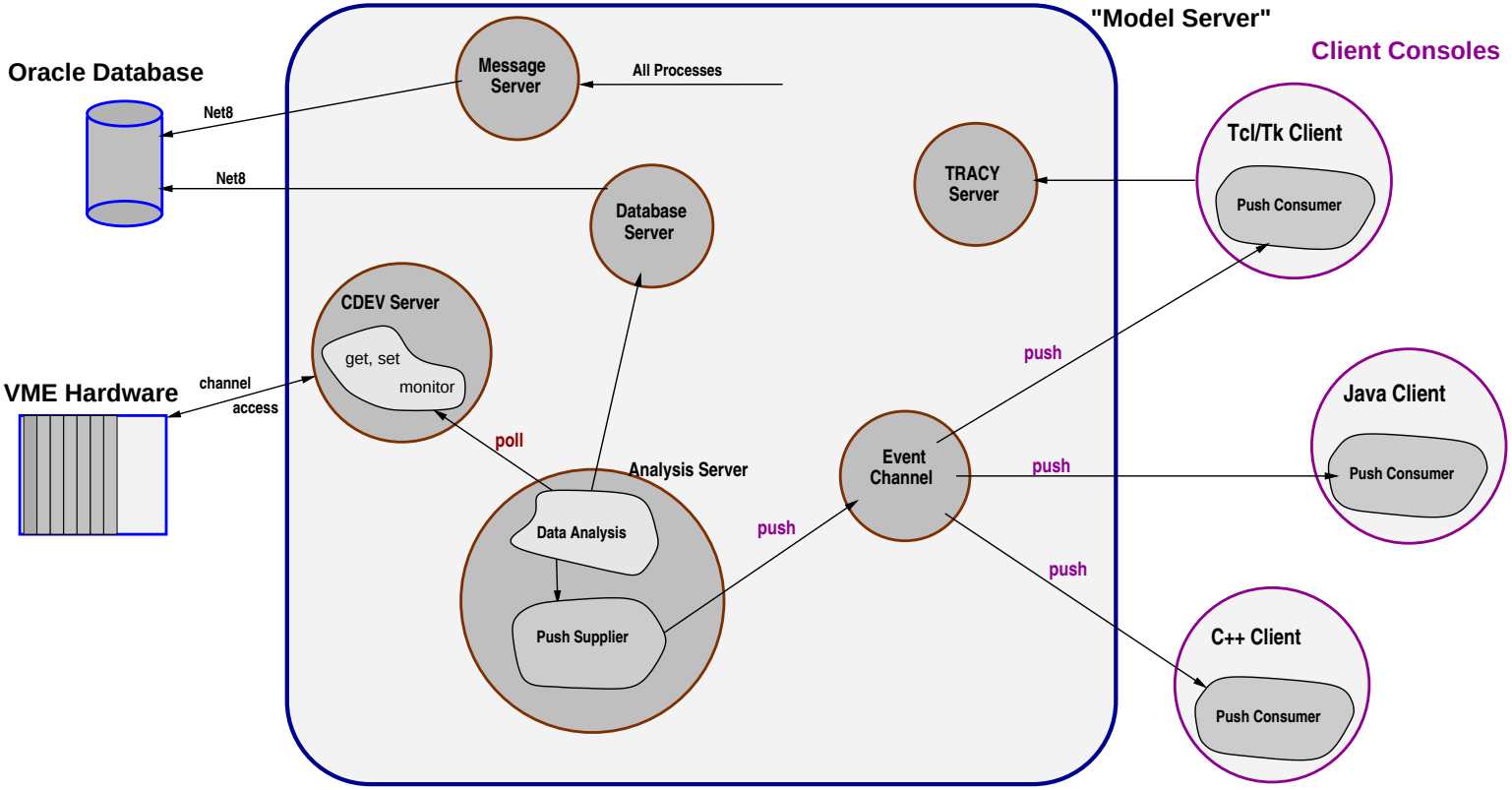
- Improve the "Machine Model" at the same time as the "Real Machine"

The CORBA Framework

- CORBA (Common Object Request Broker Architecture):
  "In the evolution of object-oriented distributed systems, CORBA is a standard that provides a mechanism for defining interfaces between distributed components."
  - Platform independence
  - Language independence (Interface Definition Language (IDL))
- ORB (Object Request Broker):
  - The ORB MICO CORBA 2.3 implementation GNU public license
  - Implementation/Interface Repository facilities
  - Naming Service and Event Service of the ORB
  - IDL to C++ mapping through MICO
  - Tcl mapping through Combat/MICO
  - Java mapping through Java ORBacus 4

Architectural Model for Beam Dynamics Applications

Applications are developed within a CORBA (Common Object Request Broker Architecture) framework:



CORBA based Servers

- CDEV Server: provides CORBA interface to the narrow CDEV API.
- EZCA Server: provides CORBA interface to the narrow EZCA API. Hardware is accessed exclusively through CDEV and EZCA.
- Analysis Server: manipulates/recalibrates data retrieved by the CDEV Server (example: quadrupole strength <-> current). The Analysis Server can provide monitored data through "EventChannel"s utilizing the CORBA Event Service. Clients can subscribe to these channels and get data automatically pushed to them.
- TRACY Server: provides CORBA interface to selected routines of the TRACY Beam Dynamics library (example: routines for tracking, orbit correction).

CORBA based Servers (cont.)

- Message Server: provides CORBA interface to the UNIX system logging service which allows the logging of messages with different priorities to various facilities. Messages are written to log files and to the ORACLE database.
- Database Server: provides CORBA interface to the ORACLE database (the OCI8 API). The OTL (Oracle Template Library) is used as a wrapper around the OCI8 API.

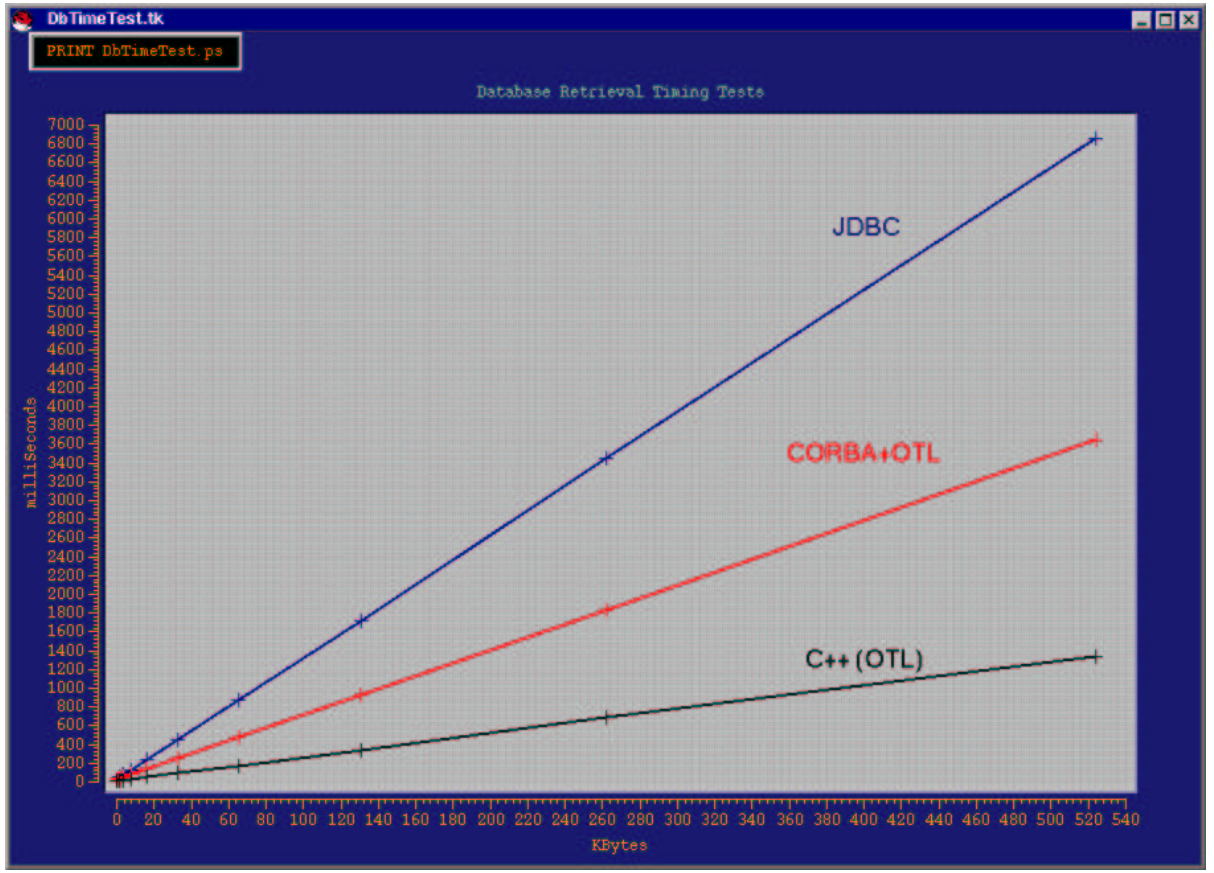
The Database Server completes the suite of essential services!

Database Server - The Performance

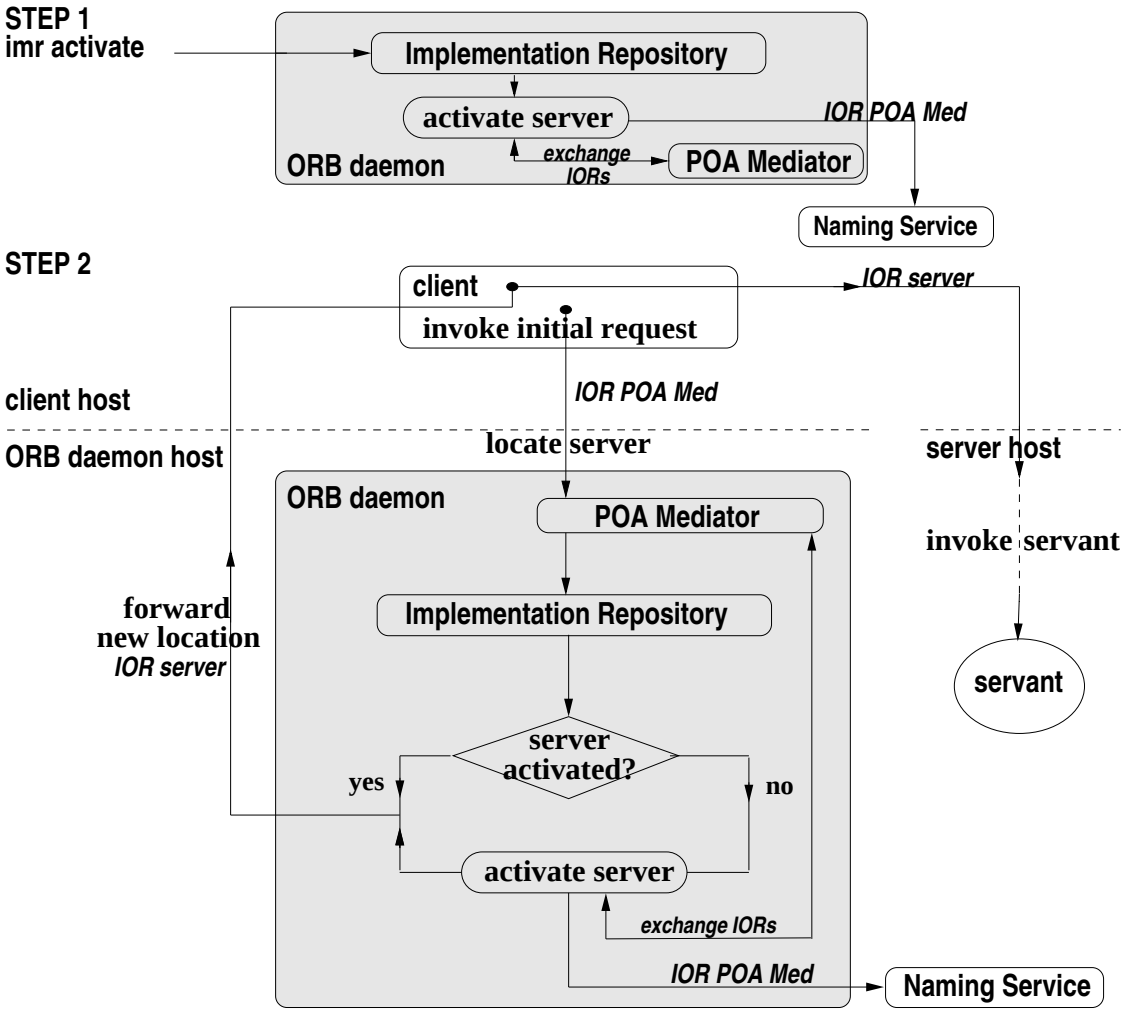
- C++: 400 Kb/sec
- CORBA:140 Kb/sec
- JDBC: 70 Kb/sec

For retrieval of BLOBS from the Oracle Database

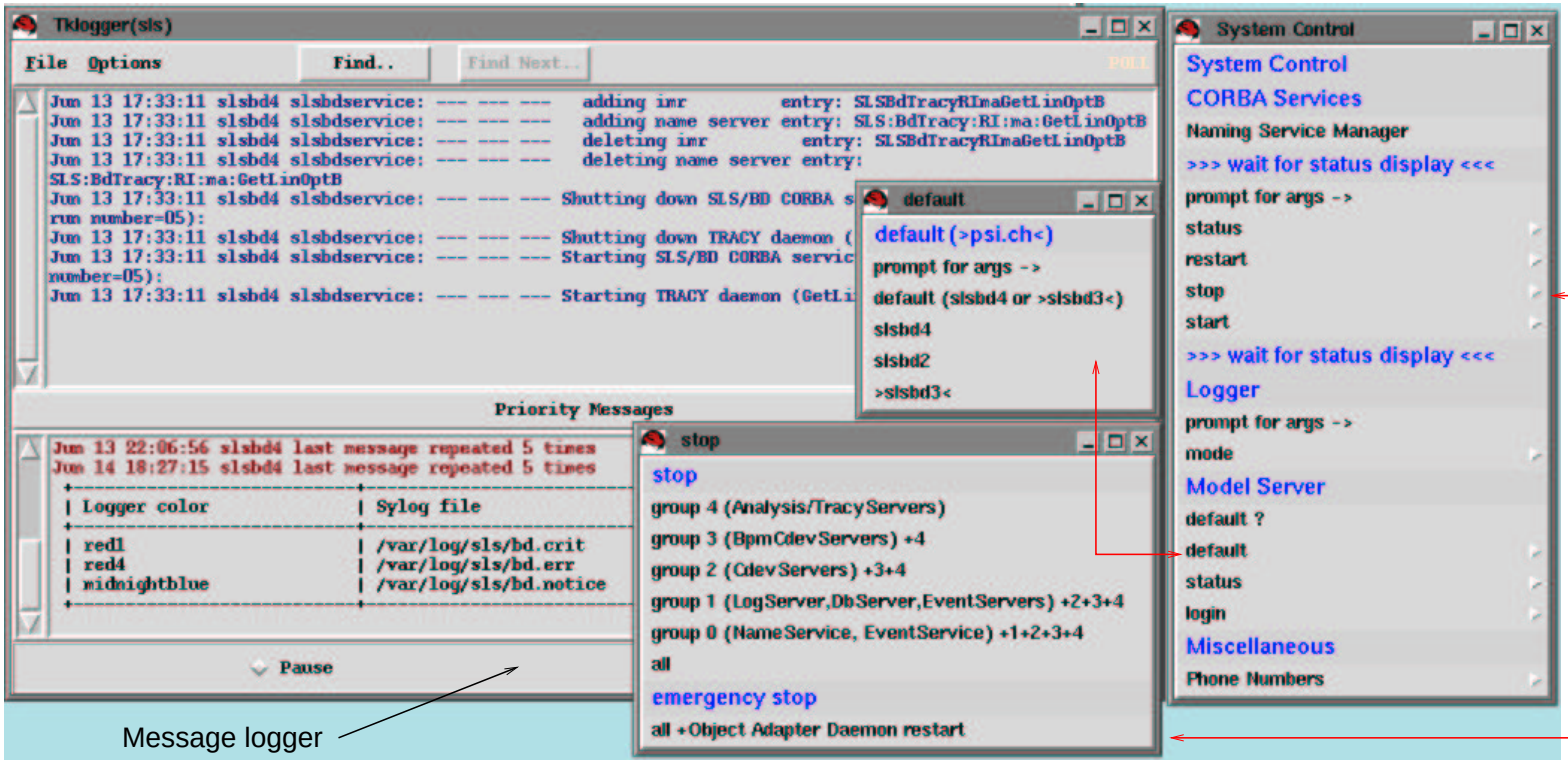
OCI: Oracle Call Interface
OTL: Oracle Template Library



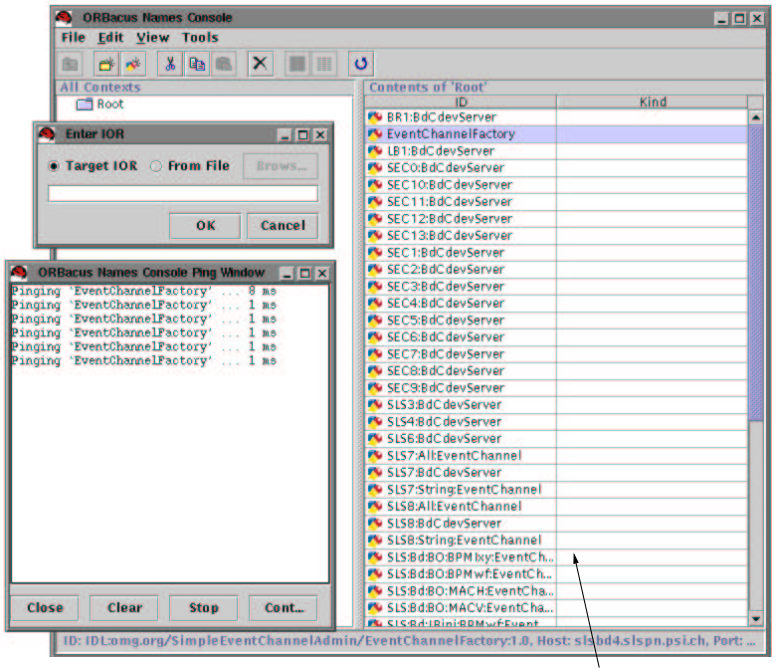
CDEV Server - The Portable Object Adapter



Server Management



Server Management (cont.)



226: run number 26 in run group 2

name service manager

Message logger

"CORBA/Model Server": Hardware

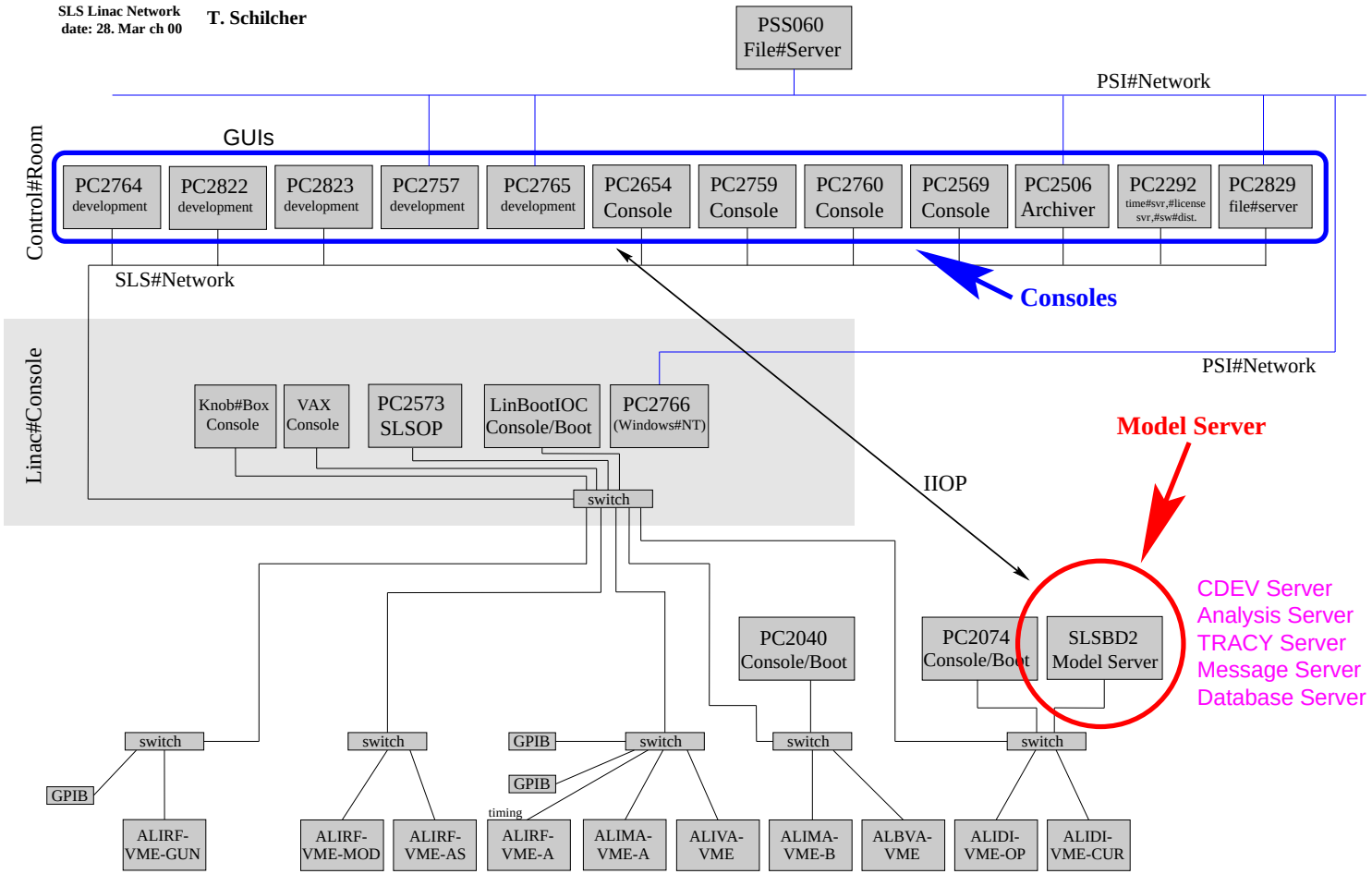
UPS

Model Server #1 ← TRACY model, feedback
SMP system:
2 x PIII 1Ghz
1 Gb Memory

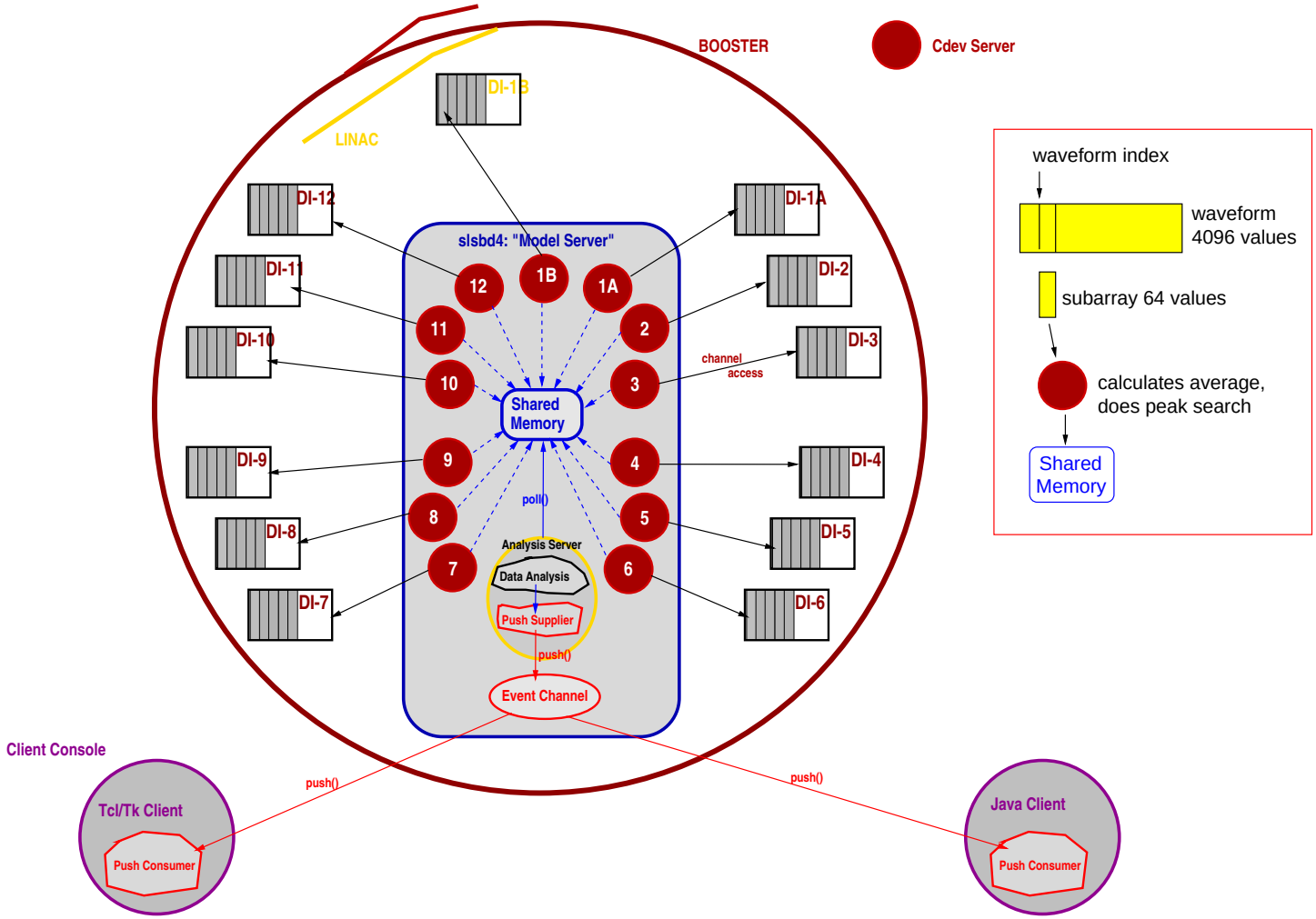
CORBA Server #2 ← MICONS = slsbd4
SMP system: default system
2 x PIII 600Mhz
1 Gb Memory

CORBA Server #1 ← MICONS = slsbd2
SMP system: mirror system
2 x PIII 500Mhz
1 Gb Memory

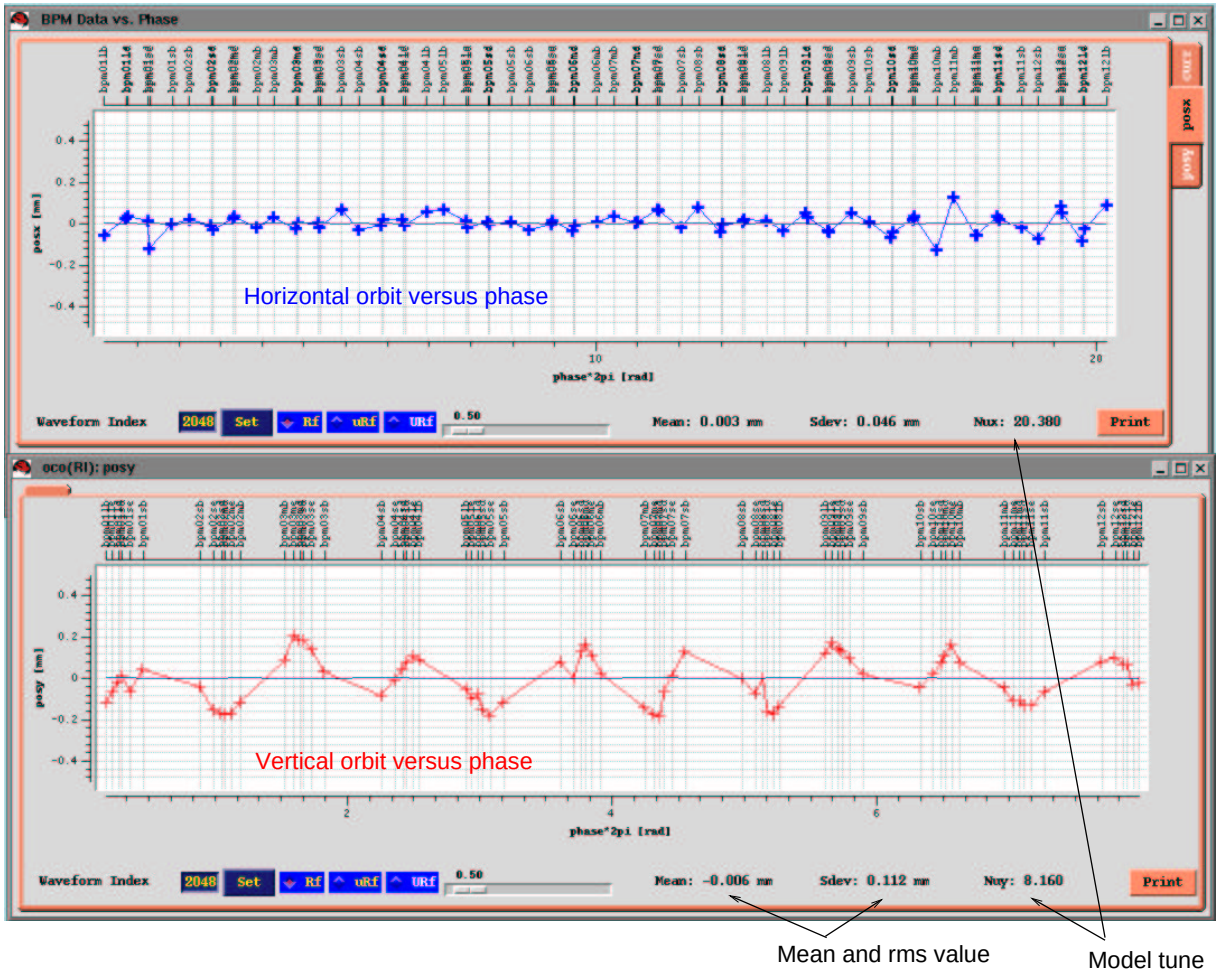
"CORBA/Model Server": Integration Control System



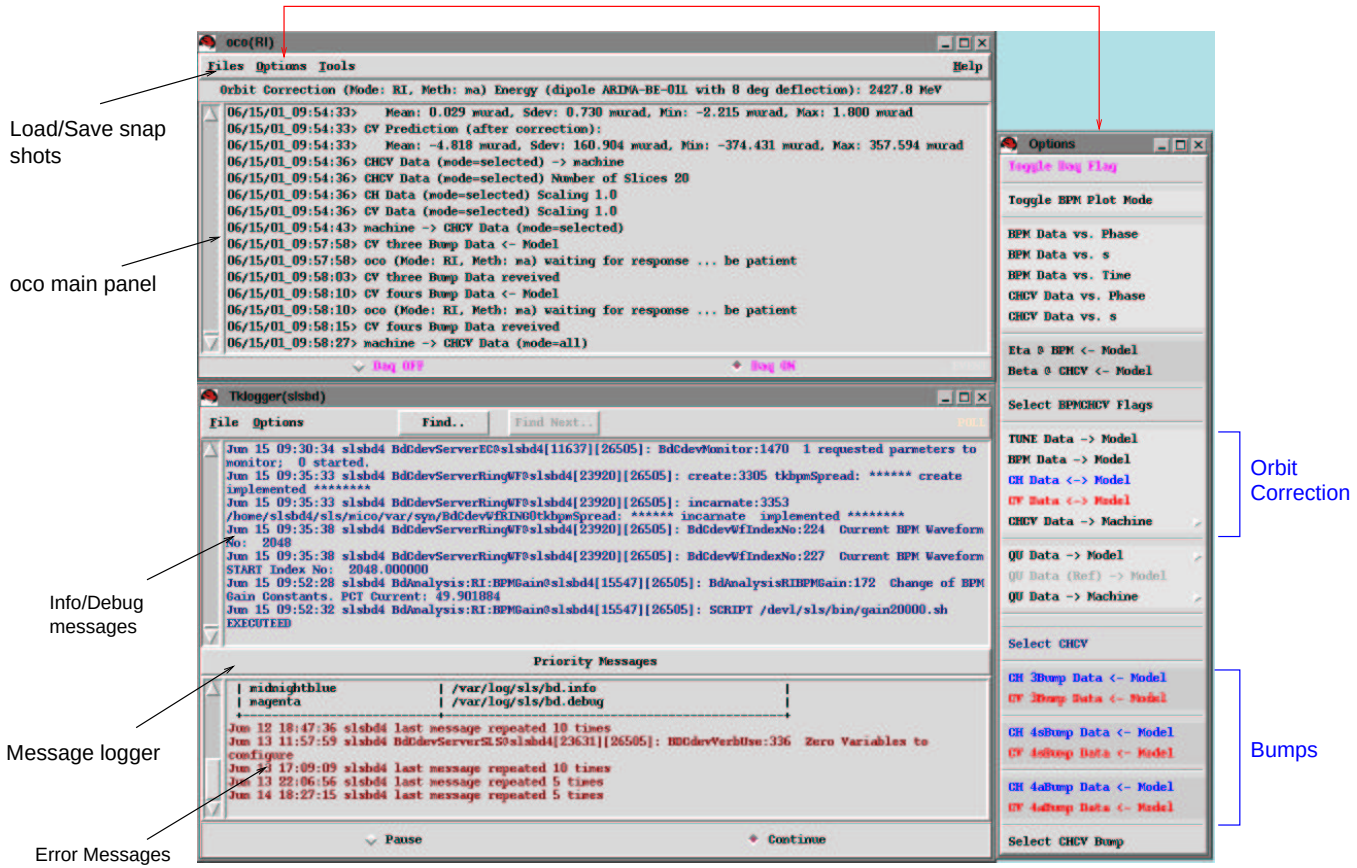
Orbit Display: Schematics of Data Flow



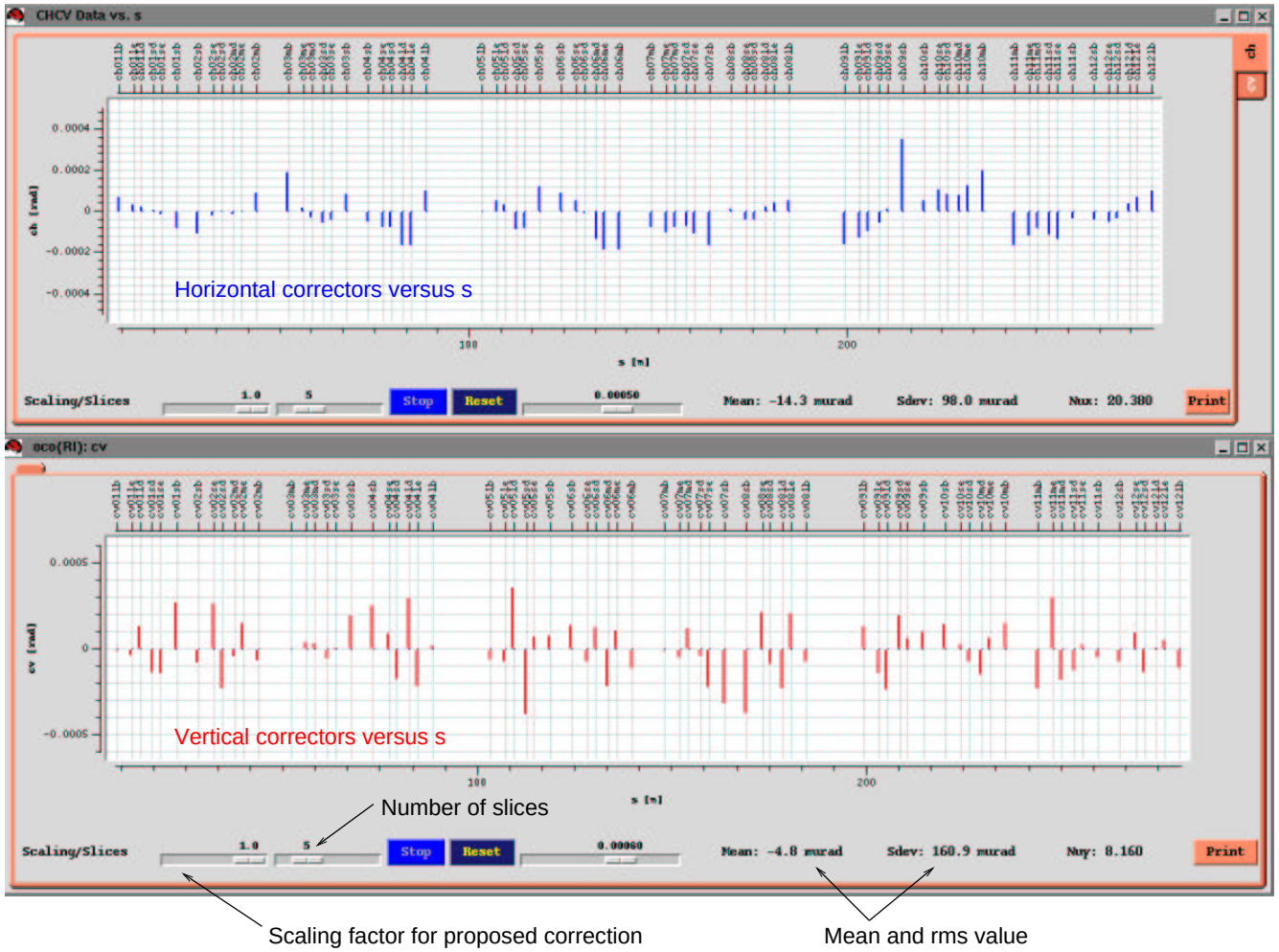
Orbit Display: Visualization from Tcl/Tk/CORBA Client



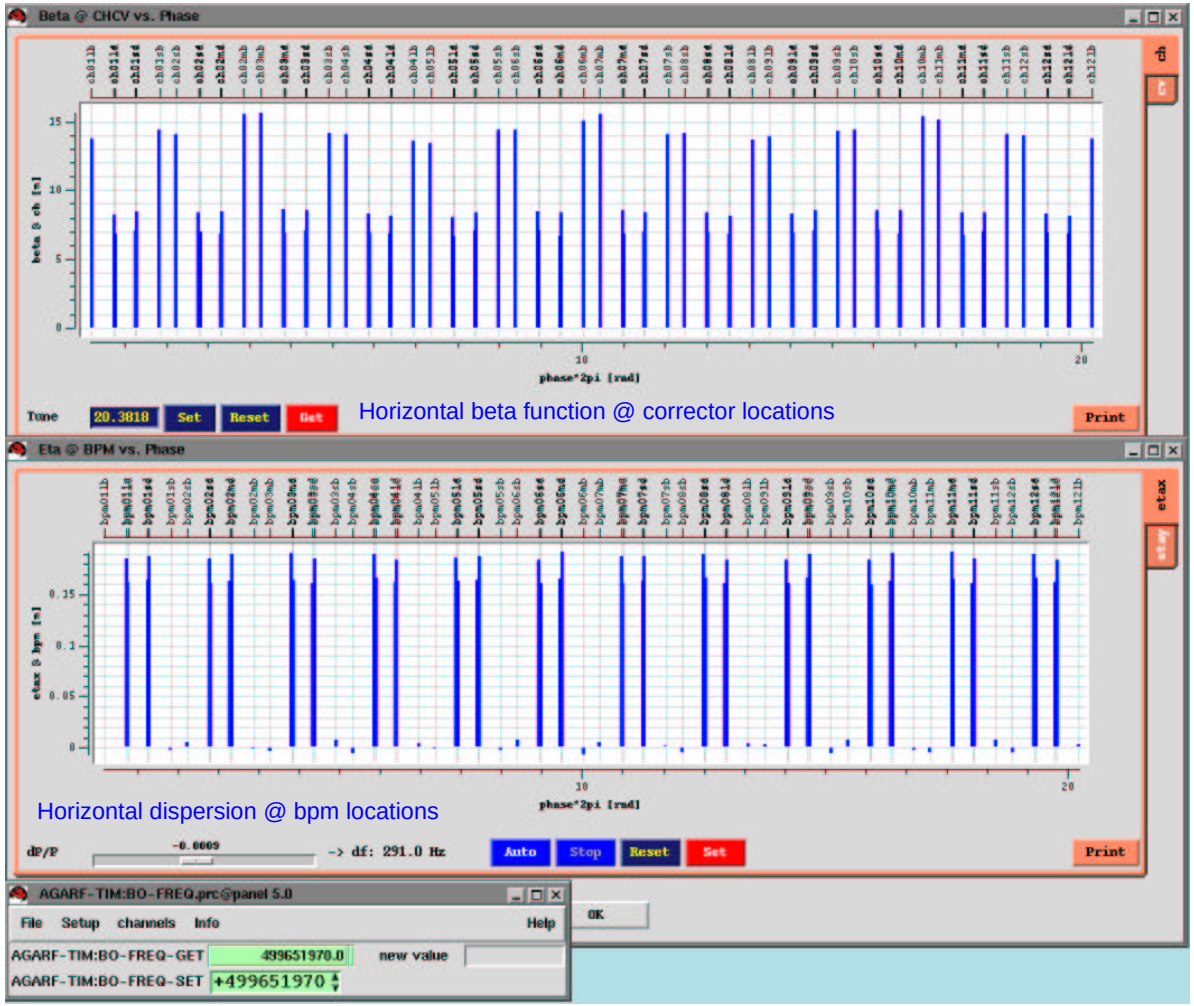
Orbit Correction: Tcl/Tk/CORBA Client



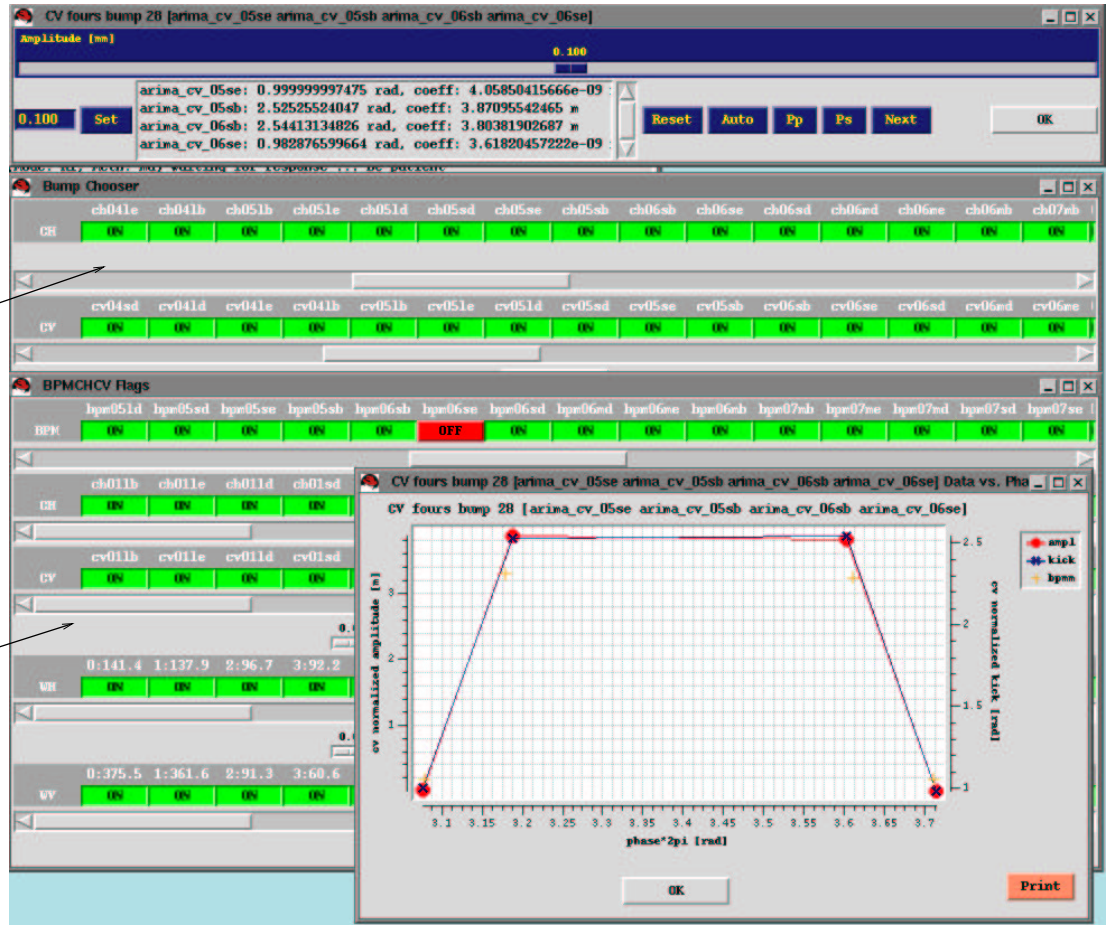
Orbit Correction: Correctors



Orbit Correction: Optical Functions



Local Bumps: Local Bumps

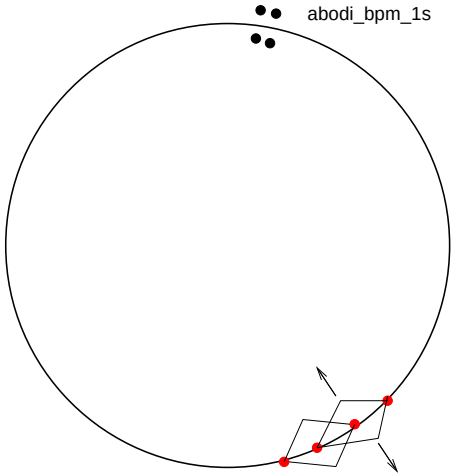


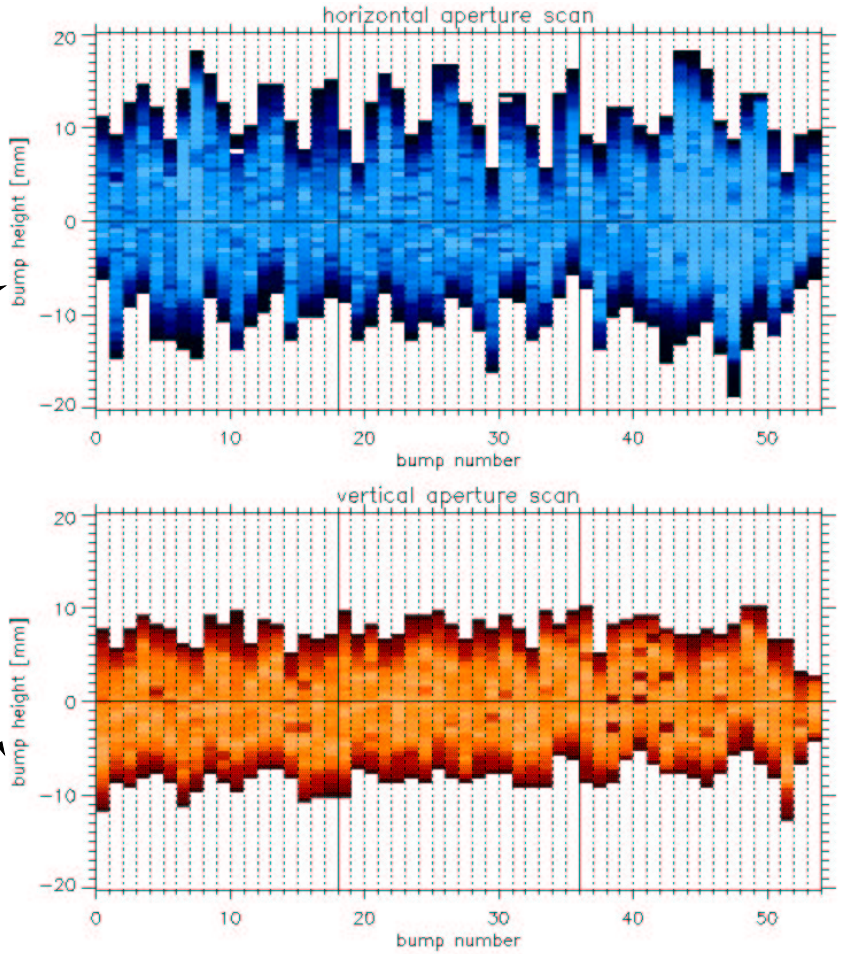
Local Bumps: Monitor Calibration in the Booster

Measurement based on sum signal
of BPM "abodi_bpm_1s"

Interlaced 3bumps (bump number 0-53)
are scanned til the sum signal is zero (colour code)

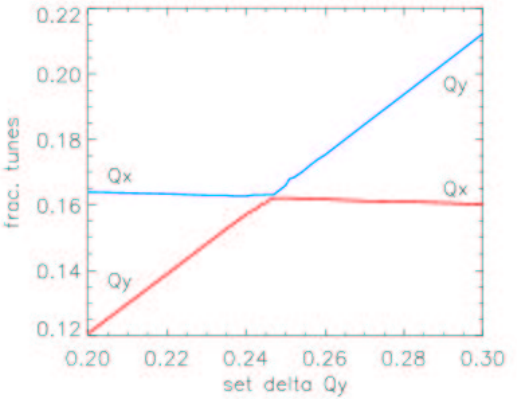
The "bump height" is calculated
from the model.





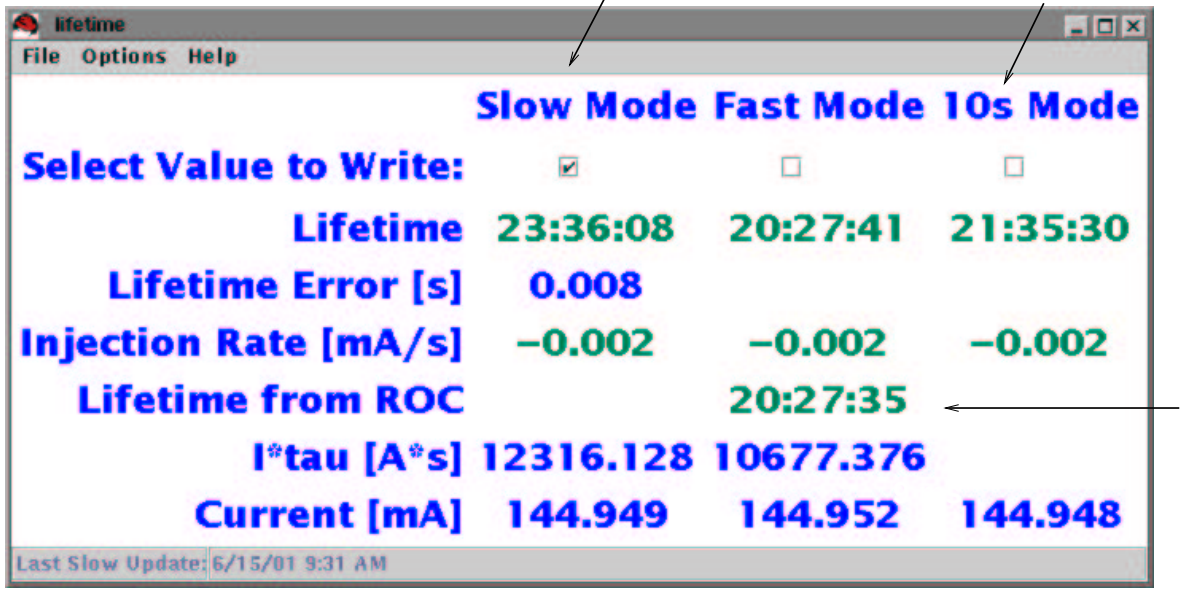
Tune Measurement: Java/CORBA Client

Design tune nux=20.38, nuy=8.16 Tune data are written to EPICS soft channels



Closest tune approach dQ=0.001
after correction with skew quads

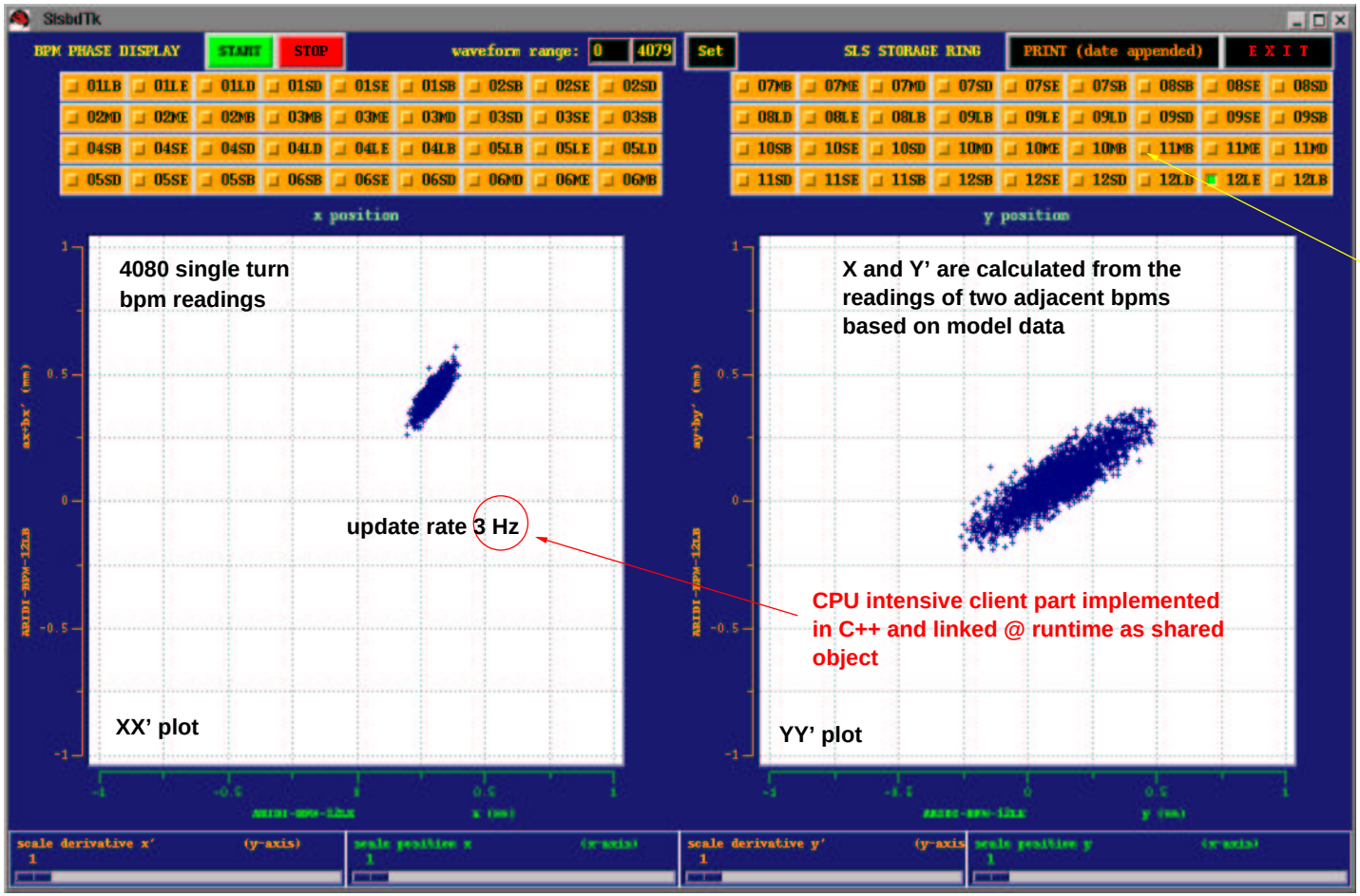
Lifetime: Java/CORBA Client



23.5 h lifetime @ 145 mA

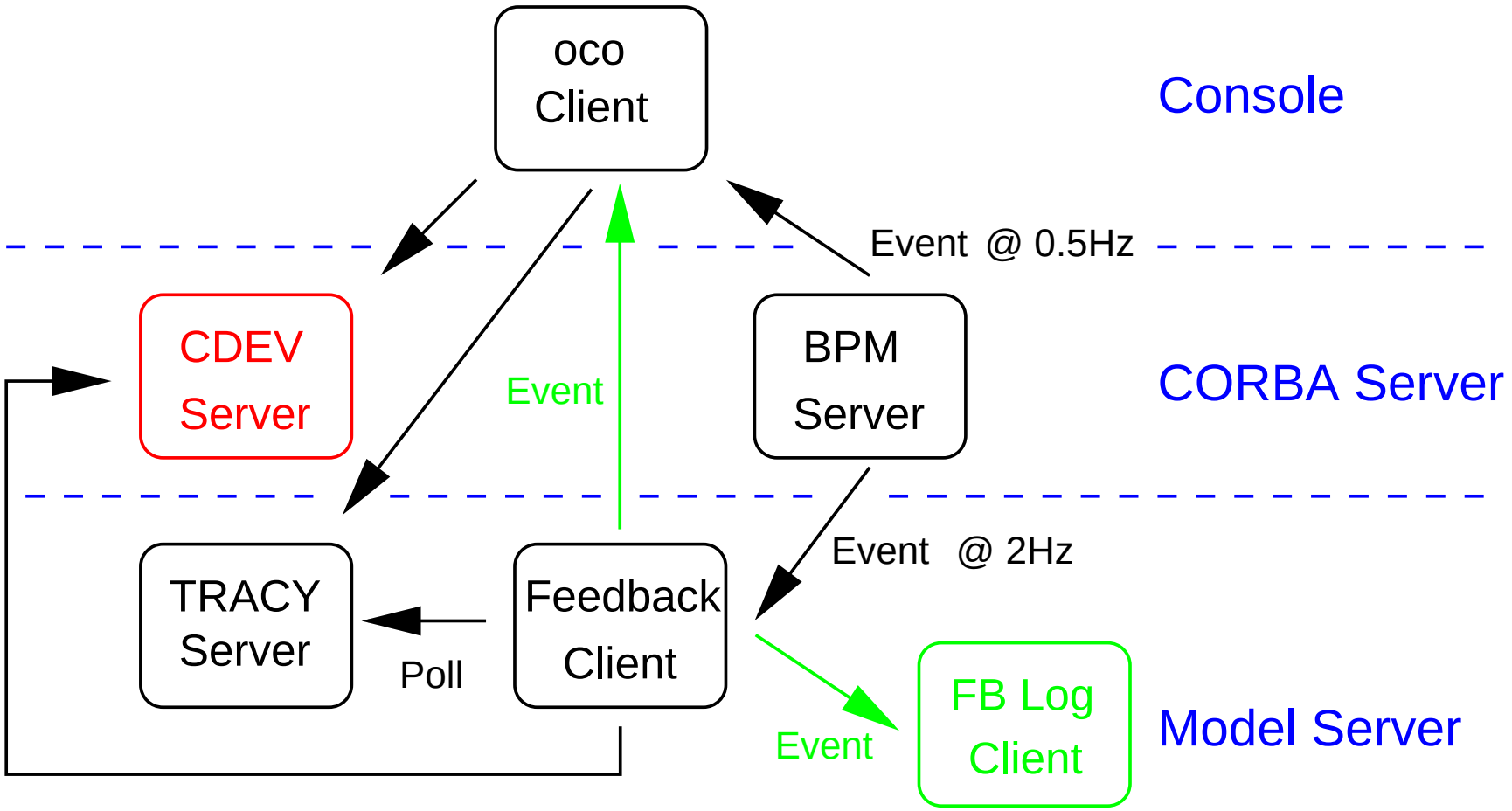
8 h @ design current of 400 mA (with 3HC)

Phase Space Display: Tcl/Tk/C++/CORBA Client

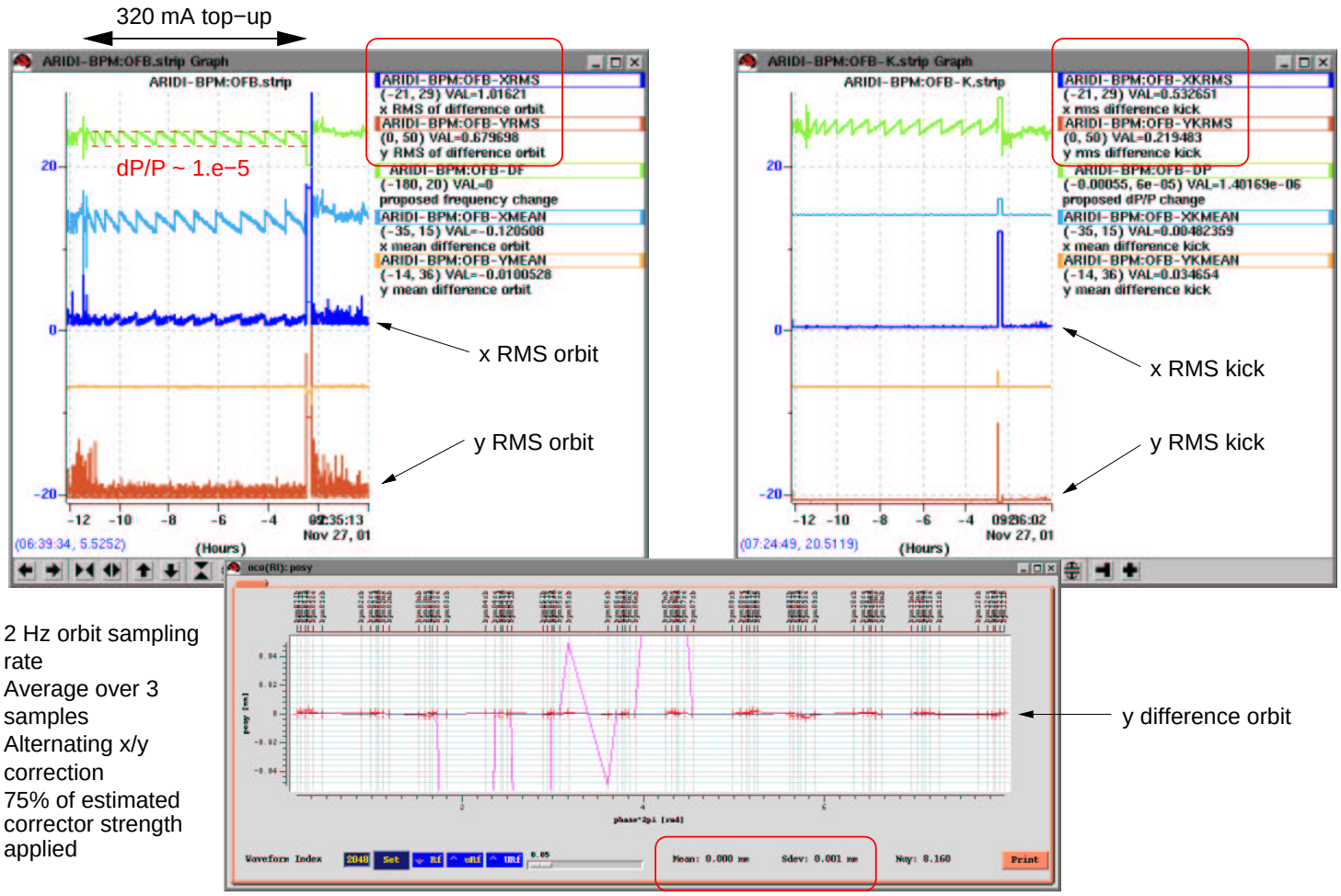


Transferline Twiss Parameters: Tcl/Tk/CORBA Client

Slow Orbit Feedback: Schematics

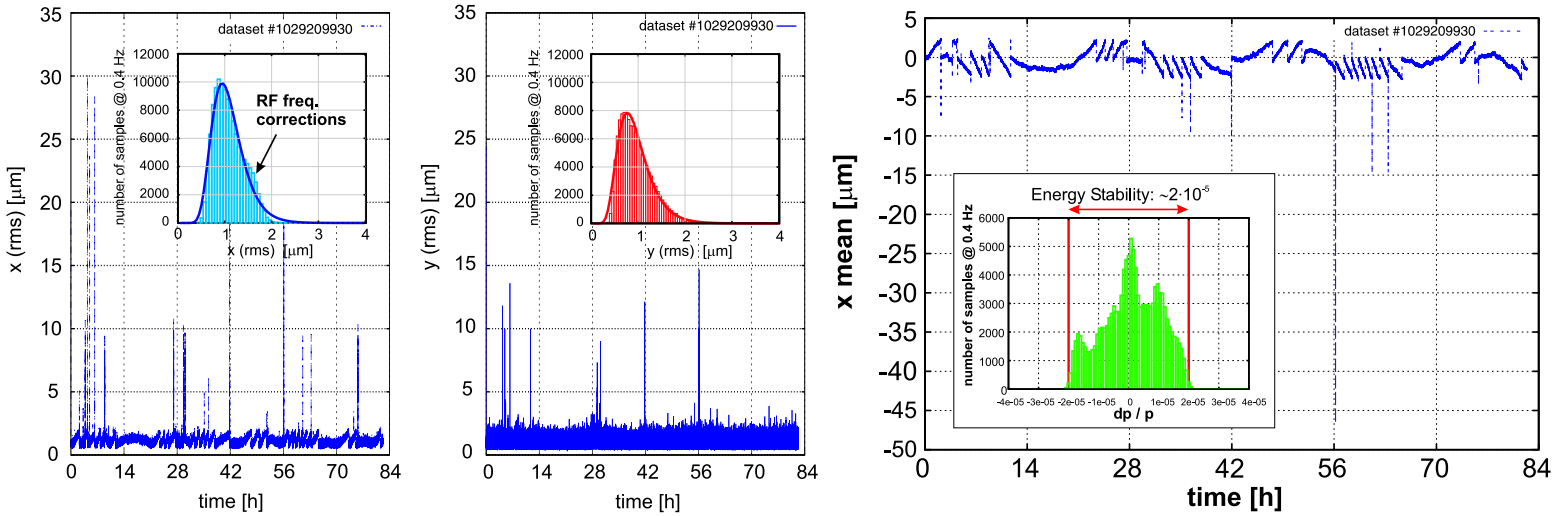


Slow Orbit Feedback: Results



- 2 Hz orbit sampling rate
- Average over 3 samples
- Alternating x/y correction
- 75% of estimated corrector strength applied

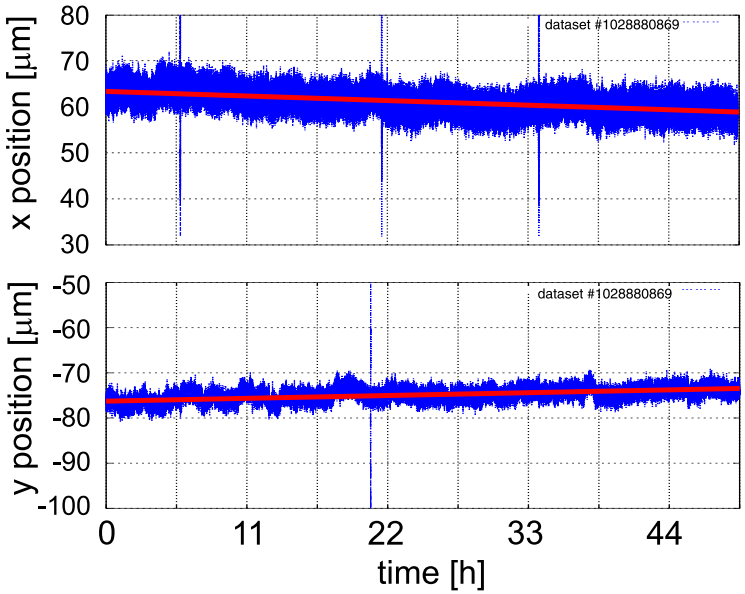
Slow Orbit Feedback: Results (cont.)

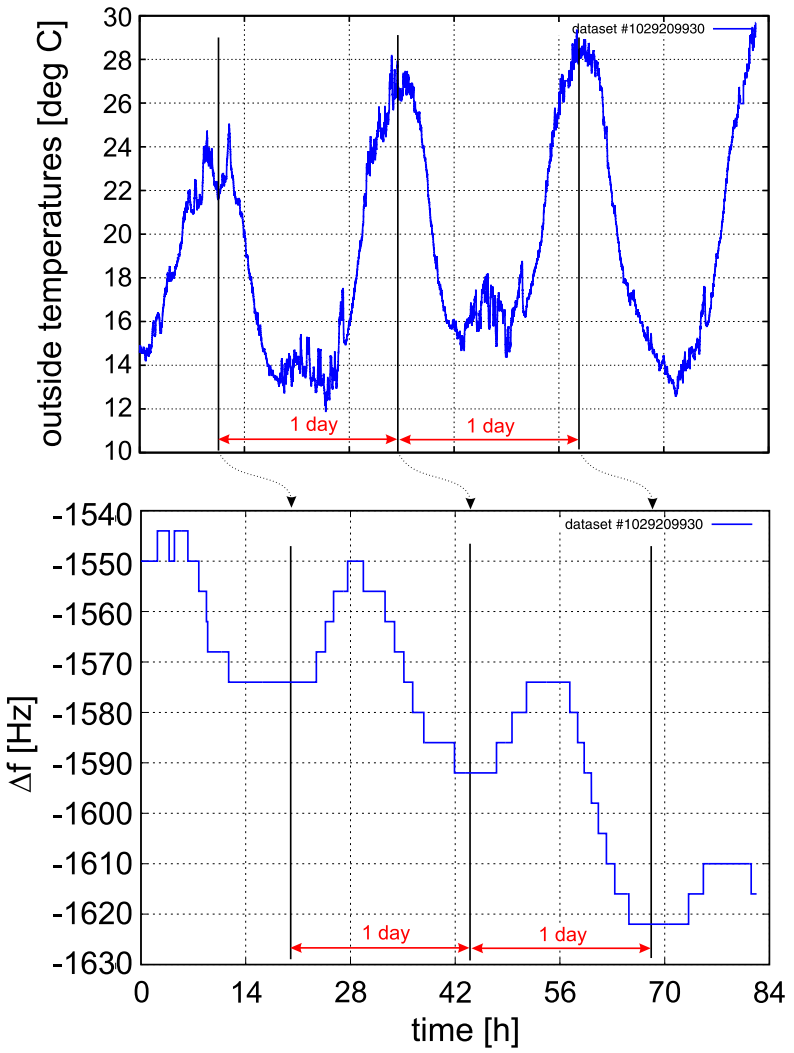


- Sample run Aug, 13-16 2002: x_{rms}, $y_{rms} \approx$ 1 μm (see histograms)
- RF frequency corrected by df whenever |df| exceeds 5 Hz (dE/E $\approx 2 \cdot 10^{-5}$) correction every $\approx$ 45 min (see "saw tooth")

Slow Orbit Feedback: Results (cont.)

- Outside air temperature and RF frequency changes –>
- X-BPM @ **PX** ≈ 9 m from ID **U24**:
  σ_x = 2.7 μm (drift: 2.3 μm)
  σ_y = 1.5 μm (drift: 1.7 μm)





Summary

- All applications needed for commissioning and operation provided
- CORBA framework reliable and flexible
- Accelerator Model well integrated into the Control System
- New Applications profit from modularity of the architecture
  (–> Slow/Fast Orbit Feedback)