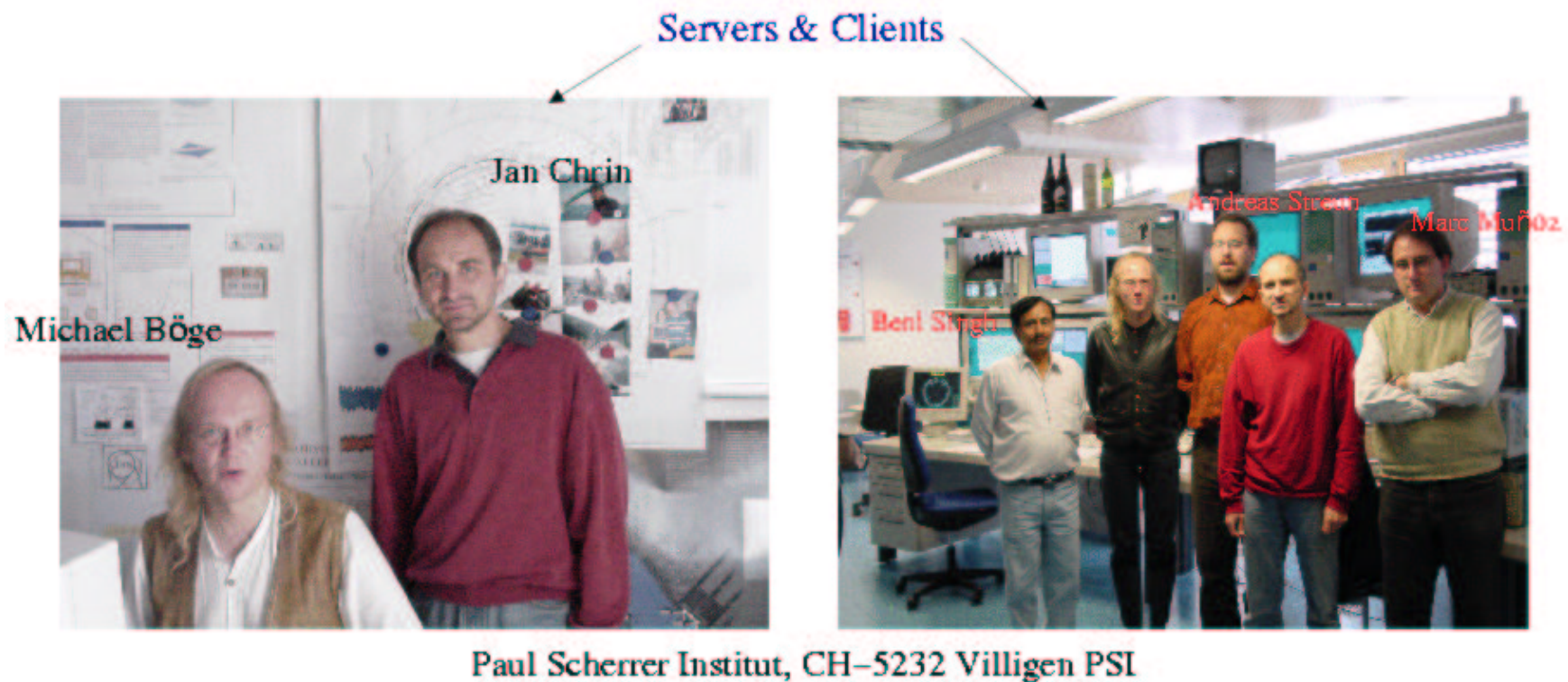


## Members of the SLS Beam Dynamics Group

- J. Chrin, M. Muñoz, A. Streun, M. Böge

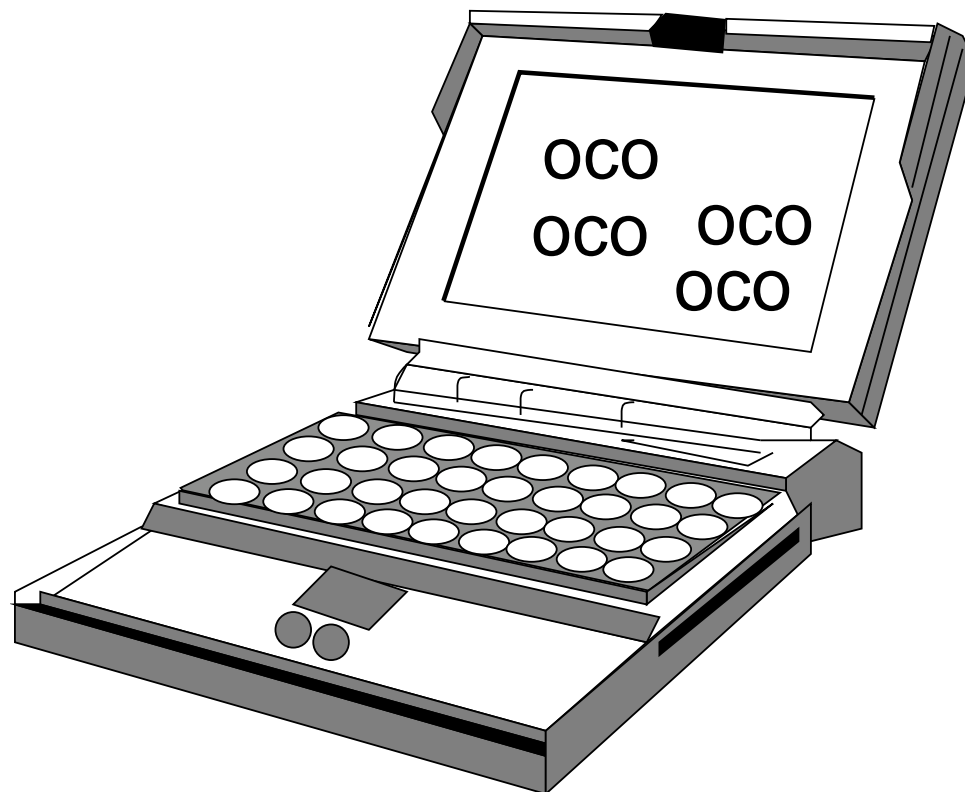


## Overview

- 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

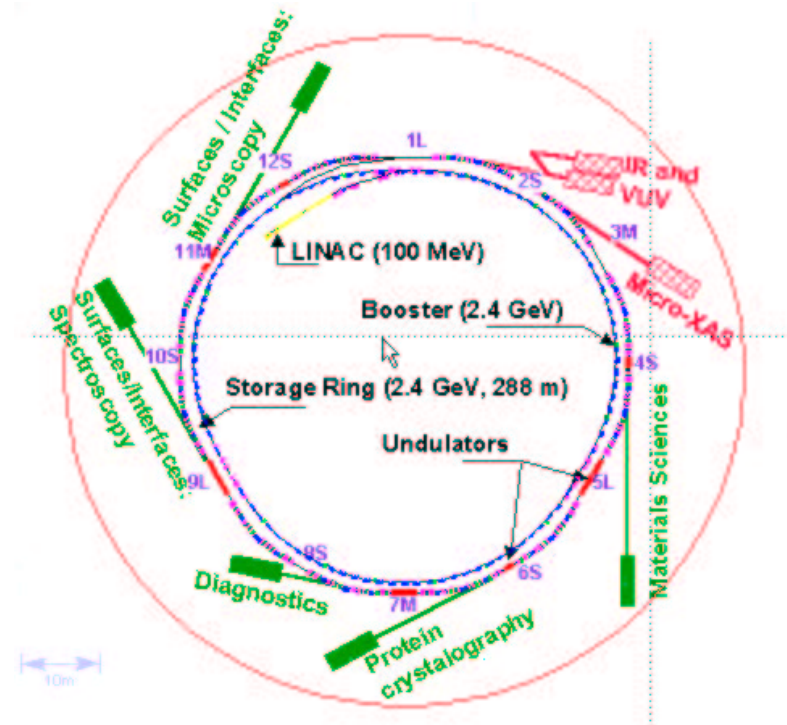
- SLS (Swiss Light Source) 2.4 GeV electron storage @ the Paul Scherrer Institute, Switzerland
- Full energy injector booster synchrotron
- 100 MeV linac
- Operation since August 2001 ( 70% of beam time for users)

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

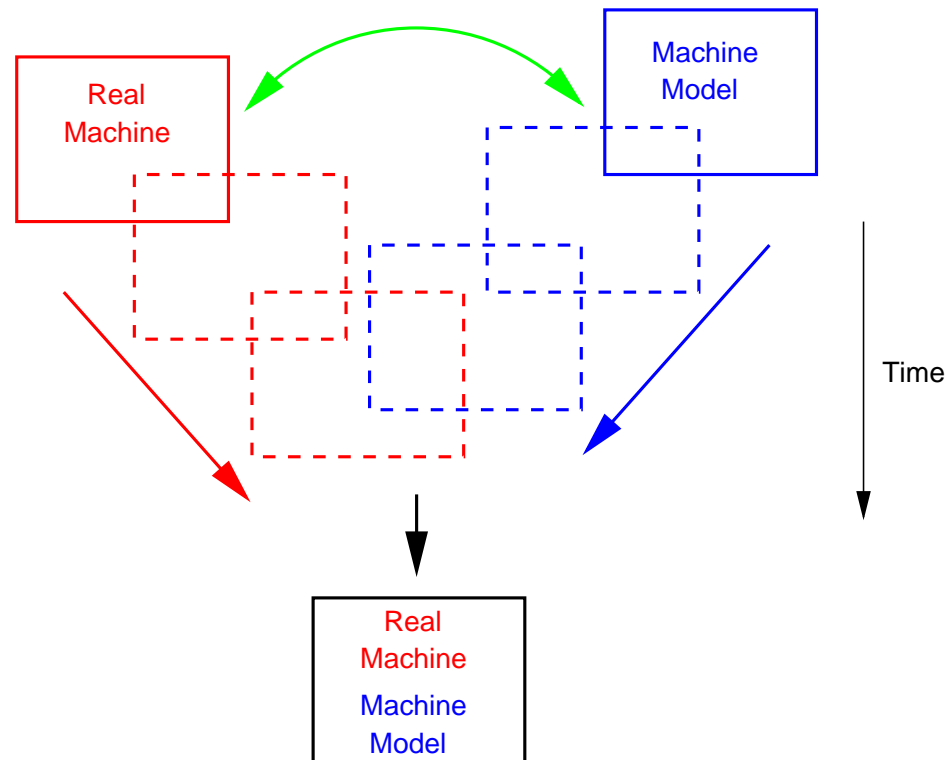
- access to an accelerator physics package
- accelerator device control
- database access and management
- logging of messages and alarms

## SLS Layout

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



## “Machine Model” and “Real Machine”



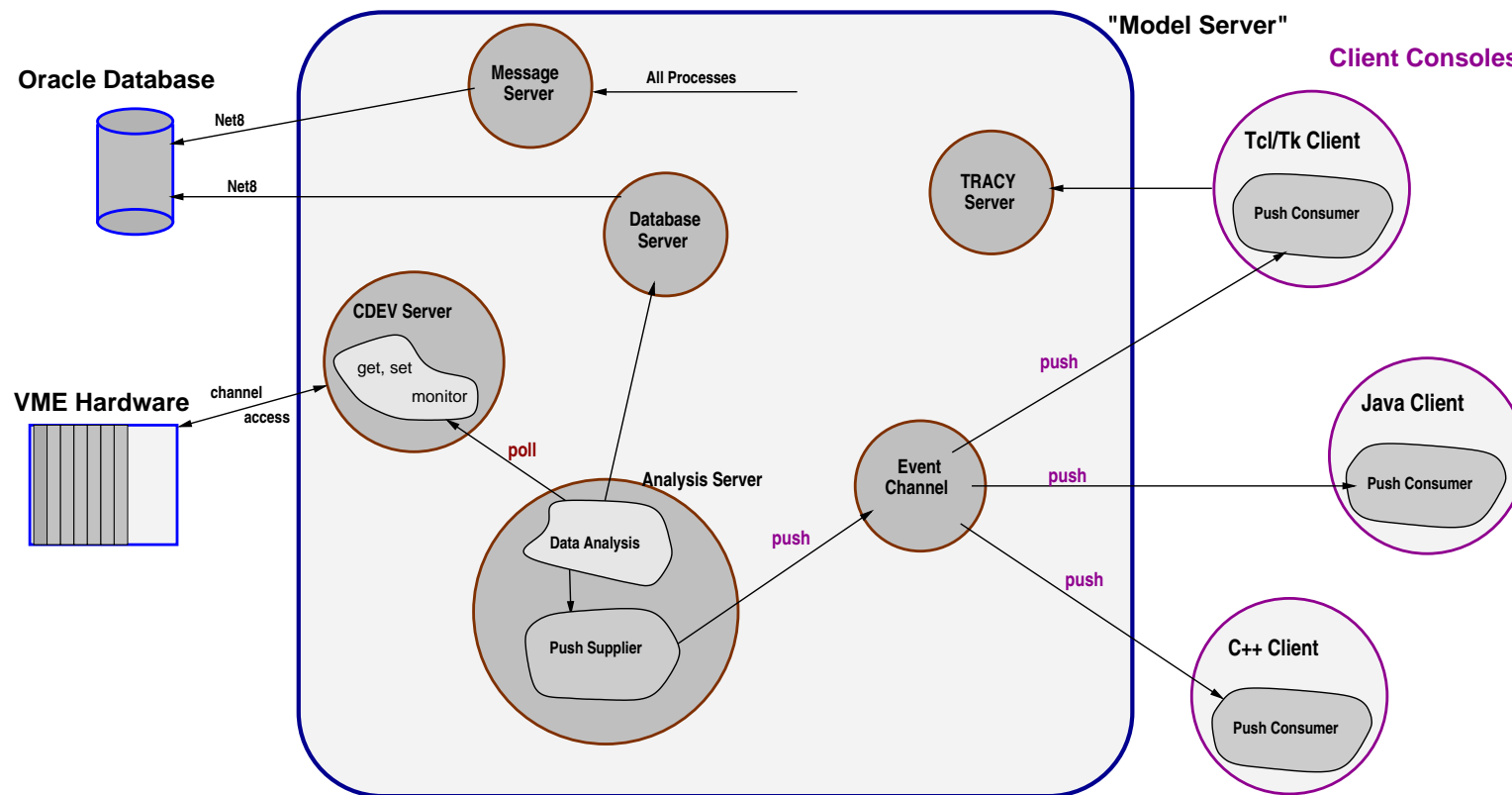
- Improve the “Machine Model” at the same time as the “Real Machine”

## 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  $\leftrightarrow$  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.

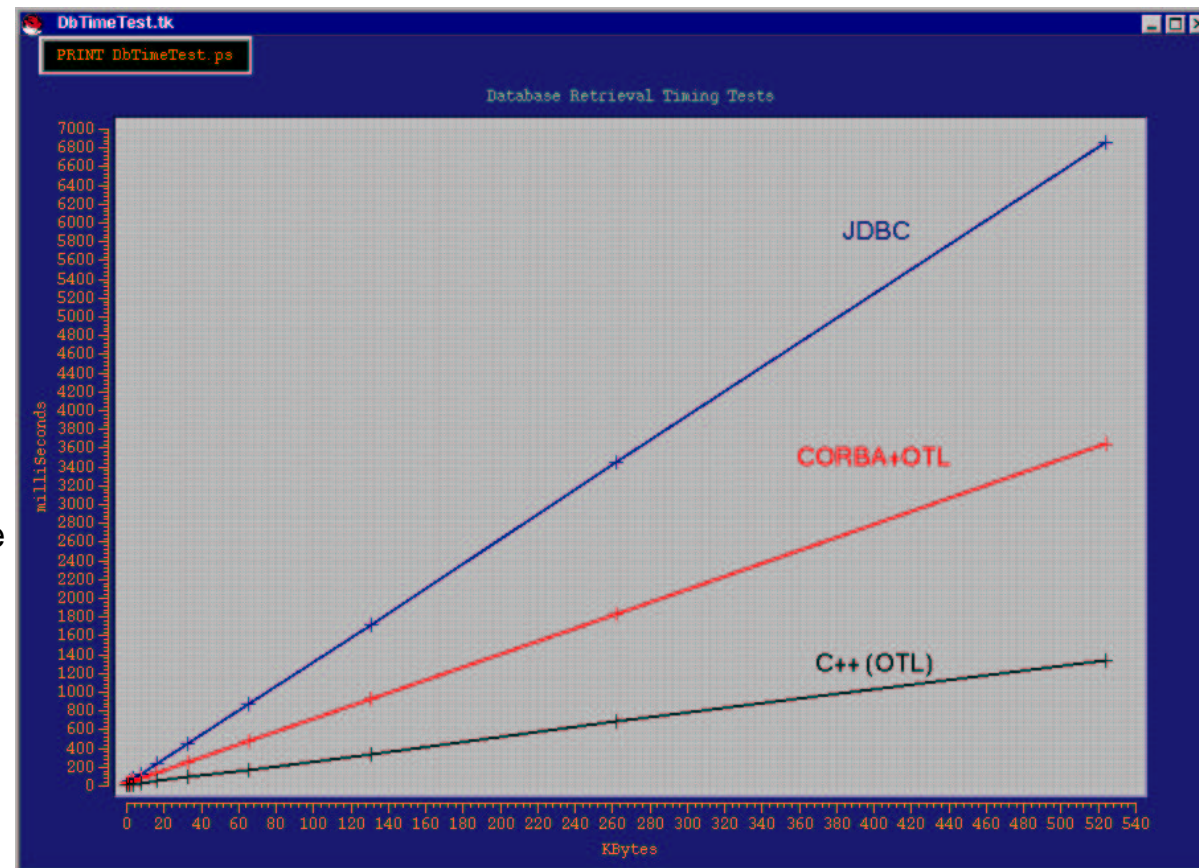
The Database Server completes the suite of essential services!

## Database Server - The Performance

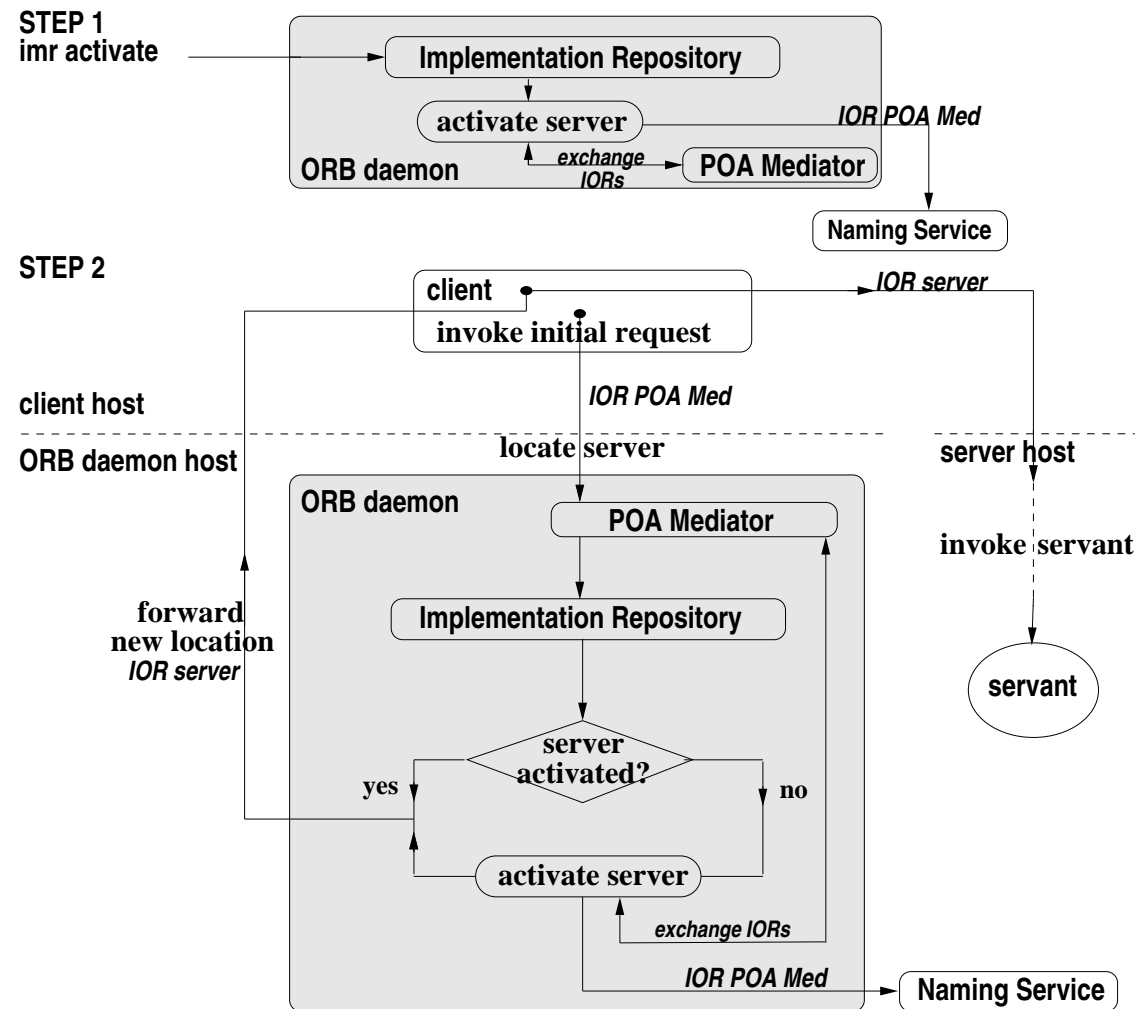
- ▶ C++: 400 Kb/sec
- ▶ CORBA: 140 Kb/sec
- ▶ JDBC: 70 Kb/sec

For retrieval of  
BLOBS from  
the Oracle  
Database

OCI: Oracle Call  
Interface  
OTL: Oracle Template  
Library



## CDEV Server - The Portable Object Adapter



# Server Management

The screenshot displays two main windows: **Tklogger(sls)** and **System Control**.

**Tklogger(sls)** shows a log of system events. The main log area contains entries such as:

```

Jun 13 17:33:11 slsbd4 slsbdservice: --- adding imr entry: SLSBdTracyRImaGetLinOptB
Jun 13 17:33:11 slsbd4 slsbdservice: --- adding name server entry: SLS:BdTracy:RI:ma:GetLinOptB
Jun 13 17:33:11 slsbd4 slsbdservice: --- deleting imr entry: SLSBdTracyRImaGetLinOptB
Jun 13 17:33:11 slsbd4 slsbdservice: --- deleting name server entry: SLS:BdTracy:RI:ma:GetLinOptB
Jun 13 17:33:11 slsbd4 slsbdservice: --- Shutting down SLS/BD CORBA s
run number=05):
Jun 13 17:33:11 slsbd4 slsbdservice: --- Shutting down TRACY daemon (
Jun 13 17:33:11 slsbd4 slsbdservice: --- Starting SLS/BD CORBA servic
number=05):
Jun 13 17:33:11 slsbd4 slsbdservice: --- Starting TRACY daemon (GetLi

```

Below the main log is a section for **Priority Messages** with a table:

Logger color	Sylog file
red1	/var/log/sls/bd.crit
red4	/var/log/sls/bd.err
midnightblue	/var/log/sls/bd.notice

At the bottom of Tklogger is a **Pause** button.

**System Control** window shows a menu of services:

- System Control
- CORBA Services
- Naming Service Manager
- >>> wait for status display <<<
- prompt for args ->
- status
- restart
- stop
- start
- >>> wait for status display <<<
- Logger
- prompt for args ->
- mode
- Model Server
- default ?
- default
- status
- login
- Miscellaneous
- Phone Numbers

Two smaller windows are also visible:

- default**: Shows a prompt for arguments, with options like `>psi.ch<`, `default (slsbd4 or >slsbd3<)`, `slsbd4`, `slsbd2`, and `>slsbd3<`.
- stop**: Shows a list of groups to stop, including `group 4 (Analysis/TracyServers)`, `group 3 (BpmCdevServers) +4`, `group 2 (CdevServers) +3+4`, `group 1 (LogServer,DbServer,EventServers) +2+3+4`, `group 0 (NameService, EventService) +1+2+3+4`, `all`, and `emergency stop`. It also includes the option `all +Object Adapter Daemon restart`.

Red arrows indicate connections between the **stop** window and the **System Control** window, specifically pointing to the **stop** and **emergency stop** options.

Message logger

## Server Management (cont.)

The screenshot displays the SLS server management interface. The main window shows a list of running services, including various EventServers and EventChannels. A message logger at the bottom shows several 'NotFound exception' messages. The ORBacus Names Console is open, showing a list of services and their status. A dialog box 'Enter IOR' is also visible.

Annotations:

- 226: run number 26 in run group 2
- name service manager
- Message logger

## “CORBA/Model Server”: Hardware



UPS

Model Server #1

SMP system:  
2 x PIII 1Ghz  
1 Gb Memory

TRACY model, feedback

CORBA Server #2

SMP system:  
2 x PIII 600Mhz  
1 Gb Memory

MICONS = slsbd4  
default system

CORBA Server #1

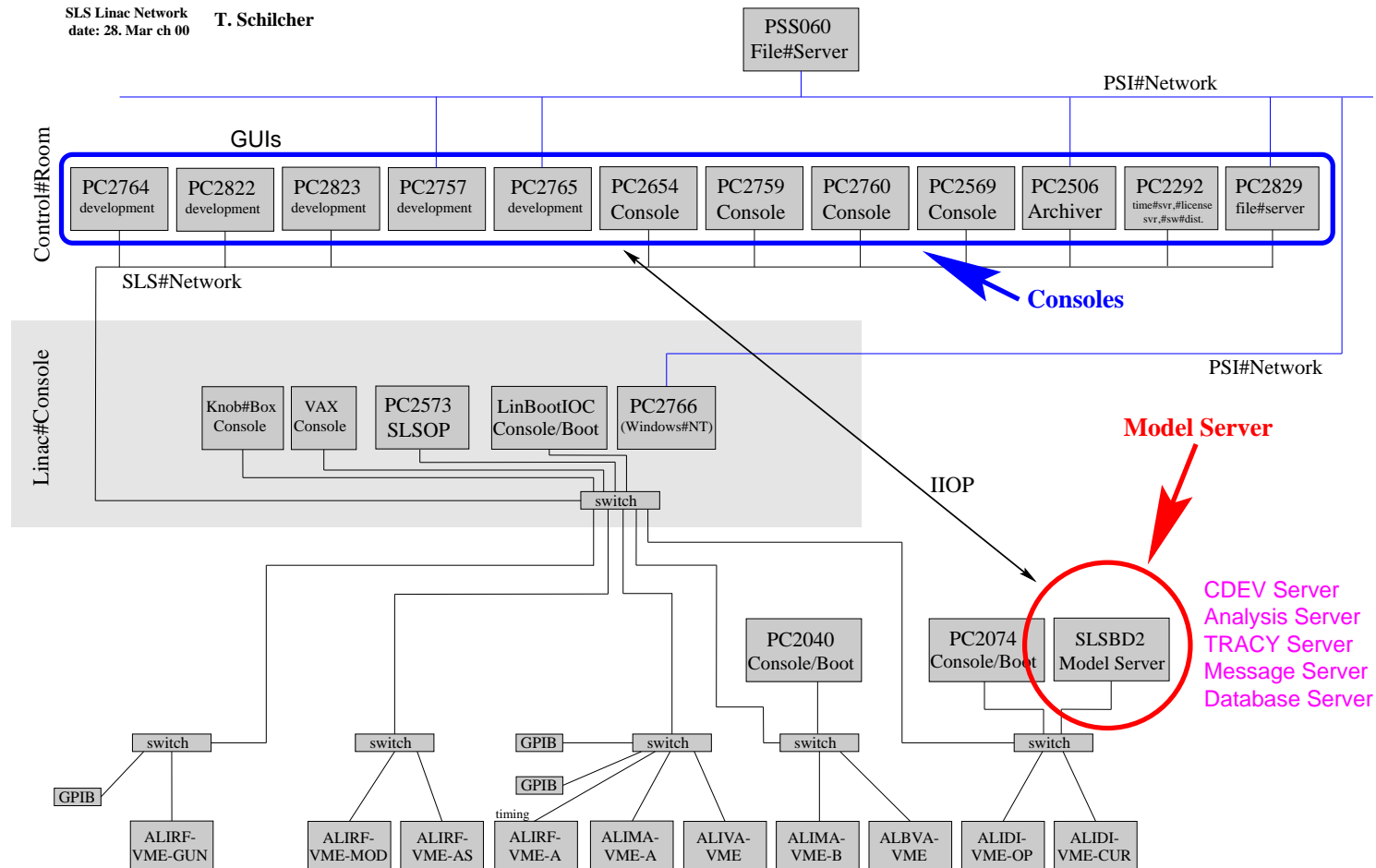
SMP system:  
2 x PIII 500Mhz  
1 Gb Memory

MICONS = slsbd2  
mirror system

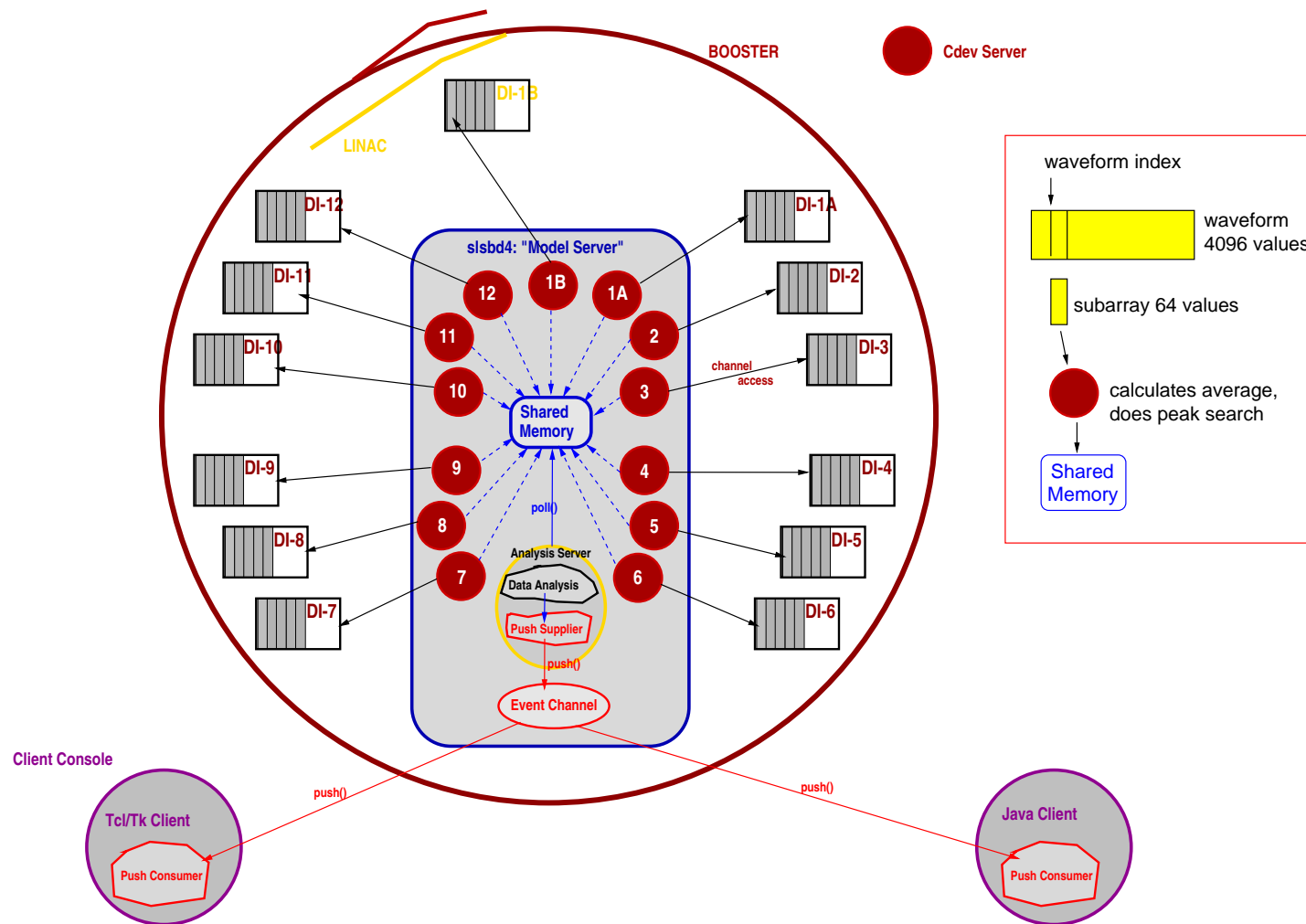
## “CORBA/Model Server”: Integration Control System

**SLS Linac Network**  
date: 28. Mar ch 00

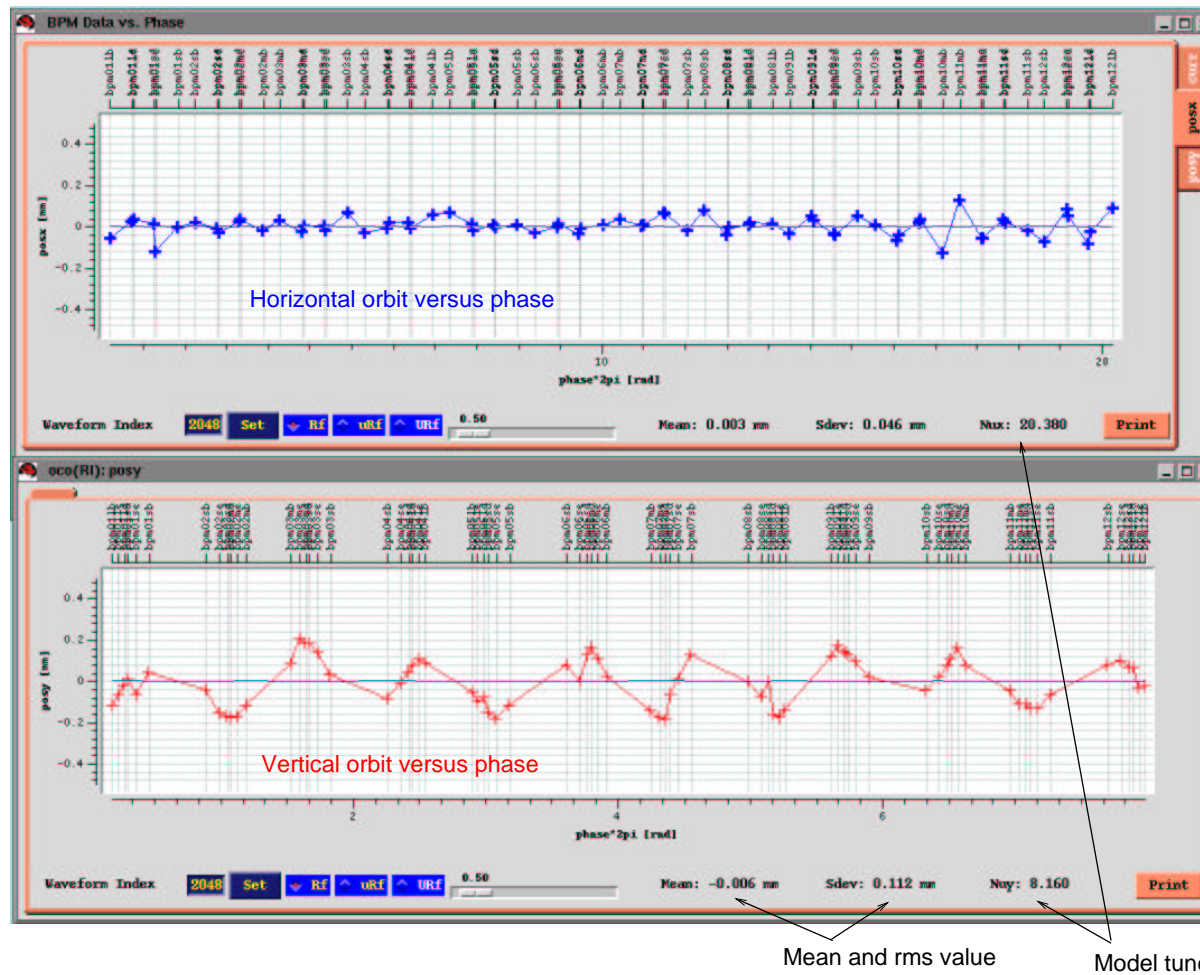
T. Schilcher



## Orbit Display: Schematics of Data Flow



## Orbit Display: Visualization from Tcl/Tk/CORBA Client

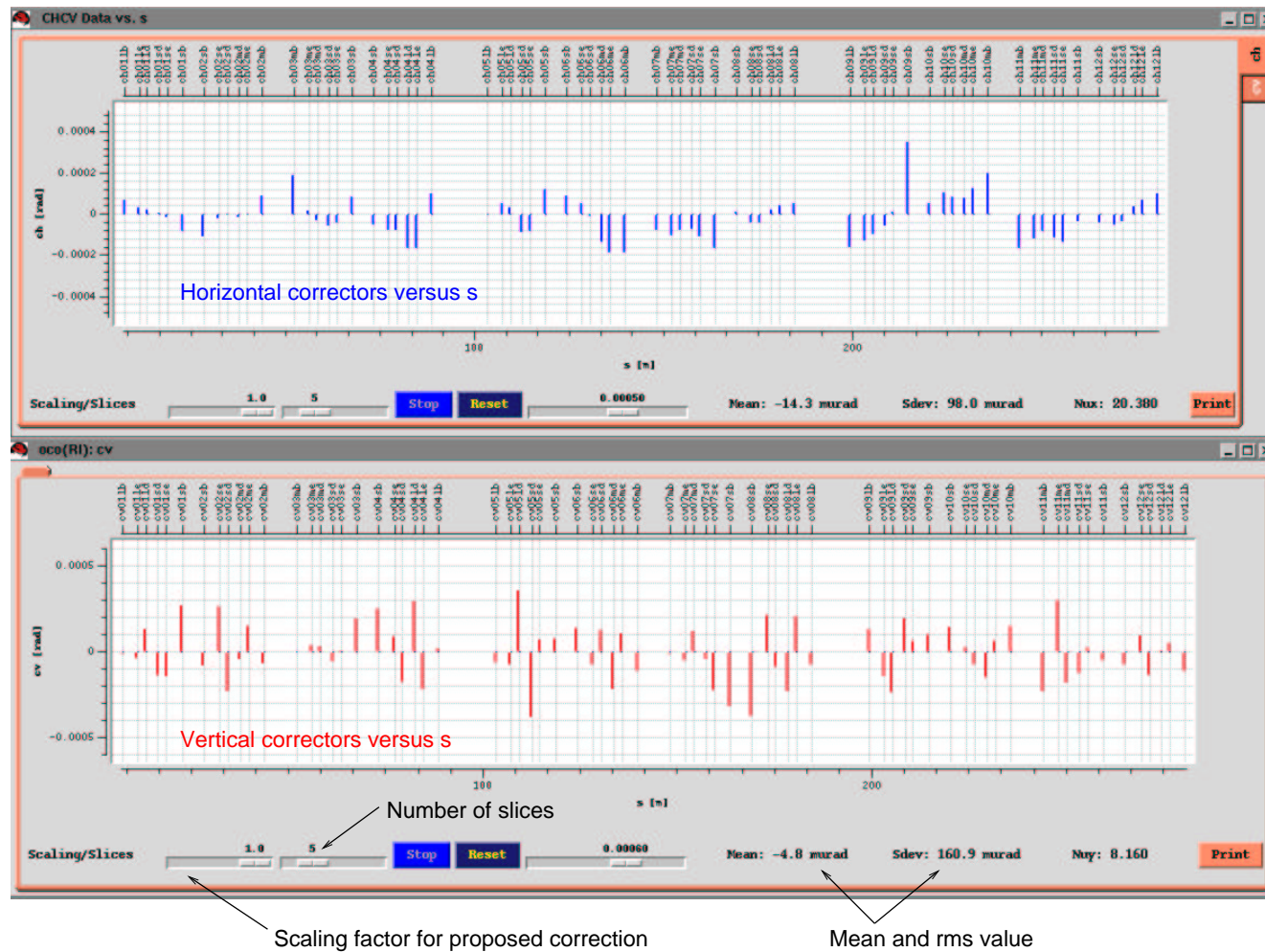


# Orbit Correction: Tcl/Tk/CORBA Client

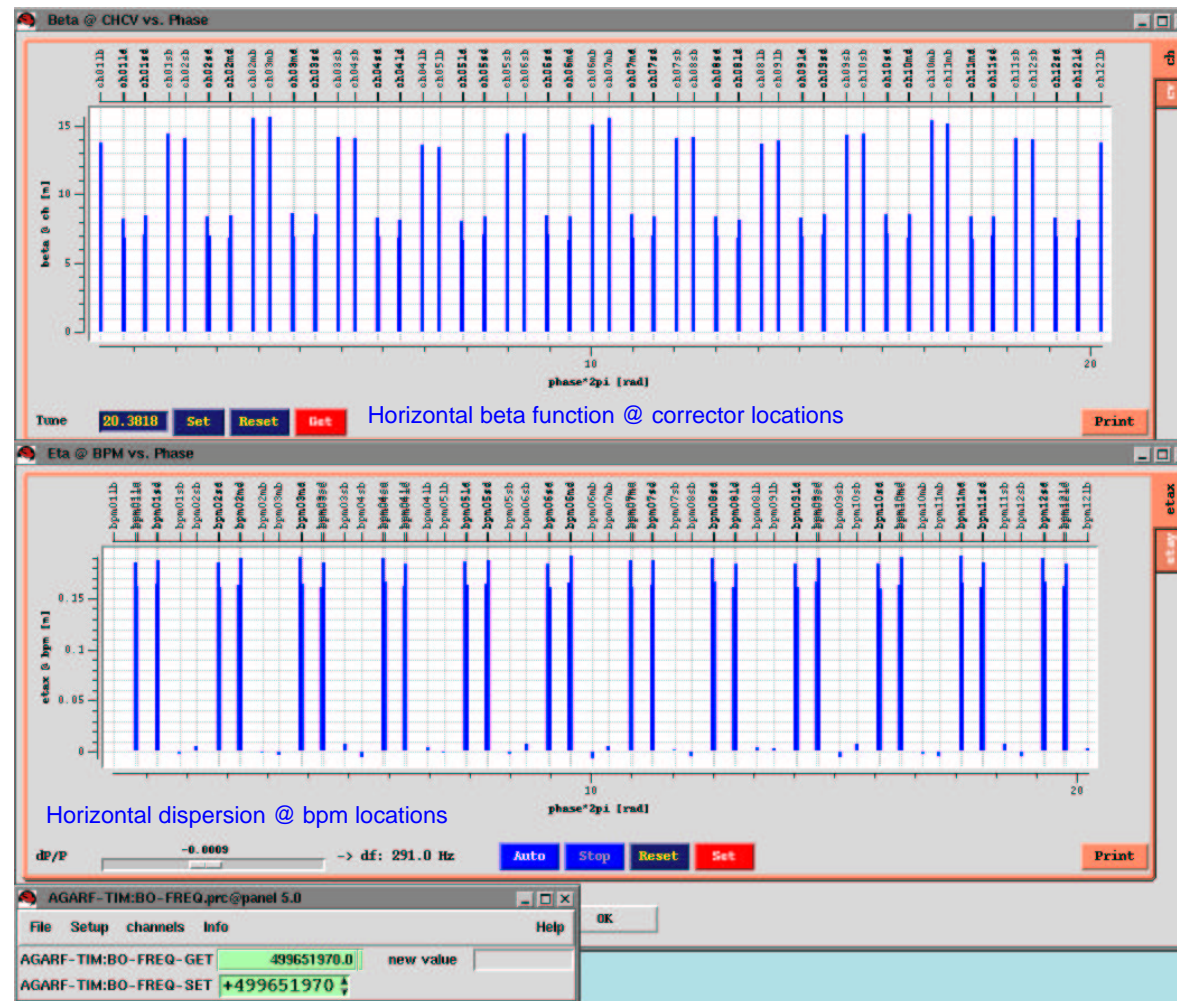
Annotations:

- Load/Save snap shots
- oco main panel
- Info/Debug messages
- Message logger
- Error Messages
- Orbit Correction
- Bumps

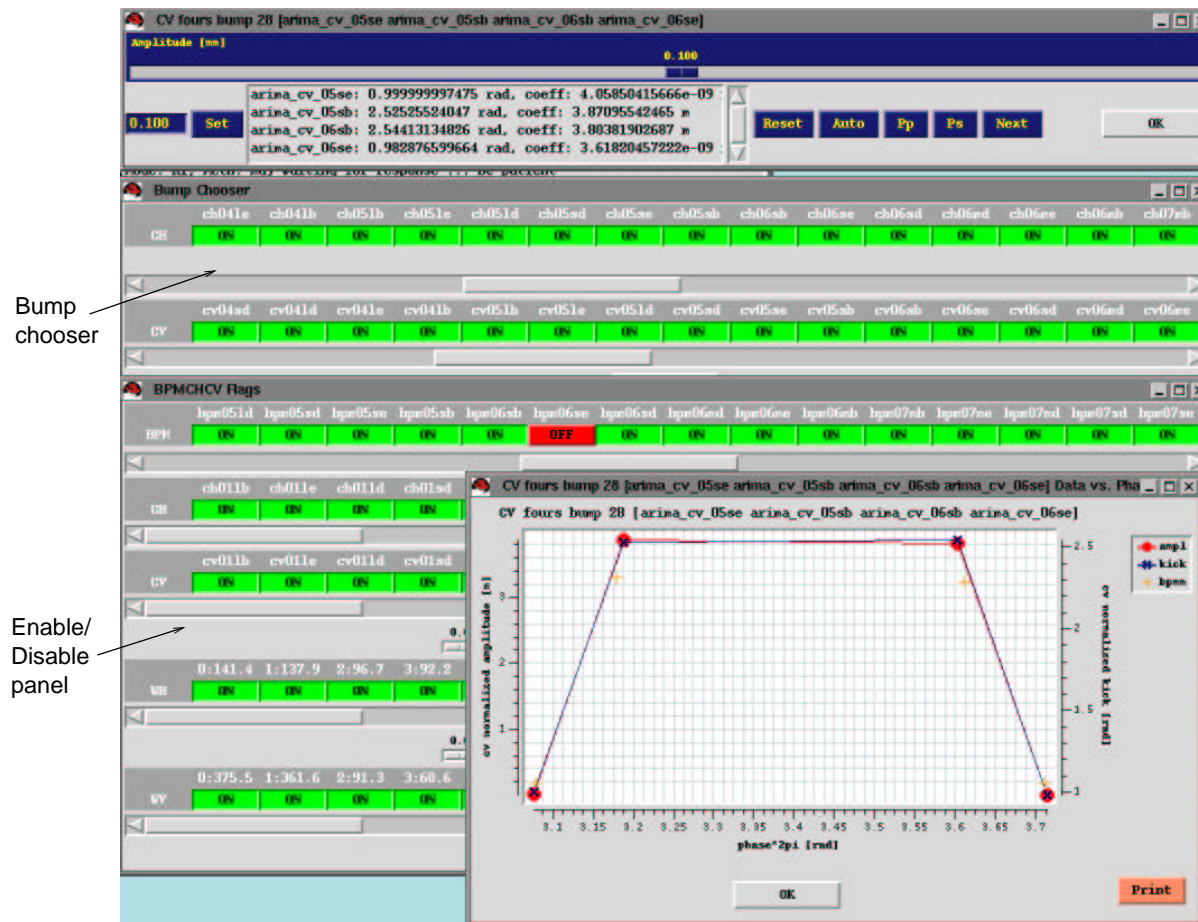
## Orbit Correction: Correctors



# Orbit Correction: Optical Functions



## Local Bumps: Local Bumps

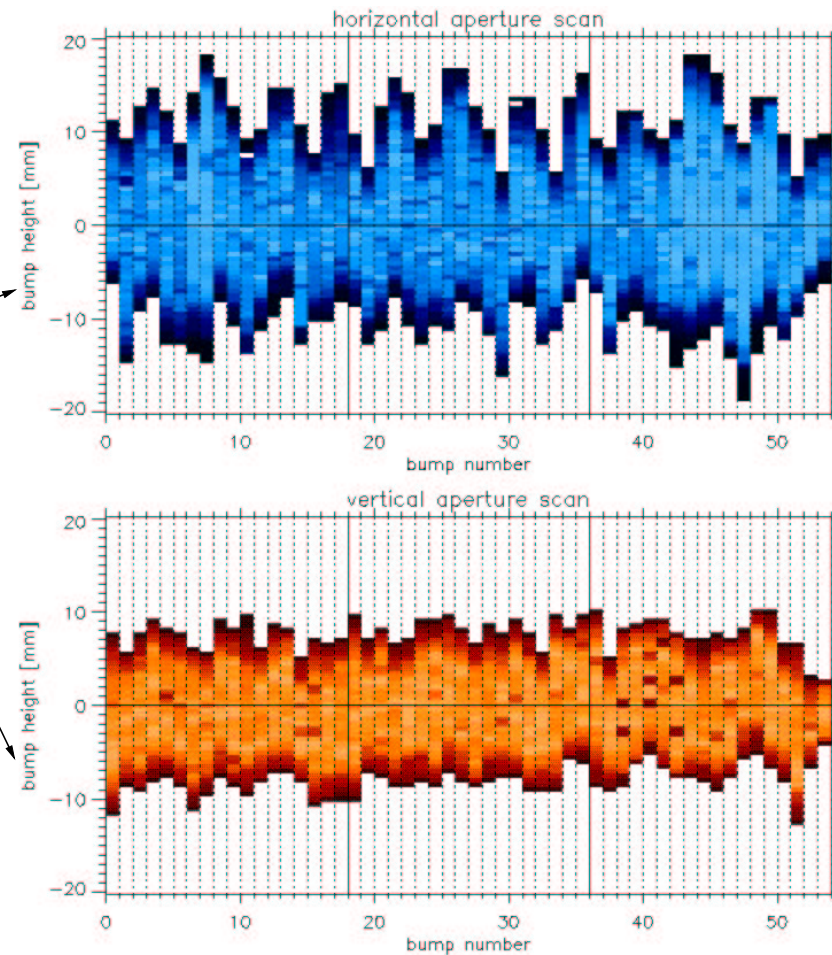
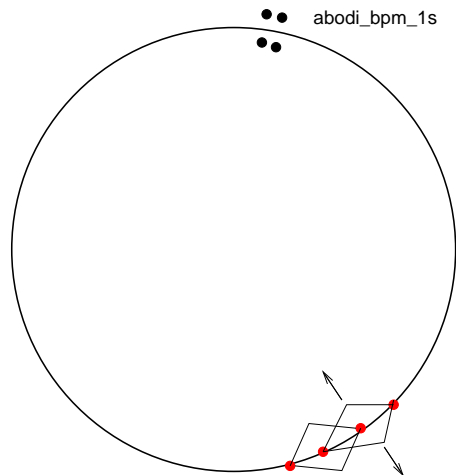


## Local Bumps: Monitor Calibration in the Booster

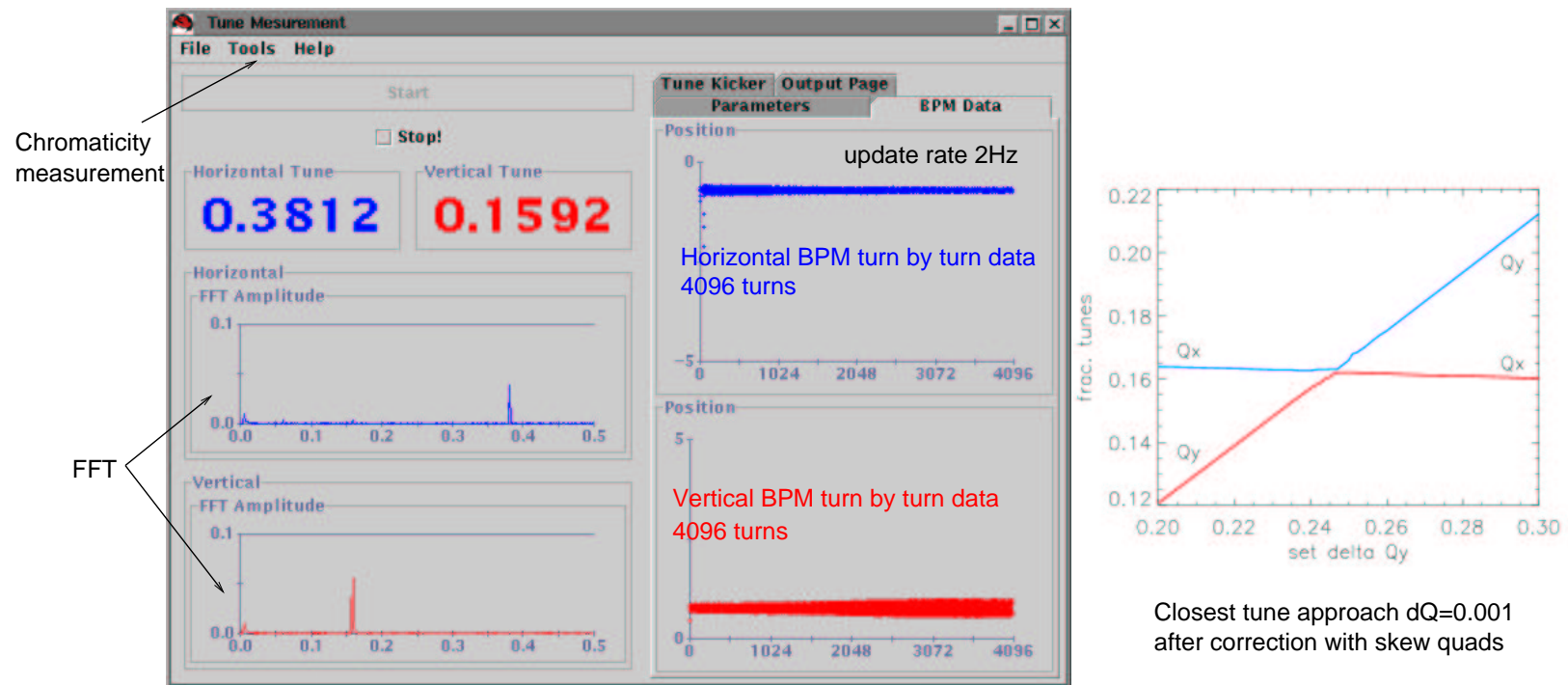
Measurement based on sum signal of BPM "abodi\_bpm\_1s"

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

The "bump height" is calculated from the model.



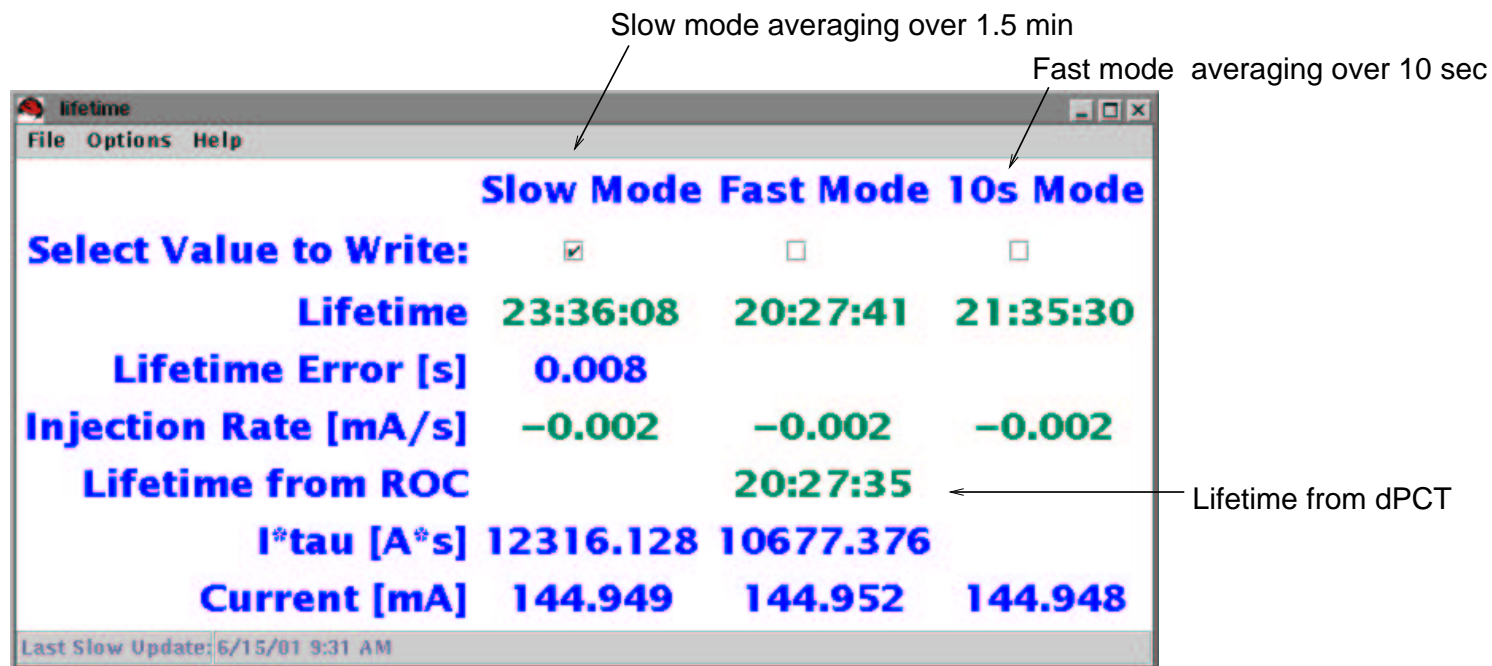
## Tune Measurement: Java/CORBA Client



Design tune  $\nu_x=20.38$ ,  $\nu_y=8.16$  Tune data are written to EPICS soft channels

Closest tune approach  $dQ=0.001$   
after correction with skew quads

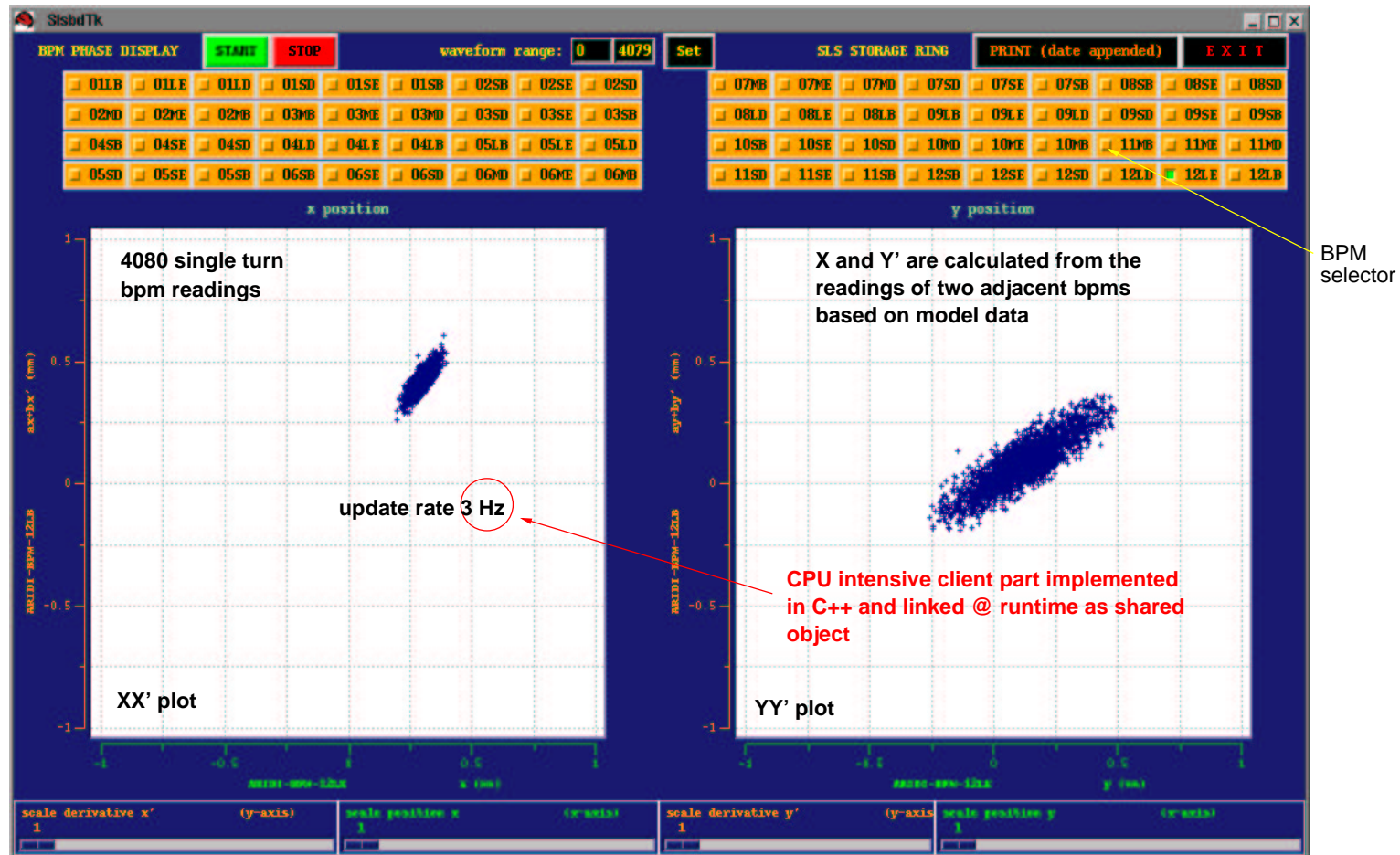
## Lifetime: Java/CORBA Client



23.5 h lifetime @ 145 mA

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

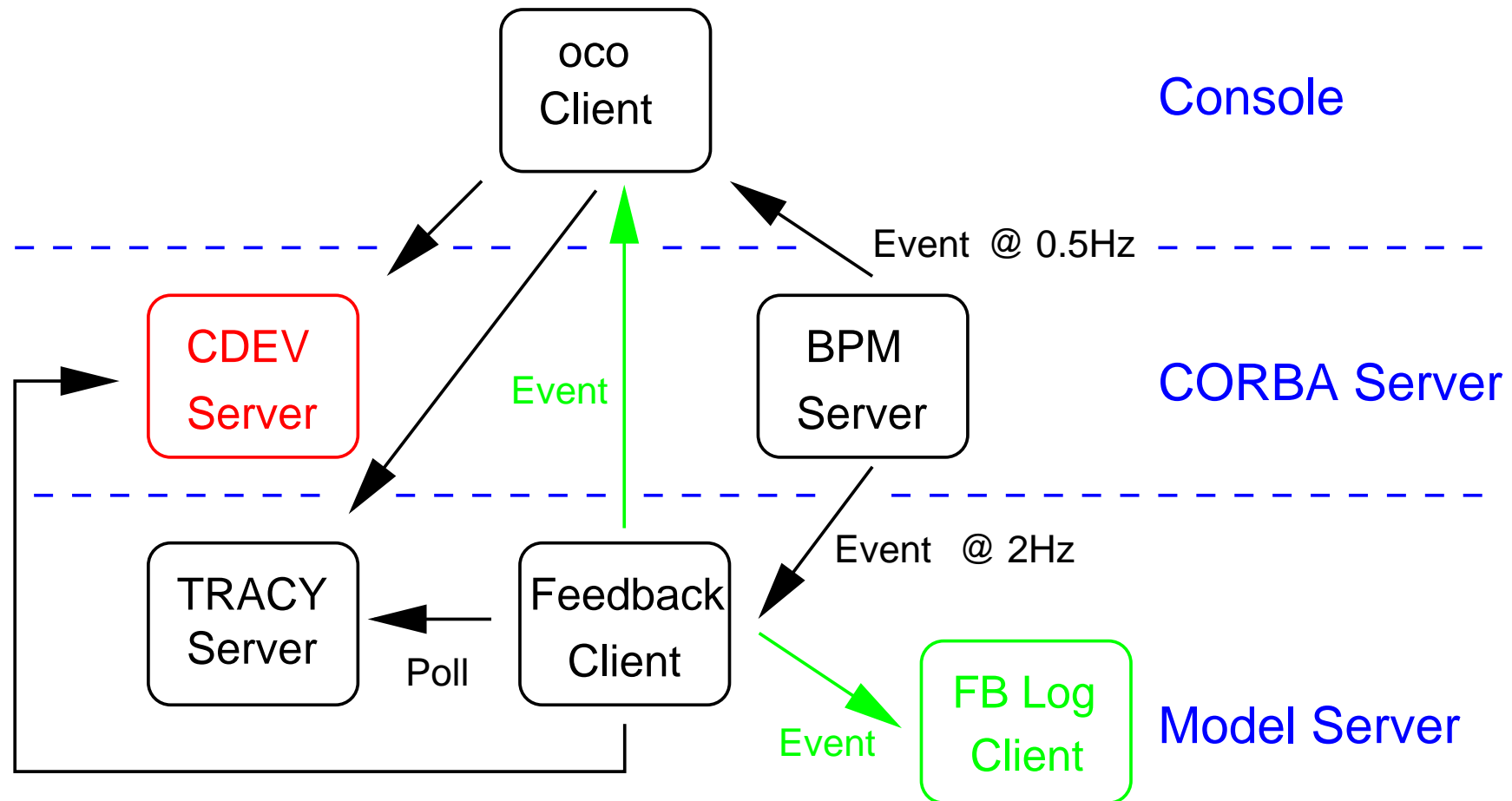
## Phase Space Display: Tcl/Tk/C++/CORBA Client



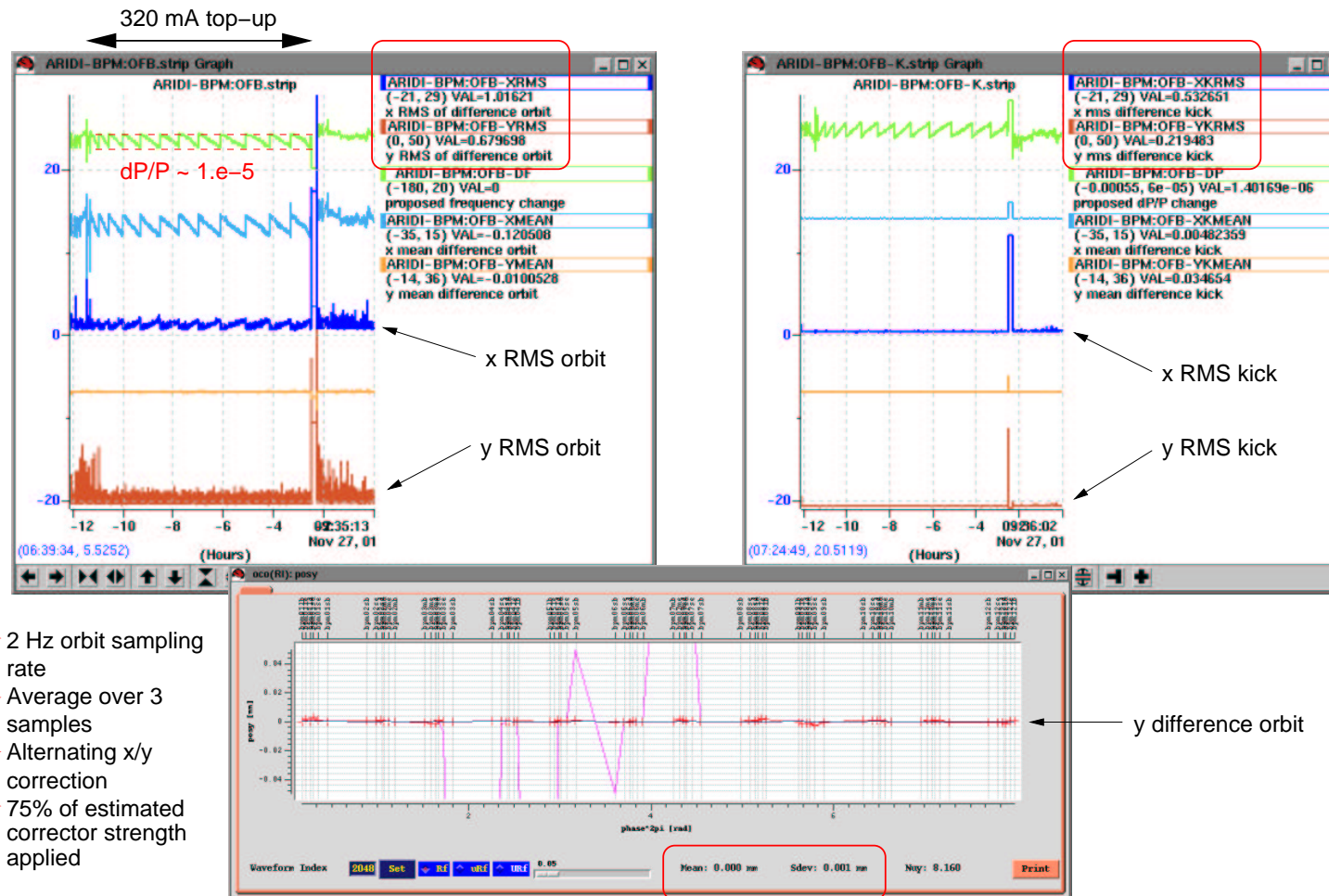
# Transferline Twiss Parameters: Tcl/Tk/CORBA Client



## Slow Orbit Feedback: Schematics

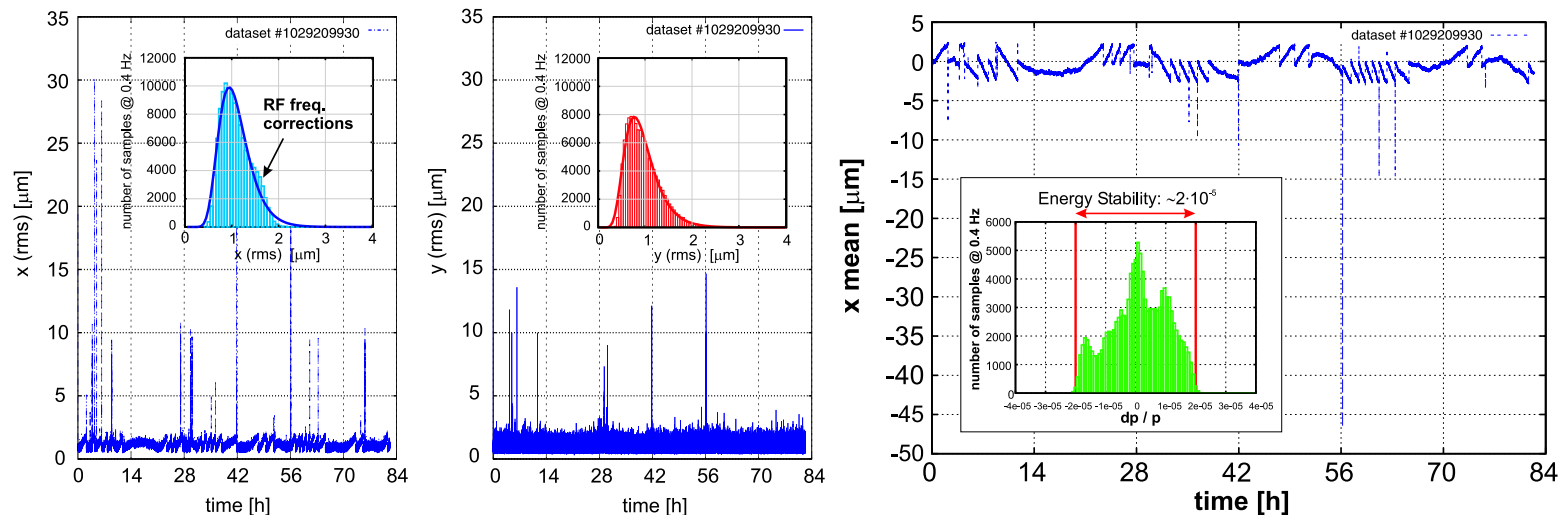


# Slow Orbit Feedback: Results



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

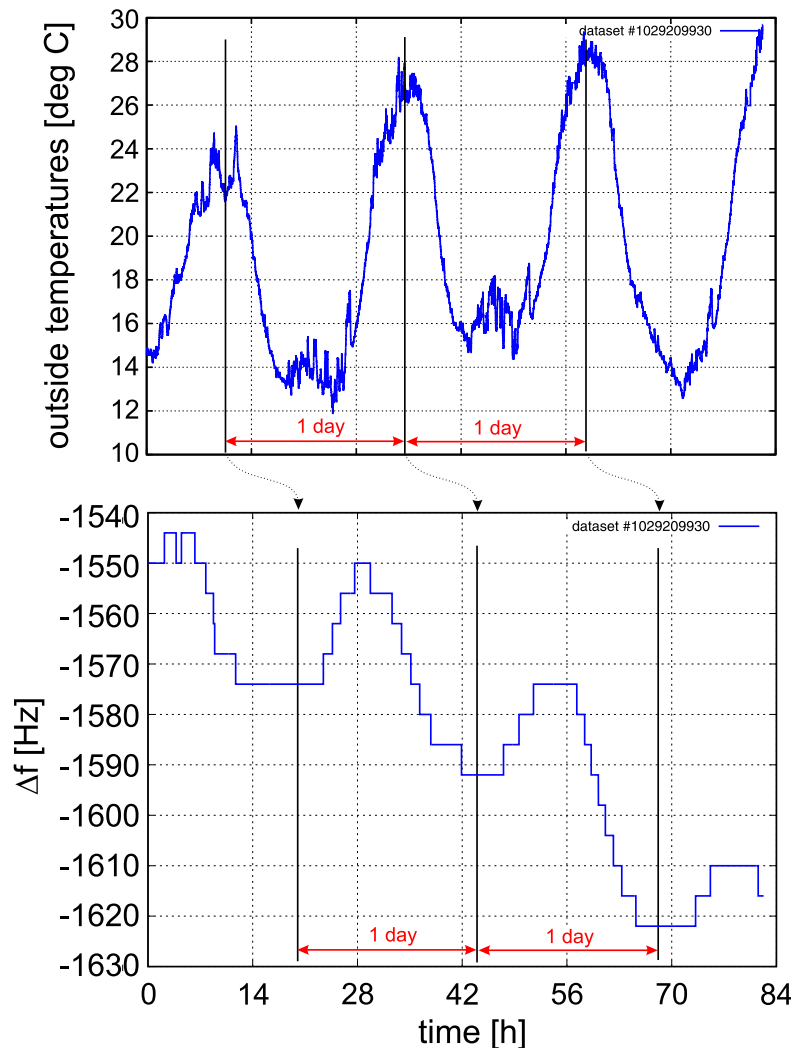
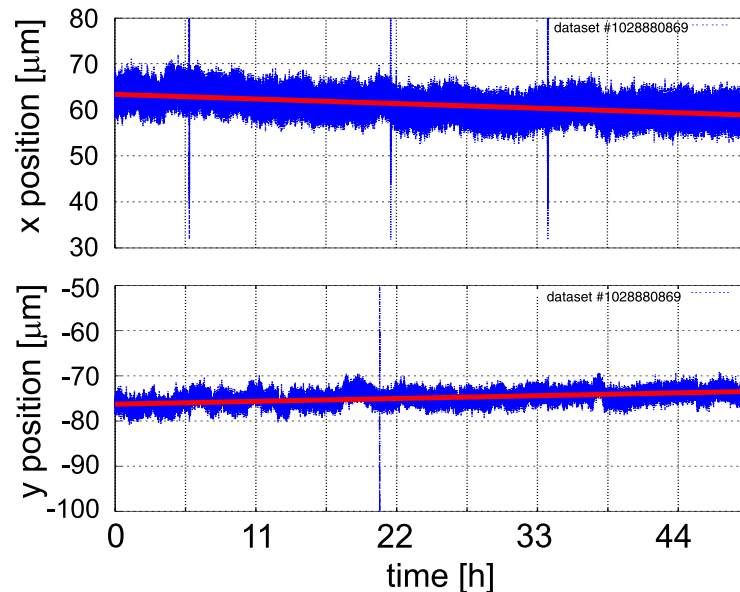
## Slow Orbit Feedback: Results (cont.)



- Sample run Aug, 13-16 2002:  $x_{rms}, y_{rms} \approx 1 \mu m$  (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  $\rightarrow$
- X-BPM @ **PX**  
 $\approx 9$  m from ID U24:  
 $\sigma_x = 2.7 \mu\text{m}$  (drift:  $2.3 \mu\text{m}$ )  
 $\sigma_y = 1.5 \mu\text{m}$  (drift:  $1.7 \mu\text{m}$ )



## 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)

