Flight Simulator for ATF2

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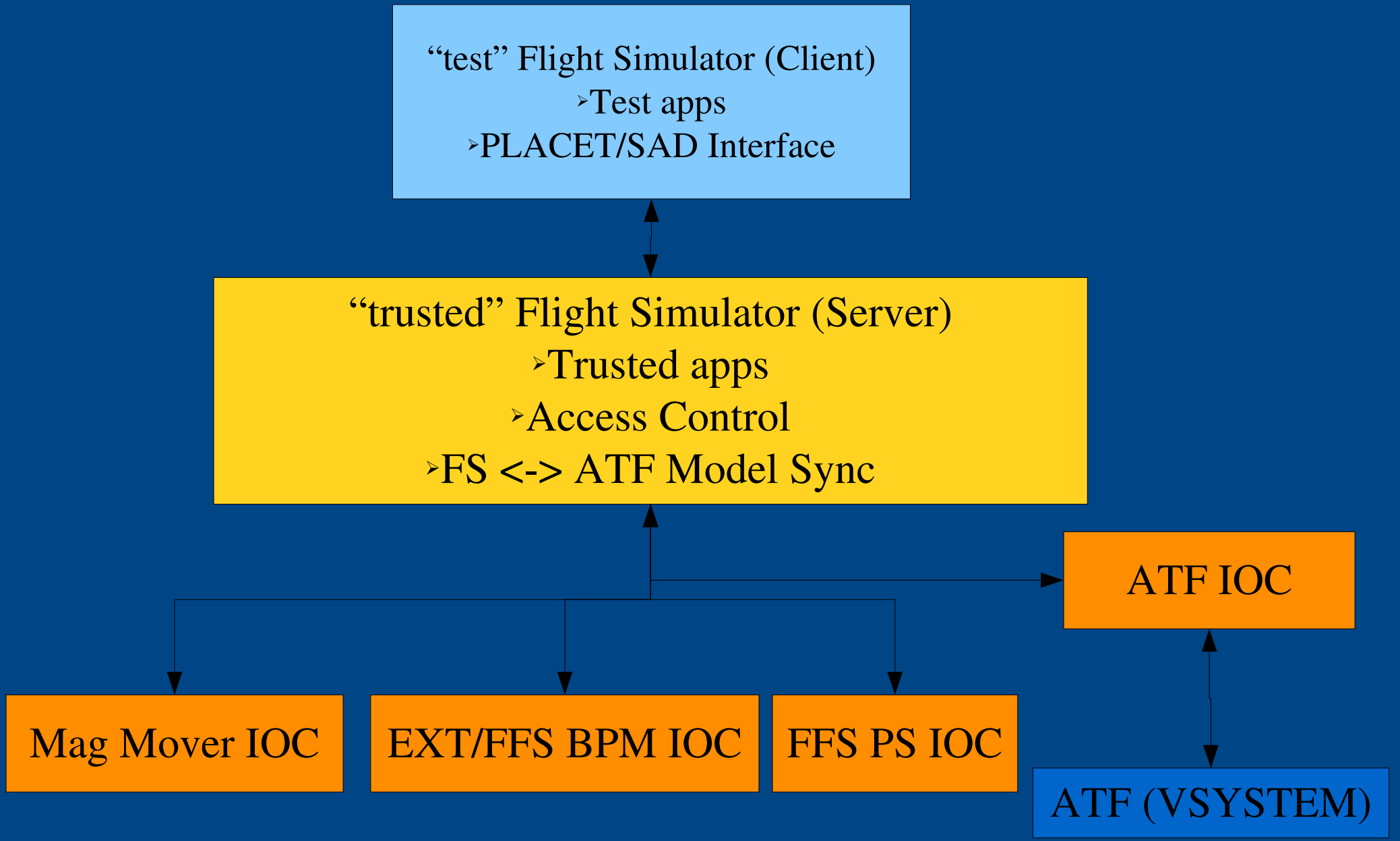
- Project goals.
- Implementation plans for ATF2
- Tests at ATF

Flight Simulator Goals

- Provide simple to use, beam dynamics oriented, portable control access framework for ATF2 tuning tasks.
- Simple and reversible transition from beam dynamics simulation to accelerator-ready code.
- Ability for international collaborators to develop beam tuning tools without need for expert-level knowledge of control systems.
- Flight simulator operates in simulation mode at external location in the same way as the production system deployed at ATF2.

Implementation at ATF(2)



Software Overview

- Core Flight Simulator software written in Matlab, based on Lucretia accelerator toolbox.
- Floodland module provides flight simulator functionality:
  - Server-client communications.
  - Access control to client installations.
  - Server-based data services (bpm averaging etc).
  - Sync epics ioc db entries with Lucretia model.
  - Maintain updated AML and Lucretia models.
  - Provide PS setting, magnet move functionality through native Lucretia functions (PSTrim, MoverTrim).

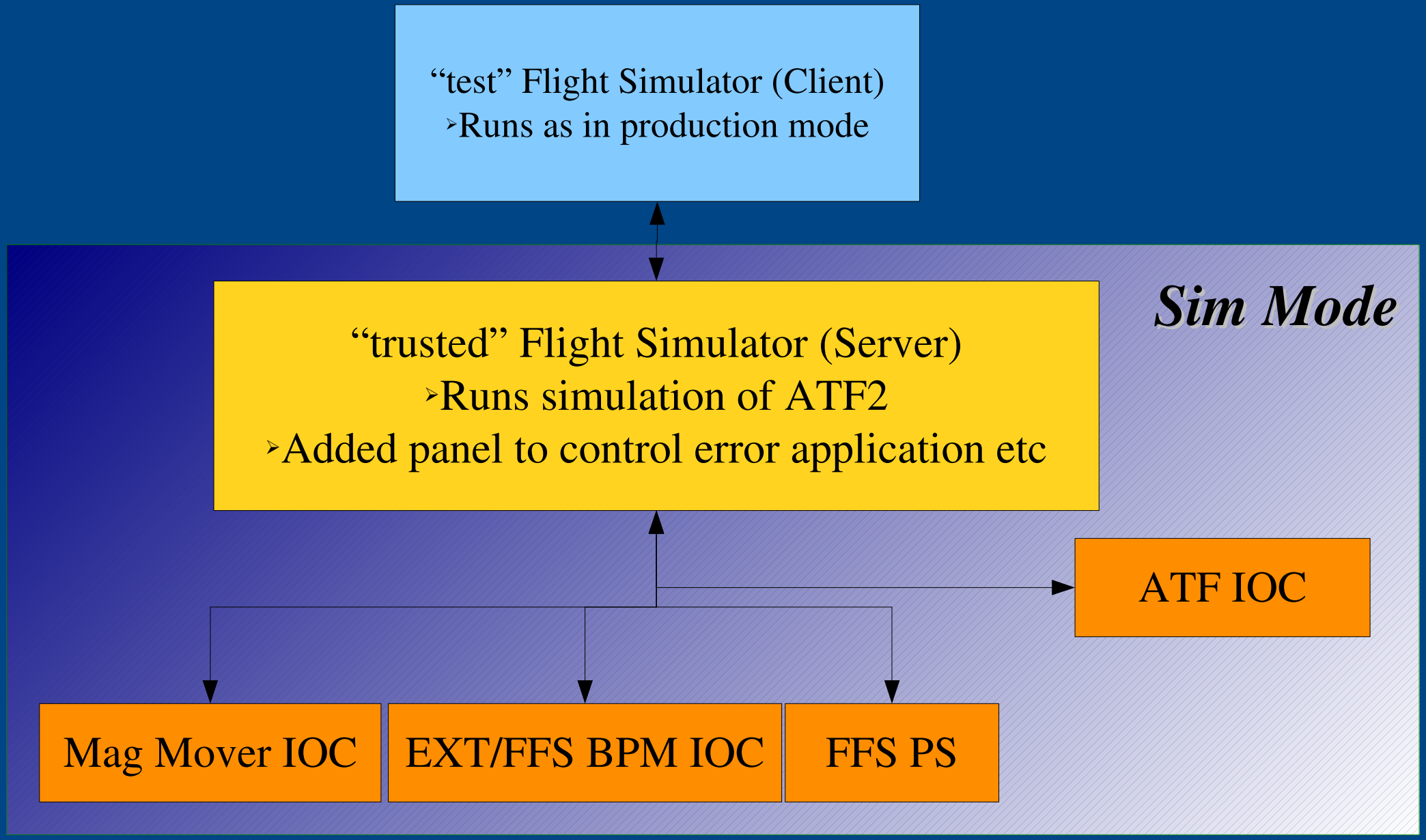
Software Overview

- Lucretia2AML
  - Synchronises Lucretia model with AML
  - Entry-point for non-Lucretia tracking code support
- Client-side runs server for non-Lucretia based support through socket communications
  - Currently tested with PLACET (running with tcl/tk & octave)
- EPICS (hardware IOC's + simulation)
    - Movers, bpms, power supplies
    - ATF interface (Vsystem –ring mags + bpms, ATF controls)
- Documentation effort starting
  - *https://confluence.slac.stanford.edu/display/ATF/ATF2*

Security

- The computer which hosts the trusted server on control system sub-net has read/write privs on all EPICS databases.
- Users test their code on client which must request access privs from trusted server.
  - When tested, code can be migrated easily from client to server which then sits on main control console.
- Security provided by ATF network infrastructure and by EPICS access control which only allows write access through trusted server.

Sim. Implementation



Simulated Functionality

- Make as similar to production system at ATF as possible.
- Runs all on single pc (or more if desired).
- Enables simulation of real machine, enabling realistic testing of accelerator-ready beam dynamics code without need of access to KEK systems.
- EPICS IOCs are also running in the simulated environment providing the ability to build and test custom hardware interface with a simulated version of the complete set of in-production IOC's, control software and tuning routines etc.

External Interface

- Client Flight Simulator installation runs a socket server to provide Lucretia and Floodland commands to external beam dynamics software
  - PLACET, SAD etc...
- Only requirement is that the external software package implements read/write access to a tcp socket.
- Example generic c++ implementation included in flight simulator software package.
- Read/write interface done using AML-like commands.

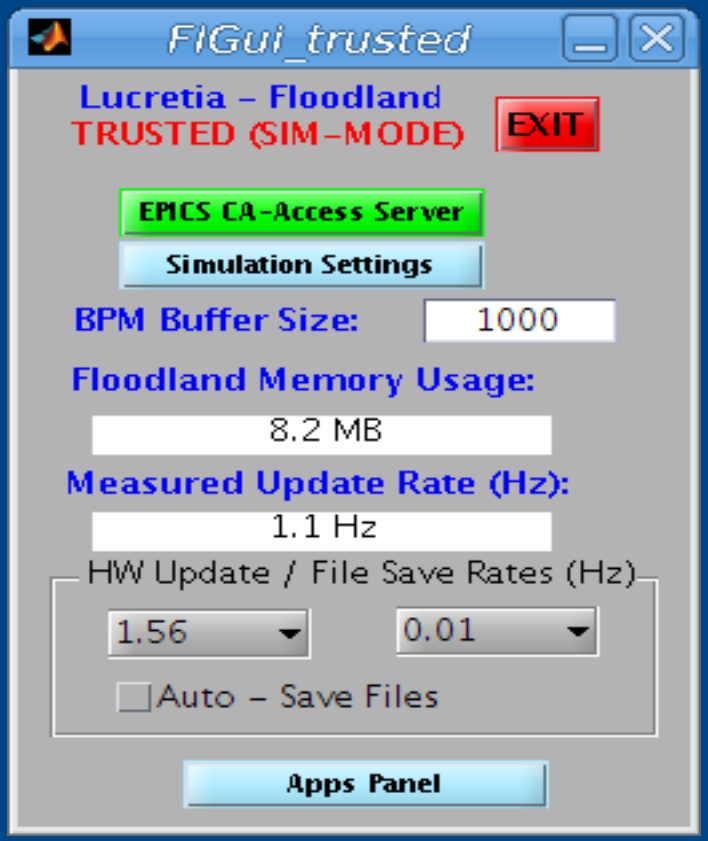
Example Server Commands (external interface)

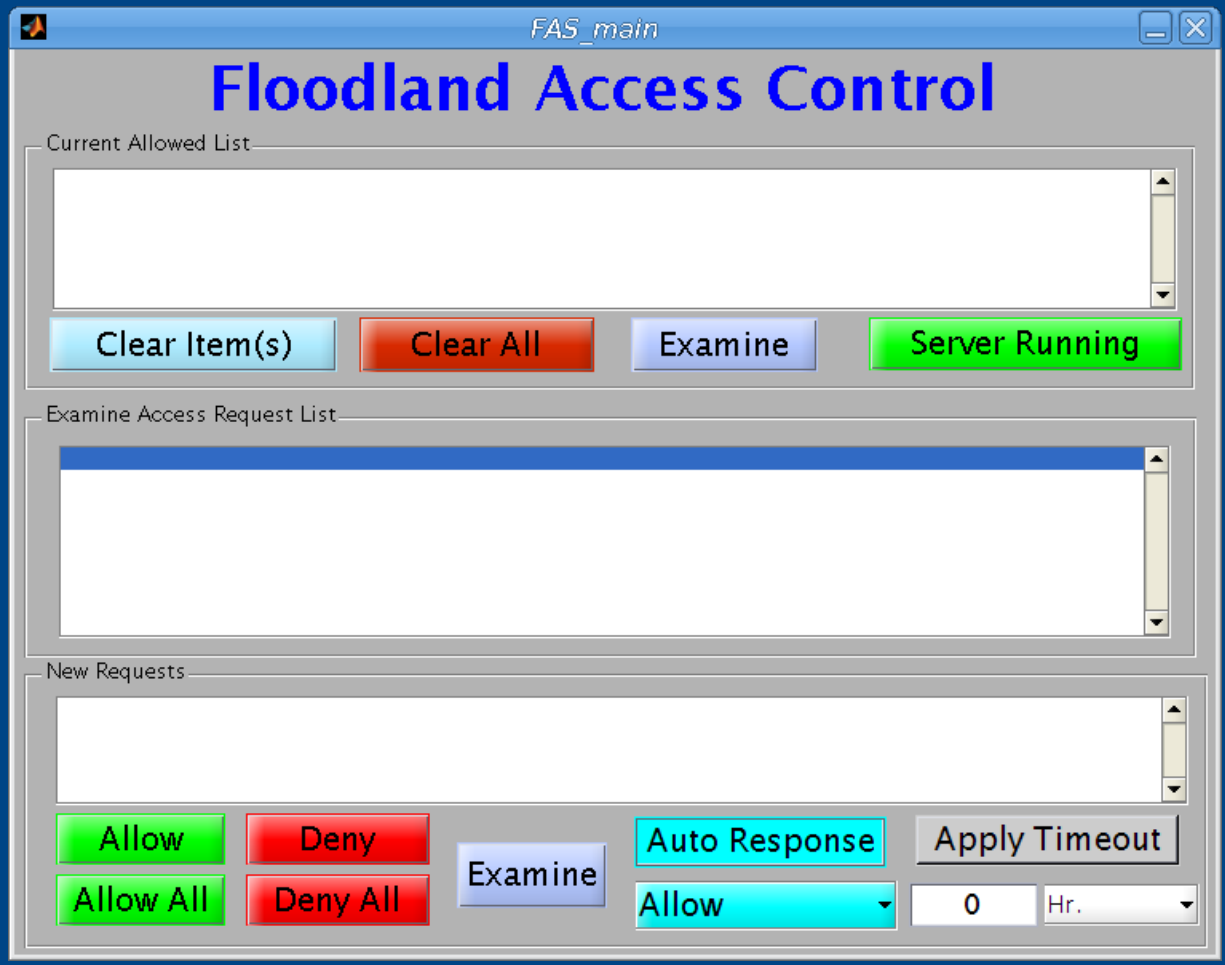
- Get/set power supply settings for magnets
  - *fl_socket << "amlget('PS1:design:num','PS2:design:num','PS5:design:num');";*
  - *fl_socket << "amlset('PS1:design:num',1.2,'PS2:design:num', 0.96,'PS5:design:num',0.5e-3);";*
- Get average orbit from last 20 bpm pulses, applying default quality cuts
  - *fl_socket << "bpmave(20,1);";*
- Request control access
  - *fl_socket << "access-request PS39 PS40;”;*

Test Implementation at ATF during May run

- Same basic software setup as for ATF2.
- Only ATF IOC used (access to ATF magnet power supplies and bpms).
- Write and run some test applications
  - EXT steering (PLACET)
  - EXT bumps (PLACET)
  - Online EXT dispersion measurement.

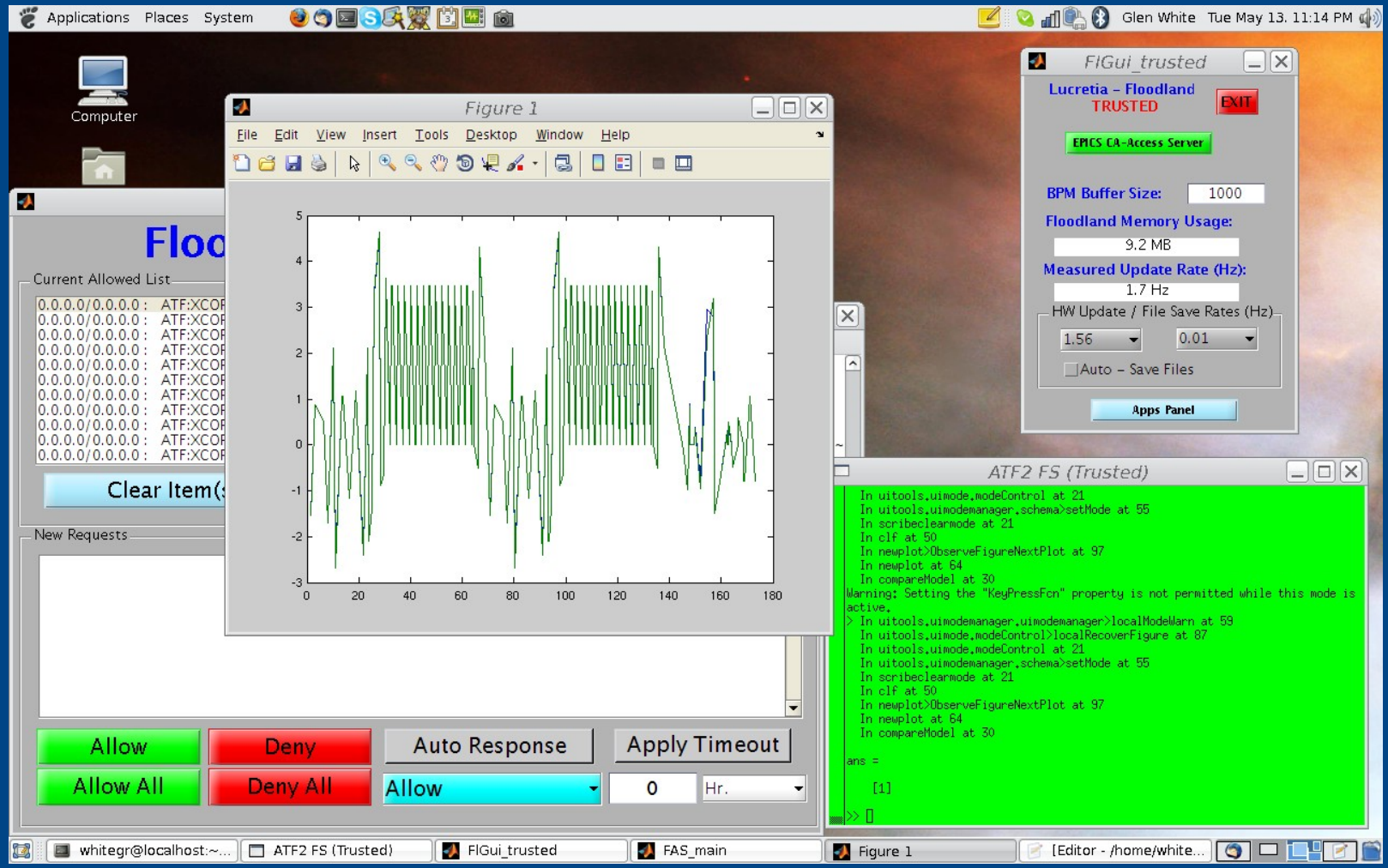
“trusted” FS (server) runs on *atfsad.atf-local*





“test” FS (client) runs on user laptop (@atf-local)

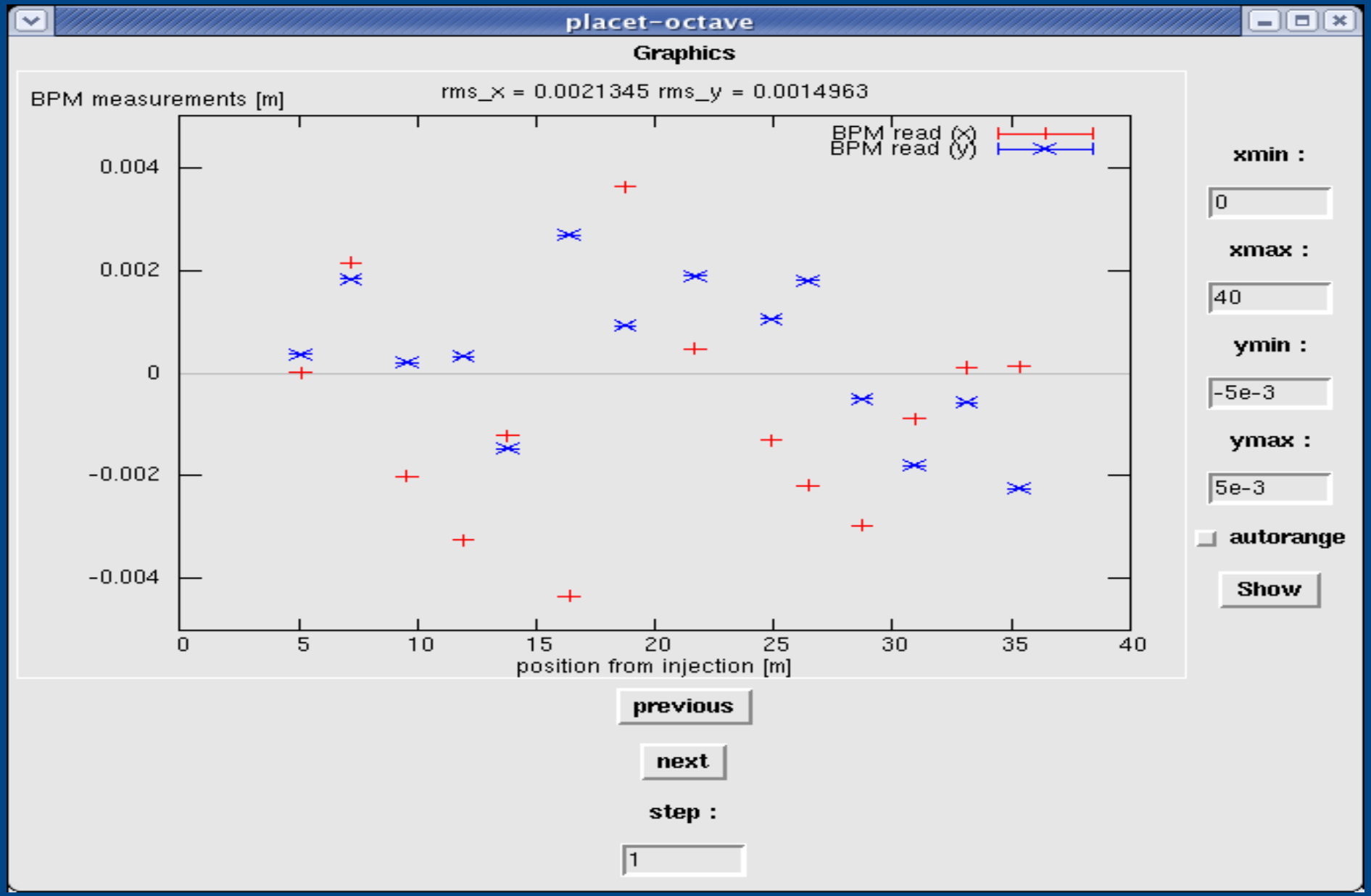
Live vs. Simulation Model Comparison



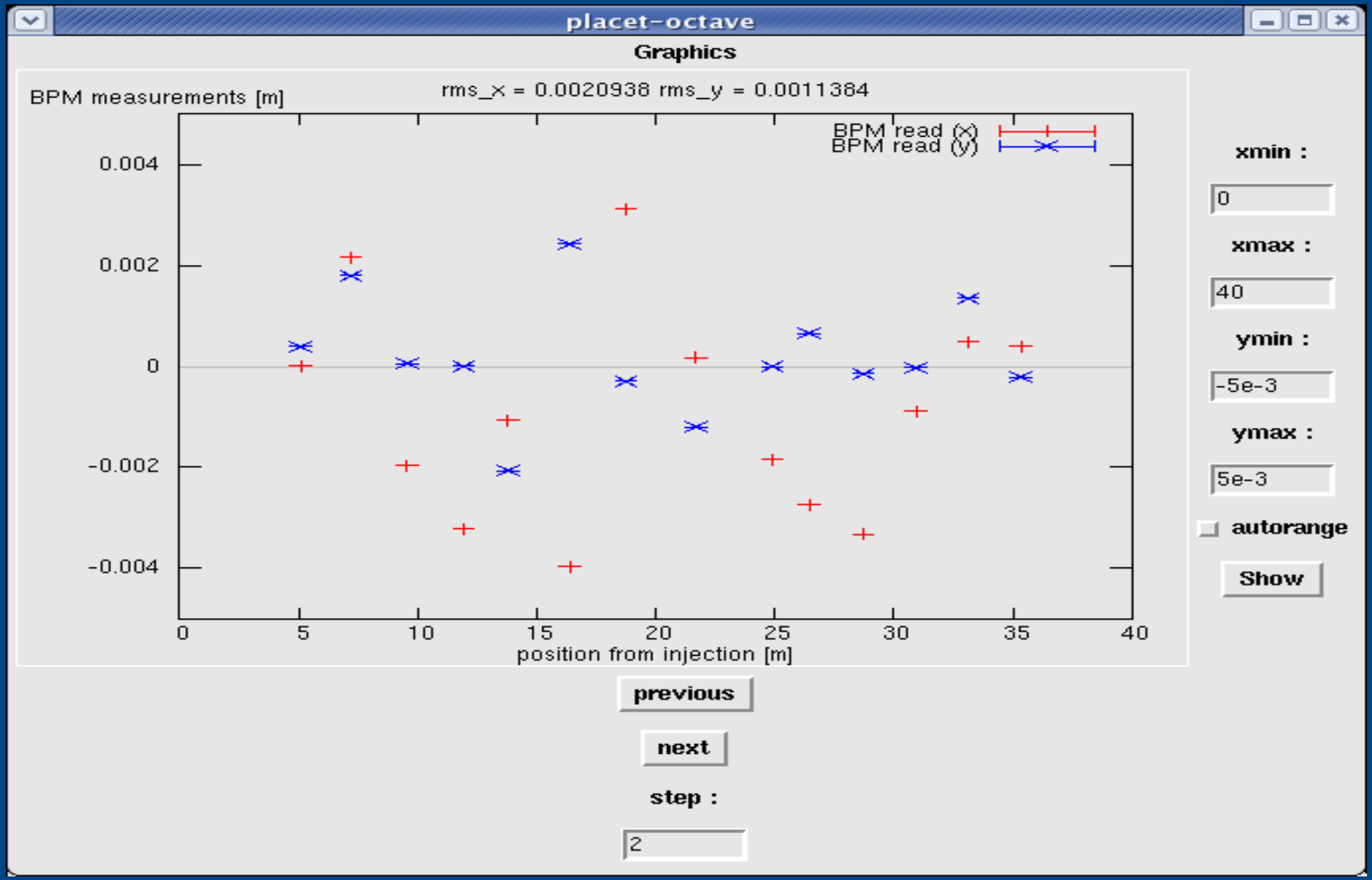
PLACET Steering/Bump Tests

- Using PLACET interface on “test” flight simulator software installation.
- Measure R12 and R34 elements between correctors and BPMs in EXT.
- Use Yves' “1-all” correction scheme to try to improve EXT orbit in x and y.
- Use bump calculator to insert orbit bump in 2 bpms for test.

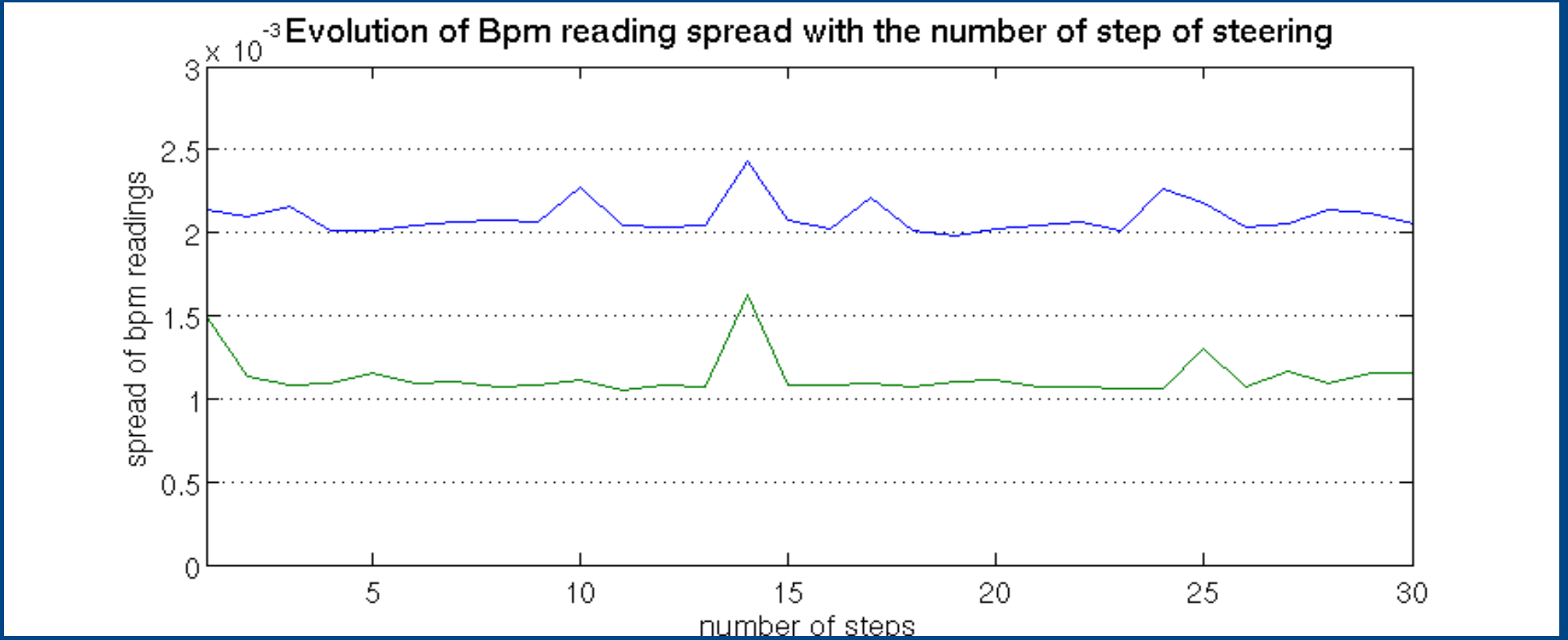
Orbit Before Correction



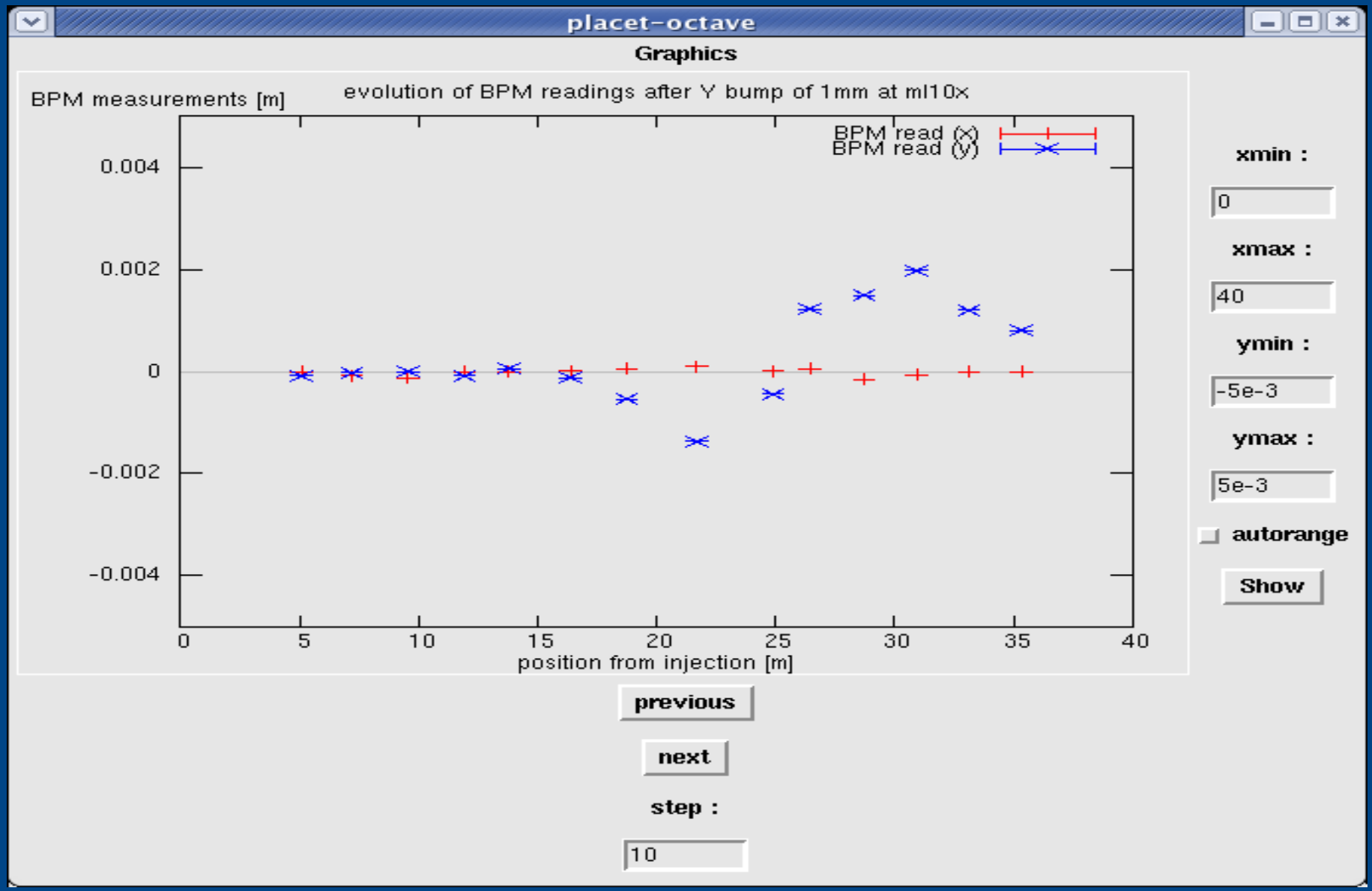
Orbit After 1 Correction



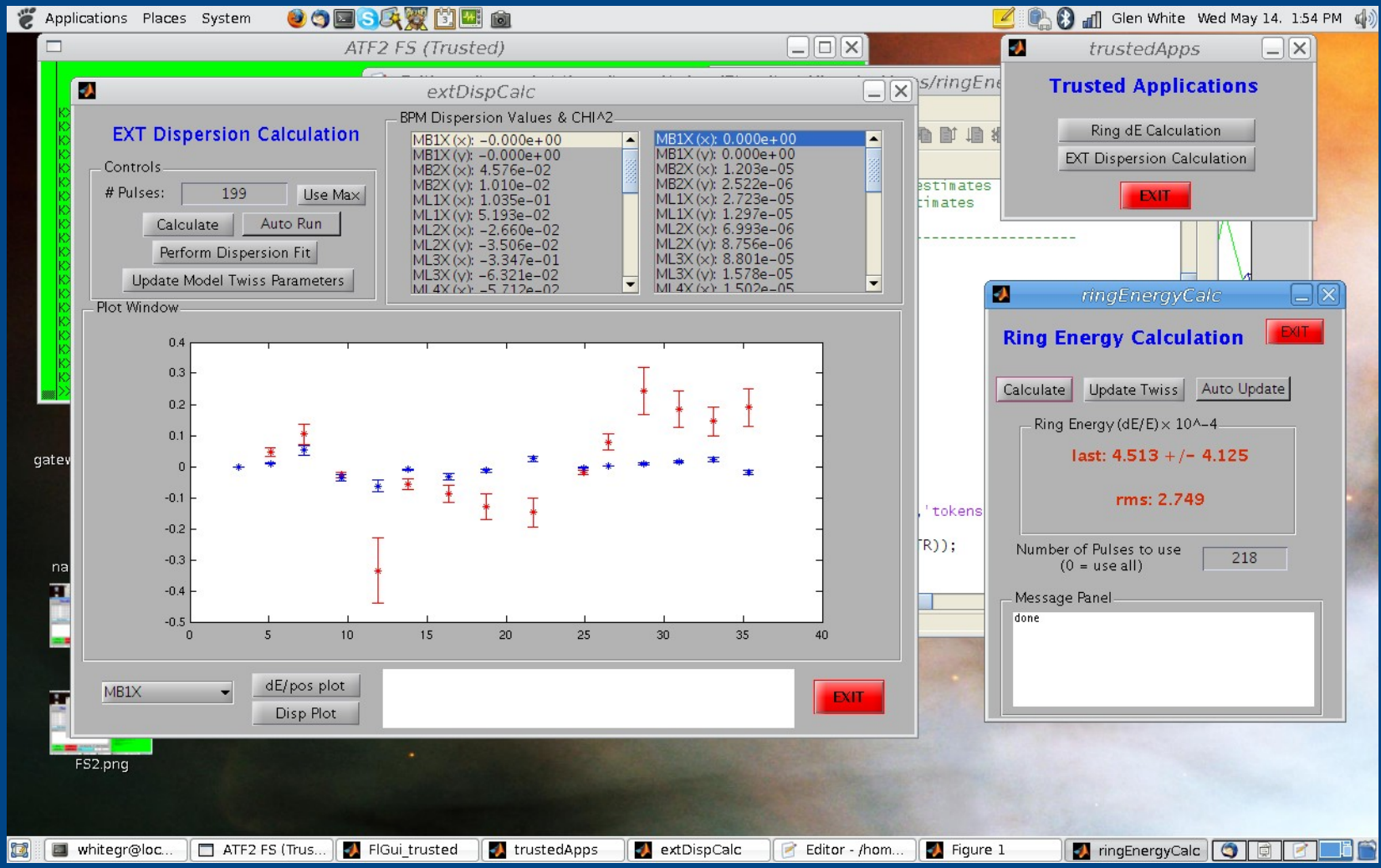
RMS Orbit During Corrections



1mm Bump @ ML10X



Disp Meas Tests



Summary

- Test implementation at ATF went well.
- Core installation and PLACET interface tested in simulation and production modes.
- Much more work can be done
  - Detailed documentation.
  - Installation improvements.
  - FS Software development (error handling, general robustness improvements, speed improvements).
  - Development of software tuning tools for ATF2.

Summary (2)

- Discussion needed on work list for utilities to help with ATF2 beam tuning.
  - Mini-workshop LAL June 18-20 for discussing international co-ordination of software development for ATF2
  - Please participate in person or via webex.
- **Many thanks to colleagues at ATF, especially Terunuma-san, for their help and advice.**