

alignment tolerances μm 30 in R-z plane

Muon Spectrometer Alignment

Internal alignment based on an array of 5800 (barrel) and 6500 (end-caps) optical sensors. Complemented for external alignment using muons tracks constraints for overlapping regions (Barrel vs Endcap, Muon spectrometer vs Inner Detector)

3 sub systems: 1 Barrel and 2 Endcaps

1200 MDT chambers described by 6 positional parameters (~7000 DoF) and 11 deformation parameters (21000 DoF in total)

Muon Alignment algorithms

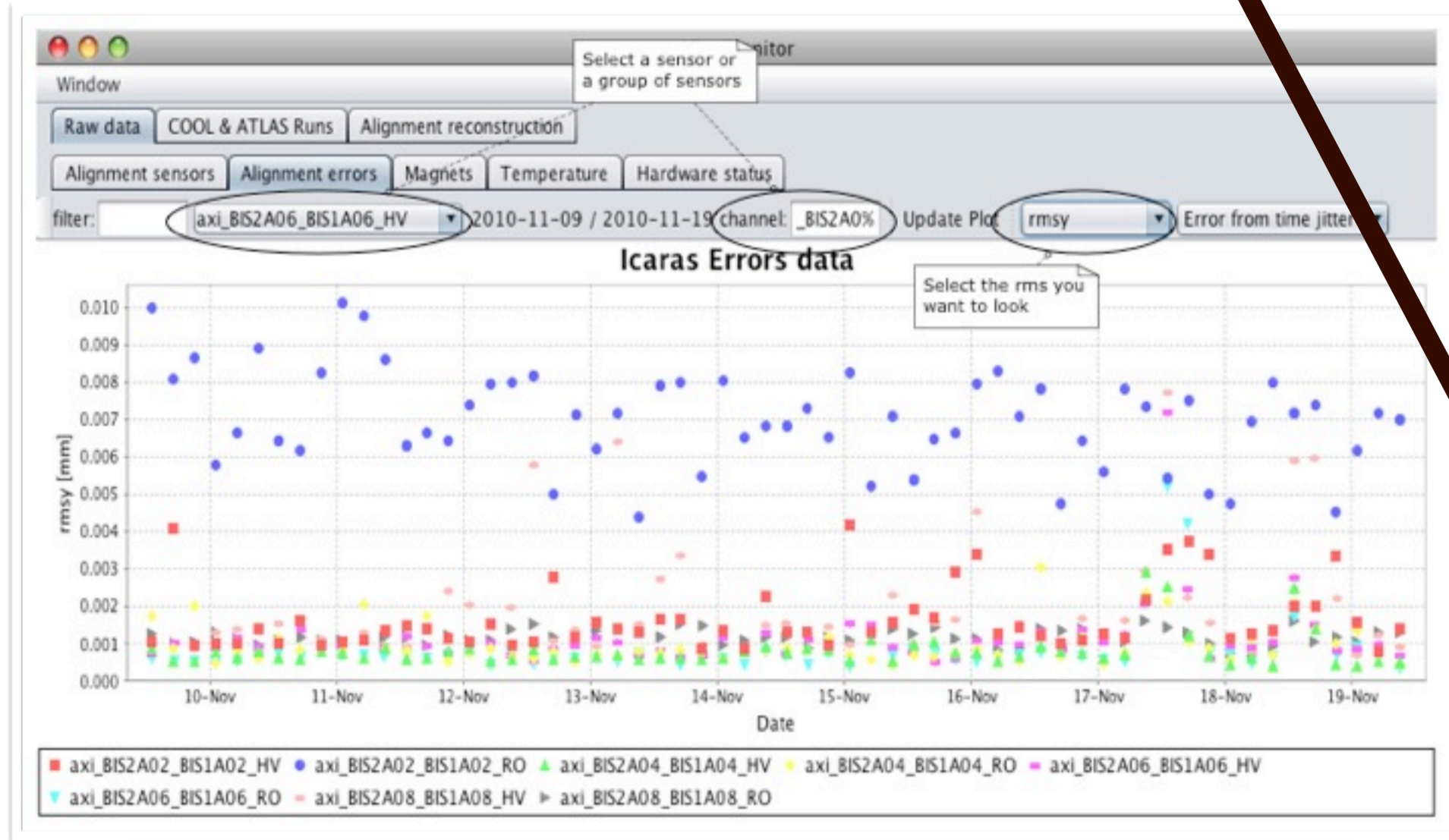
Compute geometry corrections via minimization of position and deformation parameters

J2EE Monitoring Tasks

The monitoring functionalities delivered by the Java based application inside the server are implemented as scheduled tasks and remote client access interfaces

Optical sensor errors scheduler

Compute errors on sensor's images measurements, via a linear fit which is implemented as an Oracle query (usage of REGRESSION functions library in PL/SQL).



J2EE Client Applications

Several libraries for interacting with the monitoring server

- WEB interface** : a JSP based application to follow the optical lines analysis and DAQ status.
- WEB RESTful services** : a set of REST services to gather monitoring information and DB content.
- AlignGUI** : Java Web Start application (Java Swing) which interacts with the alignment server (RMI over HTTP) to show every needed information from the monitoring system.
- AlignCLI** : command line client, mainly for administration tasks.

Sensor images monitoring

A sample of sensor images is stored on disk every day to monitor bad sensors and errors in analysis.

Channel name	Name of optical line	PC	Updated	Image	Status	Comment
19	axi_B52A02_B51A02_RO	6	Today		Image could not be analyzed	no access
20	axi_B52A02_B51A02_RO	8	Today		OK	plug ripped off, new CCD board fixed. To be recalibrated in ASAP.
21	axi_B52A02_B51A02_RO	5	Today		Image could not be analyzed	Adjust chambers
22	axi_B52A02_B51A02_RO	3	Today		OK	Failure rate is 13%, result of rasnik analysis is imprecise. Weak point in the alignment...
23	axi_B52A02_B51A02_RO	3	Today		Image could not be analyzed	not available

Alignment Data Flow

On-line : barrel and end cap DAQ systems analyze the optical sensors response every ~15 minutes and write into Oracle (online server ATONR) the parameters related to relative positions of the devices on which CCD-Lens-Mask optical lines are mounted.

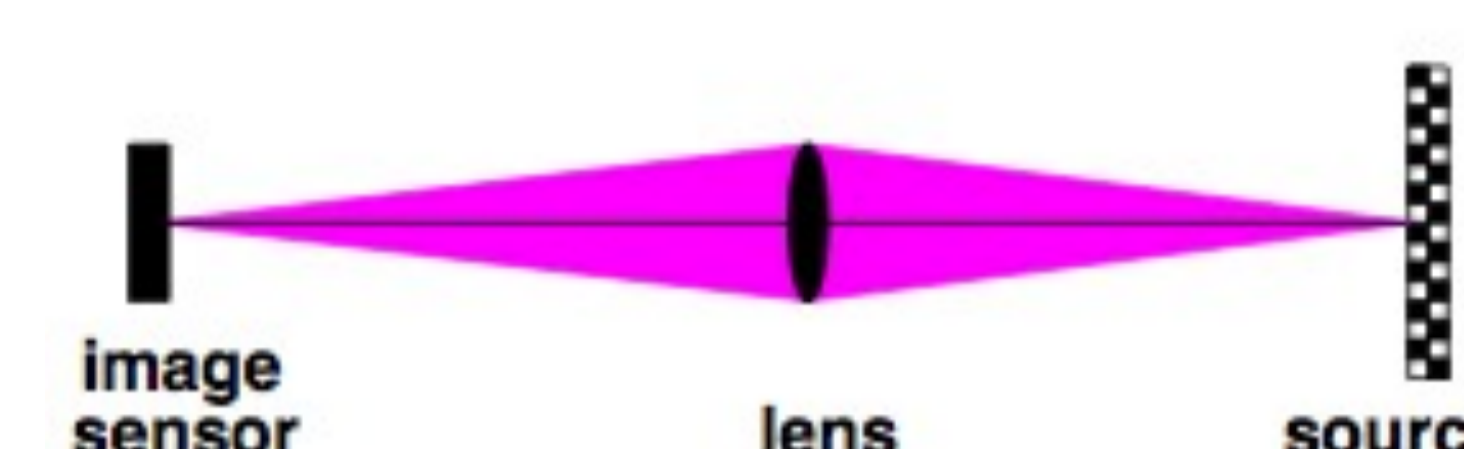
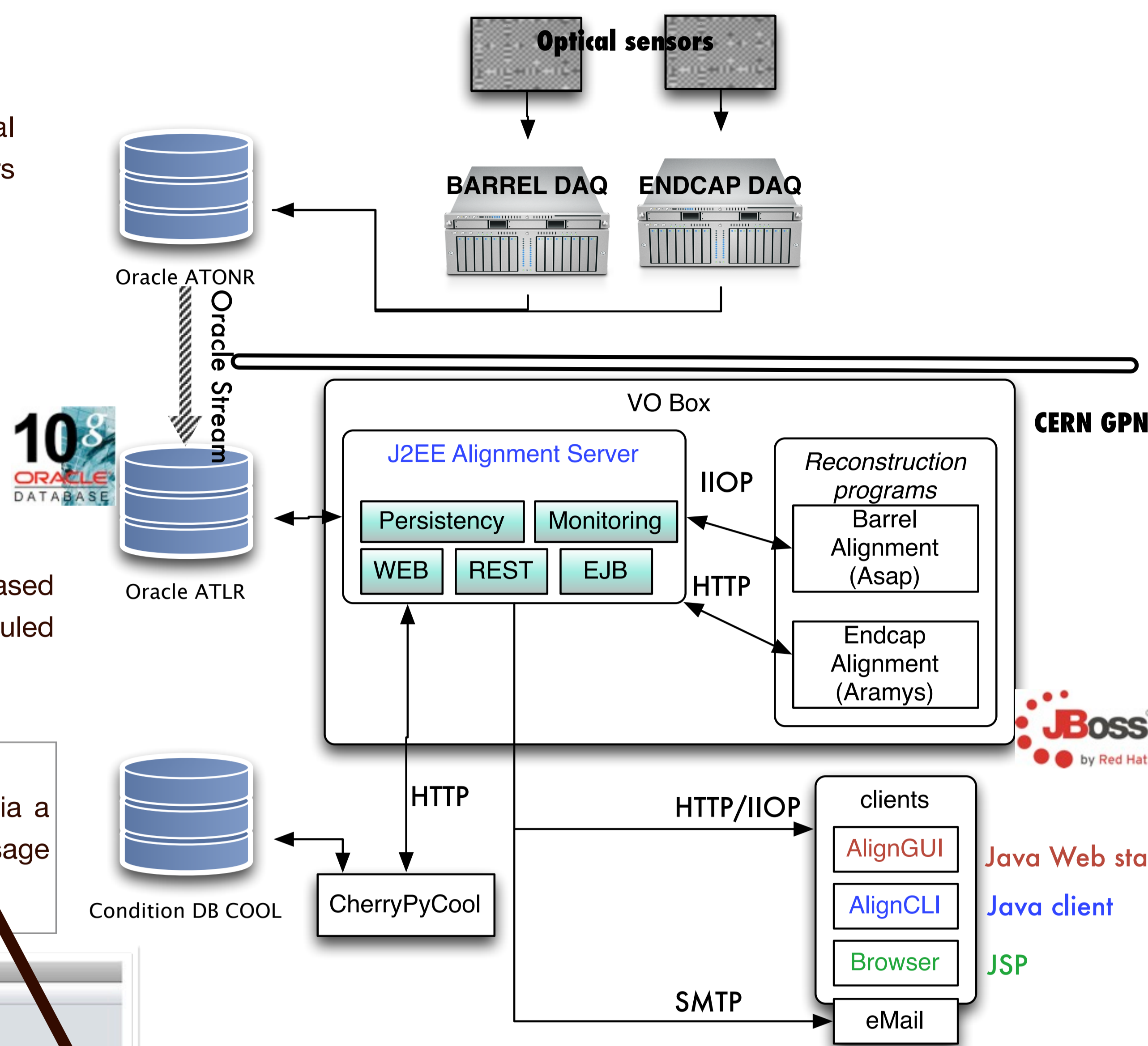
Off-line : The data are replicated to offline Oracle server (ATLR). This database contains also the output of alignment algorithms.

- I/O with DB server performed via a J2EE application (JBoss AS).
- Java server controls barrel alignment algorithm via CORBA (IOP protocol).
- End cap alignment algorithm uses the J2EE server to gather optical lines measurements and to store output corrections for the end cap wheels.

COOL Condition DB

The chamber corrections are used at the level of muon reconstruction program (Athena framework).

- Condition data migration to COOL is performed via a CherryPy server, using HTTP RESTful API methods
- The data volume of muon alignment corrections is about 2 GB per year for the whole spectrometer



J2EE Monitoring

Java libraries for DB access, handling alignment inputs and outputs, configuration data, bookkeeping of Conditions Data information

JBoss

JBoss AS, which delivers full J2EE specifications: EJB and WEB container, JMS, security via JAAS API...

Packaging

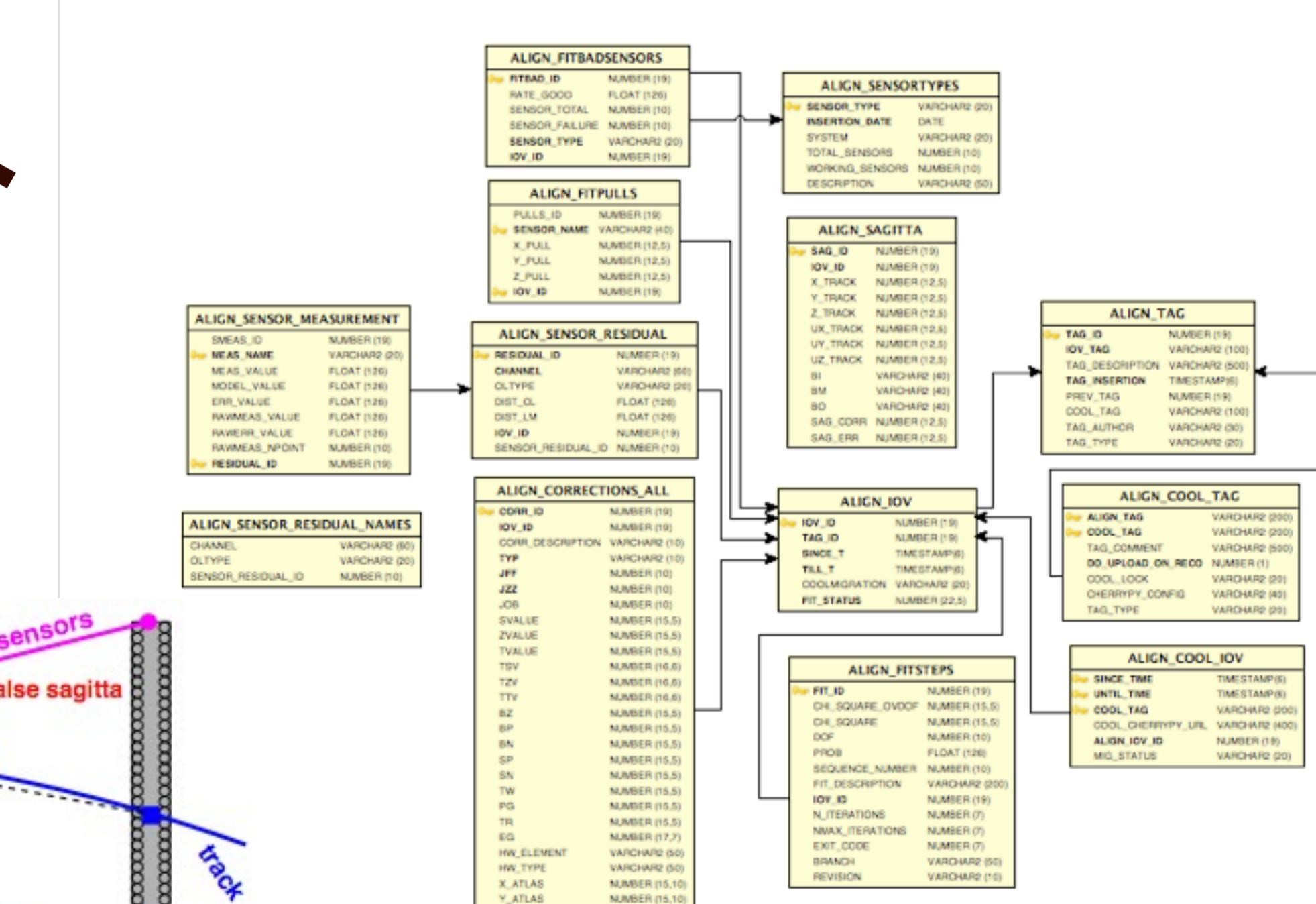
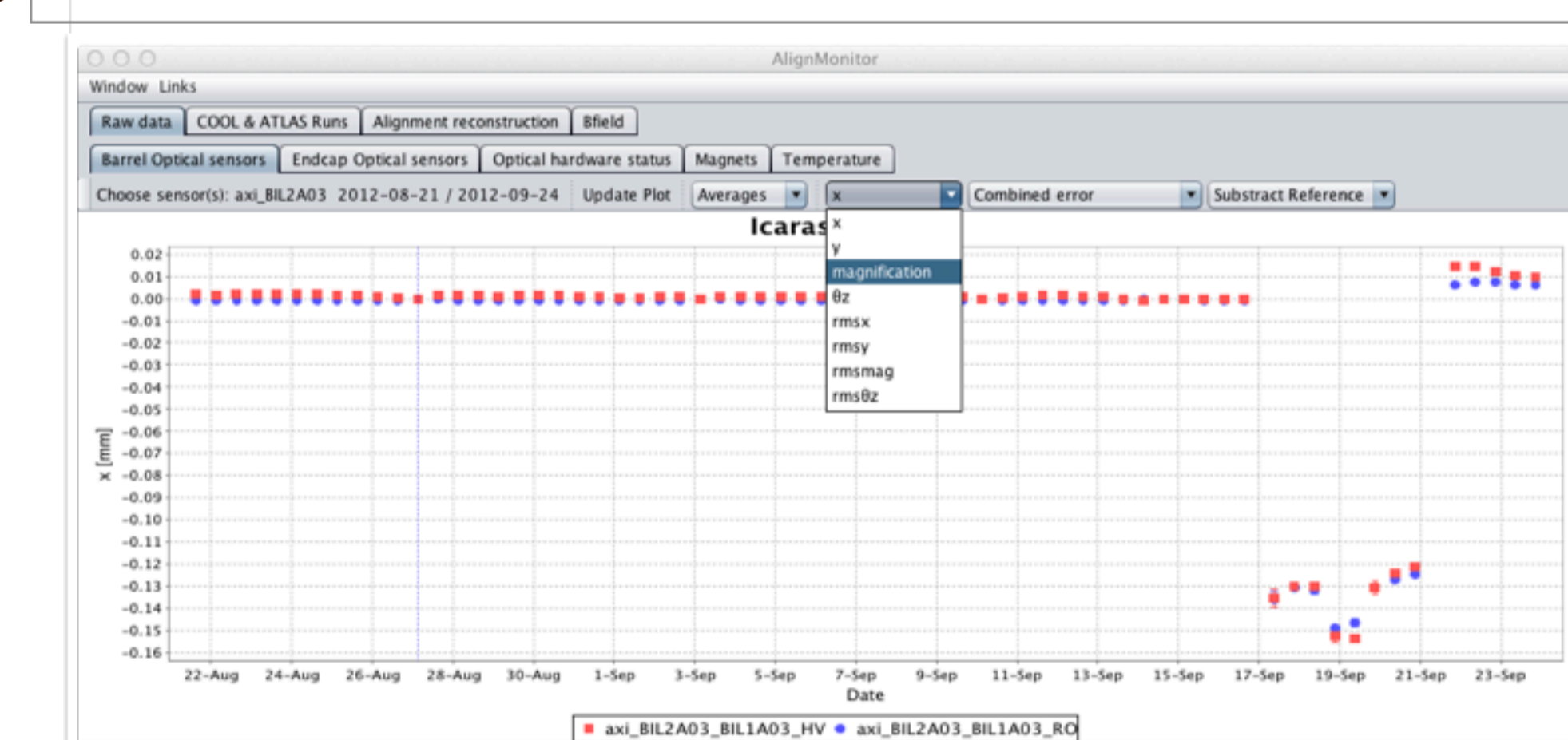
Several libraries for Muon Alignment monitoring are developed and packaged inside an Enterprise ARchive

IntervalMaker

Checks for new intervals: 3h of data should be available with stable mag field conditions.

Reconstruction Scheduler

Gather optical sensor data over the interval defined by IntervalMaker and launch alignment reconstruction algorithm via CORBA. Creates ROOT Tree for the input and read ROOT output tree.



Cool uploader Scheduler

Check the stability of every valid alignment interval respect to the previous interval stored in COOL Condition DB (Atlas). The stability is monitored by using sagitta data.

Sagitta

The correction to the sagitta measurement resulting from a set of alignment constants is computed across η/ϕ plane and saved into DB. Sagitta corrections summarize the 21k DoF in a coordinate directly relevant for tracking. The internal movements of the spectrometer are visible in the AlignGUI on the sagitta η/ϕ view.

