The Precision Laser Inclinometer: method of data processing and data storage

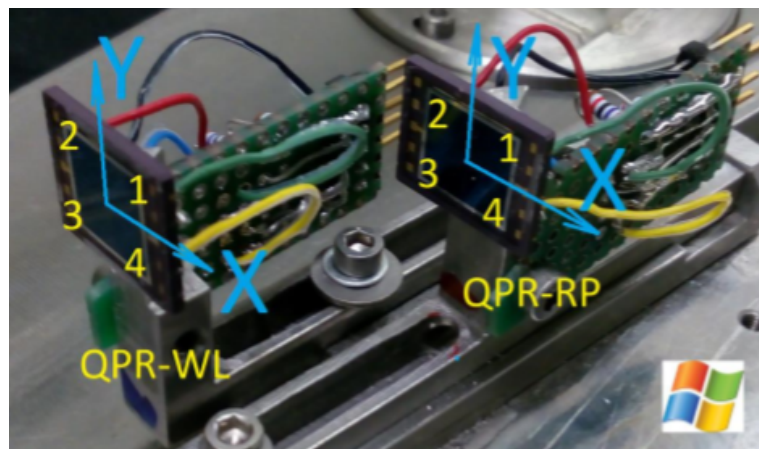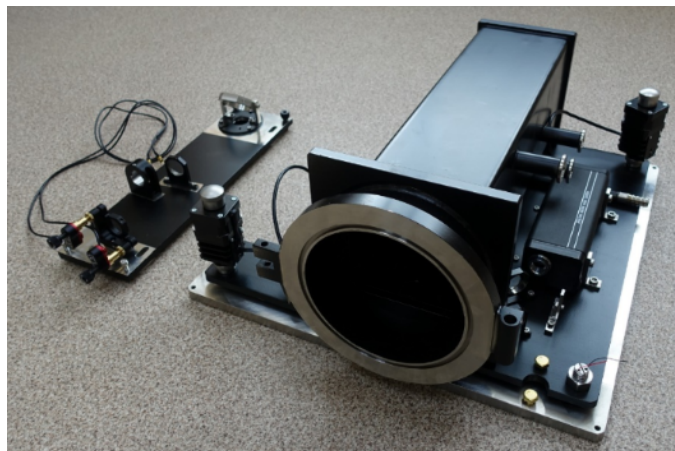Ivan Bednyakov , JINR , Russia

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Overview:

- The Precision Laser Inclinometer(PLI) as data source
- The Raw type of data from PLI
- Raw data conversion
- CERN Accelerator Logging Service(CALS)
- TIMBER User Interface for CALS
- pyTimber as python library
- Data Transfer and storage Method
- Conclusion

The Precision Laser Inclinometer(PLI) as data source

The Precision Laser Inclinometer (PLI) is an instrument for recording micro-seismic ground motion with nano-radian accuracy. The PLI has been proposed by JINR and nowadays is being developed by a JINR-CERN cooperation (P123/A1) for the further study of the PLI application to the HL-LHC program and ATLAS experiment and, in general, to multi-TeV colliders.
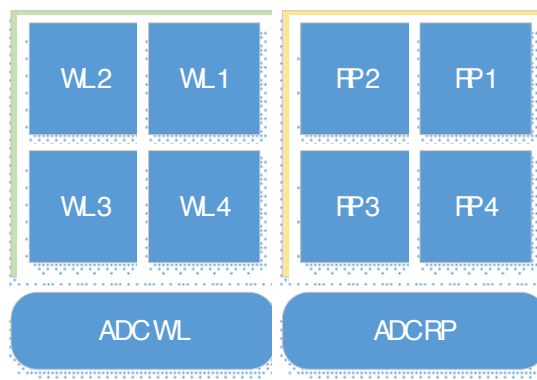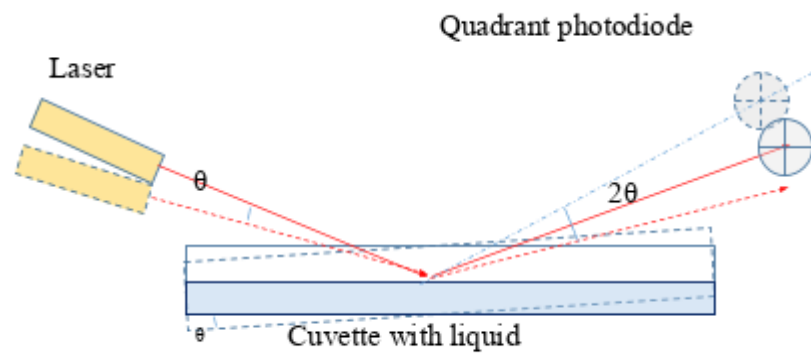
WL – comes from «Wanted/Liquid» - concerning the signal of wanted signal of the laser beam reflected from liquid surface. RP – comes from

RP -«Reference/Prism» - concerning the signal of reference signal of the laser beam reflected from optical prism.

The Raw type of data from PLI

- There are two separated programs used for PLI operation (adjustment) and data acquisition. The PLI data acquisition program written in LabVIEW using only Data Translation libraries.

- The program stores the data in the files with the name like "YYYY.MM.DD-RAW.txt" where YYYY.MM.DD is the UTC date. A file is used for covering 24 hours. Data is stored in 9 columns: the 1st column is the UTC time (HH:mm:ss,###) and other eight columns record the raw voltages UWL1, UWL2, UWL3, UWL4, URP1, URP2, URP3, URP4. In parallel the program stores the status of the PLI in the file "YYYY.MM-HIST.txt" for each month

Raw data conversion

By this Formula we can convert the Raw data, to data with form: UTC-time , X ,Y – coordinate.

$$X_{WL} = U_{WL1} + U_{WL4} - U_{WL2} - U_{WL3}$$
$$Y_{WL} = U_{WL1} + U_{WL2} - U_{WL3} - U_{WL4}$$
$$X_{RP} = U_{RP1} + U_{RP4} - U_{RP2} - U_{RP3}$$
$$Y_{RP} = U_{RP1} + U_{RP2} - U_{RP3} - U_{RP4}$$

The slopes in X and Y directions are written as follows:

Sx = Kx*X and Sy = Ky*Y

Where Kx and Ky – are the calibration coefficients;

X = X_{WL} – X_{RP} and Y = Y_{WL} – Y_{RP}
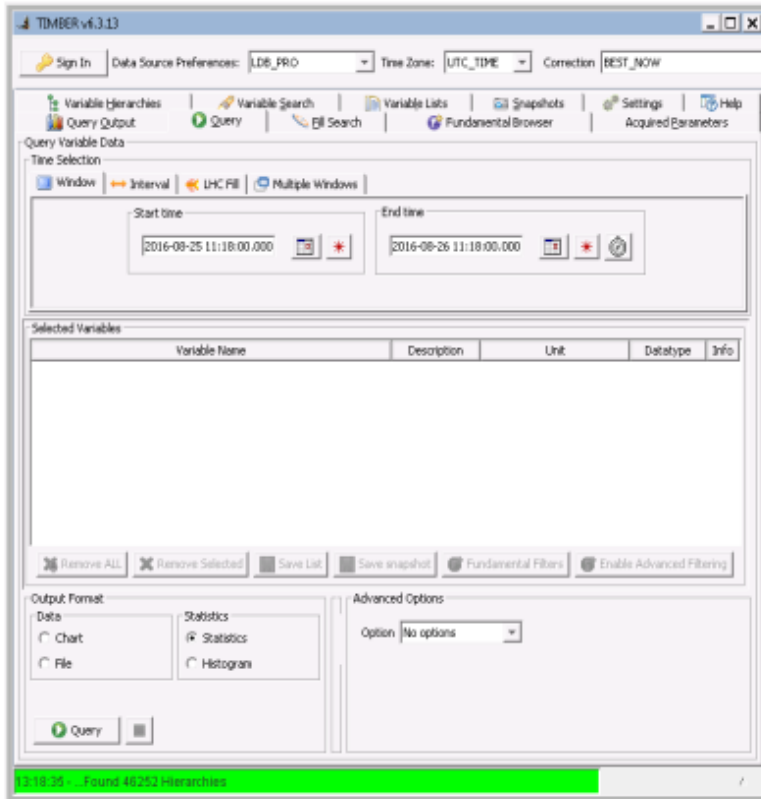
CERN Accelerator Logging Service(CALS)

The CERN-wide Accelerator Logging Service was born out of the LHC Logging Project, which was launched in 2001. The service first became operational in late 2003, and has since become what is considered to be a mission-critical service. The current mandate can be summarized as:

- Information management for Accelerator performance improvement.

- Meet INB(Basic Nuclear Installations) requirements for recording beam history.

- Make available long-term statistics for management.

- Avoid duplicate logging efforts

The logging service persists data of close to 1 million pre-defined signals coming from heterogeneous sources. These signals range from data related to core infrastructure such as electricity, to industrial data such as cryogenics and vacuum, to beam related data such as beam positions, currents, losses, etc.

TIMBER User Interface for CALS

- The CERN Accelerator Logging Service that can be queried with the Timber application(provided Java 1.8 and jws are installed)

- Windows NICE and CERN Login is needed

- pyTimber Python API for querying data of the CALS and integrated in the web "Jupyter notebook server"

pyTimber as python library

- Developed by R. De Maria, T. Levens, C. Hernalsteens
- Use Java CALS API (BE/CO) through python-jpype and cmmbuild-dep-manager (T. Levens)
- Simple API to get data, search variable, name explore variable tree:

```
import pytimber
db=pytimber.LoggingDB()
data=db.get("LHC.BOFSU:OFSU_ENERGY","2016-05-30
 00:00:00.000","2016-05-30 01:00:00.000")
vars=db.search("LHC%ENERGY")
print(db.tree.LHC.Instrumentation)
```

Data Transfer and storage Method
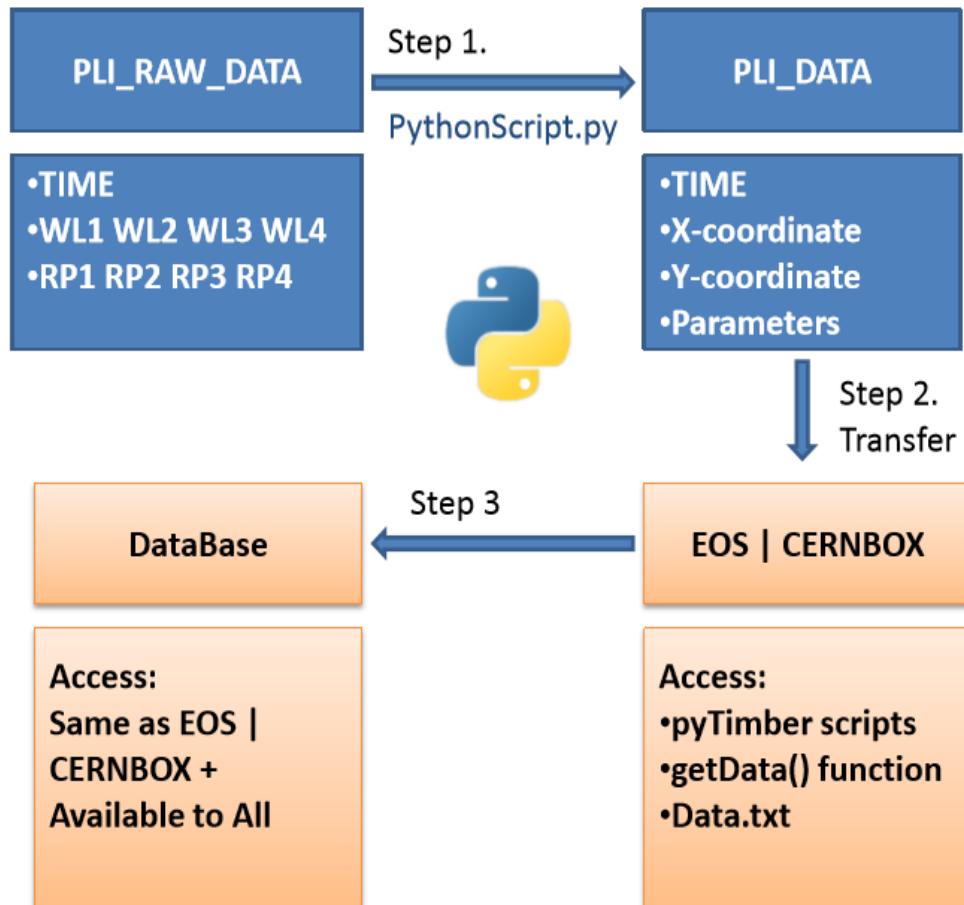
- Data from Precision Laser Inclinometer (PLI) must be presented as a part of the data entering the LHC system. These data should be available to engineers and physicists who have access

- The Raw data file stored on DFS(Distributed File System),The New File(Time,X,Y,P) must be transferred to EOS Service, including CERNBOX.

- Make a database with quick access using SQL.

Conclusion

- Data from PLI very important for us.
- To join CALS we need stable, simple data(so this data can be transferred to CALS as 1:1)
- Deploy PLI under LCH tunnel
- Installation 6 PLI, we will have a good network and can make more accurate results

Thank you for your attention!