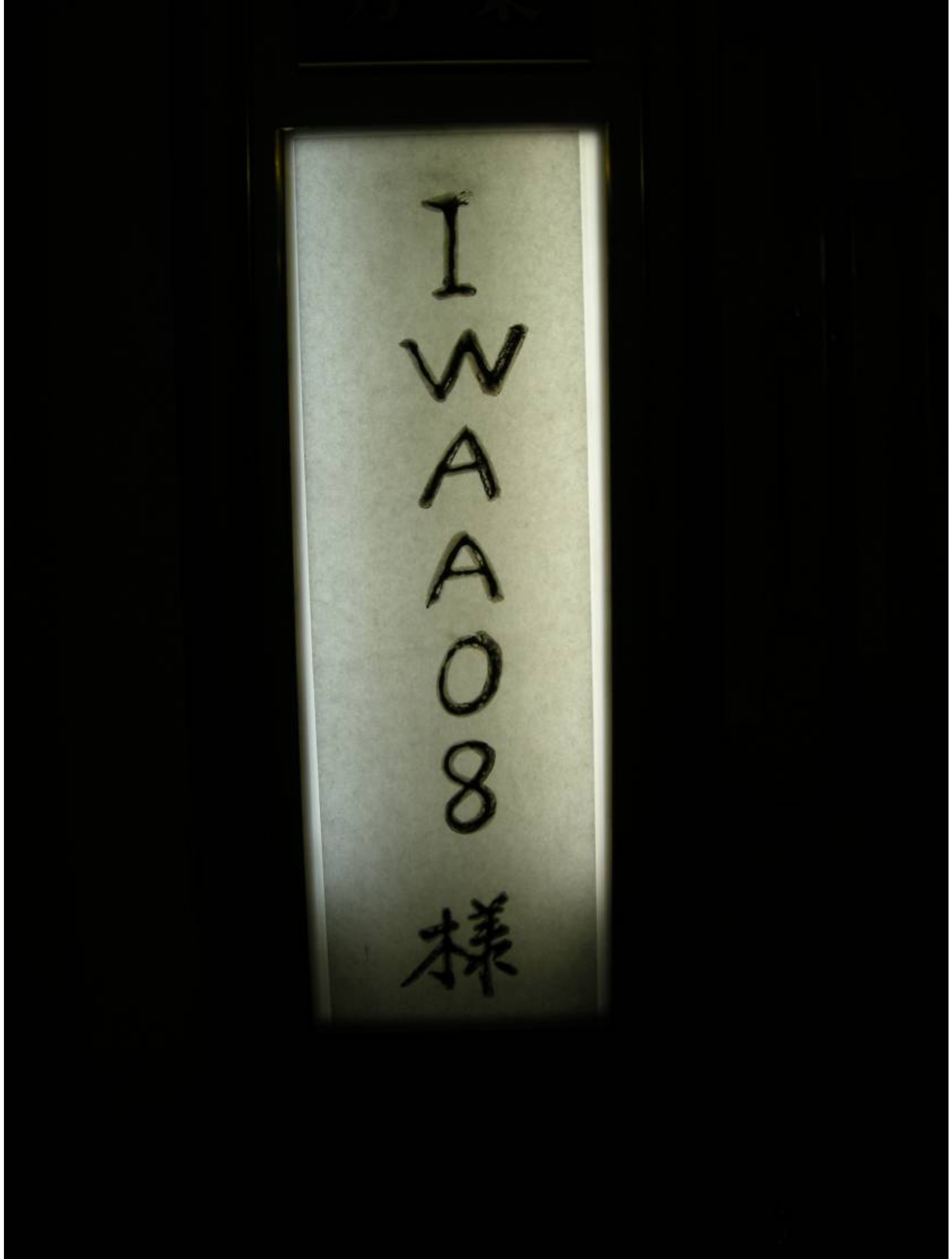
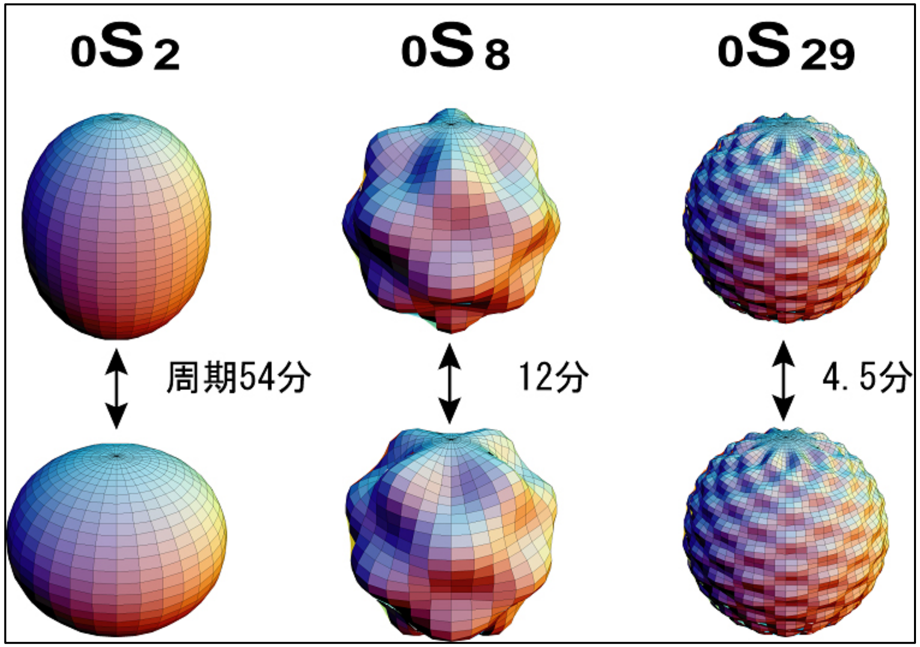
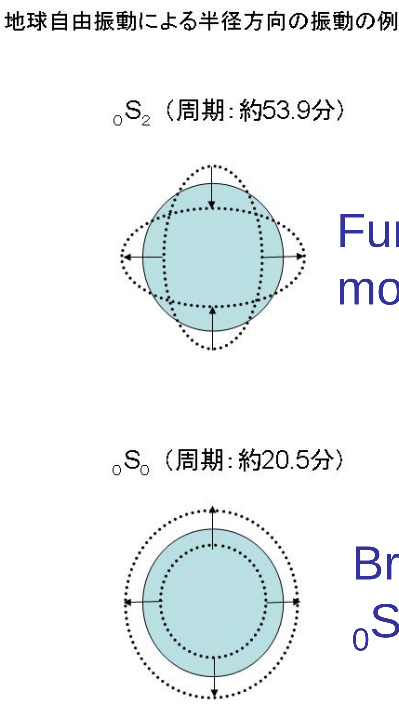

IWAA08 様

3. Free Oscillation of the Earth



Spherical modes

Illustrated by N. Suda

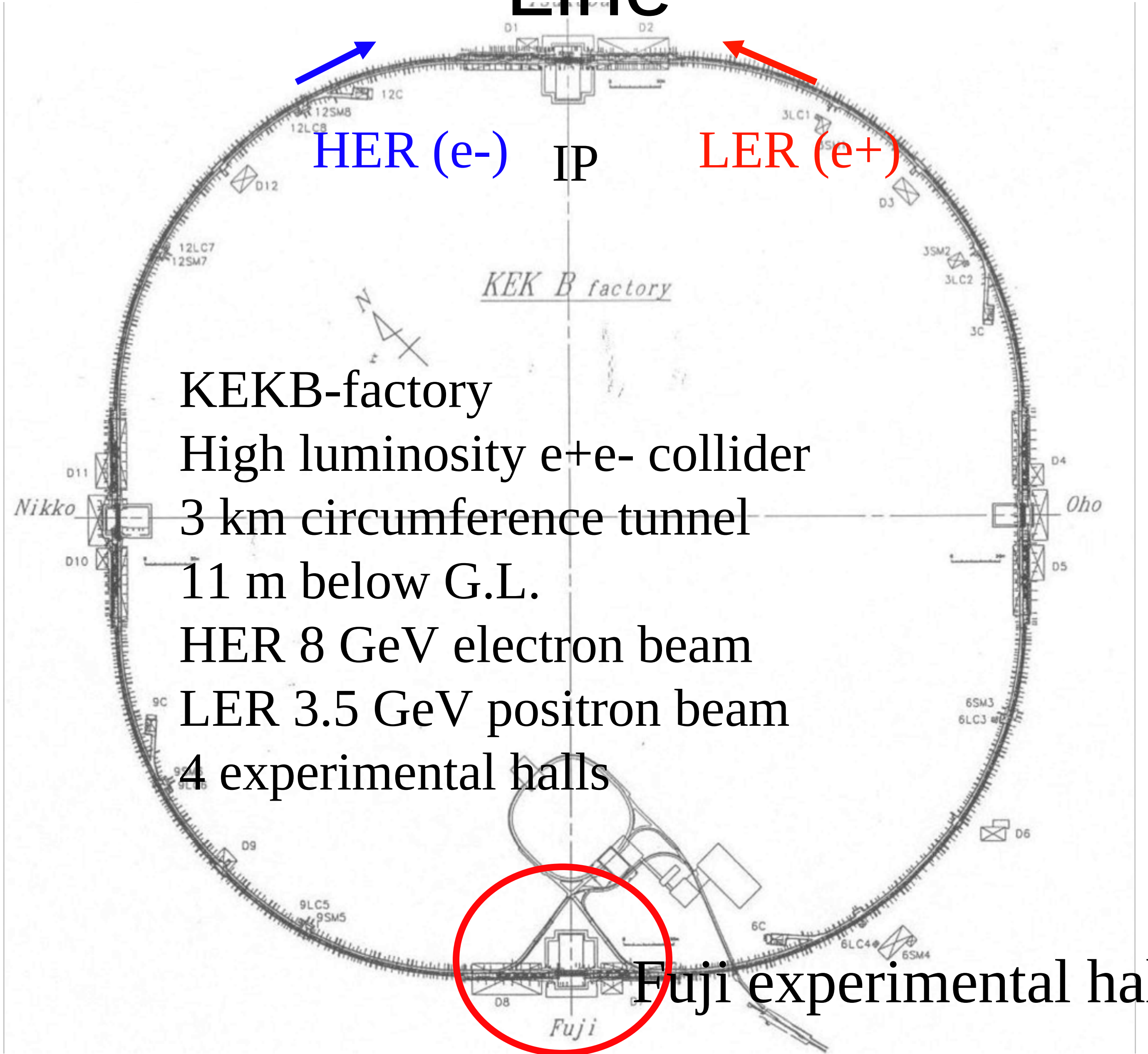


Fundamental mode $_0S_2$

Breath mode $_0S_0$

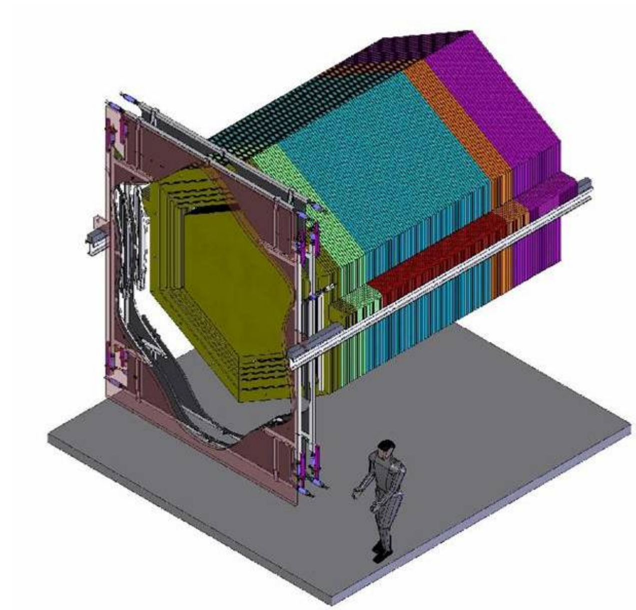
世界地図
E-XFEL
HERA
The LCLS
(Linac Coherent Light Source)
RF Gun
Linac 0
Linac 1
Linac 2
Linac 3
2 km
Existing Linac
Bunch Compressor 1
Bunch Compressor 2
3 km
Photon Beam Lines
Undulator
To Electron Beam Dump
B Factory Rings
LCLS
SPring-8
アジア
ロシア
中国
日本
インド
アメリカ合衆国
アフリカ
オーストラリア
インド洋
太平洋
ブラジル
アルゼンチン
ニュージーランド
オセアニア

Introduction to Fuji Test Beam Line



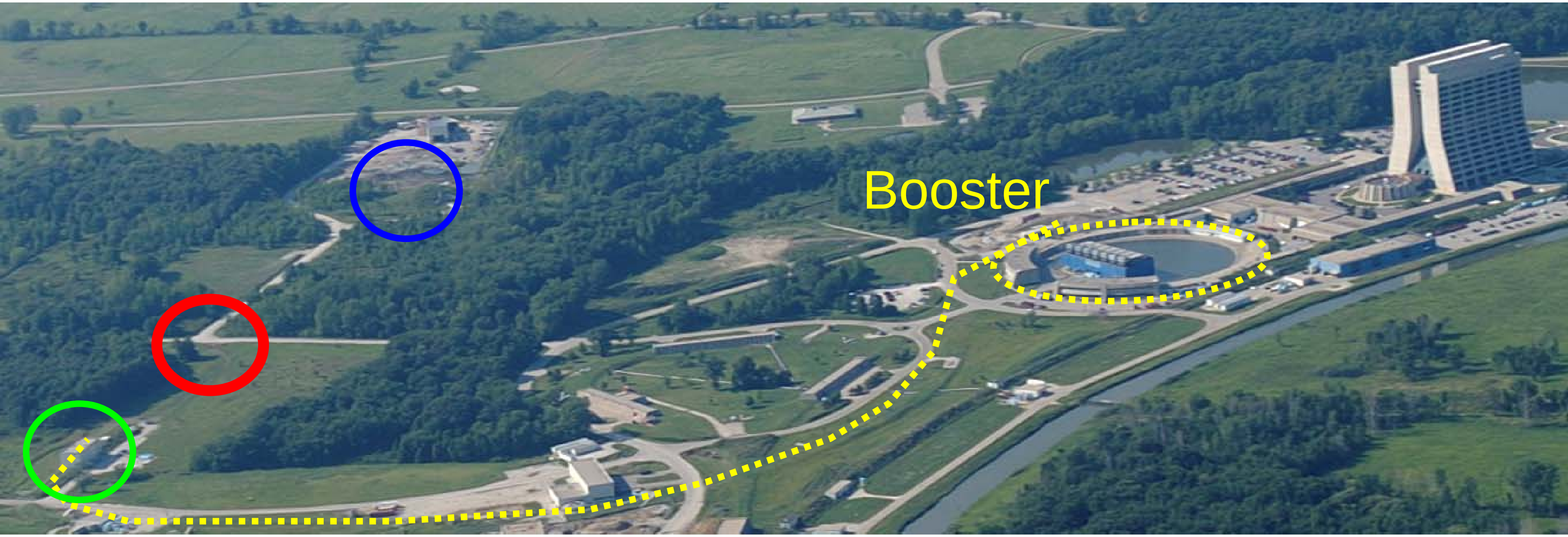
KEKB-factory
High luminosity e+e- collider
3 km circumference tunnel
11 m below G.L.
HER 8 GeV electron beam
LER 3.5 GeV positron beam
4 experimental halls

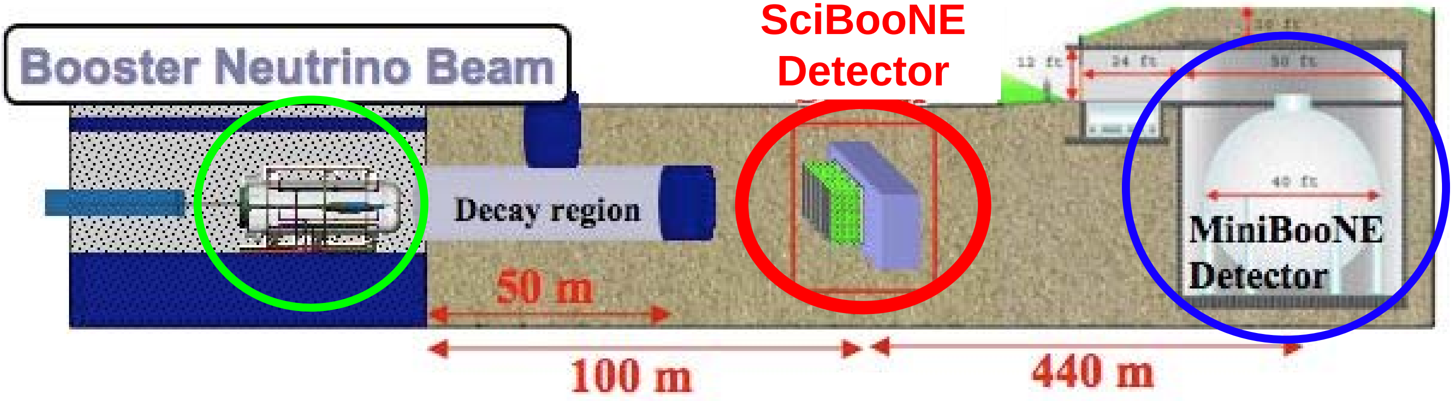
MINERνA Site orientation



- in the NuMI beam
- upstream of MINOS near detector

SciBooNE Site orientation





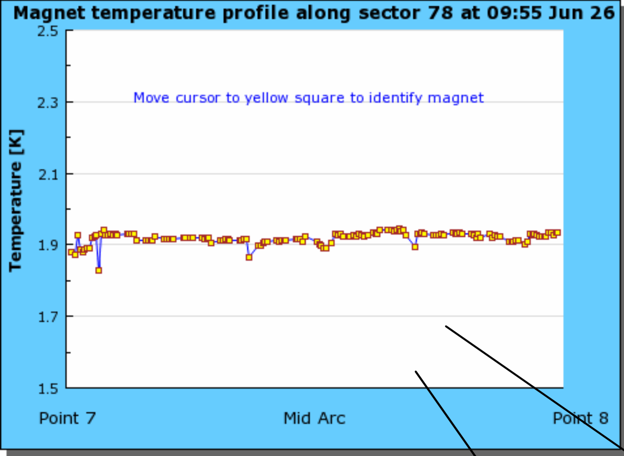
Major New Projects @ DESY

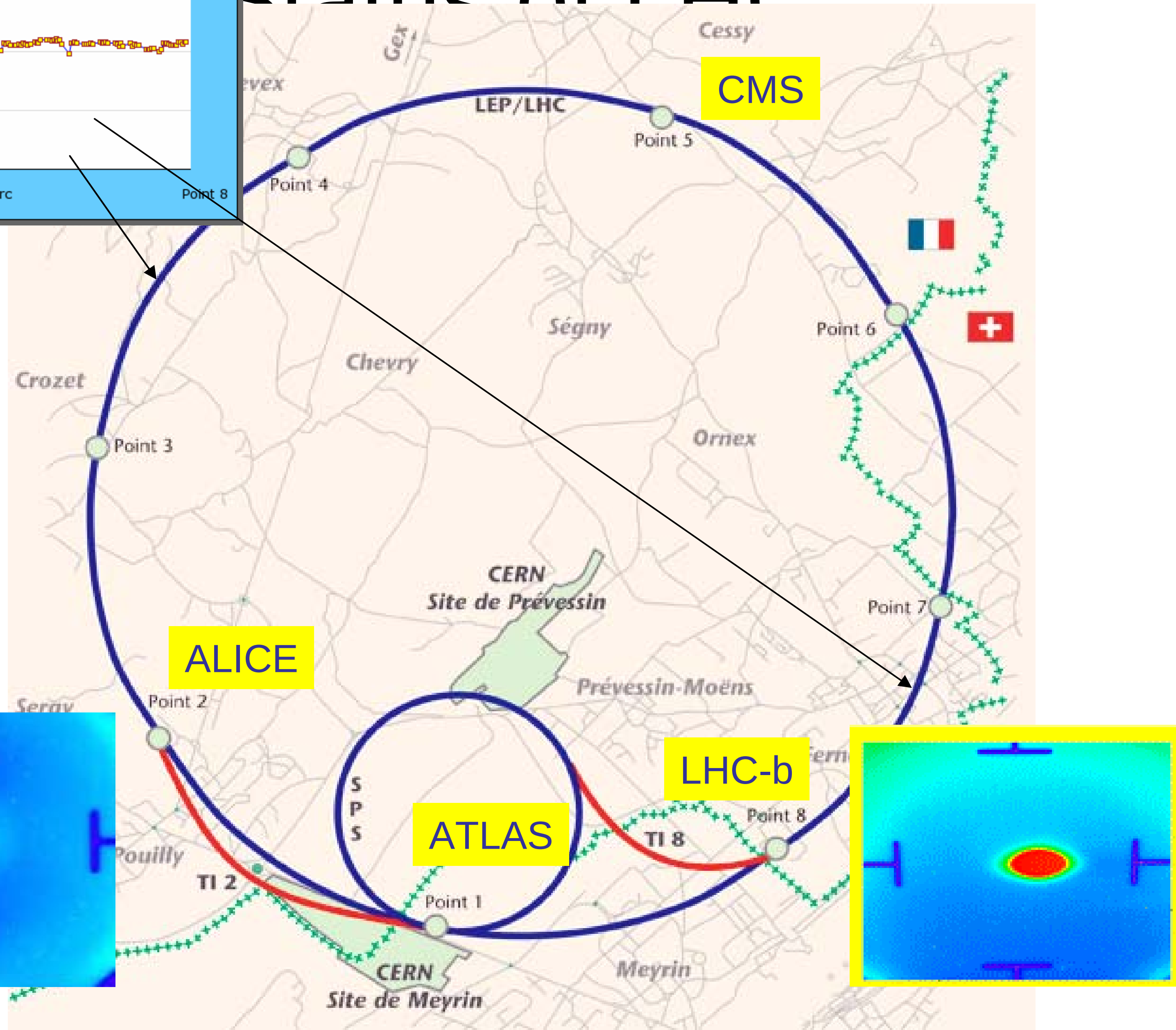
- **Rebuild of PETRA:**
  conversion from a pre-accelerator and former storage ring to a dedicated synchrotron radiation source

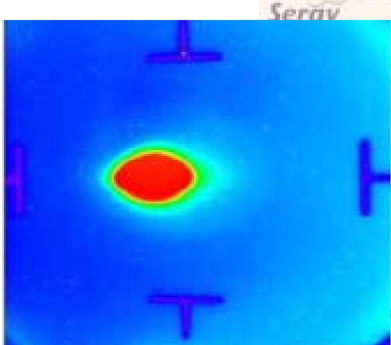
- **PETRA III will be a new high-brilliance synchrotron radiation source**

  - Total investment of 225 million €
    - German Federal Government (90%)
    - City of Hamburg (10%)
  - Conceptual design in 2002
  - Final approval of the project in May 2005
  - Reconstruction of the storage ring began on July 1, 2007.
  - PETRA III will commence user operation in 2009.

Status of LHC





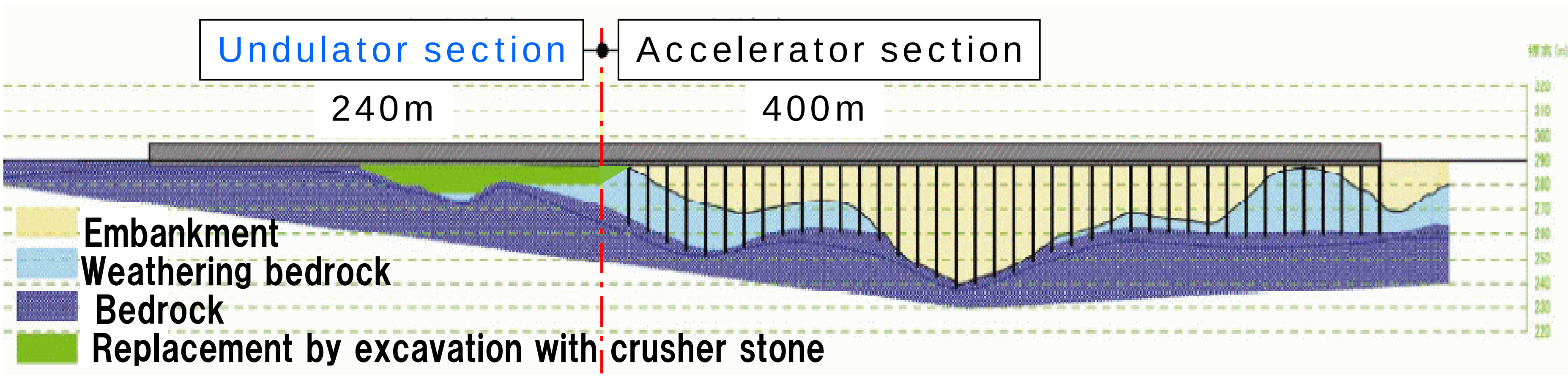


(un)stability / motion

Understructure of Undulator section

Alignment tolerance of component at installation : ±0.1mm

(at final : ±0.01mm → Next talk by Dr. Yabashi)



Bedrock or Replacement with crusher stone.

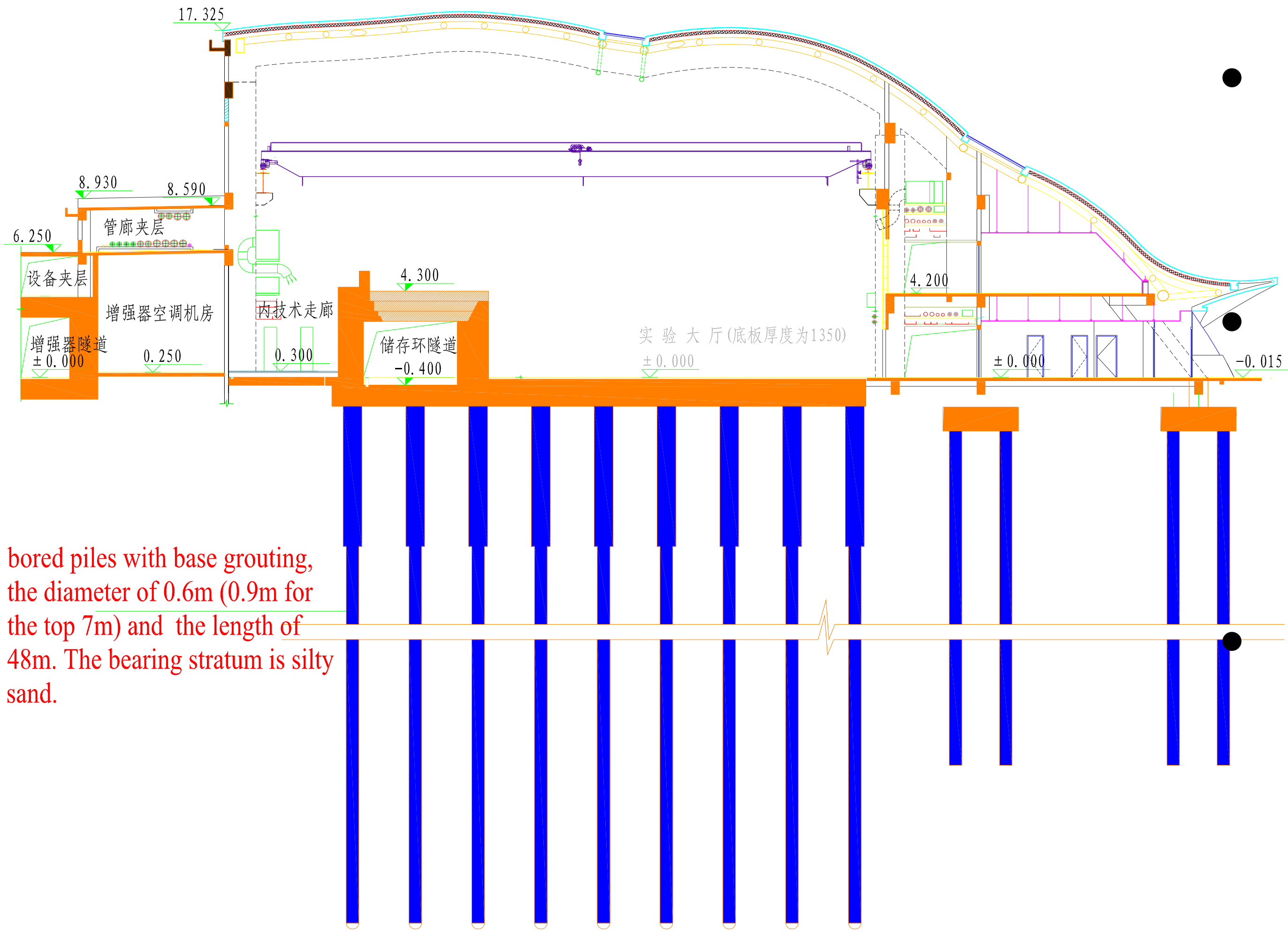
(the packing ratio of the weight density: 95%)

→ **independent from the displacement of embankment**

→ **very good**

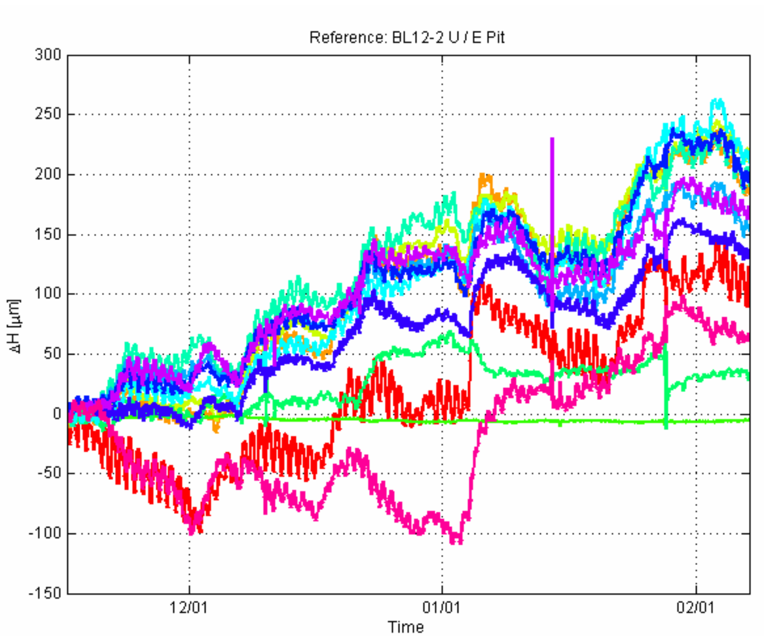
subsidence < 2mm/10years

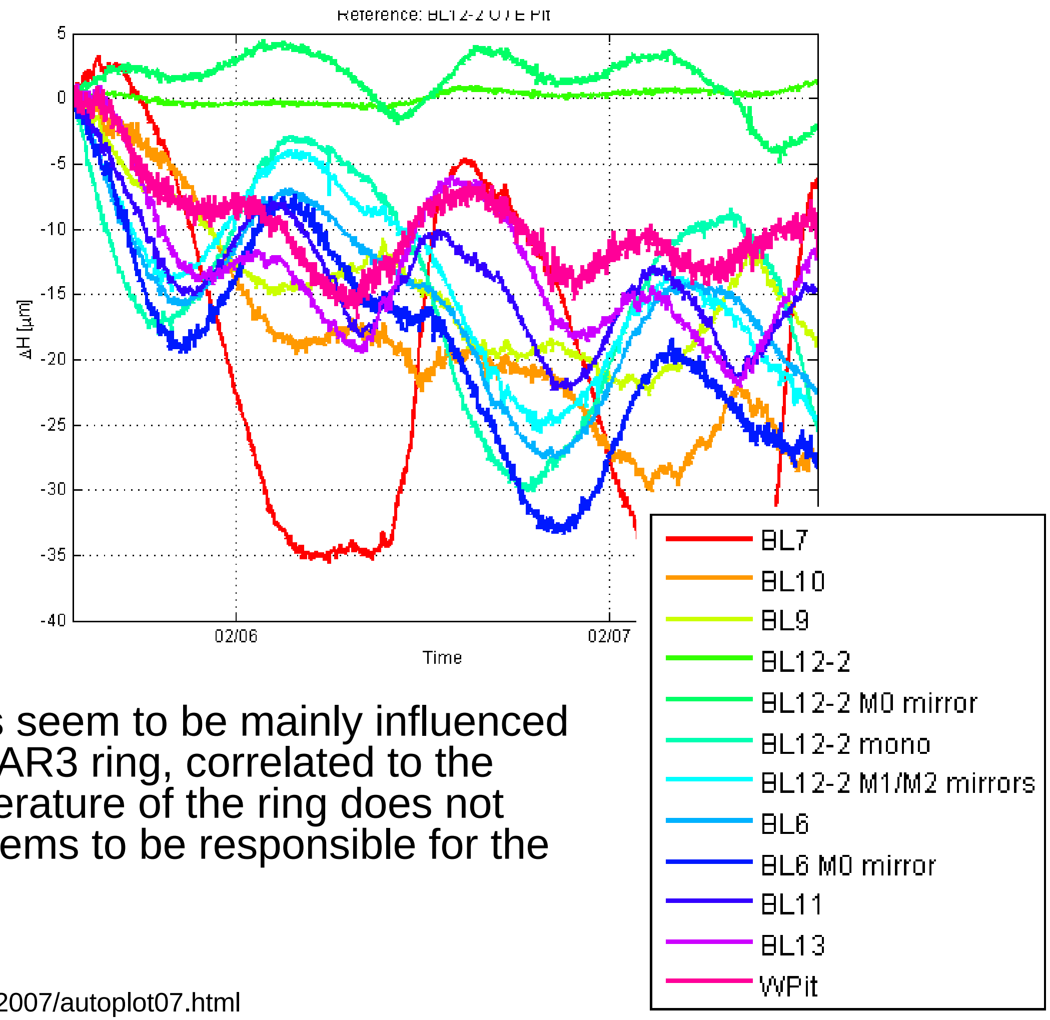
The Section of the whole foundation structure



- 1800 piles For SR, 960 piles
- Piles: diameter 0.6m, length 48m.
- Bearing layer is silted fine sand.

Preliminary Analysis

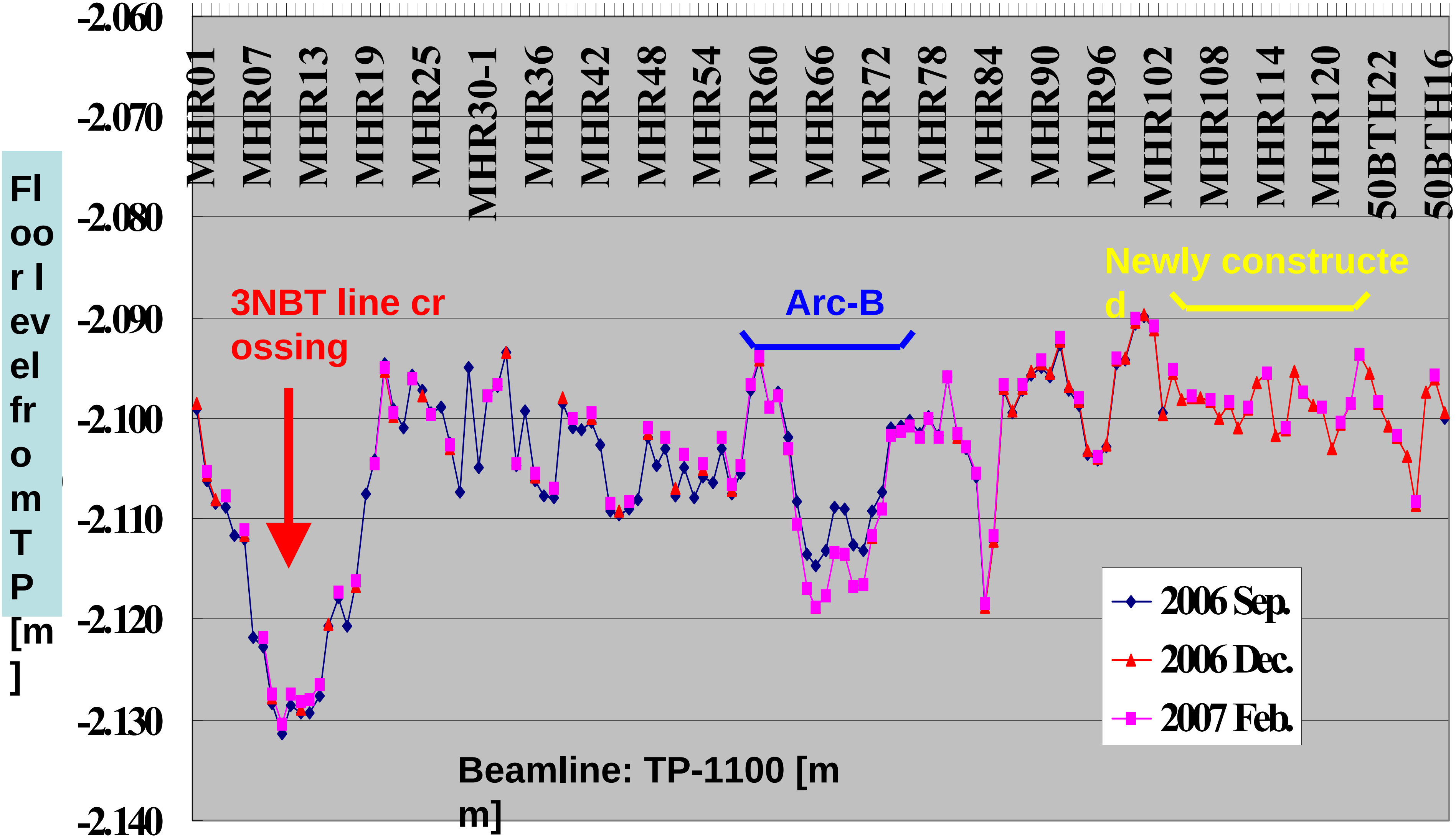




Daily variations in the floor movements seem to be mainly influenced by the outside temperature of the SPEAR3 ring, correlated to the amount of sunshine. The interior temperature of the ring does not seem to have short term effects but seems to be responsible for the annual drift of the floor [G. Gassner].

Real time data can be found here: http://www-group.slac.stanford.edu/met/Align/Spear3/SPEAR_WWW/sys2007/autoplot07.html

Floor Level of MR



Measured Sites and Instruments (cont.)

KEK site is soft ground area (alternative layers of sand, clay and gravel). The other areas are hard rock areas.

Ground motion was measured with velocity sensors:

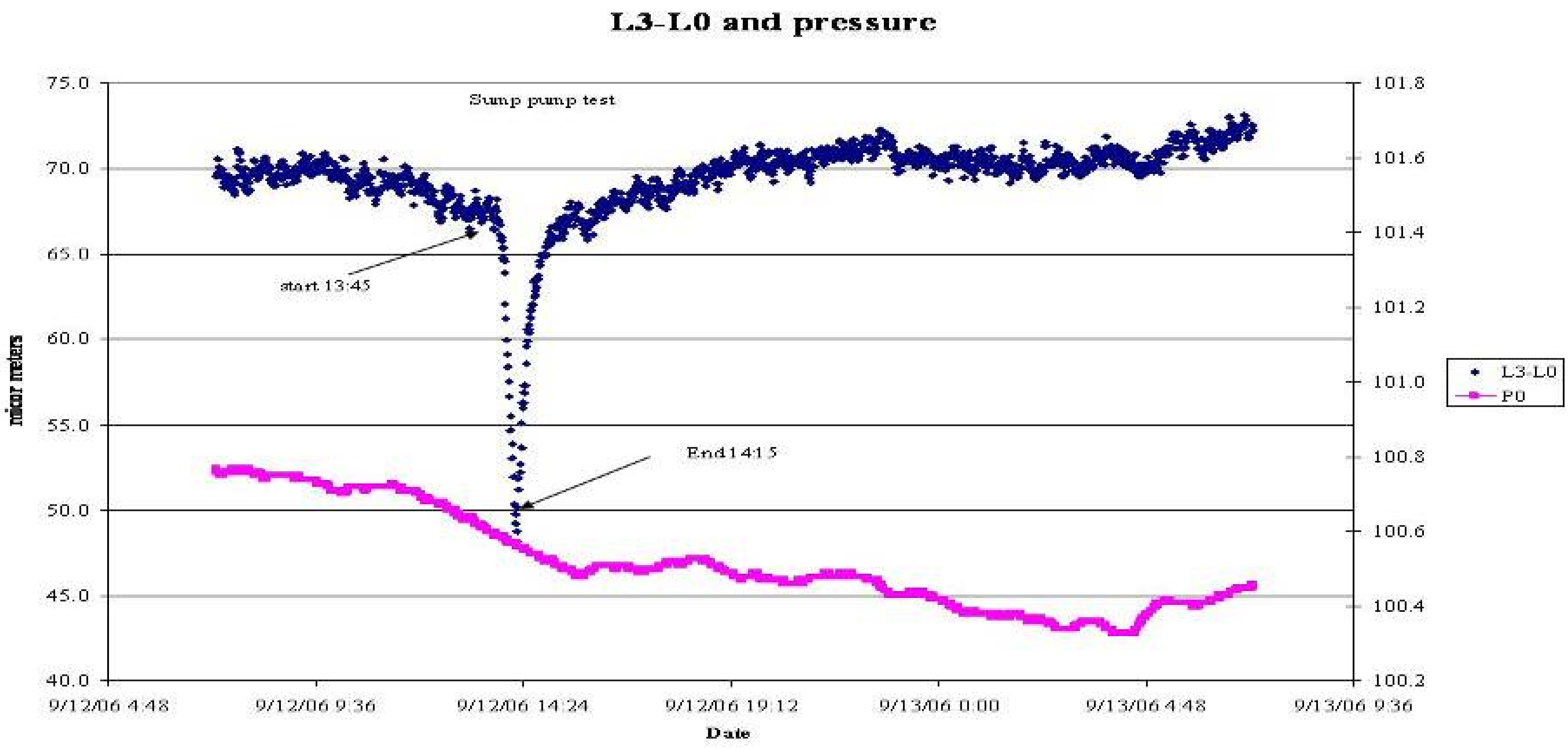
VSE355G2 of Tokyo Sokushinn Co., Ltd. at the points 1 - 3

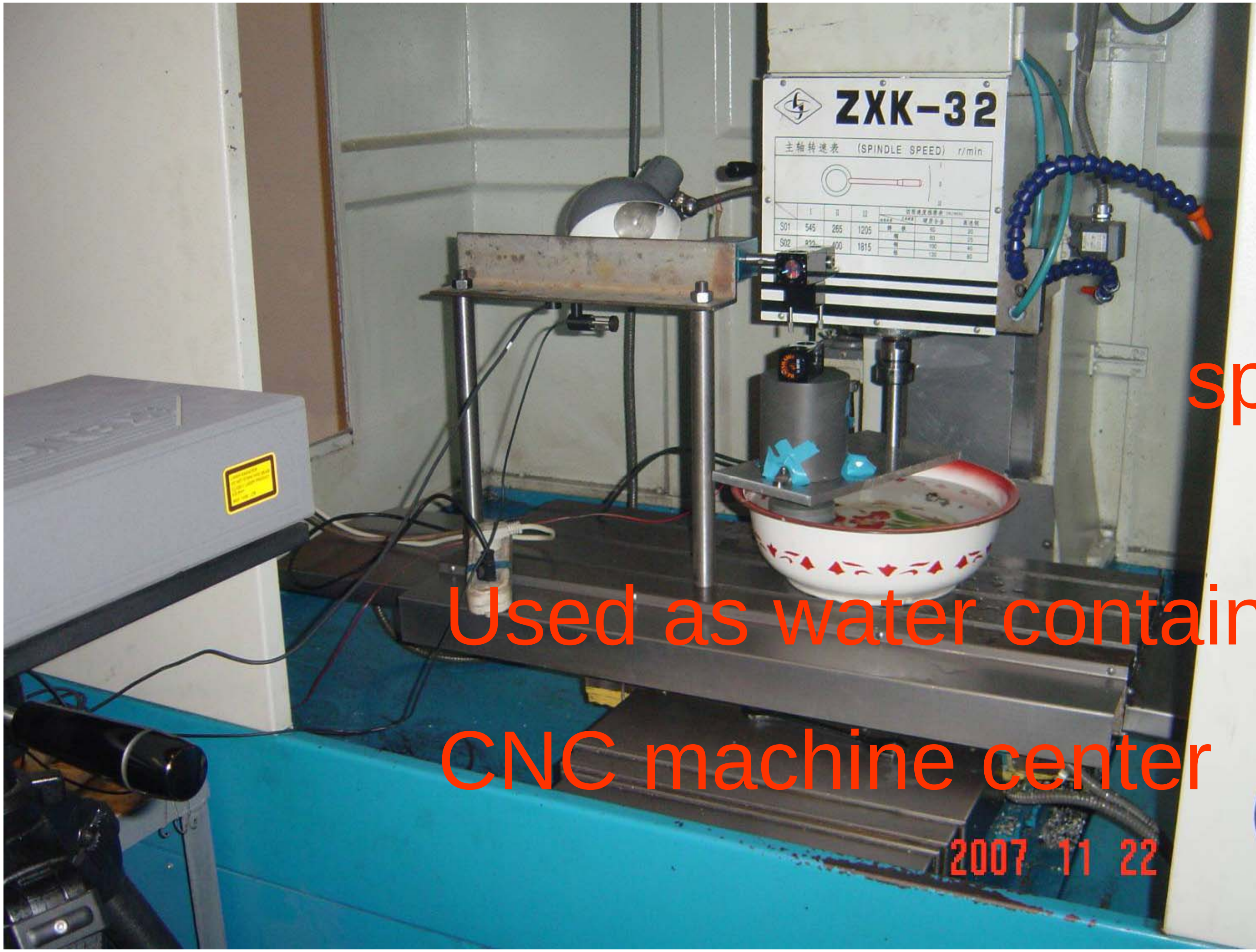
STS-2 of G. Streckeisen AG at the points 4 - 6.

	VSE355G2	STS-2
Frequency range (Hz):	0.012 - 70	0.00833 - 50
Sensitivity (V/kine):	2.5	15

(* kine = cm/sec)

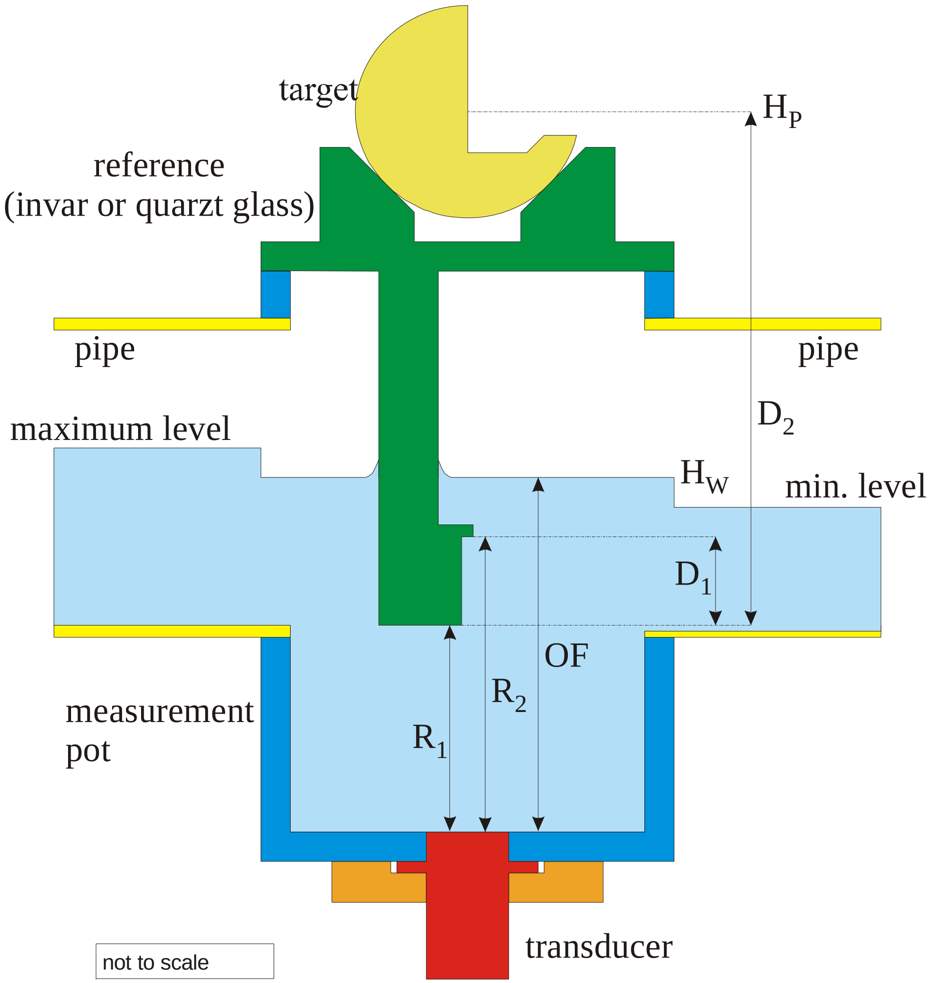
September 06 sump pump test




ZXK-32
(SPINDLE SPEED) r/min
2007 11 22
spindle
Used as water container
CNC machine center

DESY HLS

measurement pot with in-situ calibration



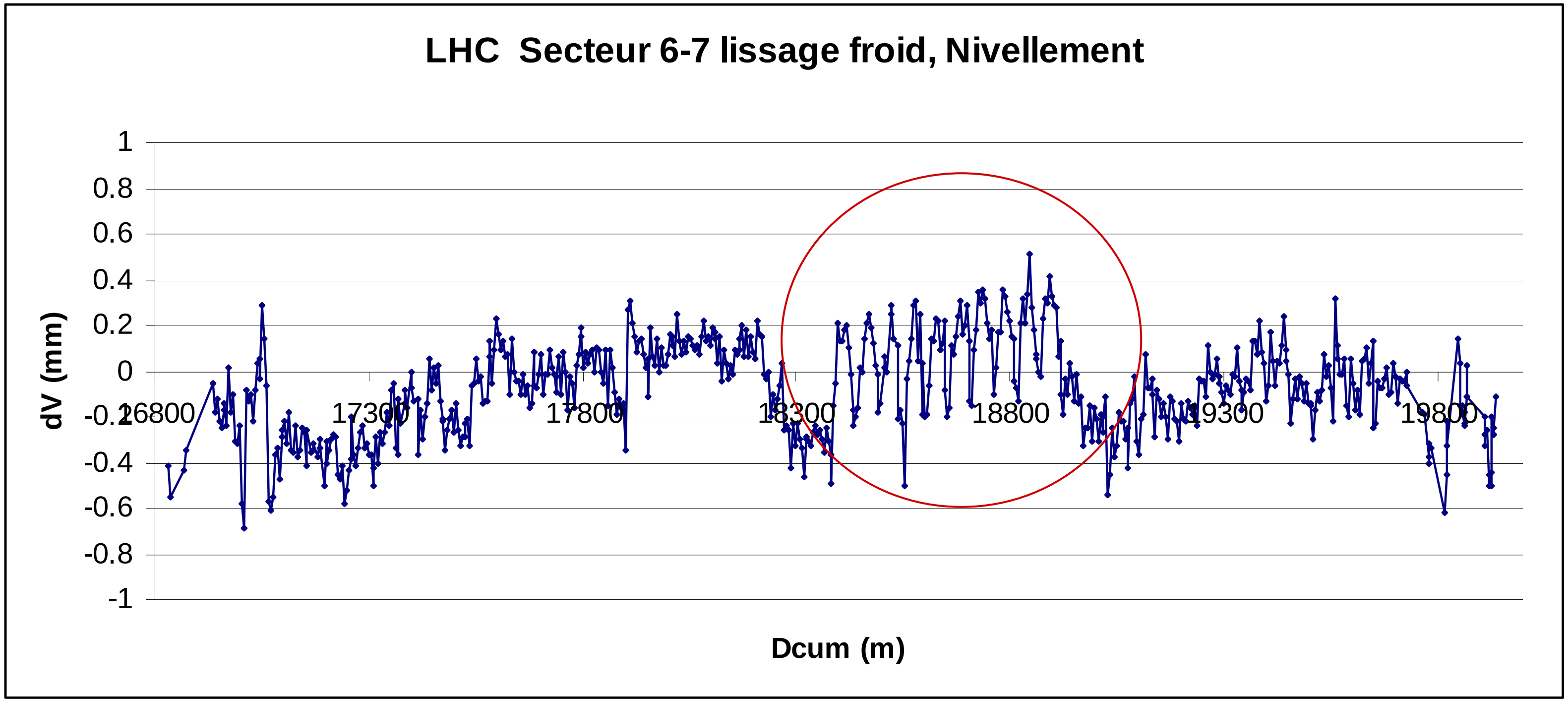
$$H_P = H_W + D_2 - D_1 \frac{OF - R_1}{R_2 - R_1}$$

DESY-HLS

- **position of transducer drops out**
- **scale drops out**


ZXK-32
主軸转速表 (SPINDLE SPEED) r/min
85-265 VOLTS
Laser measuring system
2007 11 23

LHC vertical records



- Levelling blocked at each side of the sector on deep references
- No big deviations
- Points to be moved calculated by plane (later in this talk)
- Saw tooth phenomena visible for most of the sectors

Calibration of instruments

- The calibration of the laser trackers. With respect to what?
- Calibration of the HLS
- Problems of vertical collimation with the NA2 or DNa3
- Absolute calibration of the wire sensors

- A rule: Do not believe the vendors of instruments

Fiducialisation…

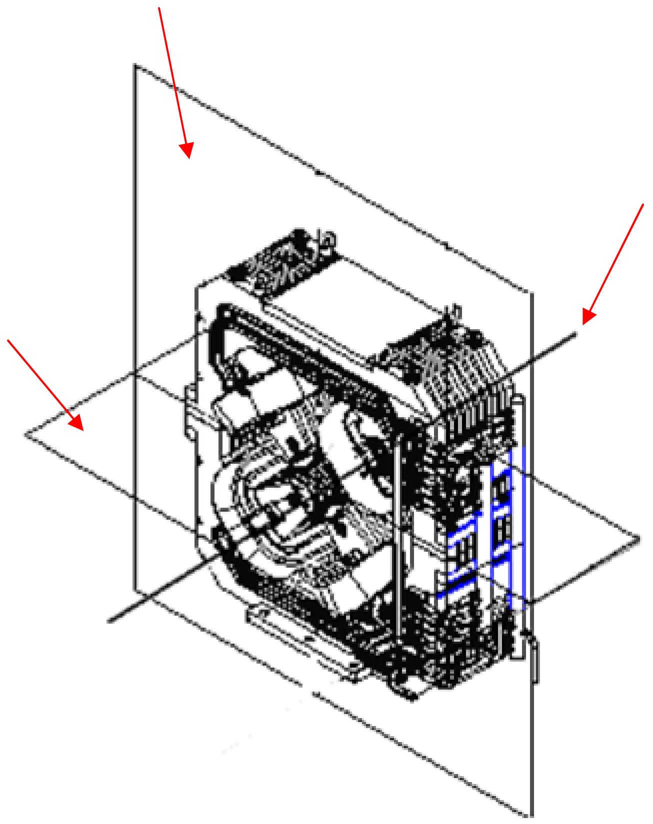
- W.r.t. magnetic axis
- W.r.t. mecanics
- Laser tracker intensively used
- + classical instruments (tilt)
- Pre-alignment on girders

Magnates, Vacuum Chamber installation and adjustment proposal

BEPCII

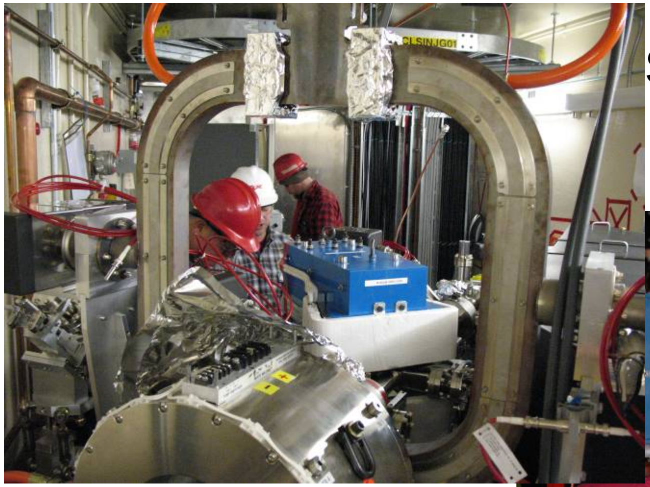
Fiducialization of Quadrupoles

- The mandrel and tiles will be placed in contact with two lower poles. Use laser tracker measure the ends of mandrel get Z-LINE.
- Put a fiducial plane into the poles, make it contact with two lower poles. Use laser tracker measure its surface get T-PLANE.
- Scan one side surface of the magnet get E-PLANE.

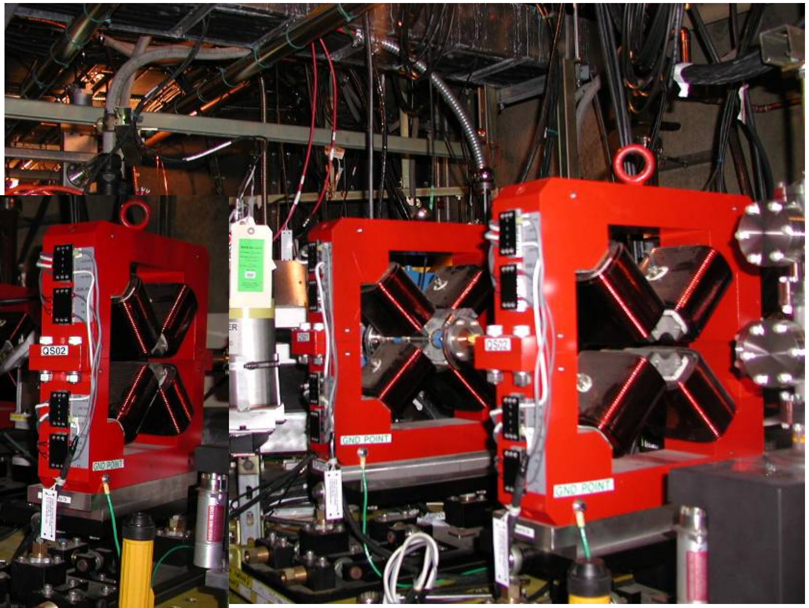


LCLS

- Injector, bunch compressor system installed in existing tunnels

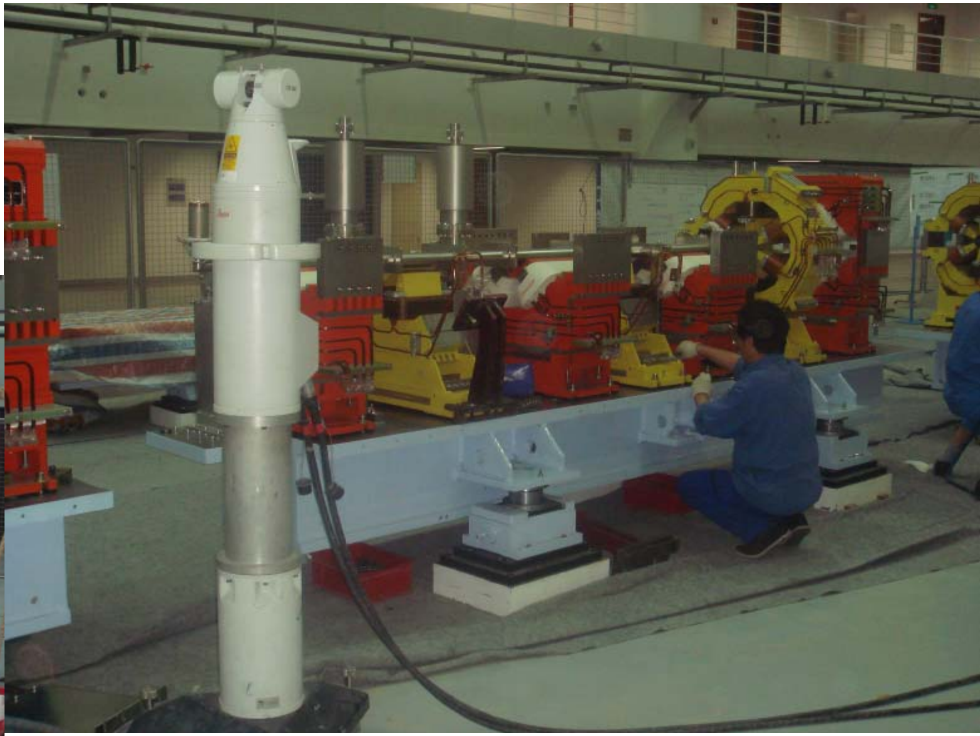


sioned, work



Storage ring（1）

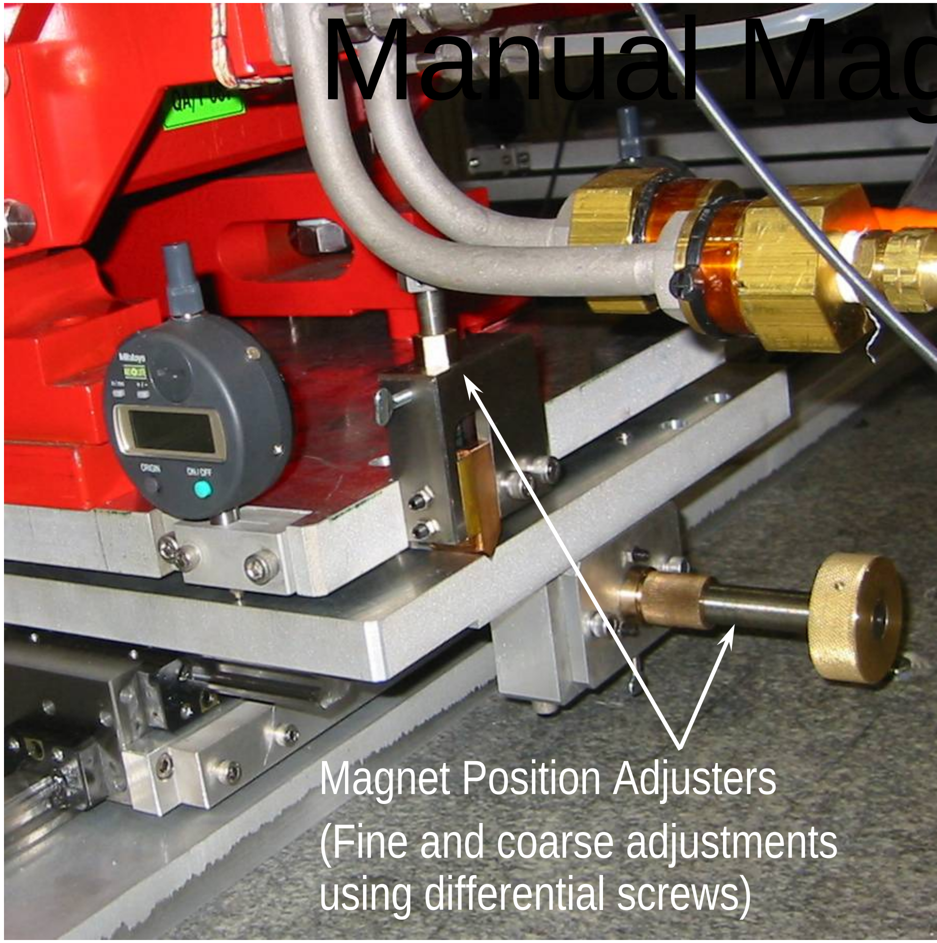
- Pre-alignment



Challenges

- Stands are of poor quality. MTA used components from previous projects and very old stands
- Time constraints. Network was done over a period of six months because access to Linac-MTA enclosure depended on the Linac downtime
- High congestion in the Linac-to-MTA enclosure, too many jobs going on at the same time
- Unstable floor at some locations. Stands were sitting over a metal ledge

Vibrating Wire R&D Setup: Manual Magnet Movers



First version with stainless steel parts did not work very smoothly. New version with Silicon-Bronze parts works well.

Dial indicators to monitor magnet motion. Mounting of horizontal indicators is now improved from an earlier version.

Survey and Alignment Concept of the RFQ

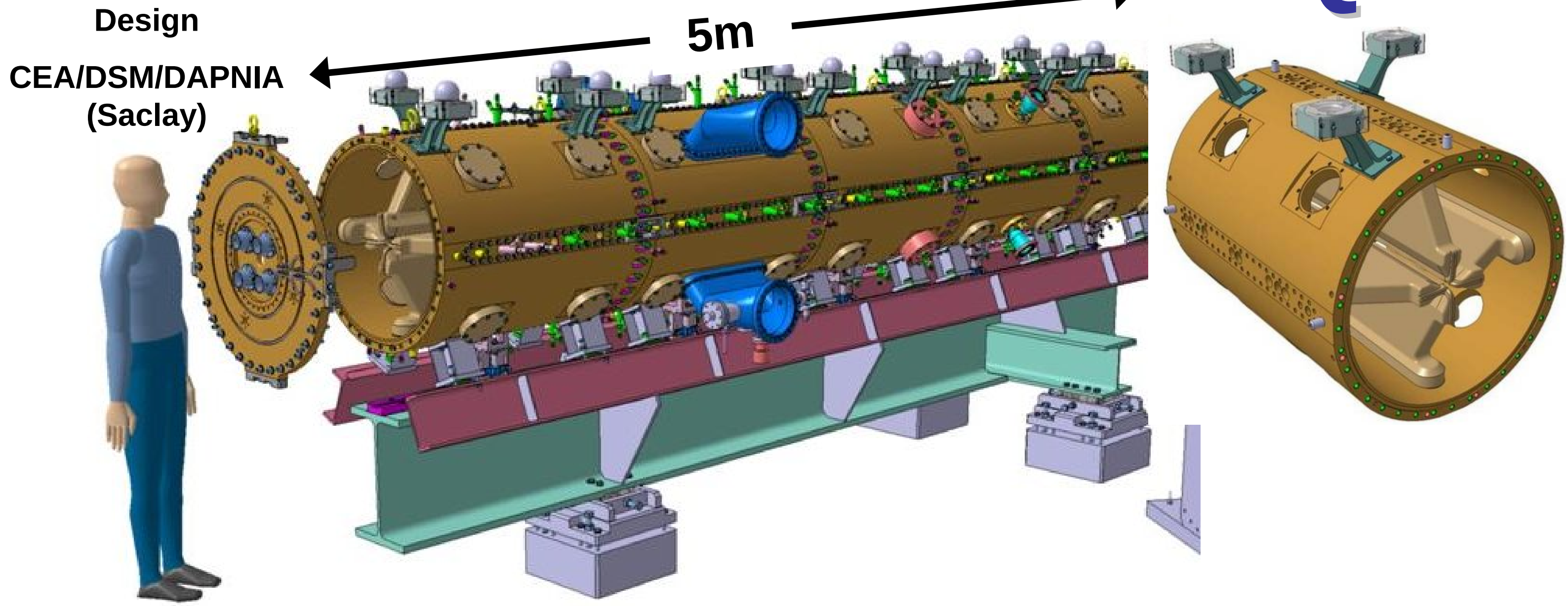
OVERVIEW

SPIRAL2

SURVEY INJECTOR COMPONENTS

ALIGNMENT LINAC CRYOMODULES

CONCLUSION



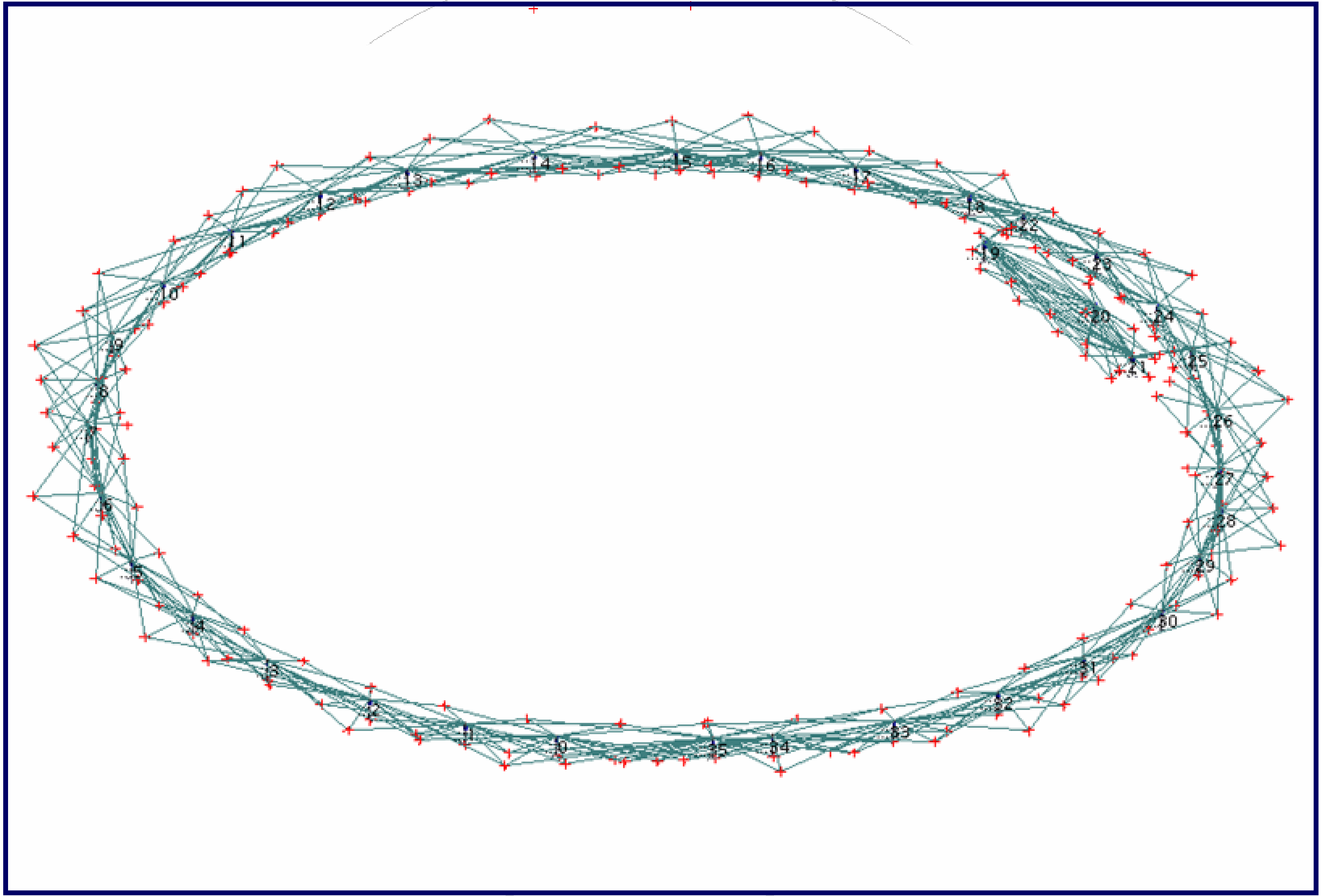
- The localization of the RFQ requires fiducial points transferred on the top of the vacuum vessel by adjustable plates equipped with a conical centering surface for a Taylor-Hobson-Sphere or retro-reflector.
- The spatial coordinates of these Taylor-Hobson-Sphere will be given in the reference system of the object.

- Located just after the ion source, the RFQ is the first step in the acceleration of the intense beams from SPIRAL2.

Methods and calculations

- Methods
- Calculations

➢ Network

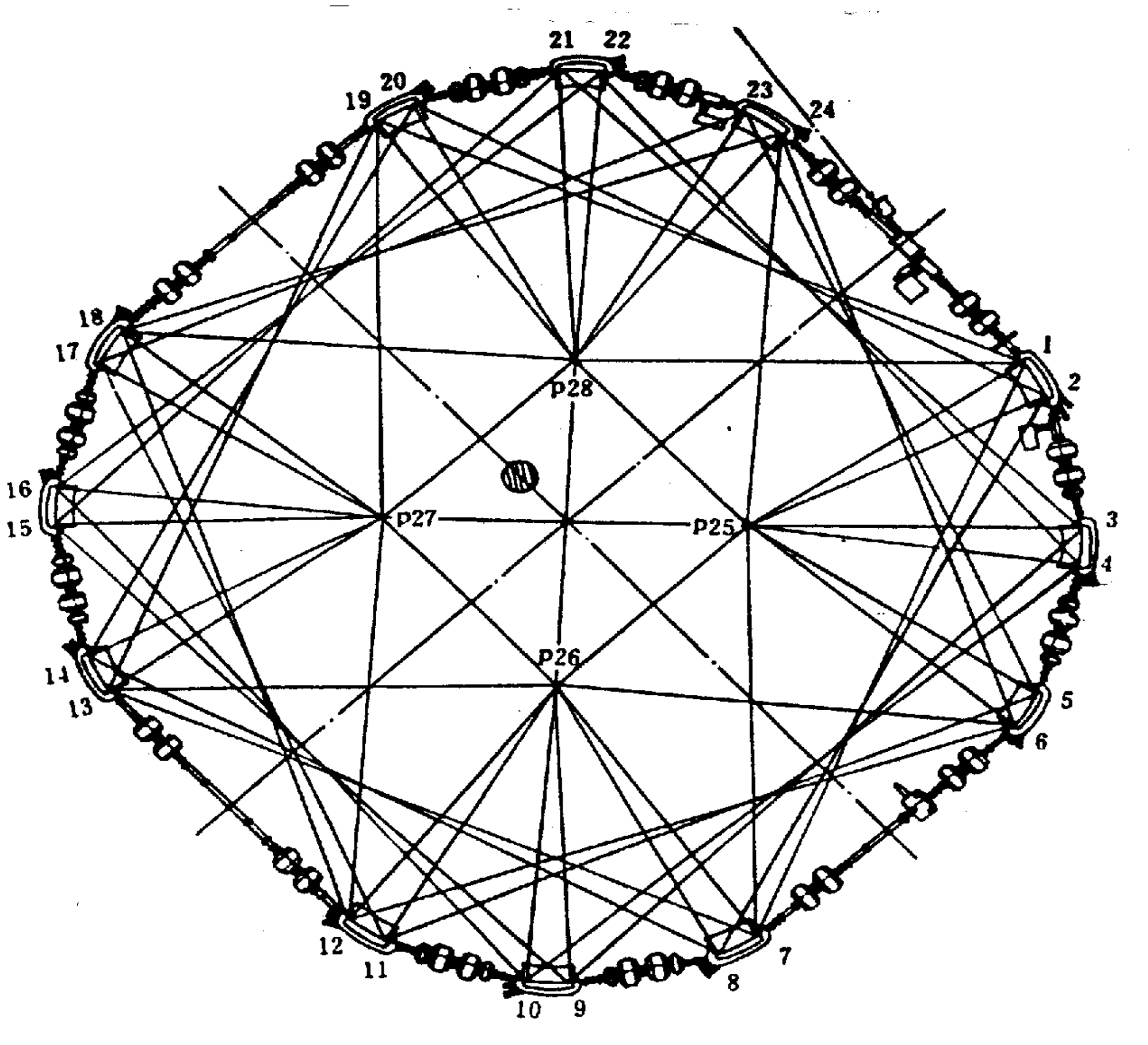


2006
Sept
Oct
Nov
Dec

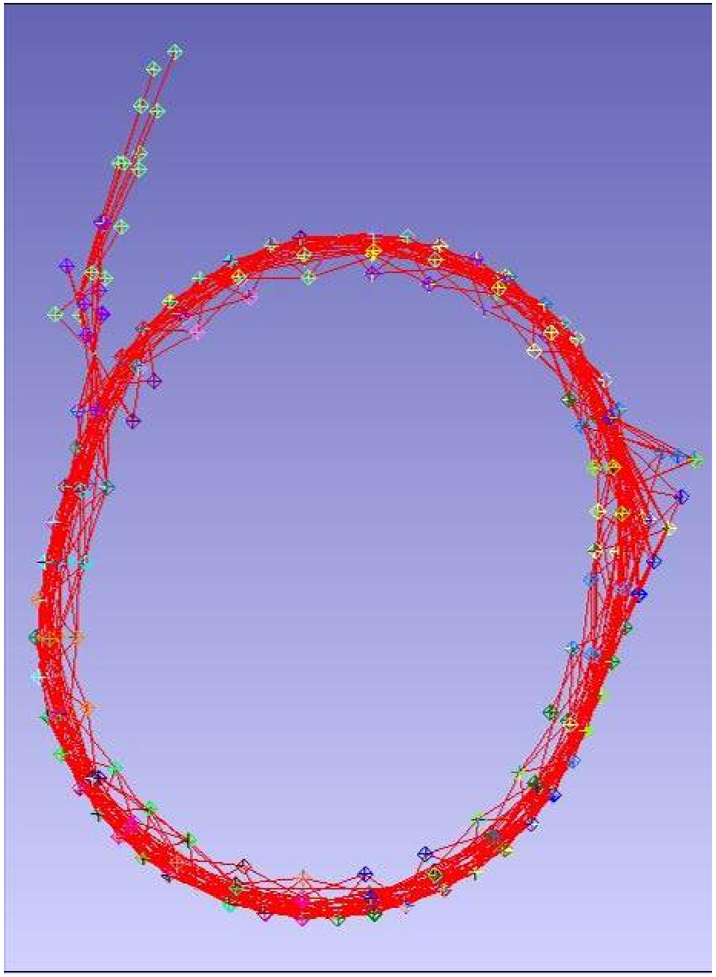
2007
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

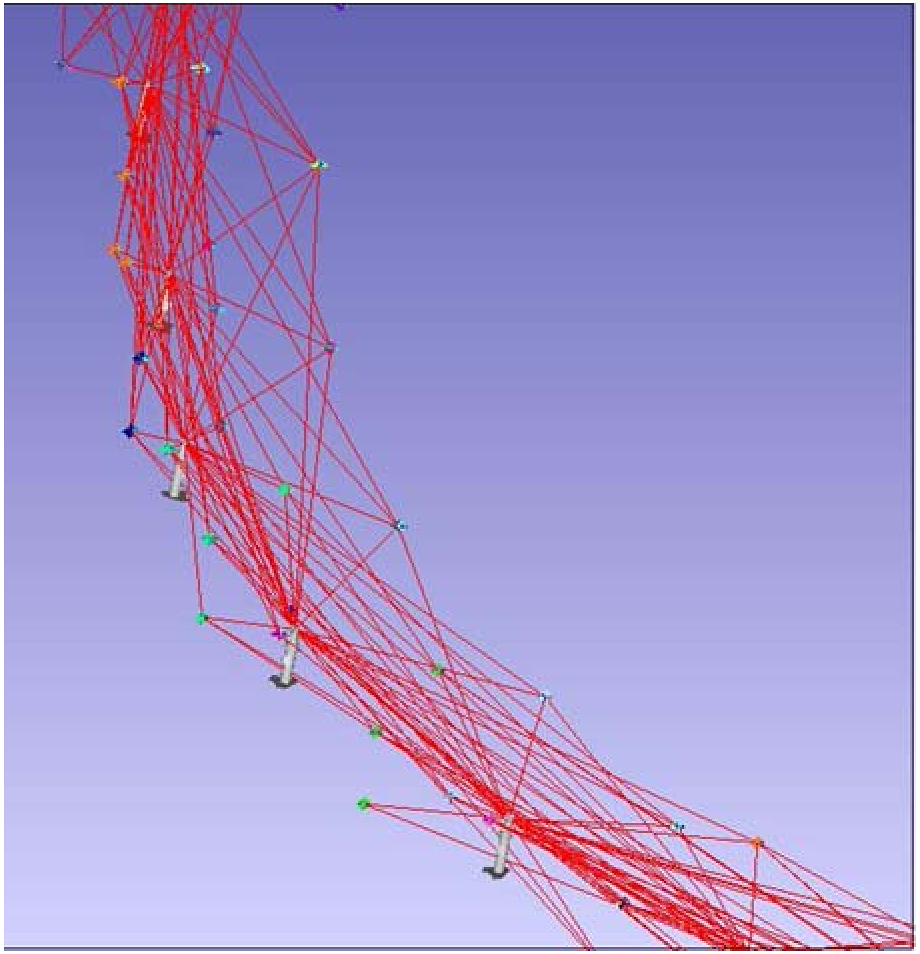
2008
Jan
Feb

Installation control network

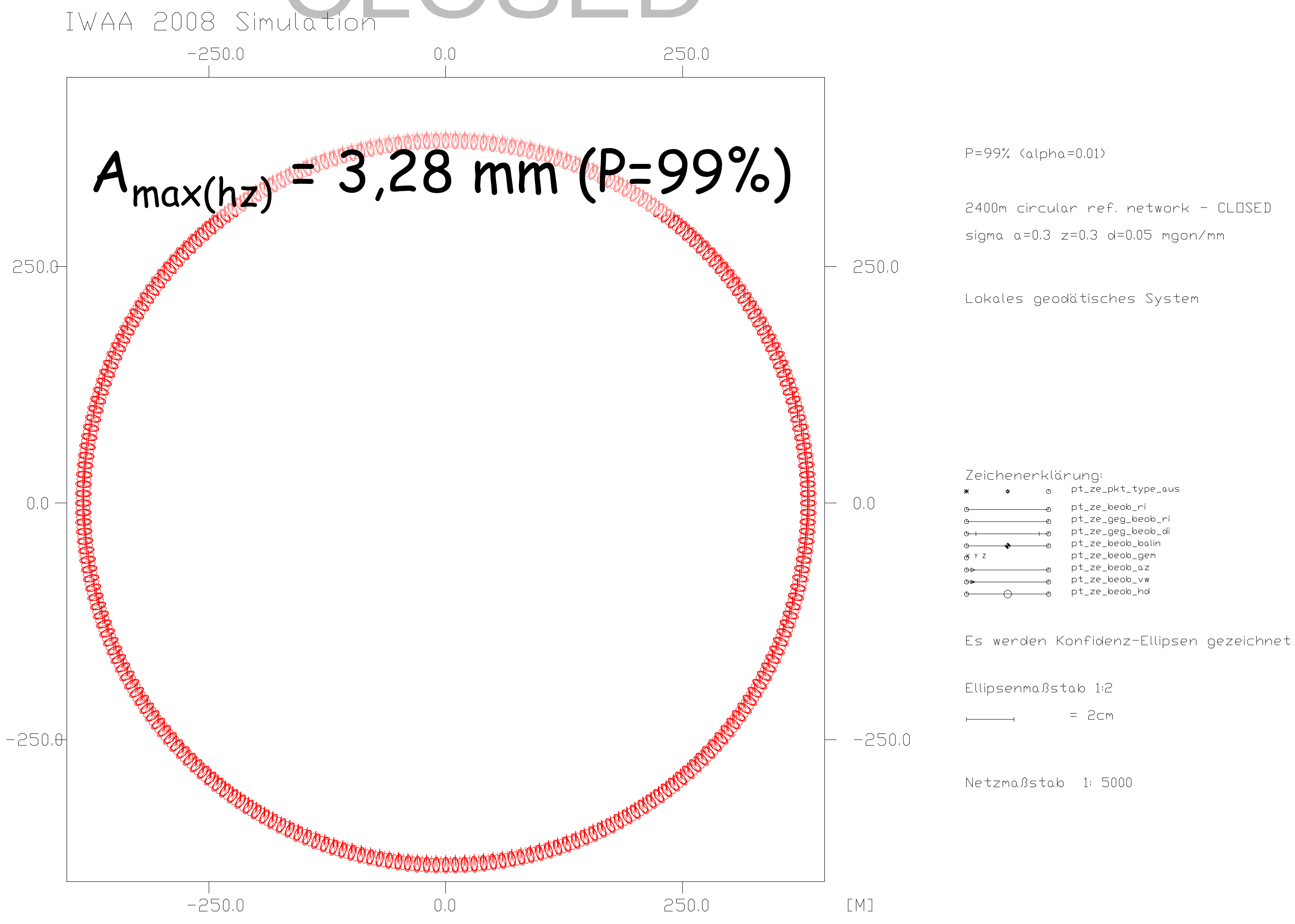


Booster network



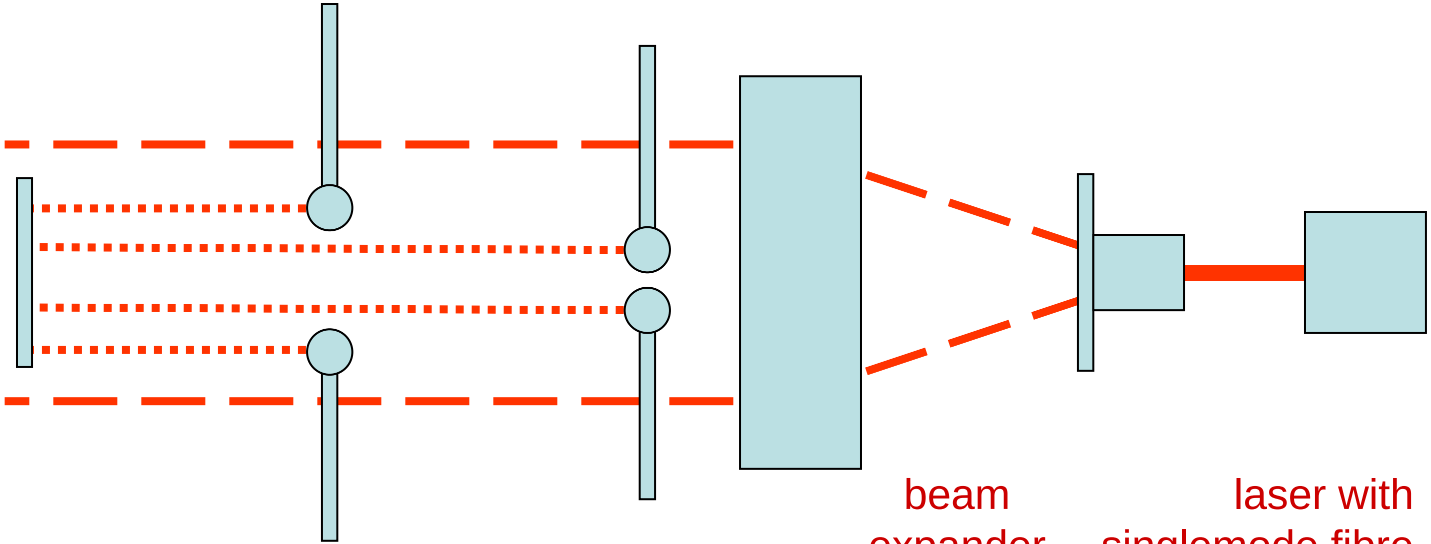


2400m circular network - CLOSED



simulation

Assembly of the SLR Poisson Spot System

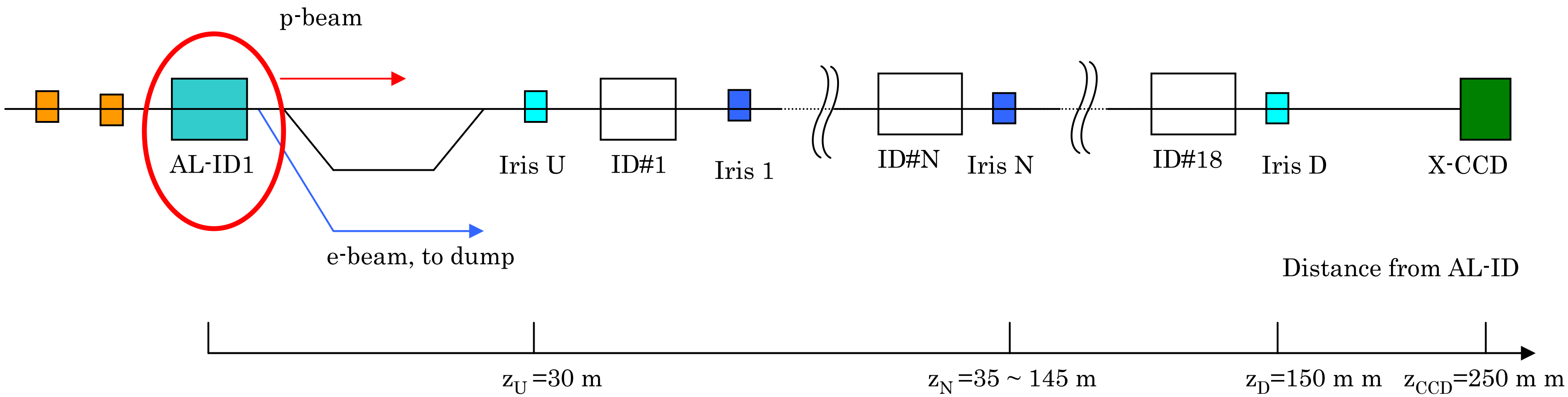


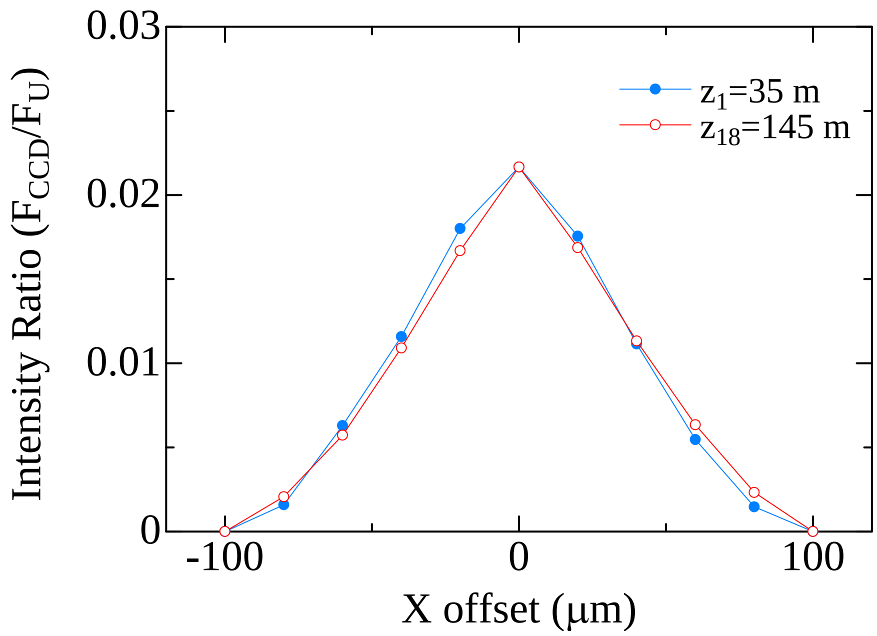
New algorithm:

Calculation of the **target displacement** by calculation of a **correlation** and subsequent subpixel estimation.

subpixel estimation is done by
calculating the maximum of the correlation function.

Alignment undulator





Iris diameter: 100 um

Sensitivity: ~ 10 um

STRETCHED WIRE OFFSET MEASUREMENTS: 40 YEARS OF PRACTICE OF THIS TECHNIQUE AT CERN

Hélène Mainaud Durand, Jean-Pierre Quesnel, Thomas Touzé, CERN

- The principle
- Some applications in the existing machines
- A possible futur for this technique

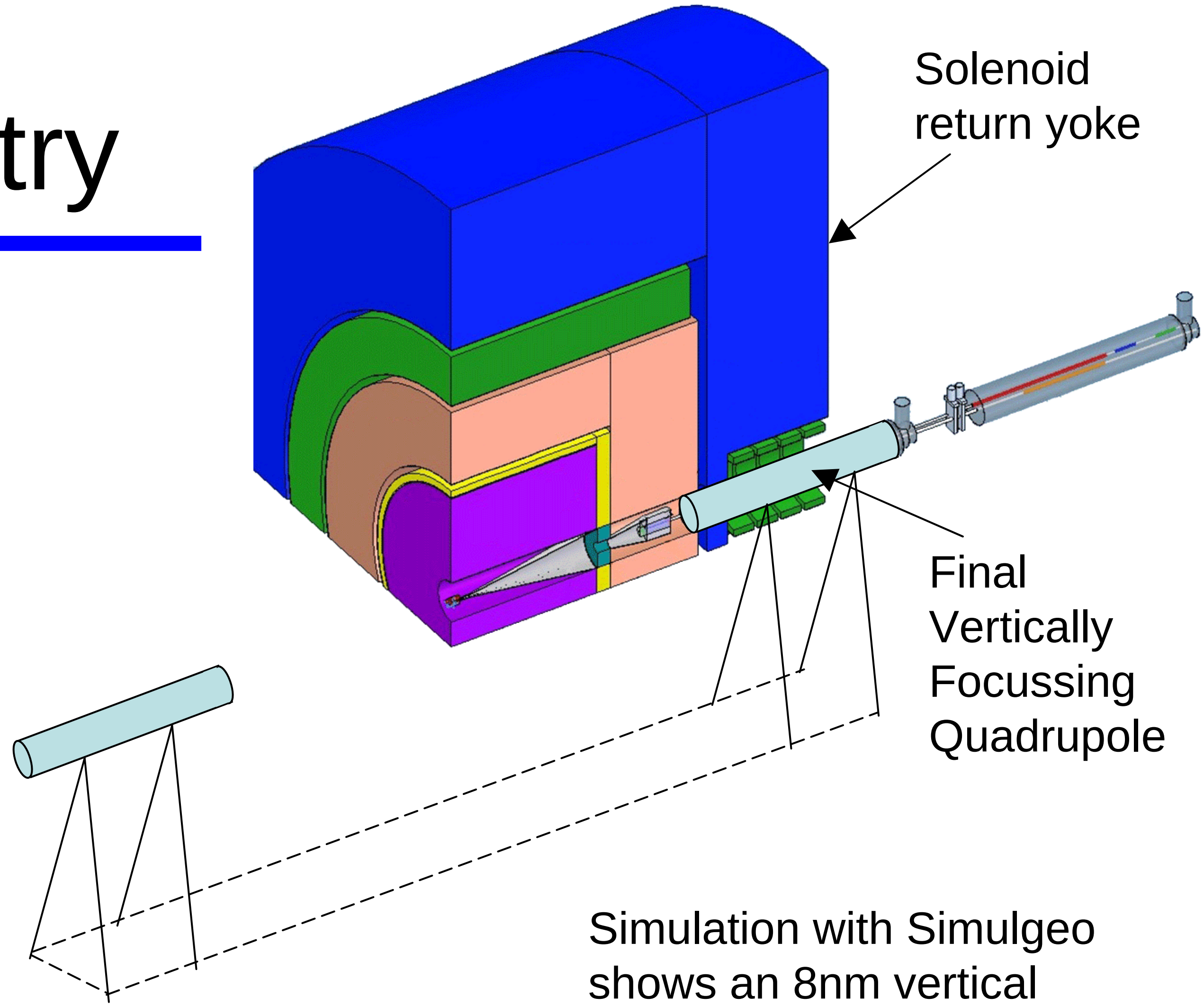
The LHC

Geometry

Measure movement of QD0s with respect to some points radially outwards through detector field yoke

Then must measure the relative motion of these end points

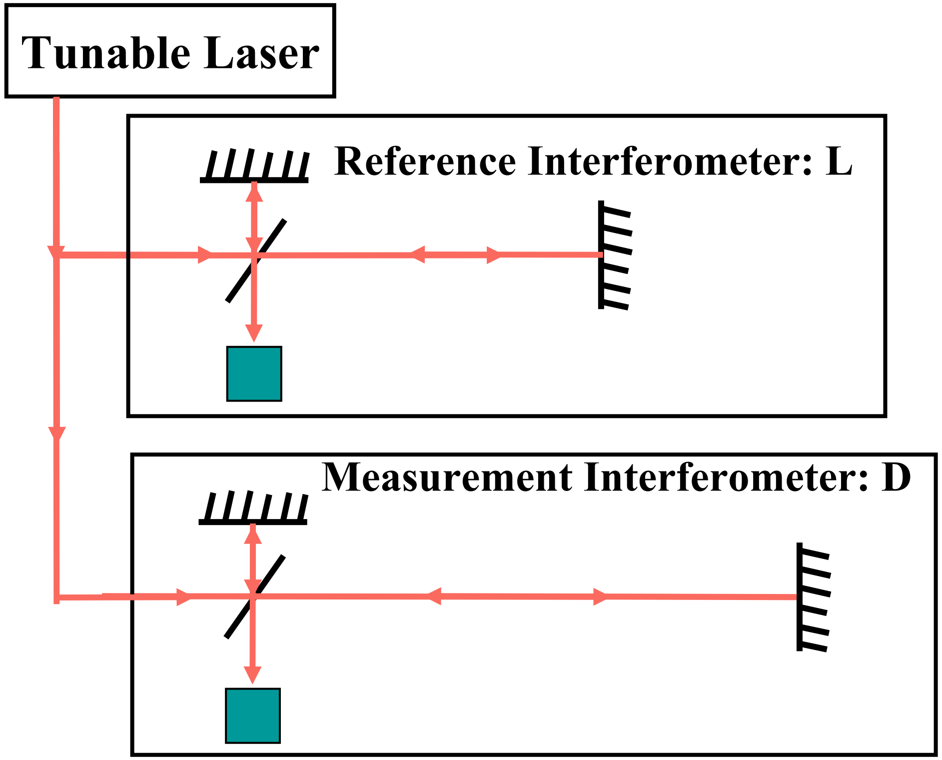
Exact geometry to be determined in synch with detector design

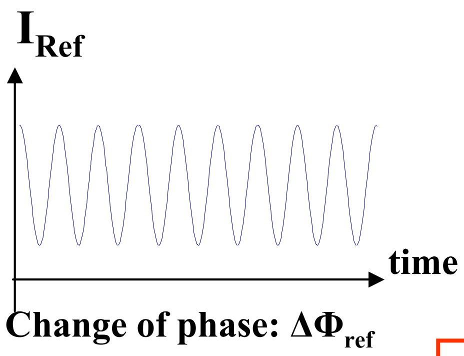


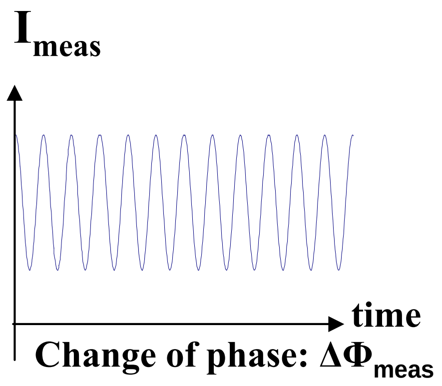
Simulation with Simulgeo shows an 8nm vertical offset resolution with this geometry

Frequency Scanning Interferometry

- Idea is adapted from the Michelson interferometer
- Instead of moving the mirror we change the frequency of the laser



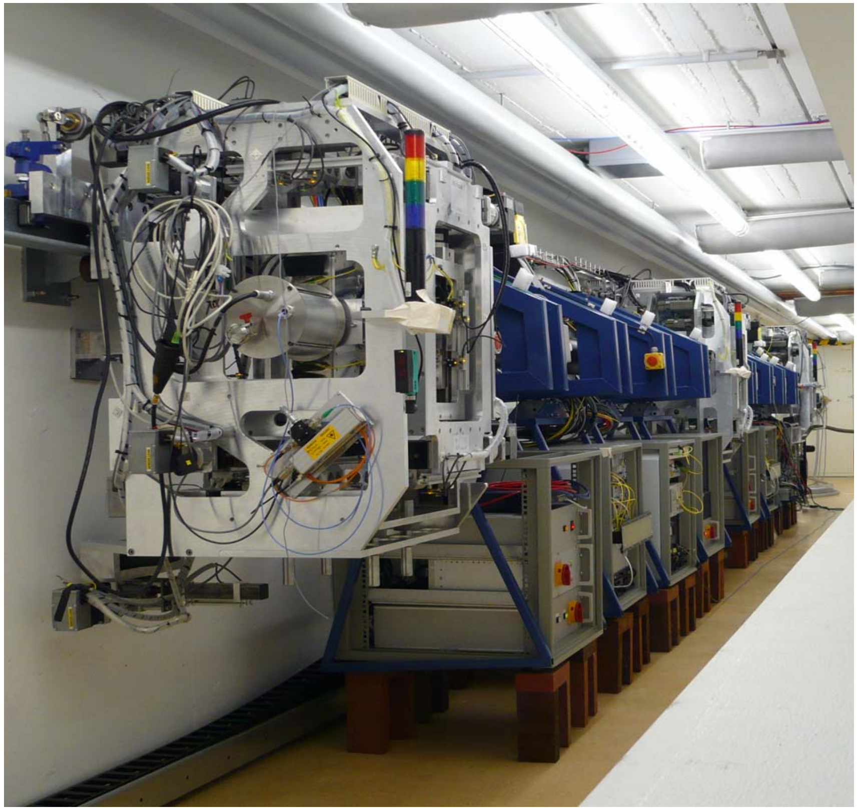




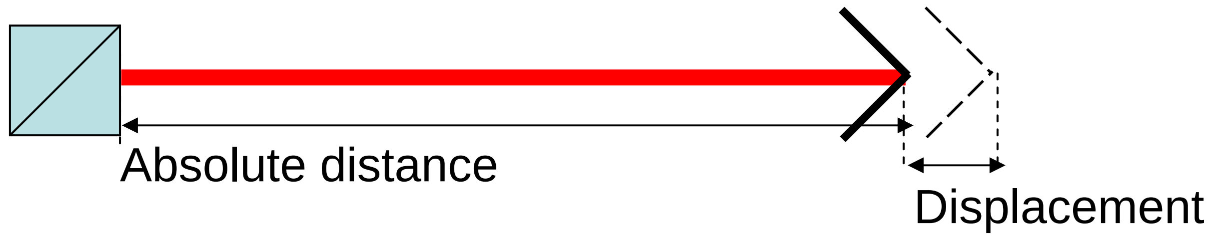
$$\frac{\Delta\Phi_{\text{Ref}}}{\Delta\Phi_{\text{MEAS}}} = \frac{L}{D}$$

Contents

- LiCAS Overview
- Straightness Monitor Basics
- Produced system
- Beam Fitting
- Stability
- The Ray tracer
- Reconstruction
- Calibration
- Autocalibration
- Conclusions



Measurement lines



We measure distances along measurement lines using two techniques:

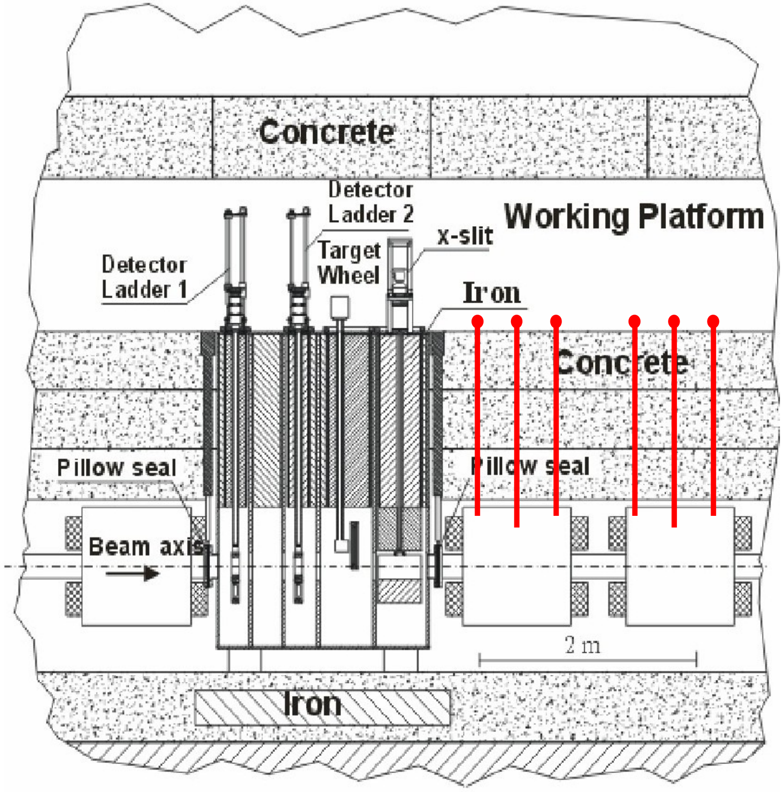
- Absolute distance interferometry
- Displacement interferometry

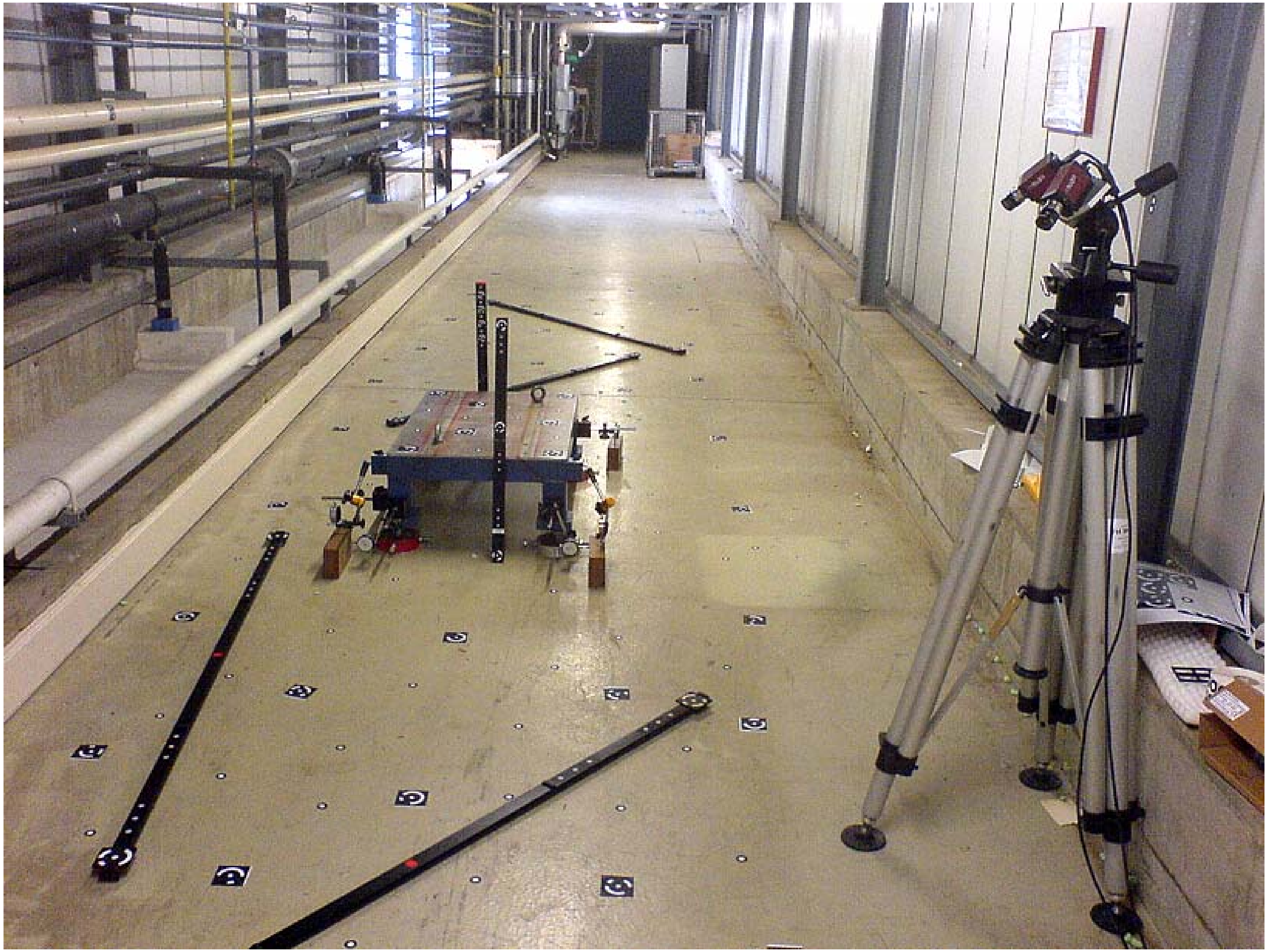
Each line is the same, and is capable of performing both types of measurement.

Purpose of the RTRS prototype

- Provide an R&D platform with which we can
  - develop methods for robotic tunnel survey.
  - develop methods for in-situ calibration.
  - determine performance of each measurement technique in complex system outside laboratory environment.
  - determine performance of overall RTRS measurement procedure over distances up to 50m (tunnel length limit).
  - learn what minimal & optimised user system should be
- Prototype has functionality beyond that of “user system”

Configuration of RALF





Acknowledgment

❑ I would like to thank

➢ Alignment and Metrology Group members who participated in the MTA project

➢ Dr. Fernanda Garcia - MTA Beam Line Installation Manager

ありがとう

Domo Arigato !!!

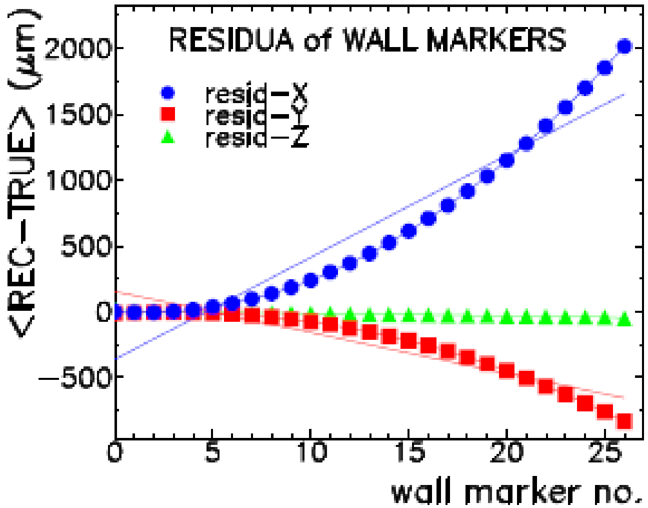
質問ですか

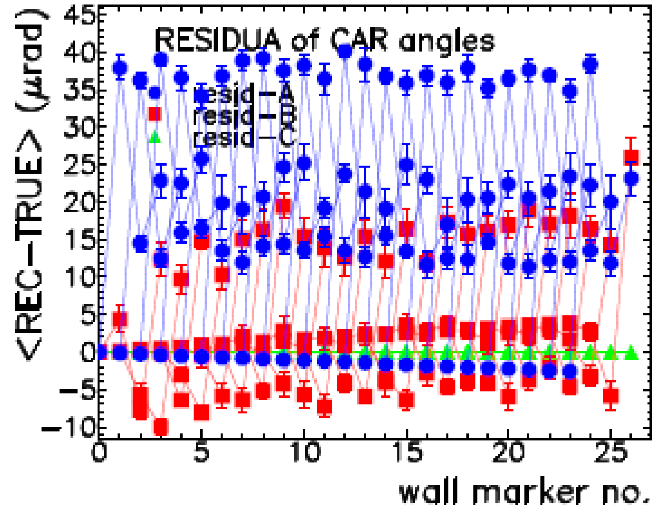
？

Beam line construction

The most downstream magnet of the FTBL.

Train Monte Carlo: systematic errors (MEAN of REC-TRUE)

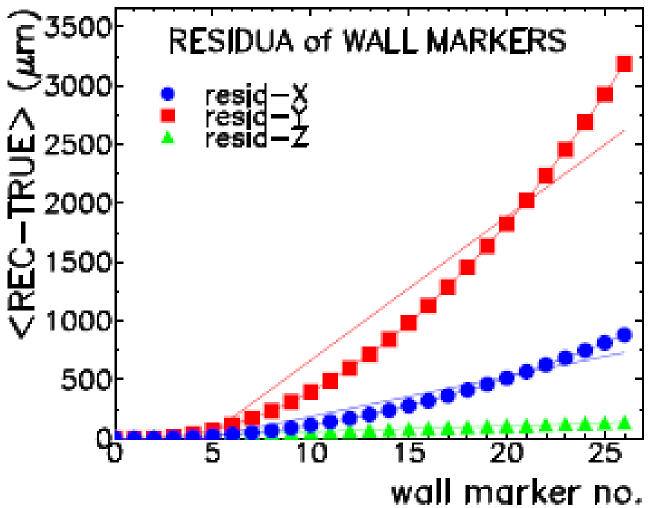




$A = Rot_X$

$B = Rot_Y$

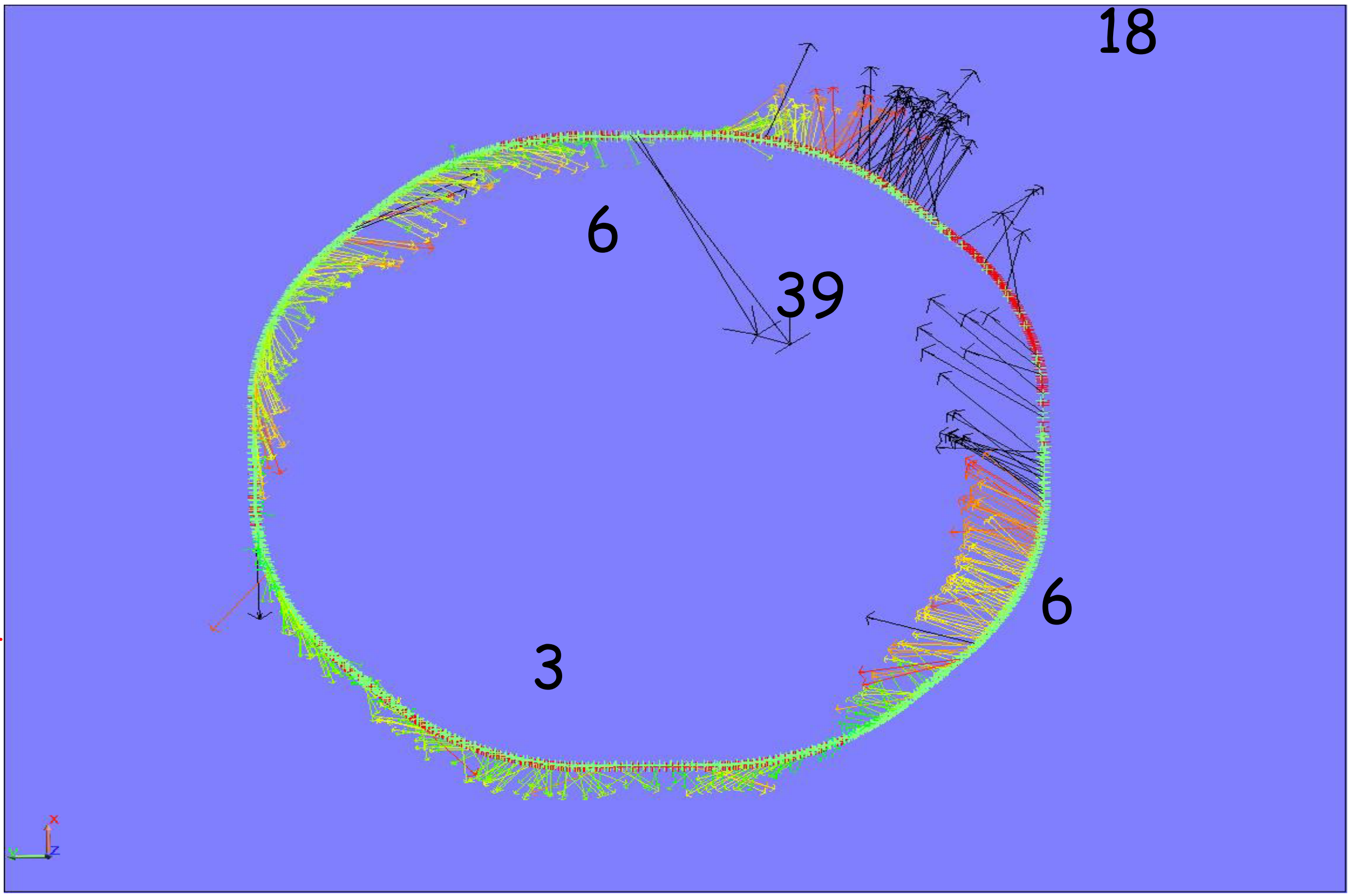
$C = Rot_Z$



- assuming calibration precision:
  - CCD: $\sigma_{CCD} = 5\,\mu m$
  - FSI: $\sigma_{FSI} = 5\,\mu m$
- linear $(\sim n)$ growth of angular errors
  quadratic $(\sim n^2)$ growth of transverse errors
- examples of straight line fits for
  two "miscalibration patterns"

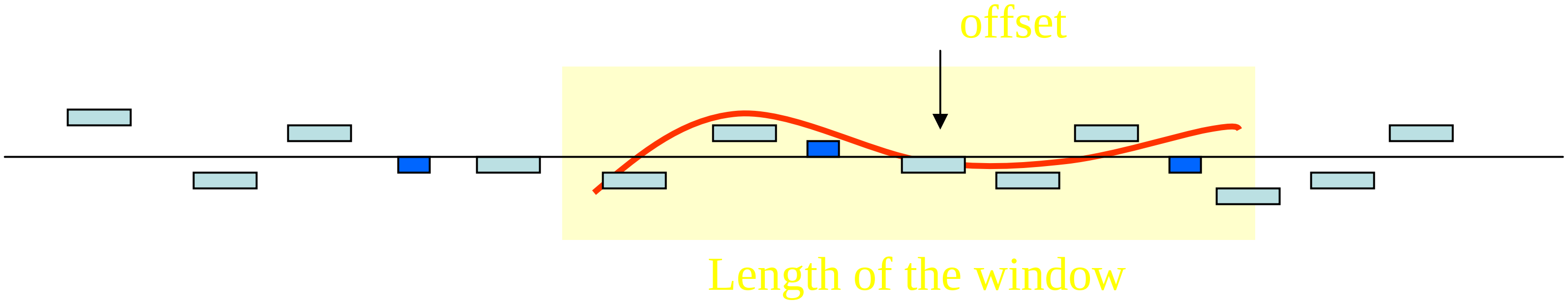
Error of old magnet positions

misalignment



Smoothing with “Plane”

- ❑ **What is Plane ?**
  - ✓Software to calculate a smooth line and the points to be displaced
  - ✓Principles : windows and polynomials
  - ✓Parameters : size of the window and Tol above which the points are rejected
  - ✓Works in vertical and horizontal plane



Beta Function

Beta function measurement

Change QM correction current

Measure betatron tune shift

$$\beta = \frac{4\pi}{kL} \frac{I_0 N_{\mathrm{main}}}{N_{\mathrm{corr}}} \frac{\Delta\nu}{\Delta I}$$

Position	β_x(meas)	β_x(MAD)
QM11	2.137	2.252
QM21	2.184	2.256
QM22	2.149	2.253
QM32	2.089	2.254
QM41	2.164	2.255
QM51	2.164	2.254
QM61	2.179	2.253

$\Delta\beta_x/\beta_x = 0.06(2\sigma)$

Stopband Measurement

Change QM main current

Measure beam life(>10sec)

around ν=1.5

$\delta\nu_x = 1.1\mathrm{x}10^{-3}$ (calc $0.8\mathrm{x}10^{-3}$)

$\Delta\beta_x/\beta_x < 2\mathrm{x}10^{-3}$

$\delta\nu_y = 1.2\mathrm{x}10^{-3}$ (calc $0.6\mathrm{x}10^{-3}$)

$\Delta\beta_y/\beta_y < 6\mathrm{x}10^{-3}$

What has not been said

Only few on geodesy aspects

From MAD files to survey data

Links with CAD

ALARA

The supports

Integration

As usually

- Do not believe the measurements.
- Mix the methods
- There is a big step between the theory and the practice, and simulations are always optimistic
- Survey people shall be integrated in the project teams since the very beginning.

Vive IWAA08. Vive next IWAA

Vive IWAA08. Vive next IWAA

DATE No.

温故知新

温故知新

温故知新


Roland

The 10th
INTERNATIONAL WORKSHOP ON ACCELERATOR ALIGNMENT
IWAA
08
February 11-15, 2008
KEK, Tsukuba, Japan
HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION
http://www-conf.kek.jp/iwaa08/
The 10th
INTERNATIONAL WORKSHOP ON ACCELERATOR ALIGNMENT
IWAA
Registration