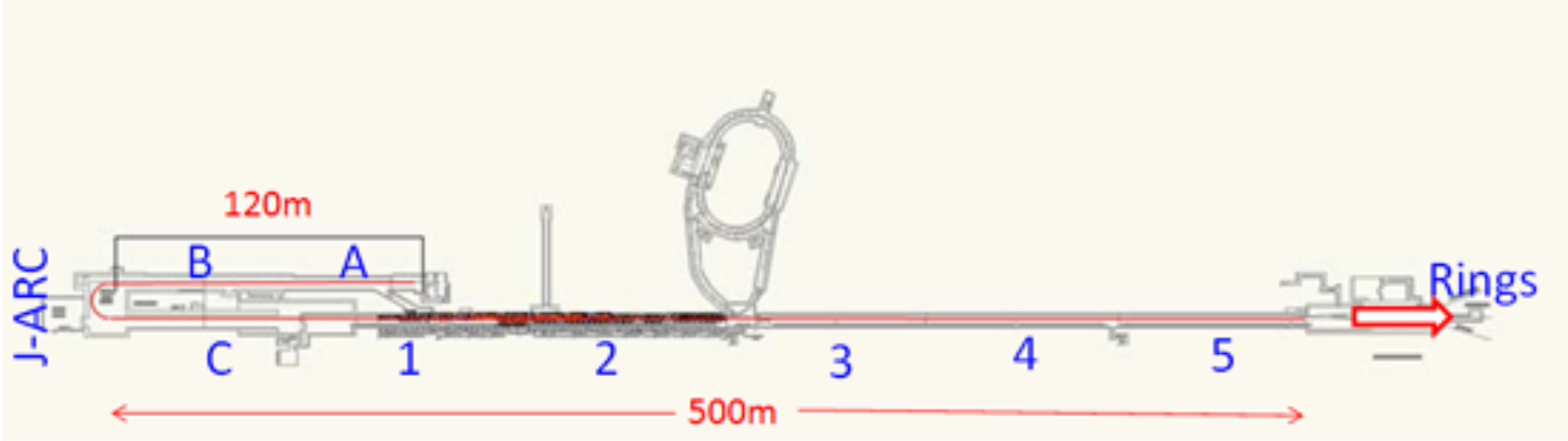
Beam line alignment status

2014. March. 4

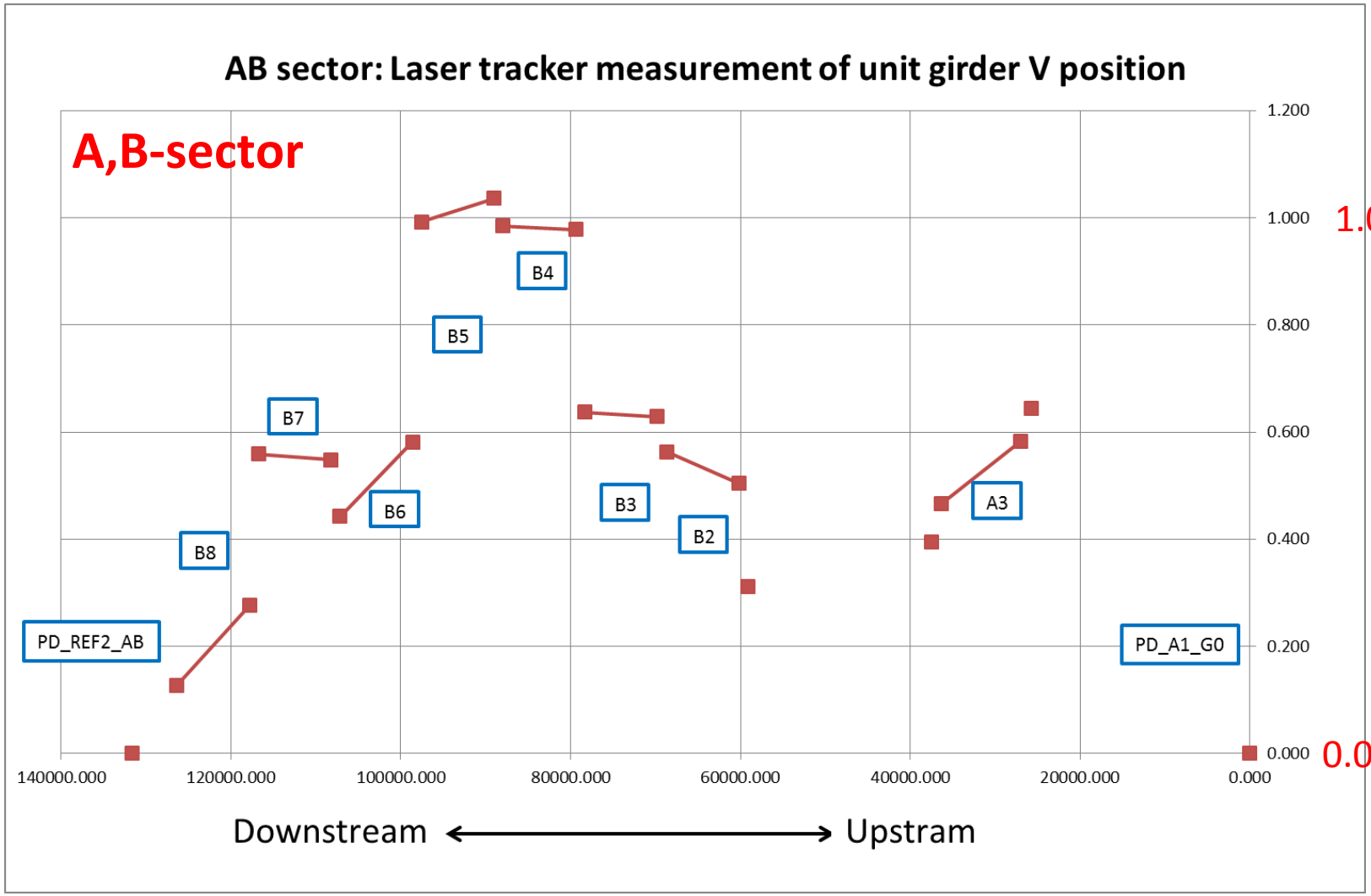
Takuya Kamitani

initial alignment strategy

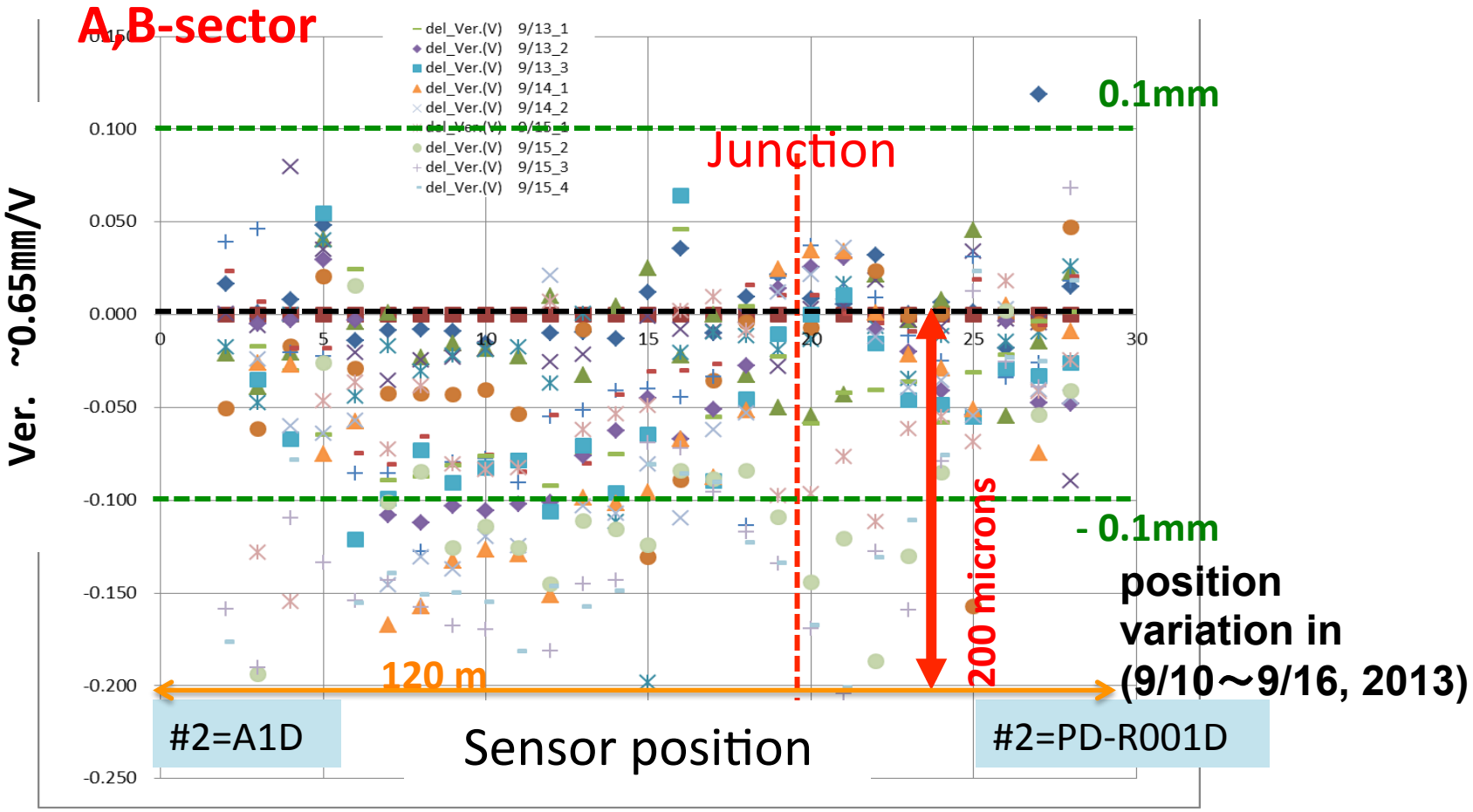


- laser straight of girders in sector-A, B
  component alignment by laser tracker
- laser straight of girders in sector-C to 5
  component alignment by laser tracker
- J-arc alignment by laser tracker

girder straightness
before laser straight alignment

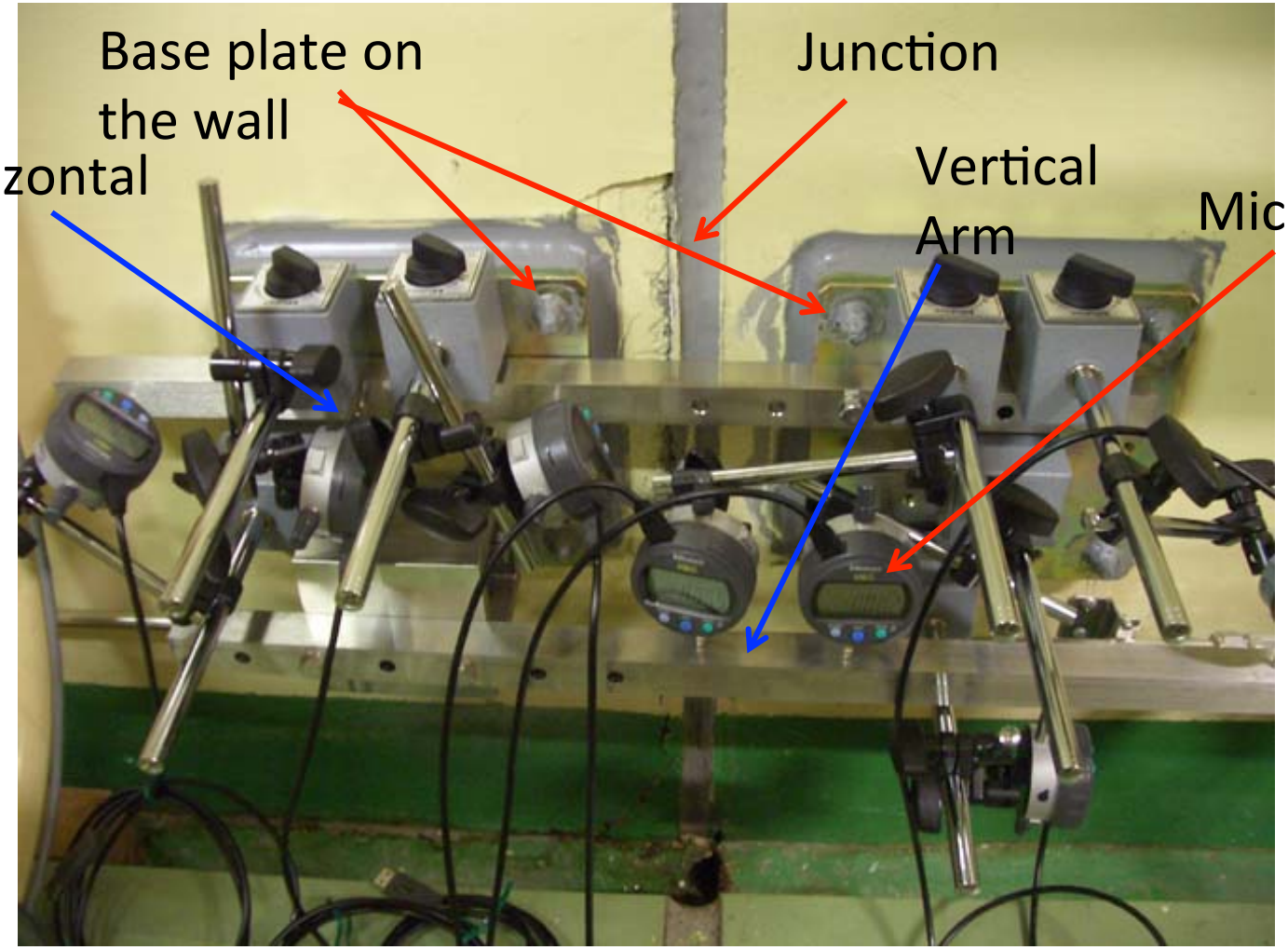


aligned in laser straight but time variation



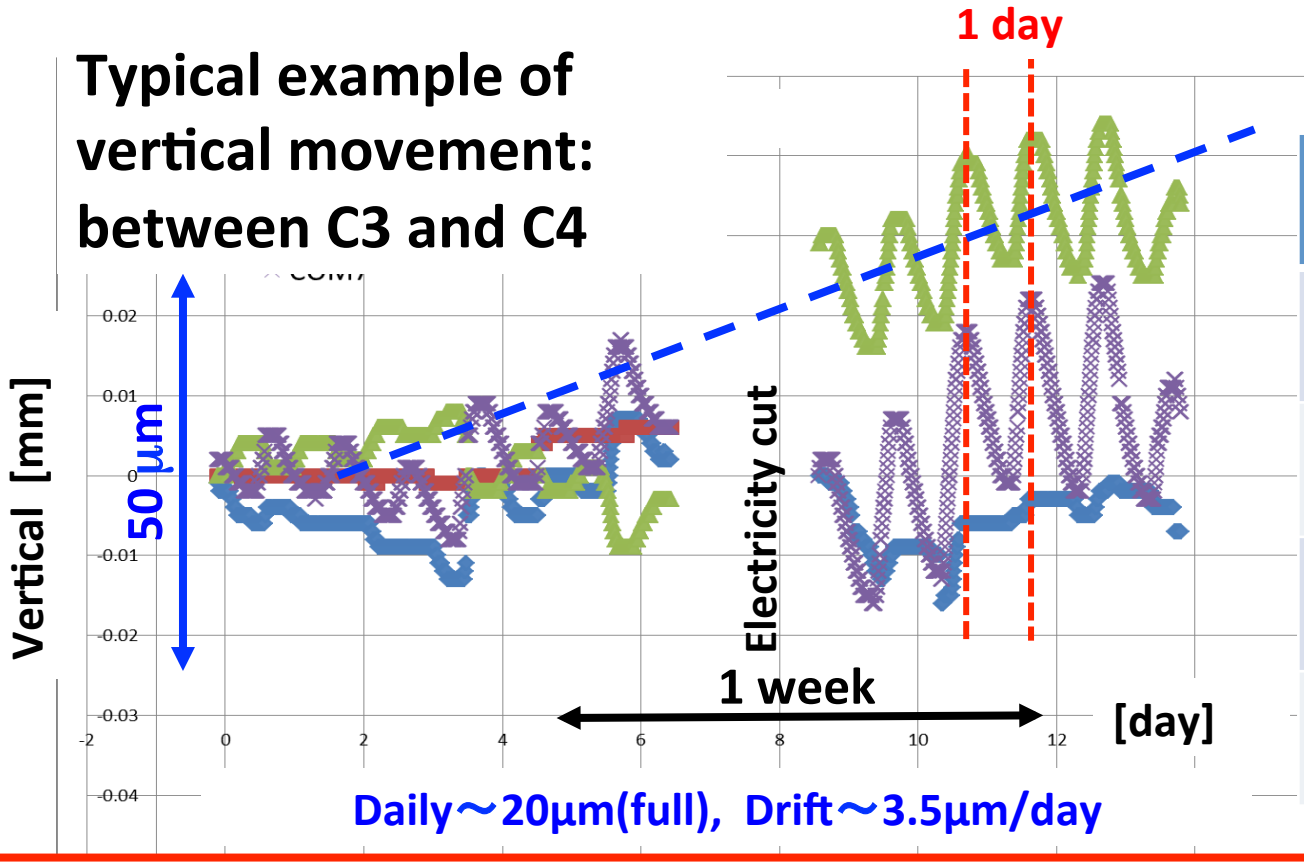
The movement over a week amounted to 200 microns or more.

Micrometer measurement setup between an expansion joint



Relative floor movement between both sides of expansion joint

Typical example of vertical movement: between C3 and C4



Daily～20μm(full), Drift～3.5μm/day

Summary at 3 junctions

Item	@C3, @12, @18
Hor. daily	2～10 [μm]
Hor. drift	2～5 [μm/day]
Ver. daily	15～30 [μm]
Ver. drift	1～5 [μm/day]

Junction: The daily movement amounts to 20-30 microns, while weekly to several tens of microns.

girder alignment

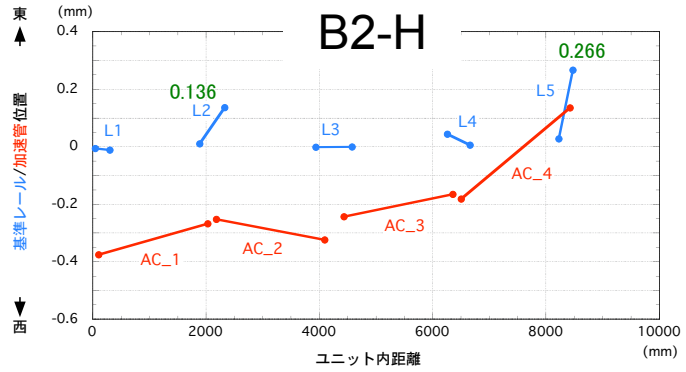
- completed (σ<0.3mm) in laser straight
  in sector-A, B

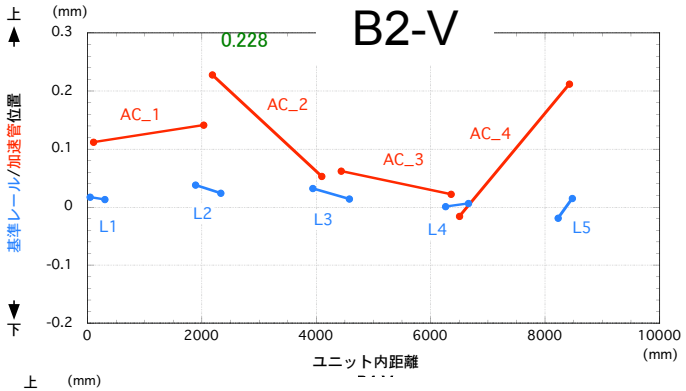
- only pre-alignment in laser straight
  in sector-C to 2 (still in construction stage)
  to be aligned in April 2014 &
  detail alignment in 2014 summer shutdown

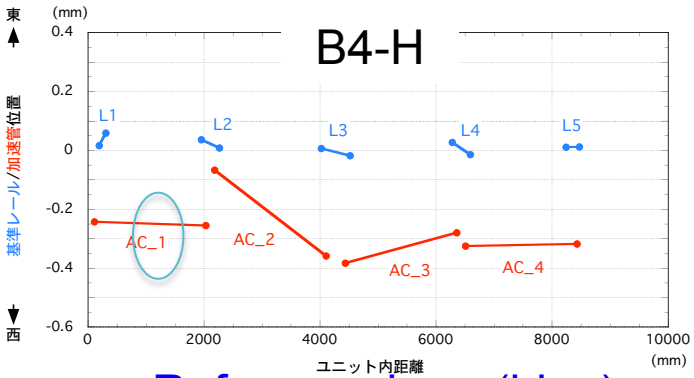
- only pre-alignment by laser tracker
  in sector-3 to 5 (in operation for PF & PFAR)
  detail alignment in laser straight
  in 2014 summer shutdown

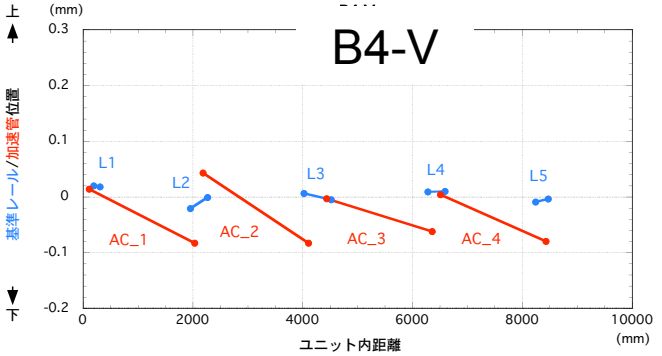
short-distance (local) alignment

Hard ware alignment on a 10m girder









Reference bars (blue) are set typically within 0.1mm.

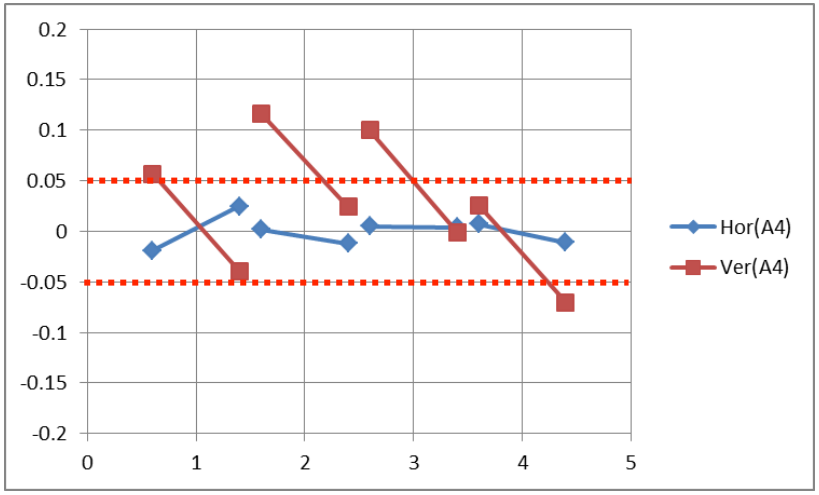
Hor. up to 0.5mm slope

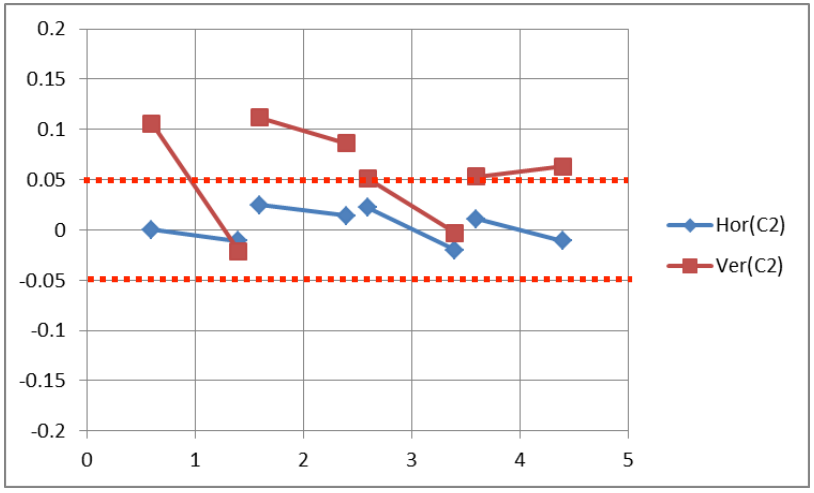
Ver < 0.2mm

Systematic error may exists in H by 0.5mm, while V stays 0.2mm from reference bar.

K. Kakihara, 22 Nov. 2012

Accelerator structure alignment on a girder, measured w.r.t. PD arms





Examples showing the present status: Statistics of three units (C1, C2, C3)

Horizontal

Average = 2 microns

Stand. Dev. = 16 microns

Easy adjustment by shimming

Vertical

Average = 5 microns

Stand. Dev. = 51 microns

A little tedious but can be adjusted by screw bolts

component alignment

- completed (σ<0.1mm) for acc. structures in sector-A, B
  - ❖ for magnets, add-on reflector base for laser tracker to be installed, to be aligned in 2014 summer shutdown

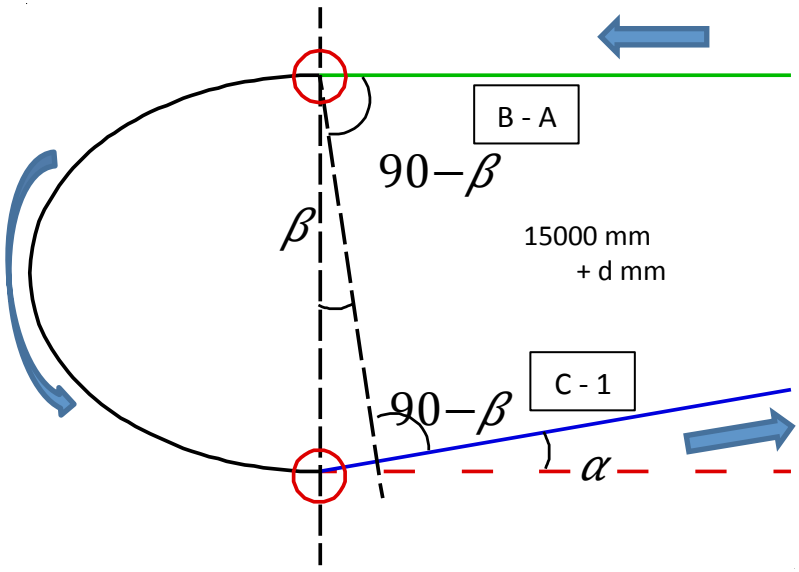
- completed (σ<0.1mm) for acc. structures in sector-C, 1 before target
  - ❖ for magnets, add-on reflector base for laser tracker to be installed, to be aligned in 2014 summer shutdown

- only rough alignment in 1-3 to 2-6 (still in construction) to be aligned in 2014 summer shutdown

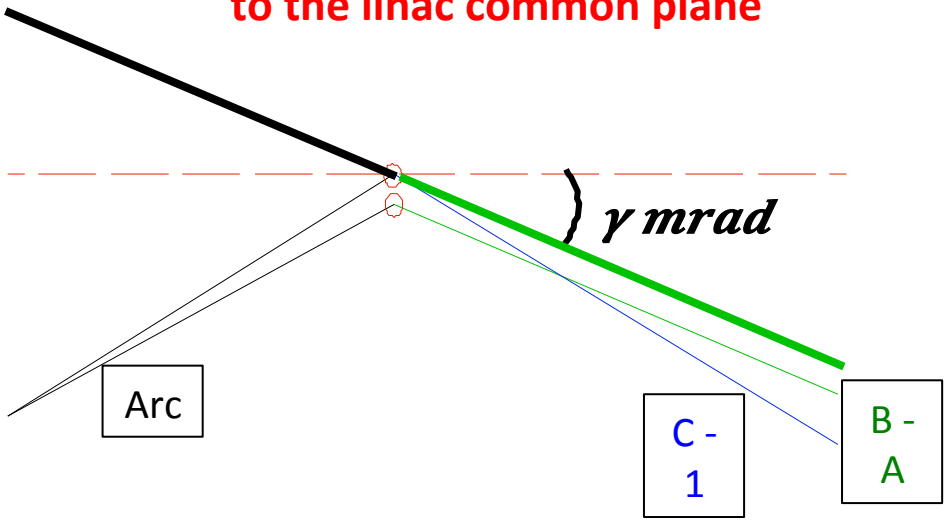
- only pre-alignment by laser tracker in sector-3 to 5 (in operation for PF & PFAR) detail alignment in 2014 summer shutdown

J-arc reference lines were re-defined

from 180 degree wrt A-B line
to symmetric wrt A-B, C-5 lines



from geoid surface
to the linac common plane



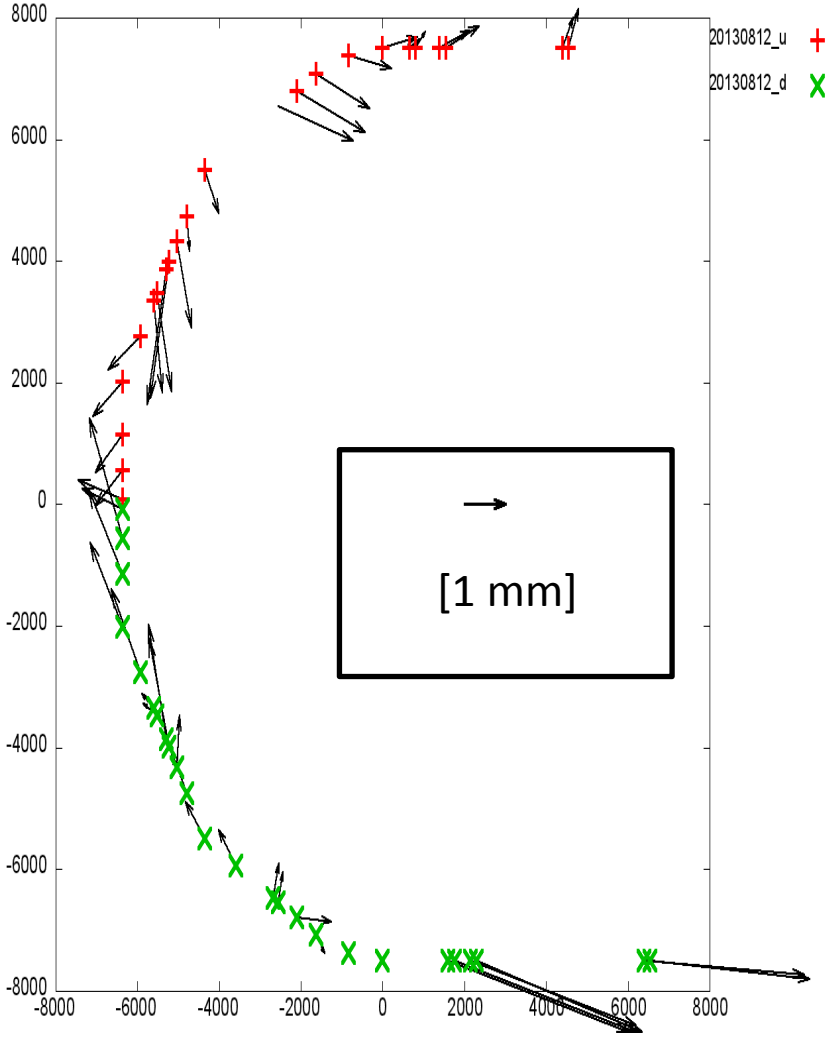
Horizontal
Both lines $\alpha/2$ from parallel lines
α = 0.114 mrad

Vertical
Inclination set along A-B
Close to C-5 line
γ ~ 0.049 mrad

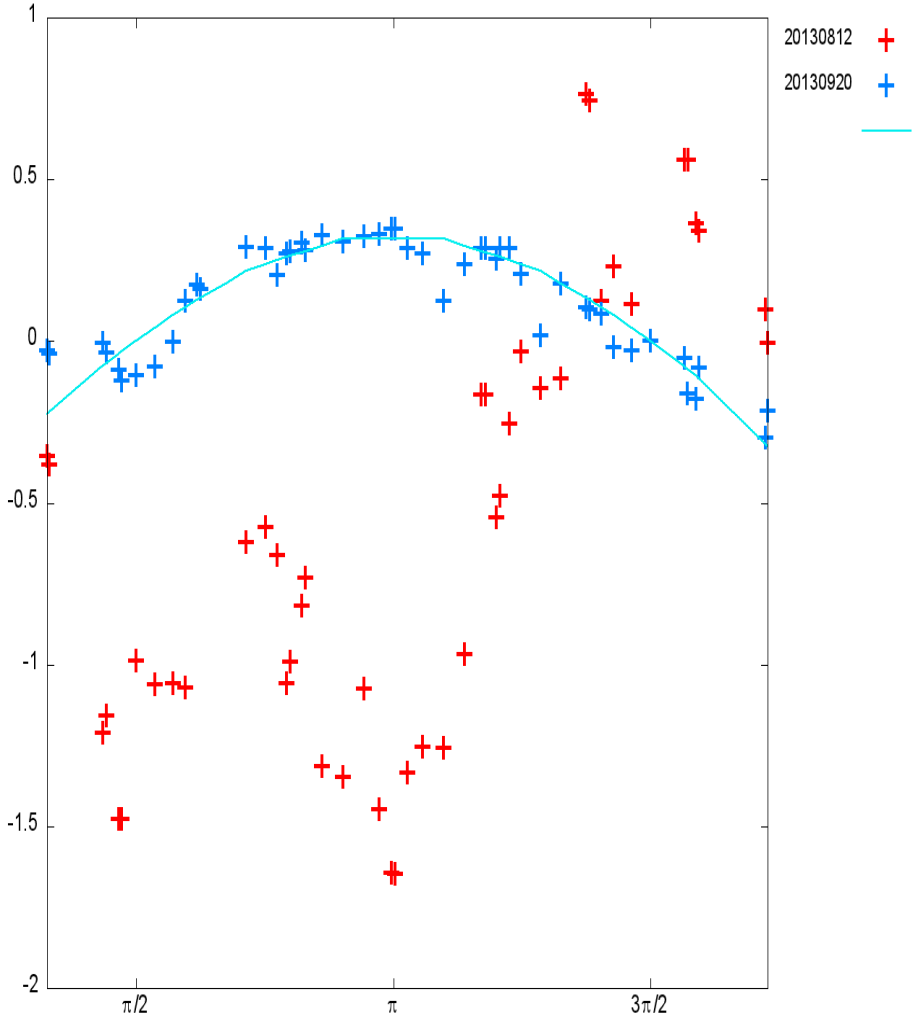
data from M. Tanaka

j-arc components position adjustment

horizontal



vertical



J-arc alignment

- once completed (σ<0.05mm),
  however systematic error by laser tracker found in horizontal plane, (seems to be OK for vertical)
  after the magnet position adjustment

- the error in position can amount to 1mm

- need re-adjustment,
  to be performed in 2014 summer shutdown