The IP position drift study and proposal of the IP slow position drift FB

Toshiyuki Okugi, KEK

2013/ 07/ 05

ATF2 topical meeting, KEK

Motivation

We observed the evidence of the IP position drift by the IPBSM fixed phase data taking.

Fixed phase data taking of IP-BSM

We took the IPBSM signal by at the same laser phase.

We took 4 conditions of laser shutters of IPBSM laser,

1) The shutters of both upper and lower paths are closed (Background).
2) The shutter of upper path is opened, but lower path is closed (Upper path signal).
3) The shutter of lower path is opened, but upper path is closed (Lower path signal).
4)) The shutters of both upper and lower paths are opened (Both path signal).

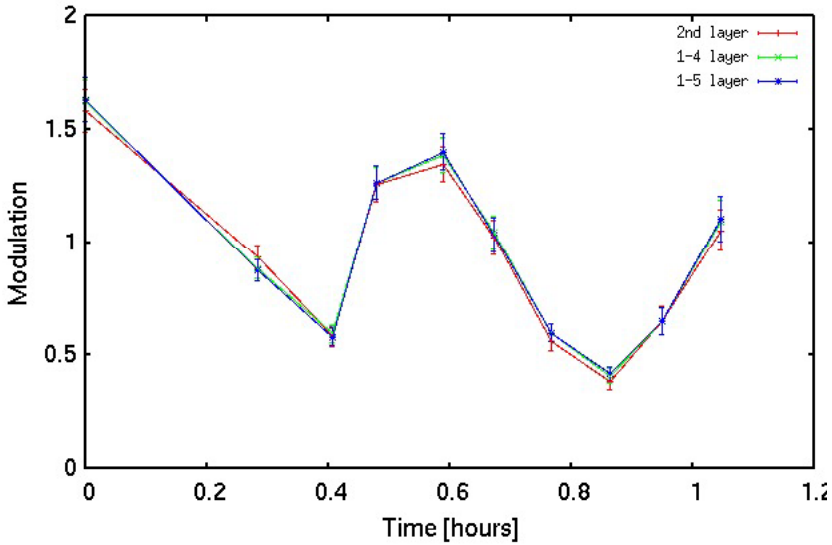
In order to decrease the signal drift in the data set, the data was taken as following sequence,

10 shots of (Background),
10 shots of (Upper path signal)
10 shots of (Lower path signal)
10 shots of (Both path signal)

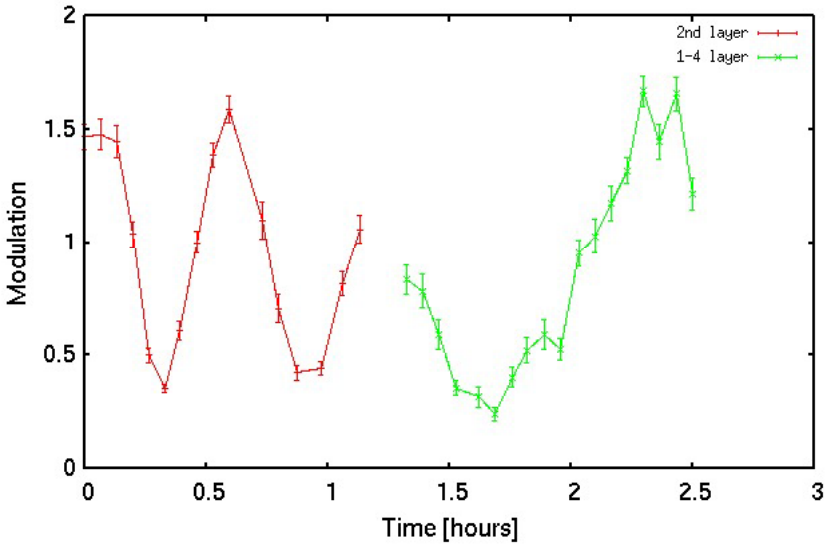
10 shots of (Background),
10 shots of (Upper path signal)
10 shots of (Lower path signal)
10 shots of (Both path signal)
…

IPBSM signal drift evaluated by the fixed phase data taking

Data at 06/06



Data at 06/13



Definition of modulation

$$M = \frac{(Both\ path) - (Background)}{(Upper\ path) + (Lower\ path) - 2\times(Background)}$$

The signal modulations both for 6/6 and 6/13 were drifted.

The first half data of 6/13 were 30degree mode, and second half data were 7.8degree mode. We observed the signal drift both for 30degree mode and 7.8degree mode.

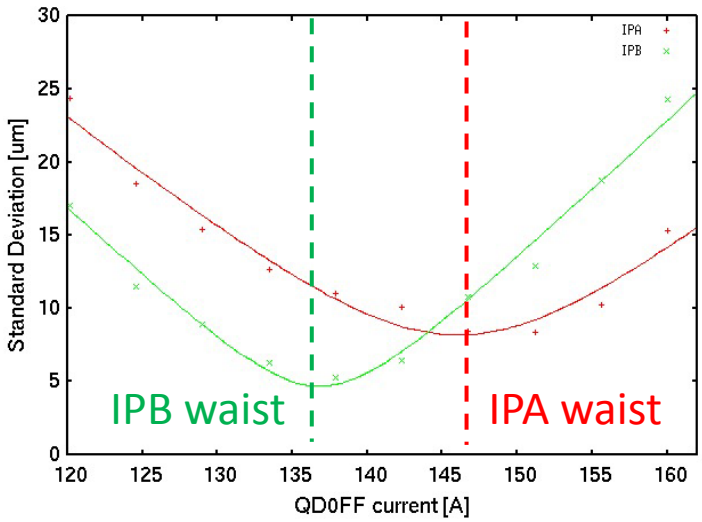
We need to check the IP beam position drift.

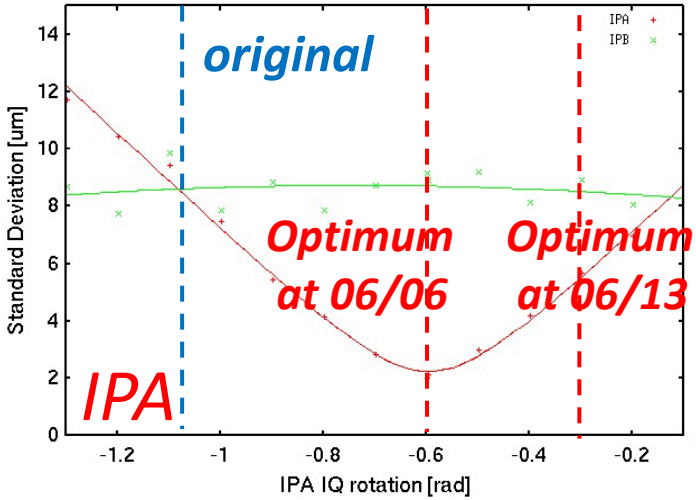
IP-BPM (online SLAC electronics) calibration

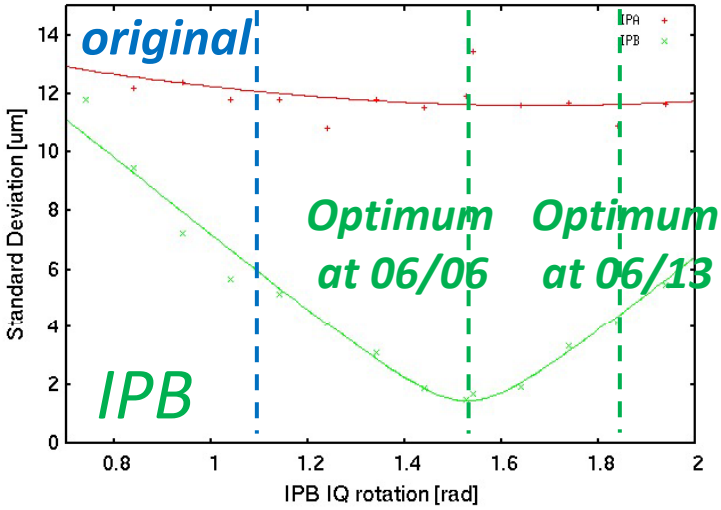
1) *Beam waist was set to IPA or IPB to be minimize the position jitter at BPMs.*

2) *We found the minimum jitter point by changing IQ rotation phase*

The readout fluctuation was reduced
IPA ; 8um -> 1.9um ,
IPB ; 5um -> 1.5um ,
IP ; 16.8um -> 4.1um .







We observed the IQ rotation phase was drifted by 0.3 in 1 week.

The position information was coupled to the angle information at no optimum IQ rotation phase.

IP beam position analysis

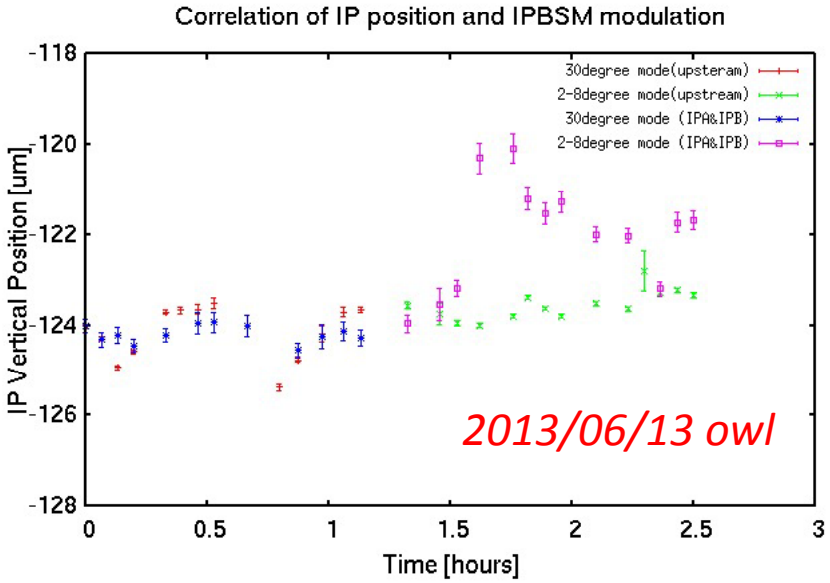
IP position drift was analyzed the following procedure.

1) We did the calibration of IPA and IPB (phase and amplitude).
The IQ rotation phase of IPBSM was optimum just after the calibration.

2) We make an empirical model to reproduce the IPA&IPB position (model independent analysis)
by using the position information of upstream BPMs (MQF16FF to MQD2AFF).

3) We can calculate the IP position by using the evaluated IPA&IPB position from upstream BPMs.

(Example of IP position analysis)



The fluctuations of IP positions by evaluated with IPA&IPB were larger than those with upstream BPMs.

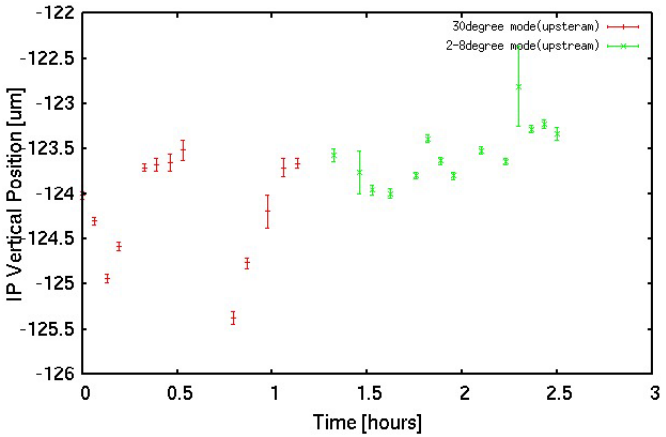
The IP position evaluations by upstream BPMs were good agreement with those with IPA&IPB just after calibration.

The IP position evaluations with IPA&IPB were suddenly jumped. (maybe caused by the jump of IQ rotation phase)

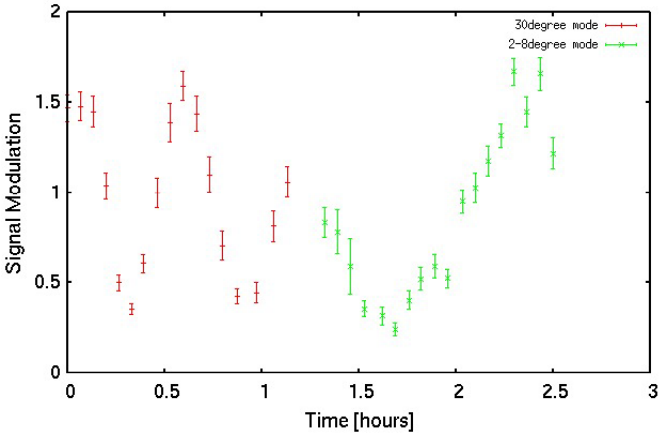
IP position was evaluated only with the BPM information, not used any information of IPBSM.

Correlation of the IP beam position and IPBSM signal

IP beam position evaluated upstream BPMs

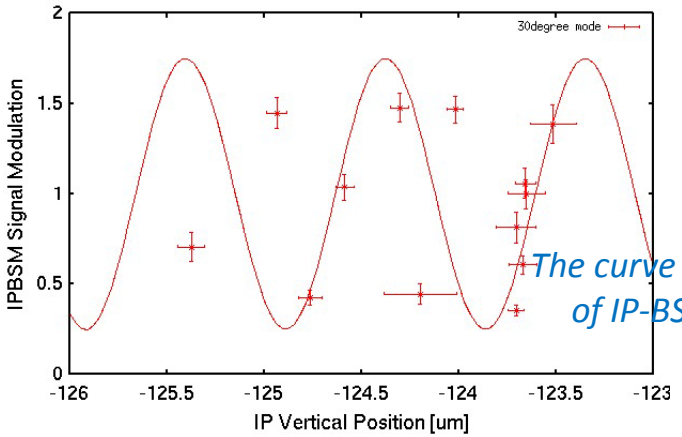


IPBSM modulation evaluated by phase fix data



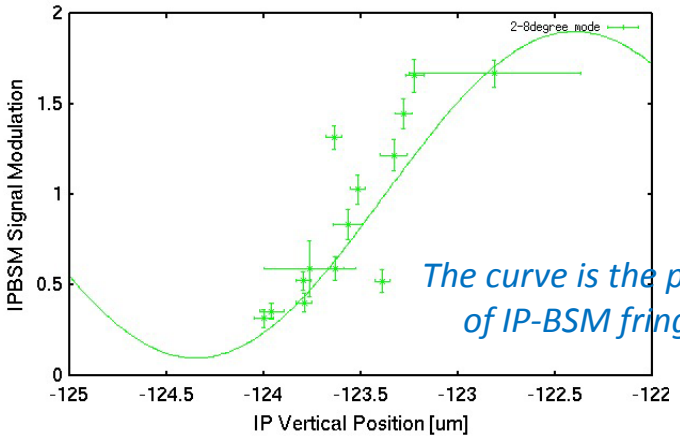
Correlation of IP beam position and IPBSM signal

30 degree mode



The curve is the pitch of IP-BSM fringe

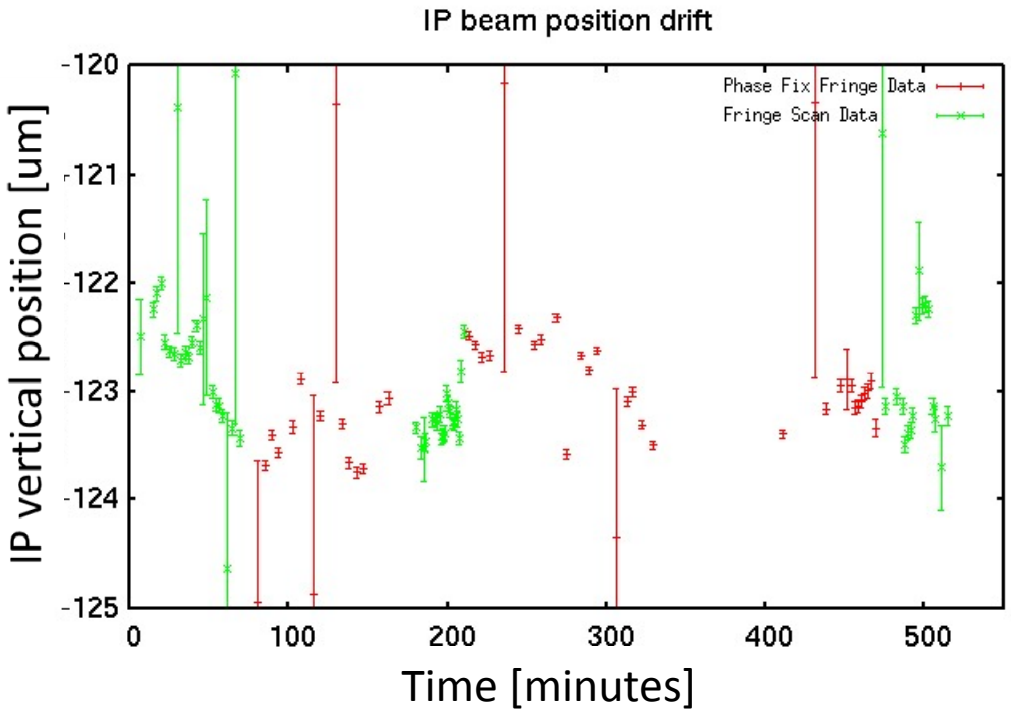
7.8 degree mode



The curve is the pitch of IP-BSM fringe

Long time IP drift data (2013/06/13 swing)

We turned on both DR & ATF orbit feedback



We can observed 2 IP drift component

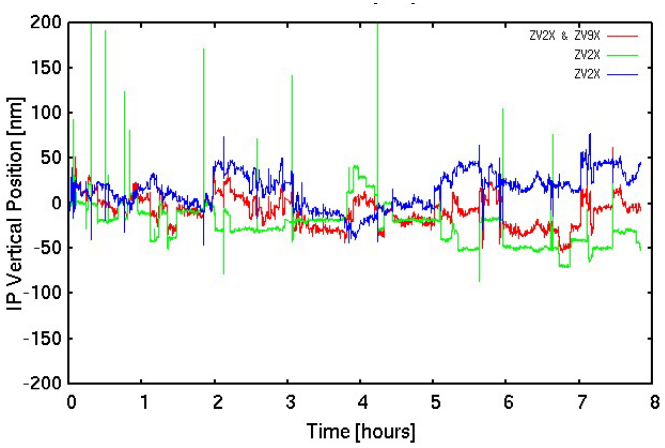
1) the period was 4 hours (slow drift).

2) the period was 30-40minutes (sensitive to IP-BSM 30degree mode)

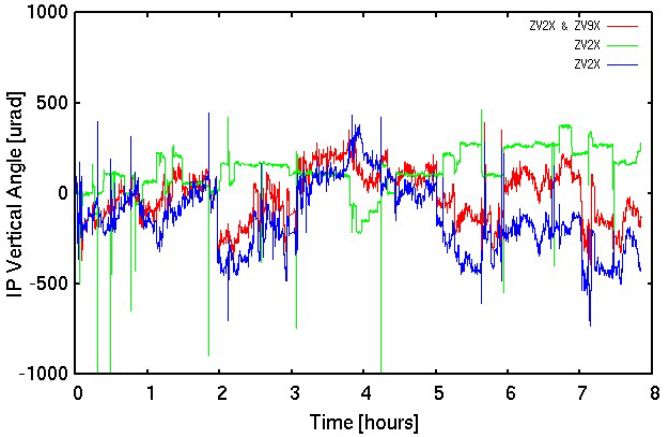
FB feedback Issues

The IP position and angle change by orbit FB was analyzed with the trend of the setting of FB steering.

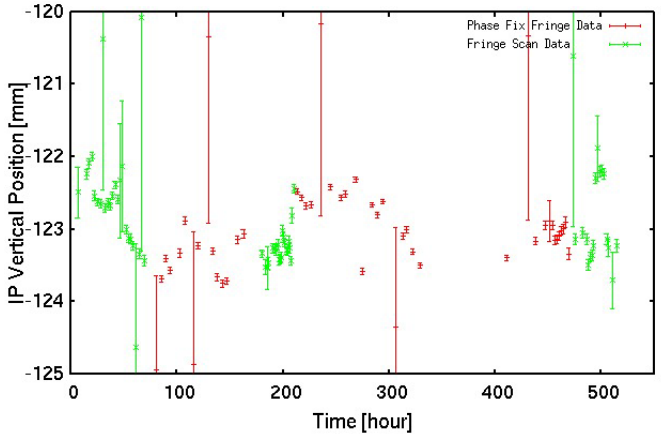
IP position change (2013/06/13 swing)



IP angle change (2013/06/13 swing)



IP vertical position drift (2013/06/13 swing)



IP position drift was about +/-1um (30 sigma).

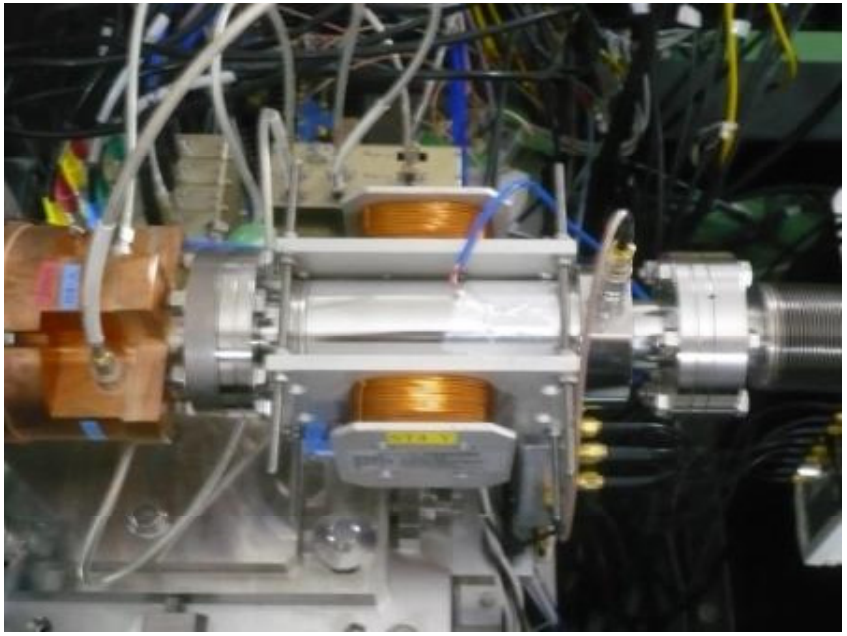
Orbit FB changed the IP angle only by +/-500urad (1-2 sigma).

The IP position drift was too much.
It seems very difficult to correct the IP position drift by orbit FB at the entrance of ATF2 beam line.

But, it is not so difficult to correct the IP beam position with the steering just before IP by monitoring the IPBPM.

The IPBPM requires
- *no IQ phase change*
- *sub micron resolution (not required the nm resolution)*

Air-core steering magnet for IP position feedback (slow drift FB)



The air-core steering magnet is borrowed from STF.

The steering magnet will be put around the FONT IP kicker. (OK?)

The rough evaluation of the performance to the IP position change

Sensitivity ; 1um/1A
Dynamic Range; +/-5um

Requirement for the preparation of the IP-BPM database

	Coordinate	Database	Action
Reference cavity	Horizontal	Amplitude	Read
	Vertical	Amplitude	Read
3 Sensor Cavities	Horizontal	Attenuator	Read, Set
		Phase Shifter	Read, Set
		Position Calib. Factor	Read, Set
		I	Read
		Q	Read
		Position	Read
	Vertical	Attenuator	Read, Set
		Phase Shifter	Read, Set
		Position Calib. Factor	Read, Set
		I	Read
		Q	Read
		Position	Read