FONT meeting: Friday, March 4

ATF updates and analysis

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Outline

IPBPM studies

- IPBPM symmetric mode using splitters on all three BPMs - different charges to study static signal
- 2-port study – different gains study on all three BPMs

Beam off week

- New IPC installation and BPM alignment update
- IP BPM cable matching
- Other cable issues
- Mover calibration checks

Appendix

- IPBPM 2 port study raw data results and integration window details
- Previous mover scan discontinuity and apparent position jump
- Siwon's hypothesis for mover jumps

IPBPM studies

N. Blaskovic, T. Bromwich

- IPBPM symmetric mode using splitters on all three BPMs
  - different charges to study static signal
- 2-port study – different gains study on all three BPMs

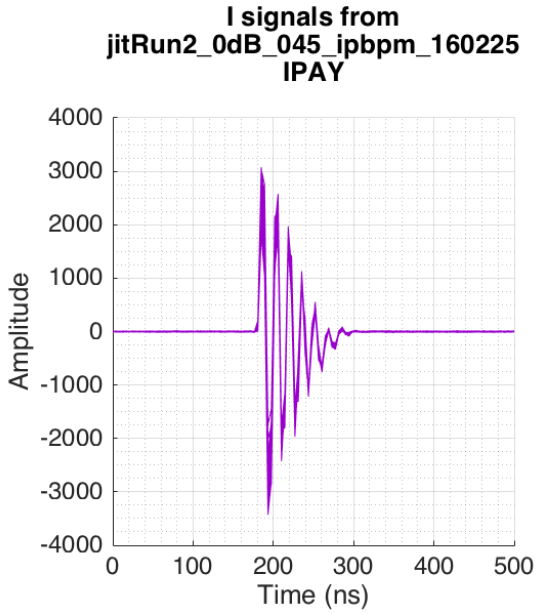
IP BPM studies

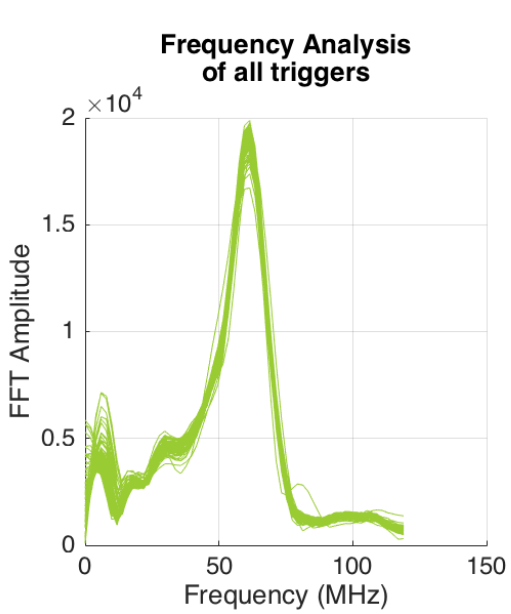
- These studies were unable to be performed in the first week as planned, because beam conditions were too poor in the first shift (charge was very low in extraction line and beam very unstable).

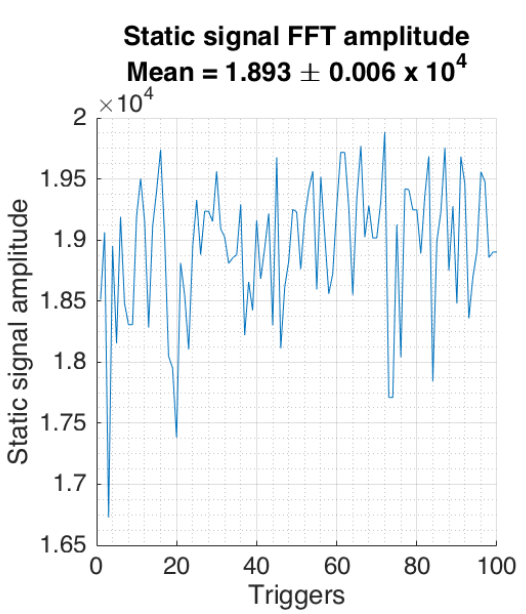
- Therefore, IPBPM studies were abandoned and the rest of the shift was used to instrument the upstream FONT region, check kickers and BPM movers for the feedback shift later in the week.

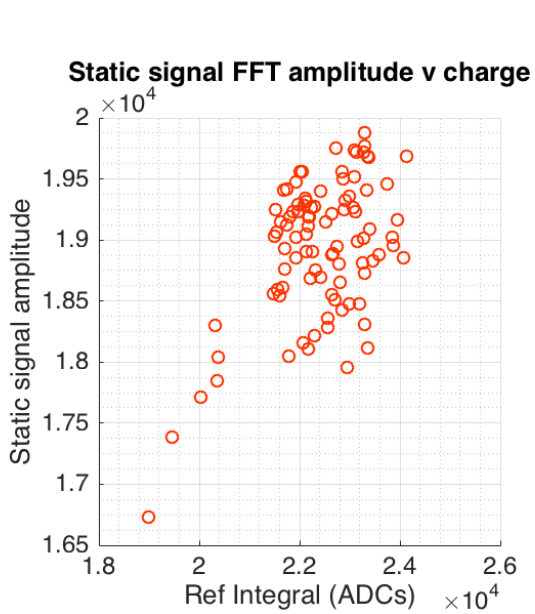
IP BPM static signal – swing/owl 25/2/16

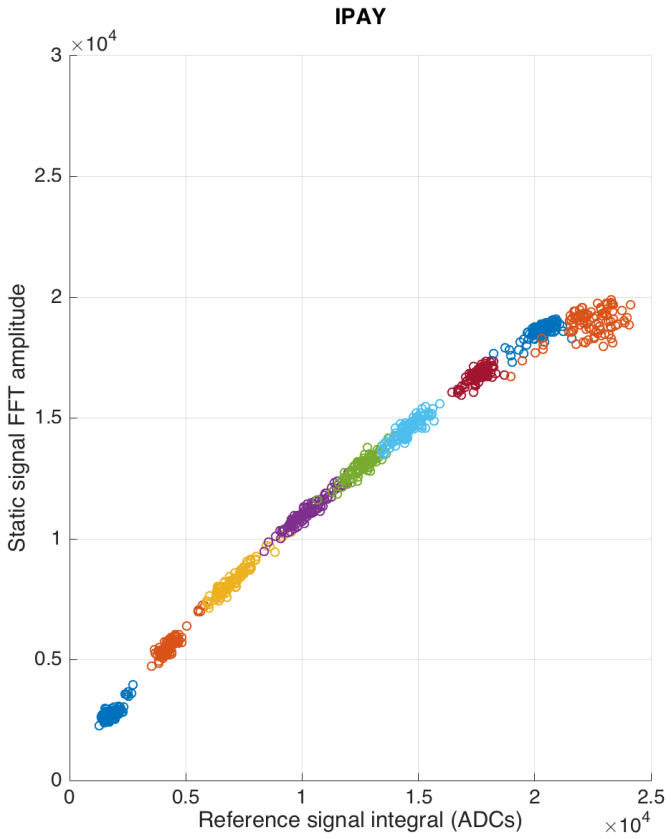
- IP BPM hybrids replaced with splitters to cancel dipole modes and combine symmetric modes.
- Perform FFT frequency analysis of all triggers to see unwanted static waveform at 60 MHz.
- Find amplitude of static signal FFT and compare at different charges (0.05 to 0.45 x 10^{10}).
- Charge determined from integral of the reference signal pulse in ADC counts.

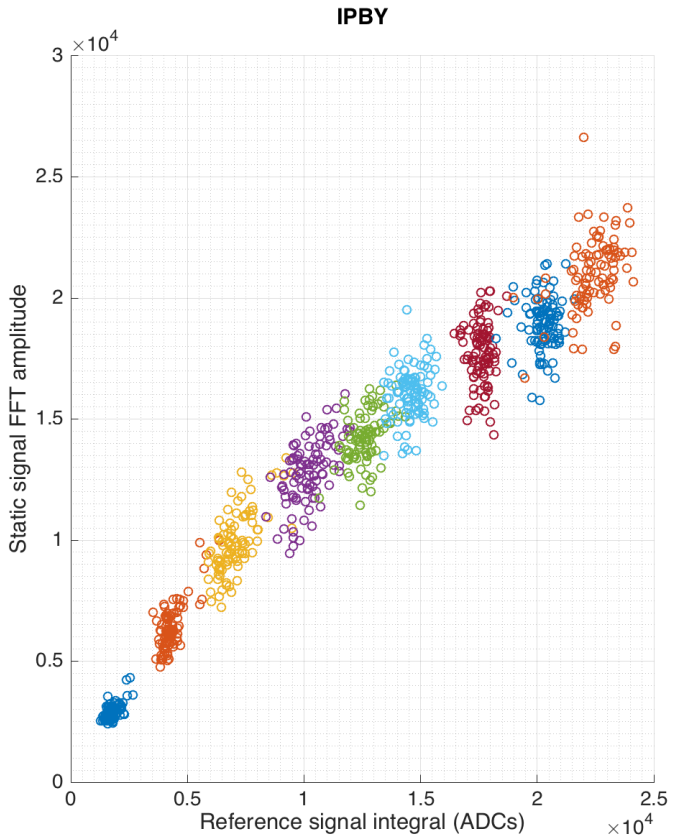


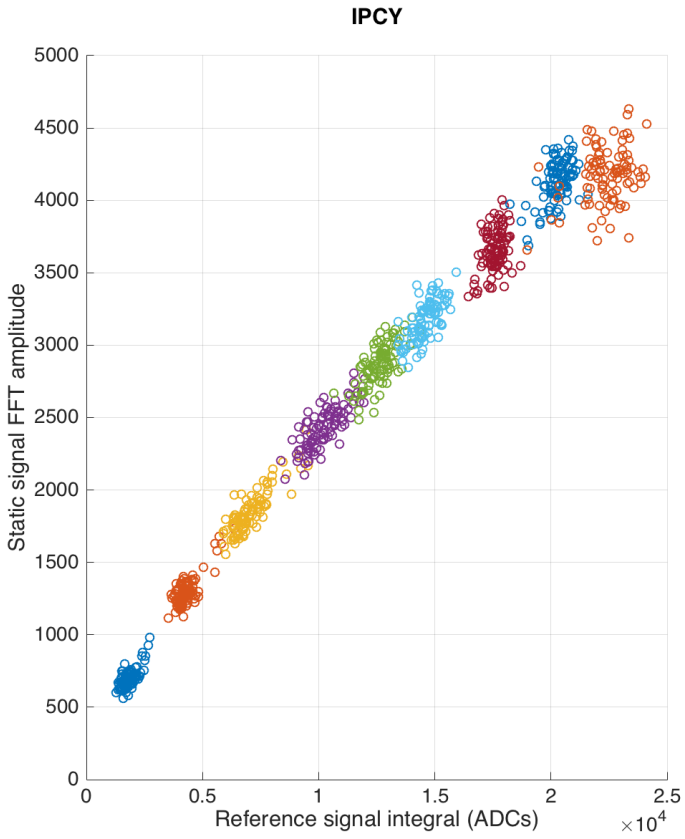












- QD0FF = 129.274 A. Beam centered as best as possible in all three BPMs. 0 dB attenuation.
- Waveforms taken in all three BPMs simultaneously at charges from 0.05 to 0.45 x 10^{10} in steps of 0.05.
- Non-linearities could imply static waveform may be a result of poor voltage connections in BPM cavity.
- Linear: static waveforms more likely to be caused by unpredicted modes in the BPM cavity.

IP BPM 2-port study – swing/owl 25/2/16

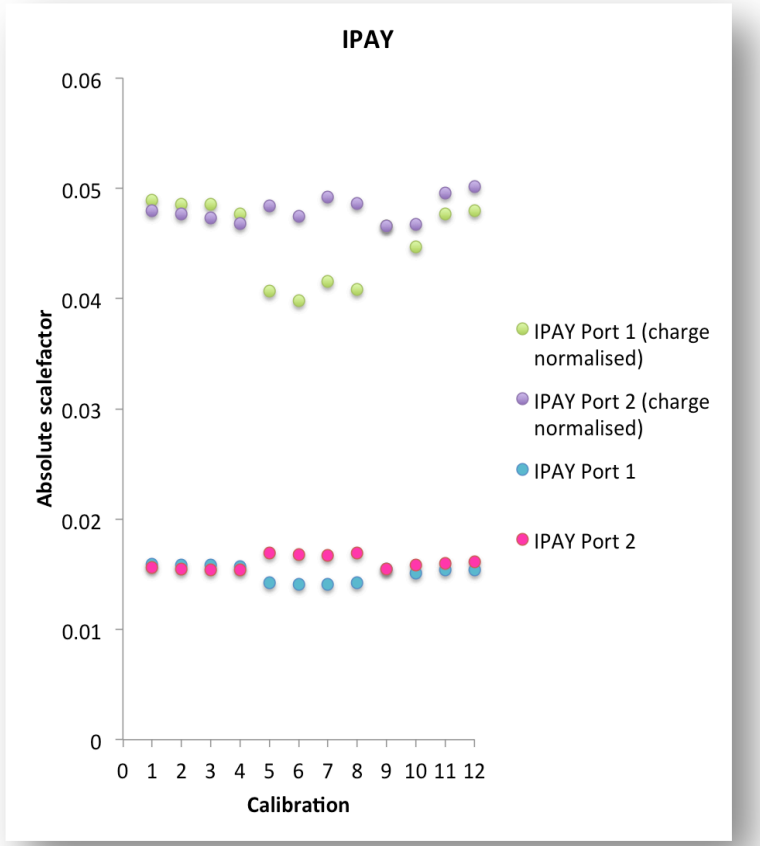
Check the gain of the two different ports on the IP BPMs, using the calibration scale factor as measure of the gain (expect values to be the same for both ports).

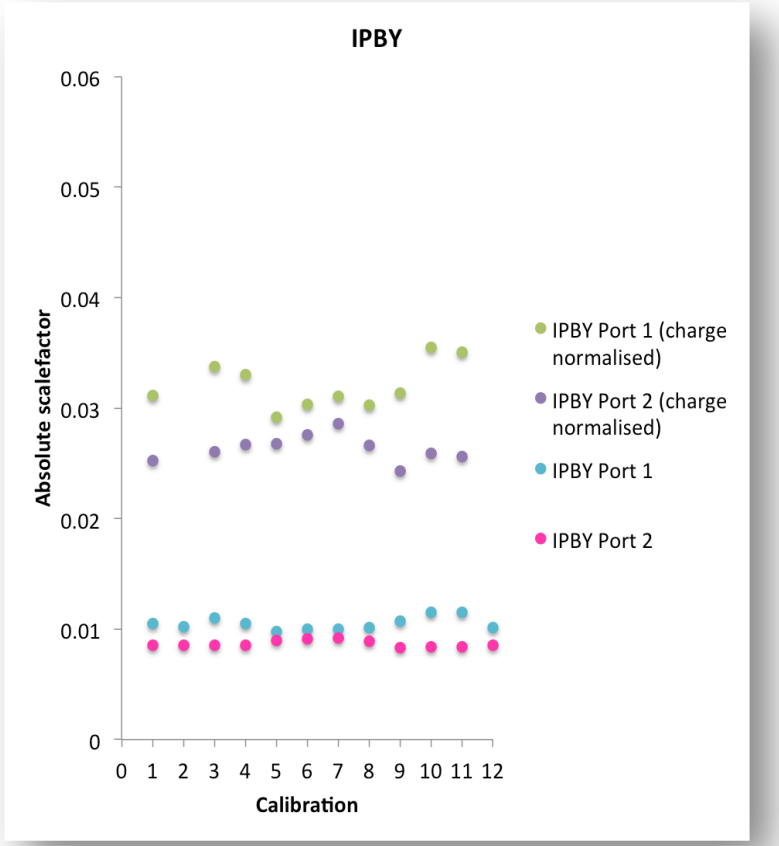
Method:

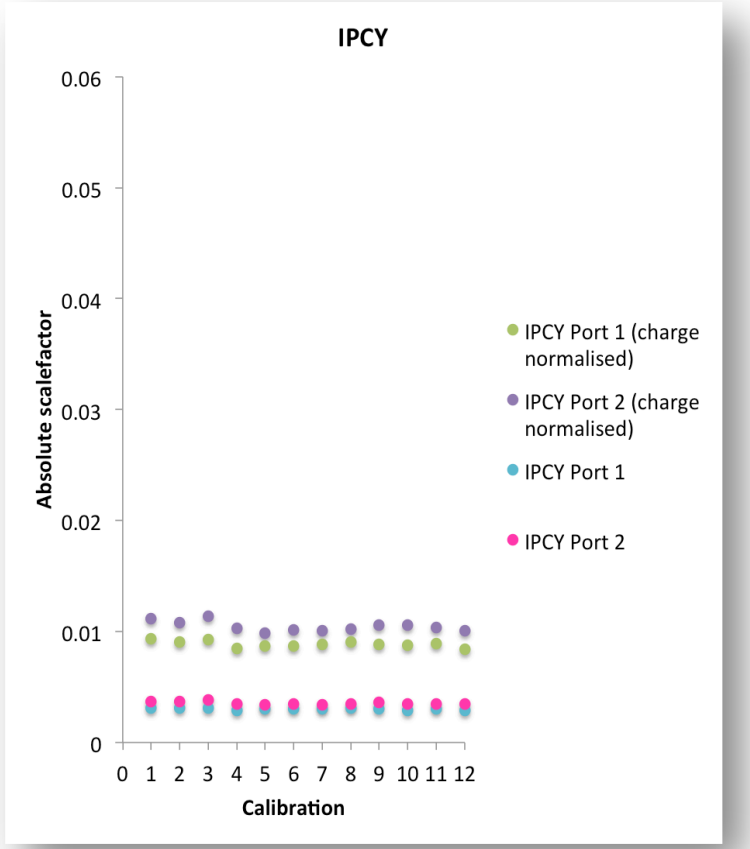
- Connect the Y-port pairs to electronics for IP BPM A and IP BPM B. Take 4 repeat calibrations.
- Take an access to switch the ports between the two sets of electronics. Take 4 repeat calibrations.
- Take another access to switch electronics again. Take 4 repeat calibrations.
- Repeat whole process for all three IP BPMs.

Beam conditions:

- 30 dB attenuation on dipole signals to achieve good calibration.
- Charge ~ 0.34 x 10^{10}.
- For each study the beam waist was moved to the required BPM using QD0FF.







- Plots of absolute calibration factor for each repeat calibration. Also plotted is absolute calibration factor charge normalised using the mean ICT value for that calibration run.
- Calibration factor calculated using a integration. Window adjusted in location to account for sample jumps between calibrations (see appendix for raw data and integration details).

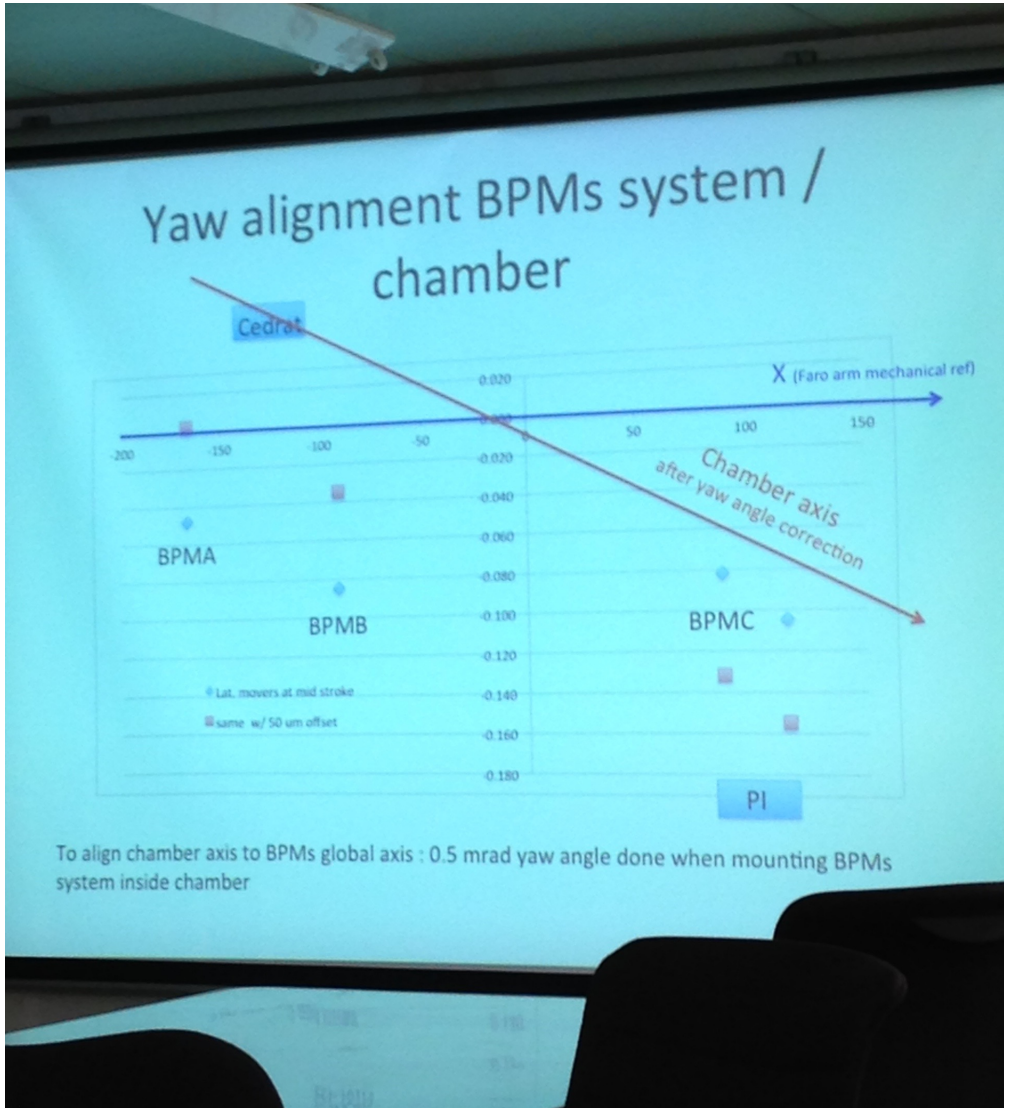
Beam off week

P. Bambade, T. Bromwich, P. Cornebise, T. Tauchi, S. Wallon, S. Yang

- New IPC installation and BPM alignment update
- IP BPM cable matching
- Other cable issues
- Mover calibration checks

IP BPM installation

- Sandry measured the alignment of the new IPC at LAL and was satisfied it was of comparable accuracy to previous IPC.
- The RF properties of IPC were measured again with the network analyser by Tauchi-san and Siwon in the KEK lab. Results were in good agreement with those measured at KU.
- Installation of new IPC was succesful:
  - Vertical position alignment within 20 μm.
  - Lateral alignment showed a 0.5 mrad yaw angle with the axis close to the center. This has been compensated for by adjusting the system within the chamber using clearance around the mounting table.
  - BPMs are now aligned the same as previously (before previous time the IP was opened) with respect to the chamber.
- IP BPM shifts next week will check this alignment.



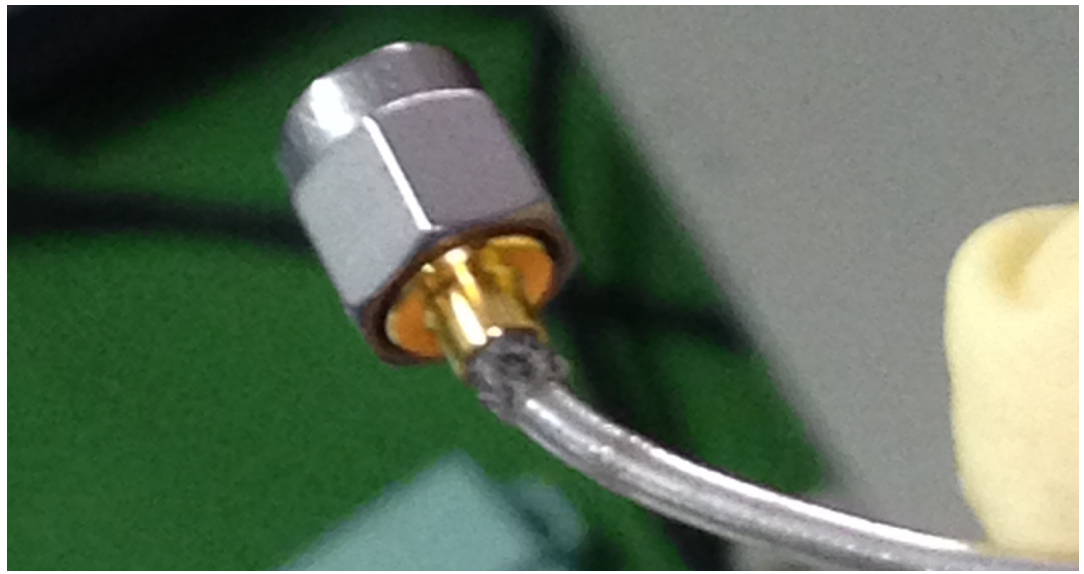
IP BPM cable matching

- TDR measurements previously showed mismatching of up to 13 mm in X and 3.8 mm in Y. New pairings should achieve order **< 2 mm** matching.
- These length differences will be re-measured with TDR once installed to confirm correct connections and best possible matching achieved (Monday morning with help from Naito-san).

New port connection	New port connection	Previous port connection	Measured by TDR		Cavity to hybrid(ns)	Error (ns)	Cavity to hybrid (m)	Error (m)	Δ Length (mm)	Error (mm)
			Mean (ns)	Std (ns)						
IPAY	**IPA-Y1**	IPA-X1	29.516	0.002	9.91	0.02	2.360	0.004	1.5	0.3
	IPA-Y2	IPA-Y1	29.529	0.002	9.92	0.02	2.361	0.004		
IPCY	**IPC-Y1**	IPC-Y1	29.523	0.003	9.91	0.02	2.361	0.004	1.1	0.5
	IPC-Y2	*IPC-X1	29.532	0.003	9.92	0.02	2.362	0.004		
IPBX	**IPB-X2**	IPB-Y2	30.465	0.005	10.39	0.02	2.473	0.004	1.2	0.8
	IPB-X1	IPB-X2	30.475	0.004	10.39	0.02	2.474	0.004		
IPAX	**IPA-X1**	IPC-Y2	30.474	0.003	10.39	0.02	2.474	0.004	0.0	0.6
	IPA-X2	IPC-X2	30.474	0.004	10.39	0.02	2.474	0.004		
IPCX	**IPC-X1**	IPA-X2	30.476	0.003	10.39	0.02	2.474	0.004	0.5	0.5
	IPC-X2	IPA-Y2	30.480	0.003	10.39	0.02	2.474	0.004		
IPBY	**IPB-Y1**	IPB-X1	30.484	0.003	10.39	0.02	2.475	0.004	1.5	0.4
	IPB-Y2	IPB-Y1	30.497	0.002	10.40	0.02	2.476	0.004		

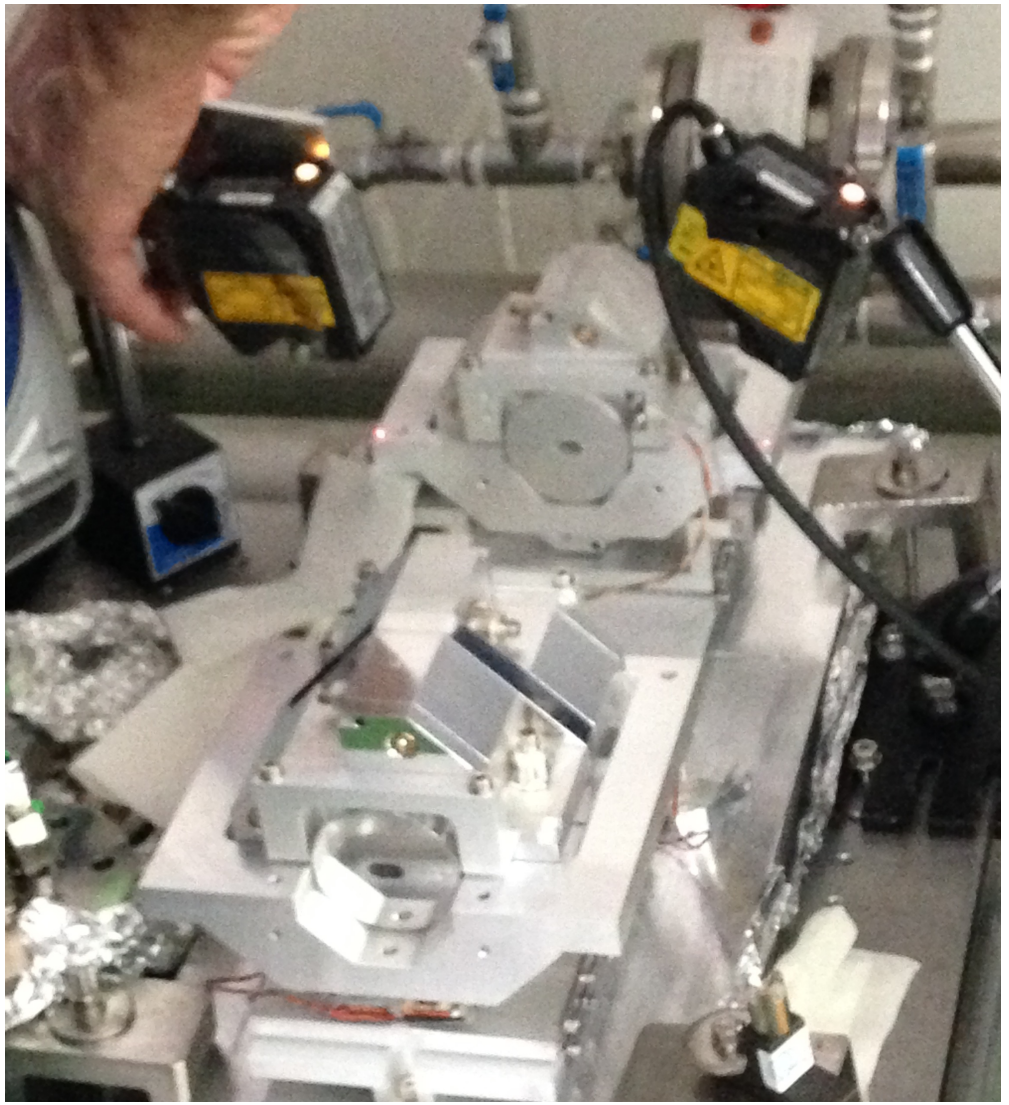
Other IP BPM cable issues

- One of the cable connectors seems a little bit damaged, but we have no alternative cables, so continue to use. We will take impedance measurements once installed to check it performs well.
- The connectors on the ends of the four shorter cables seem to be made of different materials. These different cables are now being used to connect the same ports.



Mover calibrations

- Perform mover calibration using ATF online system.
- Scan the movers over small ranges, replicating discontinuity conditions seen at 0 and 10 dB calibrations. Expect jump in mover ~ few μm, based on previous discontinuities (see appendix).
- Observe change in BPM position using a laser measurement system in both pitch and roll set-ups.
- **No unexpected discontinuities on mover system observed on either IPAB or IPC movers. Movers change as expected from ATF input voltage settings and step sizes.**



Appendix

- IPBPM 2 port study raw data results and integration window details
- Mover scan discontinuity and apparent position jump
- Siwon's hypothesis for mover jumps

2 port study: Results – IPA

IPA

	Port 1		Port 2						
	k1	σ_k1	k2	σ_k2	charge	σ_charge	IQ max	Ref max	Integration Range
1	0.0159	0.0001	0.0156	0.0001	0.3252	0.0007	48	44	49-55
2	0.0158	0.0001	0.0155	0.0001	0.3252	0.0006	48	44	49-55
3	0.0158	0.0001	0.0154	0.0001	0.3253	0.0008	48	44	49-55
4	0.0157	0.0001	0.0154	0.0001	0.3291	0.0007	48	44	49-55
5	0.0142	0.0001	0.0169	0.0001	0.3490	0.0007	49	44	49-55
6	0.0141	0.0001	0.0168	0.0001	0.3541	0.0007	49	44	49-55
7	0.0141	0.0001	0.0167	0.0001	0.3395	0.0009	49	44	49-55
8	0.0142	0.0001	0.0169	0.0001	0.3476	0.0007	49	44	49-55
9	0.0155	0.0001	0.0155	0.0001	0.3330	0.0010	47	44	49-55
10	0.0151	0.0001	0.0158	0.0001	0.3381	0.0009	49	44	49-55
11	0.0154	0.0001	0.0160	0.0001	0.3230	0.0010	49	44	49-55
12	0.0154	0.0001	0.0161	0.0001	0.3210	0.0010	49	44	49-55

2 port study: Results – IPB

IPB

	Port 1		Port 2						
	k1	σ_k1	k2	σ_k2	charge	σ_charge	IQ max	Ref max	Integration Range
1	0.0105	0.0001	0.0085	0.0007	0.3370	0.0010	49	43	50-56
2	0.0102	0.0001	0.0085	0.0008	0.3160	0.0010	49	43	
3	0.0110	0.0001	0.0085	0.0006	0.3260	0.0010	48	42	49-55
4	0.0105	0.0001	0.0085	0.0007	0.3180	0.0010	48	42	49-55
5	0.0098	0.0001	0.0090	0.0007	0.3360	0.0010	47	42	49-55
6	0.0100	0.0001	0.0091	0.0009	0.3300	0.0010	47	42	49-55
7	0.0100	0.0001	0.0092	0.0008	0.3220	0.0010	47	42	49-55
8	0.0101	0.0001	0.0089	0.0008	0.3340	0.0010	47	42	49-55
9	0.0107	0.0001	0.0083	0.0007	0.3410	0.0010	48	42	49-55
10	0.0115	0.0001	0.0084	0.0007	0.3240	0.0010	49	43	50-56
11	0.0115	0.0001	0.0084	0.0007	0.3280	0.0010	49	43	50-56
12	0.0101	0.0001	0.0085	0.0007	0.3426	0.0008	50	44	

← Sample jump

← Sample jump

← Sample jump

- Blue shaded calibrations not used because sample jumps occurred within the calibration run.

2 port study: Results - IPC

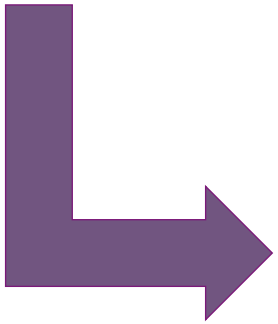
IPC

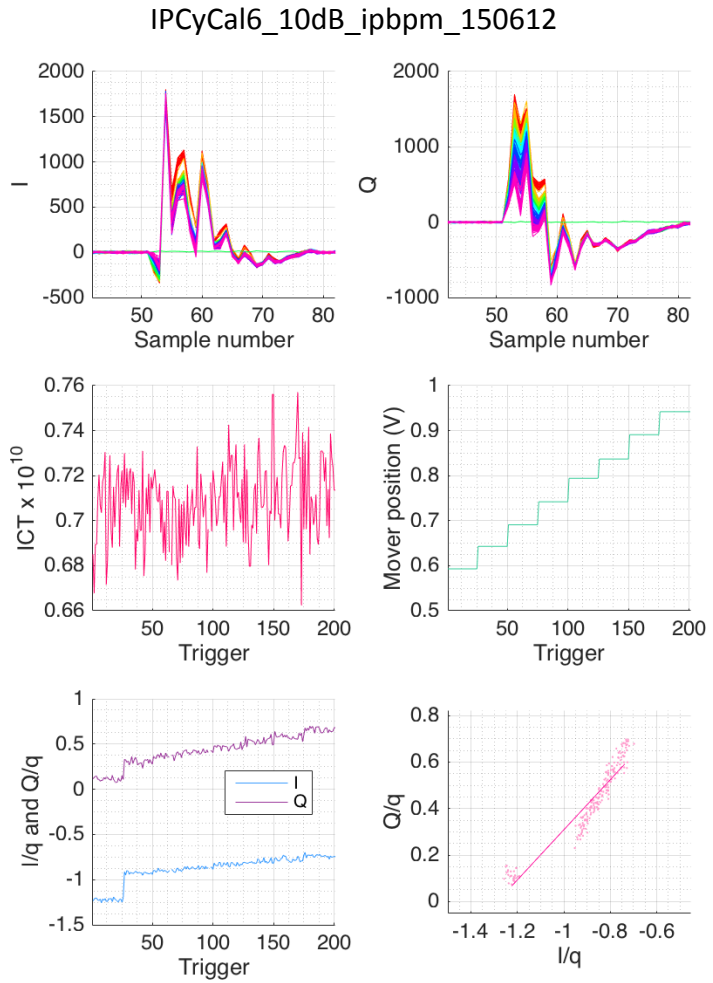
	Port 1		Port 2						
	k1	σ_k1	k2	σ_k2	charge	σ_charge	IQ max	Ref max	Integration Range
1	0.0031	0.00002	0.00370	0.00002	0.3320	0.0010	47	42	48-54
2	0.0031	0.00003	0.00370	0.00003	0.3422	0.0007	47	42	48-54
3	0.0031	0.00003	0.00380	0.00003	0.3339	0.0009	47	42	48-54
4	0.0029	0.00002	0.00350	0.00002	0.3409	0.0008	49	44	50-56
5	0.003	0.00002	0.00340	0.00003	0.3451	0.0005	48	44	50-56
6	0.003	0.00002	0.00350	0.00002	0.3454	0.0006	48	44	50-56
7	0.003	0.00002	0.00340	0.00002	0.3384	0.0007	47	44	50-56
8	0.0031	0.00002	0.00350	0.00002	0.3414	0.0007	48	44	50-56
9	0.003	0.00002	0.00360	0.00002	0.3398	0.0006	48	44	50-56
10	0.0029	0.00002	0.00350	0.00002	0.3315	0.0007	48	44	50-56
11	0.003	0.00002	0.00350	0.00002	0.3366	0.0007	48	44	50-56
12	0.0029	0.00002	0.00350	0.00003	0.3464	0.0007	48	44	50-56

Sample jump

IPCY mover scan 0.6 to 1 V in steps 0.05 V

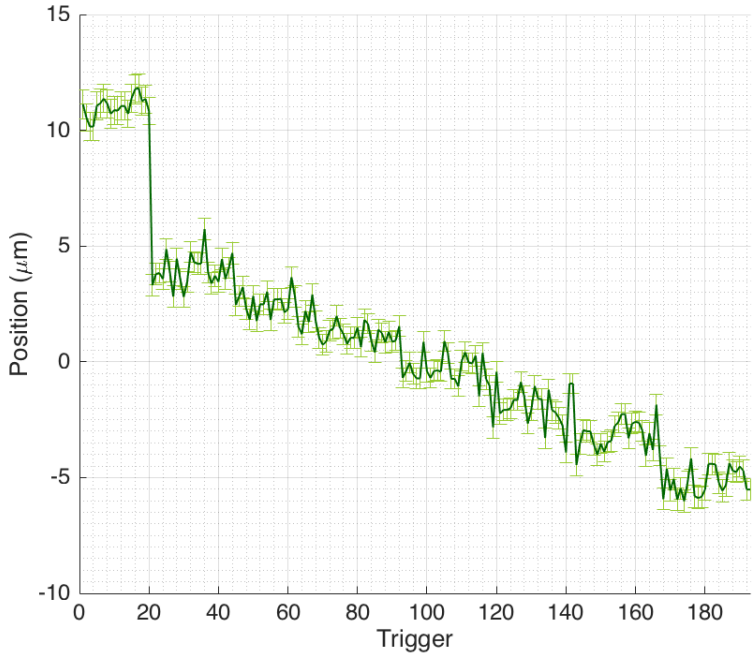
Jump in I and Q results in discontinuity in calibration





Calibrate to limited range of mover scan excluding discontinuity and calculate apparent corresponding position jump

~ 6 μm jump in this scan



Siwon hypothesis for mover jumps

- When we see a discontinuity in I and Q, the amplitude of the signal is jumping.
- Siwon believes this is due to the phase shifter in the S-band hut that controls the relative phase between the reference and dipole signals. The amplitude is phase independent, so this is not an effect of a phase change itself, but rather of the electronics in the phase shifter controller.
- There is a point where the phase jumps. Close to this point, the I signal changes with a mover scan, and the Q signal does not, but there is the risk of phase jump across the course of calibration if the phase setting is too close to the phase shift point. Far away from this point, there is a change in I and Q with position, which is not best for position data taking, but there will be no chance of phase jump.
- Siwon says the location of this tipping point in the phase shifter setting varies with beam conditions and between the different BPMs, which explains why we sometimes see it, and sometimes do not.
- He has been able to remove the calibration discontinuity in mover scans by going to the S-band hut to manually change the phase shifter setting.

Variation of beam center position due to different phase shifter settings (Siwon 8/12/15)

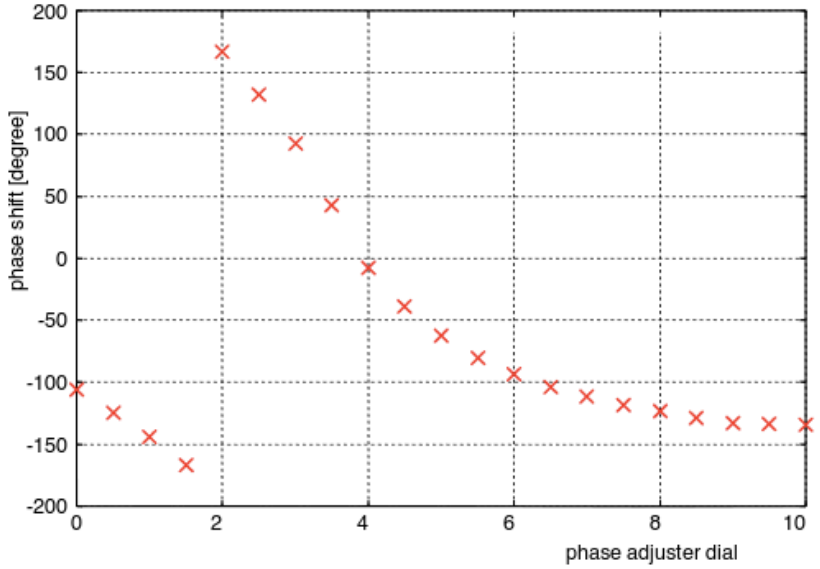
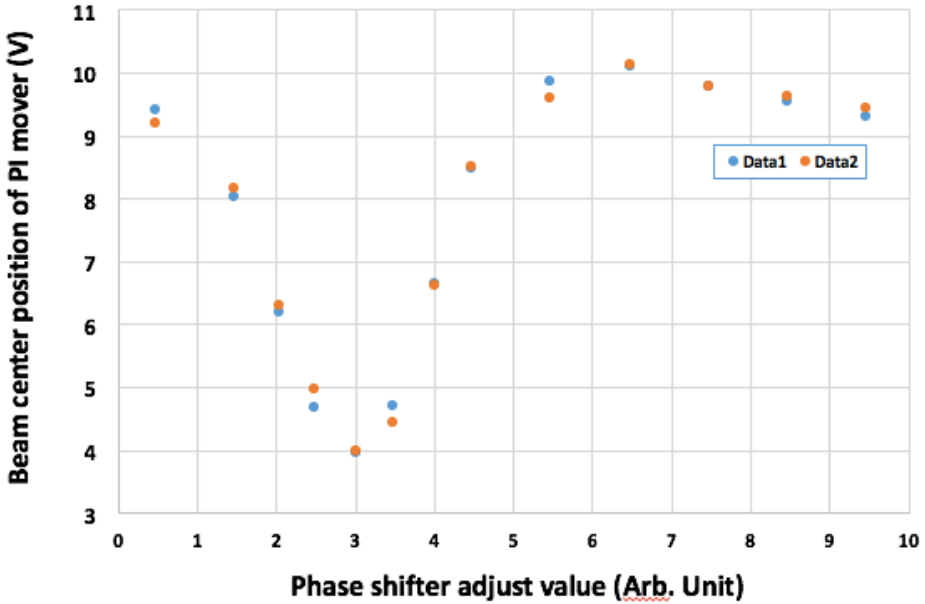


図 6: 位相調整ツマミによる位相変化



- Honda-san's Phase Detector Module tests: http://acfahep.kek.jp/subg/ir/nanoBPM/library/honda.report/detector_module_test_0.pdf (in Japanese)
- Siwon's study with IPC in December: http://atf.kek.jp/twiki/bin/view/ATFlogbook/Log20151208s

Variation of calibration slope of IPC due to different phase shifter settings (Siwon 8/12/15)

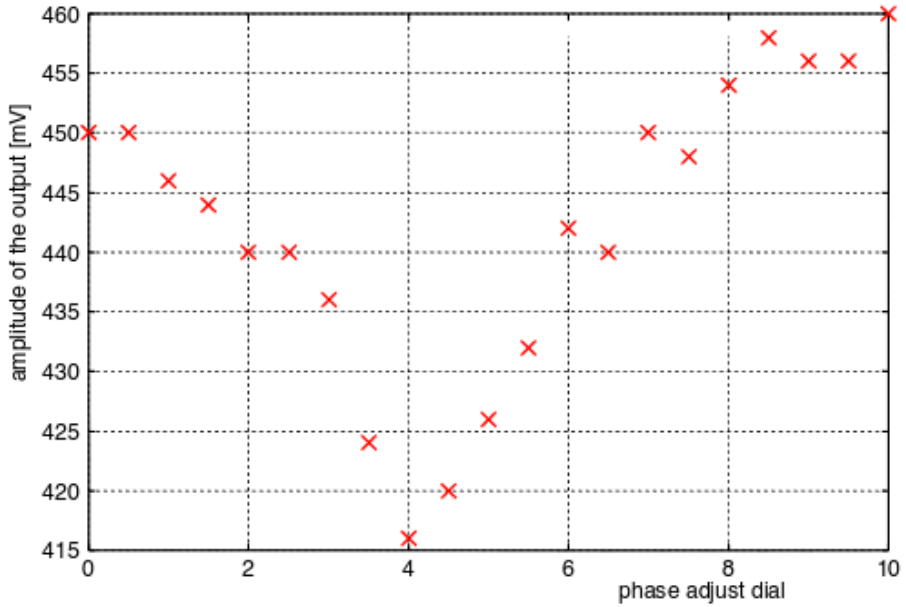
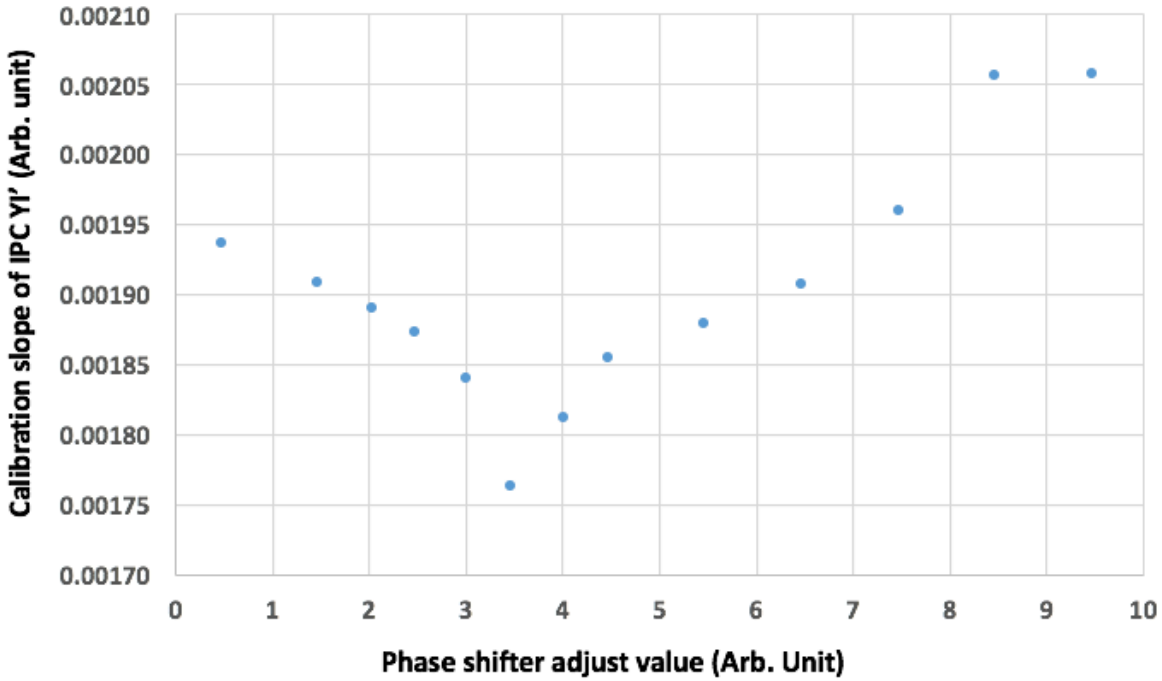


図 7: 位相調整ツマミによる振幅変化



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