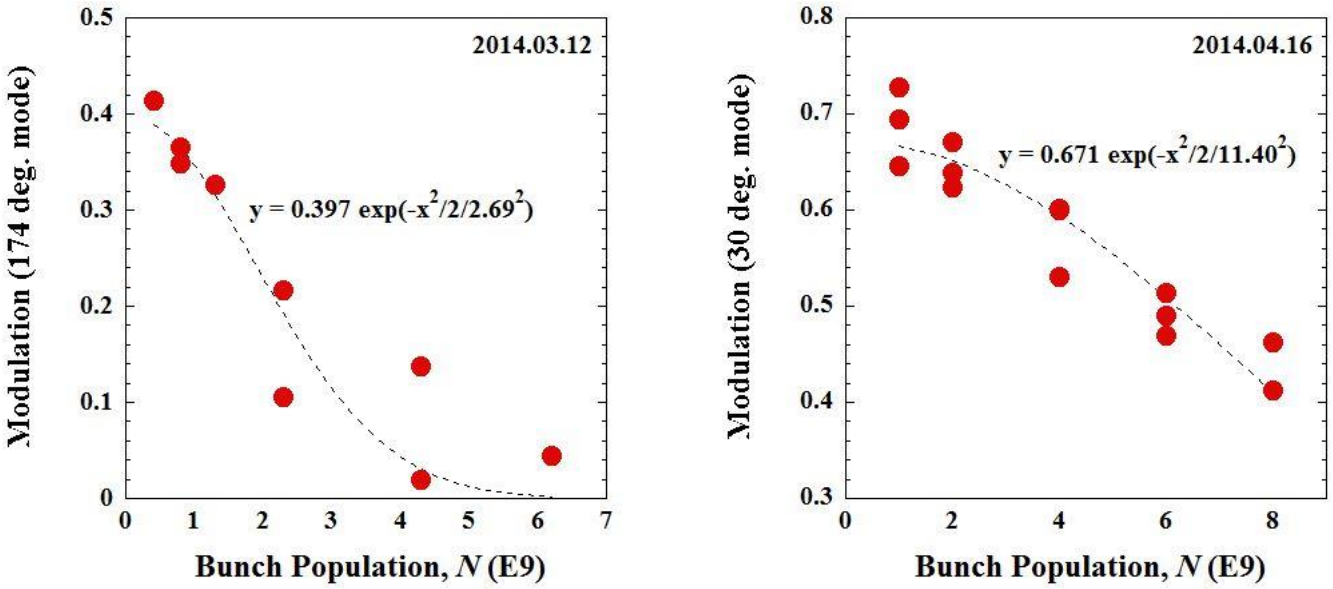
Brief review of past studies on Wakefield

ATF2 Proj. Mtg. 201502

K.Kubo

- Intensity dependence of IP beam size
- Studies using on-mover structures
  - Beam size at IP
  - Orbit change
- OTR chamber wake

Beam Size Depends on Bunch Intensity



IPBSM modulation as function of bunch population. Measured with crossing angle 174 degrees (left) and 30 degrees (right).

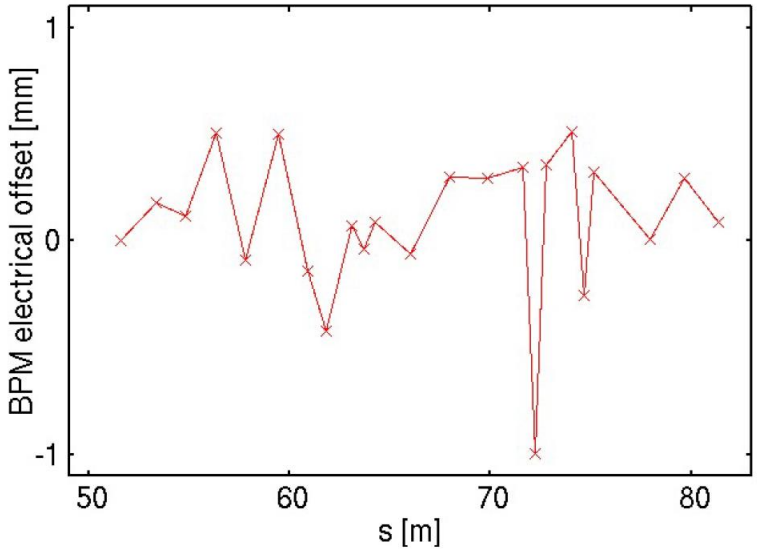
Assuming $\sigma_y^2(q) = \sigma_y^2(0) + w^2 q^2$, w is fitted as 100 nm/nC.

$\Rightarrow$ Measured minimum beam size (at 0.1 - 0.16 nC) may be larger than zero - intensity beam size by 2 - 3 nm.

Okugi's slide in proj. mtg. Feb. 2014

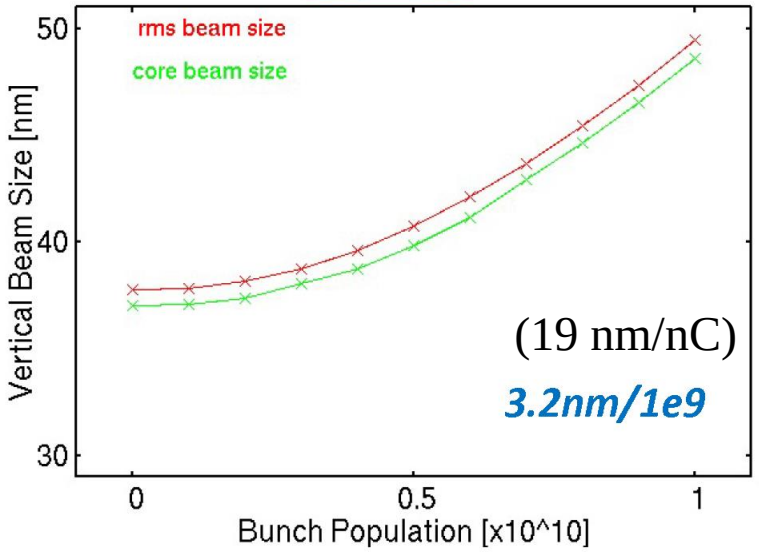
Expected beam size growth from the cavity

Beam orbit with respect to electrical center of C-band BPMs



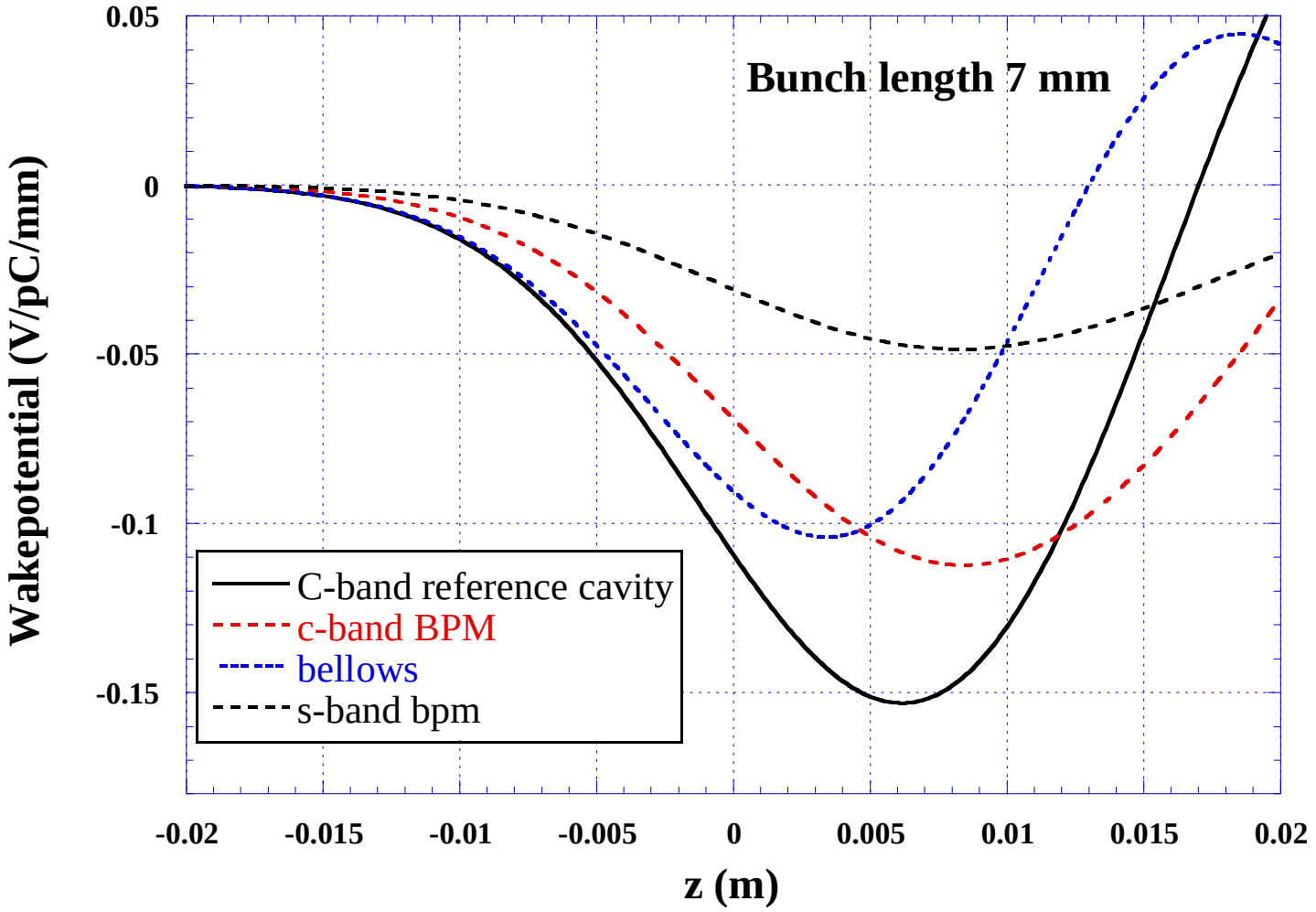
Expected IP vertical beam size growth

For V=-0.16V/pC/mm



This calc. Included cavity BPMs only.
May underestimate wakefield.
But factor 6 difference seems too much.

Examples of wake calculations

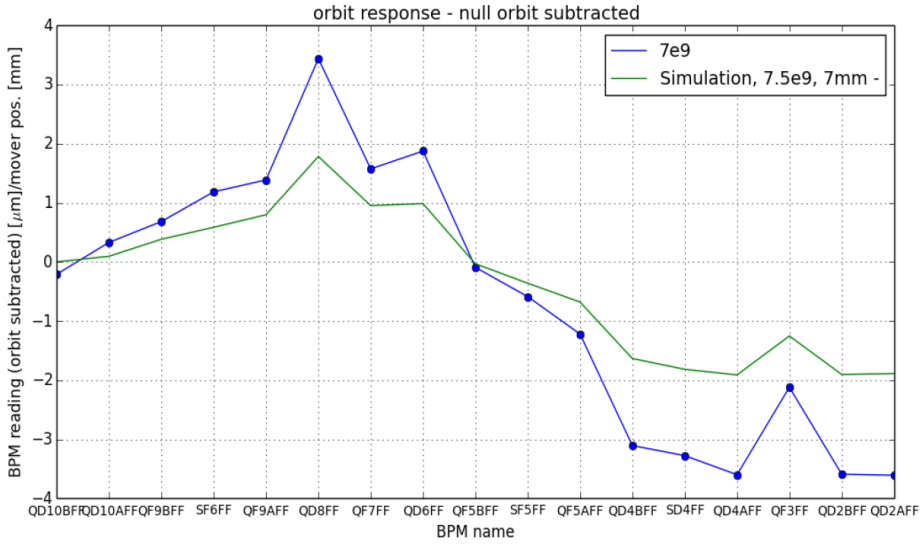


Calc. by A. Lyapin

More calculations

Comparison with simulation

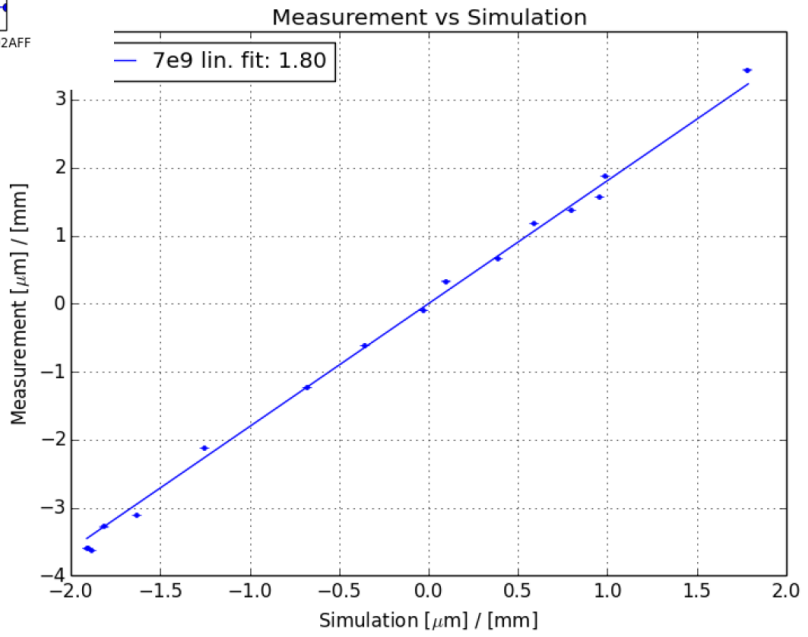
J.Snuverink, et.al., LCWS2014



Wake source on mover experiment
-- orbit change

- Measured orbit shape agrees well
- Measured effect is 0.7 V/pC/mm
- About a factor 1.8 larger than simulation (numerical calculation + tracking)
- Reduced from earlier factor of 2.0

- Possible discrepancy might be due to bunch length or underestimation by simulation



IP beam size vs mover position experiment and calc.

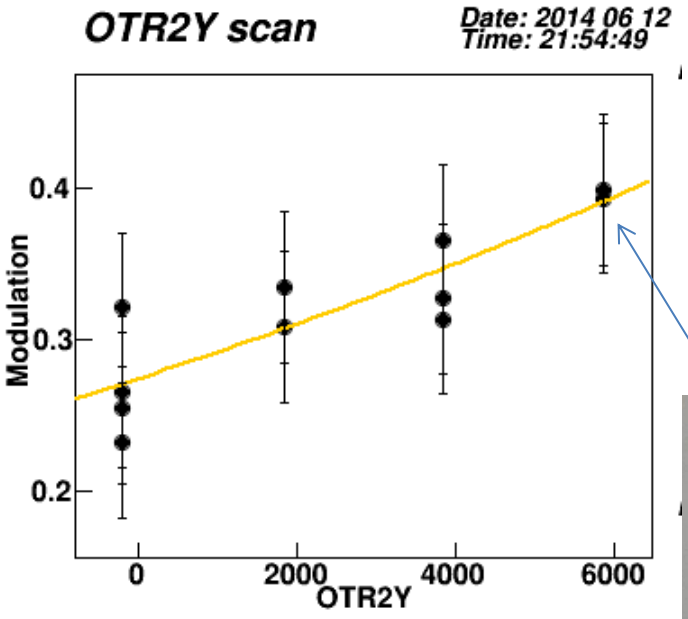
ATF2 weekly meeting 20130708 K.Kubo

Effect of wake source at the mover, offset 1 mm, bunch charge 1 nC.
IP beam size increase (nm/mm/nC)

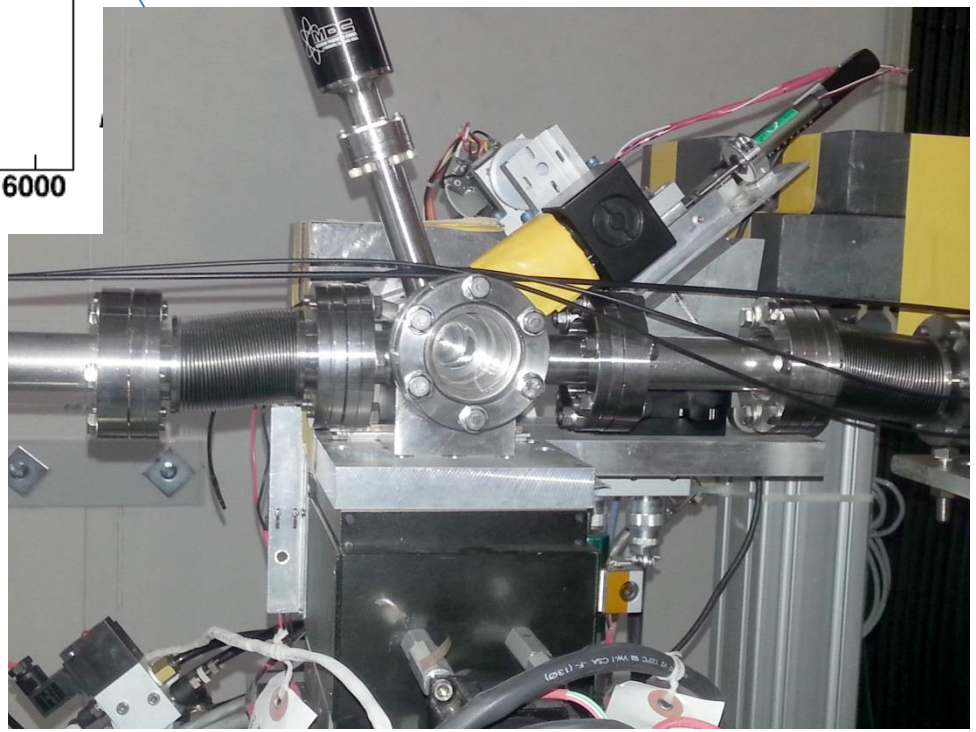
	C-band ref.	No mask Bellows	Masked Bellows
Experiment	55	47~50	7
Calc	32.2	22.6	?

Factor 1.7 – 2.2 larger than calculation
consistent wit orbit change measurement

Effect of OTR monitor chamber (beam size monitor in EXT line) to IP vertical beam size was found (June 2014)



IPBSM 174 degrees
N~0.3E10



Before OTR2X position optimization After optimization (174 deg mode)

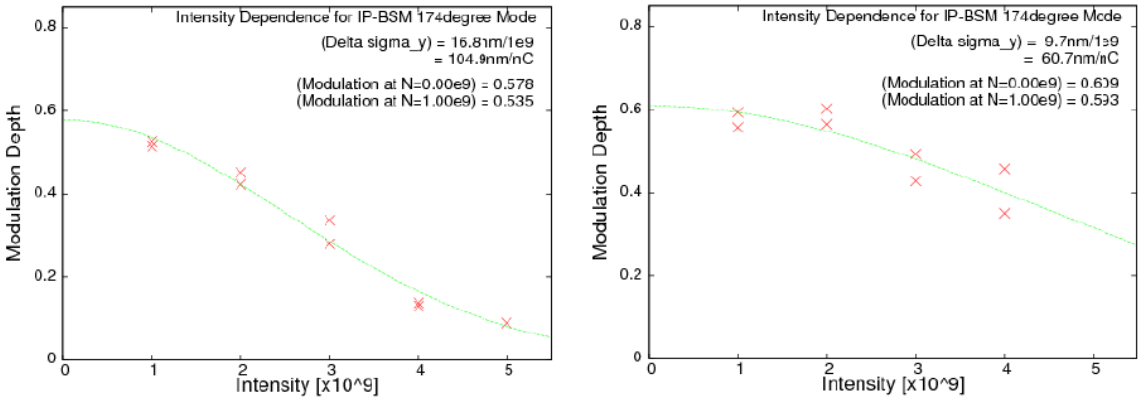


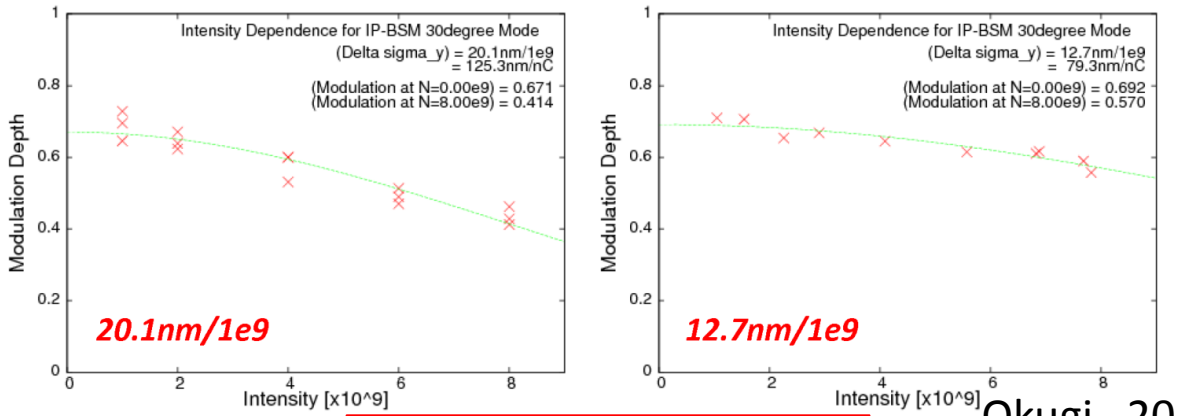
図 2　先々週測定した OTR2X の移動前後のビーム強度依存性（左は移動前、右は移動後）。

By Okugi, 2014.6.23

100 nm/nC → 58 nm/nC

Removal of all OTRs

Intensity dependence before OTRs removal *Intensity dependence after OTRs removal* (30 deg mode)



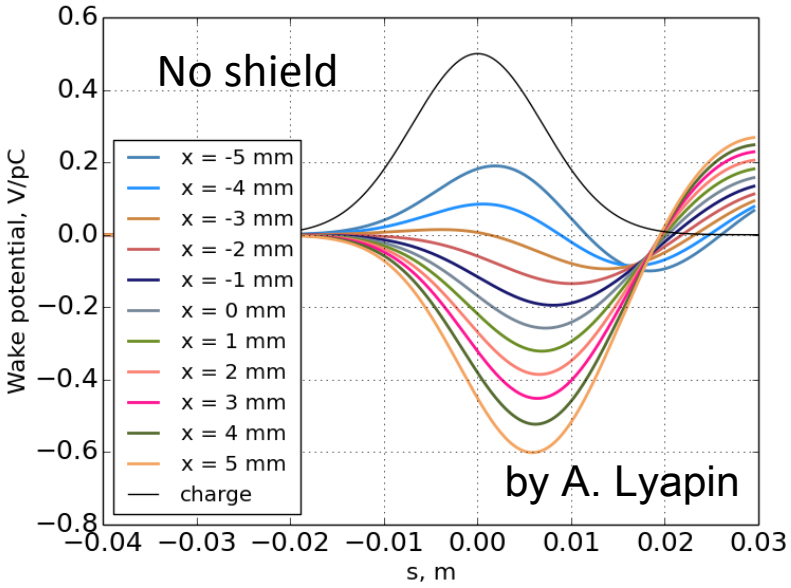
Okugi, 2014.6.26 ATF Op. meeting

121 nm/nC → 76 nm/nC

Dependence reduced by optimizing position or removing chamber. (similar effect)
(30 deg mode tend to give stronger dependence than 174 deg mode.)

Slide by K.Kubo in ATF operation meeting Nov 7, 2014

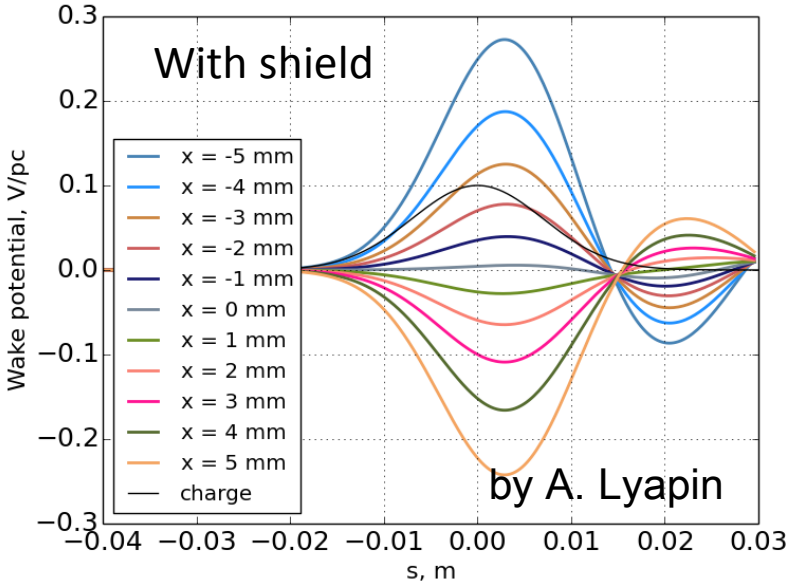
OTR monitor View Port Shield



Remove vertical asymmetry

Reduce position dependent wake (factor 0.6)

0.08 V/pC/mm → 0.05 V/pC/mm

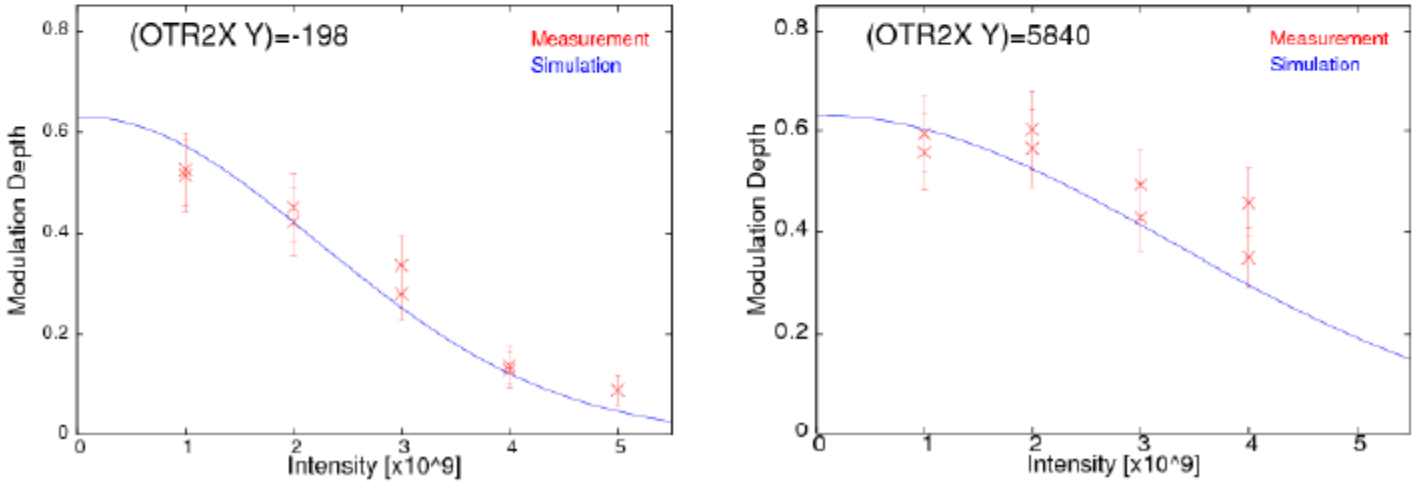


IP beam size simulation by assuming OTR impedance

Parameters of Simulation

OTR0X – OTR3X (pure capacitive impedance)	Peak Strength	-0.3V/pC/mm
	Electrical offset	5mm
Additional Intensity Dependence		10nm/1e9
Modulation Reduction Factor		0.9

Intensity Dependence



Okugi, 2014. June 6, ATF Operation meeting

Orbit Change vs. OTR chamber position

(Oct. 28, 2014, one BPM) ***of orbit kick by OTR chambers***

	OTR0X	OTR1X	OTR2X	OTR3X
R34	-209m	-190m	-275m	-75m
Movement	-65um	-40um	-100um	-25um
Ave. Wake	0.50V/pC/mm	0.34v/pC/mm	0.58V/pC/mm	0.53V/pC/mm

(Okugi, 2014.10.31 ATF Op. meeting)

(Nov. 11, 2014, many downstream BPMs)

	Kick angle/offset (urad/mm)	Wake (average in a bunch) (V/pC/mm)
OTR0	0.374	0.47
OTR1	0.317	0.40
OTR2	0.233	0.30
OTR3	0.240	0.30

(Kubo, 2014.11.11 owl shift log)

About 6-10 times bigger than expected from calculation (OTR chamber only)
Peak ~0.05 V/pC/mm

Experiments compare with calculations

Position of Wake source

- Reference cavity on mover
  - Factor 1.8~2 larger (Both IP beam size and Orbit)
- OTR chamber wake
  - Factor 6~10 larger (Both IP beam size and Orbit)

  Need to consider other moving parts.

  But discrepancy of OTR chamber effect is too large.

Strong intensity dependence after optimizing cavity and chamber positions

- Not understood yet

Wakefield in ILC FF

- Effects of transverse wakefield will be much smaller than in ATF2
  - High energy, short bunch length
  - Beam pipe aperture will be similar
    - Except for collimators (special care will be necessary)
  - Careful design of beam pipe and structures in the beam line
- But, solving the apparent discrepancies between observations and calculations is still important