Questions at 9th TB

Q1. Beam Condition for the SC-Q project

A1. those at the second goal

Q2. Differences and similarities between ATF2 and ILC, what will be learned and not learned from them.

A2. separate excel file

Q3. Backup plan if KEK can not support ATF operation after 2013.

Q4. Backup plan if KEK can not support the cryogenics

A4. We may have a possibility for US to support instead. Or, the beam test will delay a few years until the KEK budget is recovered.

Proposal : ATF2 SC-Q

A Superconducting Magnet Upgrade of the ATF2 Final Focus

Objectives:

The objectives of this experiment address the following:

- How does the interaction point spot size and position stability achieved with superconducting magnets compare with previous ATF2 warm magnet testing?
- How far can we reduce the interaction point beta* compared to the nominal ATF2 optics and is the chromaticity compensation still adequate?
- What is the implication, if any, for tuning the feedback system and final focus alignment adjustment if a final focus quadrupole and its associated sextupole move together in a common cryostat with their respective centers being magnetically adjusted?
- Are there any operational considerations for the cryogenic system that are found to influence final focus system performance?
- Are there any surprises or new ideas generated regarding how the superconducting final focus magnet system might be improved?

Mode-I

A. Achievement of 37nm beam size

A1) Demonstration of a new compact final focus system;
proposed by P.Raimondi and A.Seryi in 2000,

A2) Maintenance of the small beam size
(several hours at the FFTB/SLAC)

Mode-II

B. Control of the beam position

B1) Demonstration of beam orbit stabilization with
nano-meter precision at IP.
(The beam jitter at FFTB/SLAC was about 20nm.)

B2) Establishment of beam jitter controlling technique
at nano-meter level with ILC-like beam (2011 -?)

Requirements

Goal	ATF-EXT	ATF2
I/A	Jitter < 30% of σ_y with no feedback $r\ \varepsilon_y$=(4.5➡3) x 10^{-8}m (ε_y = 12pm)	BSM (laser in higher mode) BPMs with 100nm res. at Qs Power supplies of < 10^{-5} Active mover of Final Q
II/B	Jitter < 5% of σ_y (2nm jitter at FP) with feedback	BPM with < 2nm res. at FP IP Intra-bunch feedback for ILC style beam

In the ATF2 Proposal

Table 2.1: Beam parameters achieved at ATF and planned for ATF2, goals **A** and **B**. The ring energy is $E_0 = 1.3$ GeV, the typical bunch length and energy spread are $\sigma_z \sim 8$ mm and $\Delta E/E = 0.08$ %.

	Measured	(**A**)	(**B**)
Single Bunch			
N_{bunch} [10^{10}]	0.2 – 1.0	0.5	0.5
DR $\gamma\varepsilon_y$ [10^{-8}m]	1.5	3	3
Extr. $\gamma\varepsilon_y$ [10^{-8}m]	3.0 – 6.5	3	3
Multi Bunch			
$n_{bunches}$	20	1 – 20	3 – 20
N_{bunch} [10^{10}]	0.3 – 0.5	0.5	0.5
DR $\gamma\varepsilon_y$ [10^{-8}m]	3.0 – 4.5	3	3
Extr. $\gamma\varepsilon_y$ [10^{-8}m]	~ 6	3	3
IP σ_y^* [nm]		37	37
IP $\Delta y/\sigma_y^*$ [%]		30	5

ATF2 proposed optics IP parameters in comparison with ILC.

params	ATF2	ILC
Beam Energy [GeV]	1.28	250
L^* [m] (f^*)	1	3.5 – 4.2
ε_x [m-rad]	3e-6	1e-5
ε_y [m-rad]	3e-8	4e-8
β_x^* [mm]	4.0	21
β_y^* [mm]	0.1	0.4
η' (DDX) [rad]	0.14	0.094
σ_E [%]	~0.1	~0.1
Chromaticity W_y	$\sim 10^4$	$\sim 10^4$
$\sigma_x(\mu\mathrm{m})$	2.8	0.655
$\sigma_y(\mathrm{nm})$	34	5.7
σ_x/σ_y	82	115

ATF2

1.2nm

12pm

$\sim L^*/\beta^*_y$

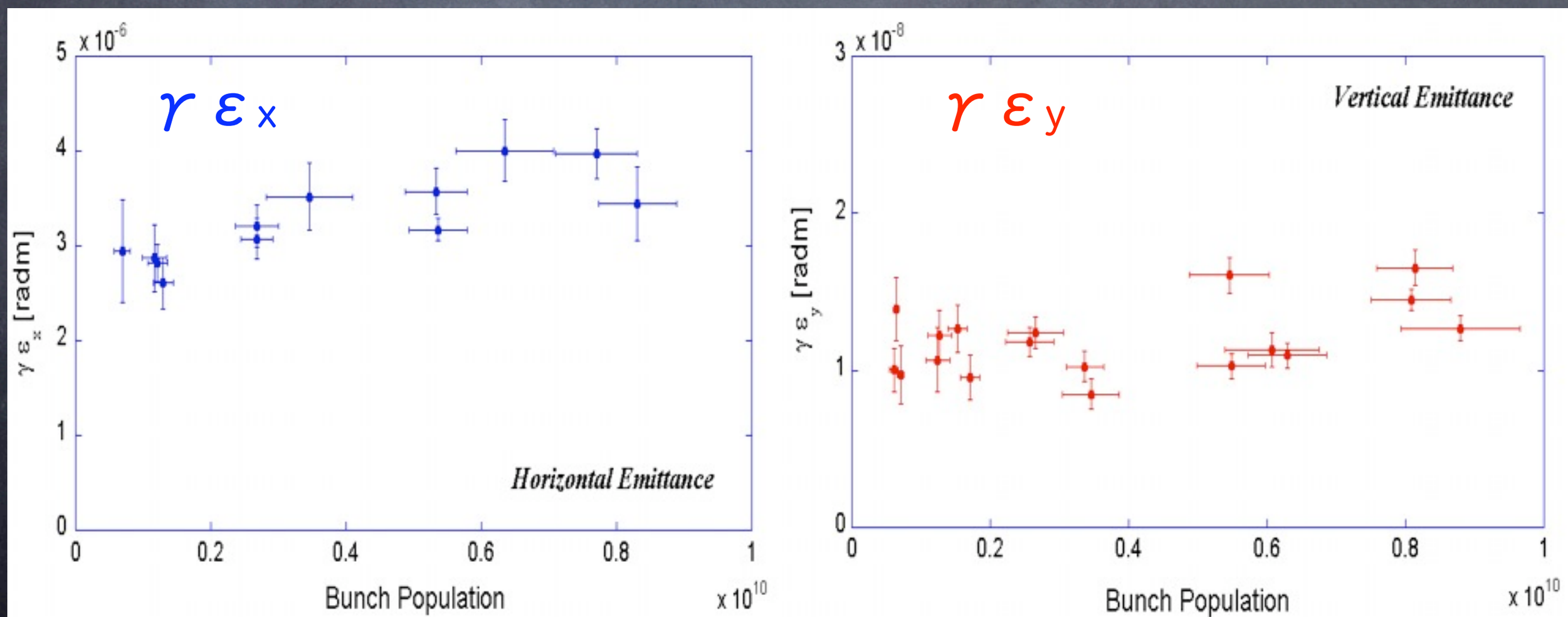
The Primary Goal is Generation of Ultra Low Emittance Beam with Energy of 1.3 GeV

Commissioning,1997, Achievement of the emittance, 2001

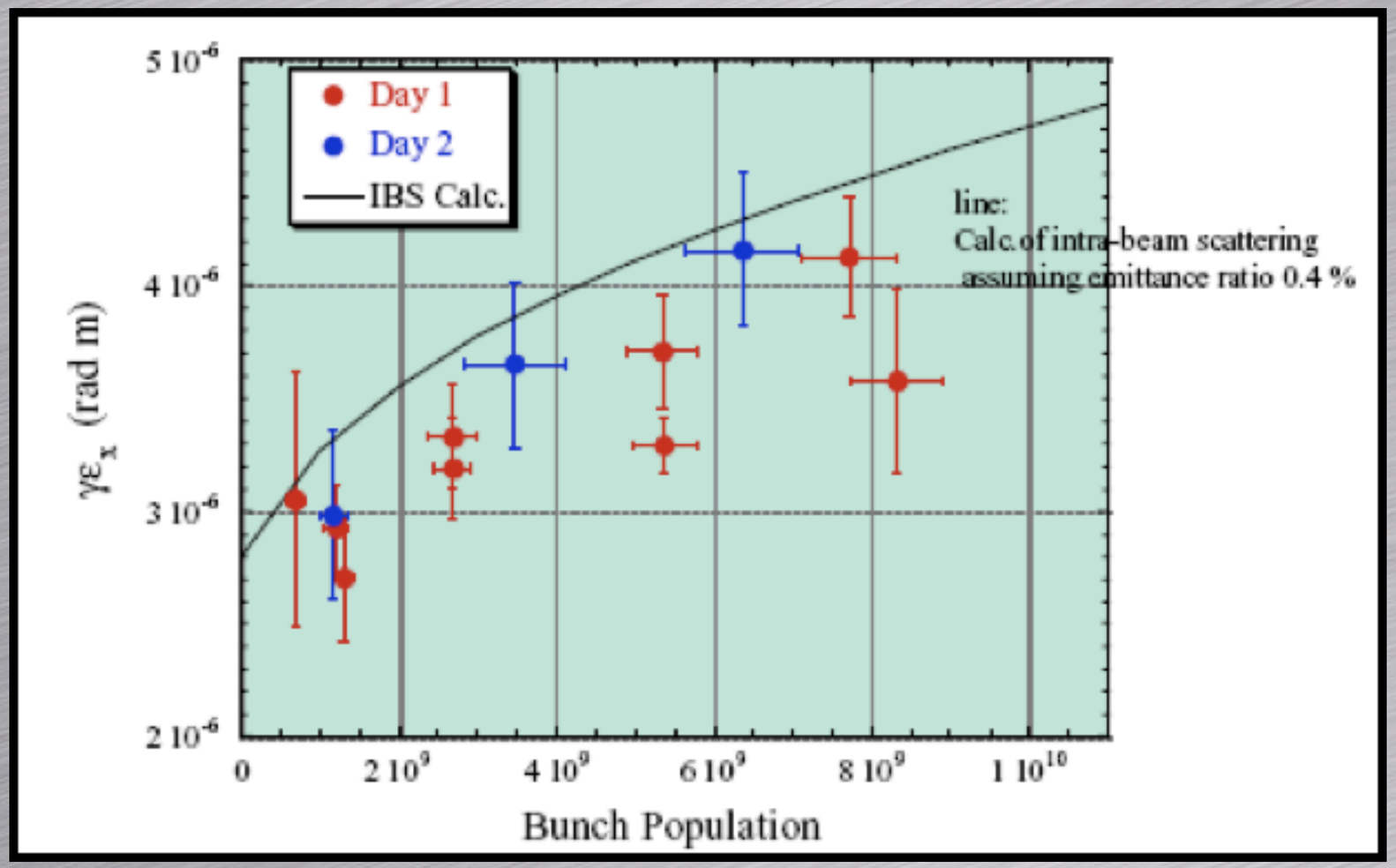
K.Kubo et al.,PRL88 (2002)194801

ε_x=1.5nm and ε_y=4pm , 2003

Y.Honda et al.,PRL92 (2004)054802



Horizontal Emittance

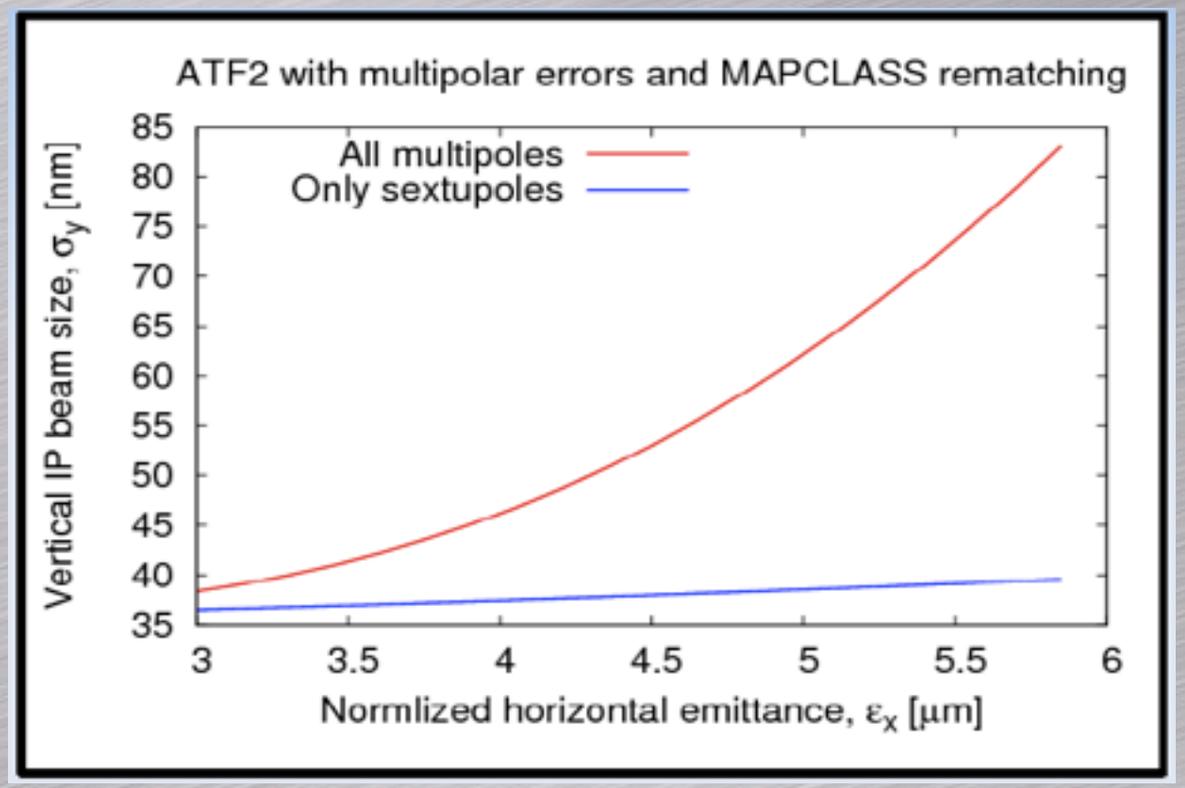


- From previous ATF measurements, only get 3um horizontal emittance at lowest beam charges.

QF1 Multipoles

Magnet Name	Sextupole/ quad	Octupole/quad	10pole/quad	12pole/quad	20pole/quad
Tolerance (tightest)*	<0.03	<0.025	<~0.01	<0.05	<0.12
QD0 at 132.2 amps	0.0255	0.0052	0.007	0.036	0.0027
QF1 at 77.5 amps	0.0274	0.0058	0.0128	0.036	0.0027

- 12-pole component of QF1FF causes coupling at IP and vertical beamsize growth
- Mitigate either through increasing (doubling) IP horizontal Beta or building compensating 12-pole magnet



Updates of Beam Parameters

Parameters	SC-Q	now	comment
Horizontal emittance $\gamma\varepsilon_x$ [μm]	3	3-5	intensity
Vertical emittance ε_y [pm]	12	<10	
Vertical jitter in pulse to pulse [σ_y]	0.3	~1	
Vertical incoherent jitter in bunch to bunch [σ_y]	0.05	0(10)	IPBPM: 2nm
beam intensity [10^{10}/bunch]	> 0.6	>0.6	FONT
Number of bunches with ~300ns spacing	30	3	Fast kicker