ATF and ATF2 news

From a visit to KEK during December 2006

Rogelio Tomas 9th-March-2007

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  - schedule
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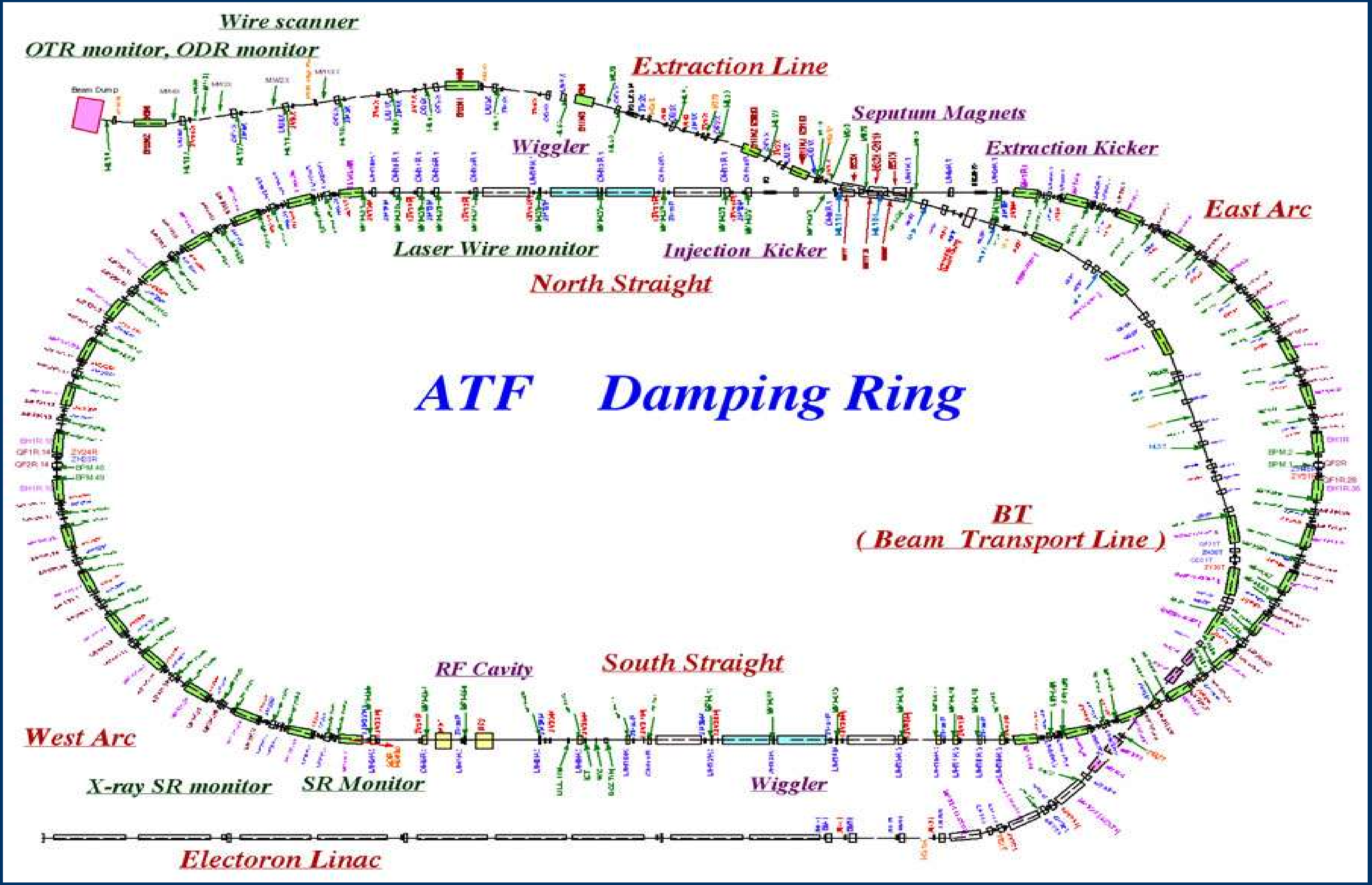
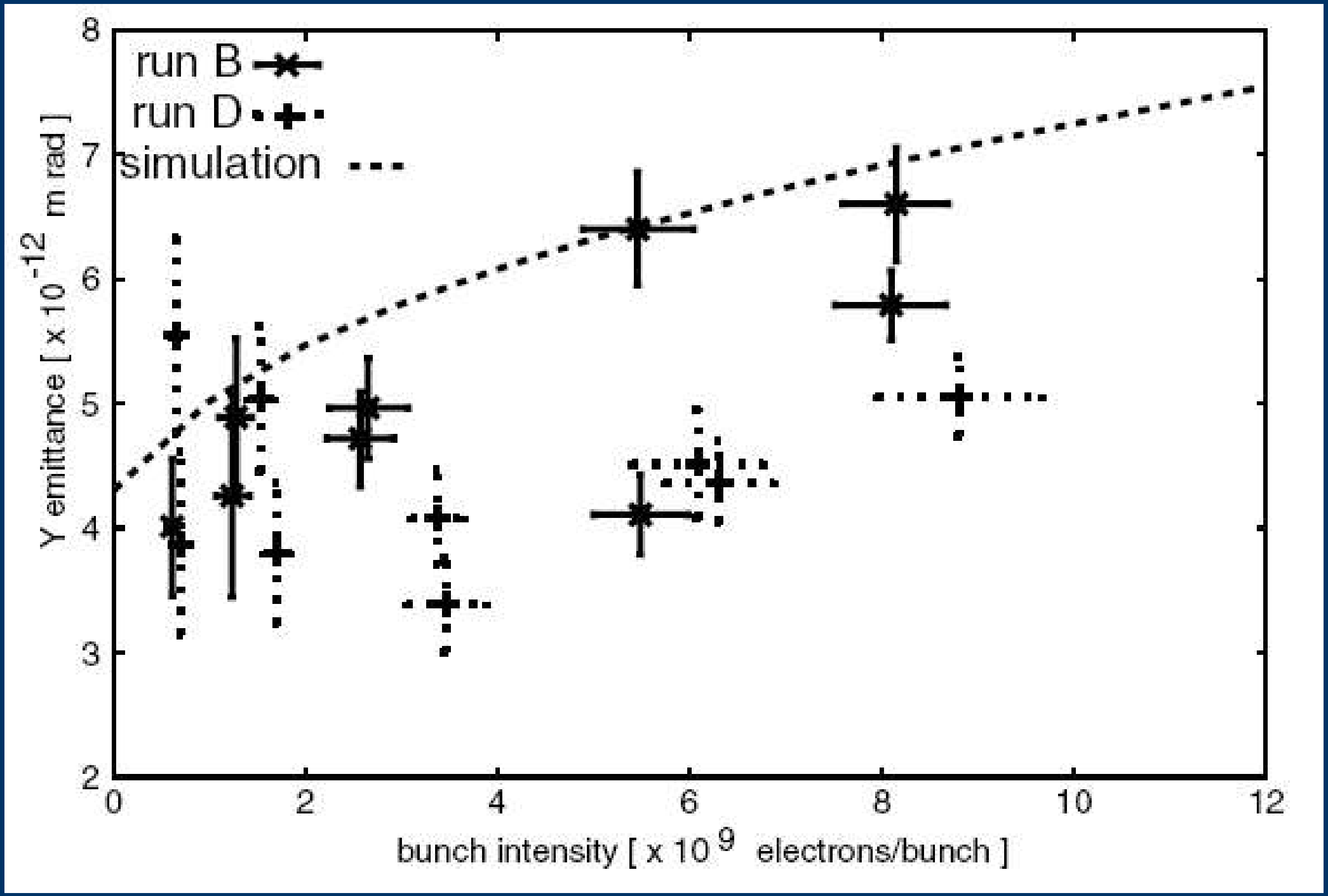
ATF complex


Wire scanner
OTR monitor, ODR monitor
Extraction Line
Seputum Magnets
Extraction Kicker
Wiggler
East Arc
Laser Wire monitor
Injection Kicker
North Straight
ATF Damping Ring
BT
(Beam Transport Line)
RF Cavity
South Straight
West Arc
X-ray SR monitor
SR Monitor
Wiggler
Electoron Linac

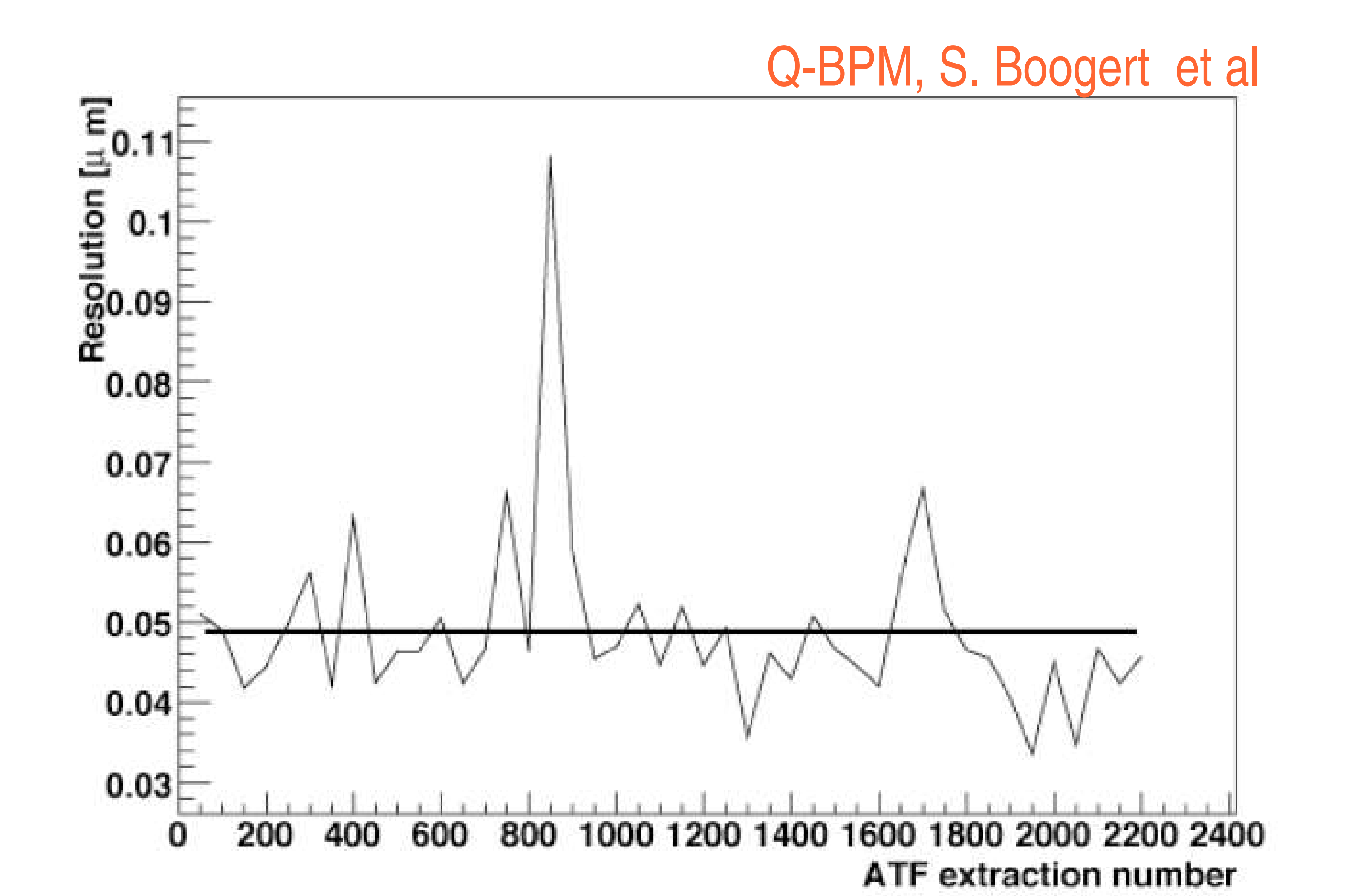
Achievements: Emittance



PRL
Vol 92
Num. 5
2004

Minimum normalized vertical emittance = 0.01μm

Achievements: Instrumentation



Demonstration of operational 50nm resolution BPMs

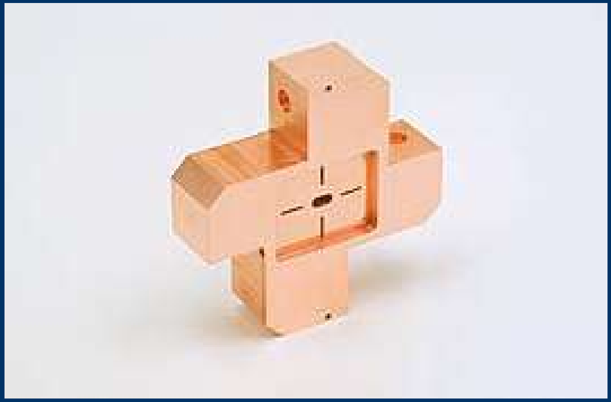
Achievements: Instrumentation II

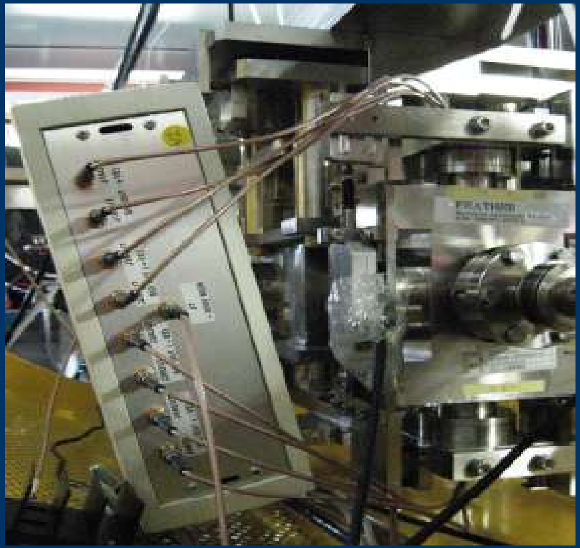
- ATF 'in the ring' laserwire is a high resolution beam size monitor → 1% resolution @ 5um
- Fast (3ns) kicker (0.6mrad) for ILC Damping ring

ATF Goals

IP-BPM

Demonstrate 2nm resolution

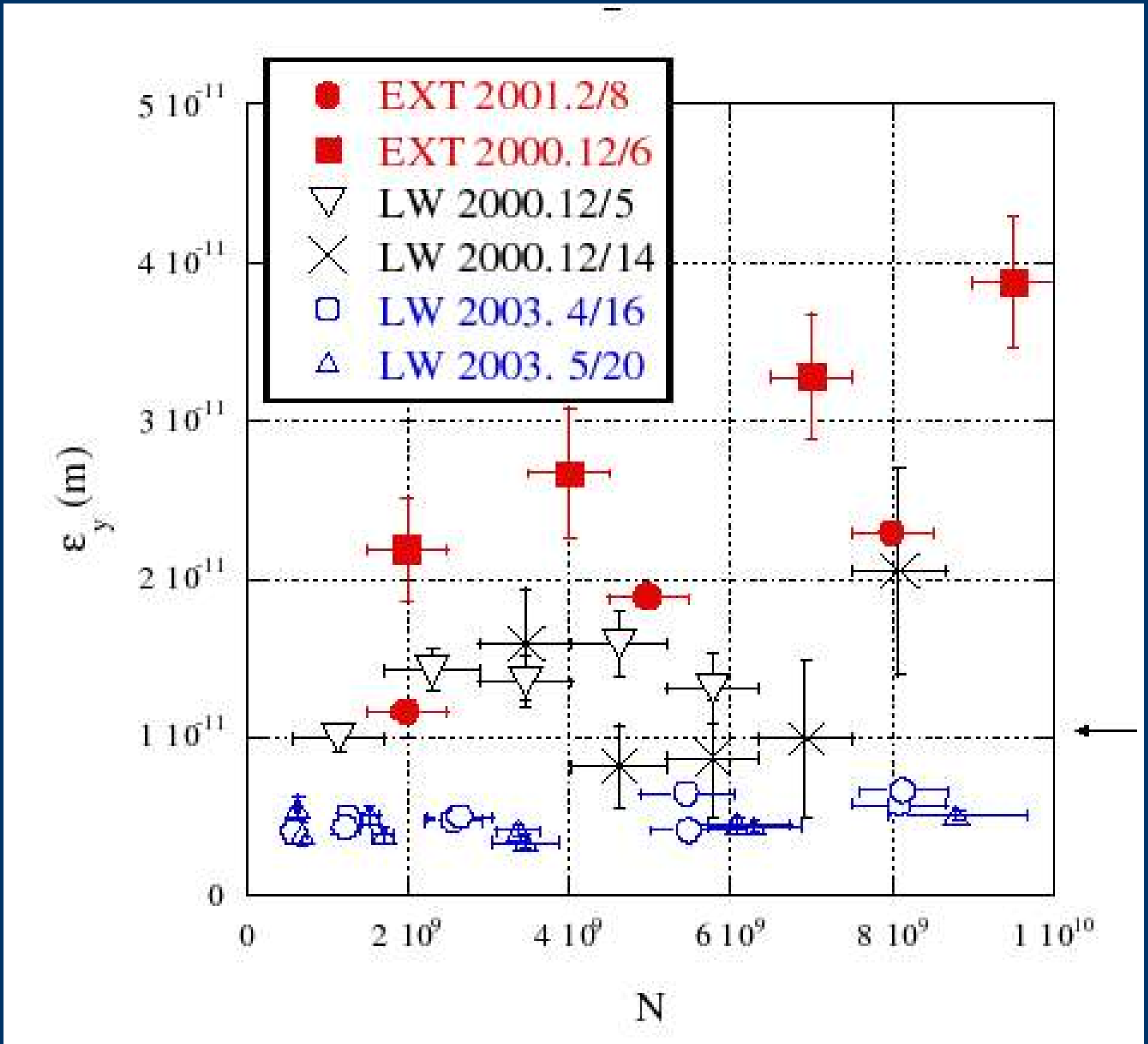




Fast Feedback system: 23ns latency

Beam dynamics: Fast ion instability, impedance measurement, microwave instability, etc.

ATF problems I



Extraction line emittance larger than ring emittance !!

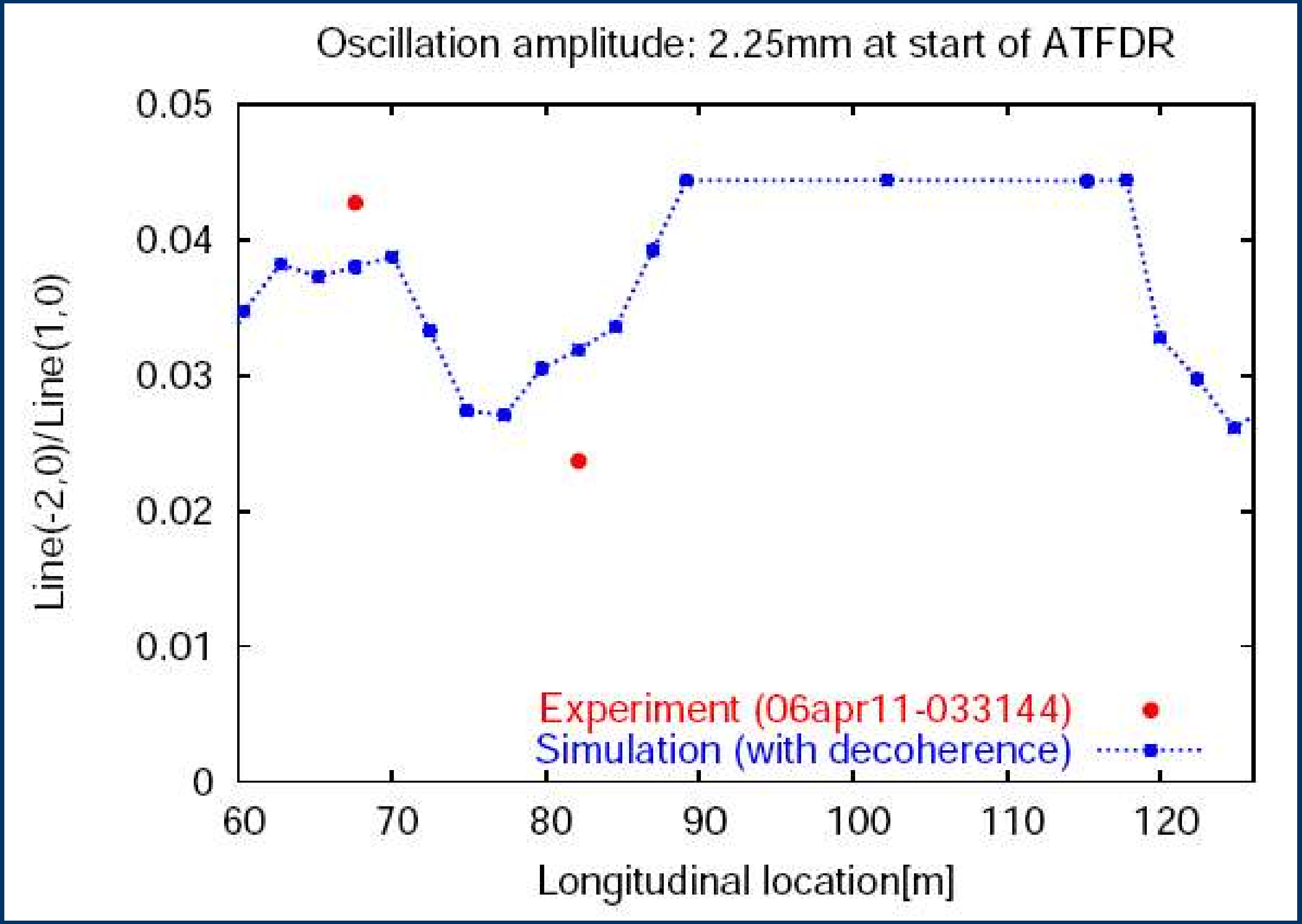
→ Coupling? Non-linear aberrations?

ATF problems II

-Are resonances a problem in the Damping ring?

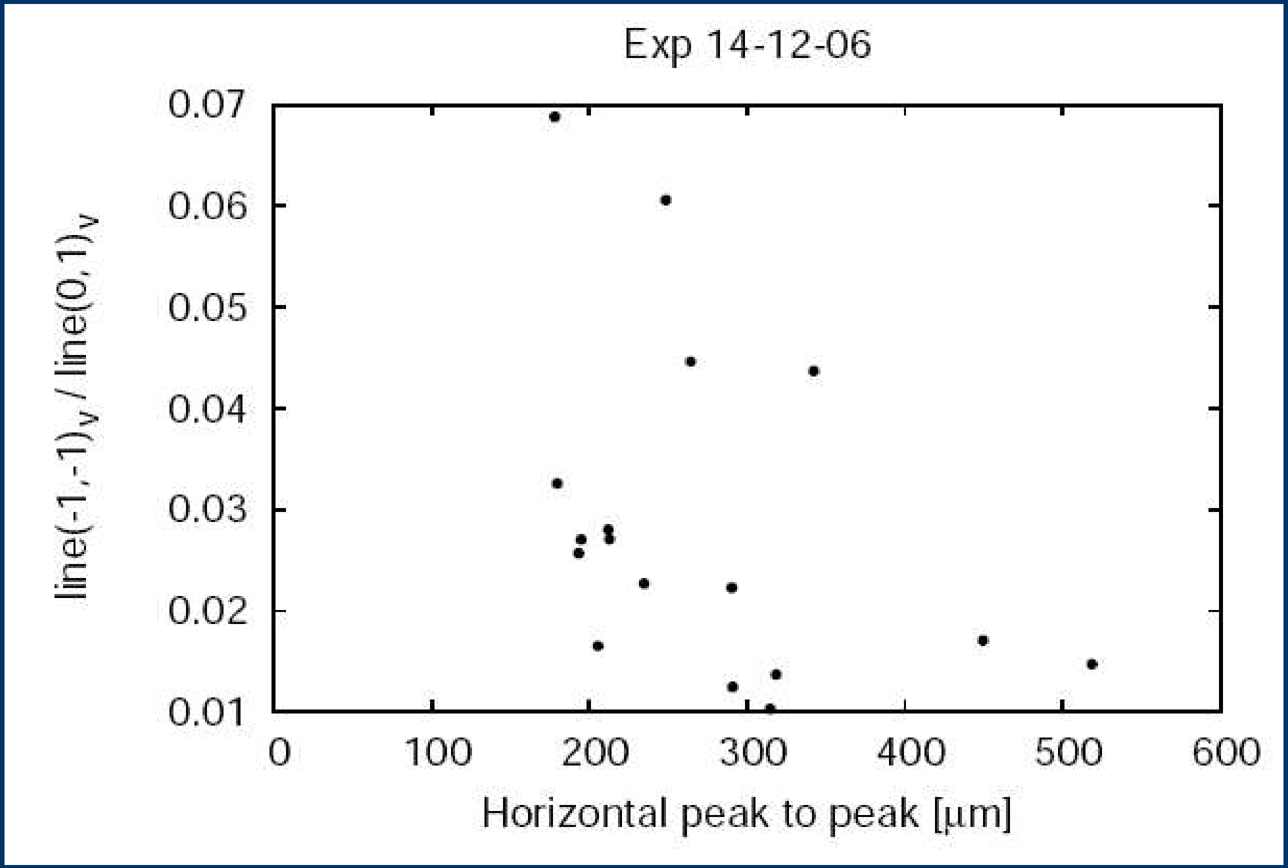
-Experiments to measure resonance driving terms have been performed by: R. Tomas, K. Kubo, S. Kuroda, T. Naito, T. Okugi, J. Urakawa and F. Zimmermann.

ATF problems II



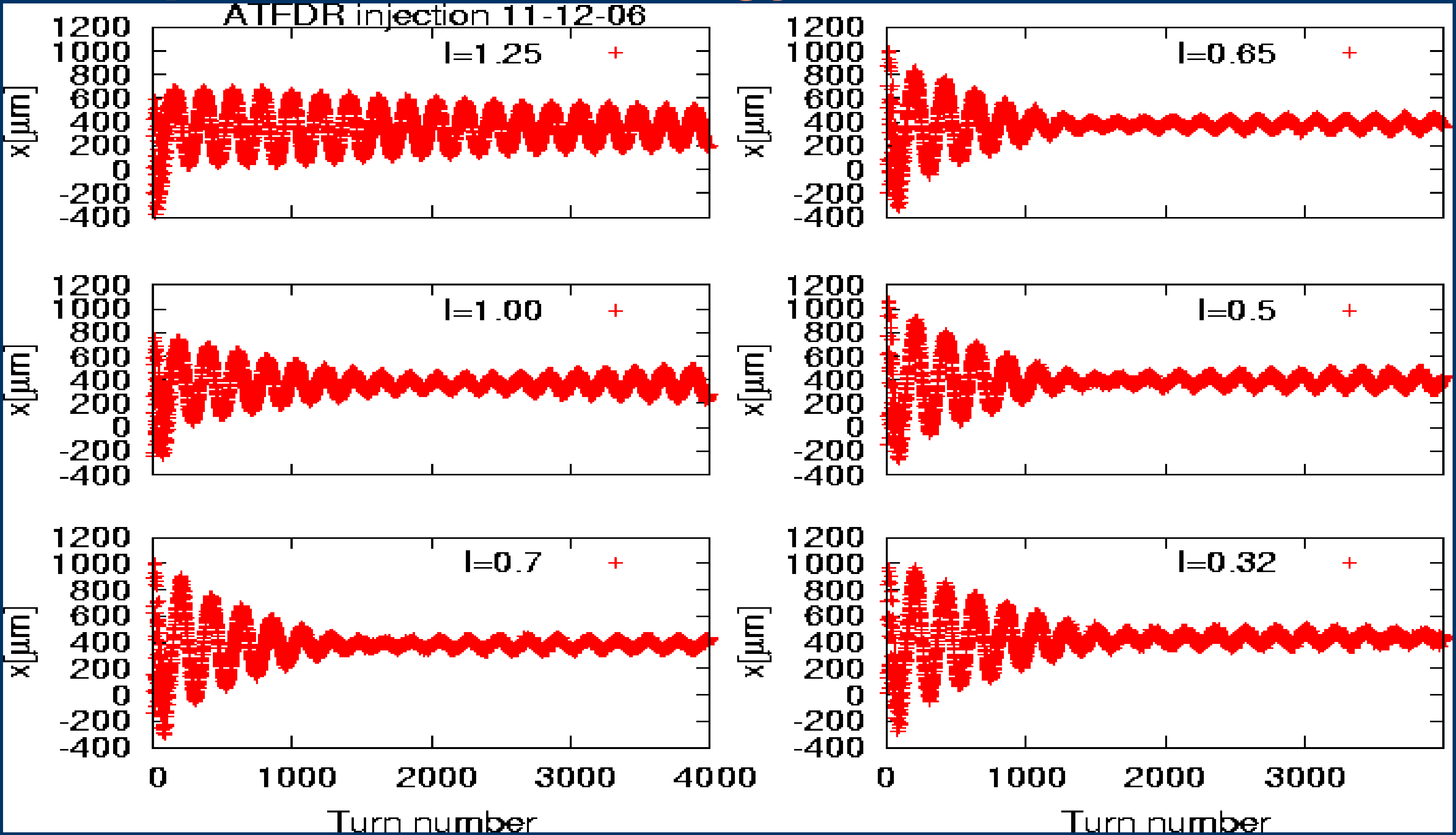
First measurement of the resonance (3,0) at two BPMs in ATFDR. Reasonable agreement with model but lack of long. information.

ATF problems II



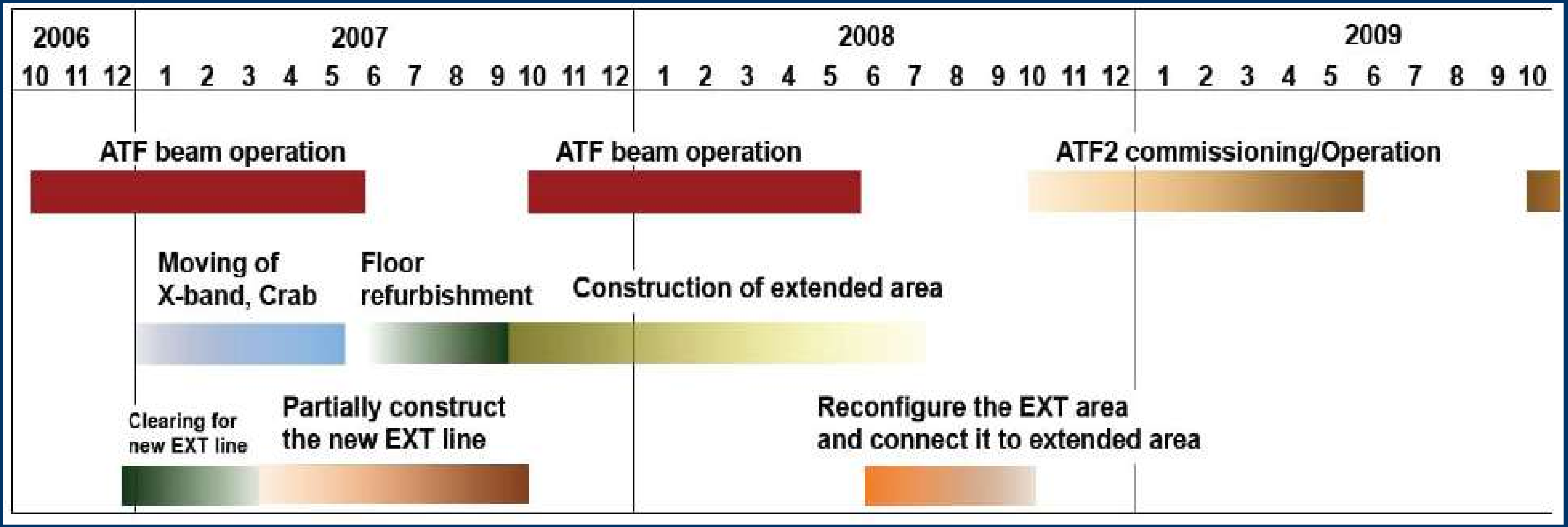
Attempt to measure resonance (1,2) failed because of not enough kick strength in both planes (simultaneously). Vertical plane remains not probed.

ATF problems III: Energy oscillations

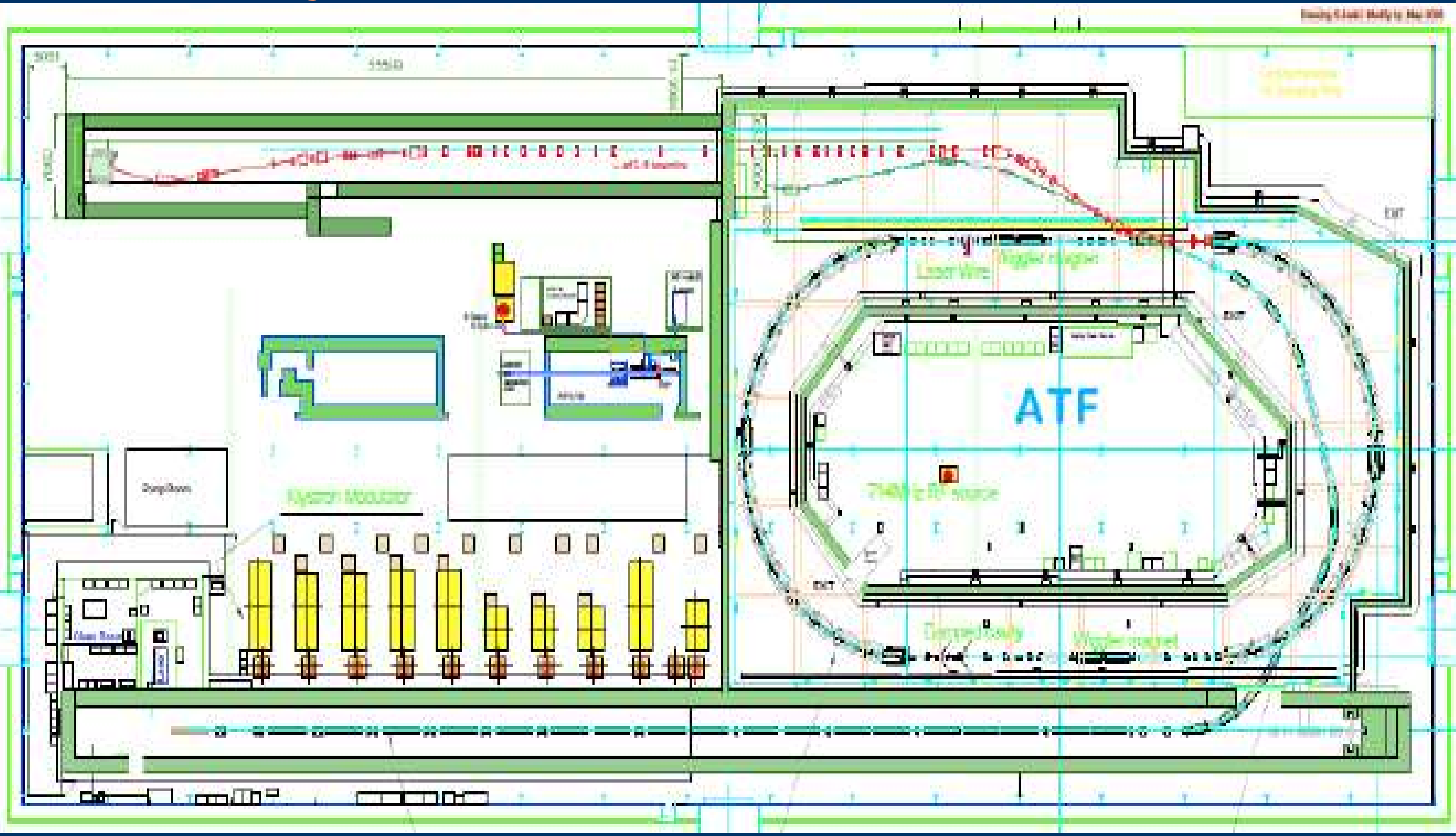


Everlasting energy oscillations after injection

ATF - ATF2 schedule



ATF2 layout


ATF
Laser Wire
Wiggler magnet
Klystron Modulator
714MHz RF source
Damped cavity
Wiggler magnet
EXIT

ATF2 Goals

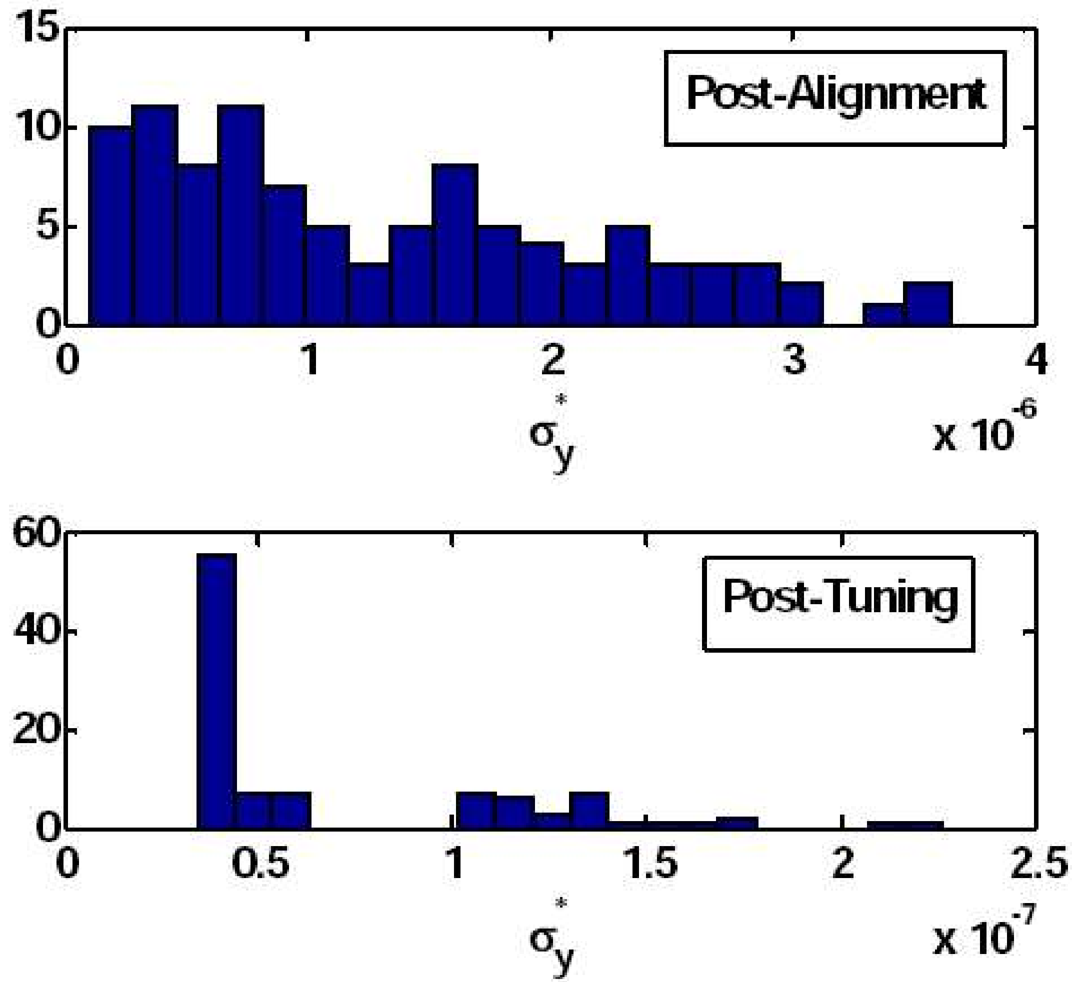
- Experimental demonstration of the Final Focus System
- Achievement of 37nm vertical IP spot size
- Experimental demonstration or test of other aspects of Linear Colliders:
  - Collimation and wakefields
  - Correction of aberrations (2^{nd} order dispersion, etc.)
  - Instrumentation

ATF2 problems: Achieving 37nm

Shintake monitor only measures below 100nm (now 300nm)

- 54% seeds converge <~ 39nm.
- 30% seeds never get to <100nm.

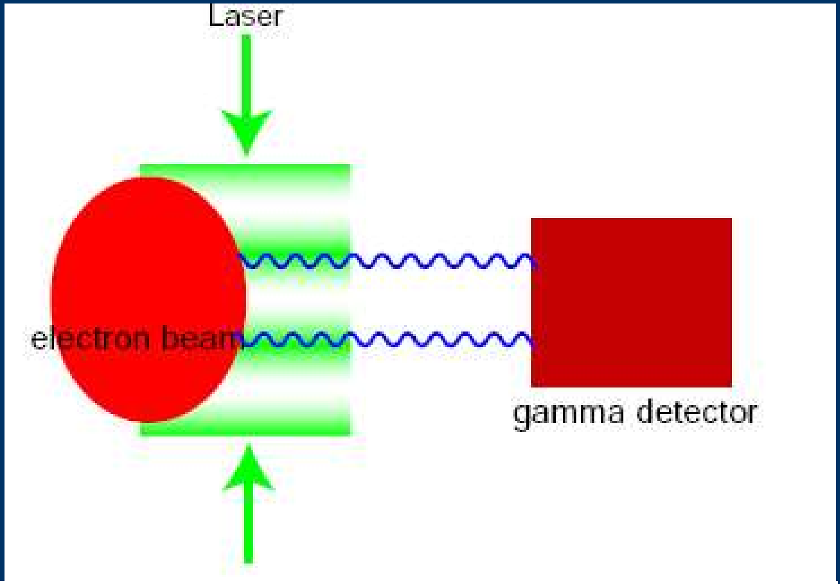
G. White



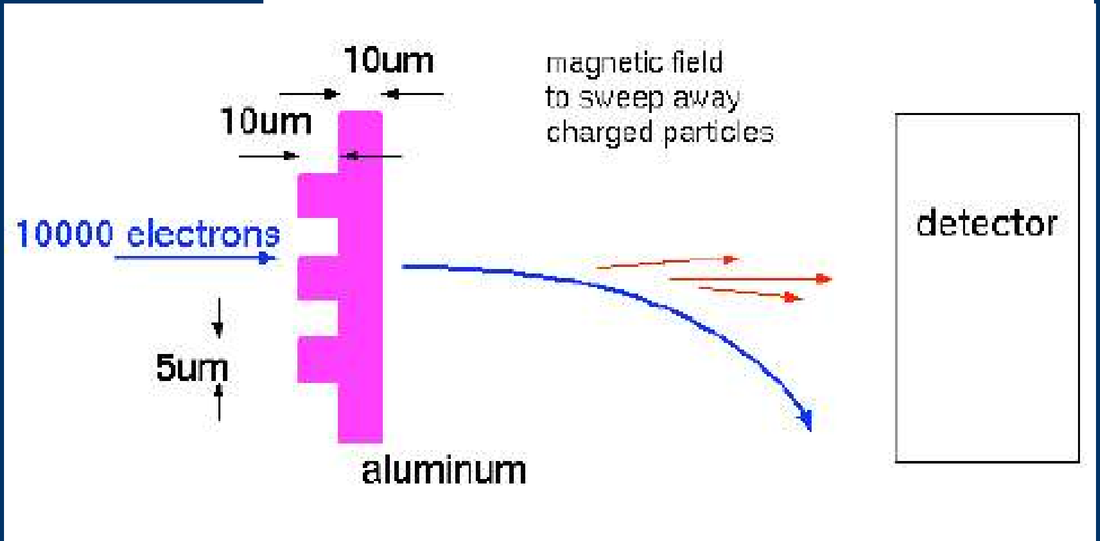
Alignment and tunning do not guarantee σy < 100nm

ATF2 problems: Beam size monitors

Shintake monitor:
2nm resolution,
$\sigma y < 300nm$



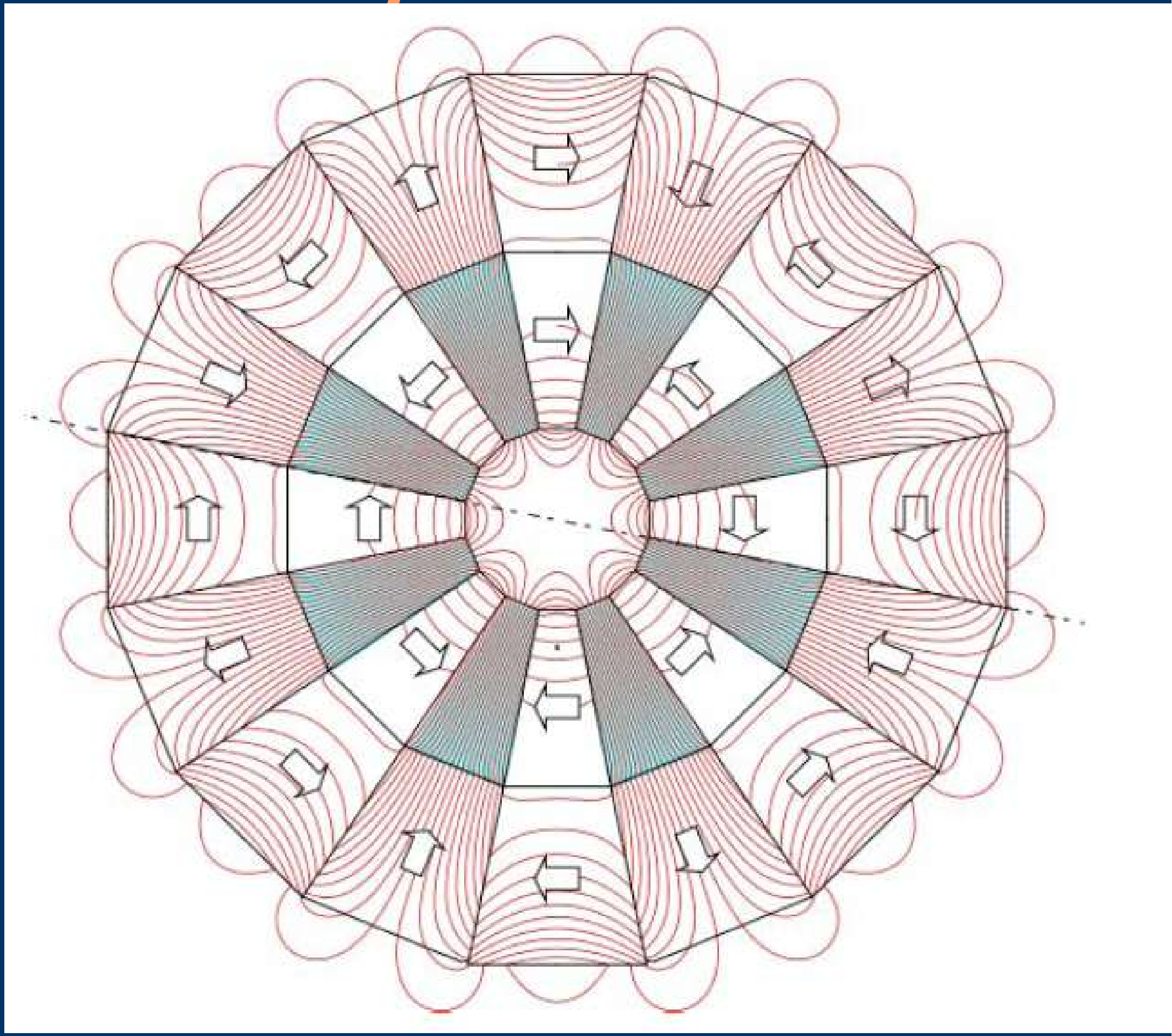
New monitor based on a pattern target:
10% resolution,
$\sigma y \sim 350\text{-}1000nm$



New tuning simulations required to prove performance

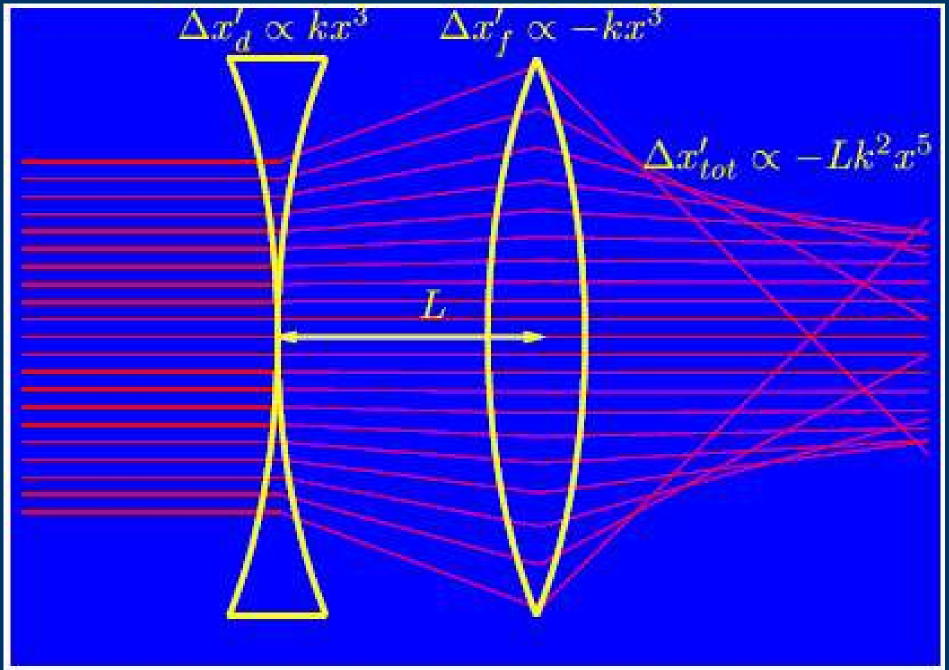
ATF2: Octupole Tail Folding?

Permanent octupole magnets have been proposed to test octupole tail folding.



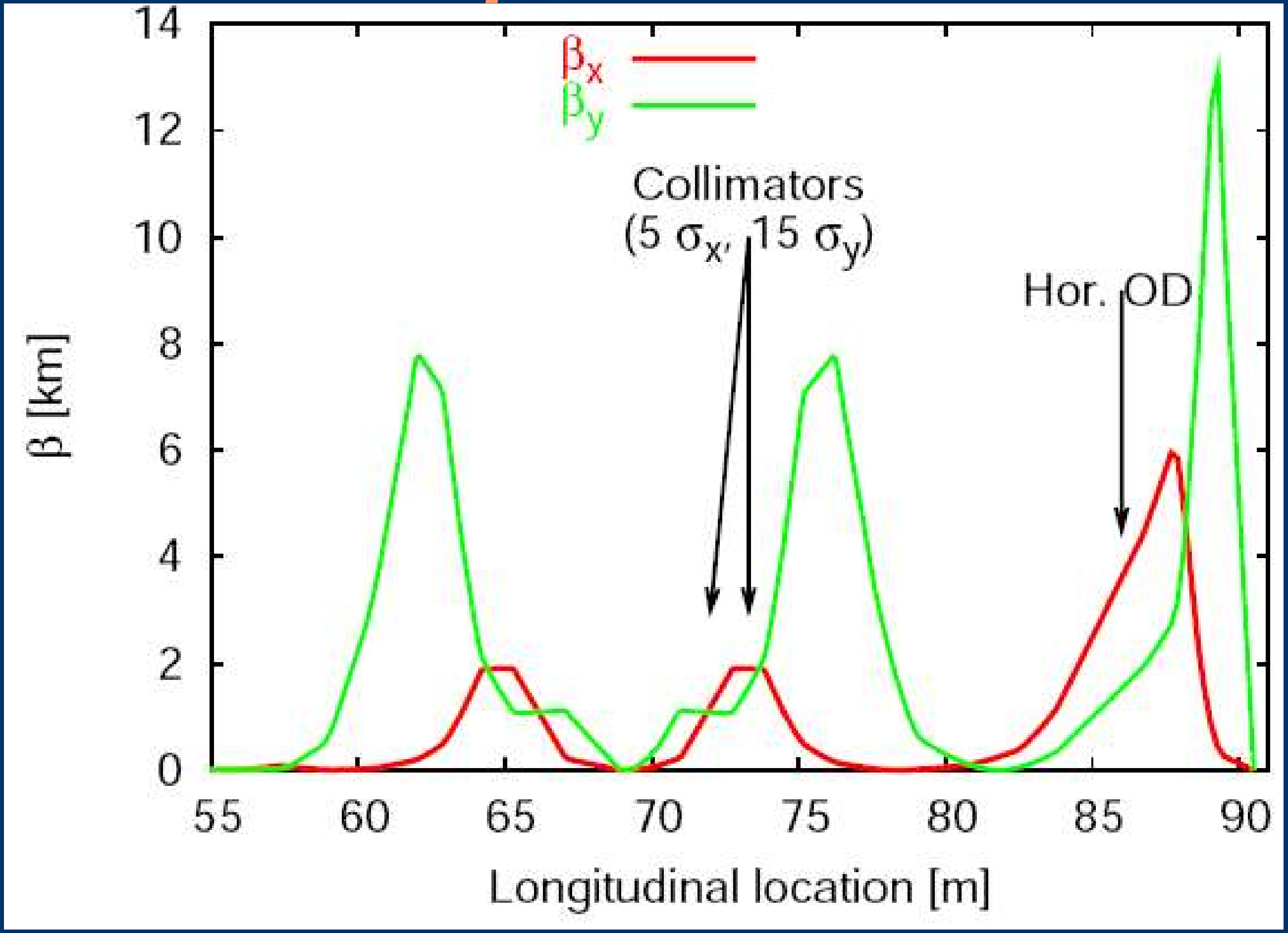
Y. Iwashita

Principle of octupole tail folding



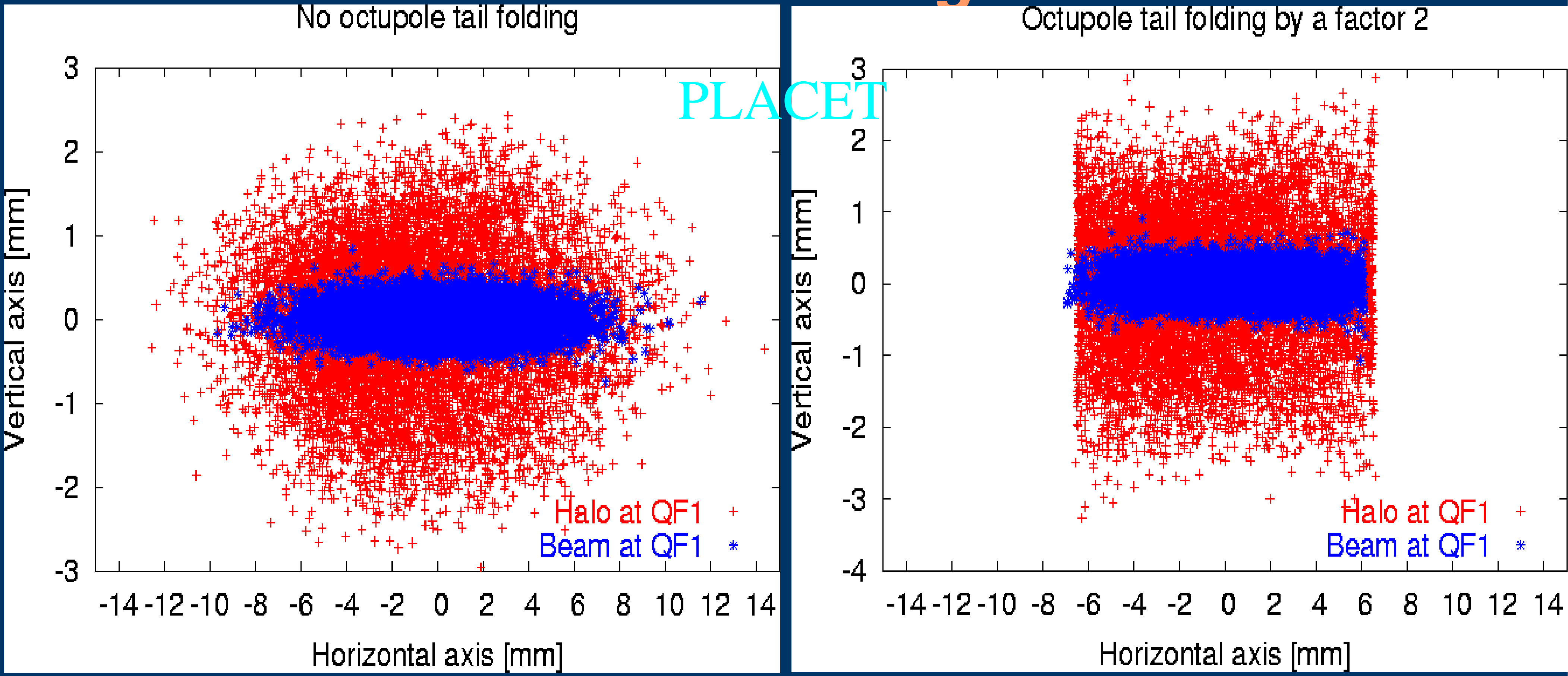
Requirements for efficient halo folding:
-Low halo divergence (large beta)
-Octupole doublet placed after collimators
-Octupole doublet placed in front of a quadrupole

ATF2 Final Focus optics



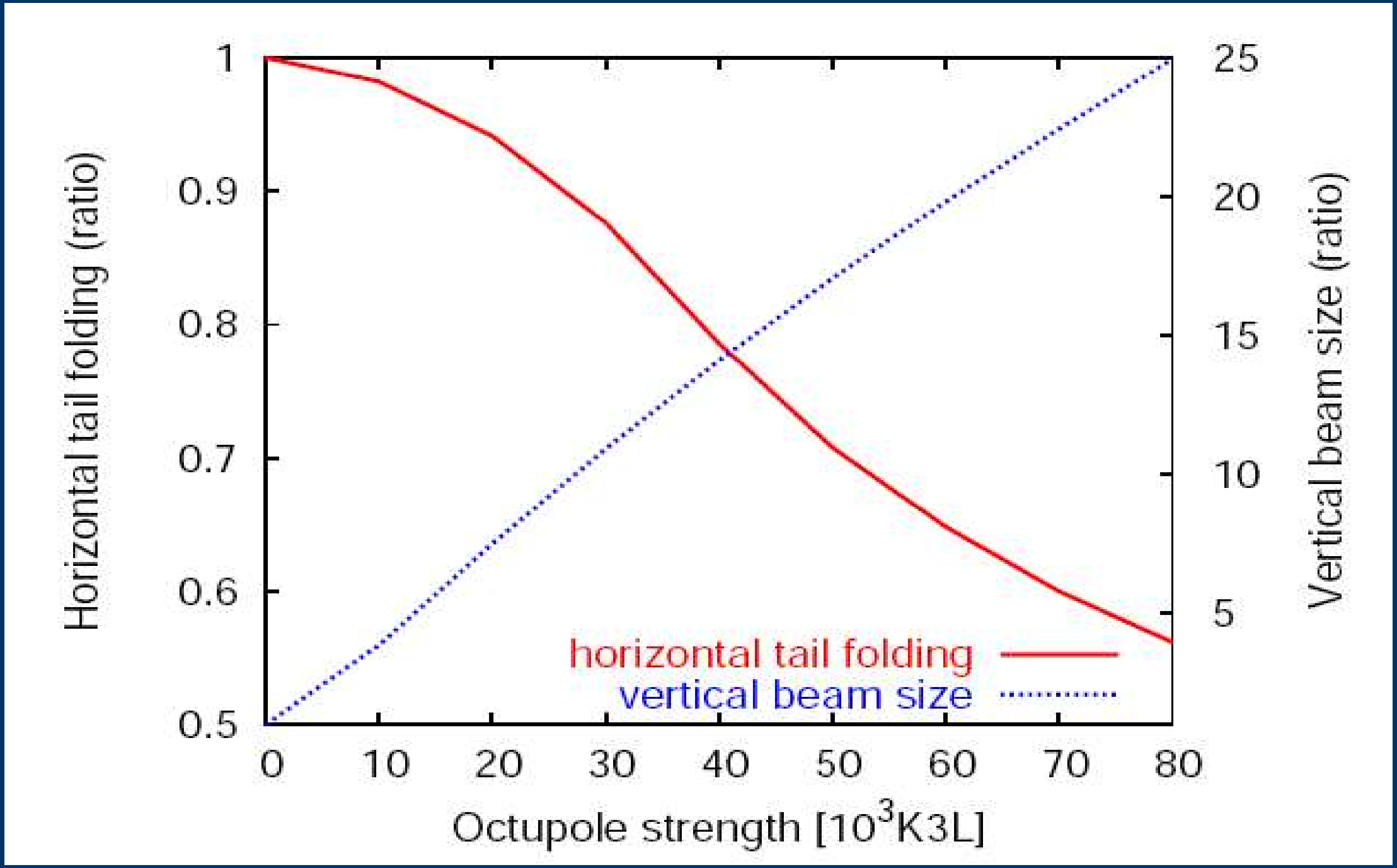
No good location for vertical Octupole Doublet

ATF2: Horizontal tail folding simulations



Folding the halo from 5 to 2.5σ is possible, but...

ATF2: Emittance blow up due to octupoles



Octupole tail folding in ATF2 needs either larger collimator gaps or different collimator location (for the vertical case).

ATF2: Magnetic field stability?

magnetic field stability

Masayuki Kumada, NIRS

an amplitude of a magnetic field of iron core electric magnet changes even under constant current. Its underling physics still remains ***puzzle***.

The observed temperature coefficient of the iron core electromagnet is about +14 ppm/degree. It is positive and cannot be explained by the standard Bloch theory.

CLIC Table

4. Discussion of the use of the table for ATF2

✓ Low frequency vibrations: 0.1Hz - 1Hz

→ Expected vibrations in the vertical direction: 300nm → 80nm

Table (Vertical direction)	Passive	Active
Amplification	1	1.5
Coherence Table/Floor	0.9	0.9

⇨ Passive table better because of the amplification in the active mode

✓ Medium frequency vibrations: 1Hz - 20Hz

→ Expected vibrations in the vertical direction: 80nm → 2nm

Table (Vertical direction)	Passive	Active
Amplification	1.5	0.1
Coherence Table/Floor	0.9	0.3

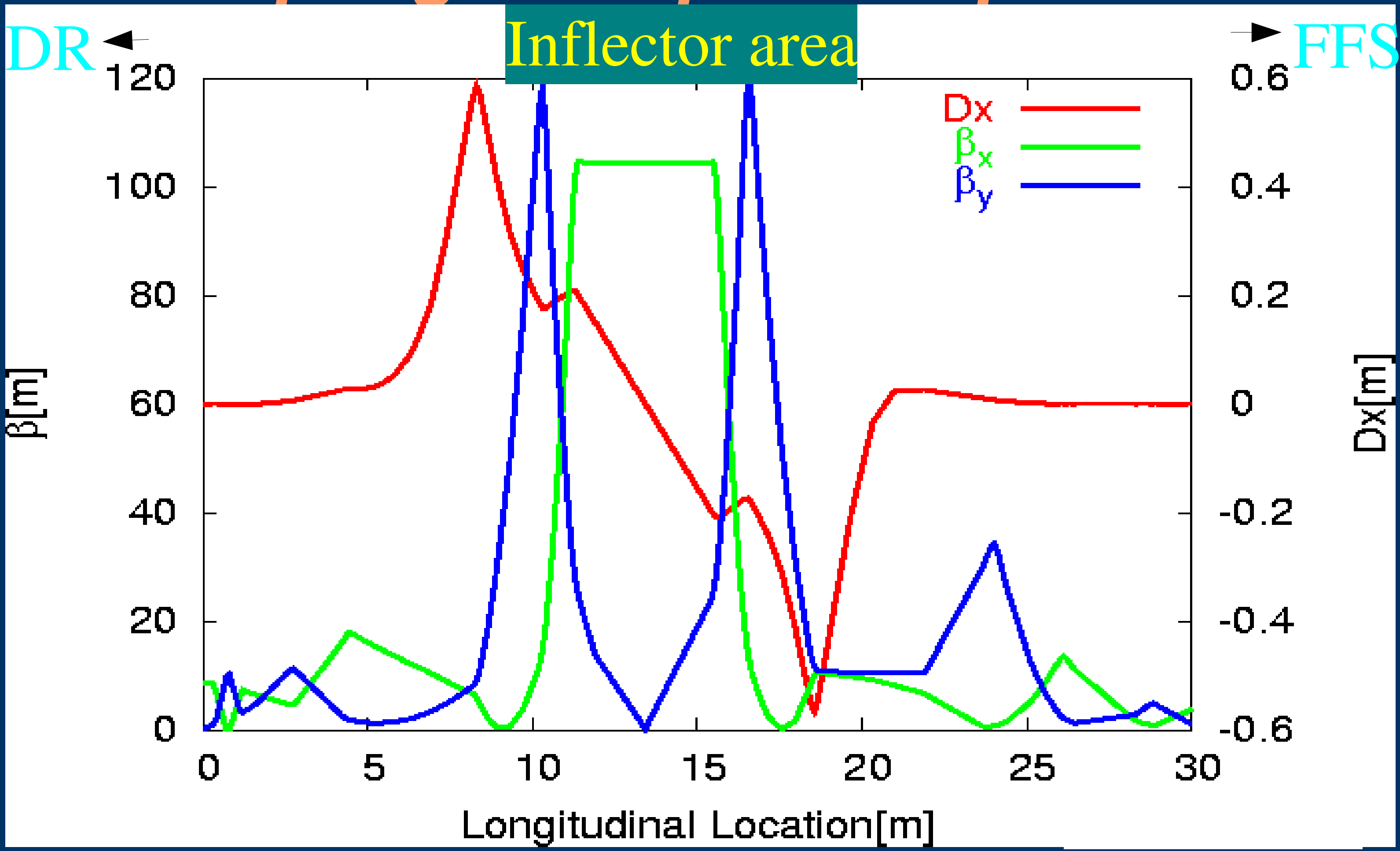
➢ Loss of coherence in the active mode

→ Even if FD motion very small, relative motion between FD and Shintake big

⇨ Passive table better

Benoit Bolzon

ATF2: Coupling & Dispersion problem



Problem: Skew quadrupolar errors in this area cause vertical dispersion

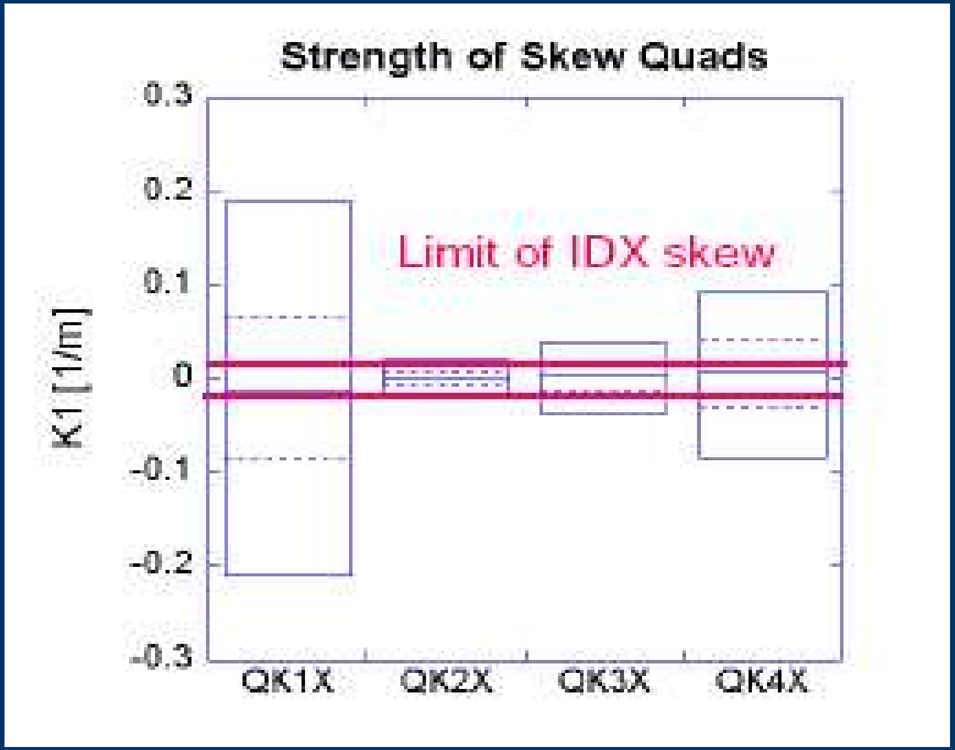
ATF2: Coupling & Dispersion problem

This vertical dispersion can be corrected in two ways:

- With orbit correctors: Large orbit bumps are required, which at the sextupoles produce large betatron coupling (T. Okugi).
- With skew quadrupoles: These certainly produce large betatron coupling (M. Woodley).

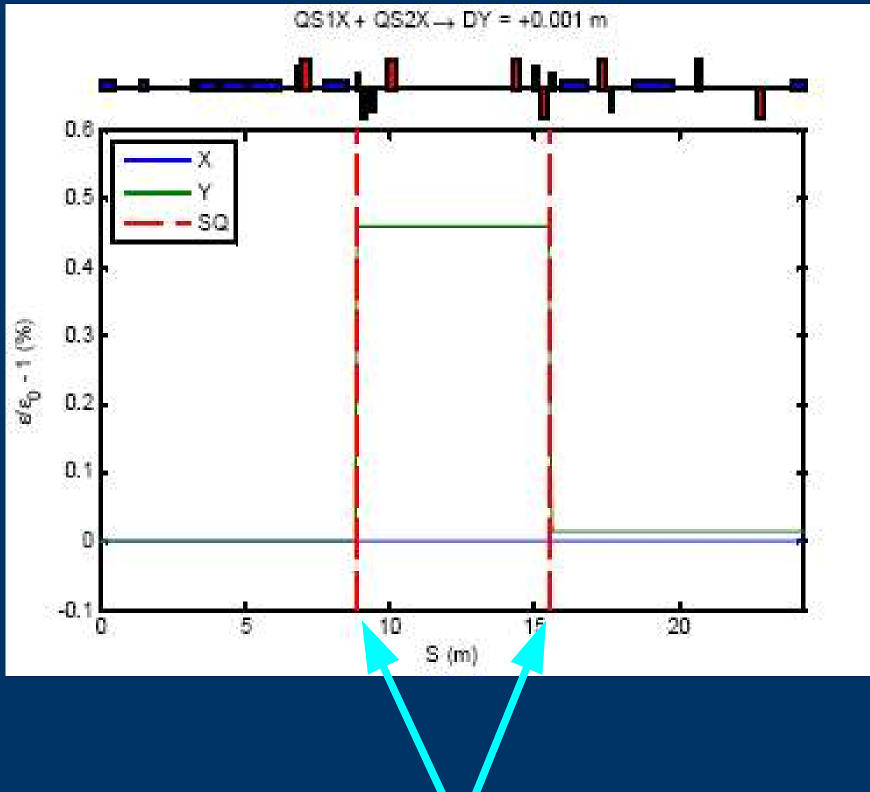
No matter what large coupling needs to be corrected

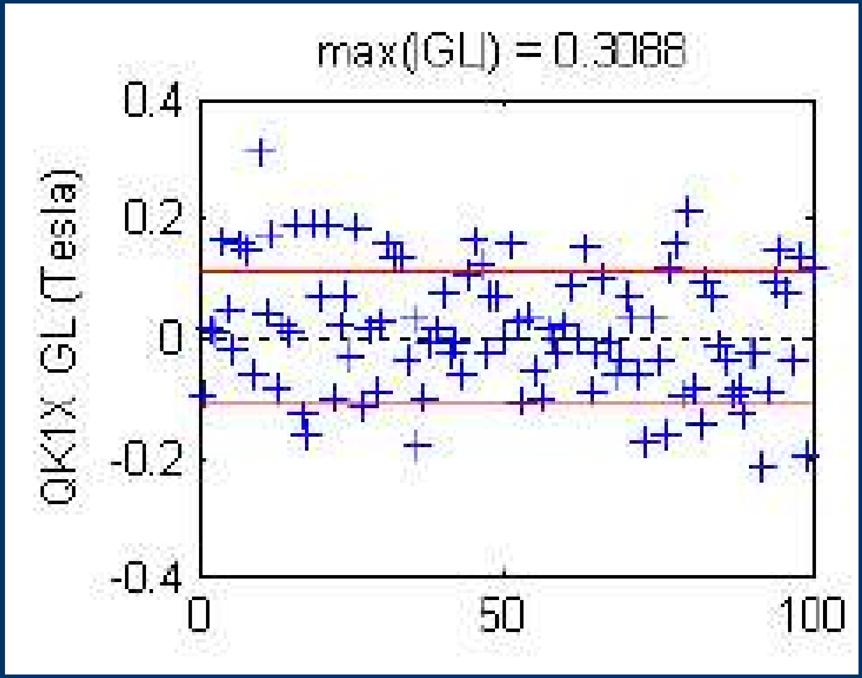
Coupling & dispersion problem: T. Okugi



In Okugi's approach existing skew quadrupoles are too weak.
Solution: new stronger skew quads?

Coupling & dispersion problem: Woodley

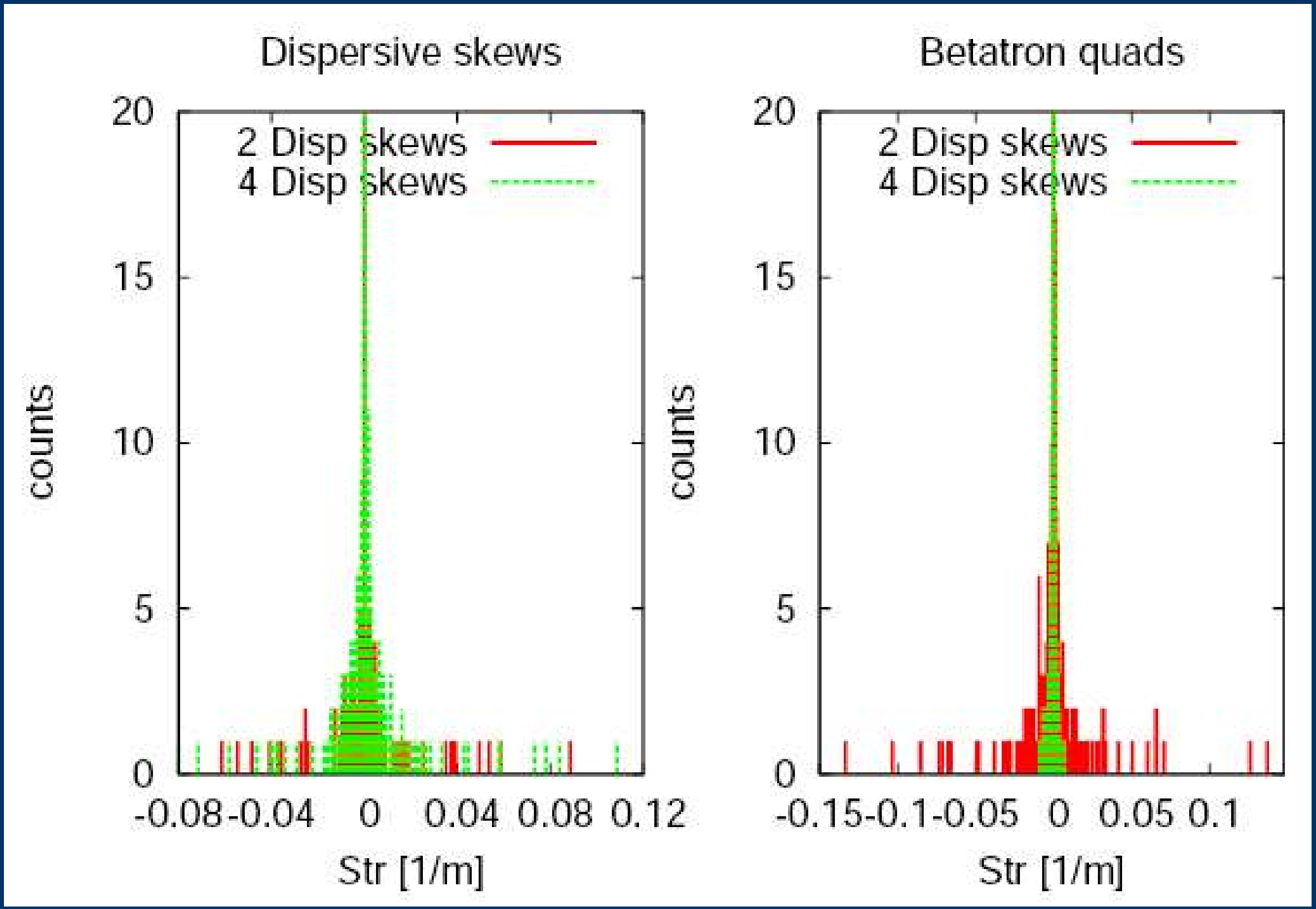




Two extra skew quadrupoles in the inflector area are enough to cancel vertical dispersion originated in this area. Coupling correction is easier than in Okugi's approach.

However: Residual vert. dispersion cannot be handled.

Coupling & dispersion problem: me



4 new dispersion + 4 betatron skew quads cancel any coupling and any dispersion. However: Difficult correction procedure and we still need 4 new skew quads...

Coupling & dispersion: conclusion

- If residual dispersion is below 5mm, M. Woodley's approach is the best.
- If residual dispersion is above 5mm, there is no easy solution.

Summary & Outlook

- ATF and ATF2 are the largest facilities built exclusively to test Linear Collider's concepts.
- Very open international collaboration:
  - Call for new R&D proposals at ATF (until May)
- Very interesting open problems

Links

ATF collaboration web page: http://atf.kek.jp/collab

ATF2 third project meeting:
http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=1295