Present and Planned ILC Activities at LNF

S. Guiducci

GDE LNF Visit

22-23 January 2009

INFN-LNF Activity History

- TESLA TDR: Layout and technical design of the Damping Ring
- Participation to ILC activity since the beginning:
  - KEK 1st ILC workshop, Nov. 2004
  - Snowmass Workshop, Aug. 2005
- BCD Decision Dec. 2005 at the Frascati meeting
- INFN contribution to the Reference Design Report (RDR), Aug. 2007
  - Responsability as DR Area System Leader
  - RF and Feedback system specification
- European Projects: EUROTeV (FP6) coordination of Damping Ring work package

Damping Rings Technical Design Phase (TDP)

- Critical R&D for R&D for cost reduction and risk mitigation:
- electron cloud
  - Code benchmarking with e-cloud instability measurements at DAFNE
- fast kickers
  - Beam test at DAFNE of fast injection kickers approaching ILC DR specifications
  - Design kickers with ILC DR specifications for installation and tests at ATF-KEK

Other LNF TDP Activities

- Feedback system R&D
  - Demonstrate damping time
- Low impedance DAΦNE bellows
- 'Minimum Machine' studies:
  - Lattice design for 3 km ring
- Linac diagnostics
  - Non intercepting beam size diagnostics based on Optical Diffraction Radiation (ODR)

Experience with FID pulsers at DAΦNE

First results of operation with FID fast pulsers have been very promising.

Routine operation with 45kV FIDs not allowed because of their very poor reliability.

After increasing ß function in the kicker region and changing the beam orbit in the septa, we tried successfully injection with a 24kV, 5ns FID.

Pulse shape is the same of the 45kV FID, just lower voltage amplitude.

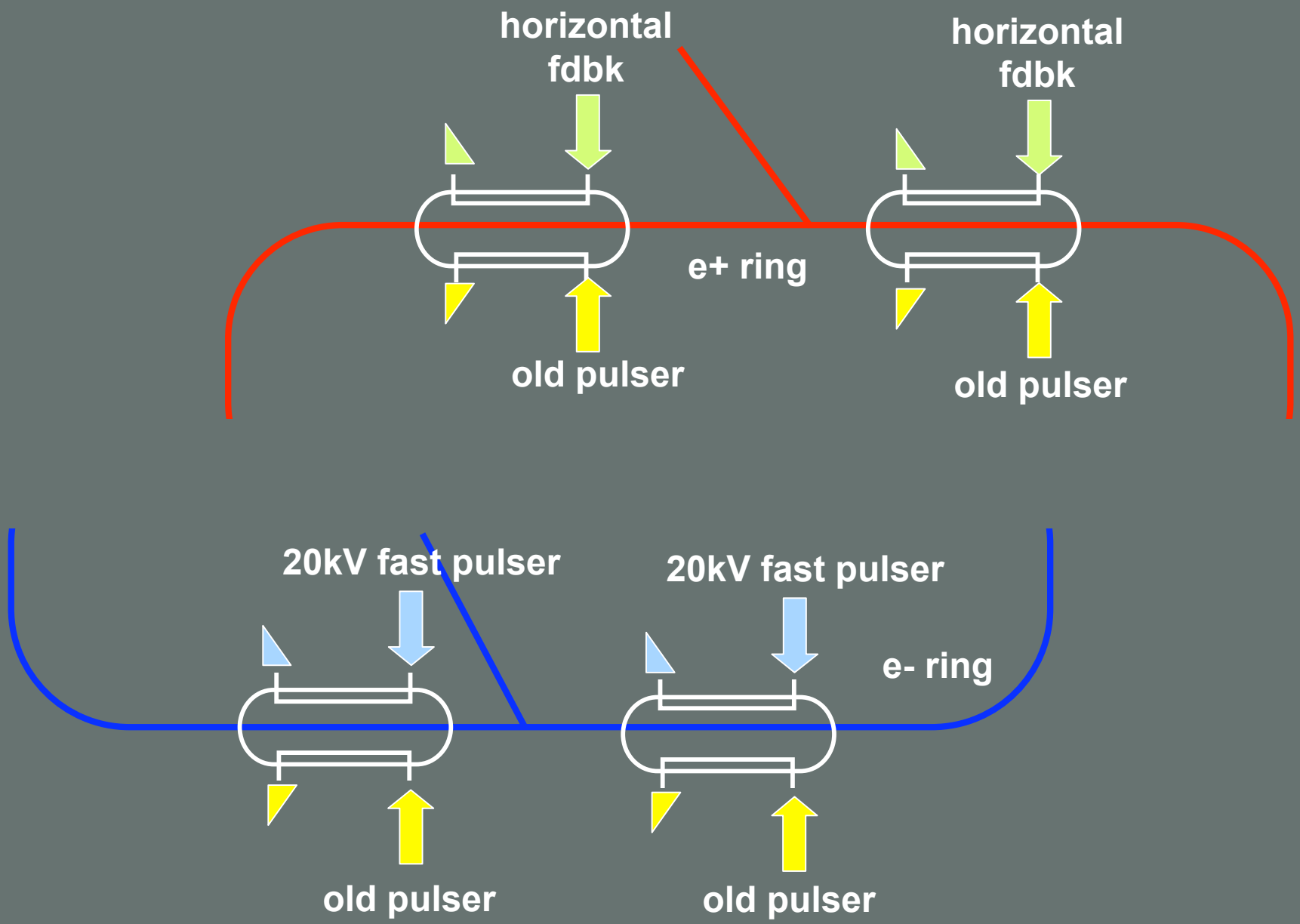
We used this 24 kV FID for lab tests and never had problems up to now.

We decided to give up the 45 kV FIDs and try to go on with the 24 kV units.

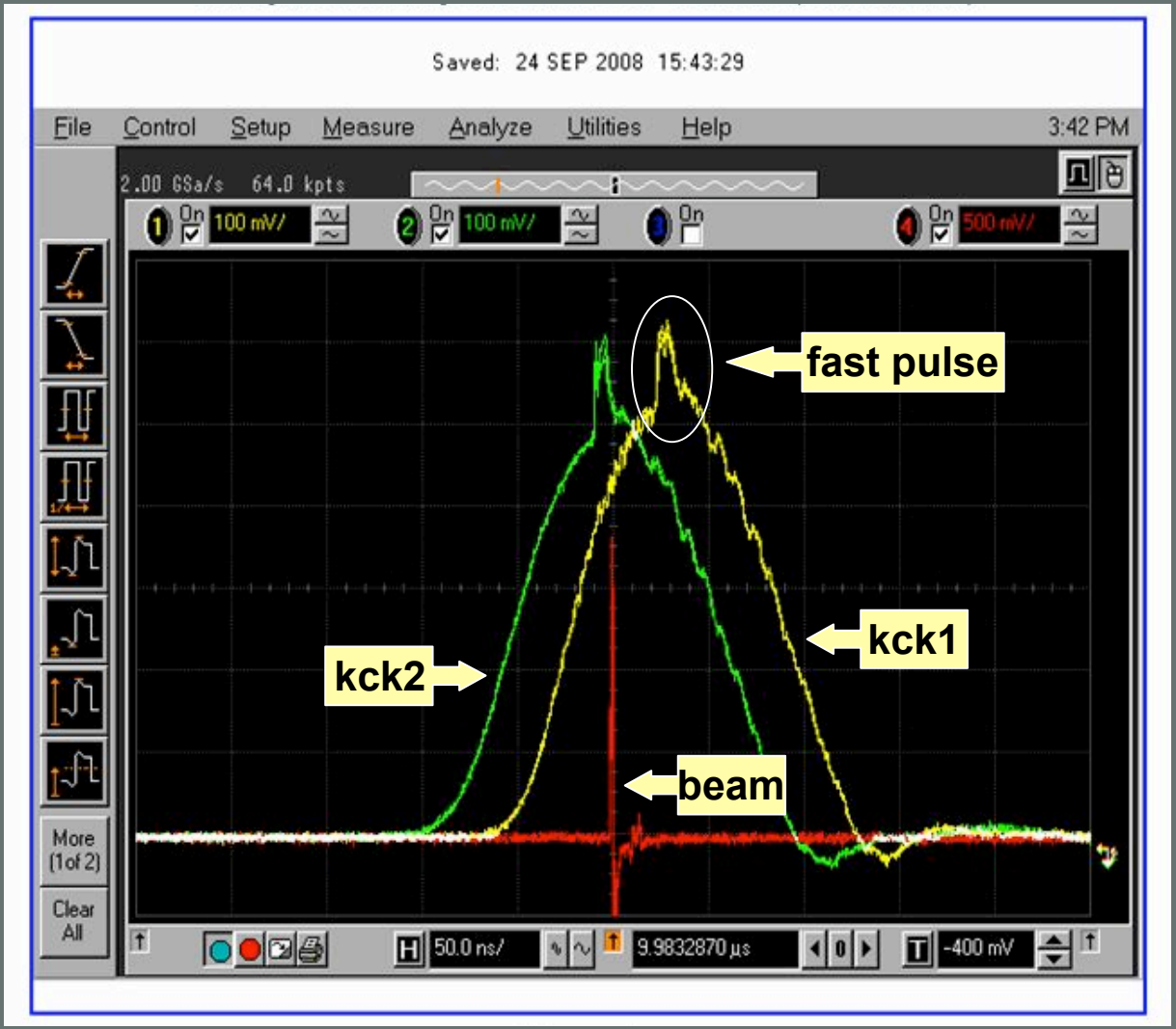
It is possible to have eight 24kV pulsers at the cost of the four 45 kV FIDs. Enough for both the rings.

The 24kV FID used for lab HV tests

Present situation - hybrid configuration



Injection with fast kickers at DAFNE hybrid configuration

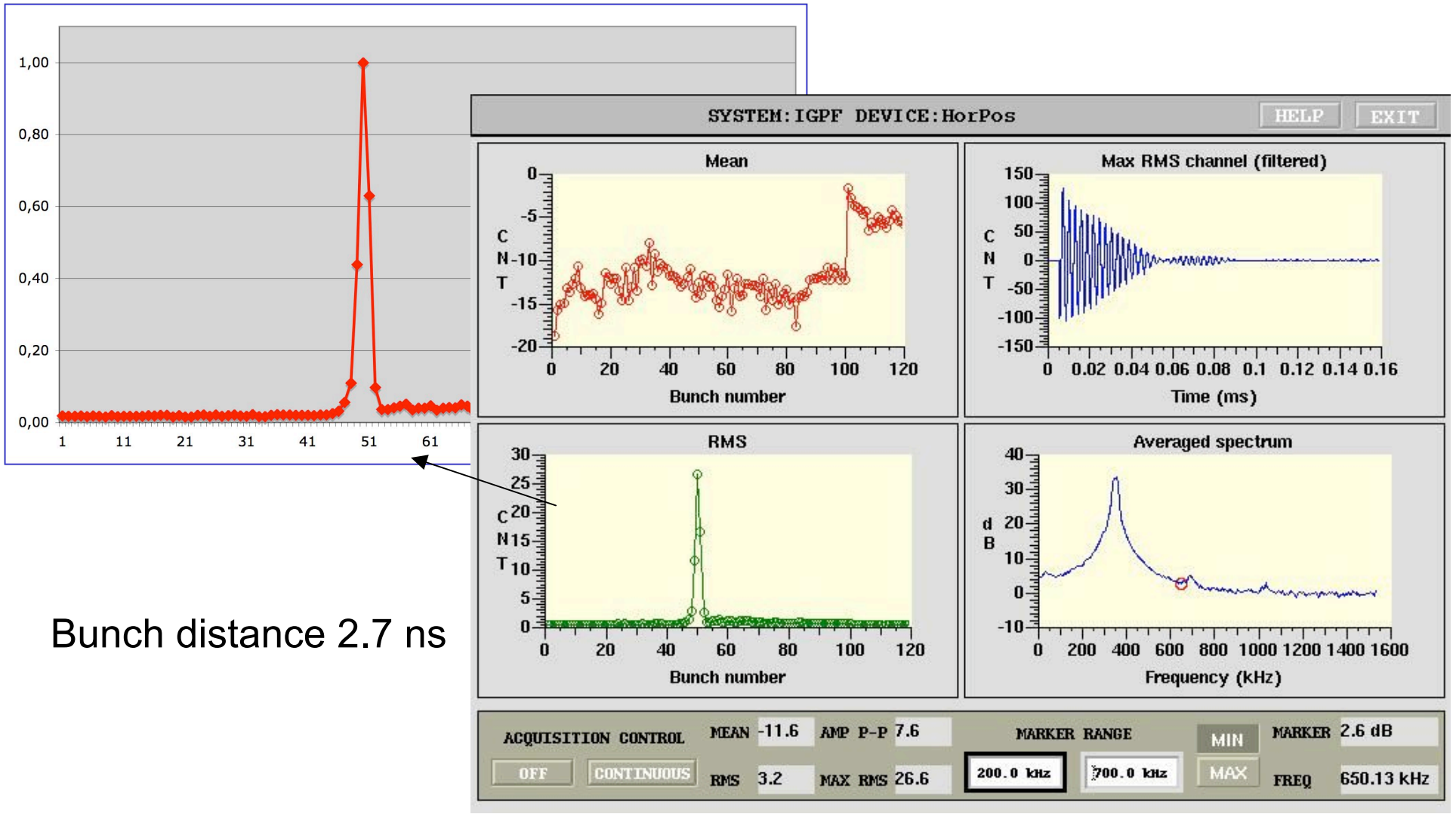


Long and the fast pulses observed in sum at the scope.
Taken from 2 striplines of the e+ ring kickers.
Different attenuations for signals from the 2 striplines.

F. Marcellini

e^+ beam oscillation with fast kick at DAΦNE

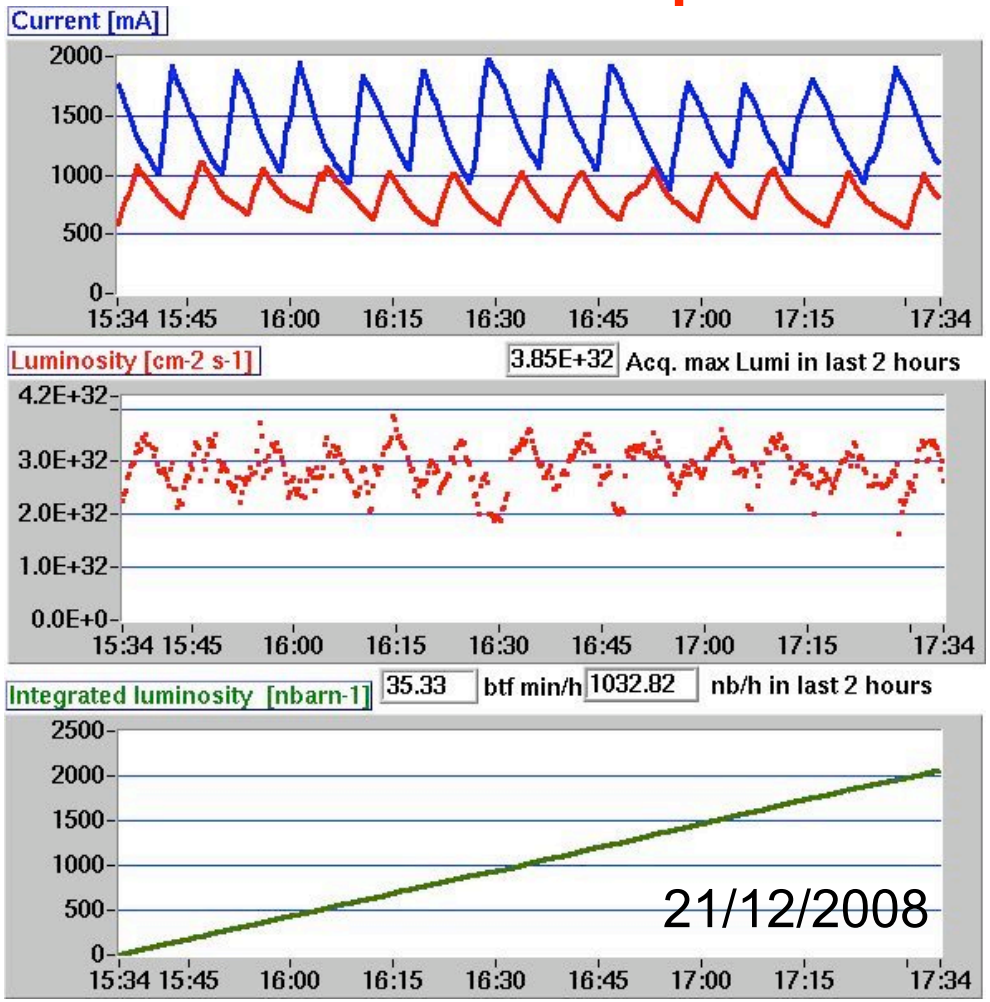
Measured by diagnostics of the horizontal digital feedback system.



Bunch distance 2.7 ns

100, of 120, stored bunches with kicker pulse centered on bunch 50

Fast pulsers reliability



L_{peak} ~ 4.0e32 $cm^{-2}s^{-1}$

Integrated luminosity 1pb^{-1}/h

Record integrated luminosity

Quasi-topping-up mode

6 e^- injections/hour

Hybrid kickers (2 fast pulsers) are operating on e^- ring since 10 days

2 e^- injections/hour

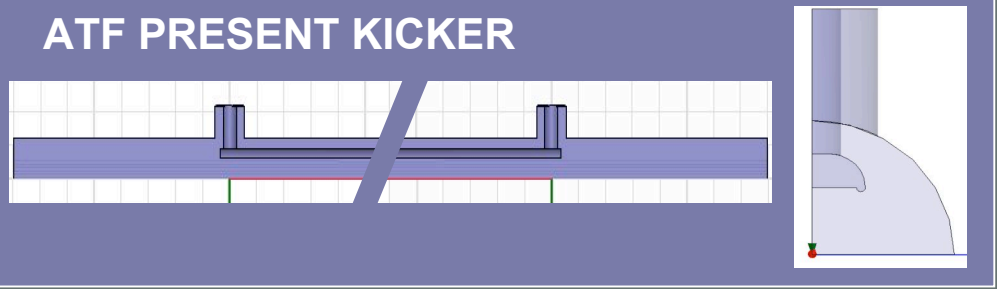
~1000 shots/inj

Total ~ $5 \cdot 10^4$ shots/day

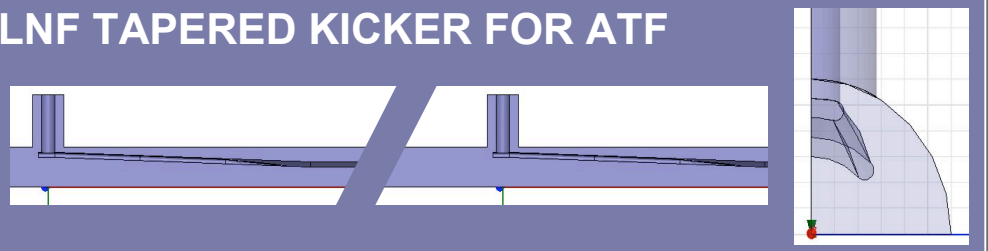
Timing has been setup within 1ns and remains stable

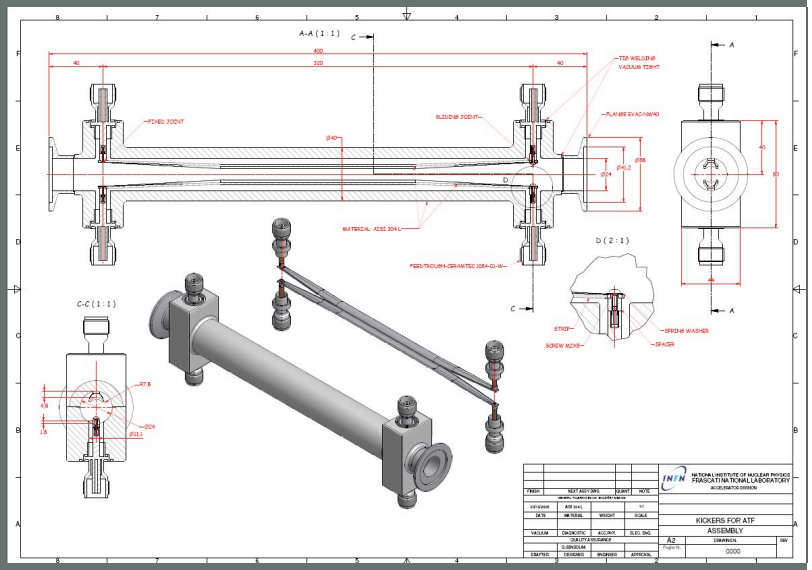
A KICKER with ILC specifications for ATF

ATF PRESENT KICKER



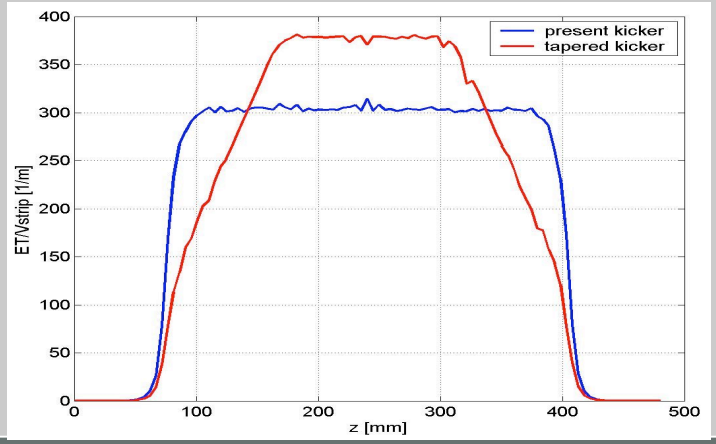
LNF TAPERED KICKER FOR ATF





Both the structures have been simulated with HFSS

Already Ordered



Deflecting field along the longitudinal structure axis

Blue: straight section stripline
Red: tapered stripline

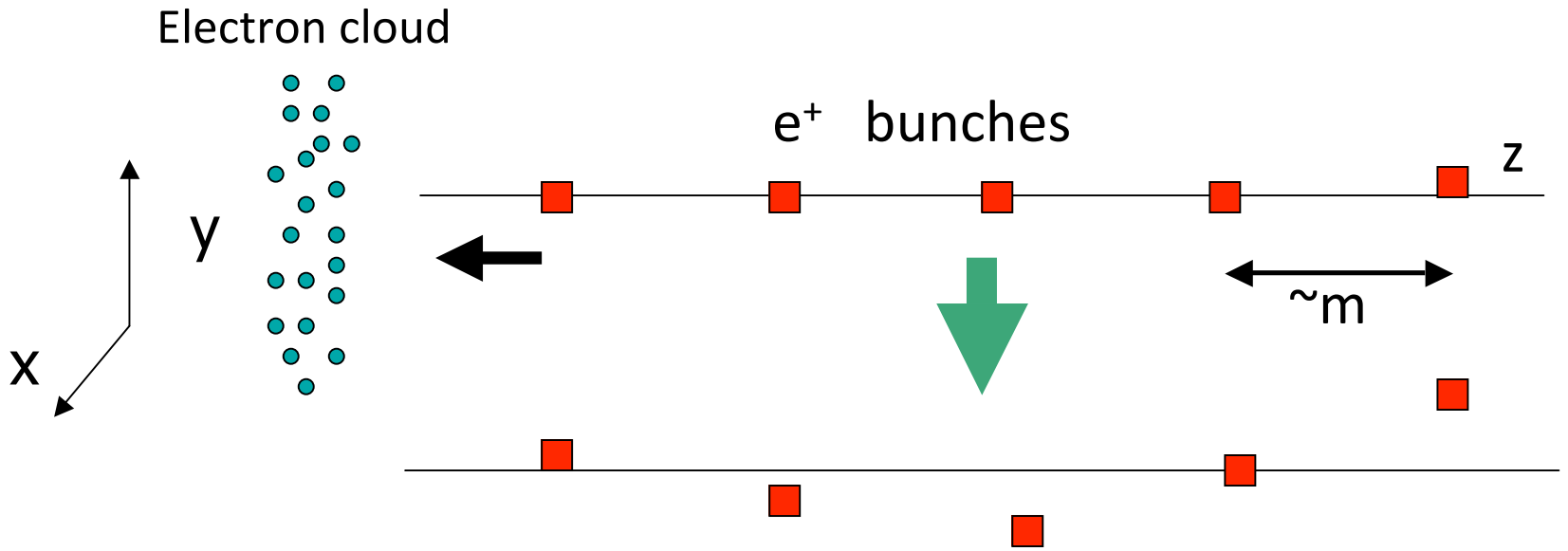
D. Alesini

Electron-cloud Studies at DAΦNE

- Positron current limited at 800 mA by the horizontal instability, stronger than in May
- Measurements versus different optics parameters
- Comparison versus e-cloud simulations
- Simulations are consistent with observations
- A pragmatic solution: **add a second e^+ Transverse Horizontal Feedback**
- **A positron current of 1.1 A has been stored**

E-cloud tracking simulation

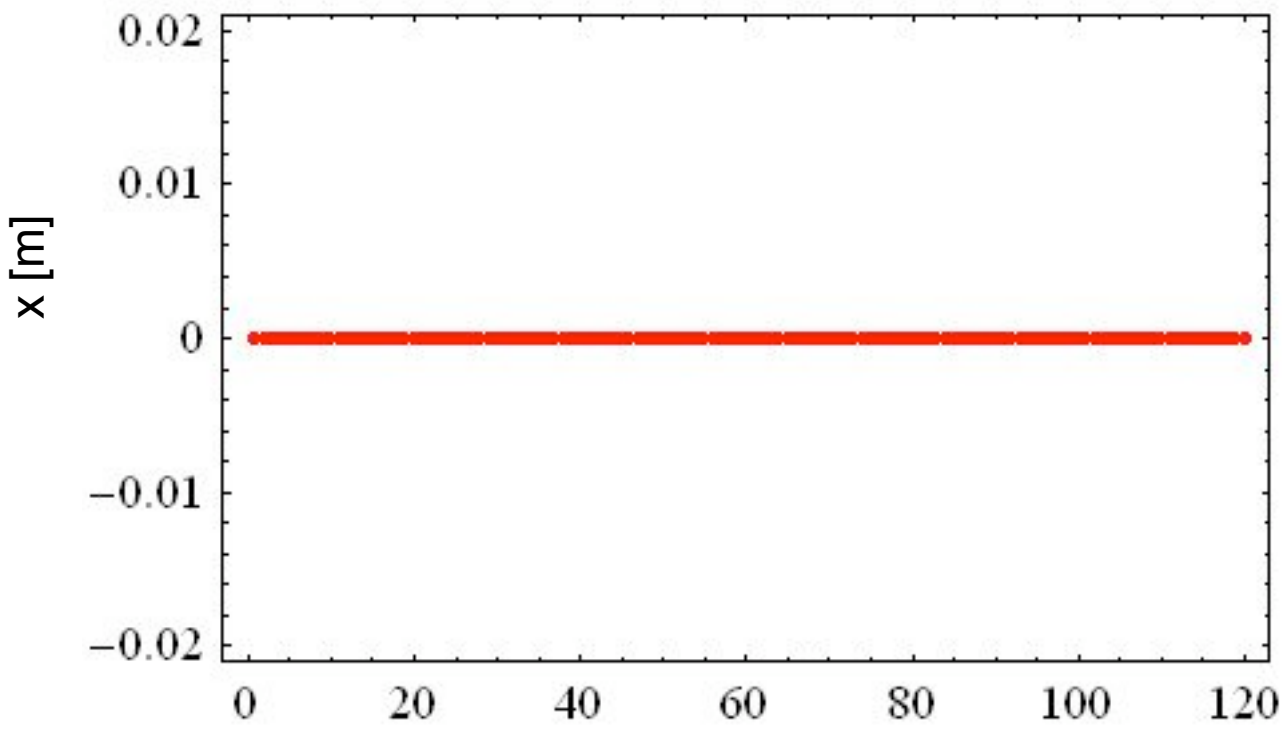
by T.Demma, K.Ohmi



- Solve both equations of beam and electrons simultaneously, giving the transverse amplitude of each bunch as a function of time.

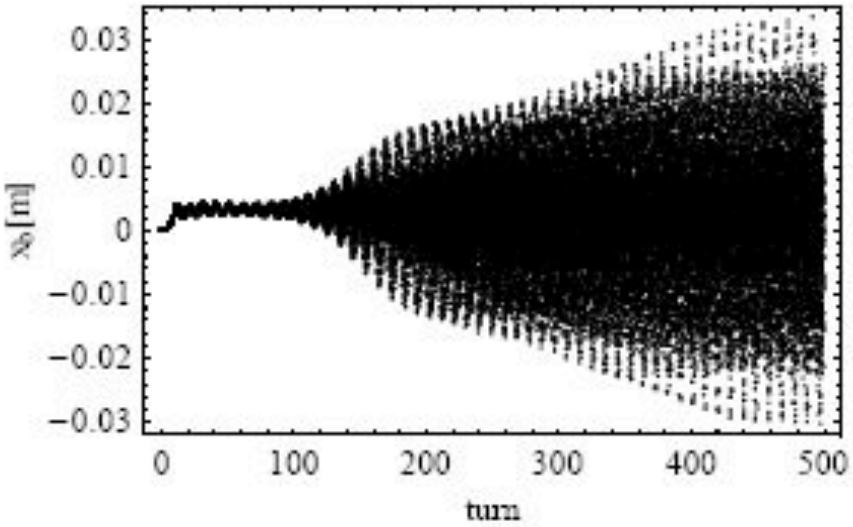
- Fourier transformation of the amplitudes gives a spectrum of the unstable mode, identified by peaks of the betatron sidebands.

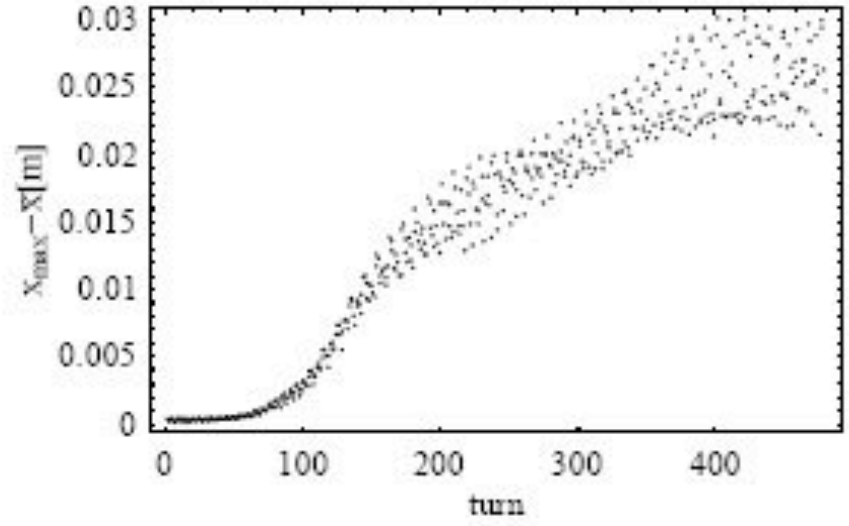
Bunch train evolution



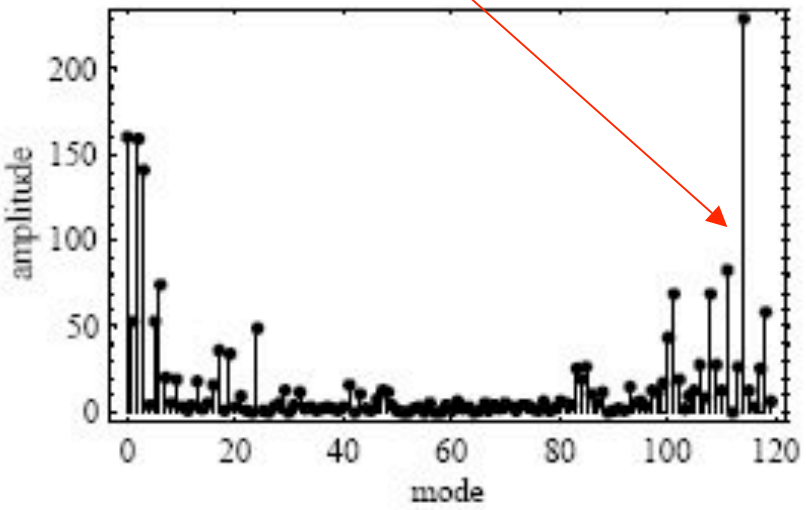
1.2 A in 120 equispaced bunches

Mode spectrum and growth rate





-1 mode (120-5-1=154)

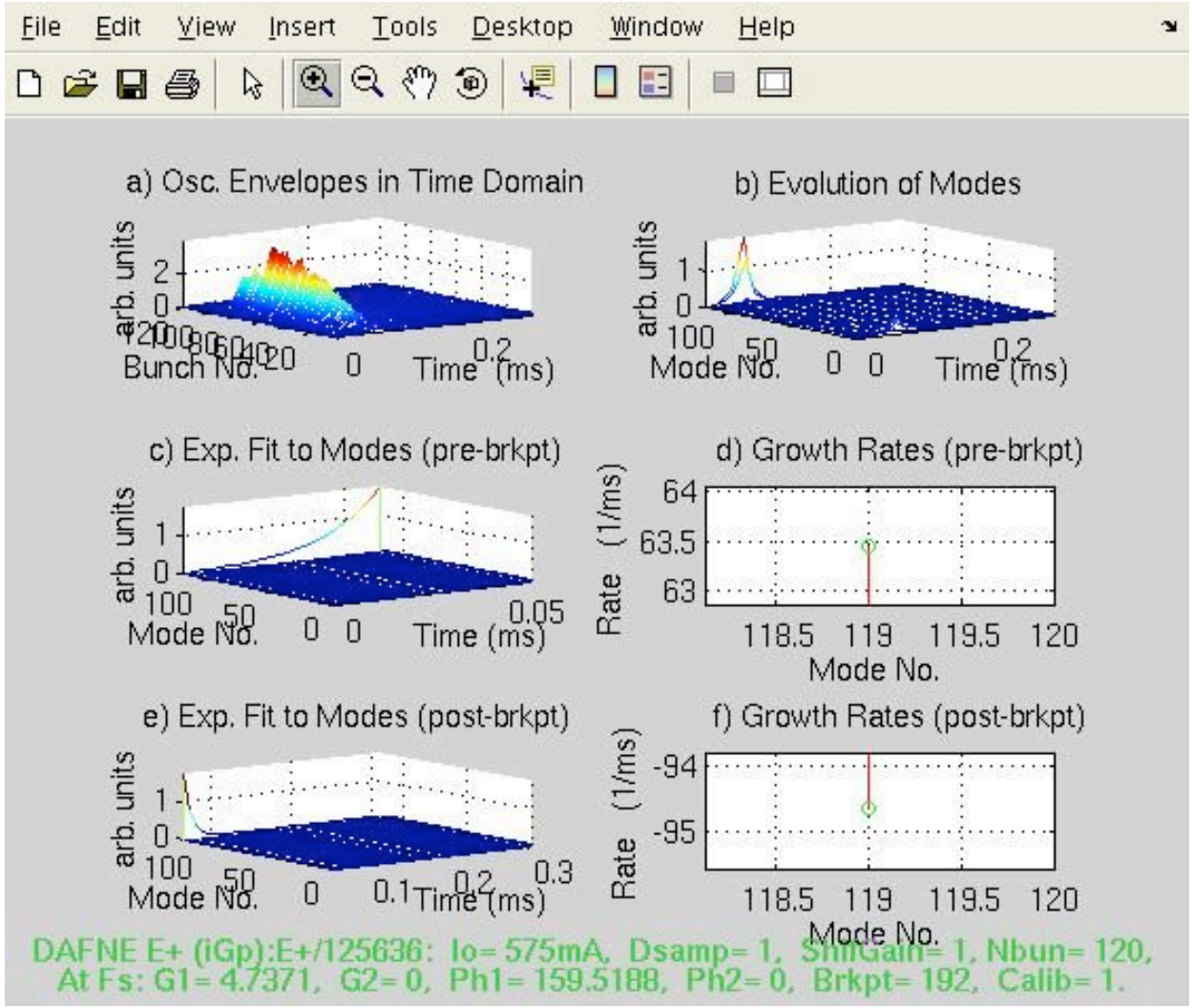


120 equispaced bunches

Beam current 1.2 A

Growth time ~ 100 turn

Horizontal e^+ grow-damp analysis, I=575mA, 105/120 bunches [October 14, 2008]



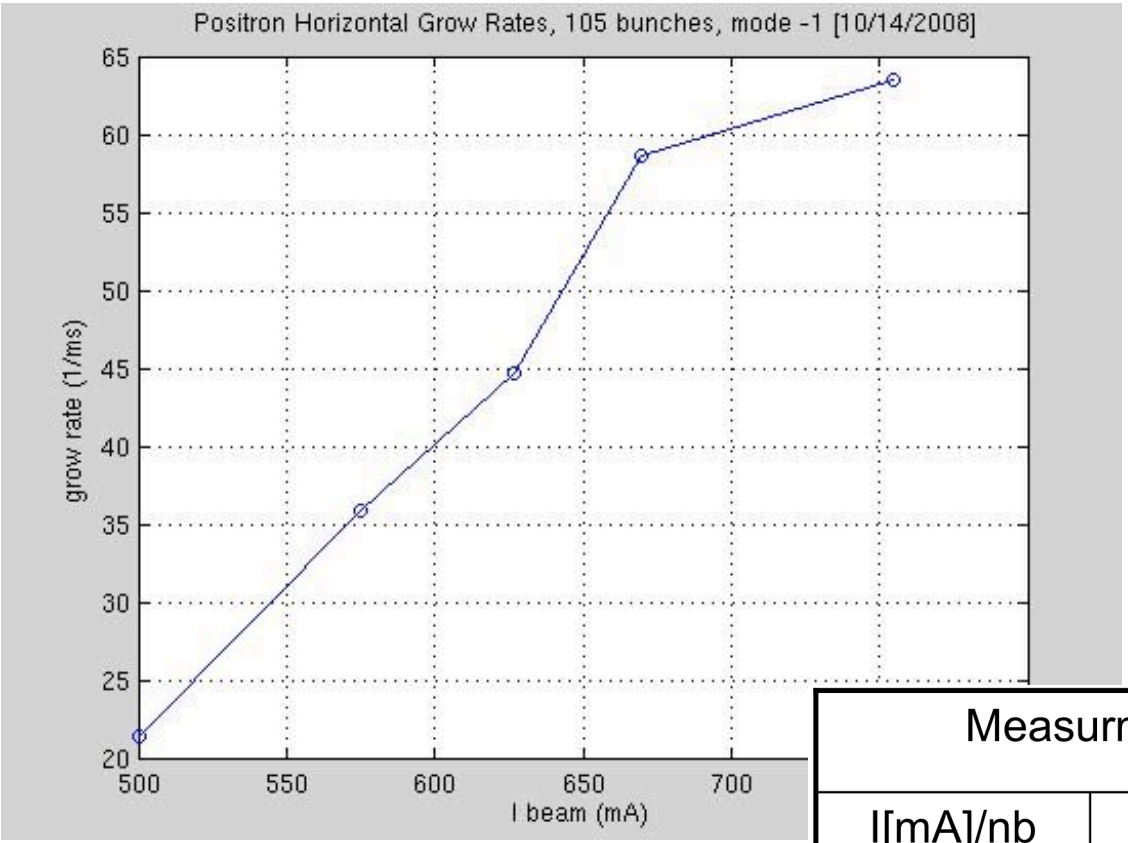
Unstable mode m=119 i.e. m=-1

- instability Grow rate >63 ms^{-1}

- feedback damping rate ~95 ms^{-1}

A. Drago

Multibunch instability caused by electron cloud at DAFNE
Simulations consistent with main observations.



e^+ beam horizontal grow rates
105 bunches

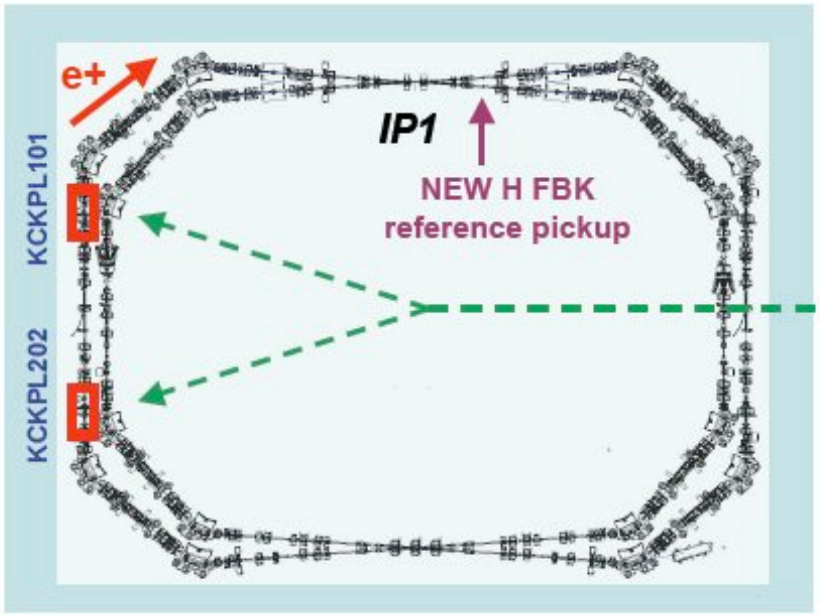
Grow rates are very fast and are linear versus beam current

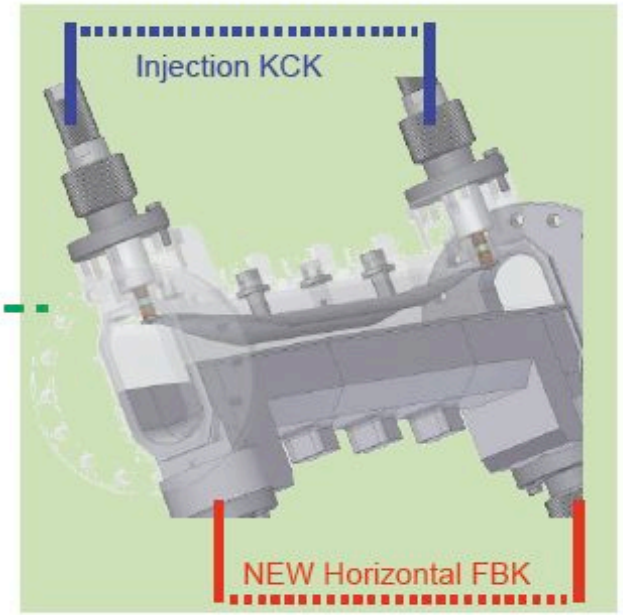
the e+ current was limited at 800mA

Measurment		Simulation	
I[mA]/nb	τ/T_0	I[mA]/nb	τ/T_0
1000/105	73	1200/120	100
750/105	56	900/120	95
500/105	100	600/120	130

A Pragmatic Solution: add a second e+ Transverse Horizontal Feedback

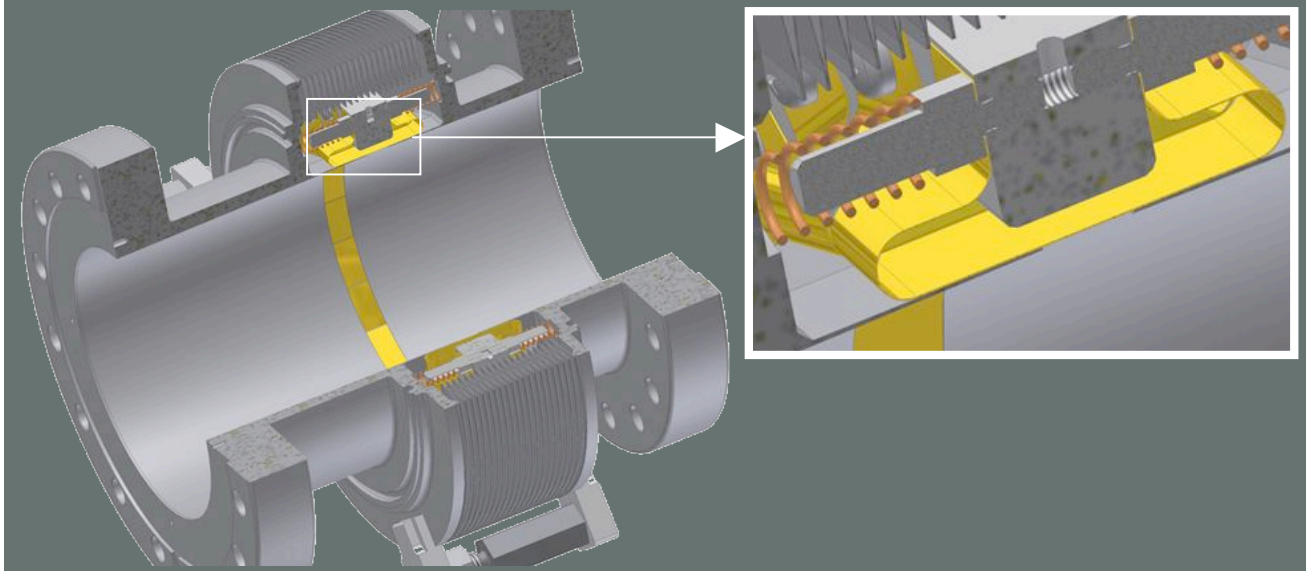
- The damping times of the two feedbacks add up linearly
- Damping time measured:
- ~100 ms-1 (1 FBKs) ➔ fb damps in 30 revolution periods (~10 us)
- ~200 ms-1 (2 FBKs) ➔ fb damps in 15 revolution periods (~ 5 us)
- The power of the H FBK has been doubled





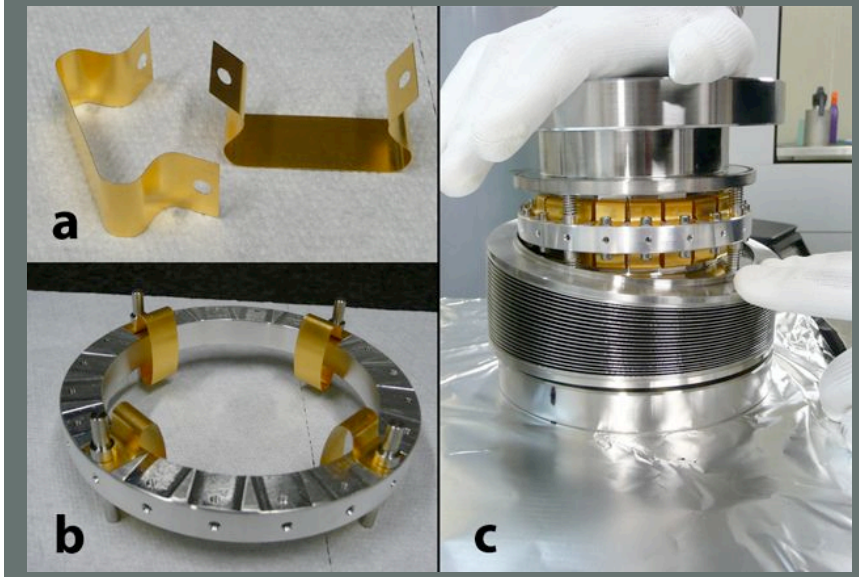
A positron current of 1.1 A has been stored

DRAWING OF THE NEW LOW IMPEDANCE DAFNE BELLOWS



The shield is composed of:

- 2 cylindrical pipes, welded at the bellows ends, give continuity to the beam pipes except for the gap between them.
- 20 Ω shaped, gold-coated, Be-Cu strips, shielding this gap.
- A floating thick aluminium ring where the 20 strips are bolted.



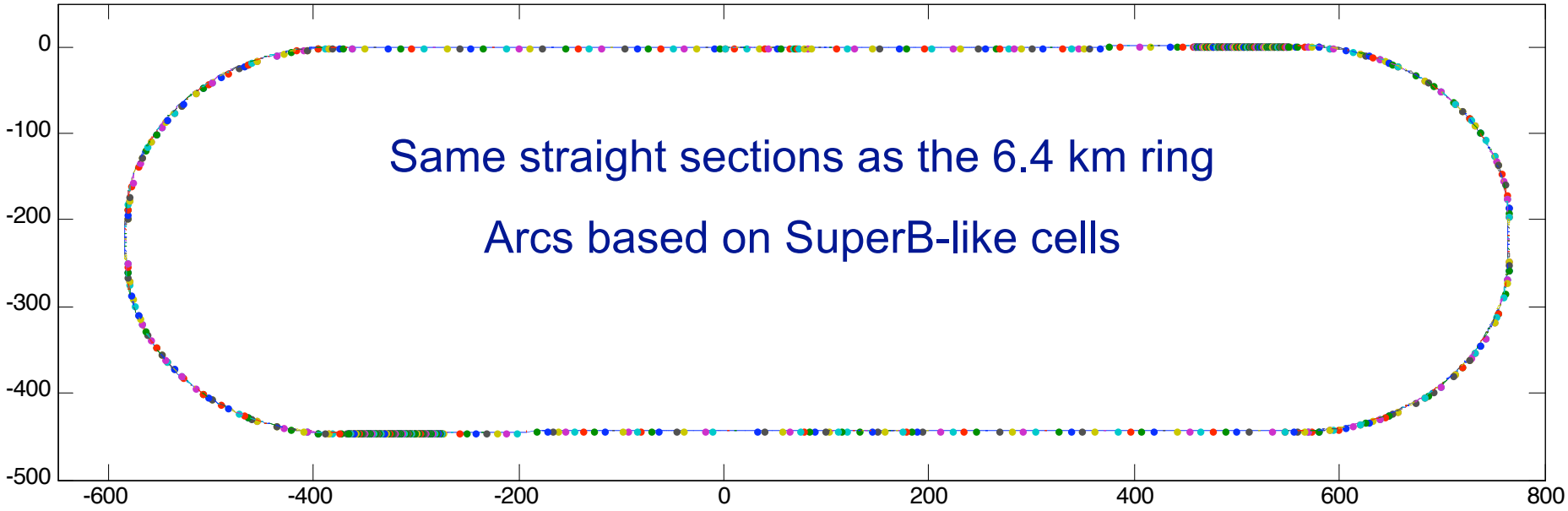
gold coated strip (a),
supporting Al ring (b),
bellows assembly (c).

Will be adopted for the ILC damping ring

F. Marcellini

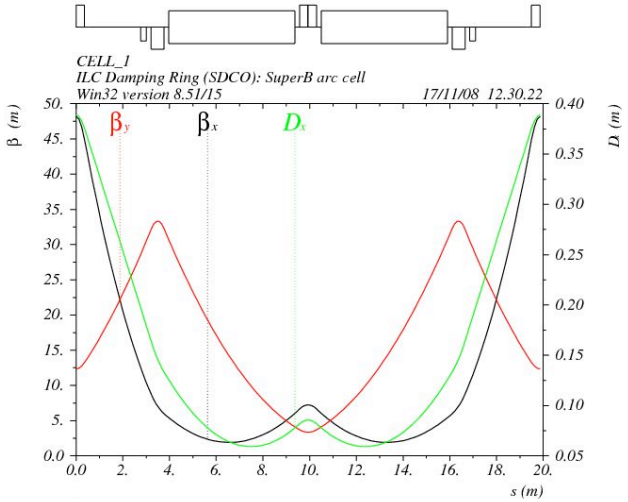
New 3Km layout

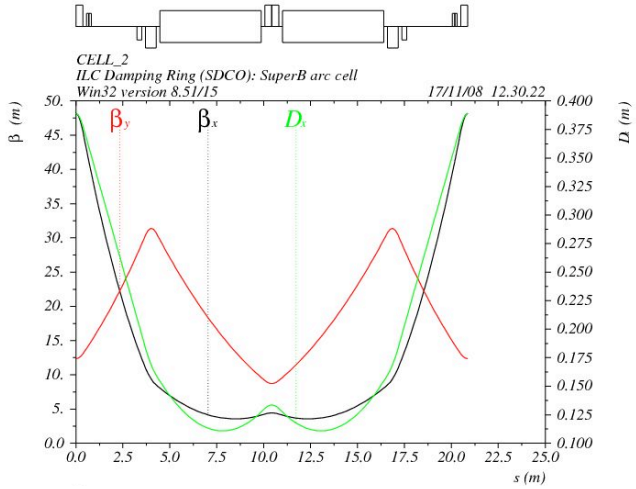
ILC Damping Ring



Same straight sections as the 6.4 km ring

Arcs based on SuperB-like cells



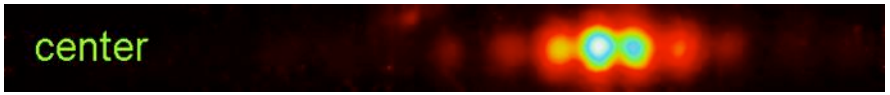


SuperB-like cells

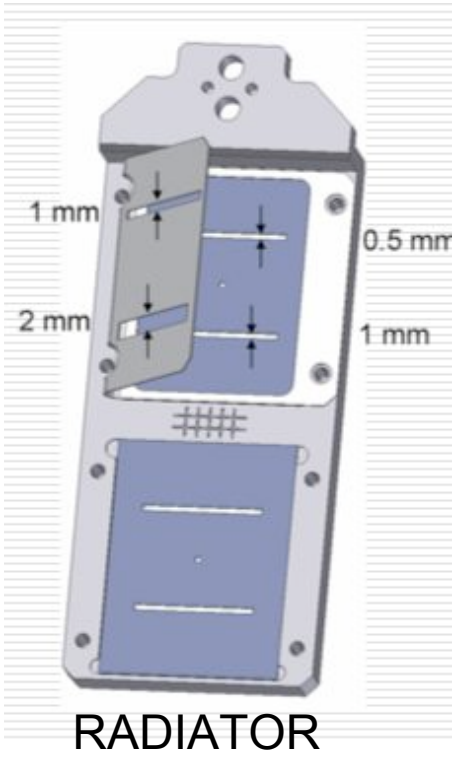
M. Biagini

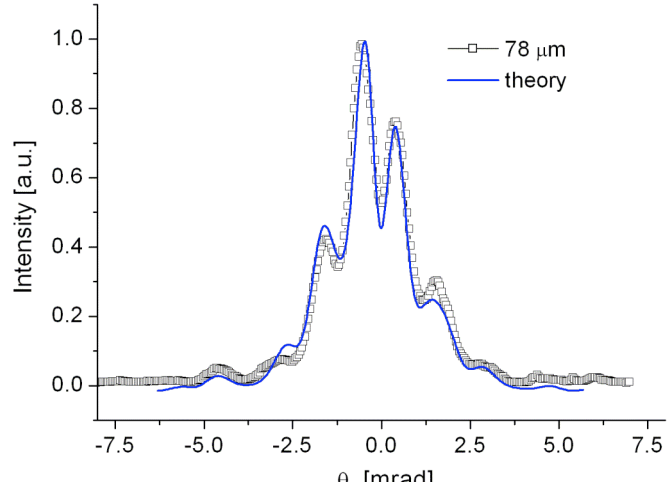
ODR Experiment at FLASH

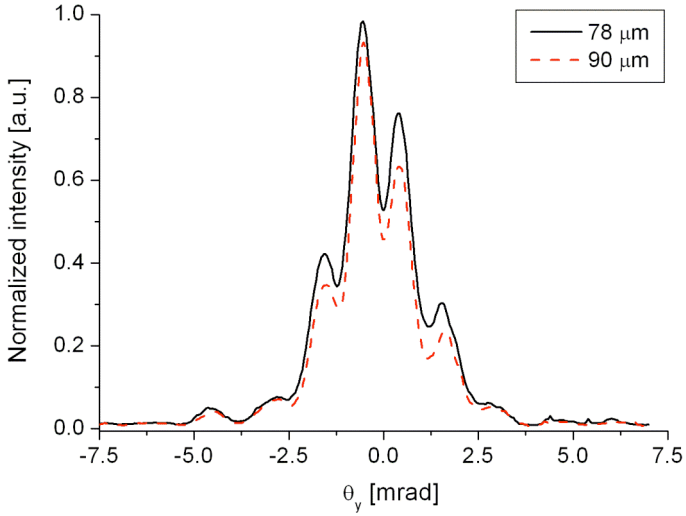
Optical Diffraction Radiation Interferometry ODRI



Non intercepting diagnostics







LNF and INFN-Roma2

2009 Plans

- Fast Kickers at DAΦNE: demonstration of long time operation
- Fast Kicker for ATF2: installation commissioning and tests at KEK
- Test on multibunch trasverse feedback at DAΦNE to reduce possible effects on the vertical emittance
- Simulations and measurements of e-cloud instability at DAΦNE
- Tests of e-cloud mitigation techniques at DAΦNE:
  - Clearing electrodes in the dipoles
  - NEG coating in the straight section vacuum chambers
- DR 3 km lattice for Minimum Machine: lattice and dynamic aperture optimization
- ODR diagnostics: improved system design for installation at FLASH end of 2009, further measurements analysis and modelling