



WP2 : Beam Delivery System

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WP2 : Beam Delivery System

- ❑ Beam delivery System Lattice Design
- ❑ Crab Cavity RF System Design **Amos Dexter**
- ❑ Fast Beam Based Feedback
- ❑ Spoiler Wake Field and Mechanical Design **Adriana Bungau**
- ❑ Super Conducting Final Doublet technology R & D

Beam Delivery System Lattice Design

ILC

- Effort on evaluation and optimisation of RDR lattice
- Small crossing angle designs
- Performance and tuning of 14 mrad IR region/extraction

CLIC

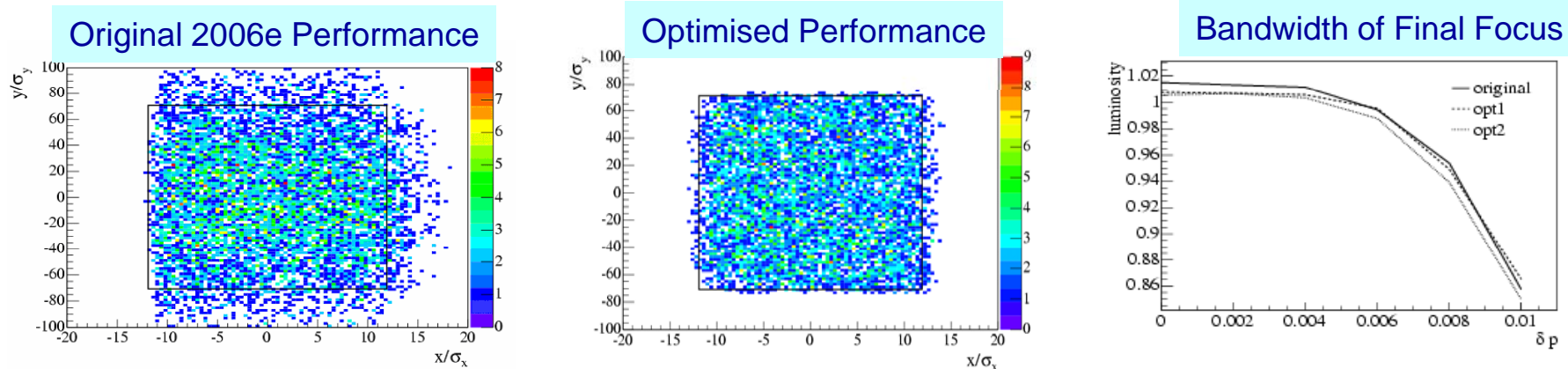
- Improvements and updates to CLIC BDS design
- BDS alignment and CSR in the BDS

ATF/ATF2

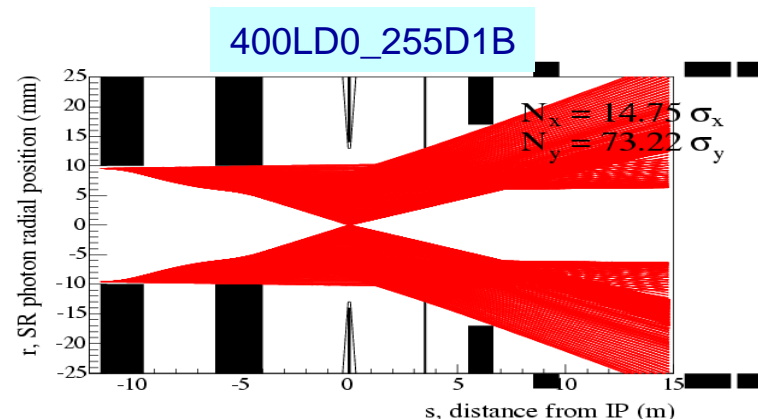
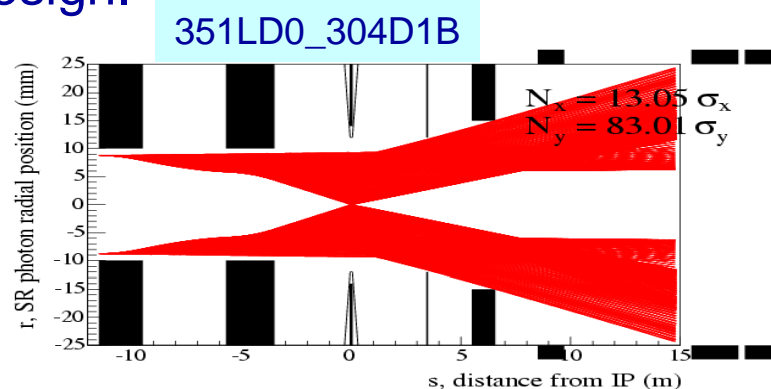
- Emittance growth investigation, emittance measurements and tuning procedures

Collimation lattice optimisation (STFC)

ILC RDR lattice collimation optimisation → Significant halo tracking improvement

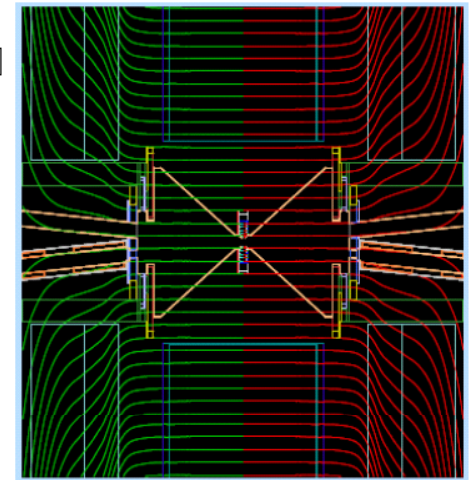
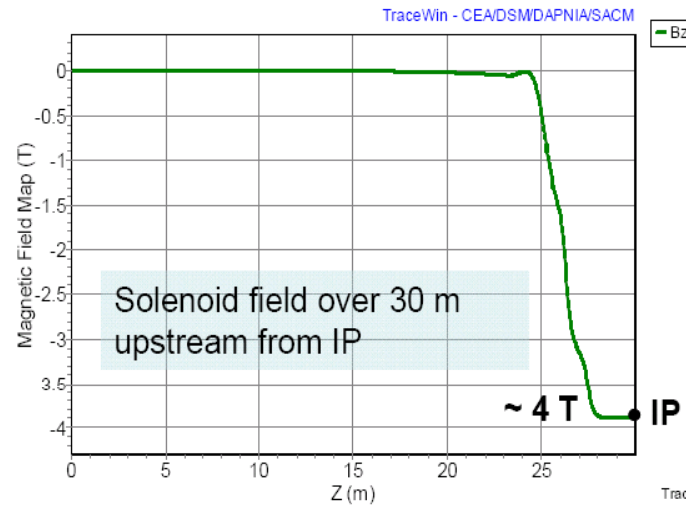


Collimation depths : Collimation depths were evaluated for the emerging final doublet designs for the push-pull detector scheme, which involves a different L^* for each detector. It was found that the collimation depth had only a weak dependence on L^* , due to wider extraction apertures in the larger L^* lattice design.

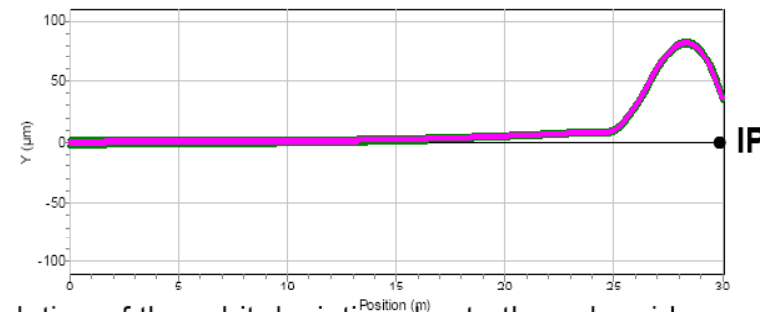


14 mrad tuning and extraction studies

- In view of understanding the tuning procedure of the 14 mrad final focus system, a program of calculating the beam properties (trajectory and beam matrix) through the complex set of final doublet, corrector, solenoid, anti-solenoid, and detector-integrated-dipole magnets has been launched. (CEA)



Vertical trajectory for the starting coordinates :
 $x=0.21$ m , $x'=7$ mrad,



CEA-TRACEWIN calculation of the orbit deviation due to the solenoid

- Beam losses in the extraction line including solenoid, anti-DID, anti-solenoid for realistic beam and machine errors, its effects on the downstream polarimetry measurements (UMAN,STFC)

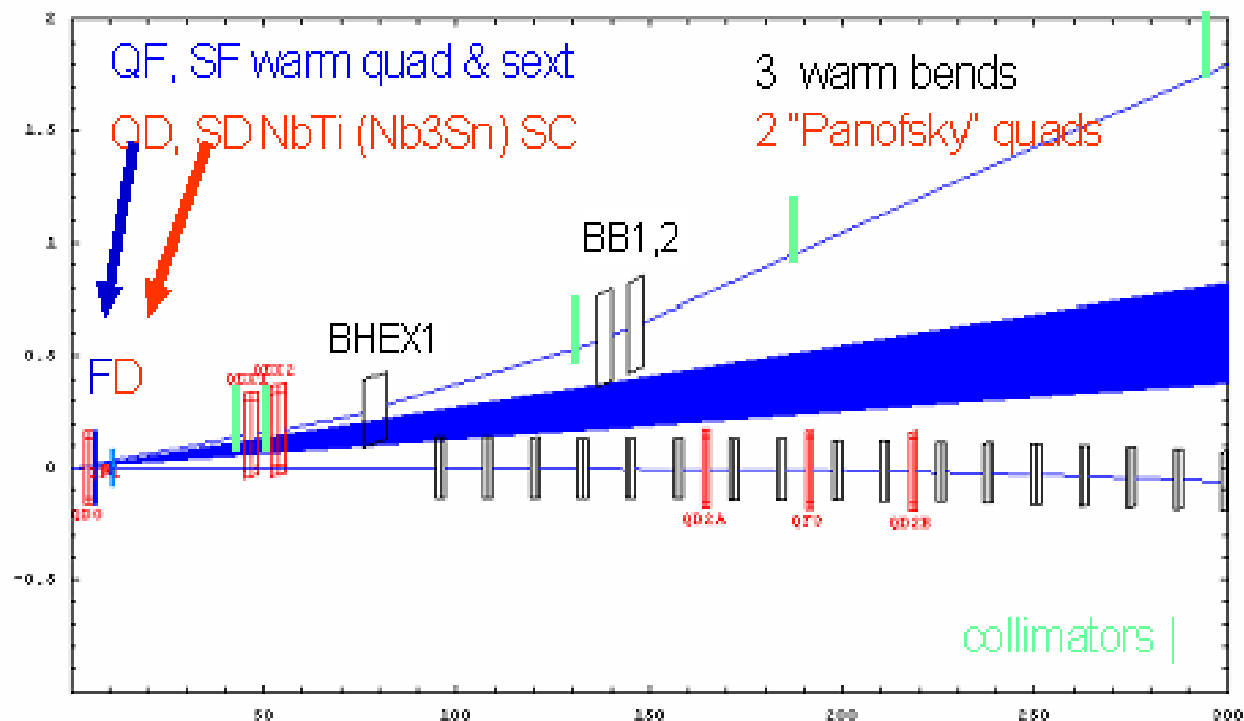
Small crossing angle IR and extraction designs

2 mrad Design

(LAL, STFC, UMAN)

Redesigned with simpler concept aiming to be as short & economical as possible

- Assumption : other ways than the present spent-beam spectrometry & polarimetry are possible to complement pre-IP measurements (LCWS07, PAC07)

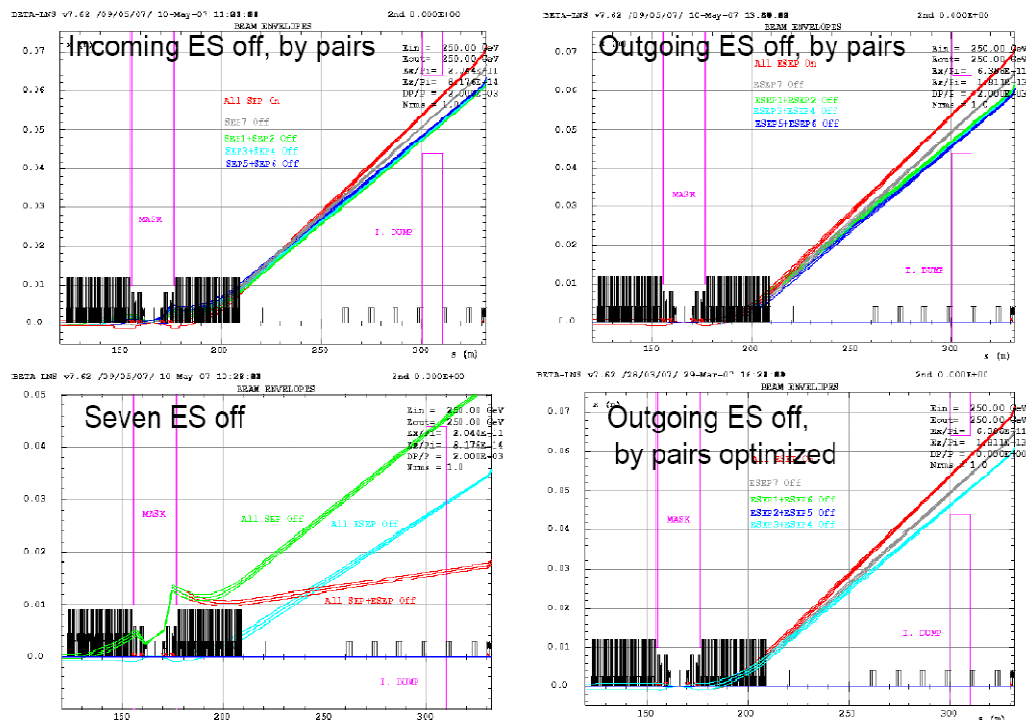


Small crossing angle IR and extraction designs

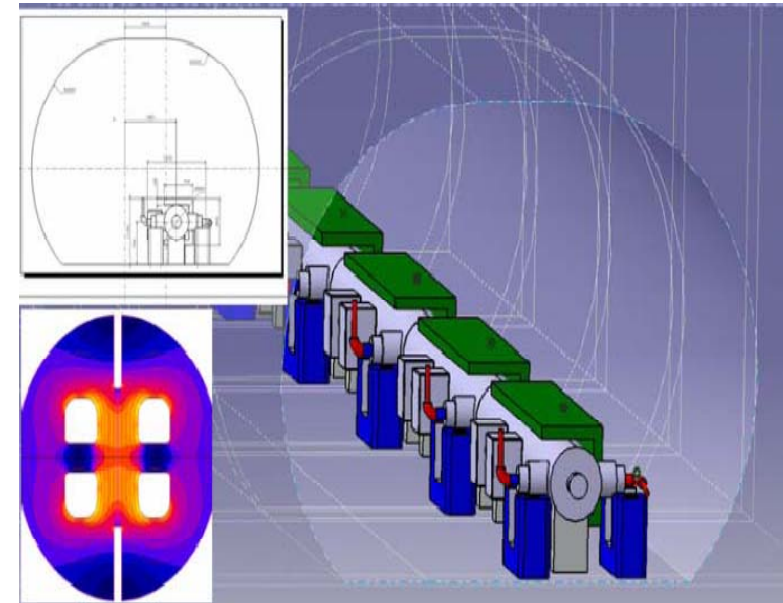
Modified Head-on scheme (CEA,CERN,STFC,SLAC,UMAN)

- Attempt to improve the technical design of key elements; the final doublet, the electrostatic separator and the intermediate collimator.
- The impact of separator failures on the beam transport has been studied in details, showing that the beam stay clear through the interaction region is robust. (LCWS07,PAC07)

Electrostatic Separator Failures

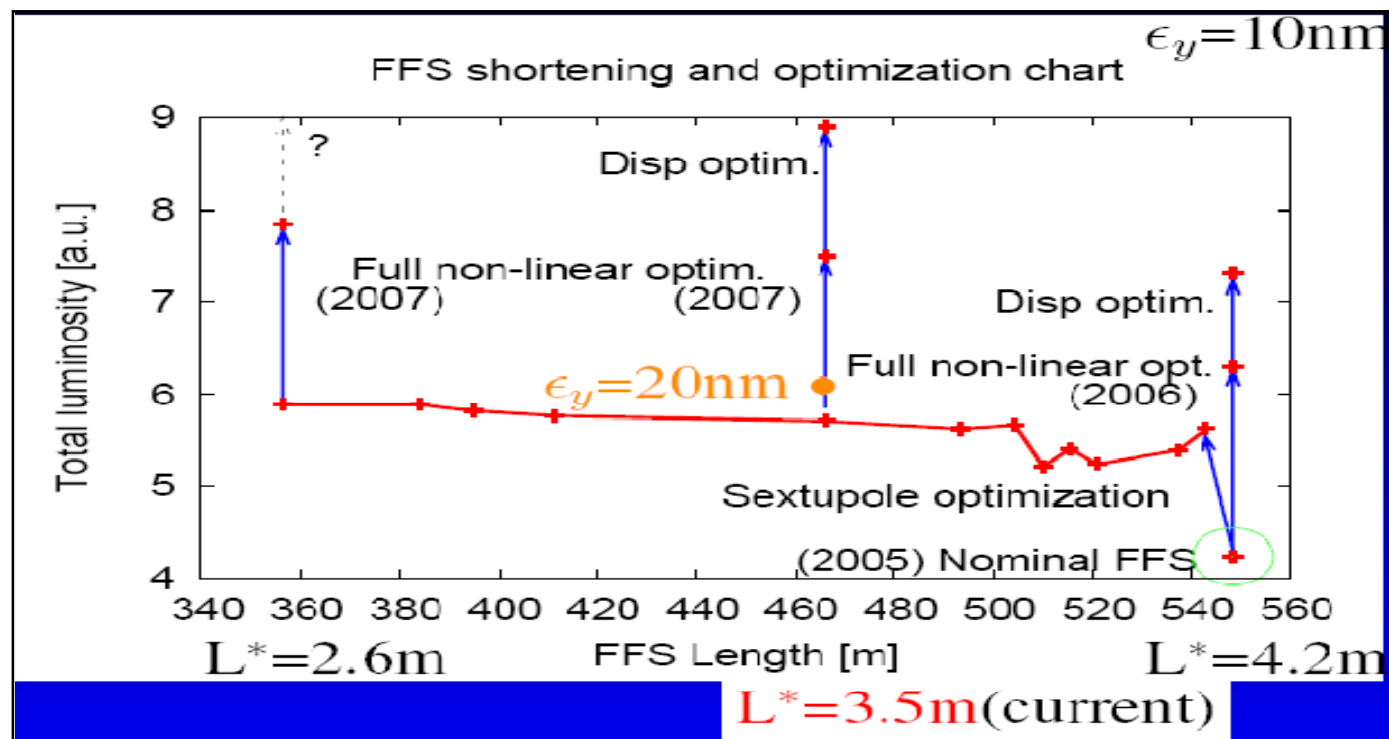


Layout of electrostatic separators with split electrodes in the enlarged tunnel.



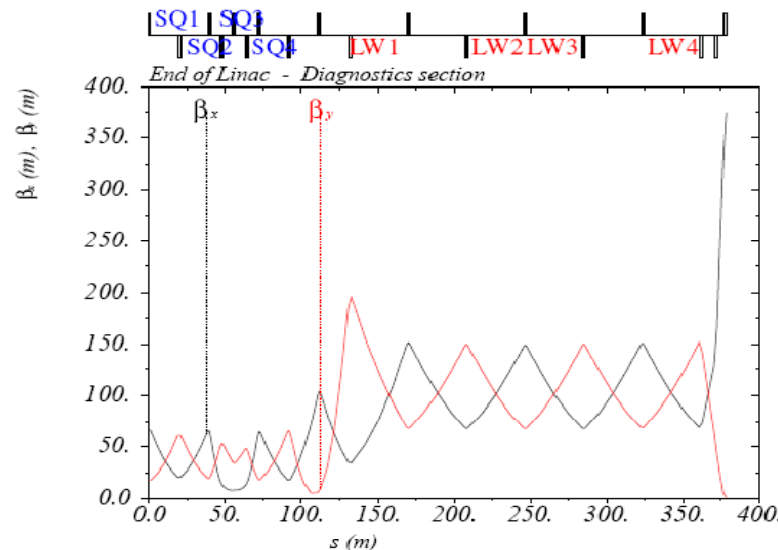
CLIC Beam Delivery System Lattice Design (CERN)

- L^* reduced from 4.3m to 3.5m : alleviates the chromatic aberrations and makes the total system shorter
- Optimization of the new and shorter FFS
- There are now two FFS systems with similar performance but different total lengths and different L^* .
- The current efforts are being devoted to the design and optimization of a low energy FFS.

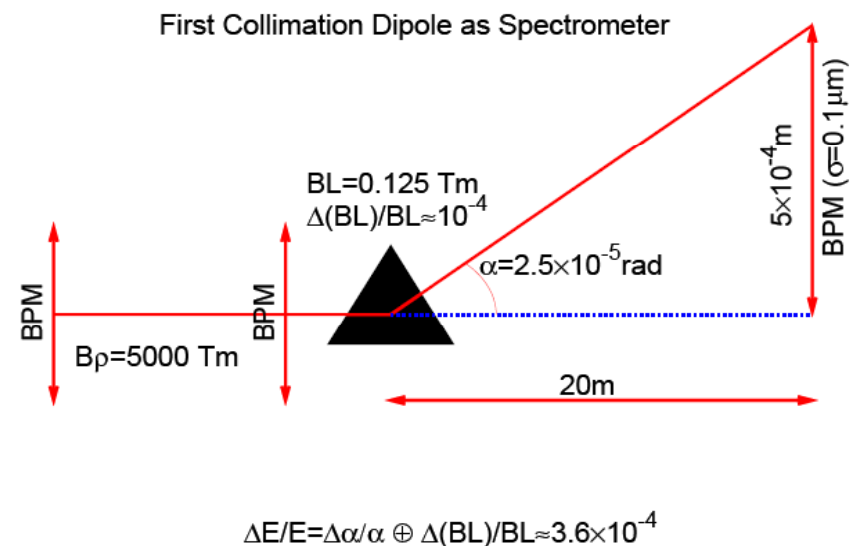


CLIC Beam Delivery System Lattice Design (CERN)

- A new diagnostics section has been added to the CLIC Beam Delivery System.
- Four laser wires are used for the measurement of the emittance and two pairs of BPMs before and after a precise bending magnet are used to measure the energy.
- Simulations have shown that the resolution of the emittance measurement should be below the 7%. The resolution of the energy measurement using the CLIC BDS BPMs should be below the 0.1%.



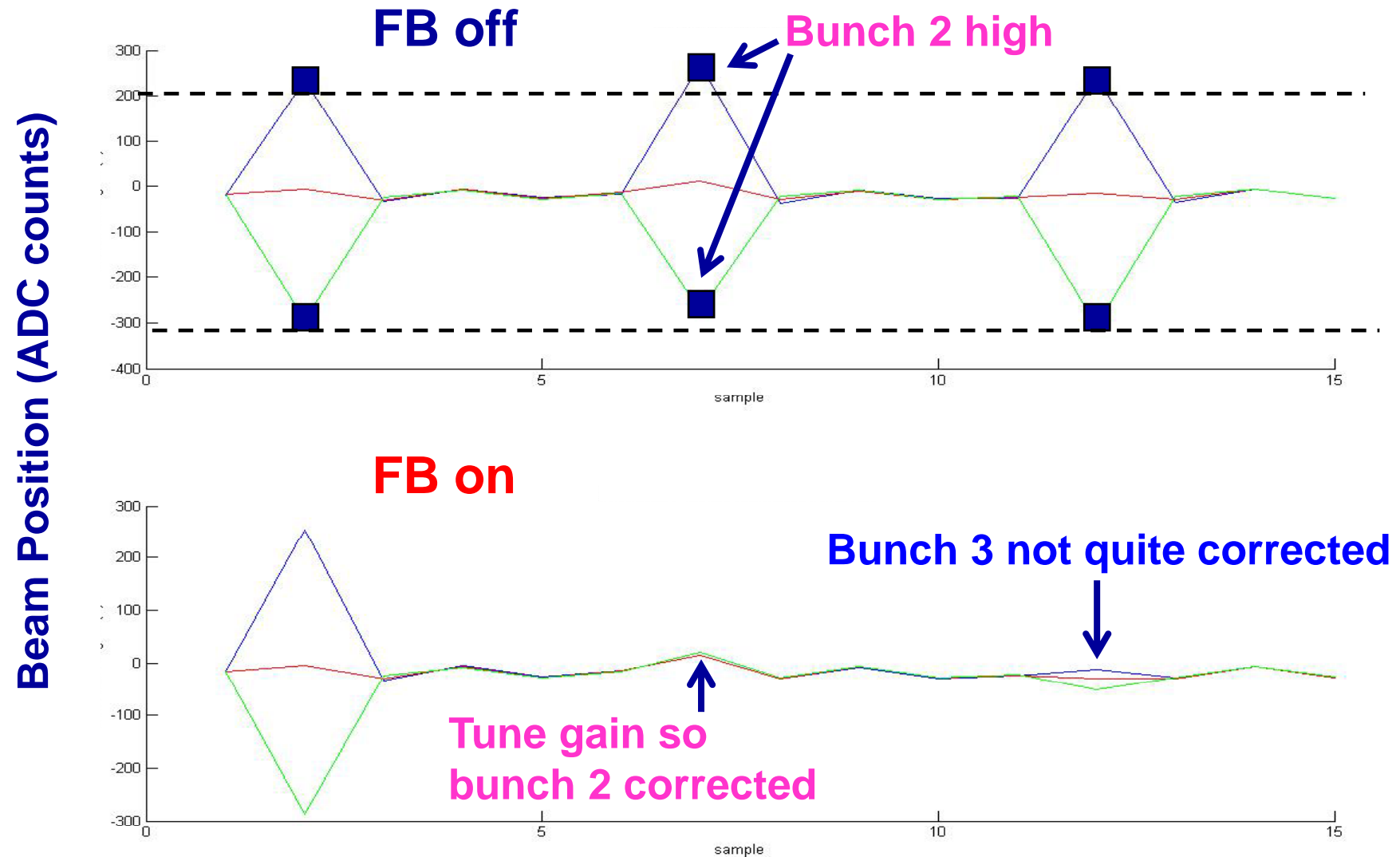
$\sigma_y = 1 \mu\text{m}$ @ Laser wires (for $\epsilon_y = 20 \text{ nm}$)



Fast Beam Based Feedback (Oxford, STFC)

- Basic functionality demonstrated for ILC:
 - closed-loop operation with latency c. 140ns
 - delay loop (preserves correction along train)
 - normalisation of position signal by beam Q
- Studying performance + optimising parameters:
 - main gain, delay loop settings, 'banana' effect,
 - performance limitations ... **plan NIM paper**
- Studying BPM resolution + improvements:
 - LO quality, zeroing of BPM electrical offset;
 - alternative BPM processor schemes

Feedback tests at ATF :Delay loop operation

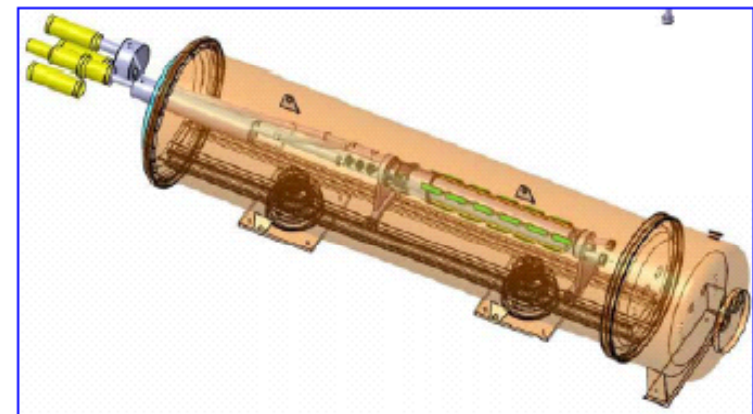
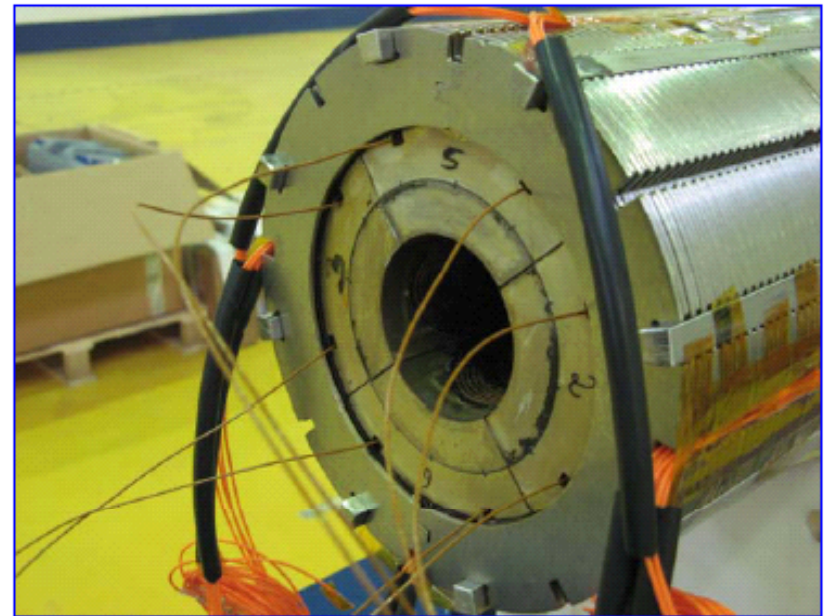


Nb₃Sn Quadrupole Program (CEA)

- Main goals : Get an experience in the *Nb₃Sn technology* keeping in mind the industrialization process
Build a 1-m-long model, 56-mm single aperture with no magnetic yoke
- Model design based on the design of LHC arc quadrupole magnets

Gradient	211 T/m
Current	11870 A
B _{peak}	8.3 T

- 2 dummy coils and 6 certified coils have been manufactured between August 2004 and February 2007
- 2 coils with short circuit have been successfully repaired in April 2007
- *The four best coils have been assembled and collared in November 2007*
- Warm field measurements of the magnet are foreseen for the end of January 2008
- *Cold tests of the magnet are foreseen in the first half of 2008.*



BDS WP Milestones (Annex 1)

Milestone Name	Planned (months)	Achieved (months)
Detailed scope and planning report to First Workshop	6	6
Demonstration of high-field super conducting quadrupole in strong solenoid complete	18	Delayed (expected to be completed in 2008)
Presentation of results and detailed implementation at second workshop	18	24
Presentation of phase 2 results to Third workshop; plans for GDI-TDR input and further R&D (phase 3 & beyond)	30	?
Optimised BDS lattice design with component specification available.	30	30
CRAB RF low-power systems test (including phase stability studies) available.	36	Delayed (expected to be completed in 2008)
Mechanical spoiler design complete	36	Delayed (possibly completed in 2008, subject to UK funding)
Demonstration of prototype intra-train feedback and scanning systems available.	36	36

Annex I BDS deliverables

4.3.2.4 Deliverables of this Work Package:

Deliverable number	Deliverables	Dissemination level
1	Fully documented optimised BDS lattice, including component (magnet) specifications.	PU ✓
2	Engineering design for ILC mechanical spoiler, including prototype evaluations of wakefield and beam-damage performance.	PU 2008
3	Prototype intra-train feedback stabilisation and scanning system.	PU ✓
4	Report on CRAB RF low-power prototype tests, including phase-stability system.	PU 2008
5	Report on demonstration of superconducting quadrupole in strong solenoid field.	PU 2008