Welcome to SOLEIL !

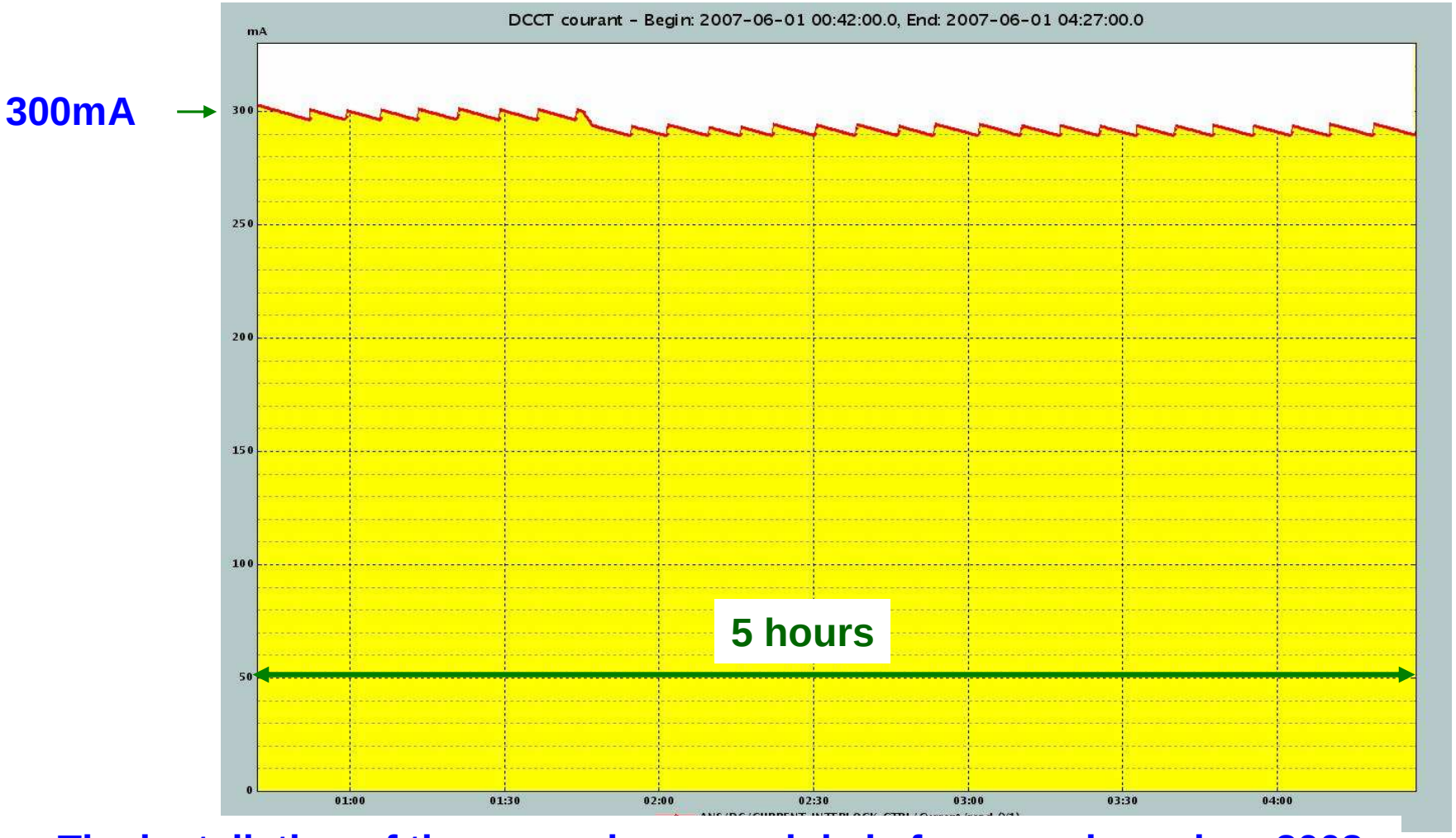
Jean-Marc FILHOL

STORAGE RING COMMISSIONING

Parameters	Design	Achieved as of Sept 2007
Energy (GeV)	2.75	2.74
RF frequency (MHz)	352.197	
Betatron Tunes	18.20 / 10.30	18.2009 / 10.2990
Natural Chromaticities	-53 / -23	-53 / -19
Momentum Compaction α_1 / α_2	4.5×10^{-4} / 4.6×10^{-3}	4.55×10^{-4} / 4.30×10^{-3}
Emittance H (nm.rad)	3.73	3.70 ± 0.2
Energy spread	1.016×10^{-3}	1.0×10^{-3}
Coupling, $\varepsilon_V/\varepsilon_H$	<1%	0.3% (without correction)
Current Multibunch mode (mA)	500	300
Average Pressure (mbar)	1×10^{-9}	3×10^{-9}
Beam Lifetime (h)	**16 h**	9h @ 300 mA / 22h @ 100 mA
Single bunch current (mA)	12	20
Beam position stability, µm (H)	20 (rms)	3 ptp
Beam position stability, µm (V)	0.8(rms)	2 ptp

Beam Current

The maximum beam current of 300mA is used routinely (for BL RP control)



The installation of the second cryomodule is foreseen in spring 2008.
This will enable to reach 500mA.

Beam lifetime

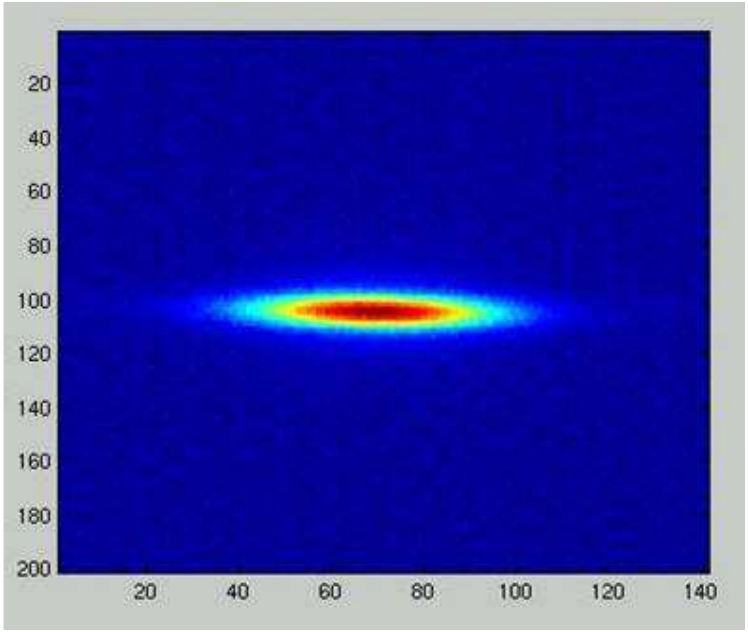
- **Maximum current: 300 mA in 312/416 buckets**
- **Total beam integrated dose: 330 A.h (Sep 2007)**
- **The Beam lifetime for 300 mA in 312 bunches is 9 hours*, limited by the vacuum (3.5×10^{-9} mbar).**
- **At 100 mA (1.2×10^{-9} mbar), the beam lifetime is about 22 hours*.**

**with a coupling of 0.3%.*

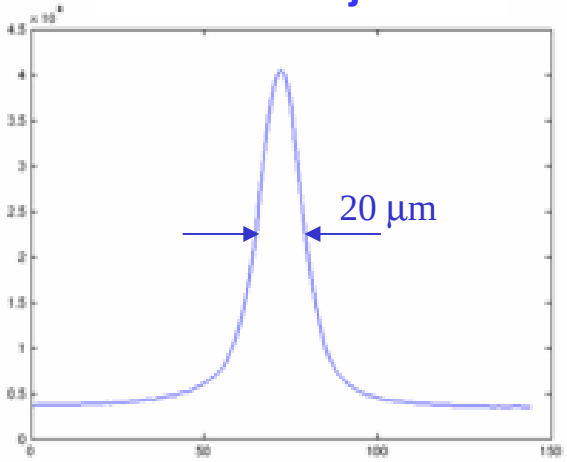
- **The injection efficiency is above 90%. We are still working on the objective to maintain this value for the different configurations of Insertion Devices.**

Beam Emittance

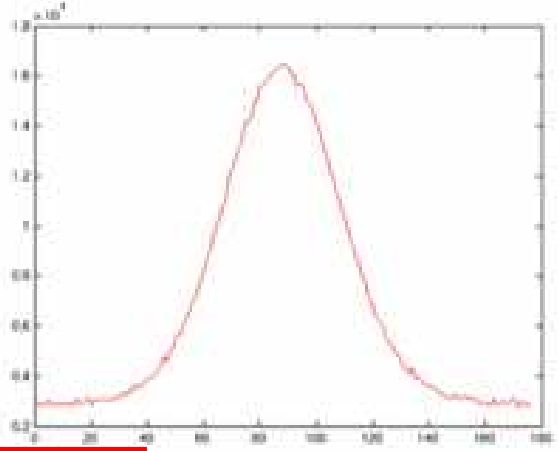
Pinhole Camera



Vertical Projection



Horizontal Projection



$\varepsilon_x \cong 3.7$ nm.rad

$\varepsilon^*_z < 5$ pm.rad ($\kappa < 0.13$ %)

$\sigma_z = 9$ µm (including 5 µm instrument resolution)

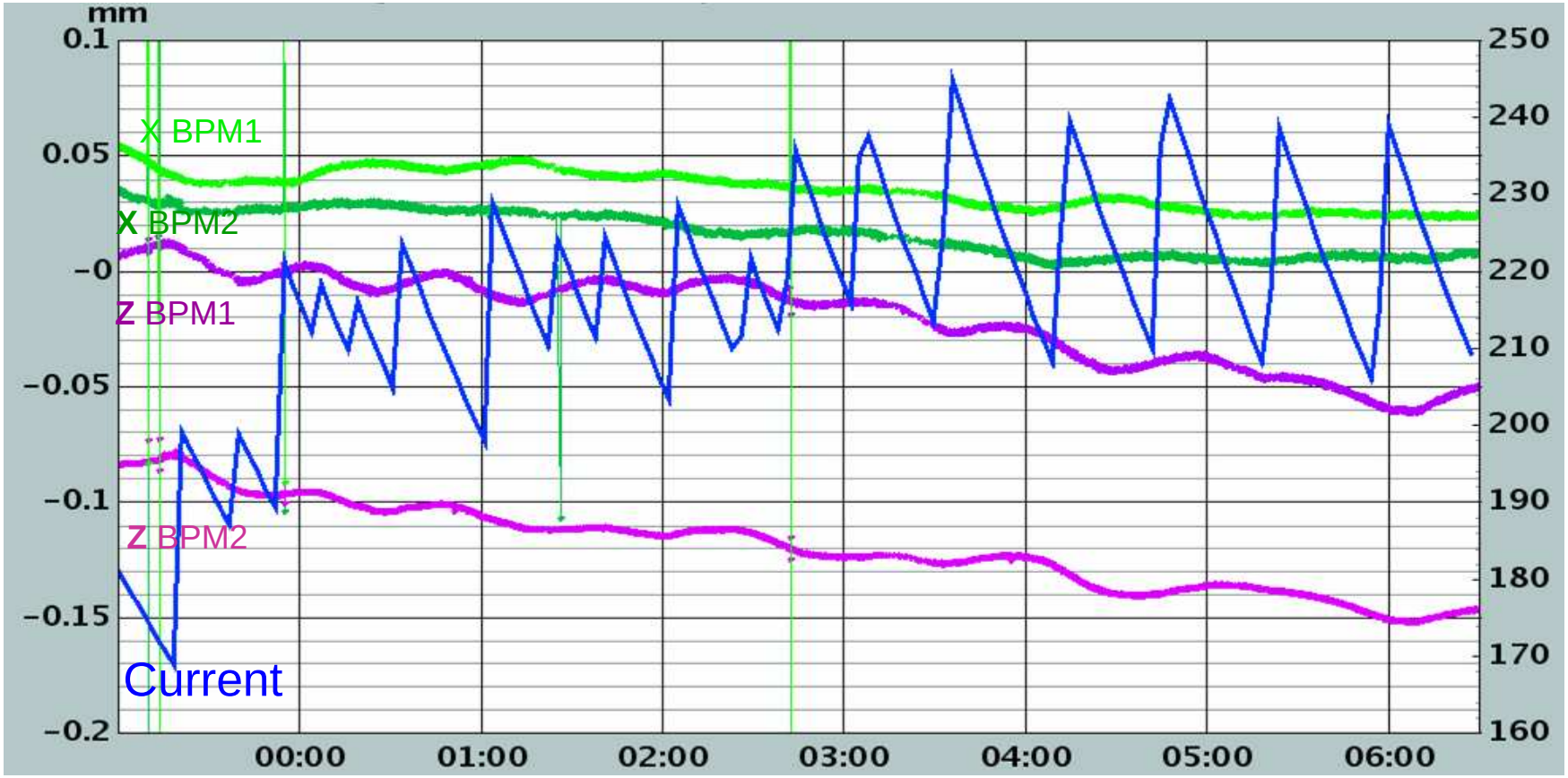
*: after correction. Before correction κ is around 0.3%.

Beam position stability

Natural position stability in both planes on 2 BPMs during a 8 hours vacuum conditioning shift.

$\Delta X \sim 25\ \mu m$, $\Delta z \sim 50\ \mu m$

No correction (SOFB OFF)



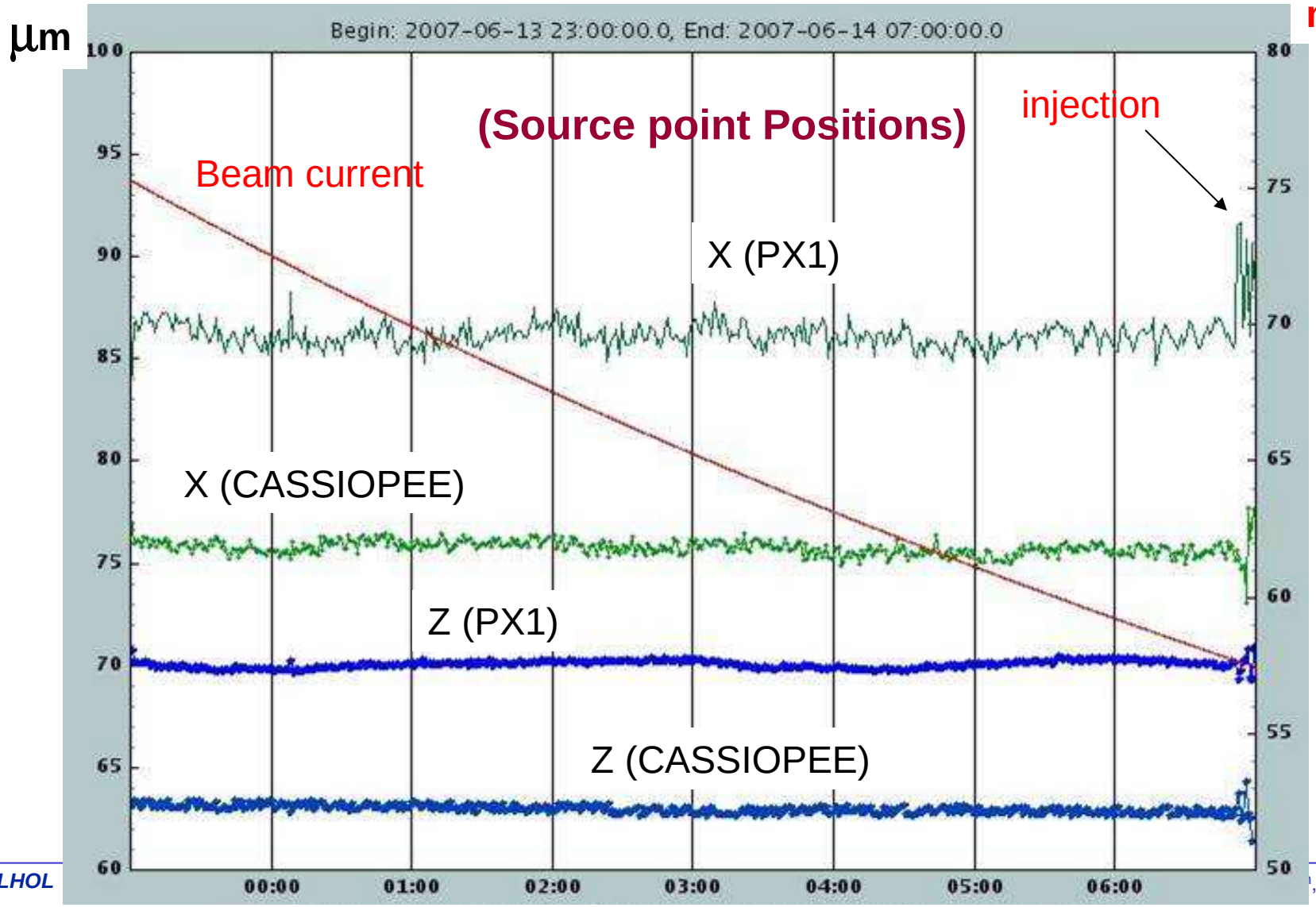
Slow Orbit FeedBack (SOFB)

- Orbit stability requirements
  - **1/10th of beam sizes (H: 20 µm rms, V: 0.8 µm rms)**
- 120 BPMs (Libera Electronics, noise: 0.2 µm rms)
  - **48 fixed on independent support (in Stainless Steel)**
  - **72 fixed onto the girders**
- 56 Horizontal and vertical correctors (sextupole secondary coils)
- RF frequency
- Algorithm: SVD 56 singular values in both plane
  - **Period of correction: 10 s**
  - **RF correction step-size : 0.3 Hz**
  - **5 seconds of BPM average using 10 Hz Libera data flow**
- Noise sources being investigated
  - **Booster power supplies**
  - **Drift with temperature (SR-tunnel temperature regulation)**
  - **ID motions (electromagnetic, in-vacuum, Apple II types) mainly compensated using dedicated feedforward correctors**

Beam position stability (with SOFB)

on 2 straight sections during a 8 hours beamline shift.

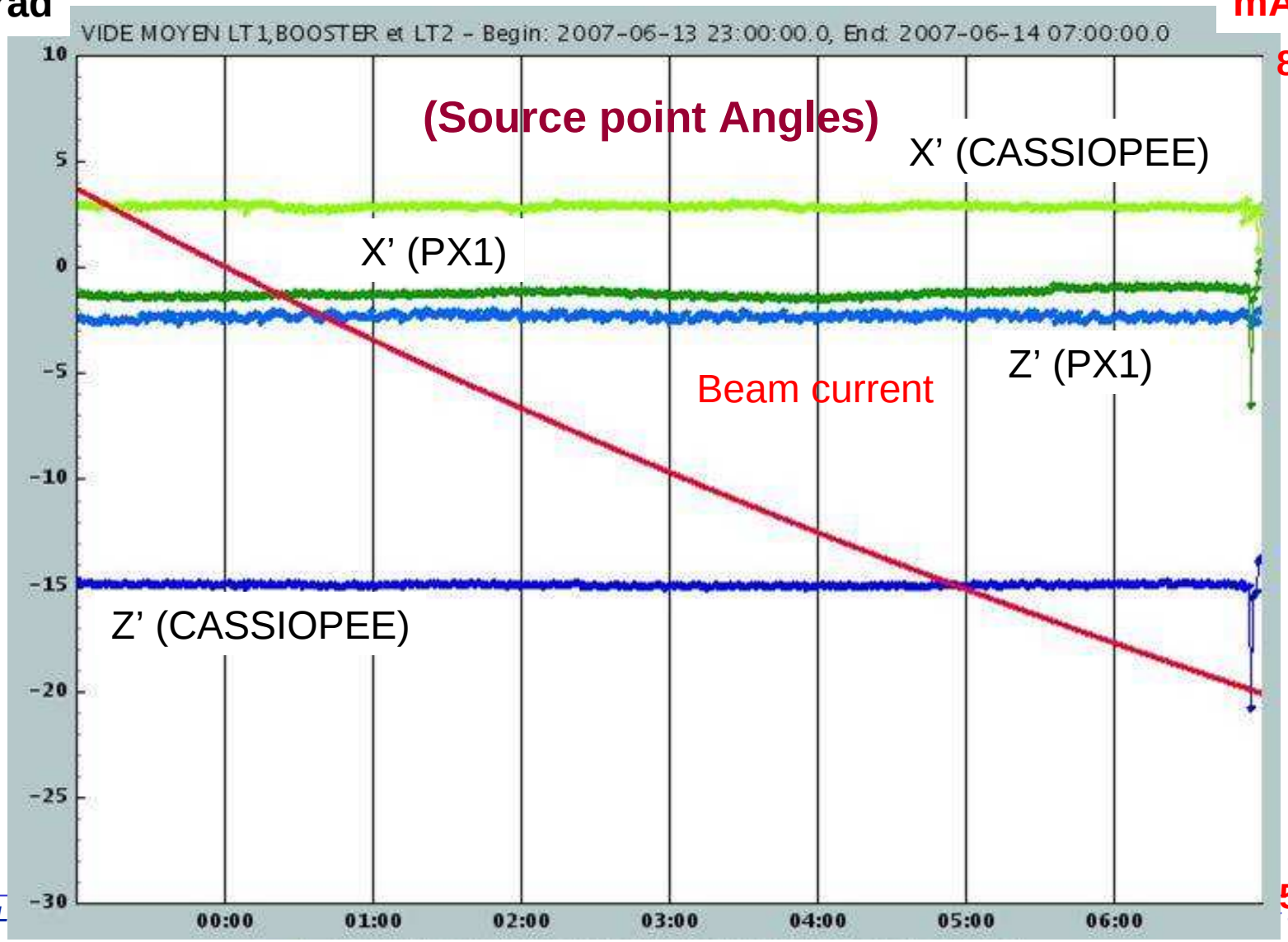
$\Delta X \sim 3\ \mu m$, $\Delta Z \sim 1\ \mu m$



Beam position stability (with SOFB)

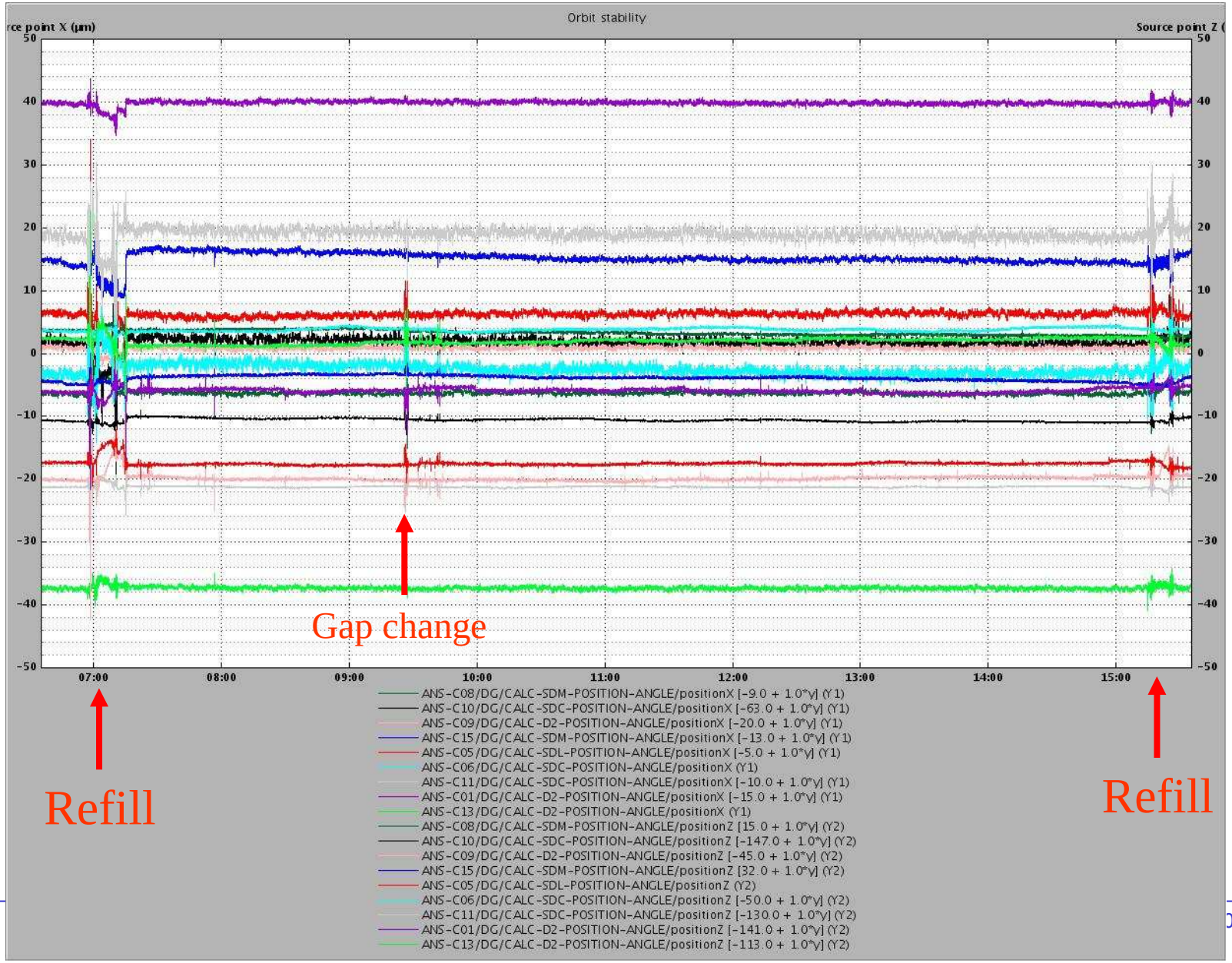
on 2 straight sections during a 8 hours beamline shift.

$\Delta X' \sim 1$ µrad , $\Delta Z' < 1$ µrad



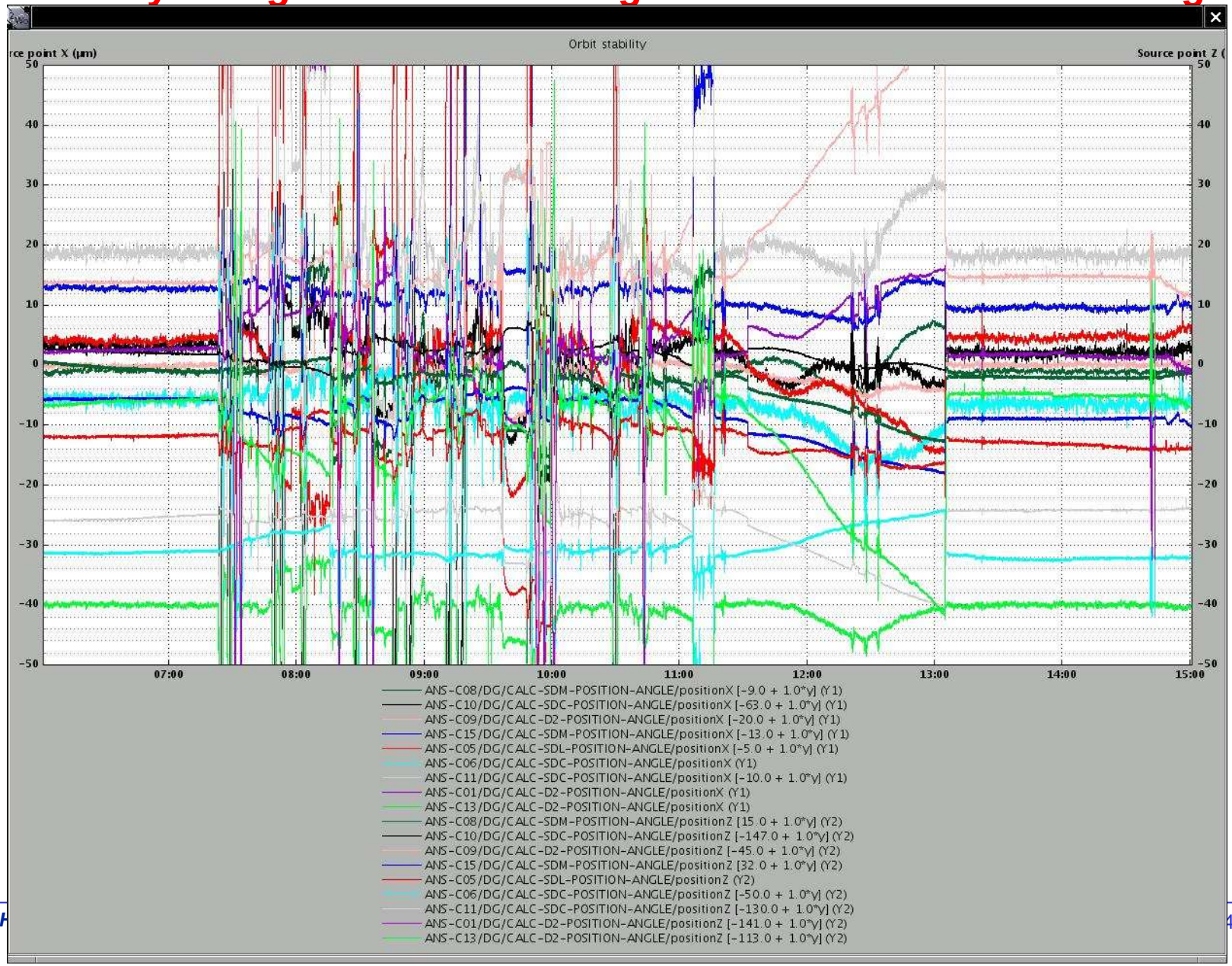
Beam position stability (with SOFB)

on many straight sections during a 8 hours beamline shift.



Beam position stability (?)

on many straight sections during a 6 hours ID commissioning shift.



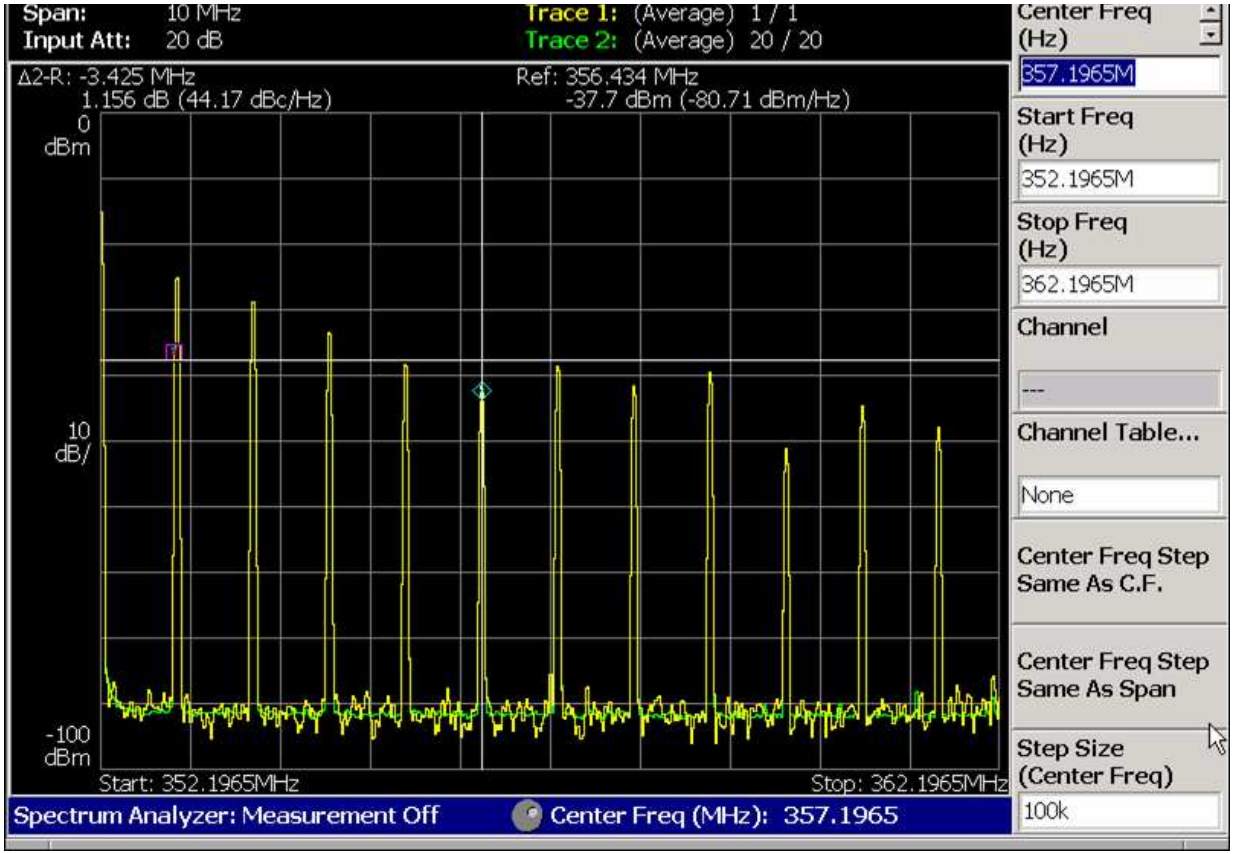
Transverse Bunch by Bunch Feedback (TFB) System

Strategy adopted: Make use of technologies and devices already developed elsewhere.

- **SPring-8 digital processor chosen for its proven performance in different machines.**
- **BPM, RF frontend, stripline kicker developed in house**

System commissioned in Dec'06 (~6 months after the TFB project started)

- **With a single chain, the beam stabilised up to 300 mA (maximum authorised value) at zero chromaticity, in both horizontal and vertical planes.**



⇨suppress also ions related instabilities (fast and slow)
⇨almost no beam size dependence with current

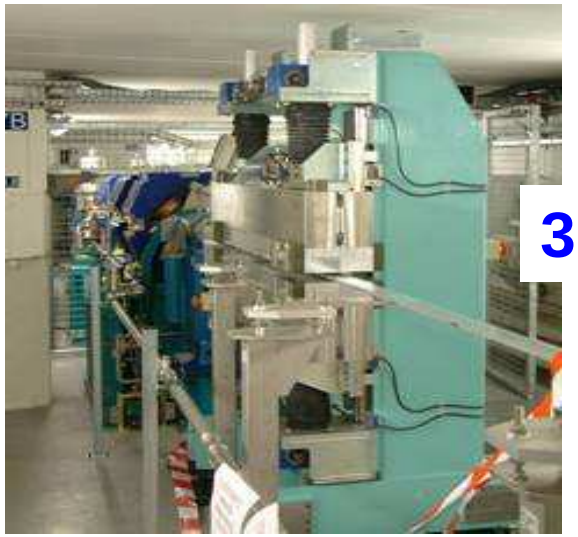
Permanently used in routine operation since April 2007

Phase 1 Insertion Devices

	HU640	HU256	HU80	U20
Period [mm]	640	256	80	20
Num. Periods	14	12	19	98
Type	Electro-magnetic	Electro-magnetic	Apple-II	Hybrid in-vacuum
Gap [mm]	19	15 (V) 50 (H)	15.5 - 250	5.5 - 30
Polarization	Elliptical	Elliptical	Elliptical	Linear H
Peak Field [T]	0.09 (H) 0.11 (V)	0.28 (H) 0.40 (V)	0.75 (H) 0.98 (V)	0.95
Quasi-Periodic	N	Y	Y	N
Photon Energy	5 – 40 eV	10 – 1000 eV	40 – 1600 eV	3 – 18 keV
Quantity	1	3	3	3

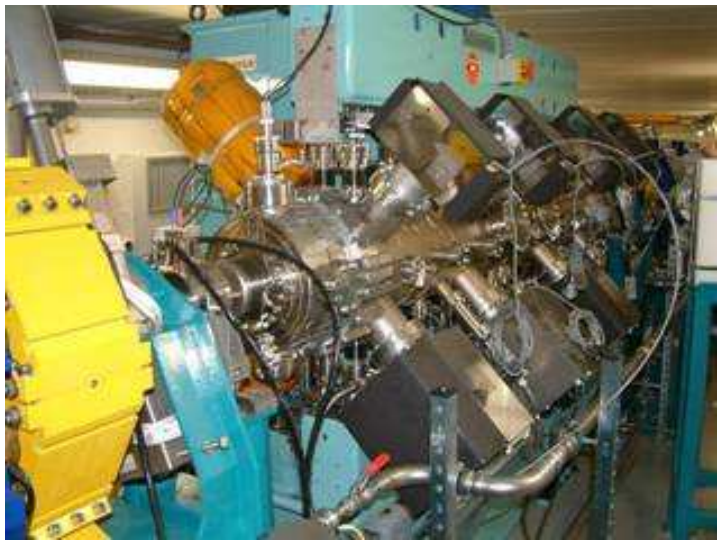
Insertion Devices for phase 1 beamlines

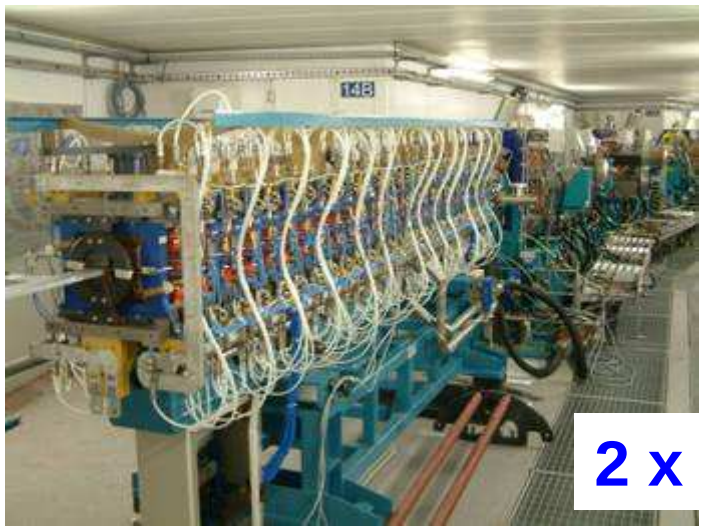
HU640
10 m



3 x HU80

3 x U20





2 x HU256

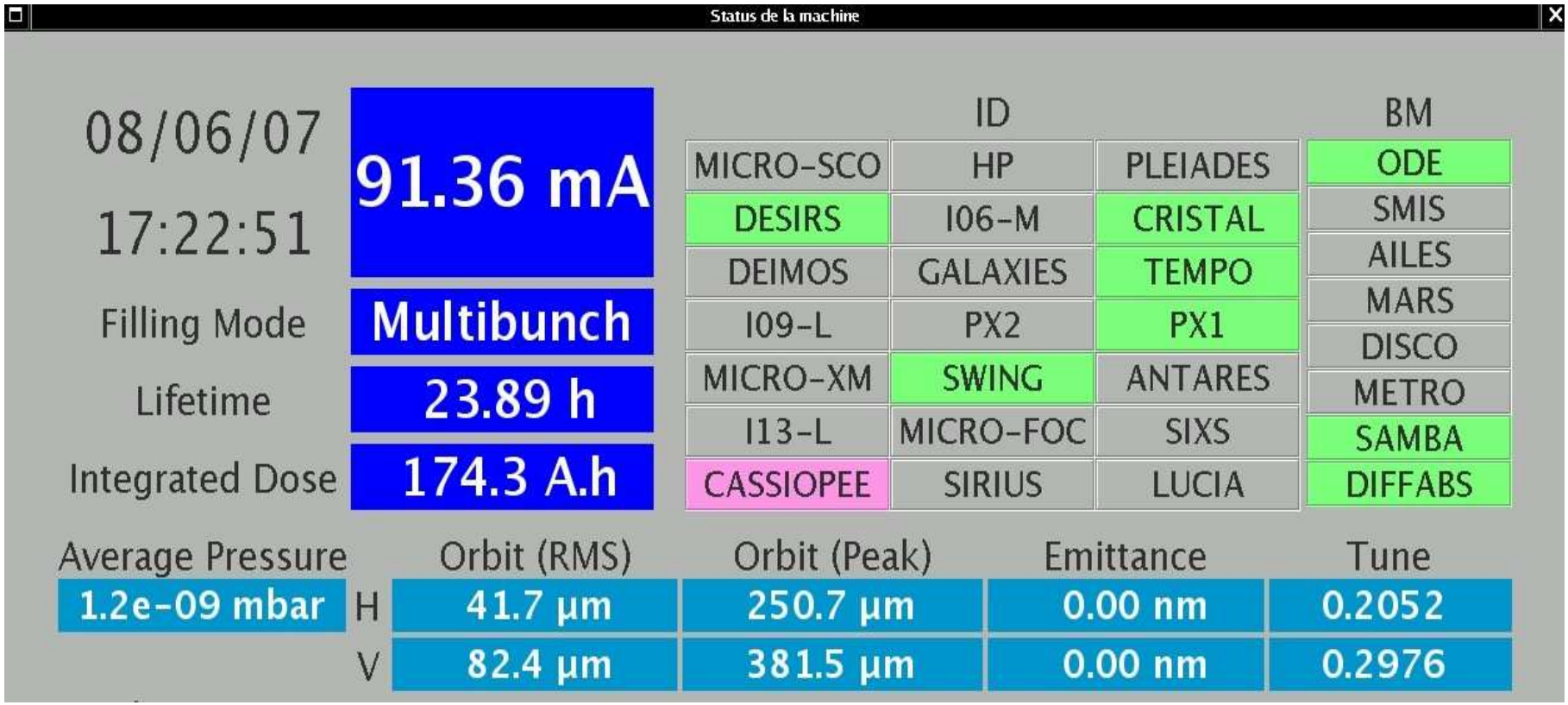
14 ID's to build for Phase 2 Beamlines

- 4 In vacuum Undulators (3 U20 + 1 U24)
- 8 Apple II Undulators: HU60, HU52, HU44, HU34
- 1 In vacuum Wiggler (WSV50)
- 1 EMPHU Undulator

- + R&D on 1 Cryogenic Undulator

9 Beamlines are taking beam

6 from IDs and 3 from BM



Expert Users are already there.

External Users from November onwards

Commissioning of phase 2 beamlines is starting

Machine operation

- Since the begining of 2007, the main part of the operation time is dedicated to the commissioning of the beamlines

- In 2007, 4900 hours are scheduled:
  - 3100 for the beamlines commissioning (and RP tests)
  - 1800 for the commissioning of the storage ring

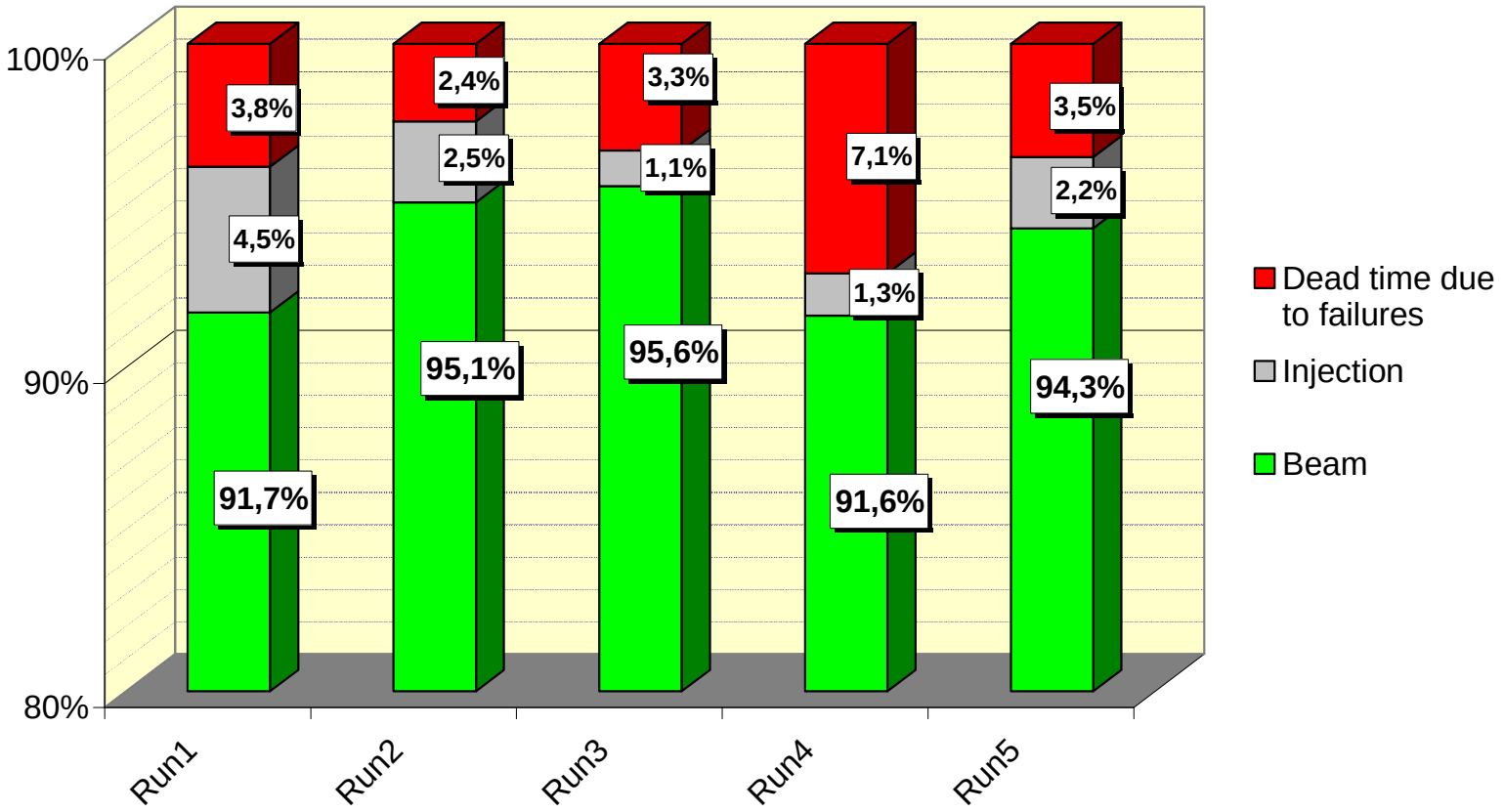
- Routine operation at 200 mA for beamlines
  - 300mA for RP qualification of beamline hutches

- Machine availability is quite good : > 93% since beginning of 2007
  - Very few RF trips : Excellent reliability of RF system
  - The injector works well despite some recurrent failures on PS

- Machine operators fully trained.
- Assisted by ~50 part-time operators from Machine and support divisions

Machine operation

From January to July 2007, **93.8%** of the 1426 total hours of beam were delivered to beam lines

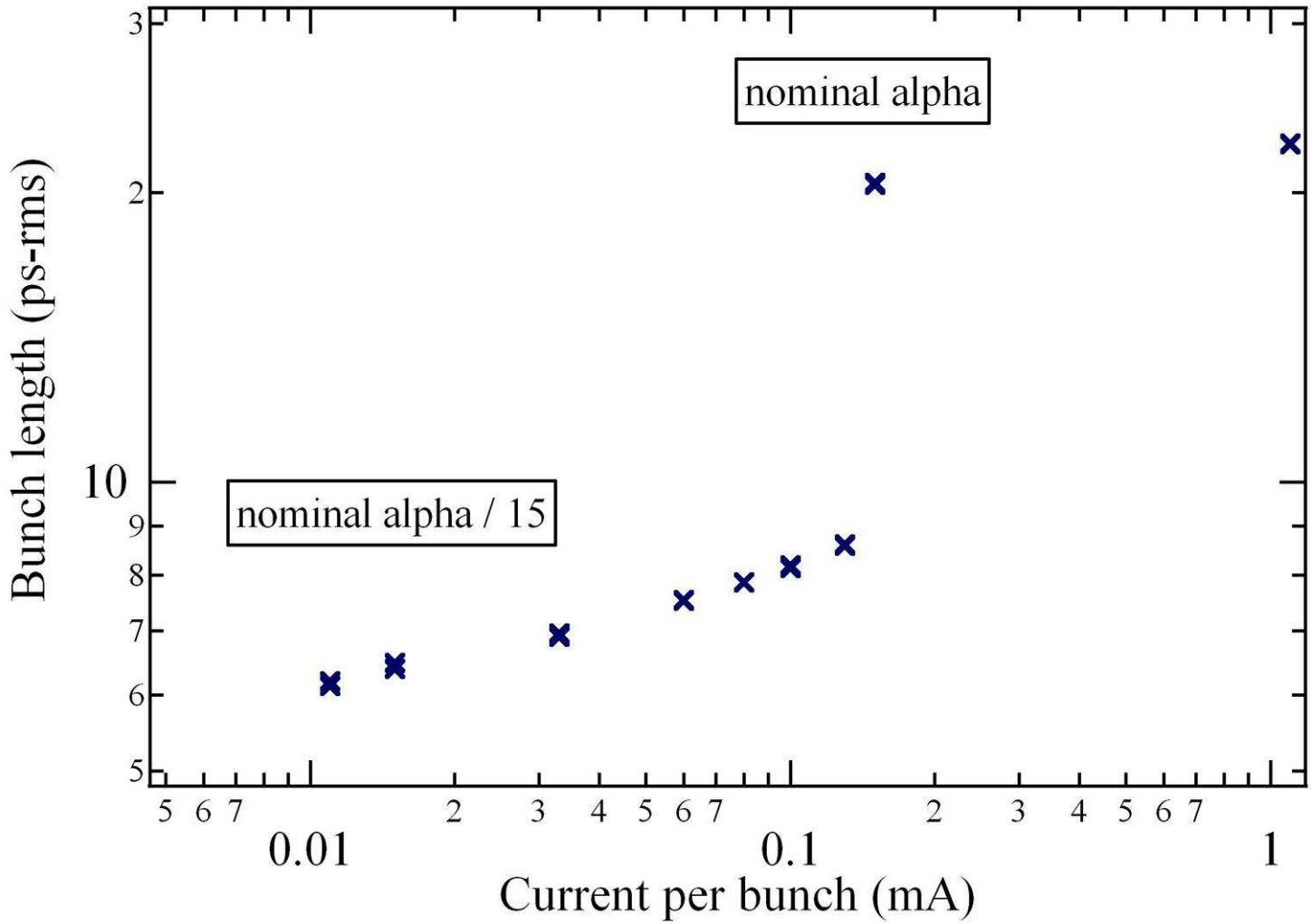


Main Objectives for 2008

- **4000 hours for beamline operation + 1500 h for machine**
- **500mA operation (with 2nd cryomodule)**
- **Implement top-up injection**
- **Single bunch** and **8 bunches** operation
- **Secure beam stability :**
  - **Compensate further Insertion Devices effects**
  - **Implement X-BPMs in front-ends**
  - **Set Fast Orbit FeedBack in operation**
- **Build, measure and install new Insertion devices**
- **Install new Front-Ends for phase 2 beamlines**

Short pulses

Preliminary results with a low alpha lattice to produce short pulses



I wish you a fruitful meeting !

Jean-Marc FILHOL