

A Light for Science



European Synchrotron Radiation Facility

The Upgrade Programme for the ESRF Accelerator Control System

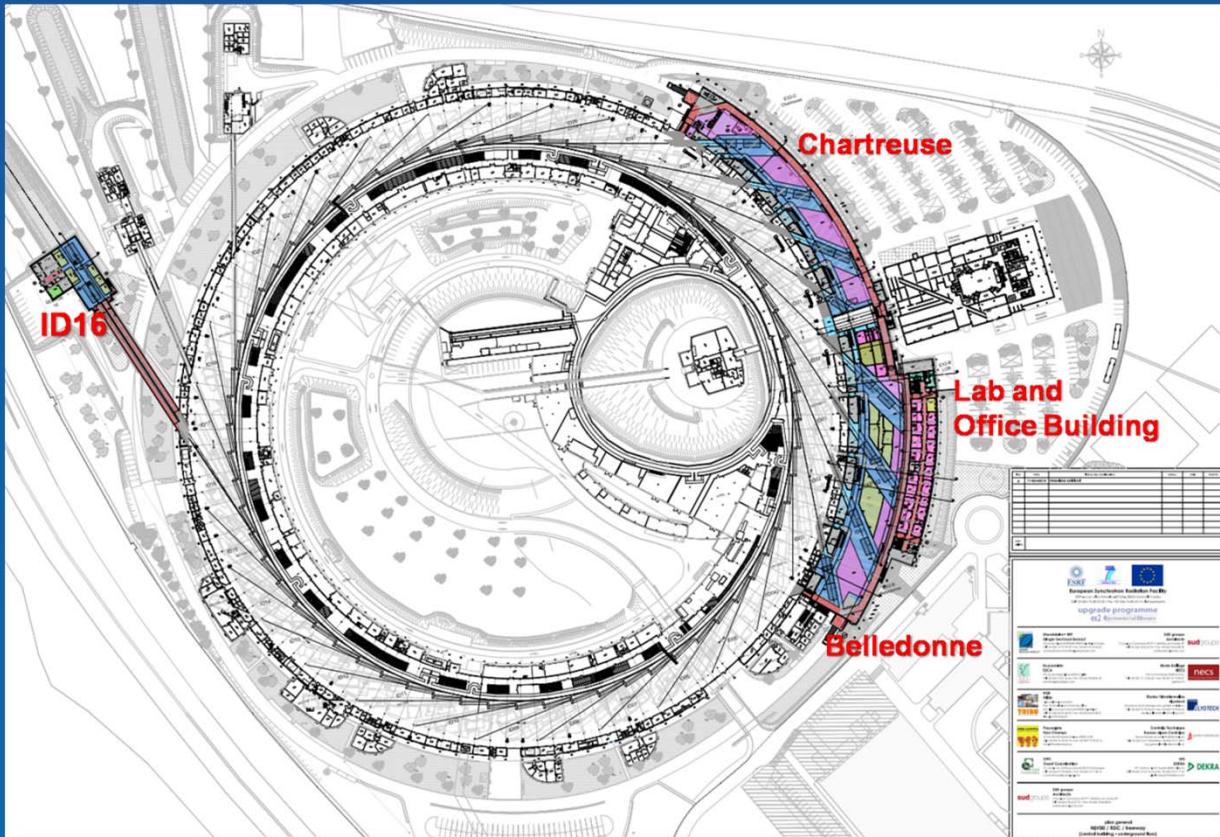
- The ESRF Upgrade Programme
- The X-Ray Source Improvements
- The Control System Upgrade
- Conclusion

The ESRF Upgrade Programme

- In 2008, the Council of the ESRF launched the ESRF Upgrade Programme 2009 - 2018
- Funding for a first phase of the Upgrade (2009 to 2015) has been secured to deliver:
 - Eight new long beamlines, mainly with nano-focus
 - Refurbishment of many existing beamlines to maintain them at world-class level
 - Continued leadership for X-ray beam availability, stability and brilliance
 - Major new developments in synchrotron radiation instrumentation

The ESRF Upgrade Programme

- Construction works for the experimental hall extension will start in November 2011

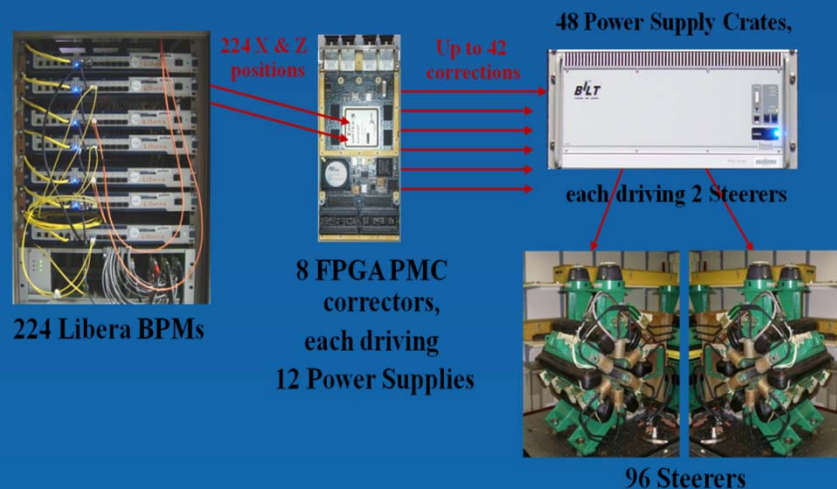


The X-Ray Source Improvements

• *BPMs and Fast Orbit Feedback*

- Beam position monitoring system replaced at the end of 2009 with 224 Libera measurement systems
- Exchanged all 96 steerer power supplies in 2010
- Installed a fast and redundant communication network
- 8 FPGAs to calculate corrections at a 10KHz rate

Steering magnets power supplies → 10kHz data flow



The X-Ray Source Improvements

- *BPMs and Fast Orbit Feedback*
 - Currently under commissioning
 - Should be operational at the end of 2011
 - **Improves the beam stability for nano-focus beamlines**
- *MOPKS010 : Fast Orbit Correction for the ESRF Storage Ring*
- *MOPKS014 : Architecture and Control of the Fast Orbit Correction for the ESRF Storage Ring*

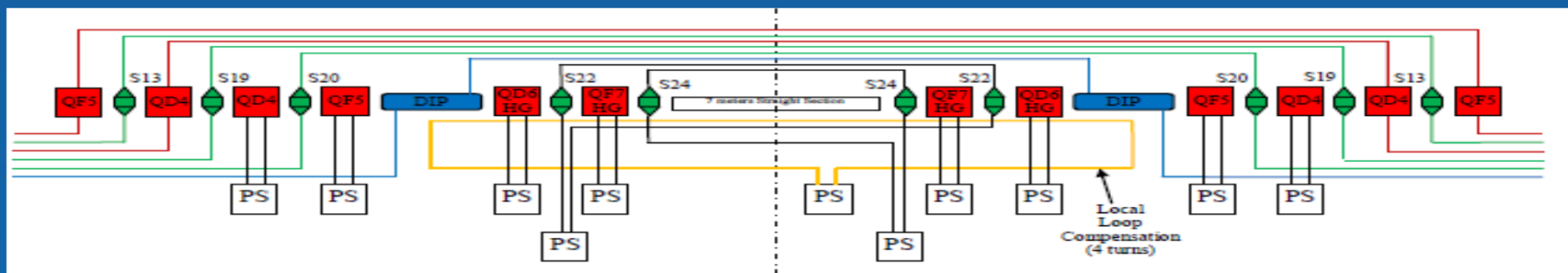
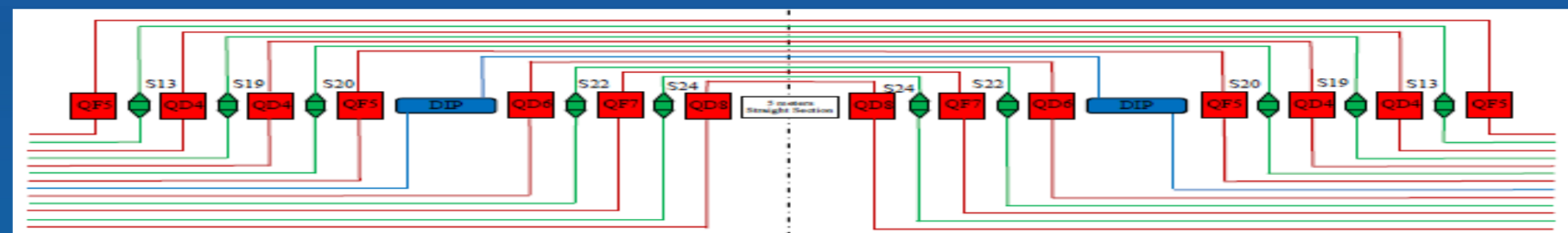
The X-Ray Source Improvements

- *Ultra-Small Vertical Emittance*
 - High precision Libera beam position monitors
 - New algorithm for coupling correction for the storage ring
 - A vertical emittance of $\varepsilon_z = 4.4 \pm 0.7$ pm could be reached
- 32 new skew quadrupole magnets have been installed (2011)
 - Correct the coupling induced by insertion device movements
- The goal is an ultra small vertical emittance of $\varepsilon_z = 2$ pm.
- First tests are promising
- **Increase brilliance and reduce divergence**

The X-Ray Source Improvements

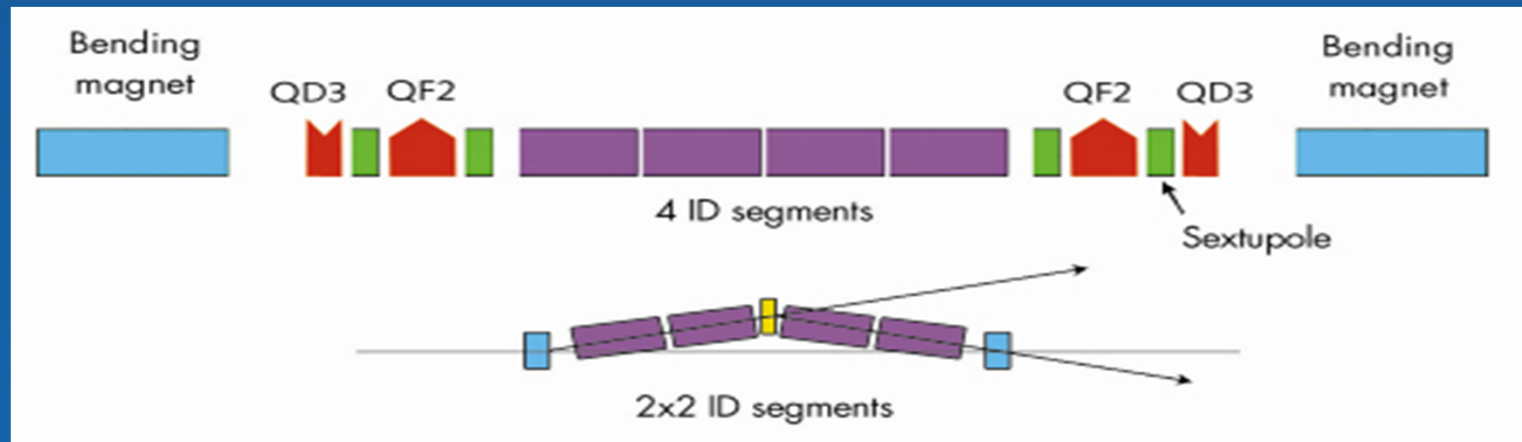
• 6 or 7m Straight Sections

- Today 5m straight sections with family wise power supply steering
- Power supplies need to be controlled individually
- The beam steering algorithms had to be revised



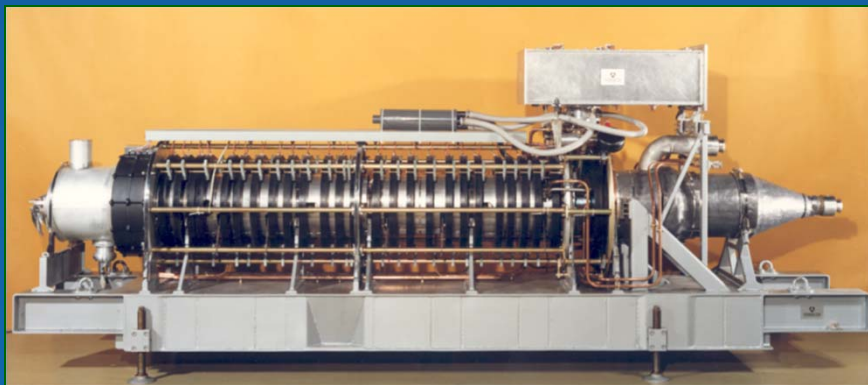
The X-Ray Source Improvements

- *6 or 7m Straight Sections*
 - *4 insertion device segments instead of 3*
 - *Canted undulator approach*
 - *2 insertion device segments per beamline*
- **Insertion device flexibility or higher brilliance**



The X-Ray Source Improvements

- *High Power Solid State Radio Frequency (RF) Amplifiers*
 - The RF system is the sub-system with the highest failure rate
 - Replacement of the klystron based RF transmitters with solid state RF amplifiers
 - High redundancy, less power consumption, less tuning effort
 - Installation of the first amplifier is in progress
- **Operation reliability**



Control System Upgrade

- Move to a Tango-only Control System
 - Taco developed in the 1990
 - Tango is a collaborative development
 - More features
 - More development and survey tools
 - 2010 still 45% of Taco devices
 - Software redesign of large sub-systems
 - Vacuum, front-ends, insertion devices
 - Long shutdown period from December 2011 until May 2012
 - Reach 80% of Tango devices in 2012
 - **Easier maintenance and higher reliability**

Control System Upgrade

- Increase the Reliability
 - Tango administration system
 - Overview of all device servers running on control system hosts
 - Configuration and optimization tools
 - Failure statistics to identify infrequently occurring software crashes
 - *WEPKN002 : Tango Control System Management Tool*
- Survey of all control computers with NAGIOS
 - Detection of CPU, memory or disk problems

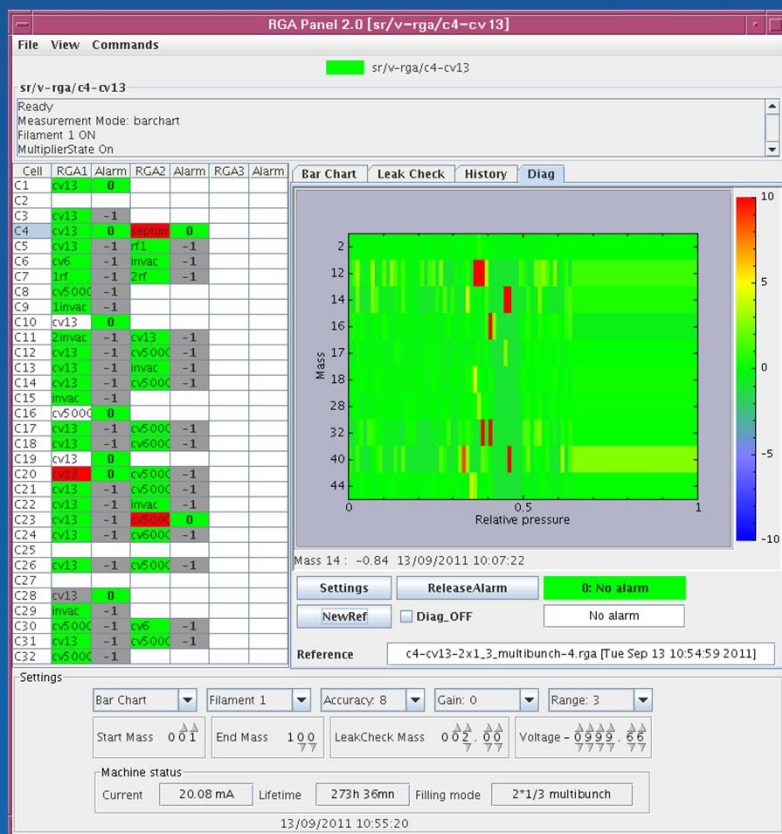


Control System Upgrade

- More high-level analysis tools
 - Allow better diagnostics or prediction of problems on the accelerator complex
 - An example is the vacuum leak detection system
 - Based on the residual gas analysers (RGA) installed on the storage ring
 - Detect air leaks, water leaks and any abnormal out-gazing
 - GUI enables the handling of all RGAs around the storage ring
 - Provides complex alarm configuration
 - Online and post-mortem data analysis.

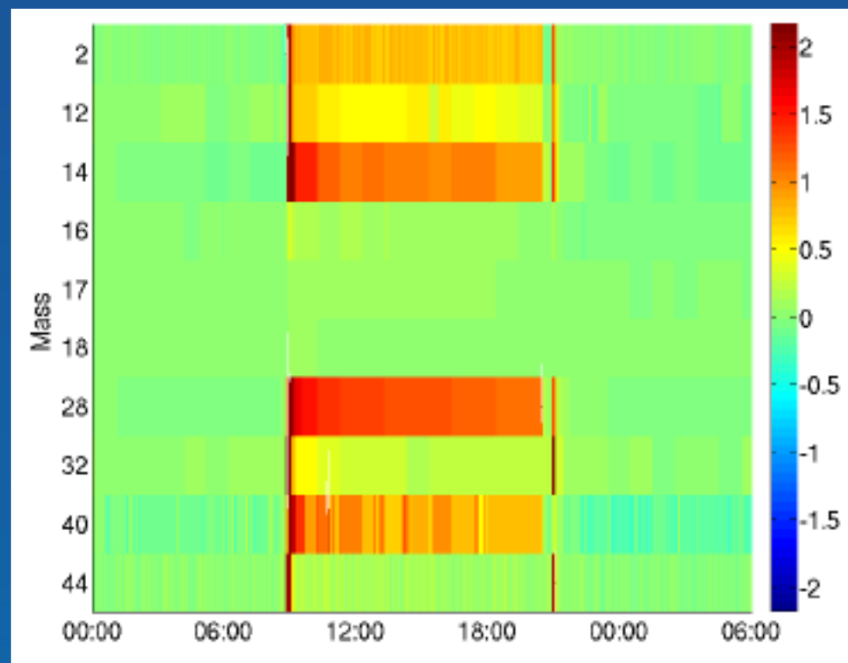
Control System Upgrade

Vacuum leak detection GUI



Air leak footprint:

Masses 14, 28 and 40 (N, N₂, and Ar)



Conclusion

- Conducting the upgrade in parallel to full user operation and maintaining the high stability and reliability of the X-ray source is very demanding
- The challenge is to restart the accelerator complex, after 5 month of shutdown, with the same reliability
- All the different modifications and improvements on the X-ray source as well as on the control system will hopefully lead to a successful implementation of the new beamlines.