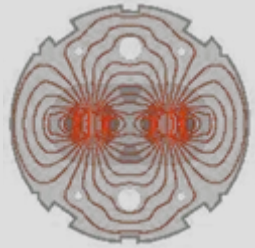
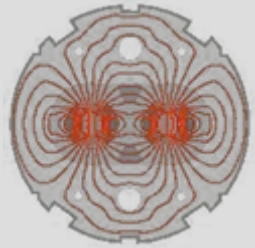
LHC On-Line Modeling



- Goal of the LHC On-line Model
- The Team and the Tasks
- Status of MAD-X
- Scheme of the LHC On-line Model
- Interface to LSA
- Examples of NL measurements to understand the “real” model
- Conclusion

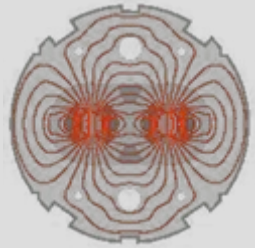
Goal of the LHC On-Line Model?



Main design features:

- **MAD-X is the principle engine of the LHC on-line model.**
- **A complete and trustworthy (non-)linear model of the LHC will be composed with the databases of the measured magnet errors and beam-based measurements.**
- **Testing of knobs with MAD-X *before* send-to-hardware.**
- **The online model is *not* a real-time tool but should give answers within in minutes.**
- **All functionalities of MAD-X are utilized ➔ Duplication with other tools may occur but the emphasis is on uncovered features.**
- **Experimenters and operators should profit from a fully functional on-line tool.**
- **Speed-up the off-line analysis time such that it can be done in the control room.**

The Team and Tasks

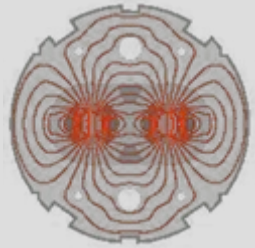


- **Frank Schmidt – Overall Responsibility, MAD-X General Support, (Non-)linear LHC Model from Fidel/Wise**
- **Werner Herr – Responsibility for Applications, SDDS MAD-X Version, Closed Orbit Correction**
- **Ilya Agapov – Interface to Control System, Application Development, Beam-Based Model Adjustments, PTC_TWISS module**
- **Massimo Giovannozzi, Thys Risselada – LHC Optics, Fidel/Wise, MAD-X Error Routines**

In Collaboration with:

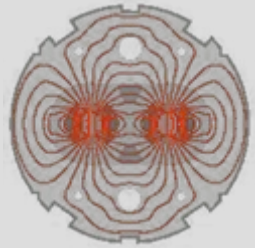
- **Fidel & Wise (Laurent Deniau, Luca Bottura, Rob Wolf and team & Per Hagen) - Harmonics**
- **Rogelio Tomás, Masamitsu Aiba & Akio Morita (KEK), Rama Calaga (BNL) , Glenn Vanbavinckhove – Beta-Beating**
- **Gianluigi Arduini, Jörg Wenninger, V. Kain – SPS Operation, 1000 turn BPM system, Standardization of SDDS**
- **LSA Team (Mike Lamont, Greg Kruk, Jutta Netzel) – General control system support**
- **Alastair Bland – TECHNET Support**

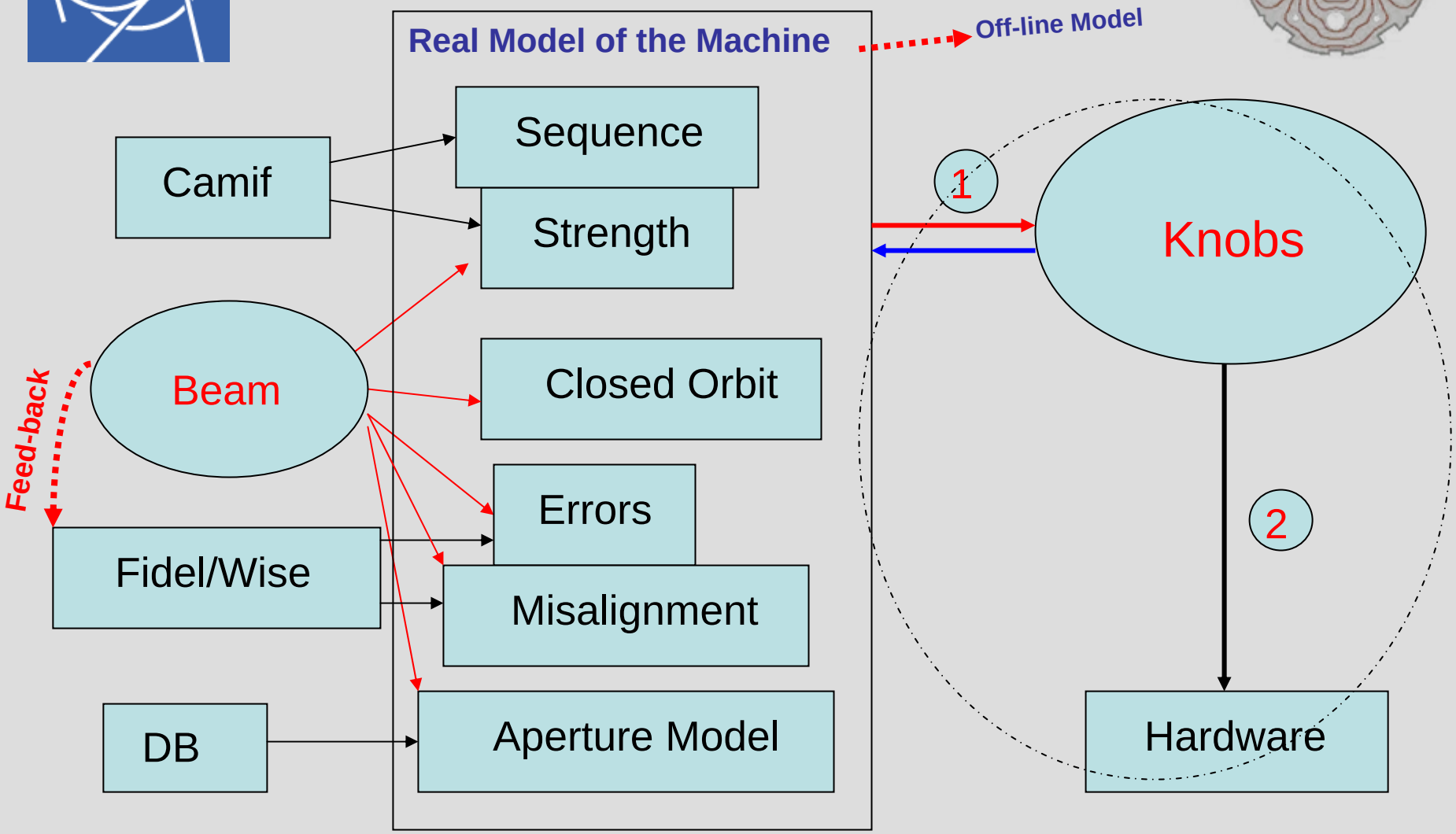
Status of MAD-X



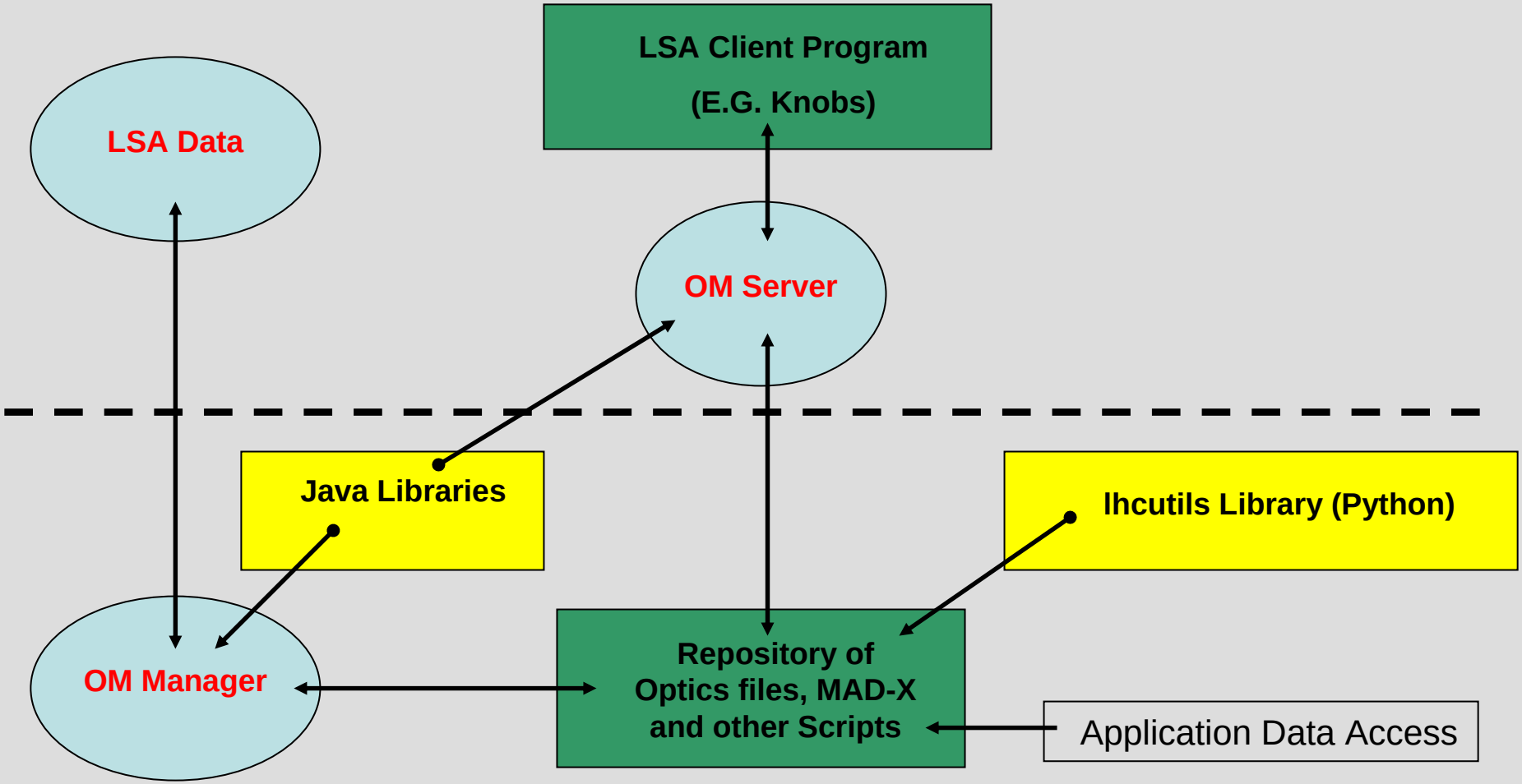
- **Is MAD-X ready for the LHC commissioning?** ➔
- **Is MAD-X properly maintained?** **ABP no longer provide several exclusive FTEs for program development and maintenance, instead there is one code custodian and a large group of MAD-X Module Keepers.**
- **Is MAD-X still further developed?** **ABP has stopped the full blast development of MAD-X since the code fulfills the minimum LHC requirements. However, work is being done for a full PTC object oriented LHC on-line model.** ➔
- **Is MAD-X reliable?** **MAD-X has made use of the well debugged MAD8. Moreover, the independent programs SixTrack and PTC provide a continuous check such that any inconsistency could be eliminated.**
- **Is MAD-X fast?** **There is some speed loss compared to MAD8 due to the mixture of Fortran and C. The object oriented PTC extension is more time consuming by definition.**

Scheme of the On-Line Model

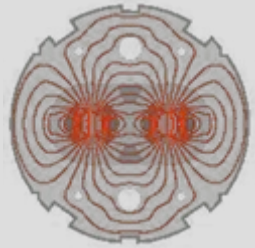


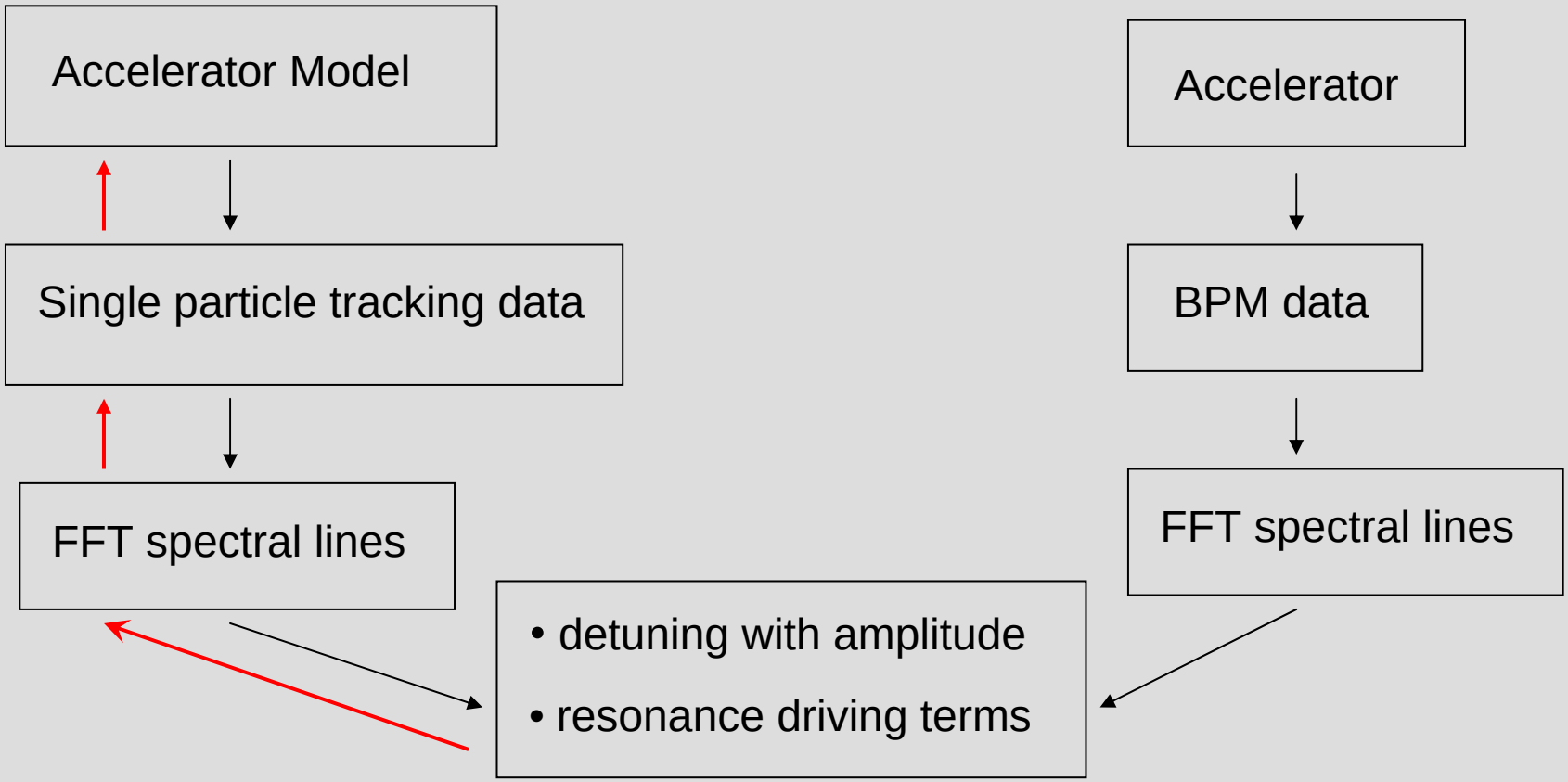


Interface to LSA



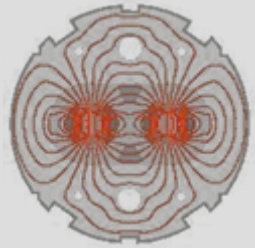
Relation Accelerator versus Computer Model

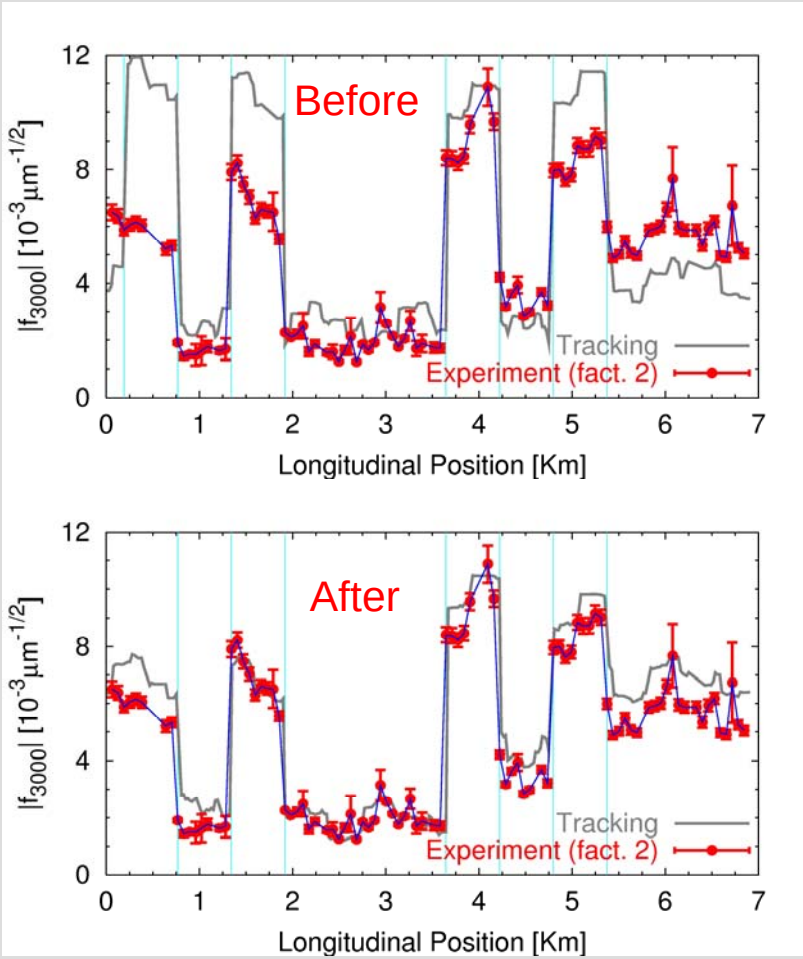




Missing Sextupoles (SPS)

(F. Schmidt, R. Tomas et al.)





Specially arranged SPS configuration for extraction sextupoles

+ + + + - - - -

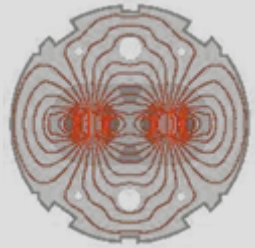
(3,0) resonance driving terms

Data fully decohered (factor 2 correction applied)

Comparison with nominal model

One extraction sextupole accidentally disconnect

Uncompensated Skew Sextupole Resonance (PSBooster) (P. Urschütz, M. Benedikt)



CERN PS data

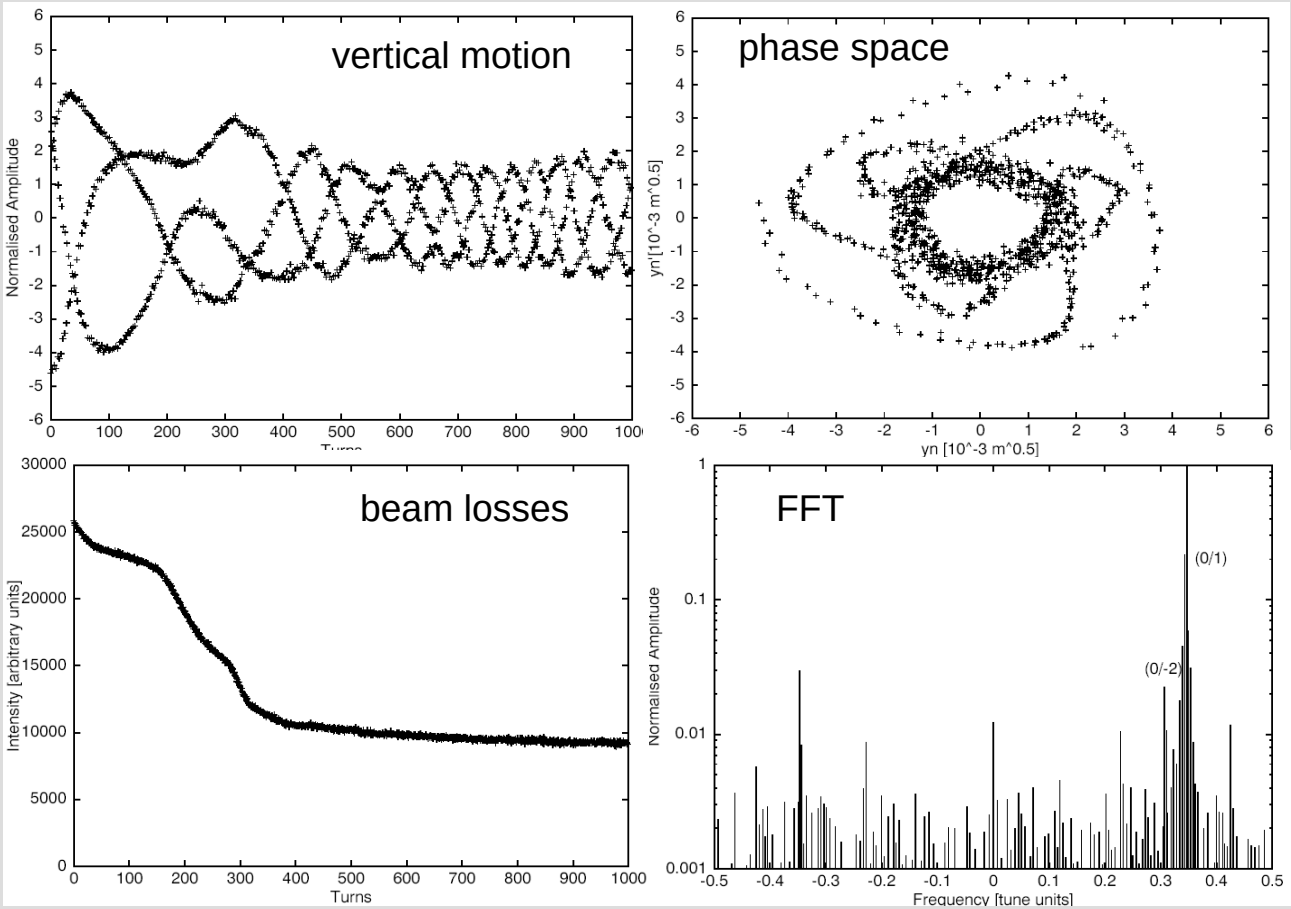
vertical plane

3Qy = 16

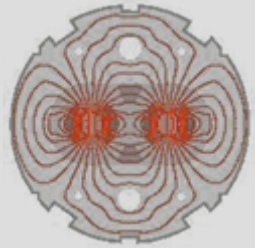
and

(0, -2) spectral line

Uncorrected machine



Corrected Skew Sextupole Resonance (PSBooster) (P. Urschütz, M. Benedikt)



CERN PS data

vertical plane

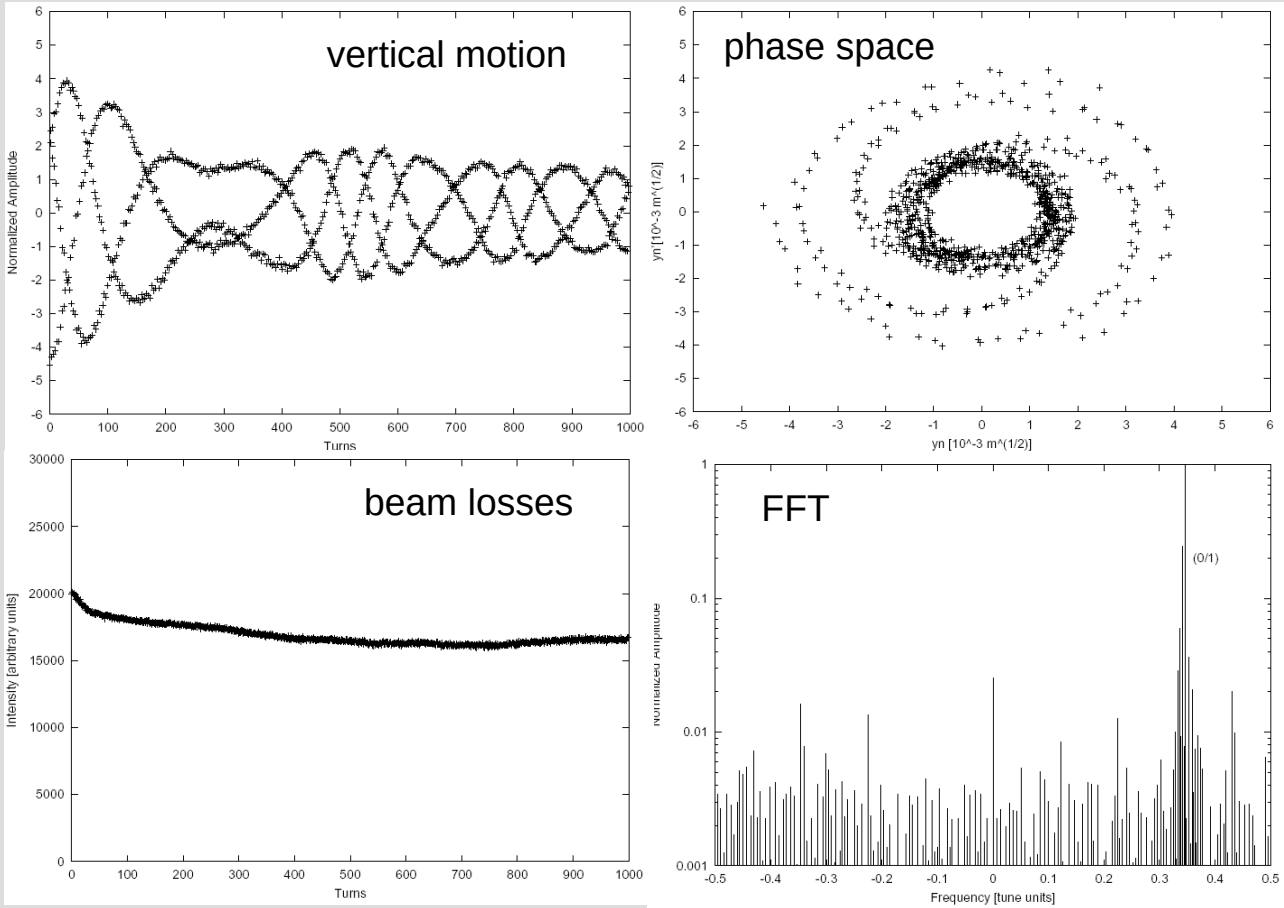
3Qy = 16

and

(0, -2) spectral line

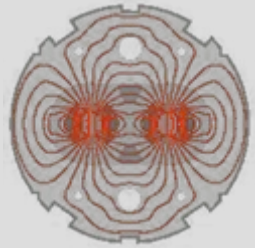
Resonance compensated with skew sextupoles

Setting based on the reduction of the (0, -2) line amplitude

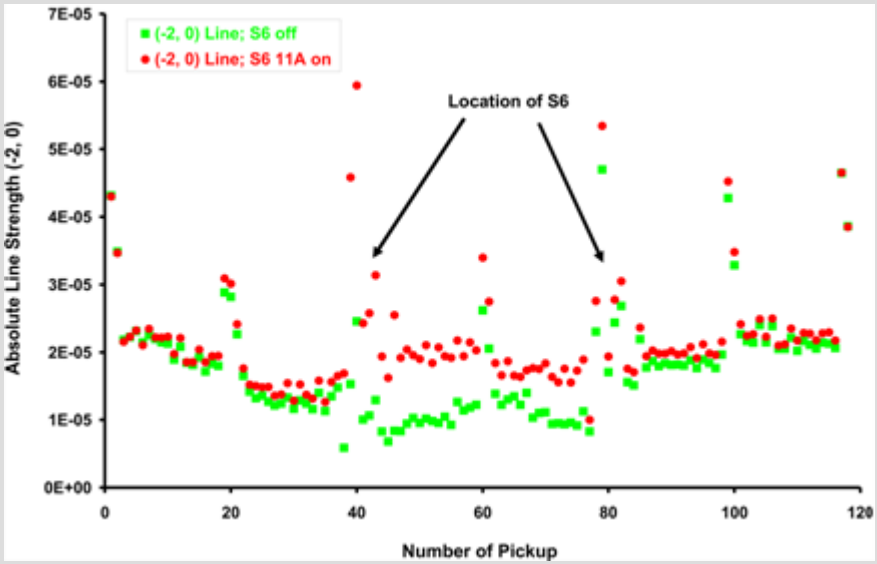


Longitudinal Location of strong Sextupoles (Tevatron)

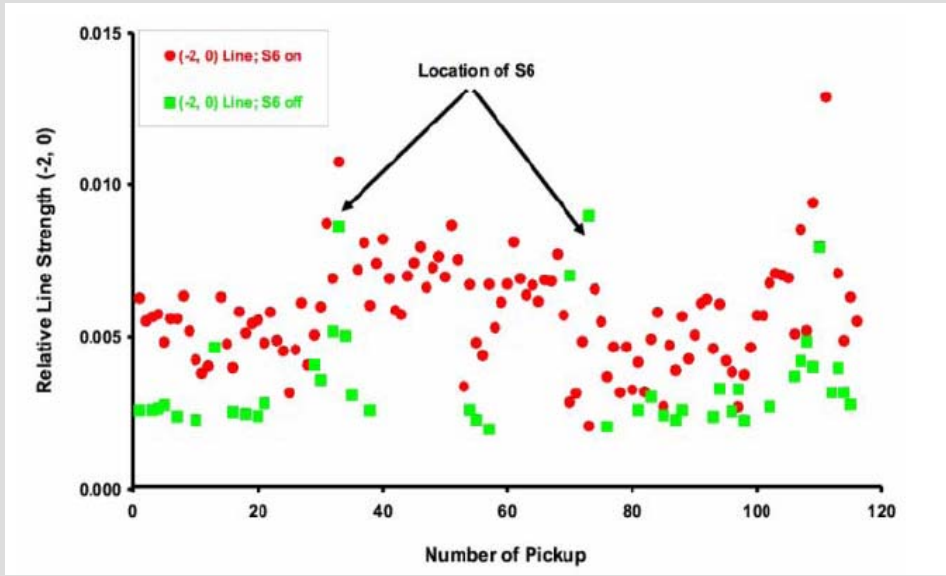
Y. Alexahin, F. Schmidt et al. EPAC06



(3,0) resonance detection from (-2,0) spectral line at Tevatron

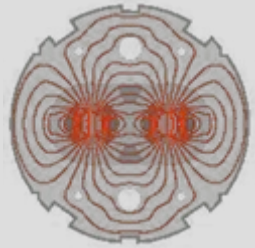


Tracking data



Beam data

Conclusion



- **Release of the Online Model Software**
- **Model of the LHC (still work in progress)**
- **Experiments and Testing**
  - **•Applying the Online Model in the SPS start-up with beam.**
  - **• Complementing the theoretical SPS model with beam-based corrections ➔ needed for the LHC.**
- **Being ready for Sector Test and LHC Commissioning!**