Brainstorming on applications of the LHC On-Line Model for CICs

- ***Mandate***
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Online model mandate

- The main online model tool is MAD-X.
- The first ingredient is the best theoretical tool we can obtain by using all available measurements of the LHC magnets. To this end, these data should be obtained by Fidel and/or Wise.
- In particular, since Fidel is being incorporated into LSA we are presently in the process to derive this model from LSA including harmonics and at any energy. This has the additional advantage that we can profit from corrections and machine settings that will be necessary to control the real machine via LSA.
- Additionally, there will be an attempt to build an effective model of the LHC with the goal to operate with a model that is sufficiently close to the real machine to judge with confidence any machine adjustment before it is sent to the machine.
- To this end we will make full use of YASP, K-Modulation (if we decide to do it!) and in collaboration with Rogelio's beta-beating team beam-based experiments.
- A number of features are available like depicting along the ring beam envelops, apertures, measured and interpolated closed orbit together with bumps.
- Emphasis of the online model is the production and evaluation of knobs and the simulation of trims with the LSA interface.
- In general the online model shall provide the necessary infrastructure for applications and studies that should be driven by the users.

Activities & Requests

- Bump knobs for lumiscans are investigated with the online model including imperfections.
- We have to agree on Energies to be studied of course any Energy can be studied
- Naturally effective Model only at Energies with Beam Data
- Predictive Power of effective Model is being tested: Can one find known imperfections with good precision? Can one correct (non)linear longitudinal distributions of imperfections back to the desired Model (by inverting measured distributions and feed into model)? ==> Experiments at various Labs around the world.
- Studying BPM quality (work in progress)
- The aperture model has to be complemented by the collimator settings. These settings should be readily available from LSA. It seems no big issue to implement this into the online model.
- For online control of collimation it is essential to allow to depict nx, ny, n1, nskew along the machine.
- Aperture tolerances should be added to the graphs.
- Additionally it would be interesting to show at critical longitudinal positions the available clearance in the physical phase space x-y.
- A studies was outlined to distinguish between triplet misalignments from errors in the transfer functions of the D1/D2 magnets. The online model team can certainly provide the infrastructure and some usage help in such studies.
- Presently the OM has just a few users. It is essential to review how to optimize it in a multiuser mode. Federico's input is certainly welcome as the first power user of OM. It is also essential to work on a thorough documentation on how to use the OM applications.

Specific Requests

Massimo:

a list of knobs/applications for the on-line model

- Effect of a radial steering
- generation of long bumps through the arcs for setting the spool pieces
- simulation of non-linear chromaticity measurements
- simulation of detuning with amplitude measurement
- simulation of polarity errors
- simulation of k-modulation measurement
- simulation of dispersion measurement
- analysis of energy mismatch from a measured orbit

Frank Z:

- The top energy studies could profit from applications using the ac dipoles, or the two other similar harmonic exciters like the tickler, to explore the optics and the aperture (but some of the optics analysis could perhaps be incorporated into Rogelio's programme).
- We could also wish to have support for the alternative aperture measurement technique proposed by Stefano in 2006, which involves well-defined scraping with collimators, followed by local orbit bumps. Maybe YASP can take care of some aspects here?
- Tools for beam-based alignment of the IR quadrupoles and for D1 transfer function checks would be welcome.
- Dispersion measurements that vary the rf frequency synchronized with the momentum collimator settings might be considered too.
- In addition, standard knobs for tunes, 2-D tune scans, chromaticity, higher-order chromaticity, off-momentum beta beating, global coupling correction, and possibly semi-local coupling correction in individual IRs would be needed.

Status and Plans

- Theoretical Model
  - LHC V6.503
  - Harmonics (Wise&Fidel) PH, MG
  - Misalignment PH, FS (end of July)
- Effective Model (at selected Energies)
  - YASP
  - K Modulations
  - Beta-beat (==> Rogelio)
  - Beam based Measurements
- Operation (LSA)
  - Get Machine settings (~August)
  - Corrections
  - Harmonics any Energy (LSA ==> Fidel) (~August)
- Basic Knobs for Operation
  - Bumps
  - Tune (July)
  - Chromaticity (~August)
- OM server started with LSA and Monitoring (done)
- Infrastructure embedded in LSA
  - GUI to run your MAD-X file
  - Knob creation for LSA
- Graphics
  - Various Accelerators (LHC of course)
  - Twiss parameters
  - Aperture
  - Beam Envelop
  - Measured and interpolated Closed Orbit
  - Bumps
  - Various aperture parameters like n1 (~August)
- Multiuser Mode (~August)
- Documentation (~August)

How to use it?

- ***Get an appointment with Ilya to set you up how to use it.***
- ***Federico, as our first power user, is preparing to help others to get started.***
- ***In this process the documentation will be continuously improved.***
- ***The user should know what she/he wants and come with MAD-X input files, OM provides infrastructure, set out rules to produce knobs, add features to GUI etc.***
- ***Example (nx, ny, n1…): User brings MAD-X input files to calculate these quantities; he might use OM optics or bring his own; GUI is extended to plot together with aperture, closed orbit etc.***
- ***Federico has volunteered to take over some relevant and more general requests of the users***