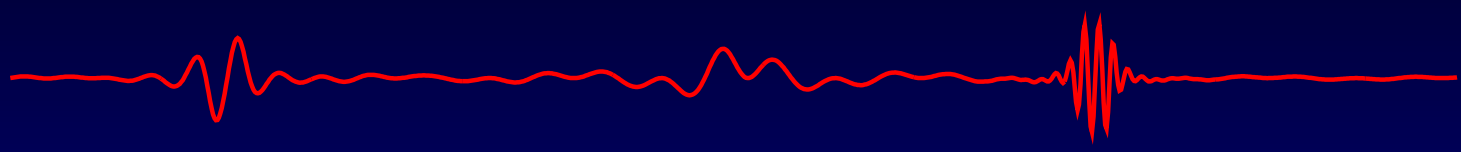
LHC optics correction status



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R. Tomás

LCU - November 2007

Goal

Ensure LHC optics within specs.

Means

- Simulations
- Experimental tests in RHIC and SPS
- Tool development

Status of simulations

Realistic simulations prove that the following correction approach

$$\Delta\vec{k} = -R^{-1}\Delta(\vec{\phi}, \frac{\vec{D}_x}{\sqrt{\beta_x}}, Q_x, Q_y)$$

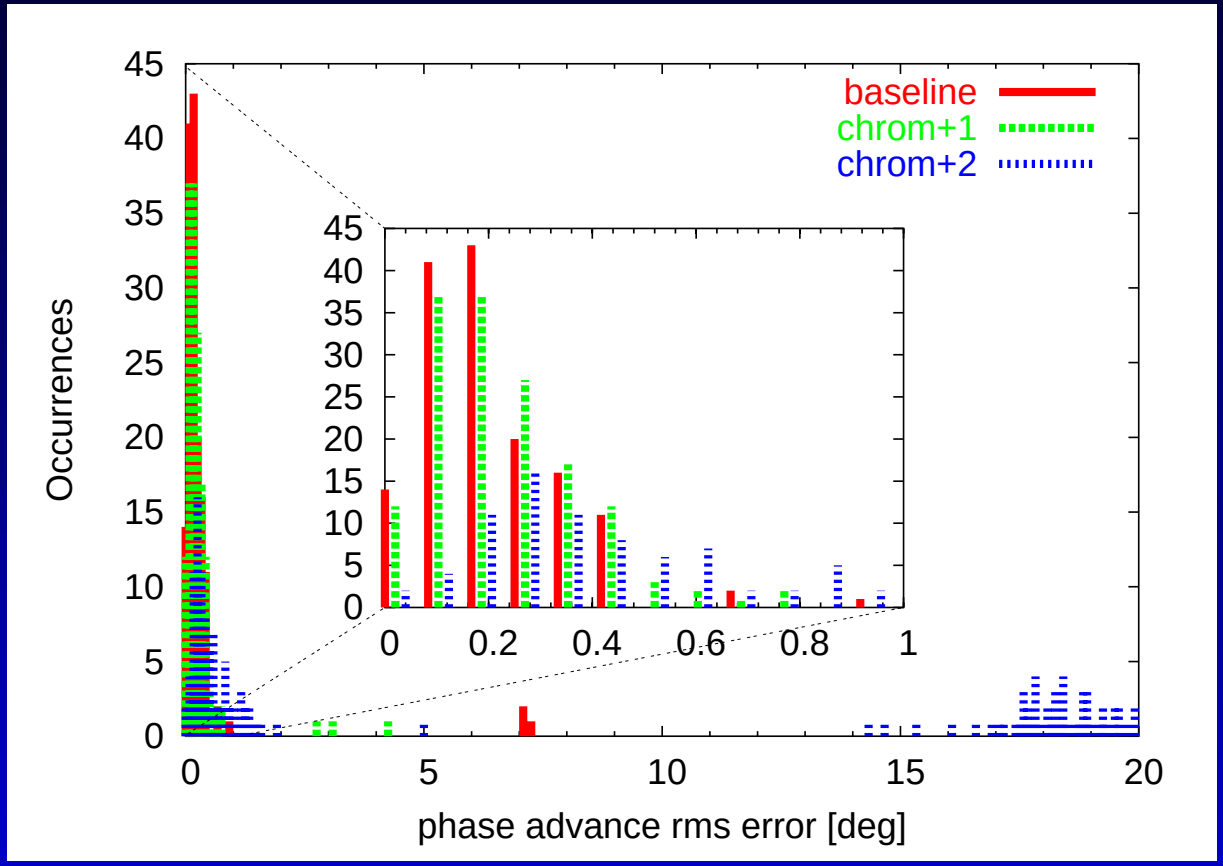
works if:

- $\sigma_\phi < 1^\circ$
- failing BPMs < 10%
- $\sigma_{\frac{D}{\sqrt{\beta}}} \approx 0.01 m^{1/2}$

$\rightarrow$ Might be tight for LHC commissioning

Why it might be tight

Phase error histogram from RHIC kick data



Strengthening correction I

Use A. Morita's COD approach to measure ϕ.

- In CO mode BPMs are usually more reliable than in turn-by-turn mode
- $\sigma_\phi < 1^\circ$ requires $\sigma_{BPM} < 25\mu$m

$\rightarrow$ Very promising as a complementary and/or independent measurement

Strengthening correction II

Use LEP method to infer βs from ϕs (M. Aiba)

- Calibration independent β measurement at BPMs
- But model dependent
- Error depends on ϕ and σ_ϕ
- Expected σ_β/β <3% in the arcs

$\rightarrow$ Very promising as complementary measurement

Strengthening correction III

Use K-modulation to measure βs at independent quads ($\approx$100)

- Preliminary considerations show that high resolution tune measurement is required
- LEP: simultaneous modulation of quads over many minutes to reach high accuracy in ΔQ ($\approx 10^{-5}$)
- Simulations required to prove usability

$\rightarrow$ Promising but controls application required!

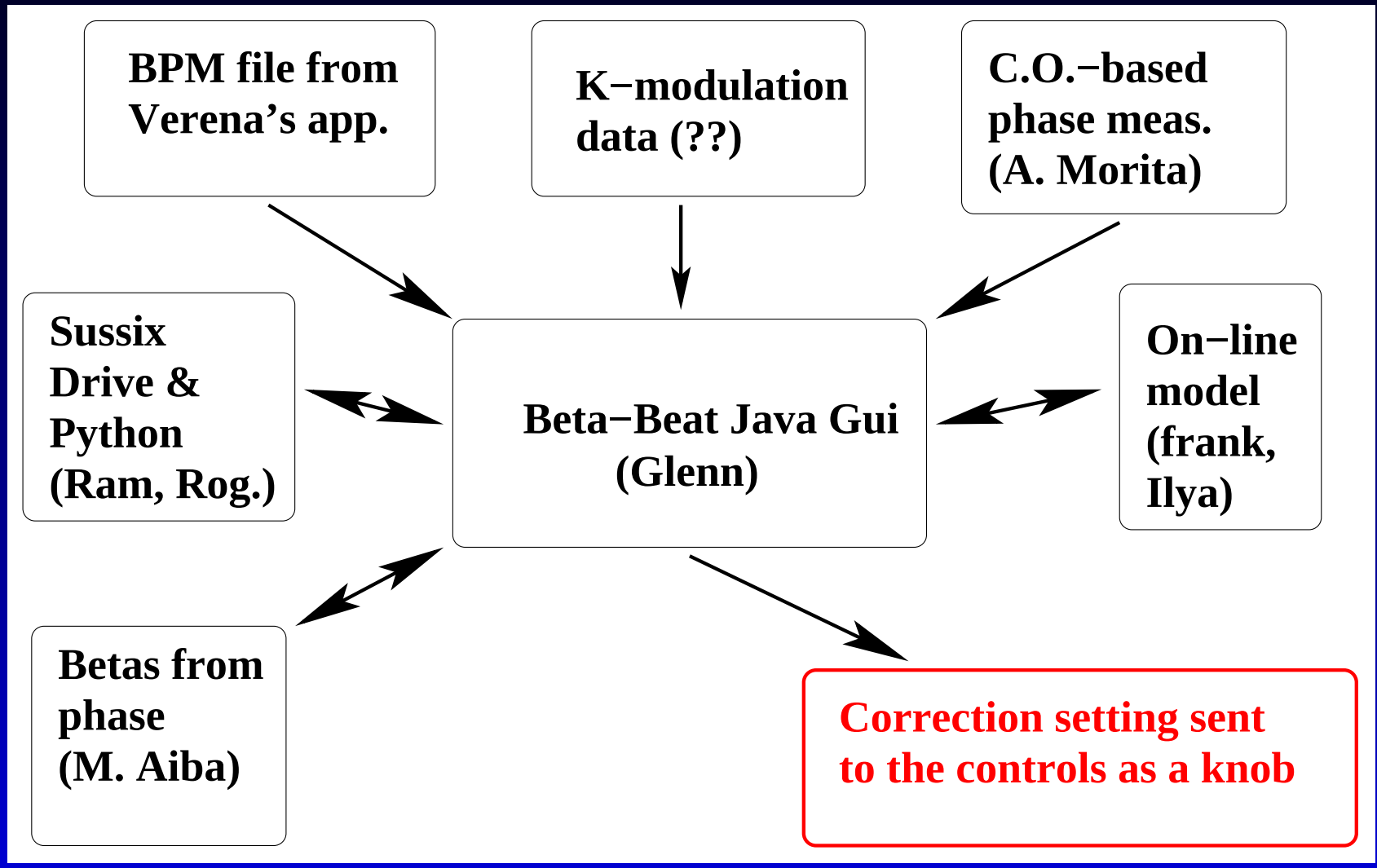
Strengthening correction IV

Use AC-dipole instead of kick

- Better σ_ϕ thanks to the coherent oscillation
- Only way to excite oscillations at top energy!
- (pilot bunch is safe at all energies!)

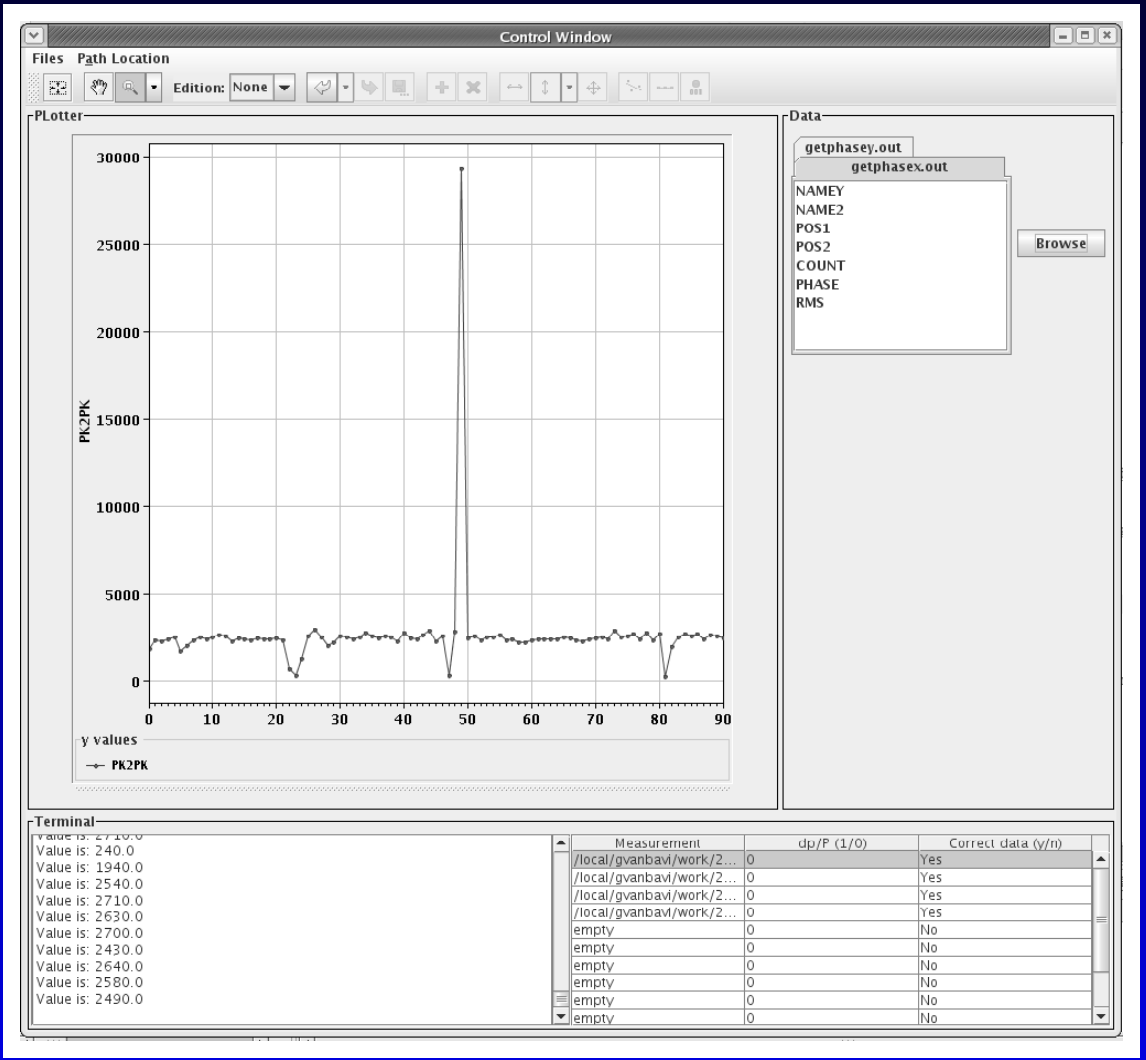
$\rightarrow$ To be used

On-line application I



On-line application II

A screenshot from Glenn's application



Summary and outlook

- A big collaborative effort is being done to guarantee the measurement and correction of the LHC optics
- First BNL-KEK-SLAC-CERN LHC optics correction meeting, October 2007