Optics-measurement-based BPM calibration with Ballistic optics

LHC MD233 "Balistic optics in the triplets" 7-November-2015

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State-of-the-art

β function is being computed using two different methods:

- N-BPM phase advance method.
- Transversal oscillations amplitude (Amplitude method).

Amplitude method

- The amplitude method depends on the BPM calibration $x_{measured} = C \cdot x_{correct}$ where C is a calibration factor.
- Since the β function is related to the position through the equation $x = \sqrt{\beta \cdot \epsilon}$, the $\beta_{measured} = C^{2} \cdot \beta_{correct}$.

Calibration procedure

- The calibration factor C^2 has been computed using the $\beta_{correct}$ coming from a fit of the β from phase.

Motivation

MD motivation

The goals of the MD are:

- To improve the knowledge on the BPM alignment in the triplet.
- To disentangle better optics errors from the triplets and from Q4.

Analysis motivation

- Challenging β^* control in HL-LHC.

Motivation

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The goals of the MD are:

- To improve the knowledge on the BPM alignment in the triplet.
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Analysis motivation

- Challenging β^* control in HL-LHC.
- Here we compute C^2 using β from phase in dedicated optics (ballistic).

MD description

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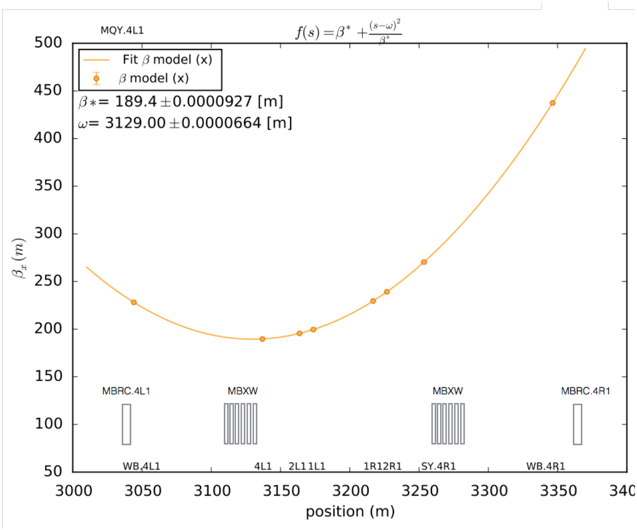
- Triplet is switched off.
- Optics measured with AC-dipole.

MD specifications

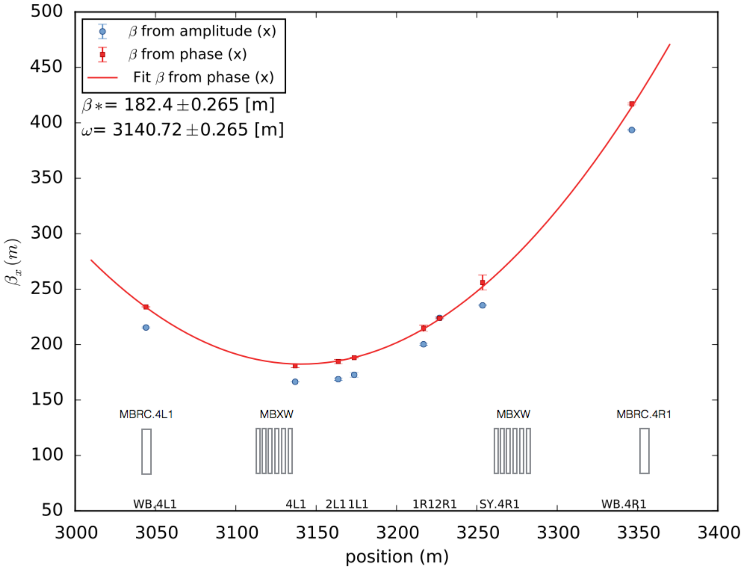
- Beam: both
- Beam energies:
  - Injection
  - Flat top
  - Ramp
- Time required (hours): 8 hours

- Beam: Beam 2
- Beam energies:
  - Injection
- Time (hours) : 4 hours

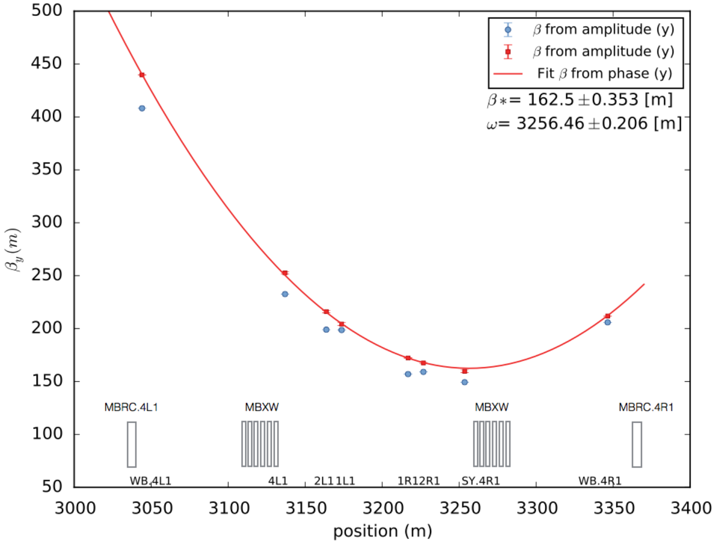
Analysis of the parabolic behavior of β from model at the IRs



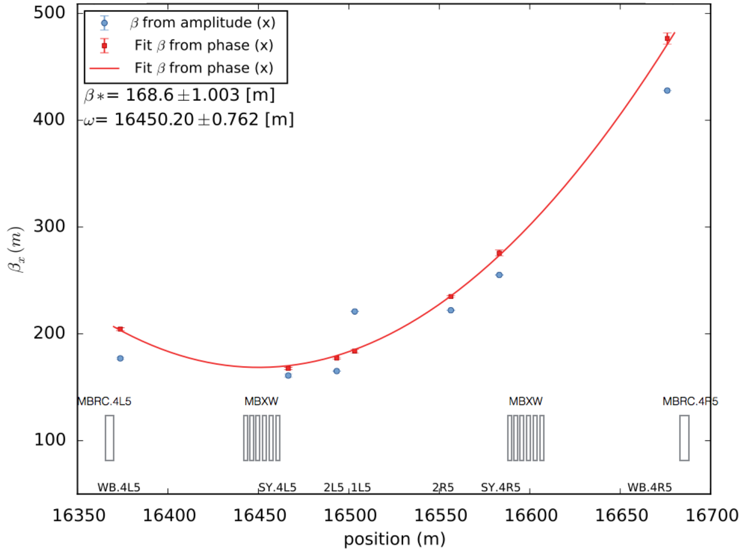
Measurements IR1 I: Horizontal



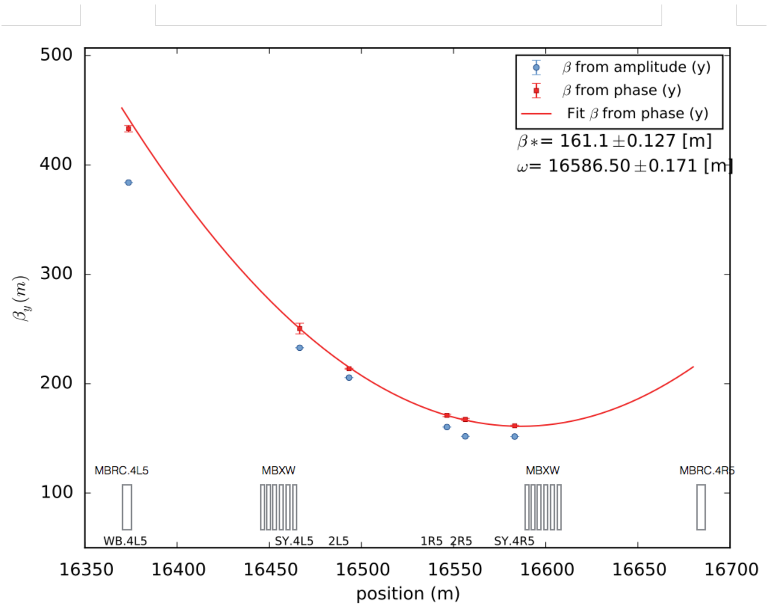
Measurements IR1 II: Vertical



Measurements IR5 I: Horizontal



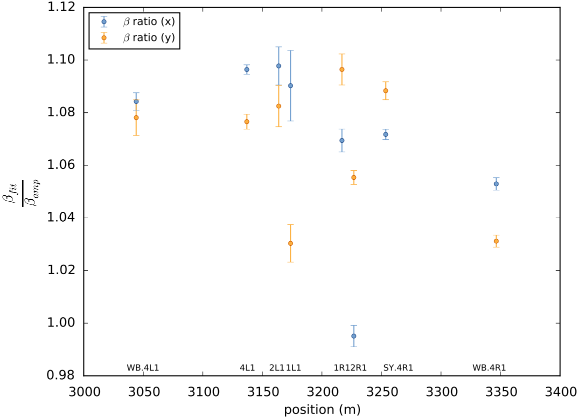
Measurements IR5 II: Vertical



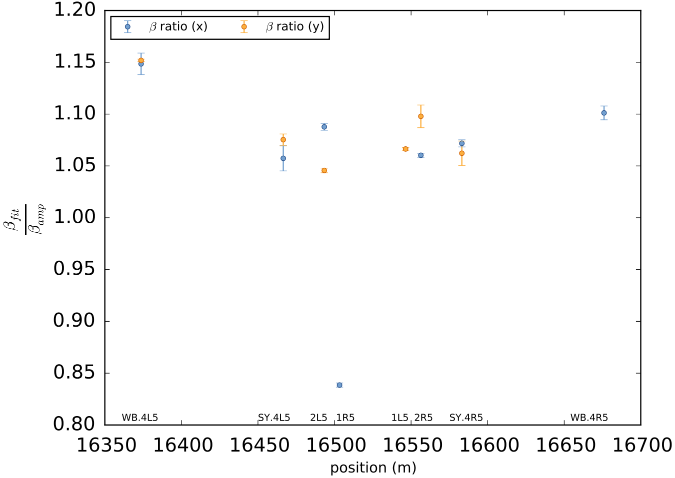
Calibration ratios I: IR1

β phase fit $\rightarrow \beta(s) = \beta^* + \frac{(s-\omega)^2}{\beta^*}$ at the current BPMs positions.

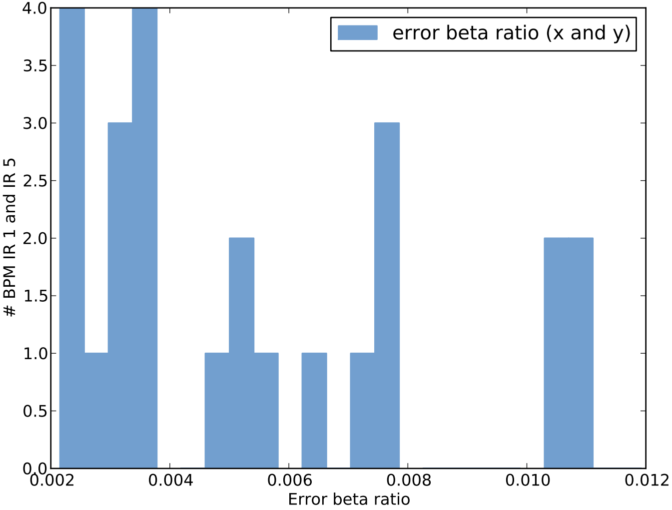
β ratio $= \frac{\beta phasefit}{\beta amplitude}$



Calibration ratios I: IR5



Error calibration ratios



Conclusions and outlook

Conclusions

- C^2 can be measured with an accuracy smaller than 1.2 %.
- C is acquired with an error lower than 0.6 %.

Outlook

- Study of calibration dependence with beam orbit in the BPMs
- Hopefully complete set of data (both beams 6.5TeV) in 2016