

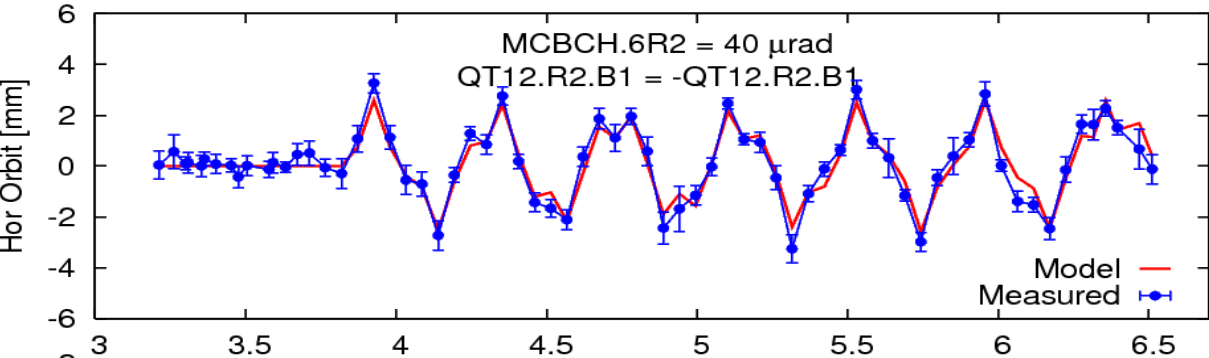
# Polarity Tests & Optics

M. Aiba, R. Calaga, A. Franchi, M. Giovannozzi, V. Kain, M. Lamont, A. Morita, L. Ponce, Y. Sun, R. Tomas, G. Vanbavinckhove, W.~Venturini-Delsolaro, J. Wenninger, F. Zimmermann

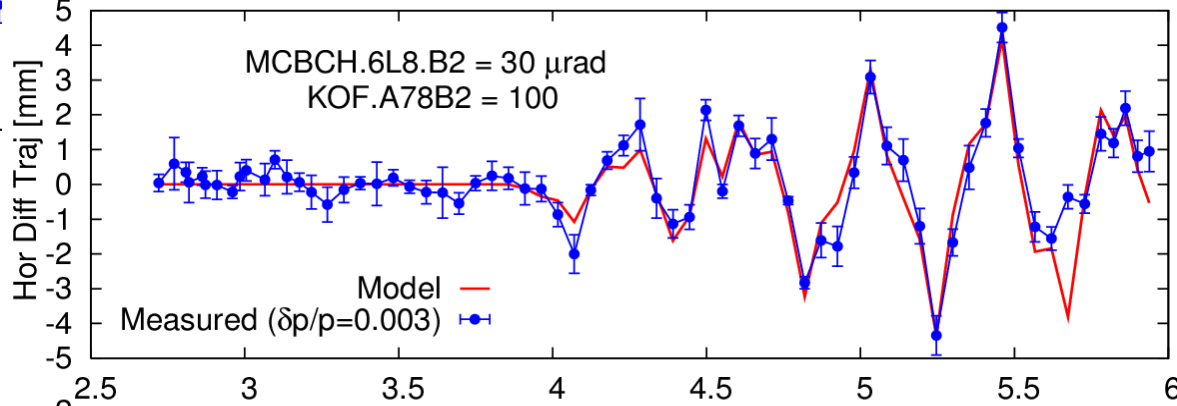
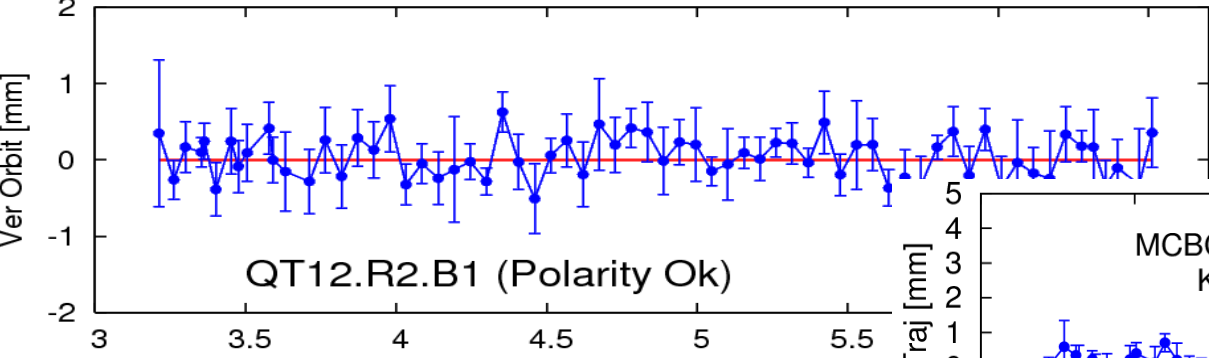
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Ack: Operations Team

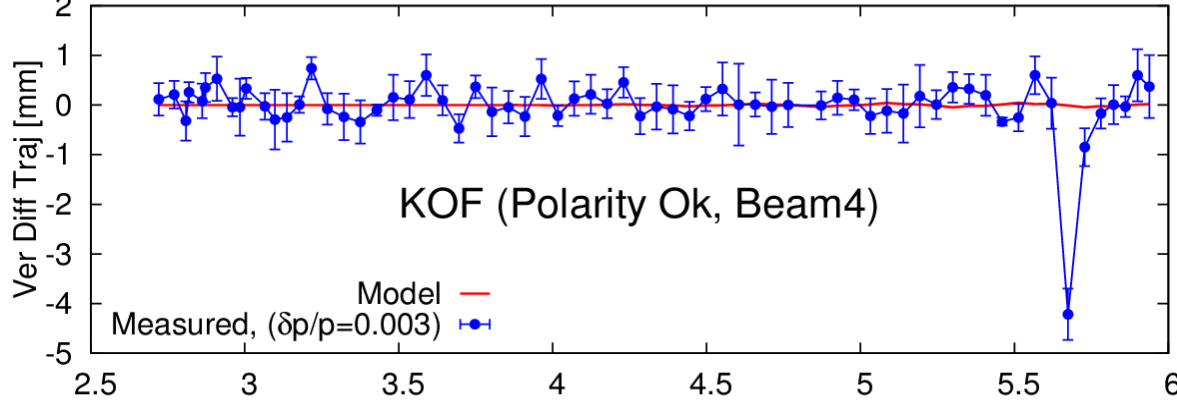
# Polarity Tests, Difference Orbits



Beam 1, QT12.R2



Beam 2(4), KOF -  $\delta p/p=0.003$



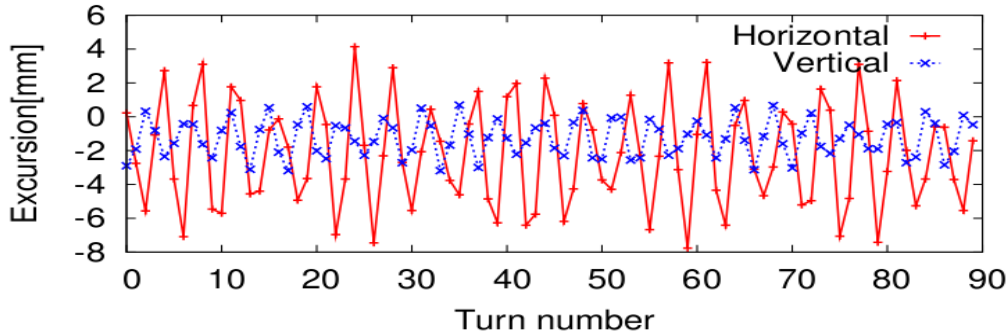
# Polarity Tests

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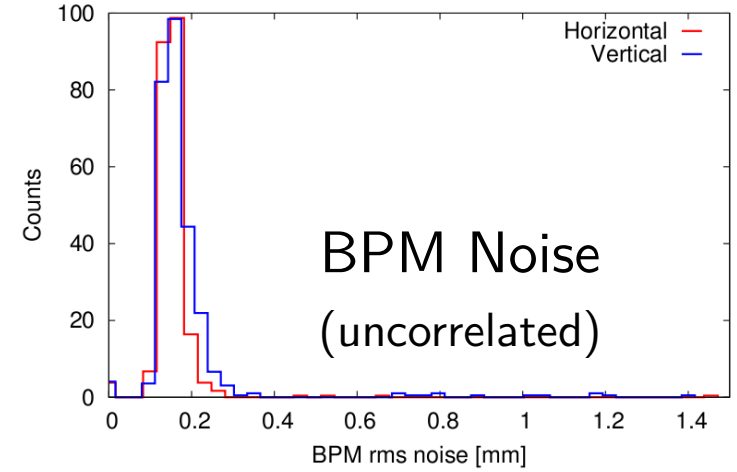
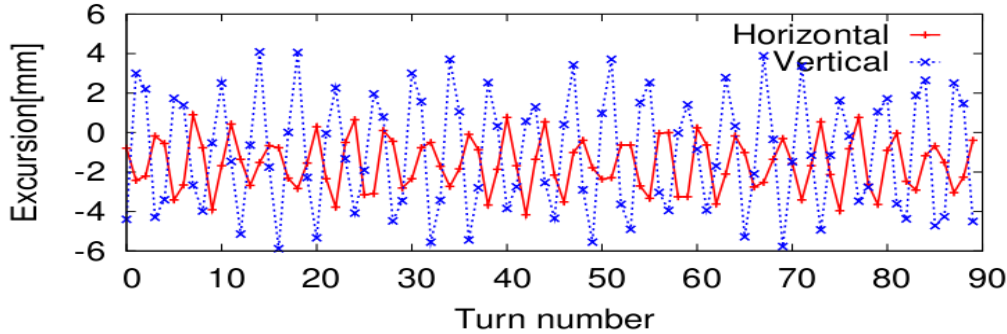
- Very robust & clean signals from difference orbits to detect polarities of circuits
- Nominal lattice with reversed polarities & higher order circuits with  $dp/p$
- Orbit effect due to initial large offset for QT11.78 also found ([Y. Sun](#))
- Beam 2:
  - QT{11, 12, 13}, **MQS**
  - SF{1,2}, SD{1,2}, MSS
  - KOF, **KOD**
- Beam 2:
  - QT{11( $\delta x_{\text{initial}}$ ), 12, 13 (noisy)}, **MQS**
  - SF{1,2}, SD{1,2}, **MSS**, MCS
  - KOF, **KOD** ( $\delta p/p$  -or-  $D_{y, \text{initial}}$ )
- Future measurements with single passage -or- circulating beam

# Optics Measurements, Beam 2

BPM.12R1.B2

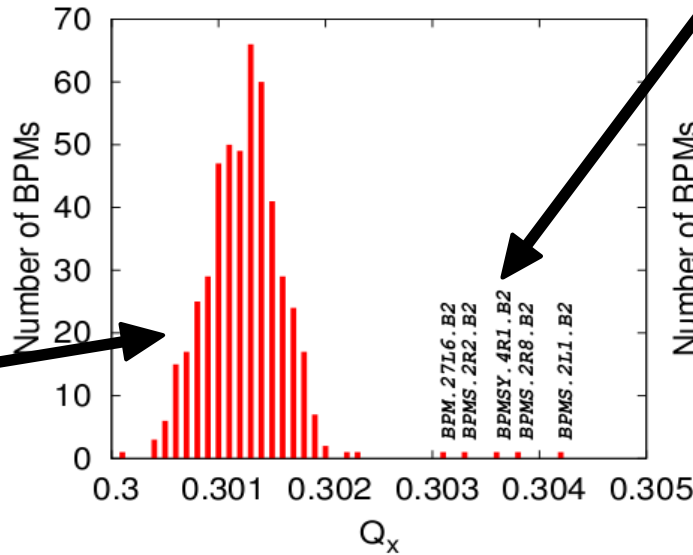


BPM.11R1.B2



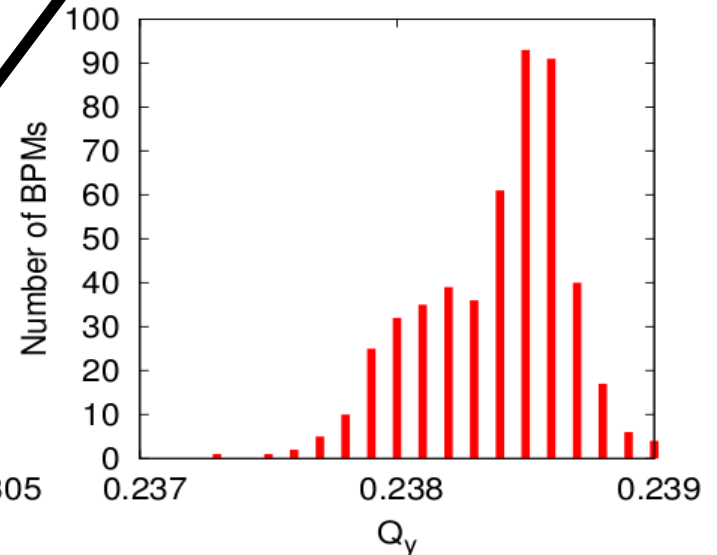
Possible faulty BPMs

Horizontal tune

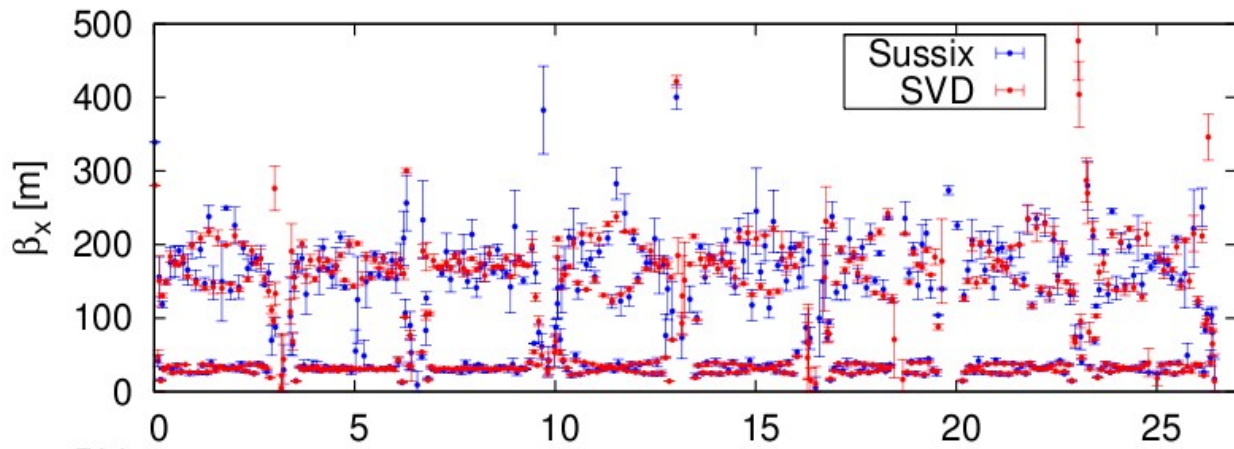


Large tune spread  
(only 90 turns)

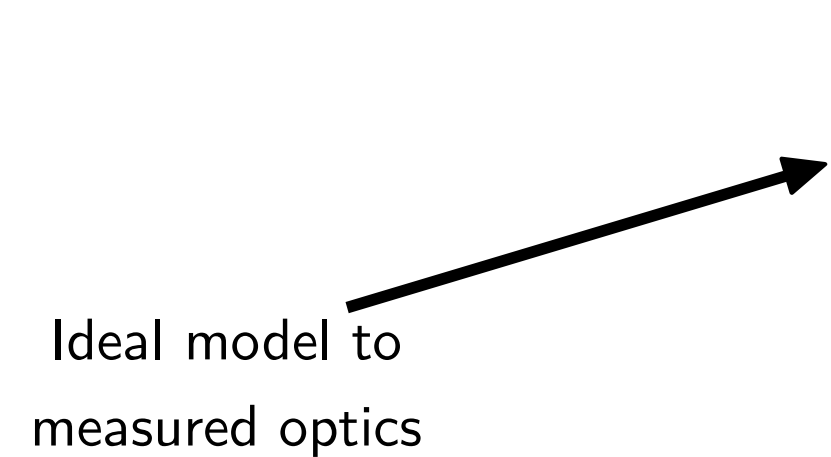
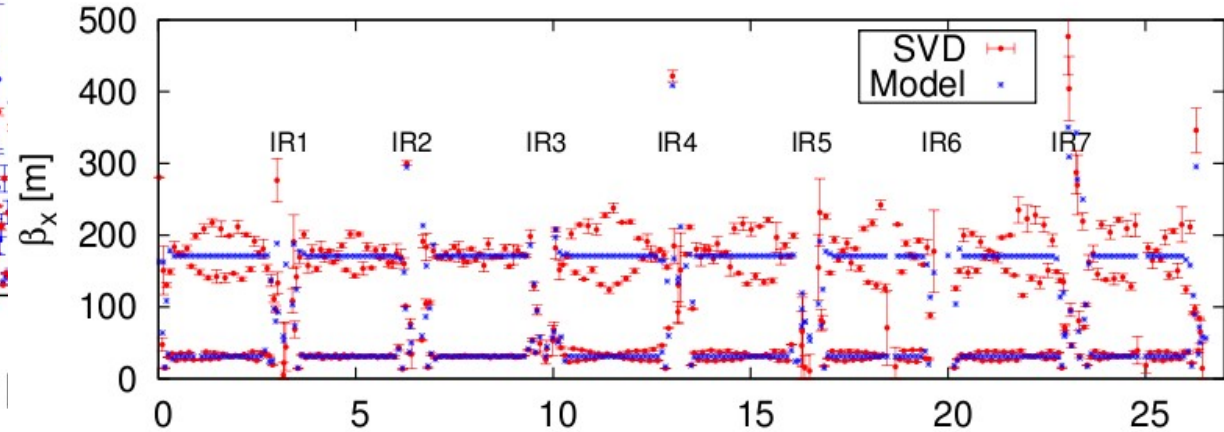
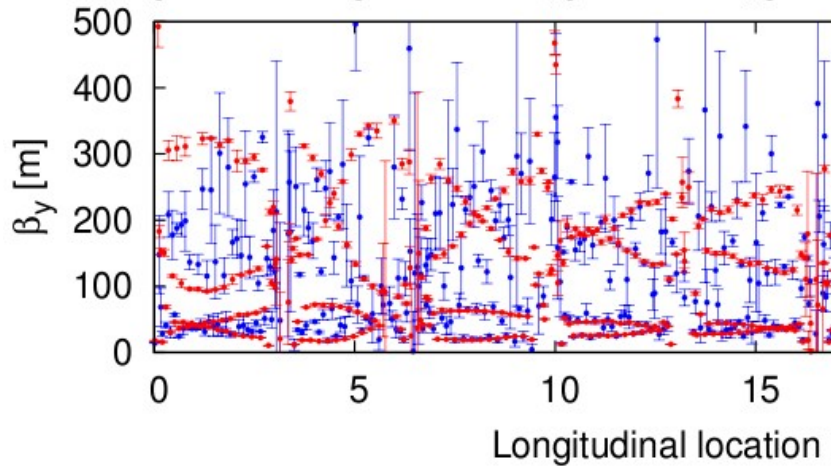
Vertical tune



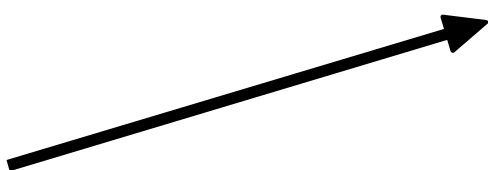
# Optics, Beam 2



Two different algorithms

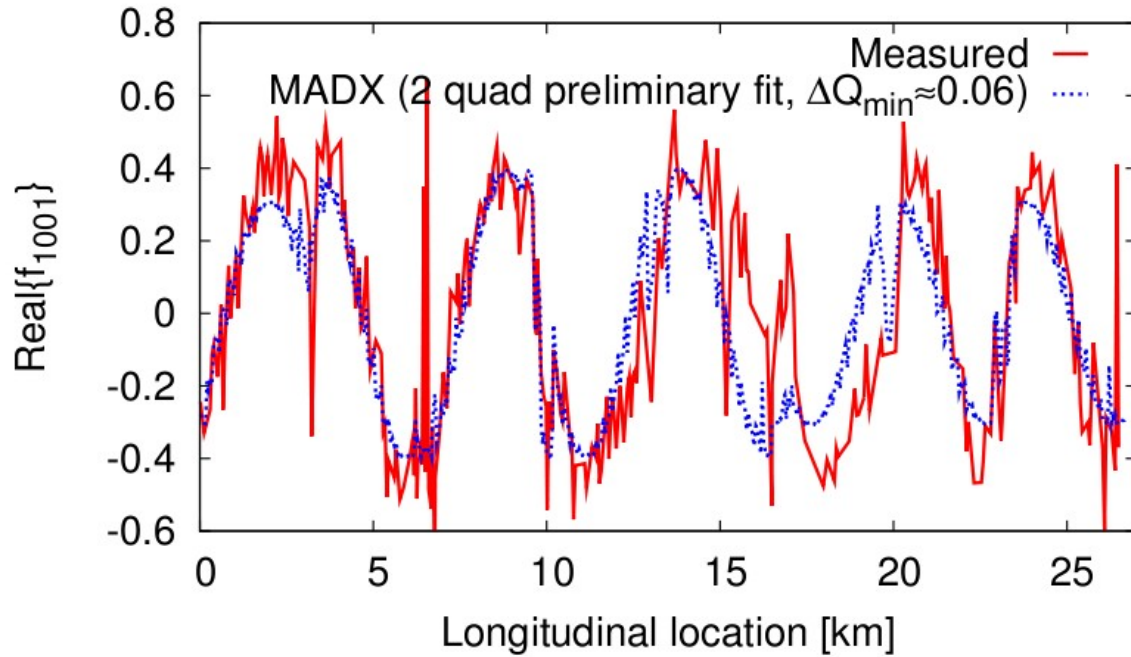


Ideal model to measured optics



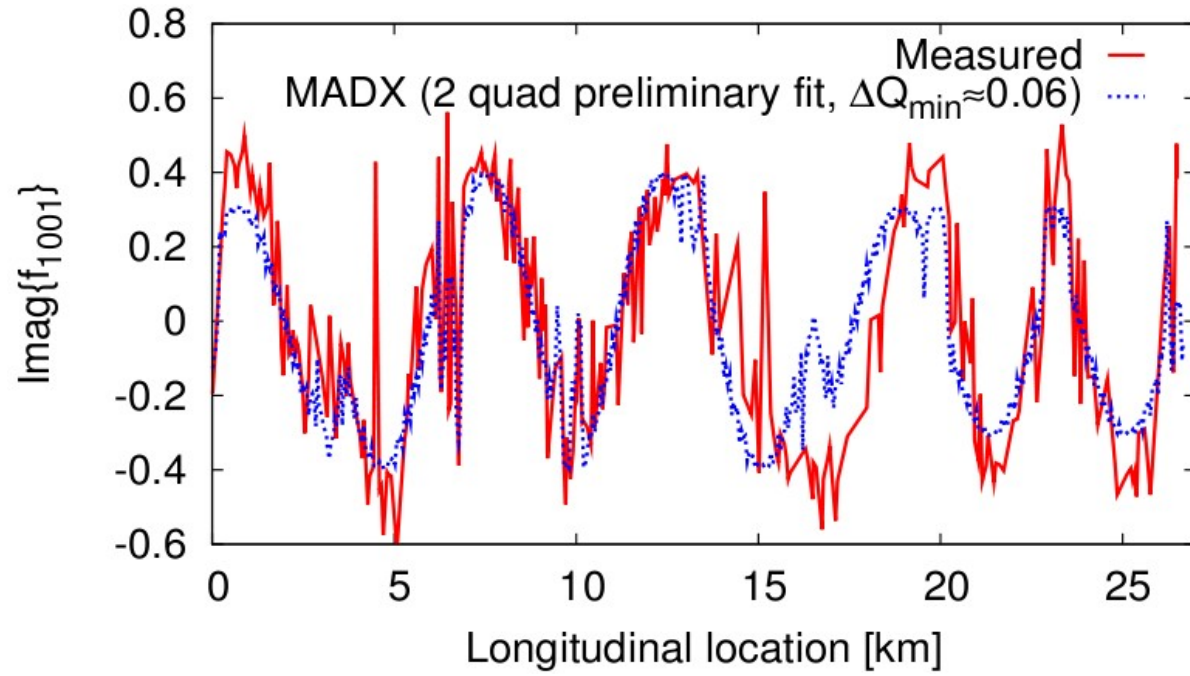
Longitudinal location [km]

# Coupling, Beam 2



Integer tune difference clearly seen in the measurement

$\Delta Q_{\min} \sim 0.06$   
(uncorrected)



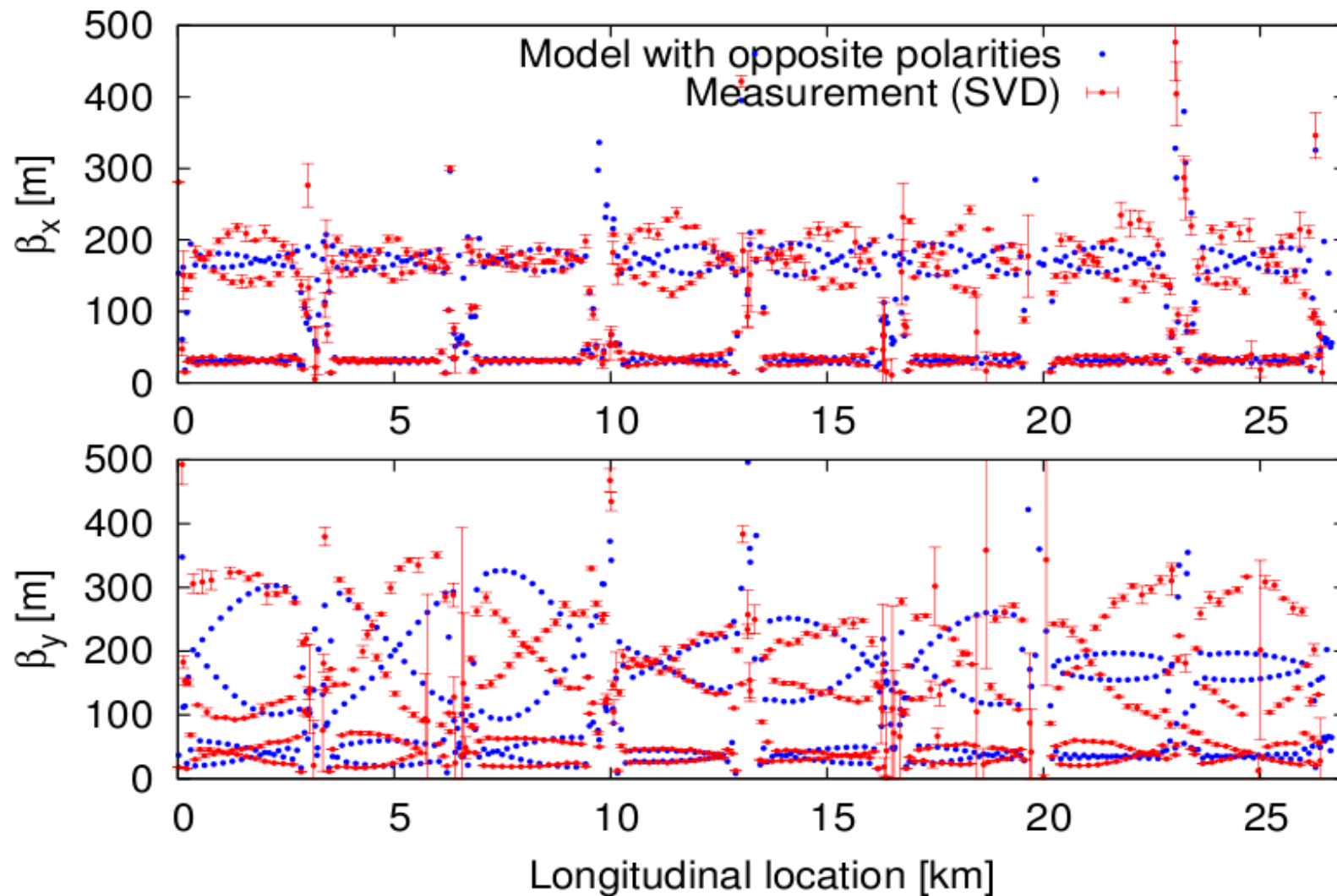


# Optics Measurements, Beam 2

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- Successful measurements of optics functions & coupling possible with **only** 90 turns
- SVD provides a better measurement, perhaps due to large spatial correlation (500 BPMs)
- Robust identification of faulty BPMs (1-2%, tolerance for correction - < 10%)
- Strong coupling signal measured and corresponding driving terms. Integer tune difference clearly visible from this measurement
- A complete model to measurement comparison underway
  - Complete **error model** ( $a_2, b_2 \dots$ ) & orbit feed-down (small effect compared to meas)
  - Known **polarity errors** during this measurement
  - Estimation of **unknown error sources** for the remaining differences
- Optics & coupling tools ready for LHC beams, multiple algorithms and future additions (ex: harmonic analysis) to make the flexible & robust measurements/analysis and apply corrections

# Model with **Only** Opposite Polarities



- Need to include complete **error model** (a2, b2...) &
- Estimation of **unknown error sources** for the remaining differences