Preliminary analysis of orbit bump data for MCS and MS checks

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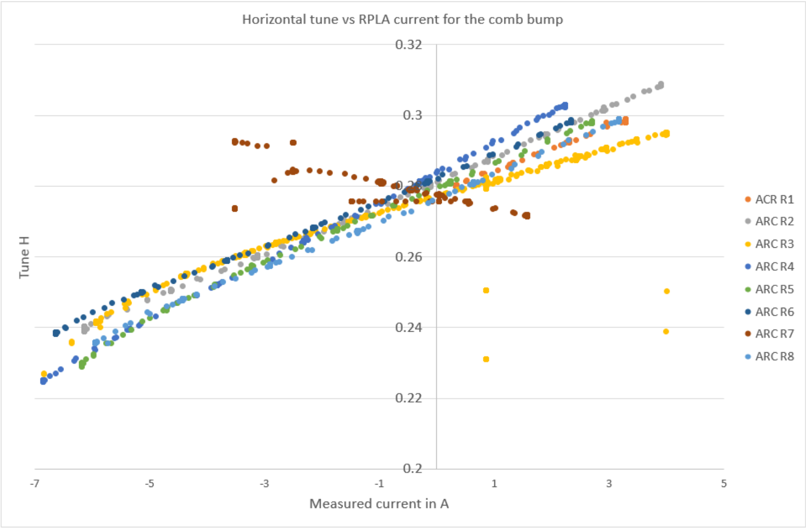
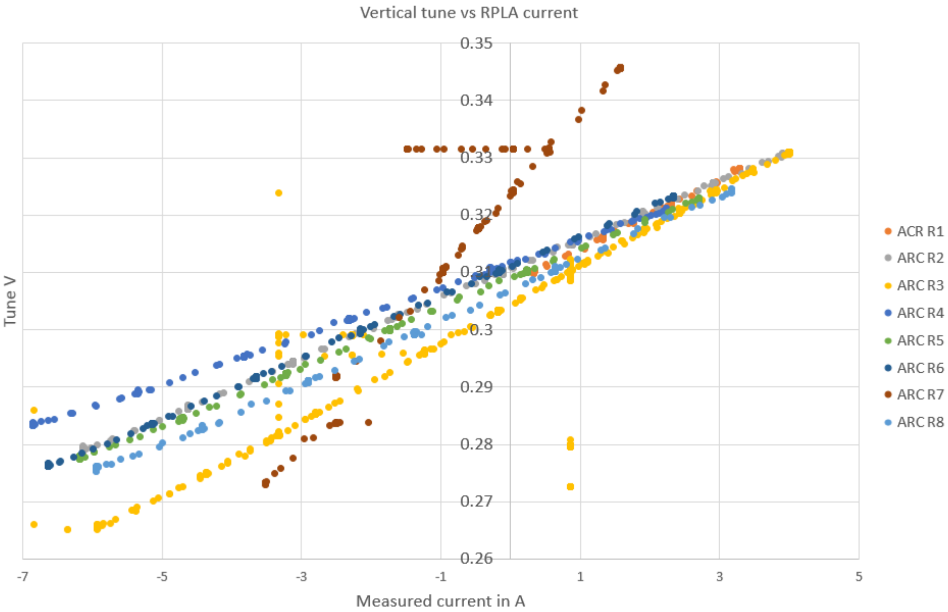
thanks to OMC, OP teams, Alessio, Per and Matteo

Starting MCS analysis (Benoit)

- MD done by Rogelio in the night of April 9th 2016





Next steps

- Correlation with comb bump amplitude in mm
- Comparison with MAD models to assess MCS strength needed to reproduce the data

LHC injection model (Ewen)

- optics: /afs/cern.ch/eng/lhc/optics/runII/2016/opt_inj_thin.madx

- main dipoles errors (b3 only included for the moment):

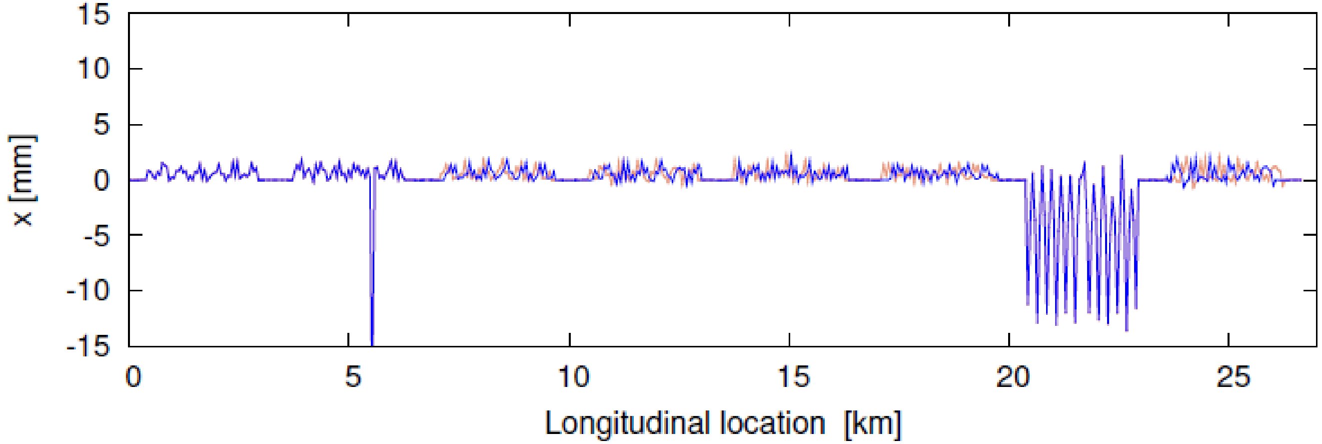
old: /afs/cern.ch/eng/lhc/optics/V6.503/WISE/After_sector_3-4_repair/injection/injection_errors-emfqcs-10.tfs
new: LHC-emfqcs.tfs + dynamic decay of b3 (Per & Matteo)

- /afs/cern.ch/eng/lhc/optics/SLHCV1.0/ errors/corr_MB_phaseI model MCS setting
  kcs strenght from LSA Trim application

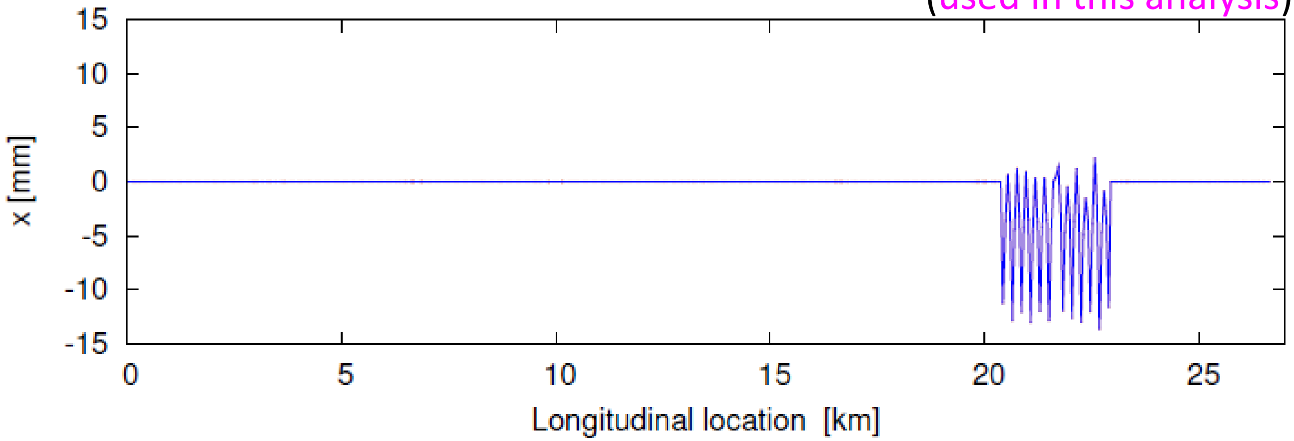
- Main Sextupoles setting from LSA Trim application:
  For beam 1 one setting
  For beam 2 three settings

Orbit matching (Ewen)

match measured orbit bumps using virtual correctors (work in progress)



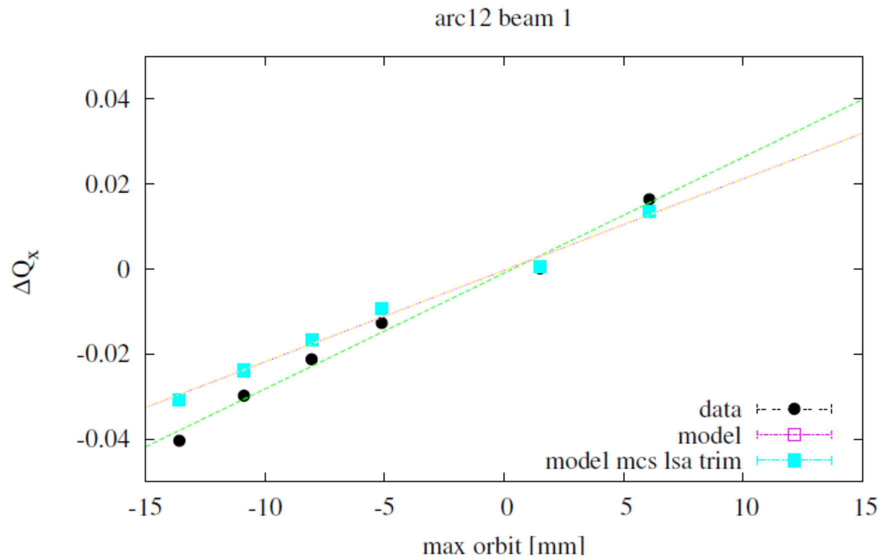
match measured orbit bumps using virtual correctors arc by arc (used in this analysis)



Tune shift vs bumps amplitude beam 1

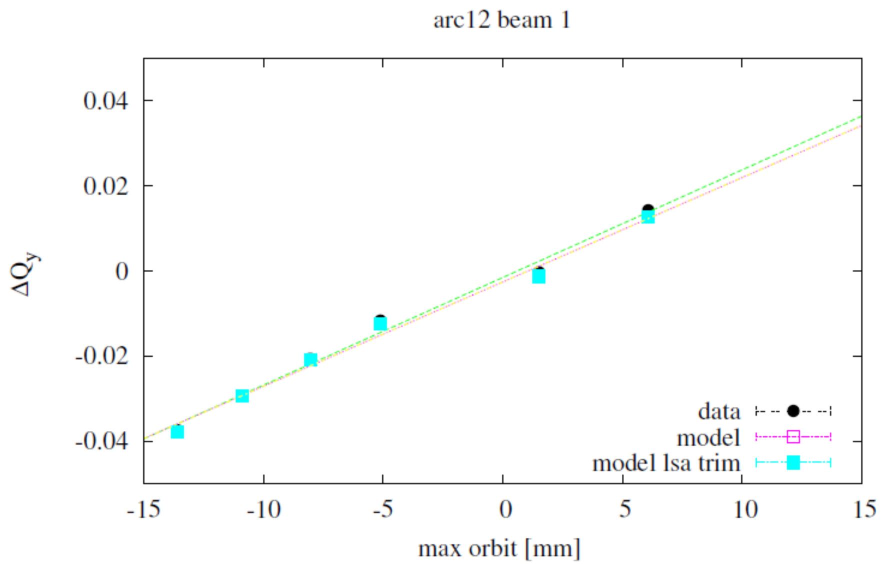
MCS setting LSA Trim and MCS computed for new table + dynamic b_3 at the time of the measurement match perfectly !

$\Rightarrow$ b_3 of main dipoles ~100% corrected



H tune shift vs orbit shows missing sextupolar component compensation

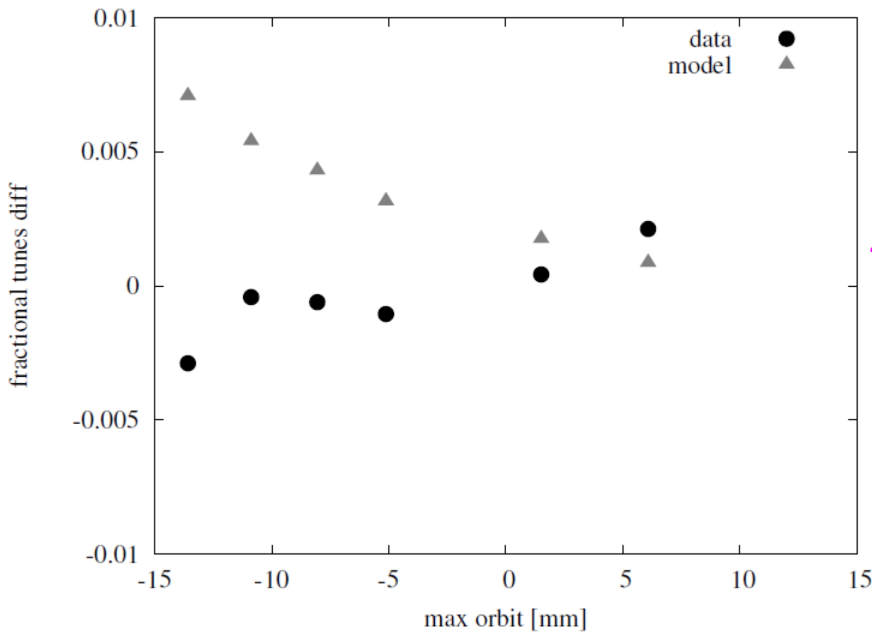
V tune shift vs orbit agree pretty well with the model



Chromas from the model
dq1 ~ -17.
dq2 ~ 5.

Context: paper of Mark Hayes

arc12 beam 1



Benoit, Ewen, Roge, Tobias
(MCS studies 2015)

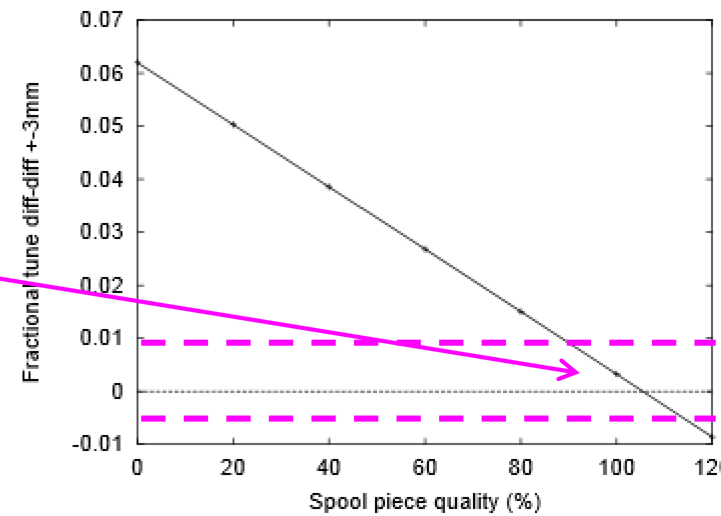
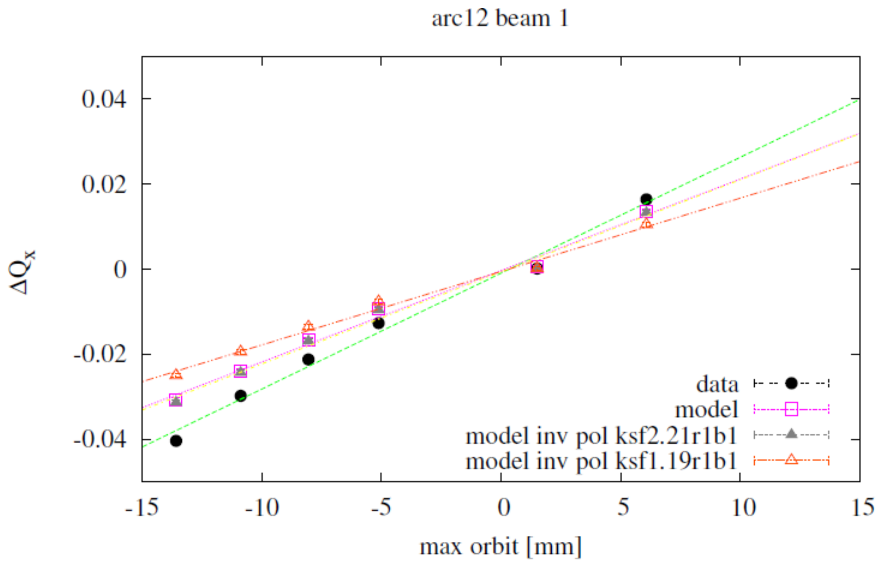


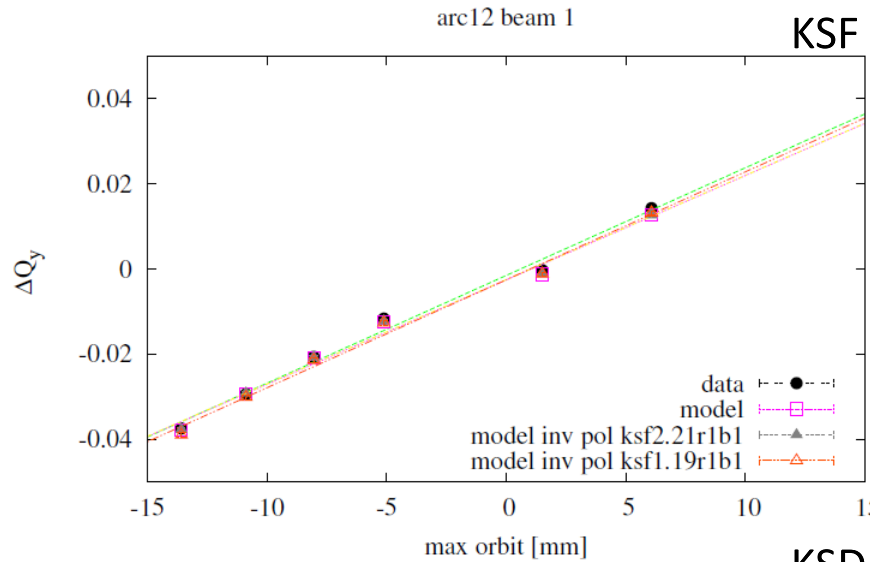
Figure 4: The fractional tune difference $(Q_x - Q_y)$ for two bumps at $\pm$ 3 mm as a function of spool piece quality. The line at $y = 0$ is drawn in to guide the eye.

$\Delta Q_x \approx \Delta Q_y \Rightarrow$ almost 100% of b3 corrected by MCS settings

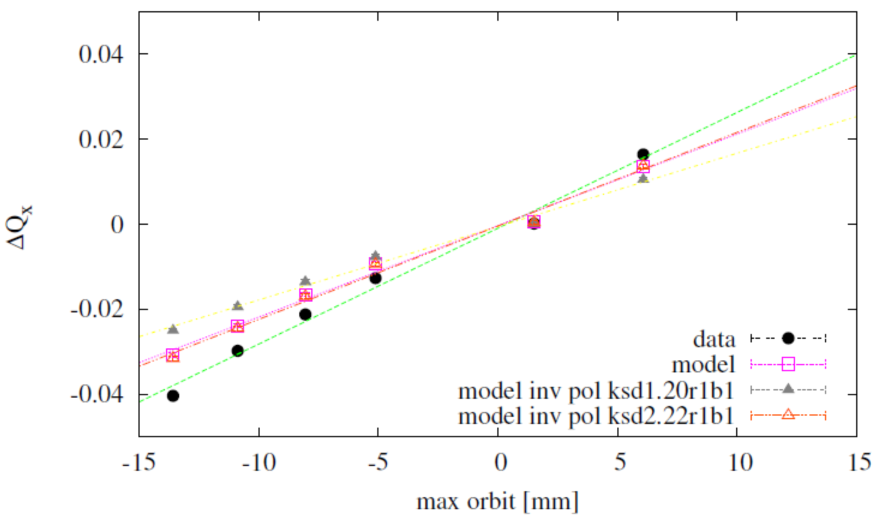
Effect of a MS inverse polarity

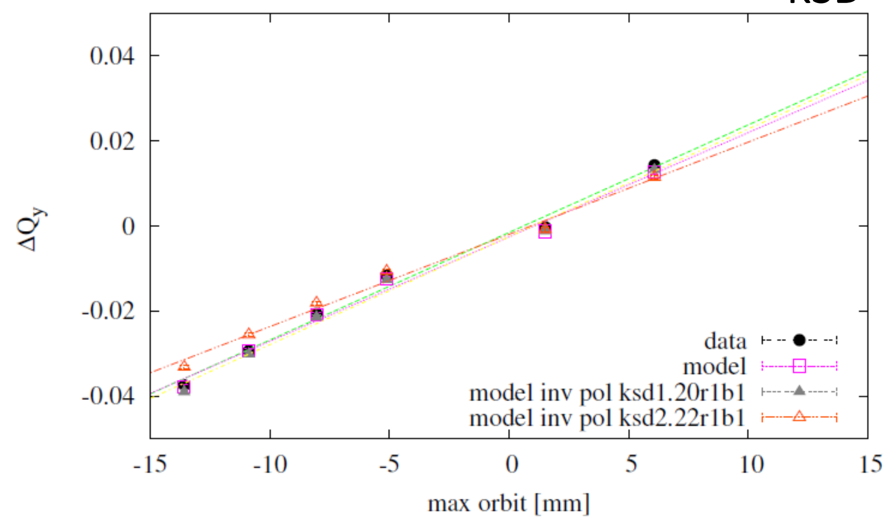
KSF





KSD

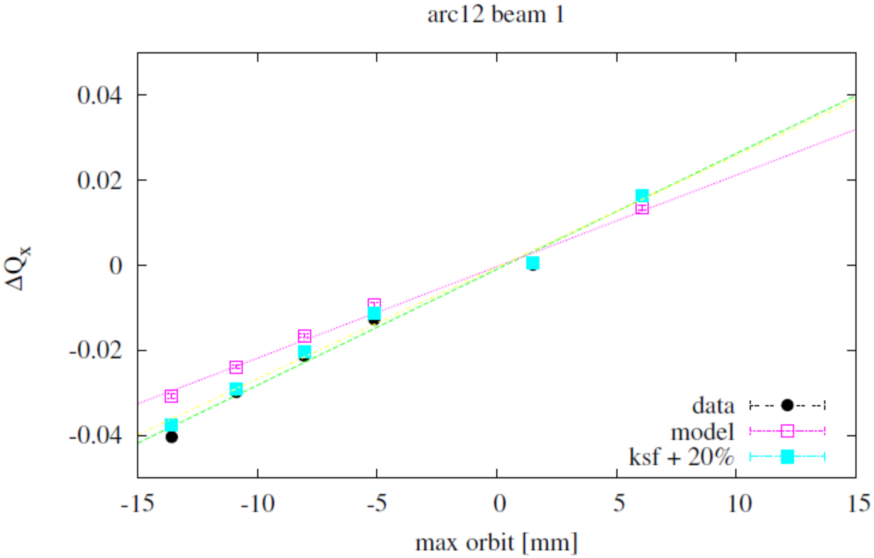


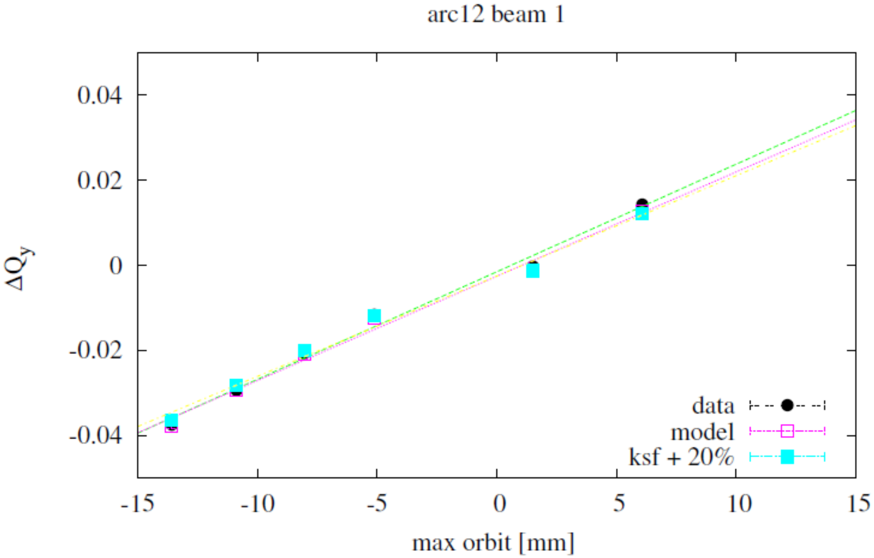


Difficult to « put in evidence » the inverse polarity of a single sextupole of the arcs

Changing KSF strength

20% more KSF strength would explain H tune shift for arc12 beam 1

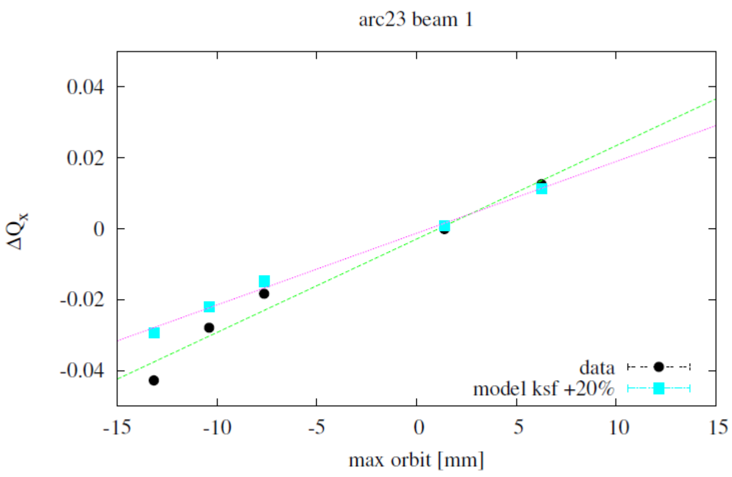


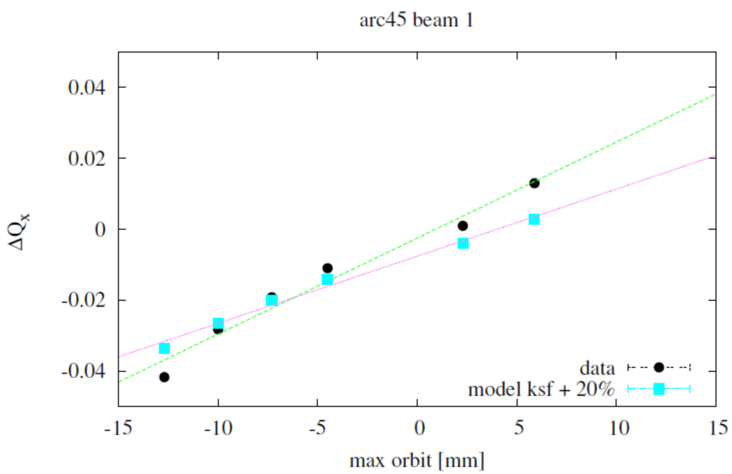


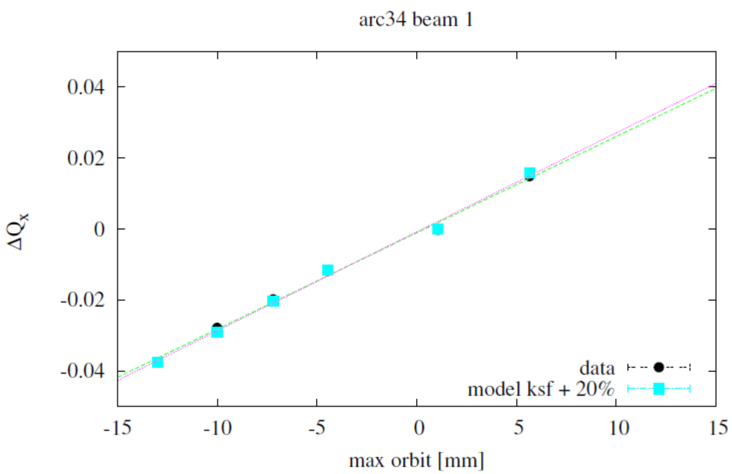
H tune shift vs bumps amplitude beam 1

20% more KSF strength OK for arc34

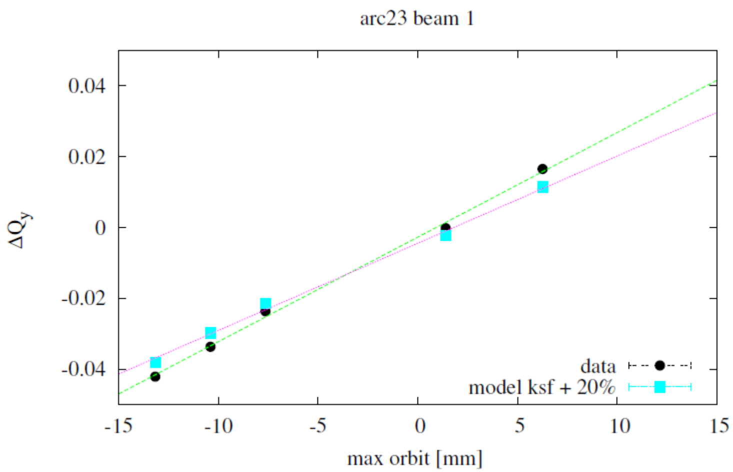
not enough for arc 23 and 45

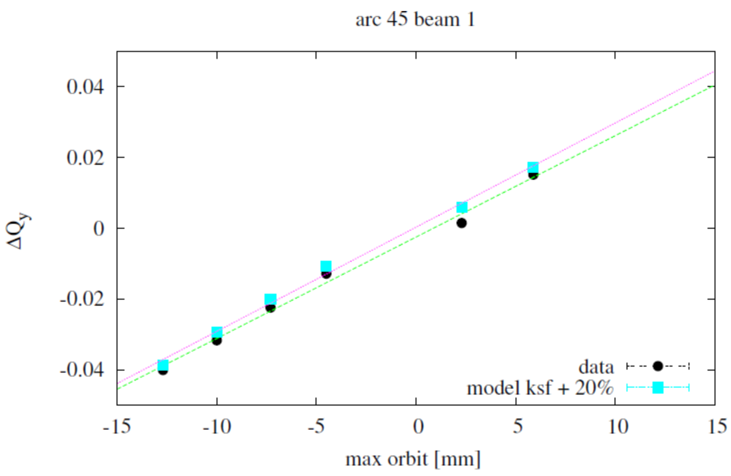


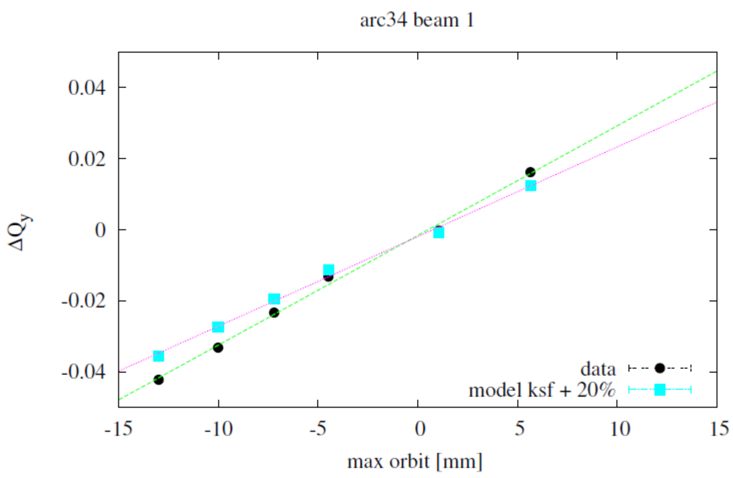




V tune shift vs bumps amplitude beam 1





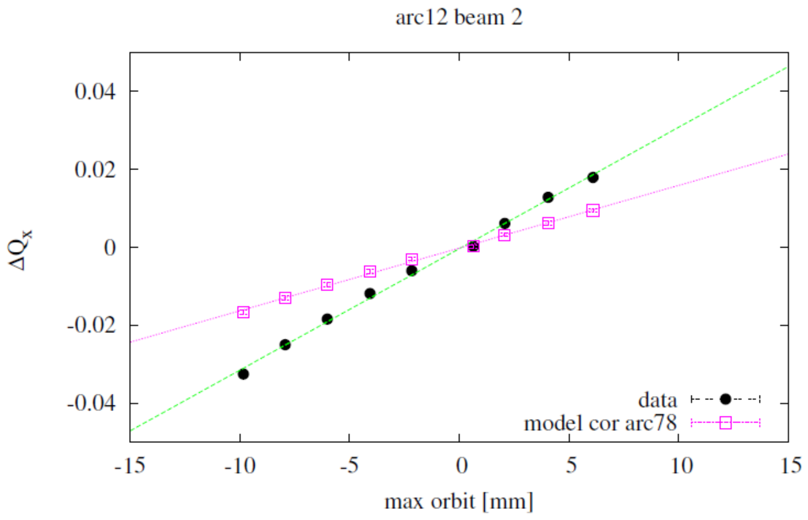


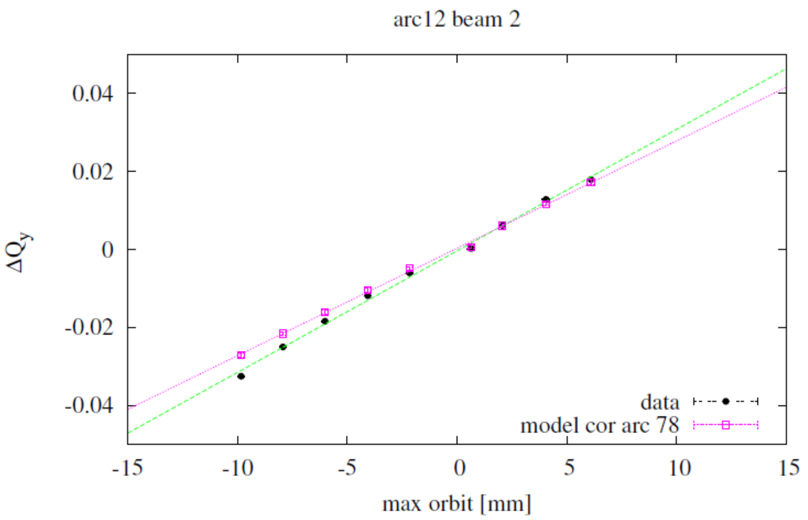
Beam 2

MCS off in arc 78

Correcting the other arc for arc78 missing MCS strength

Still big difference in H tune shift
⇒ KSF strength for beam 2 ??





Very preliminary

Next steps

Complete beam 2 study

Study the impact of full ring orbit matching

Explore effect of BPMs calibration ?

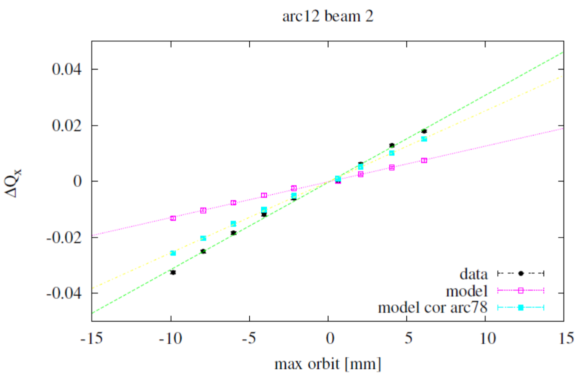
Include alignment errors and a3 of main dipoles in the model

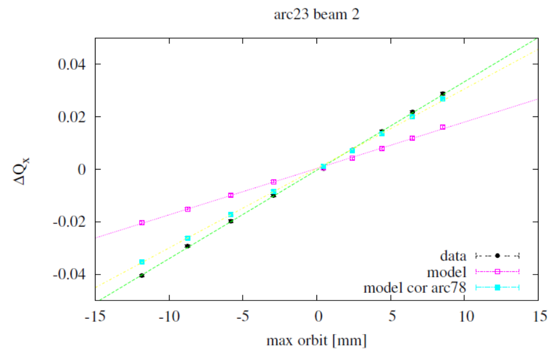
Check other sources of b3 …

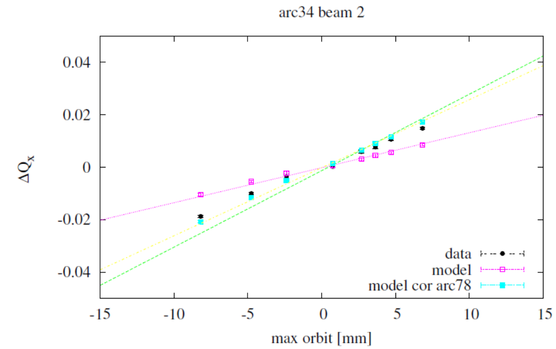
Check with Ezio the possible hysteresis of sextupoles at injection

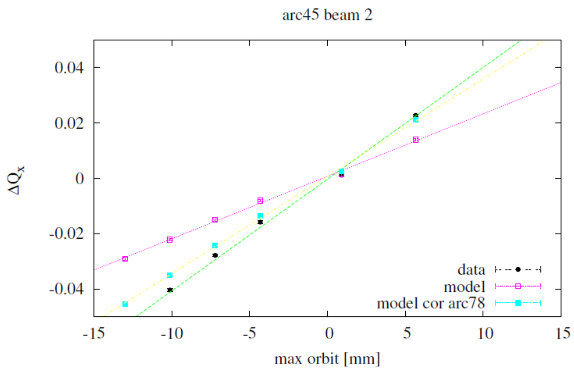
…?...

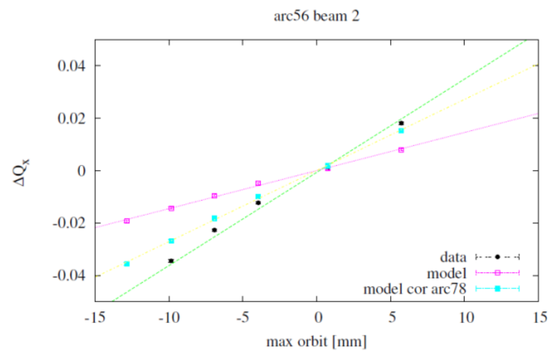
H tune shift vs bumps amplitude beam 2

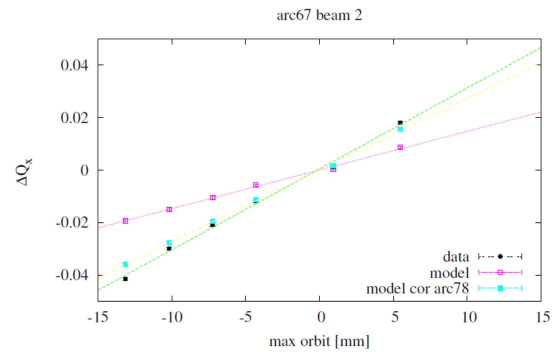


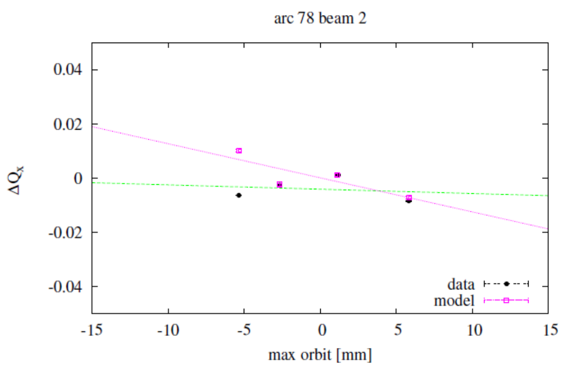


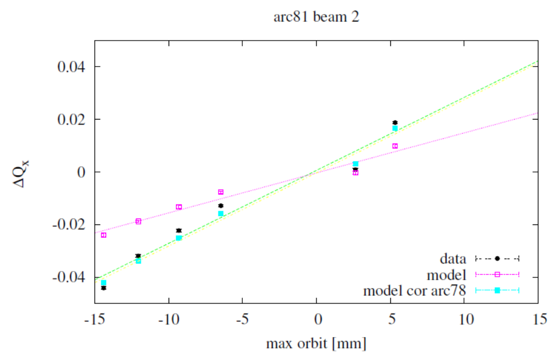




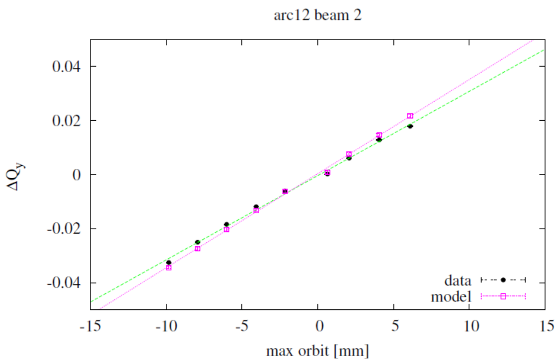


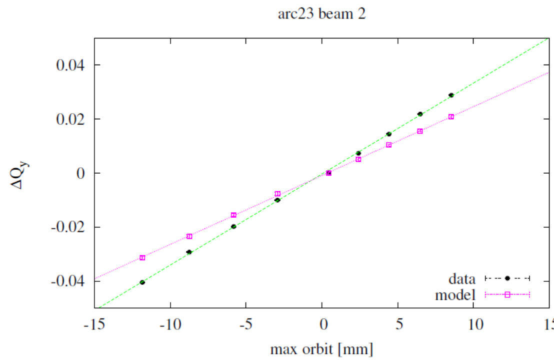


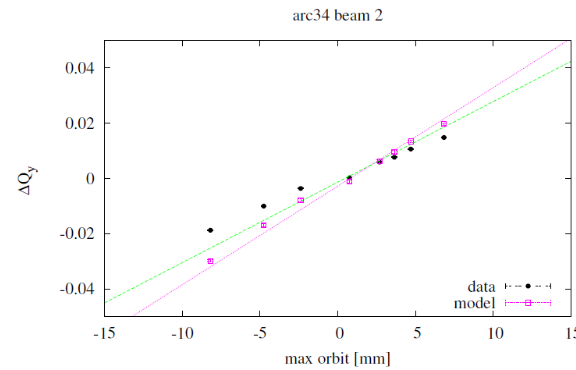


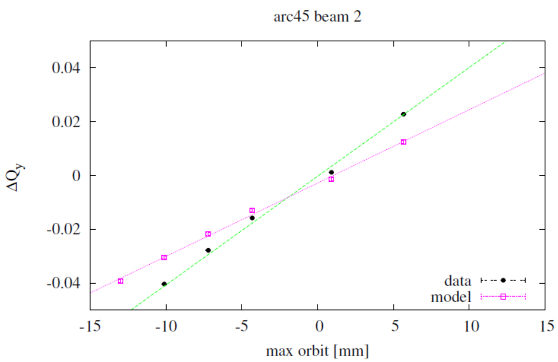


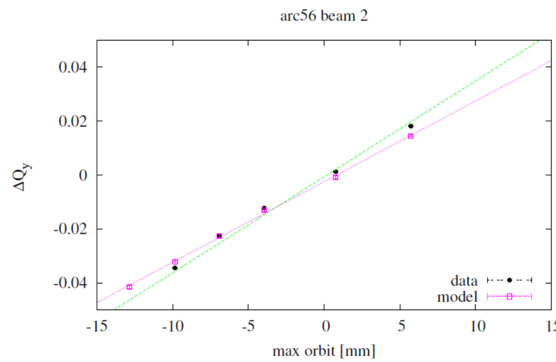
V tune shift vs bumps amplitude beam 2

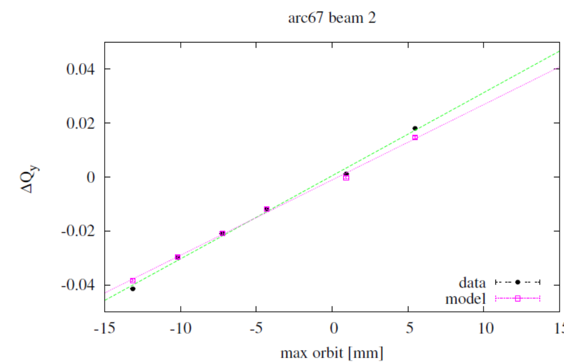


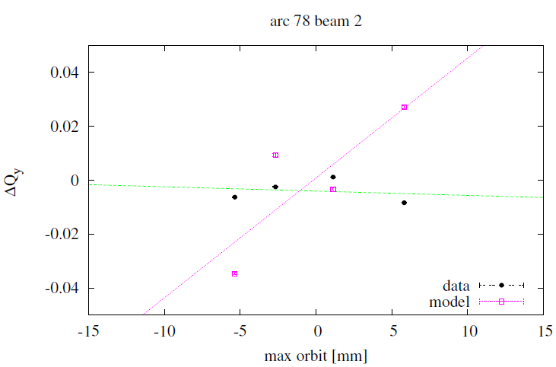


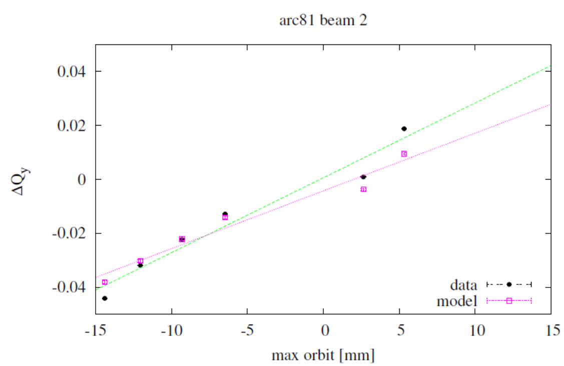






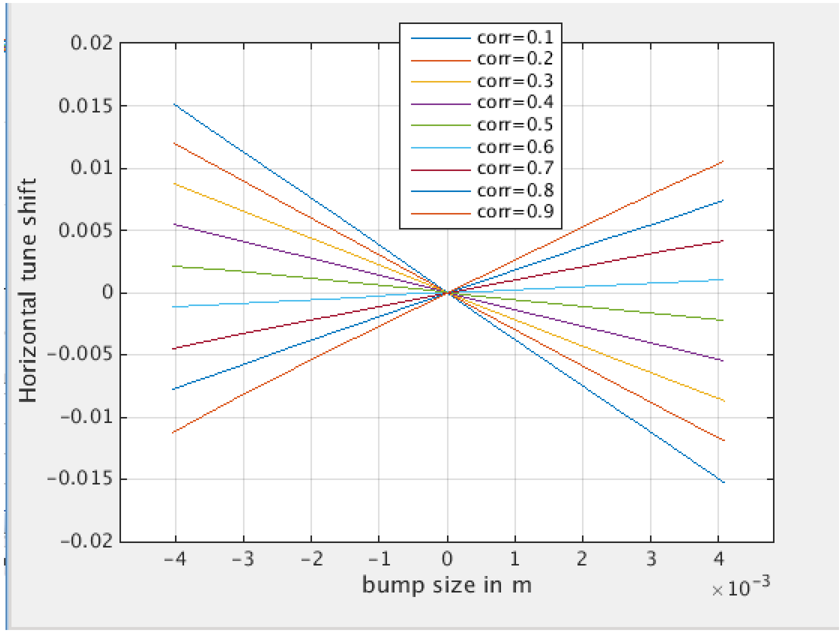


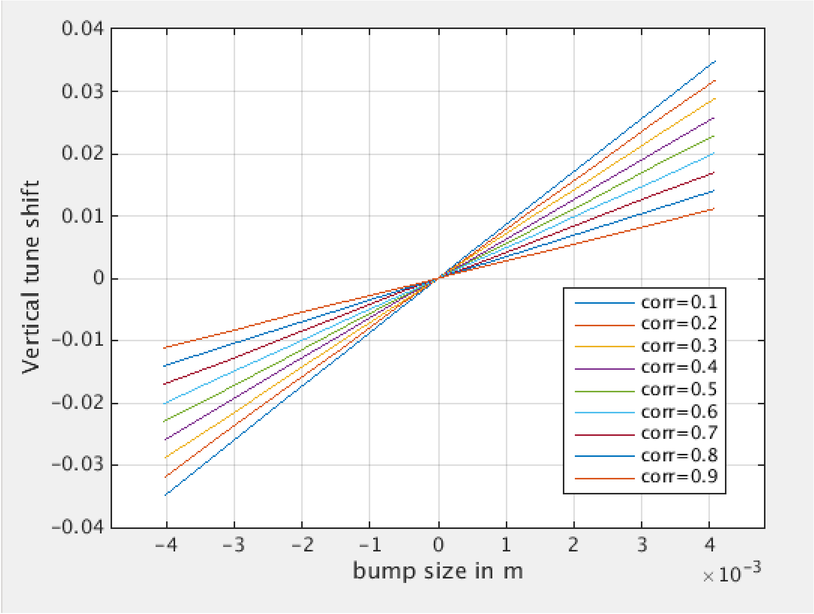




Impact of reducing the KCS correction

Benoit, Ewen, Roge, Tobias (MCS studies 2015)





Horizontal tune shift reduces and changes sign

Vertical tune shift increases