LHC WITH LONG RANGE COMPENSATION

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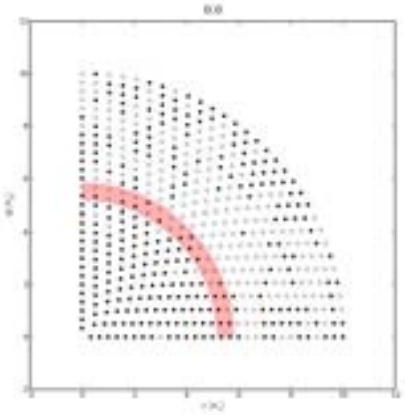
SLAC, LARP Mini-Workshop on Beam-Beam Compensation 2007

Outline

MODELL etc.

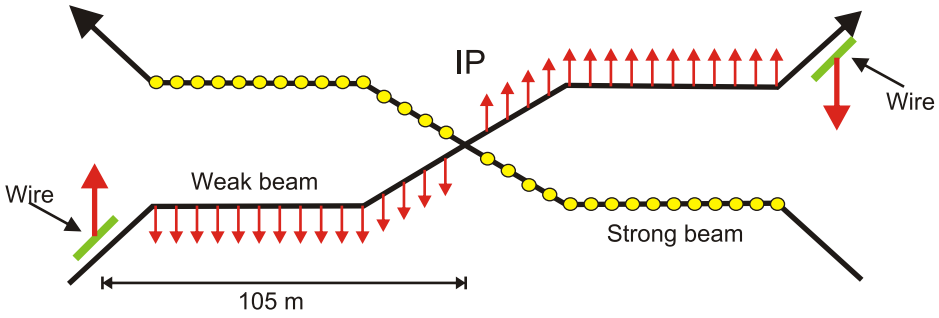
- BBTrack: weak-strong tracking code
- Linear Transfer matrices between nonlinear elements
- Stability defined by Liapunov criterion (300.000 turns)

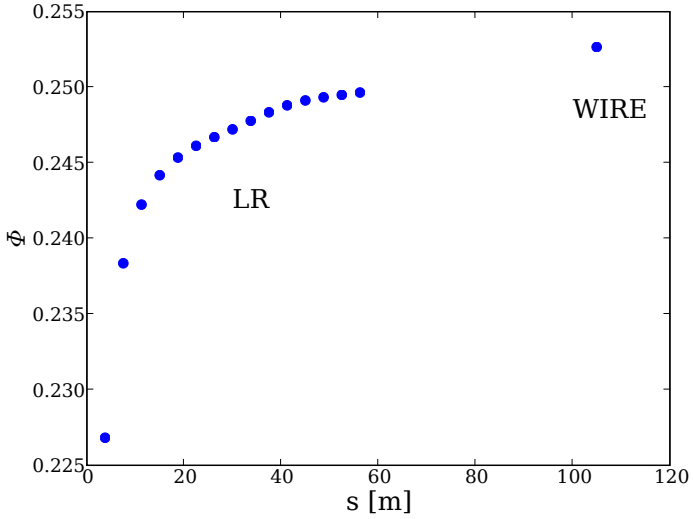


- Tunes (tune diffusion) with help of sussix (incorporated in BBTrack)
- IP1 & IP5 only

NOMINAL LHC I

- Position: 104m from IP (reserved), defined by equal β functions (or ratio corresponding to the average beam-beam encounter).

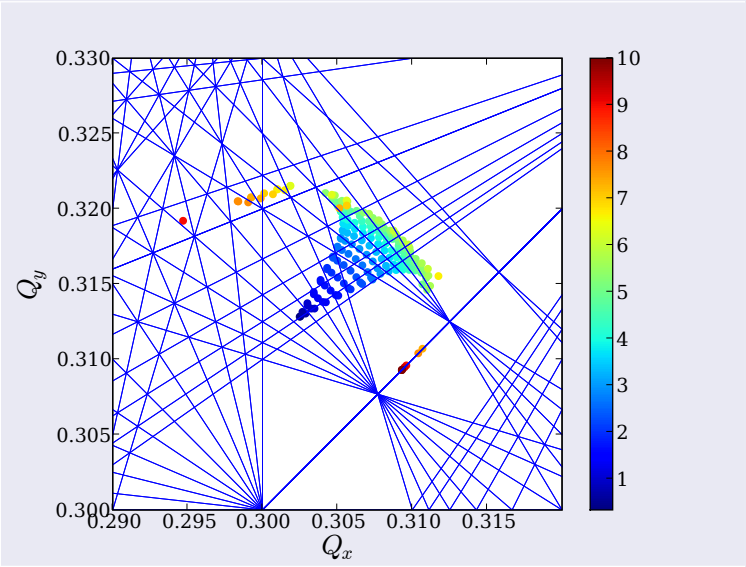




- Required wire - current: 81Am
- Average beam-beam separation: $9.5\sigma \rightarrow$ enough for the compensation to work and for the wire to be in the shade of the collimators.
- $\beta_{wire} \approx 1800 \rightarrow$ enough to place a wire with finite extensions.

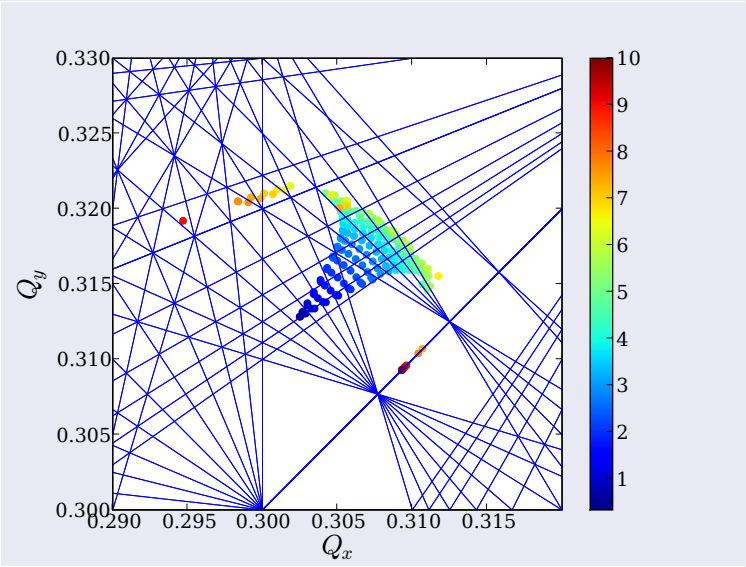
NOMINAL LHC II

Uncompensated

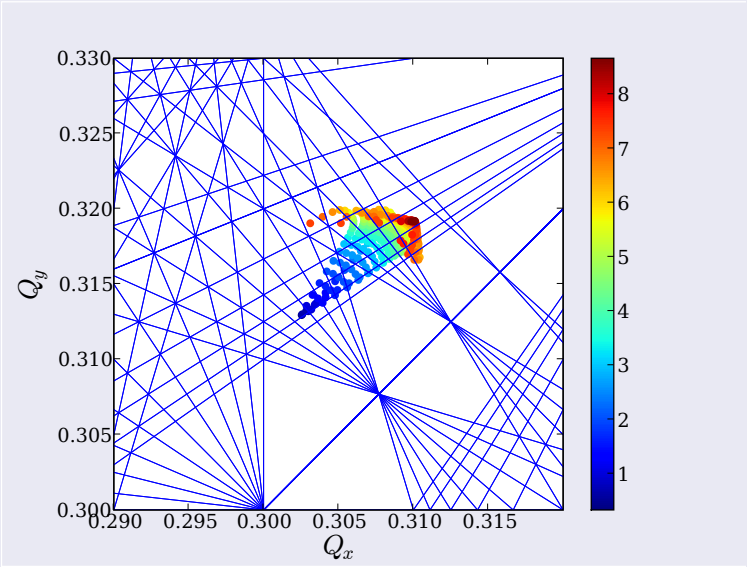


NOMINAL LHC II

Uncompensated

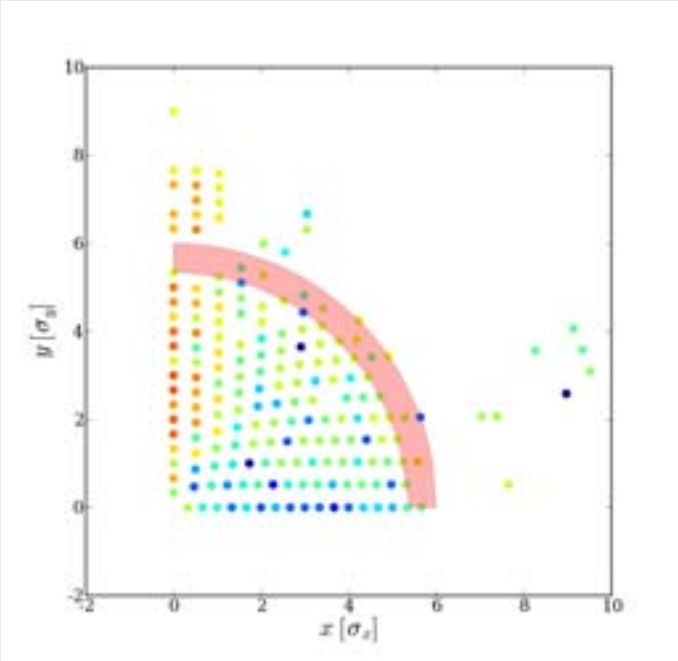


Wire-compensated



NOMINAL LHC III

Uncompensated



$DA = 5.4\sigma$

The color indicates the tune diffusion.

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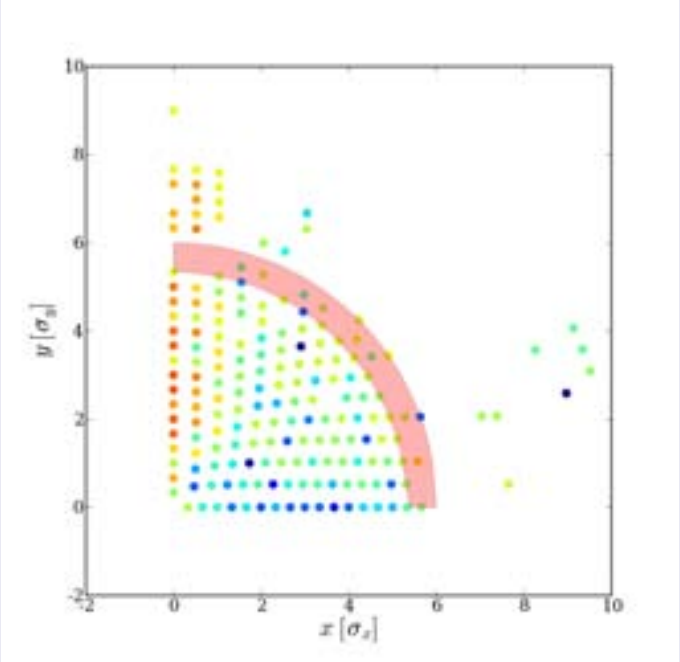
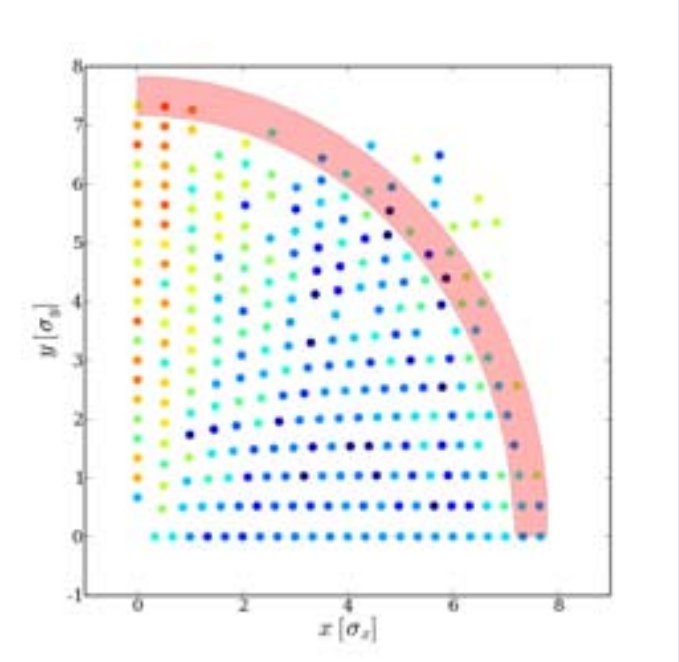
NOMINAL LHC III

Uncompensated



$DA = 5.4\sigma$

Wire-compensated

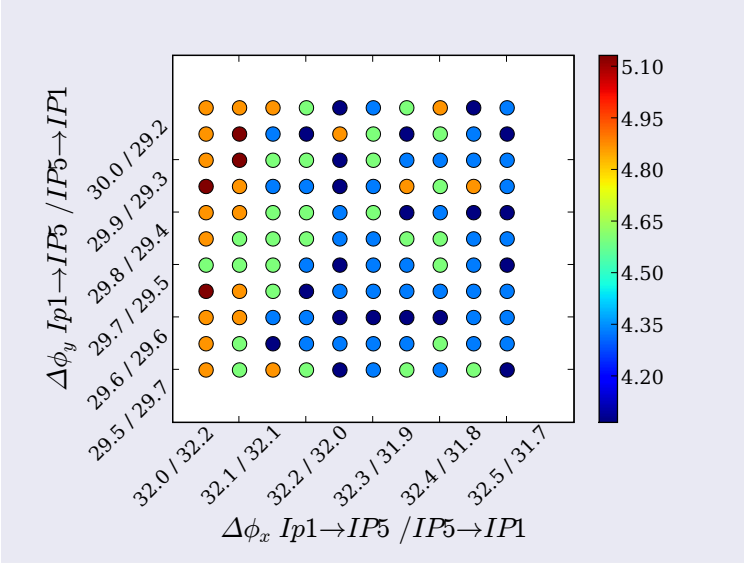


$DA = 7.2\sigma$

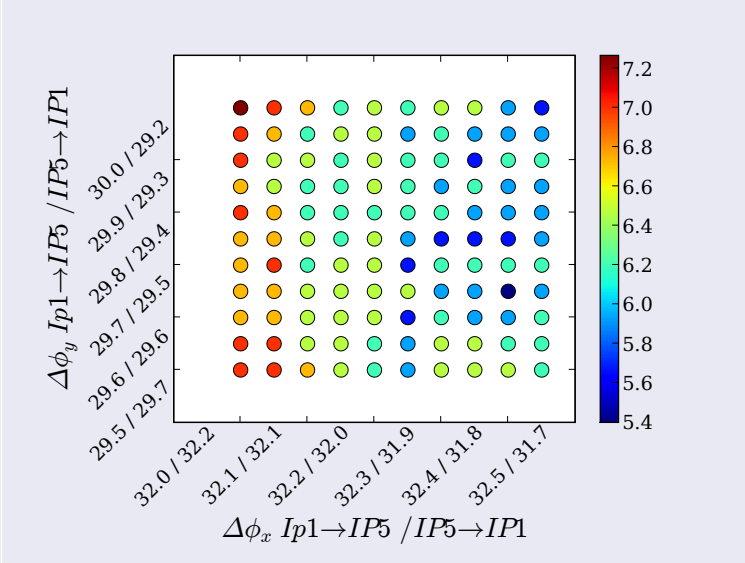
The color indicates the tune diffusion.
Lower amplitude particles are also "stabilized".

NOMINAL LHC IV

Uncompensated



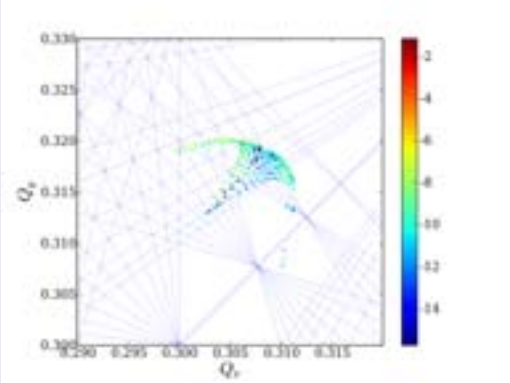
Wire-compensated



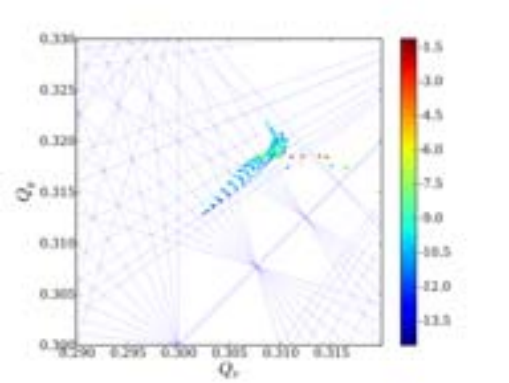
The color indicates the DA.
It works for all Phaseadvances (overall tune constant).

EXTREME PACMAN

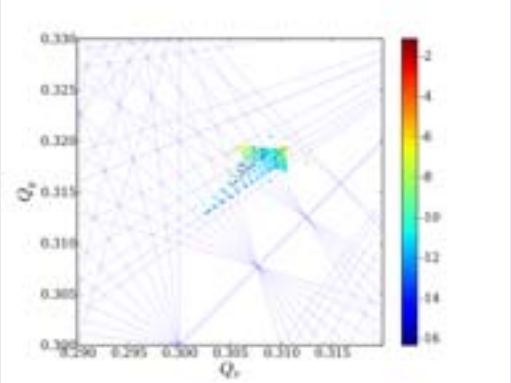
No Compensation



Nominal Compensation

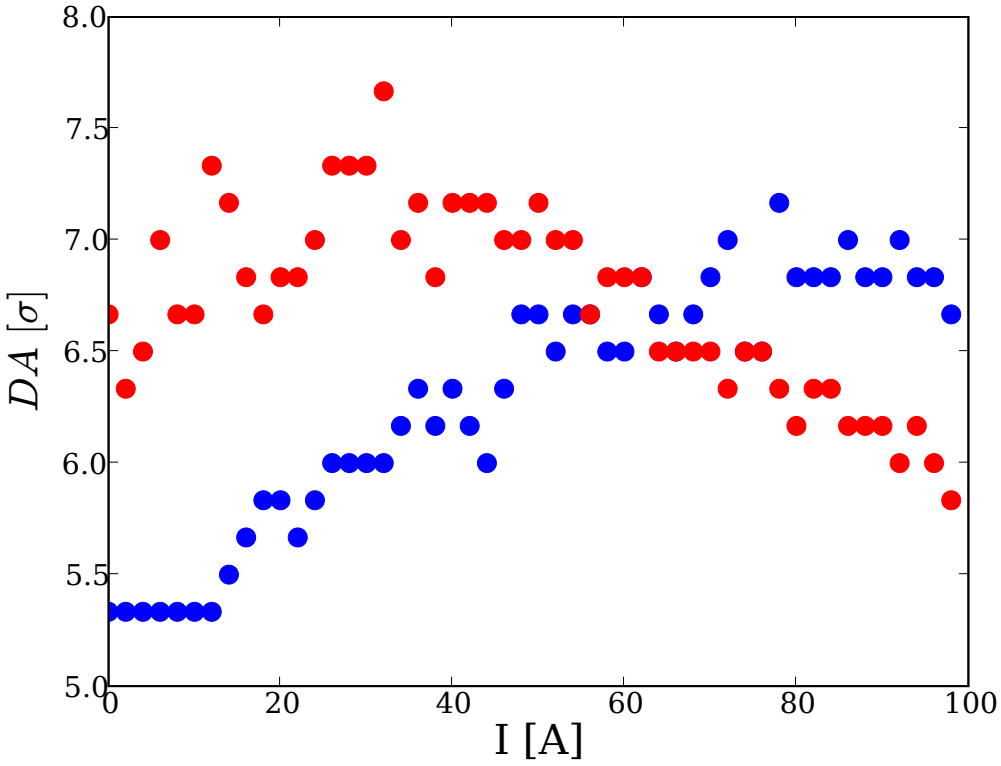


Optimal Compensation



Color = Tune diffusion

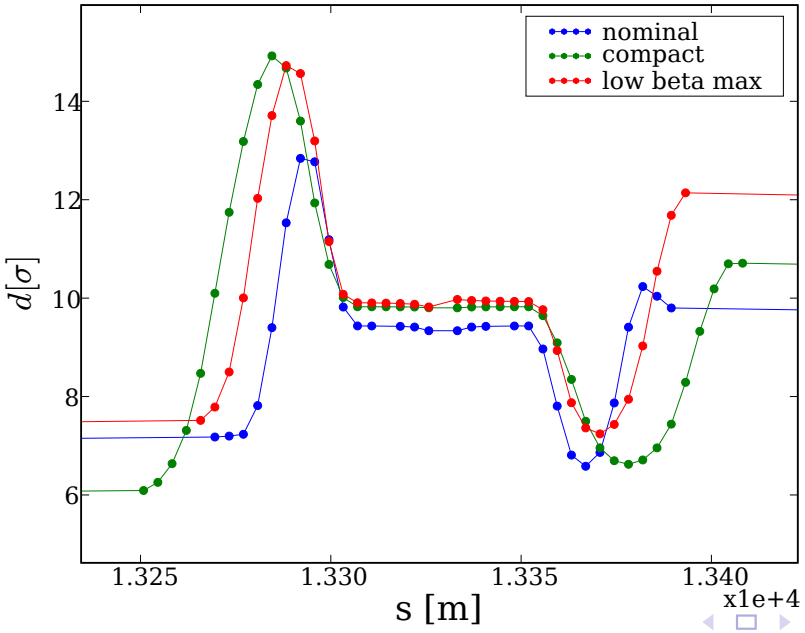
DC CURRENT: PACMAN vs. NOMINAL BUNCH



UPGRADE SCENARIOS

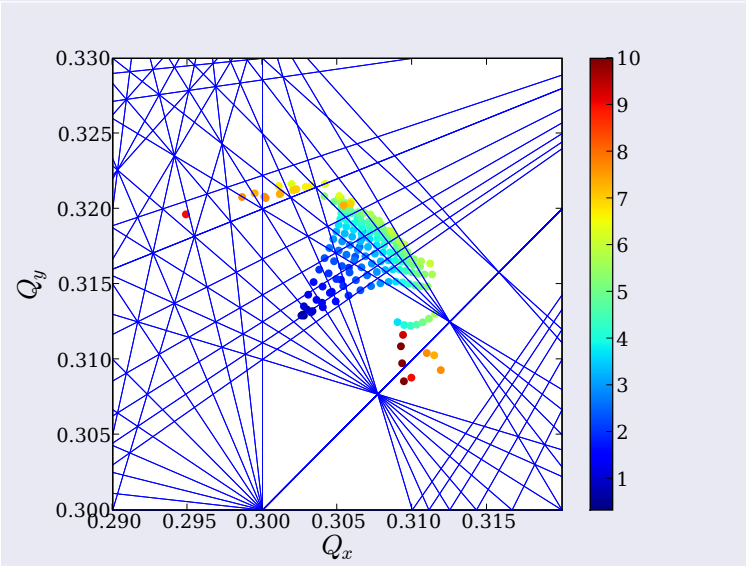
3 Alterantives are studied

variable	nominal N	low β	Compact
$\beta*$ [m]	0.55	0.25	0.25
particles/bunch [10^{11}]	1.5	1.15	1.15
#LRBBIs	15	17	21
wire position [m]	104	136	170
β_{wire} [m]	1780	3299	2272



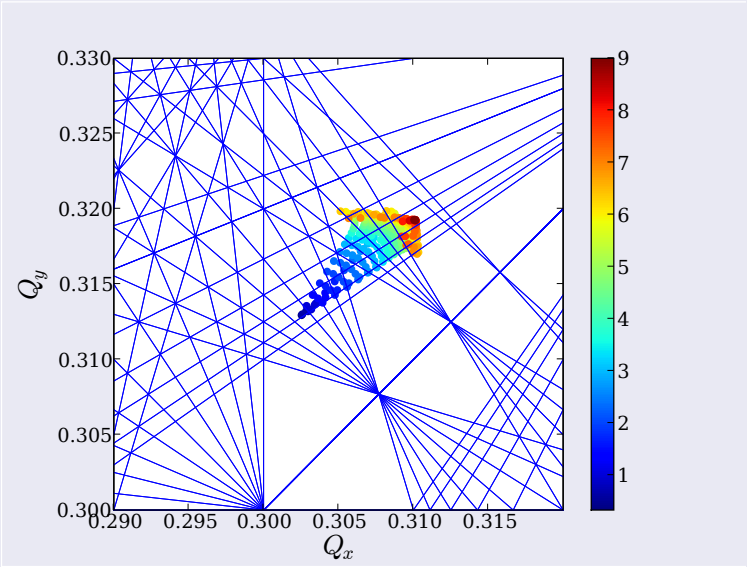
UPGRADE I - INCREASE N

Uncompensated



$DA = 4.33$

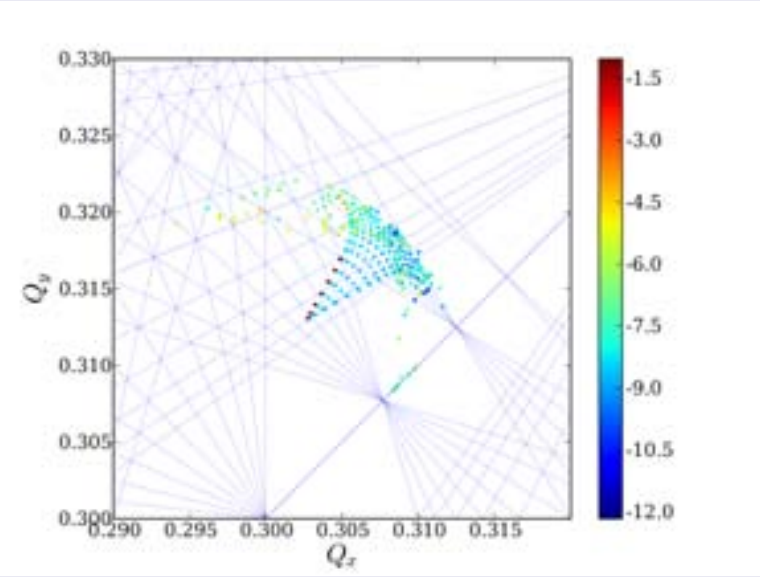
Wire-compensated



$DA = 6.33$

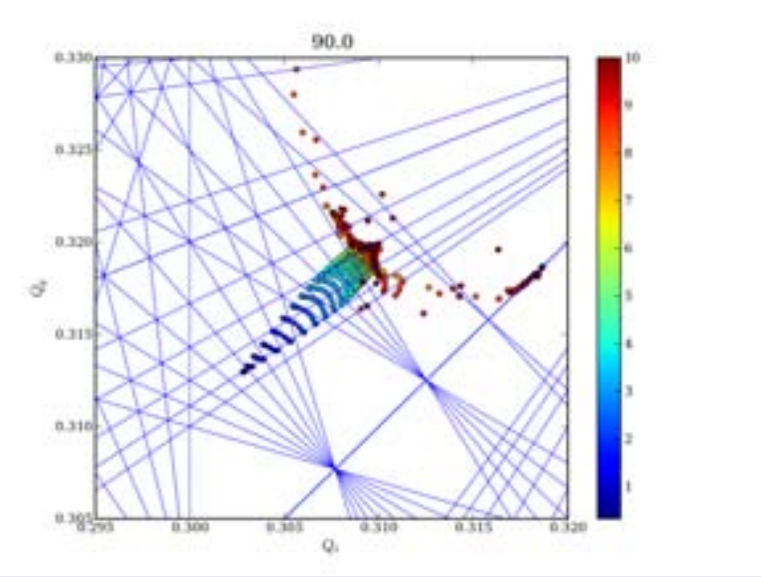
UPGRADE II - LOW β max

Uncompensated



$DA = 5.16$

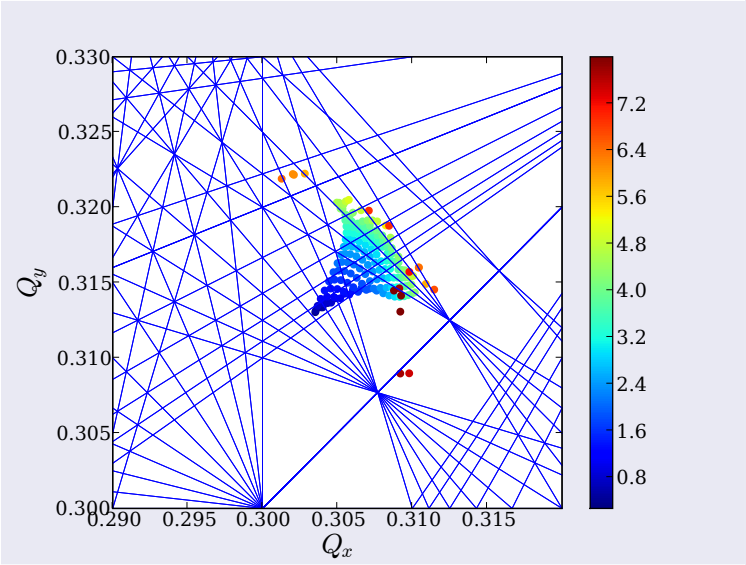
Wire-compensated



$DA = 7.1$

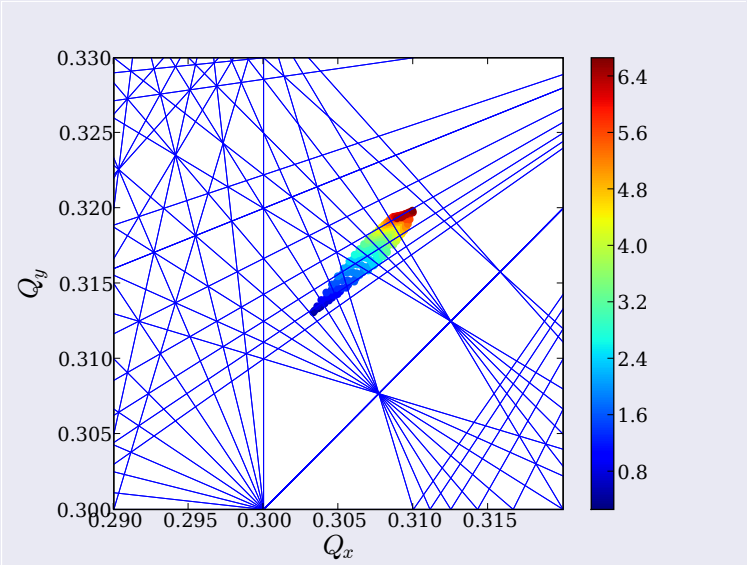
UPGRADE III - COMPACT

Uncompensated



$DA = 4$

Wire-compensated



$DA = 5.2$

CONCLUSIONS

- Wire compensation works
- Wire compensation should become part of the 'official' roadmap phase 1 upgrade
- Low β-max optics is the better one.