Progress in Optical Modeling in RHIC

or

RHIC: 1994 - 2004 - 2014

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2014 RHIC Retreat

In my talk at last retreat entitled “Ramp Optics Development Infrastructure: Problems & Plans” with subtitle “Ghosts of RHIC and Other Stories” I presented the plan for improving OptiCalc. This is a very brief report of the progress on that plan (more detailed reports will be presented later in 2 + 1 talks).

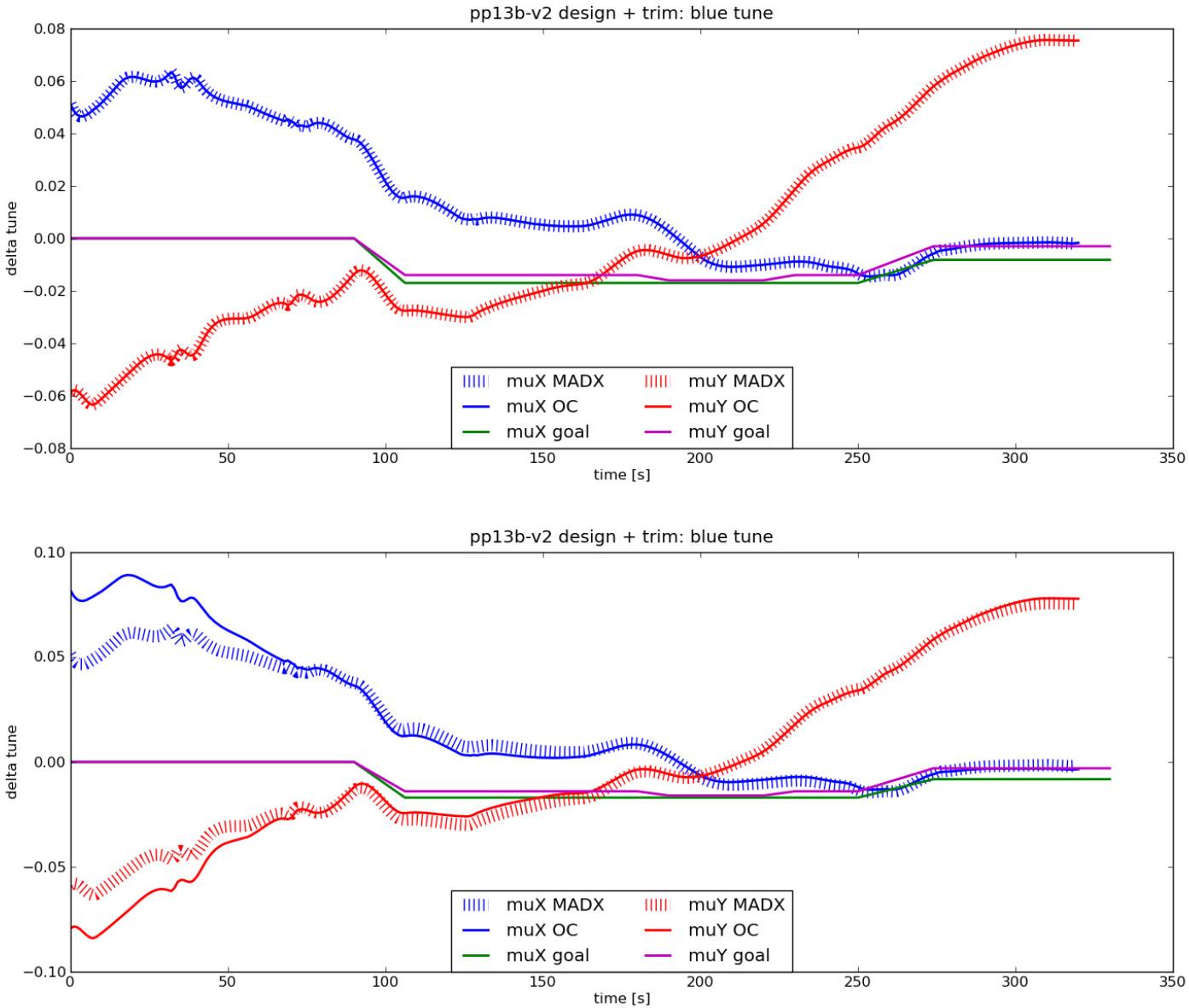
In short: all items listed in the plan and items subsequently added to it are more or less done or addressed.

The answer to the question from the talk: “Are the strengths from 1994 used in the calculation of the beam properties?”, is yes. Furthermore it was possible to access optics belonging to those strengths:

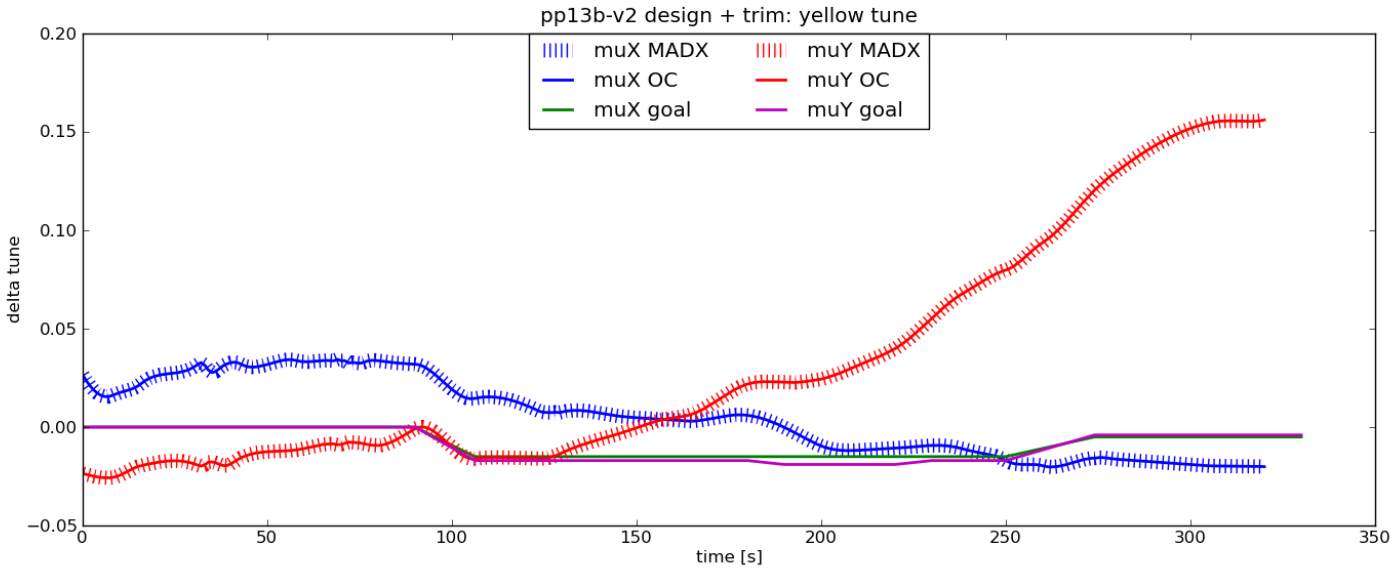
```
> cdevCommand Blue get muX
28.19
> cdevCommand Blue get muY
29.18
```

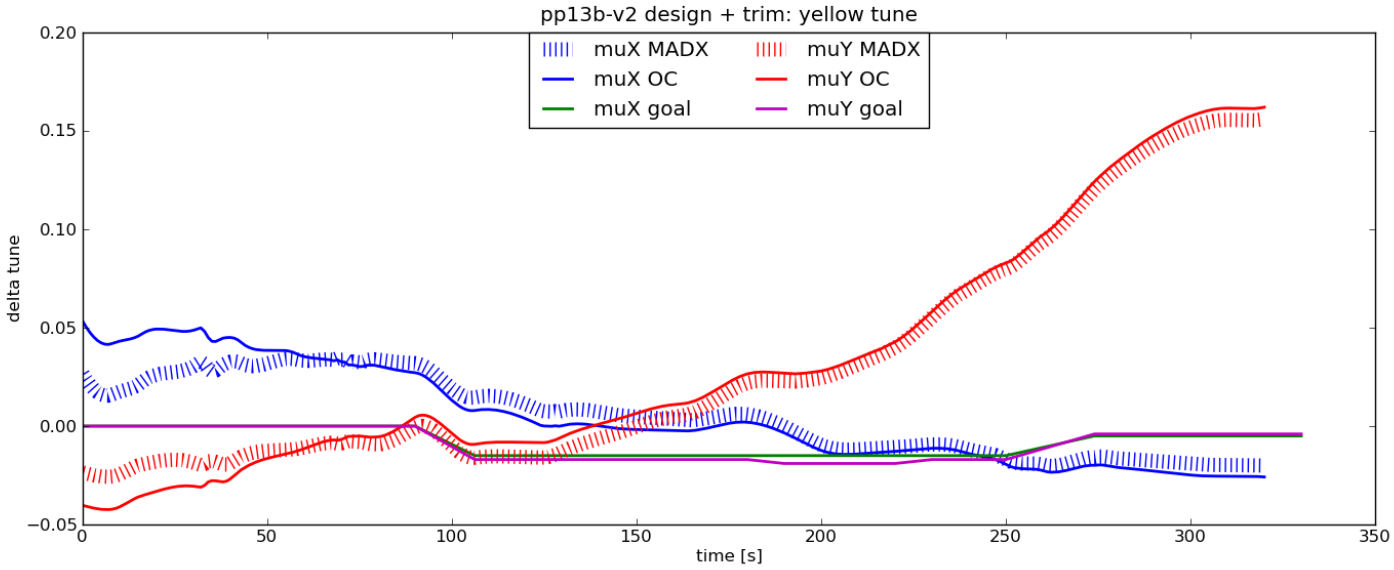
The state of OptiCalc

The following plots show tunes and chromaticities of pp13b-v2 ramp calculated by MADX and the current OptiCalc (top), and MADX and the version of OptiCalc from Run 13 (bottom). The values shown are deltas from the goal values at time 0. The closer the calculated tunes and chromaticities are to the goal tunes and chromaticities, the better the model describes the reality. These plots show that the results of MADX and current OptiCalc are very close. Apparent similarities of tunes calculated by new and old OptiCalc are deceiving: the similarity was achieved by treating the offset of the beam in arc dipoles as a free parameter and requiring that the tunes calculated by new OptiCalc be always closer to goal tunes than the tunes calculated by old OptiCalc. The plots also show that calculations of yellow chromaticities at higher energies are greatly improved.

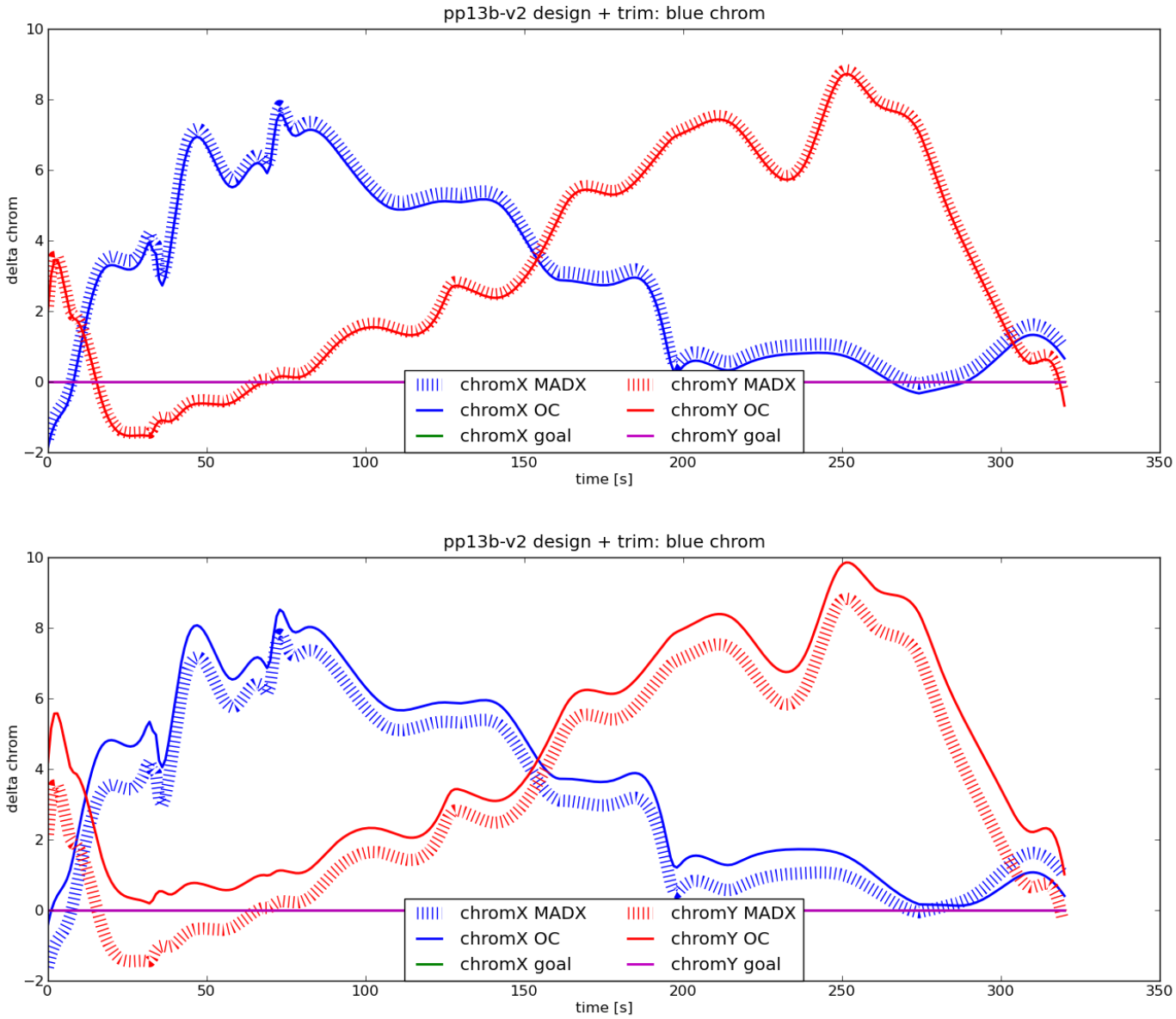


Calculated blue tune differences.

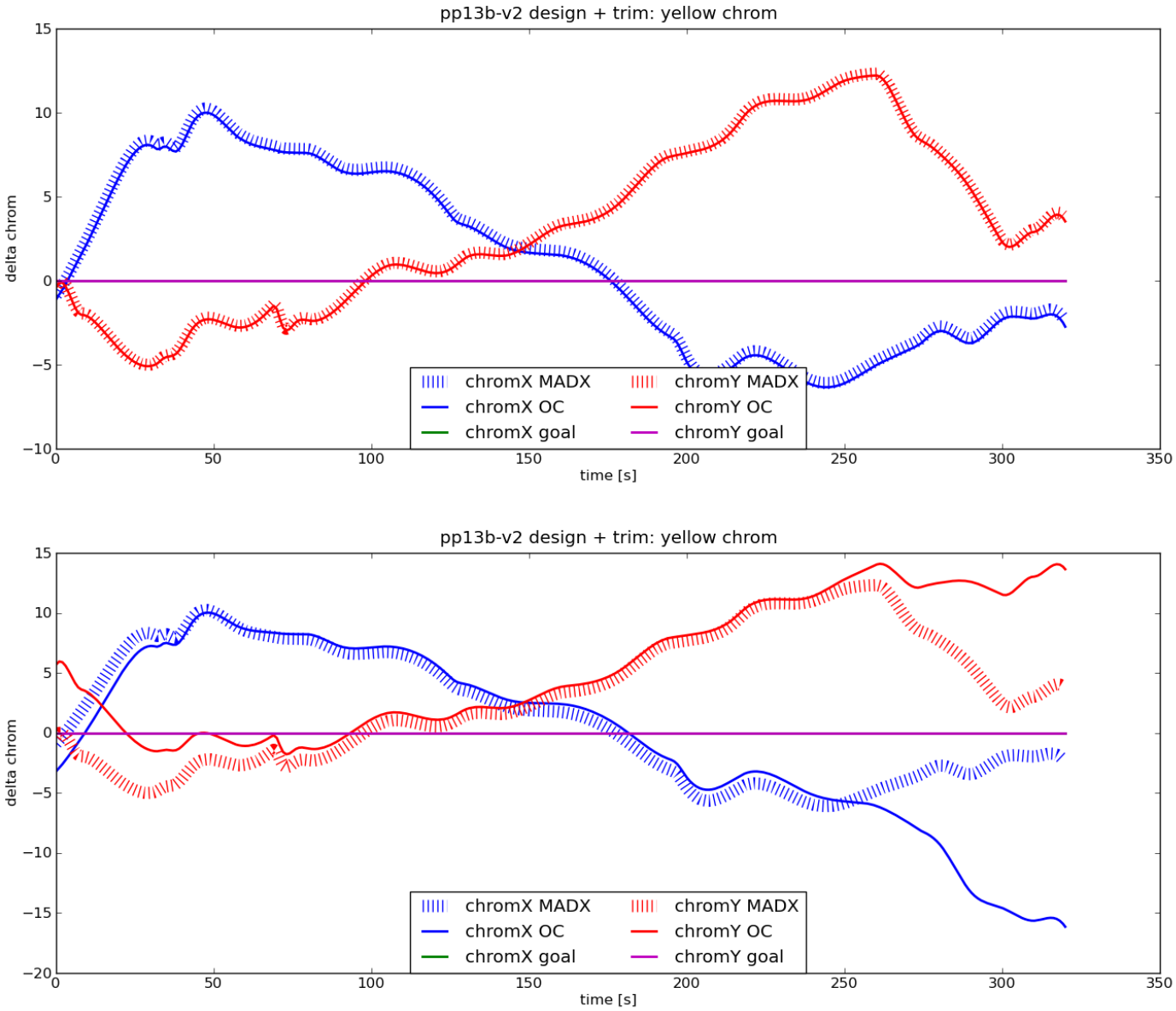




Calculated yellow tune differences.



Calculated blue chromaticity differences.

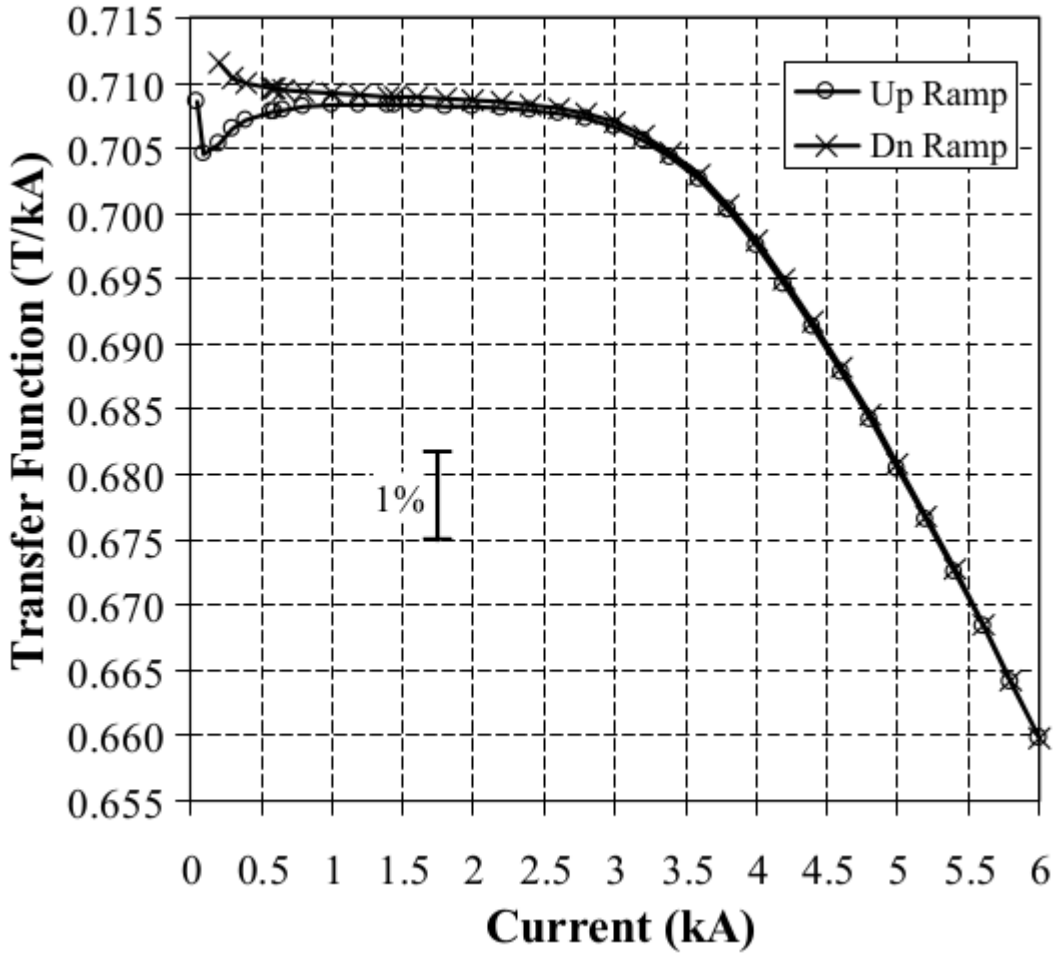


Calculated yellow chromaticity differences.

The state of OptiCalc improvement project

The remaining known problem with OptiCalc is its use of warm measurements of sextupole components at the ends of dipoles. Before using cold measurements those measurements have to be fitted. Previous fits of field measurements were scaled to achieve better model - measurements agreement. Redoing the fits will allow us to see how well model and measurements agree without that scaling. Previously data were fitted to 10th order polynomials which are converted by OptiCalc / RampManager to cubic splines before use, during re-fit we could use scipy routine for spline fitting and avoid the issues related to fitting of the polynomials of higher order. Previous fitting procedure excluded the field measurements of main dipole and quad magnets at currents below 400 A. It would be beneficial to use those measurements when running at below normal injection energies.

During the attempt to fit the data, I discovered that most of the data for arc dipoles are missing from database tables where they are supposed to be.



Plot of transfer function for a typical 80 mm dipole in the straight section from RHIC Configuration Manual.

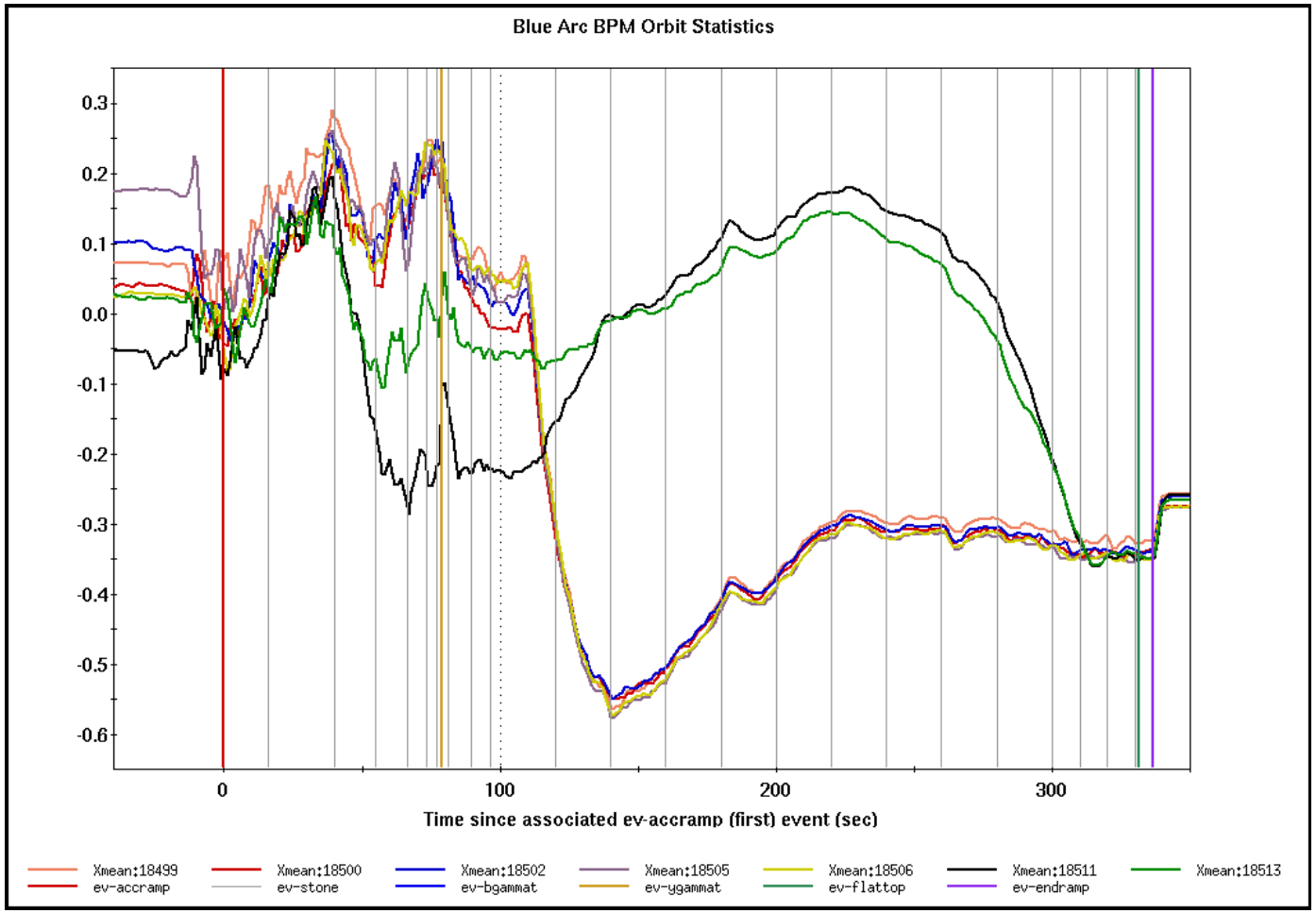
Summary

Achieved:

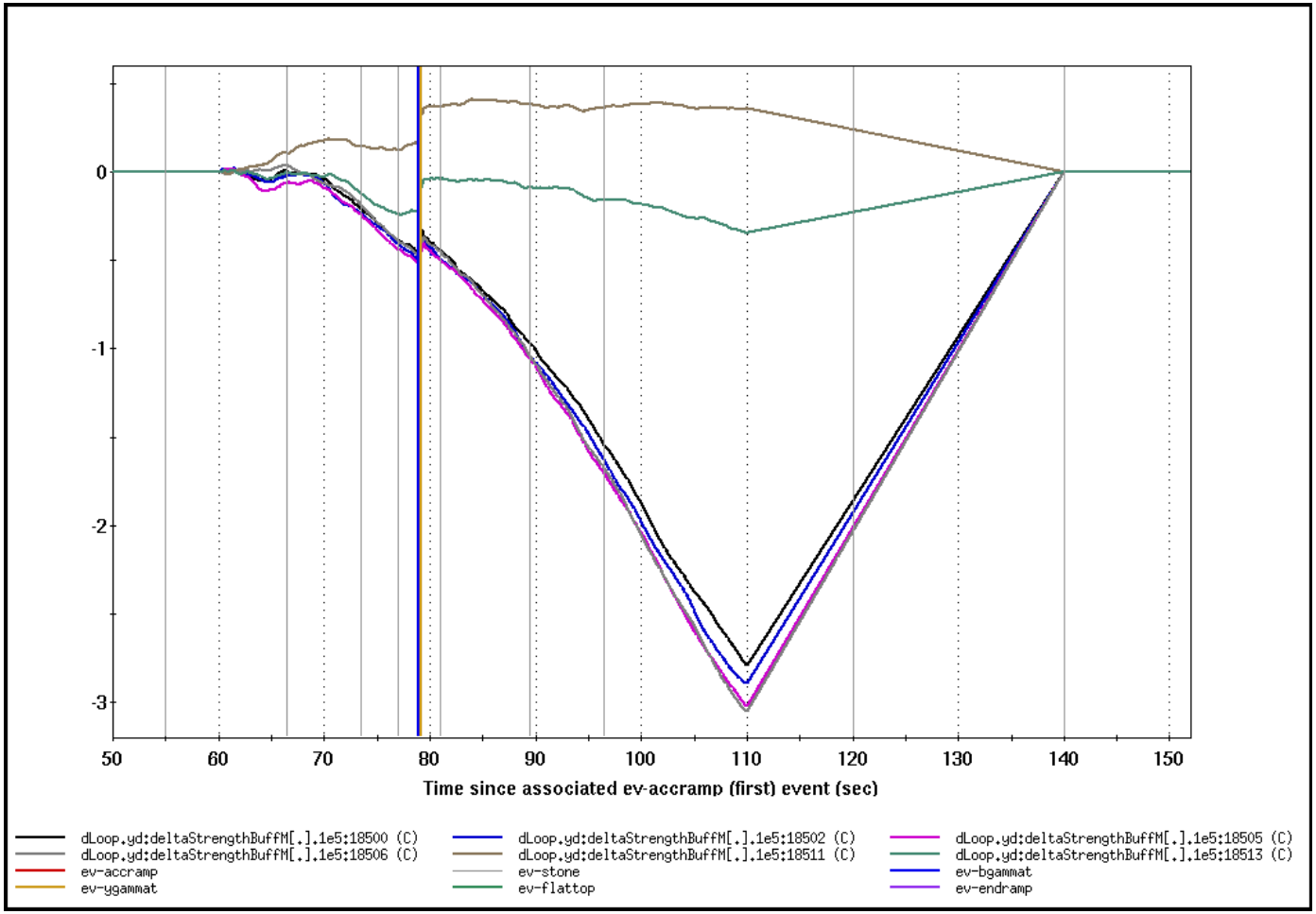
- The code and strengths from 1994 are no longer used.
- MADX can provide optics data for ramps.
- The code which calculates optics functions in OptiCalc is probably fixed, the rest of OptiCalc needs some work.

To do:

- Copy all measurements of magnet fields into database and re-fit them.
- Fit B2 lead and return ends measurements and use them in OptiCalc.
- Fix tune / chromaticity smoothing procedure.



Xmean during He3 – Au ramps.



Dipole strength corrections during He3 – Au ramps.