

Implementation of a fast chromaticity jump at transition

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The goal

Implement “knobs” to provide a controlled positive chromaticity jump in both planes at transition, using the existing sextupole families

Requirements

- Provide desired (incremental) chromaticity jump $\Delta\xi_x$, $\Delta\xi_y$ at transition
- Leave chromaticities $\xi_{x,i}$, $\xi_{y,i}$, $\xi_{x,f}$, and $\xi_{y,f}$ in two steps around transition unchanged
- Power supply limitations (\rightarrow later)

\rightarrow Six requirements, plus power supply limitations

Free parameters

- 8 sextupole families per ring
- Sextupoles are anchored in two stepstones, 2 seconds before and after transition

→ 16 free parameters

But:

Sextupole settings in stepstones before and after transition must be very close (power supply limit)

Sextupole power supplies are unipolar → limit when one of them would have to change polarity

” Knobs”

Using the 16 free parameters (=power supplies), a fitting routine aims at achieving the desired chromaticity jump, while chromaticities in stepstones remain unchanged.

This routine also needs to know about power supply limits.

The challenge is to find the right figure-of-merit for the fitting procedure.

Results

- Horizontal chromaticity jump can be changed by several units in both rings
- Vertical chromaticity jump can only be changed by about 1 unit or so – Au72 was much better than dAu80 in that respect (blue only)!
- Still tuning the fitting algorithm to somewhat improve that situation

Test at injection

Goals:

- Keep chromaticities $\xi_{x,+}$, $\xi_{y,+}$ in one γ_t quad polarity constant
- Change chromaticities $\xi_{x,-}$, $\xi_{y,-}$ in the other polarity, using the same sextupole strengths in both polarities

→ 4 conditions

This can be accomplished by 4 sextupole families

→ Sextupole settings can be found by simple matrix inversion

Using sextupole families in outer arcs only, the horizontal chromaticity “jump” at injection can be changed by 17 units in Blue, and 4 units in Yellow.

Vertically, it's only 1 unit in Blue, and 0.3 units in Yellow.

→ Good enough for a proof-of-principle!

Outlook

- The chromaticity jump knobs will be used to provide a positive chromaticity jump at transition (according to the model) on Day One.
- Injection tests will provide a proof-of-principle.
- If everything works as planned, these knobs should be integrated into the RampEditor
- APEX proposal: Observe transition instability as function of chromaticity jump height.