Dynamic aperture tracking with beam-beam (or: what we are doing ...)

> Not: coherent beam-beam multiple bunches, 6D coherent beam-beam etc.

→ dynamic aperture with SIXTRACK, preparation with MADX

Three different tasks:

- Tune scan for dynamic aperture with beam-beam (first: no errors)
- Dynamic aperture with linear imperfections and beam-beam
- Dynamic aperture with different crossing schemes (first: no errors, later with errors)

## Tune scan for dynamic aperture with beam-beam

- At present done by Dobrin Kaltchev at TRIUMF
- Includes head-on and long range interactions
- No linear or non-linear errors, therefore no corrections (at present)
- Dobrin Kaltchev will (probably) come for a visit and report

## **Linear imperfections**

Basic idea (steps):

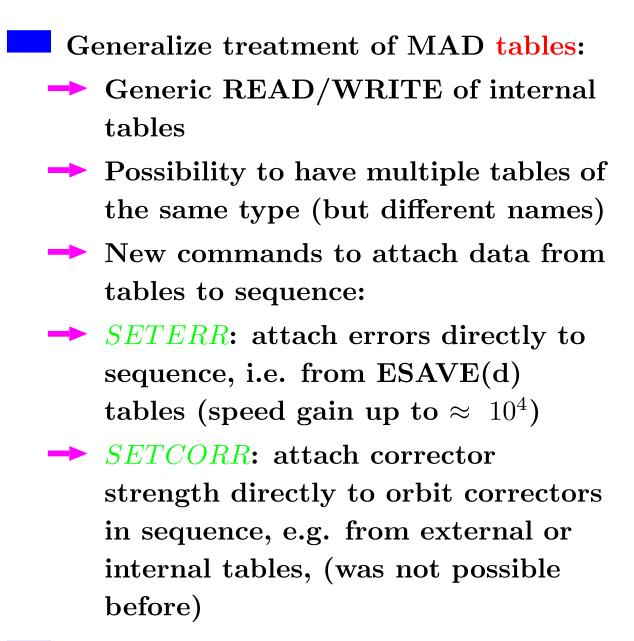
- Assign field and alignment errors on both beams
- Correct errors, simulate operation, i.e. use only information available in control room (NO matching !) :
  - Ideal model (e.g. for orbit correction)
  - → Knobs (e.g. for  $\beta$ -adjustment, tune<sup>\*)</sup>, chromaticity<sup>\*)</sup>, adjust collision etc.)
  - Derive beam-beam elements from the two corrected beams and install them (all with MADX)
- Track one or both beams with beam-beam elements (with sixtrack) to get dynamic aperture

<sup>\*)</sup> a little bit of cheating ...

# The problem:

- Installation of beam-beam elements must be followed by a USE command
  - → Wipes out all errors !
  - → Wipes out all corrections !
  - Must retain this feature, many users rely on that !
  - Additional "features":
  - Special treatment of correctors (a booby-trap even for well established MAD users...)
  - Two beams (all operational, but should be used with care)
  - Result: large re-write of several modules in MADX necessary
  - Idea: try to invest in the future at the same time

## The solution:



En passant: several "features" fixed

#### **Status of linear imperfections:**

- MAD program is set up
- Use "private" version of MAD and optics version V6.4 (V6.5 has additional complications)
  - Errors as specified by optics team, further by A. Lombardi and L. Bottura
  - Still missing (needed): a few knobs, presently done "by hand" (e.g. collision adjustment)
    - Simple, just additional work
    - ... but required for long tracking campaign
  - Still missing (if needed): coupling correction probably can use Stephane's module directly

#### **Status of linear imperfections:**

- I studied sensitivity of footprints (in other words: separation of long range interactions) on quality of corrections  $\rightarrow$  ongoing (interrupted by CAS and other studies and activities)
- Hope to derive quantitative values for tolerances and if possible measurable quantities to allow operational correction facilities, i.e. a kind of quality factor for operators

#### **Crossing schemes:**

- Study dynamic aperture with beam-beam for different configurations:
- $\rightarrow$  HH, HV and VV crossings
- → Flexible filling patterns
- → Nominal and PACMAN bunches
- → Different integer tunes
- **First with some simplifications:** 
  - $\rightarrow$  Optics version V6.4
  - Only two interactions points IP1 and IP5
  - → No imperfections
  - Only nominal and extreme PACMAN bunches
  - Nominal, i.e. not self-consistent optical parameters

### Status crossing schemes:

Done:

- Optics version V6.4 modified for HH, HV, VV and different integer tunes
- Tune adjustment with beam-beam interactions
- Testing, footprints for comparison etc.
- Next:
- Setting up tracking environment (partially done with the help of EMI, FR)
- Tracking with sixtrack (will be done together with DK, at least part of it)
- Long term: combine with imperfections and corrections