# 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[*)], chromaticity[*)], 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**

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[*)] **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:

- **Generalize treatment of MAD tables:**
  - **Generic READ/WRITE of internal tables**
  - **Possibility to have multiple tables of the same type (but different names)**
  - **New commands to attach data from tables to sequence:**
  - *SETERR*: **attach errors directly to sequence, i.e. from ESAVE(d) tables (speed gain up to** $\approx 10^4$**)**
  - *SETCORR*: **attach corrector strength directly to orbit correctors in sequence, e.g. from external or internal tables, (was not possible before)**
- **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 → 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:
  - HH, HV and VV crossings
  - Flexible filling patterns
  - Nominal and PACMAN bunches
  - Different integer tunes
- First with some simplifications:
  - 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**