The LHC with local coupling

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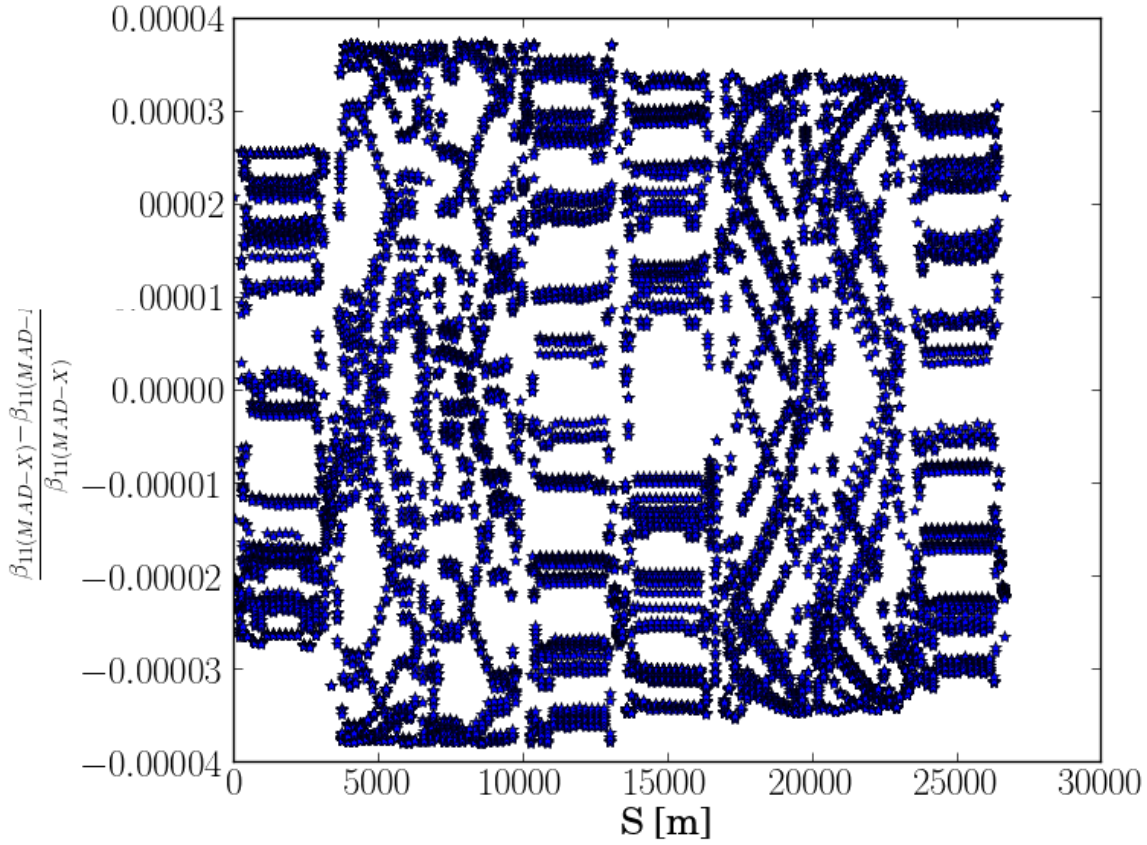
The study

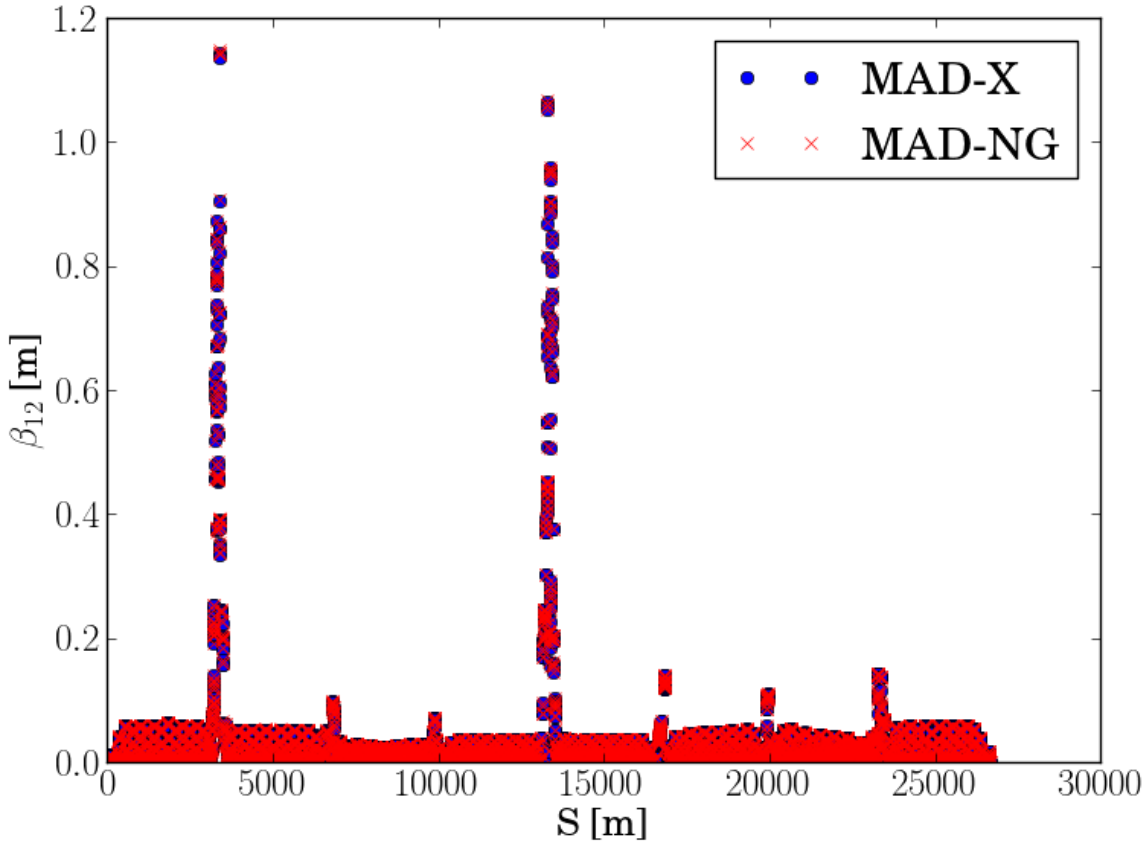
- The same study used to show the beam size increase due to local coupling in 2018
  - LHC ion optics 50cm for IP1, IP2, IP5
- Steps in the script
  - 1. Adjusting just the collinearity knob at the IP2 to 15, i.e. changing two skew quadrupoles close to Q3 so that an almost closed bump is created
  - 2. Save TWISS (MAD-X)
  - 3. Match the tunes MAD-X)
  - 4. Save TWISS (MAD-X)
  - 5. Track 900 particles for 10 turns each (PTC)

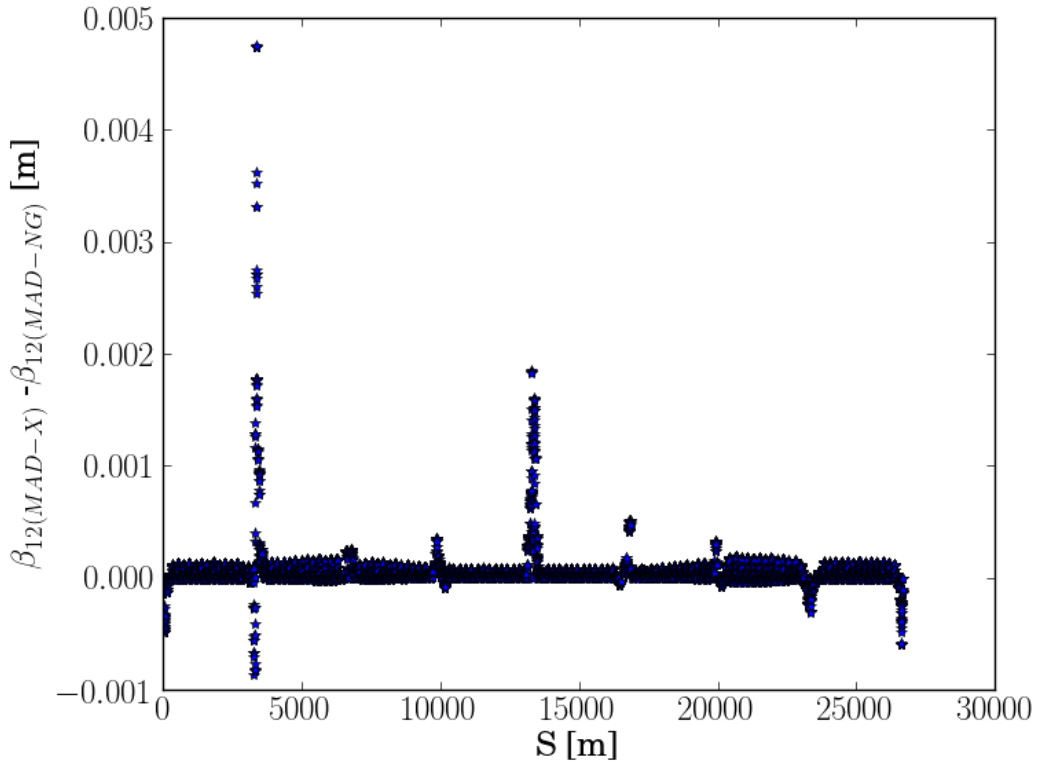
Results after matching



Normalized difference between MAD-X and MAD-NG
Almost no difference!

Results after matching (beta12)





Almost identical specially if you consider the difference in the physics models!

Time spent

- 1. Adjusting just the collinearity knob at the IP2 to 15, i.e. changing two skew quadrupoles close to Q3 so that an almost closed coupling bump is created
- 2. Save TWISS (MAD-X)
- 3. Match the tunes MAD-X)
- 4. Save TWISS (MAD-X)

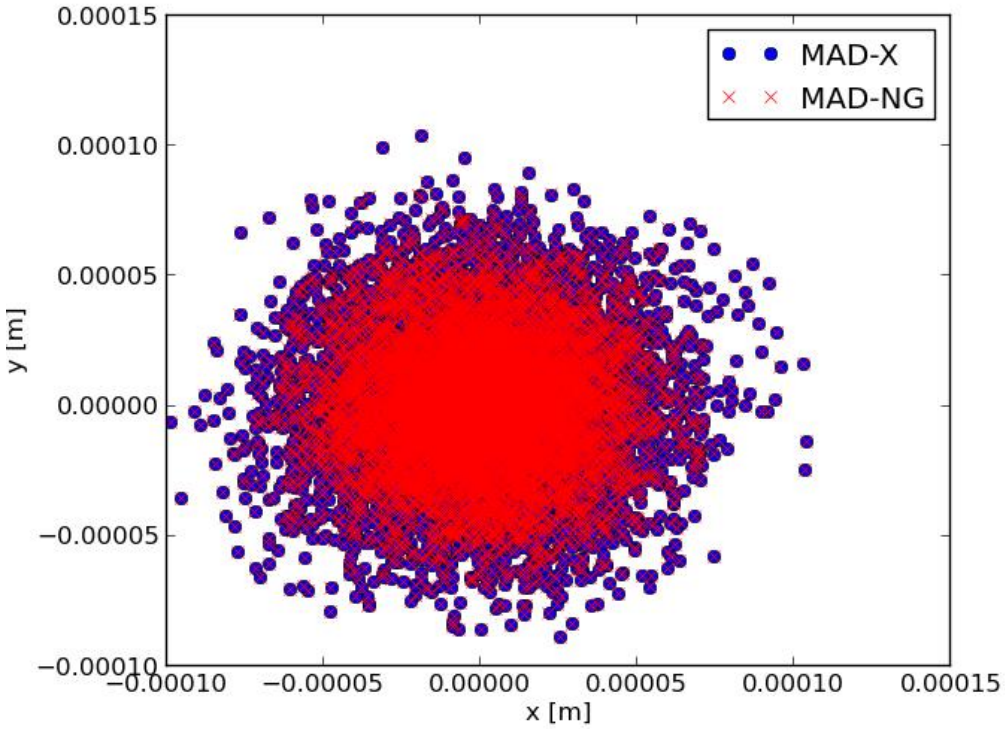
- Time reported is on lxplus with MAD-NG version 0.9.3 (faster than the previous version) and MAD-X 5.06.01

MAD-X: 7 seconds (Laurent's MACOS: 7s)

MAD-NG: 42 seconds (after adding the –jp=vl argument to the running) (Laurent's MACOS: 21.5s)

Tracking

- Some initial issues with the closed orbit not added to the initial coordinates for tracking in previous MAD-NG version
  - Now one can use `cofind=true` and the closed orbit is automatically added
- **Time (tracking)**
  - **MAD-X (PTC): 3min 1 sec (Laurent's MACOS : 1 min 30 sec)**
  - **MAD-NG : 2min 5 sec**
  - **(Laurent's MACOS : 1 min 33 sec)**
  - **MAD-X (thin) 12 seconds**



Tracking results almost identical between the 3 codes!

Conclusion

- The handling of the optics functions including strong local coupling effects is working nicely in MAD-NG
- The TWISS with matching is slower compared to MAD-X
- Tracking faster/similar to PTC tracking but slower than MAD-X