Needs for the injector chain magnets

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Outline

- **Magnetic measurements support for day-to-day machine operation.**

- **Magnetic measurement support for improvement of the machine models for high intensity, high brightness operation.**

Day-to-day operation

- **B-train required to drive the frequency programmes of the synchrotrons**

- **Diagnostics for the operation of these systems is vital ➔ often difficult to disentangle from other potential problems**
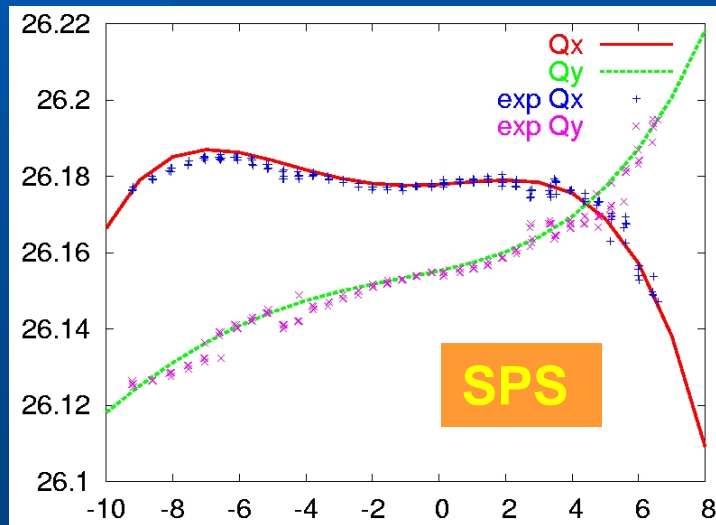
Machine modelling

- **Continuous evolution of the requirements on the injectors ➔ more and more precise understanding of the beam dynamics, in particular optics (including non-linear effects):**
  - New multi-turn extraction in the PS
  - Transfer of the LHC and high intensity beams from PS to SPS through the PS magnet stray fields
  - Operation of the Pole Face Windings in the PS (in particular 5 current operation)
  - Low energy working point for the LHC beam in the SPS
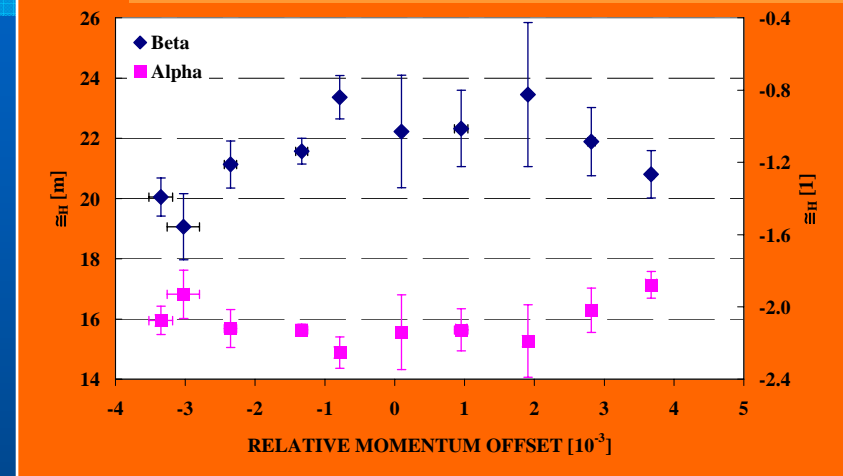 - Dynamic effects in the SPS vs. cycle type and ramp

Machine modelling

- **Up to now: pragmatic approach ➔ beam-based measurements**

Tune

SPS

$\Delta p/p$

Machine modelling

- **Advantages:**
  - "Beam never lies"
  - In some cases direct measurement of the required beam parameters

- **Disadvantages:**
  - Poorer predictability for different conditions (energy, ramp speed…)
  - In some cases assumptions needed in the interpretation of the measurement

Machine modelling

- **Magnetic measurements (at least of a reference magnet) can be very useful to:**
  - **Bench-mark beam measurements**
  - **Enhance predictability**
  - **Characterize new elements before installation**

- → **need to be supported by:**
  - **analysis of the magnetic measurements**
  - **magnetic model to enhance predictability after bench-marking against magnetic measurements**

Summary

- **Magnetic measurements needed for day-to-day operation (B-trains) → need to come with good diagnostics tools**

- **Magnetic measurements (+ analysis tools and magnetic modelling) could certainly help in bench-mark beam measurements and enhance predictability of the behaviour of the machine**