Continuous Tune Measurements

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- **Motivation & implementation**
- **Q and Q' correction**
- **Other potential uses**
- **Summary**

Introduction

- Motivation : provide a fast tune correction for an entire cycle.
 - for setting up and for cycle maintenance.
  - fast measurement and trimming !

  …to avoid the (very) lengthy single point measurements.

- The tune measurement relies on Lars Jensen's **'Hadron multiQ'** system.
  - continuous tune measurements covering up to 4 seconds in one cycle (initially 1.5 s).
  - one tune point / 30 msec time interval.
  - beam excitation is done by the transv. damper (chirp sweep).

Software choices…

- Presently, trims & acquisitions are tied to the HP/UNIX world (C-tree…).

- Choice for the required data handling SW :
  - old HP/UNIX :
    - pro : one can build a single application for all tasks.
    - con : it will 'disappear' in the near (?) future.
  - SPS2001 :
    - con : it's in its (very) early infancy.
    - con : the data flow involves many different applications.
    - pro : this is the future (?).
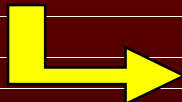
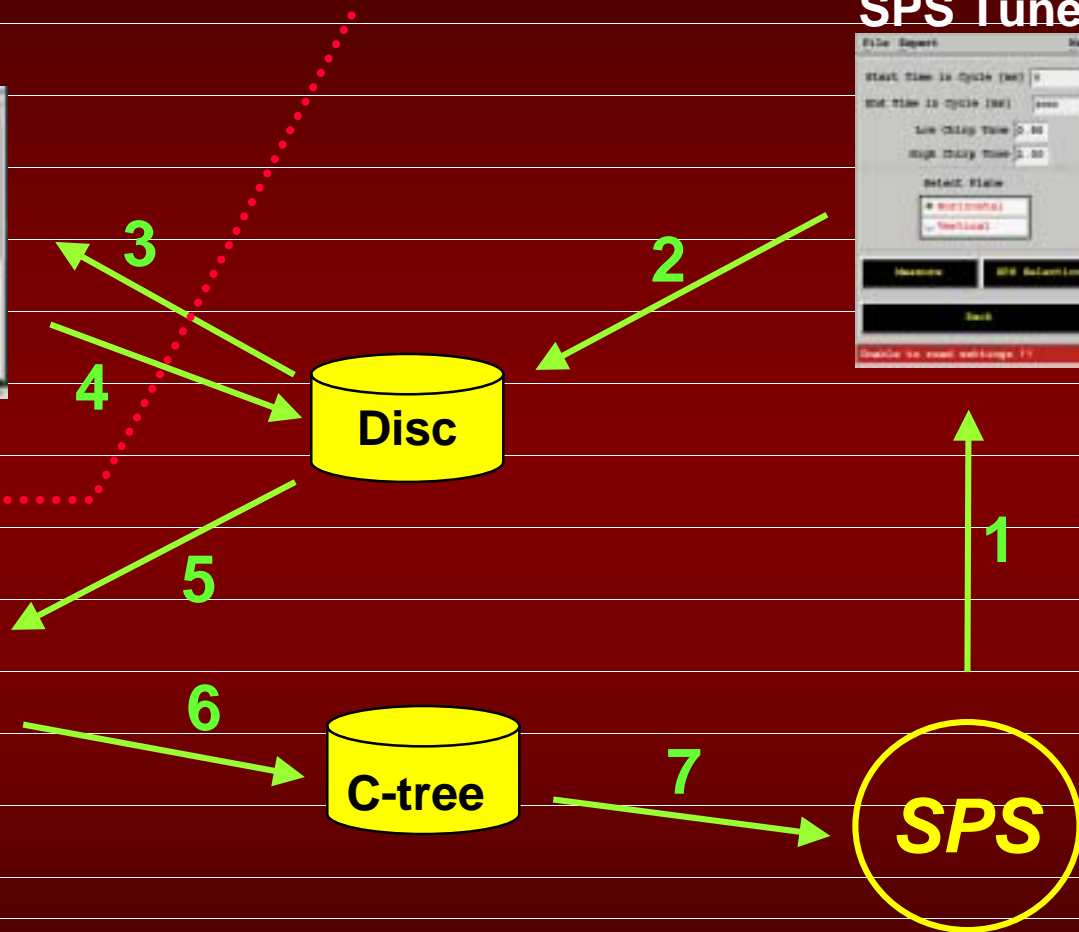 ➡ **Bet on SPS2001 & JAVA**

Control SW structure
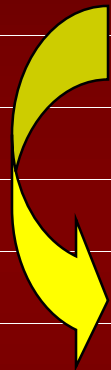
Functionality

- User Interface :
  - Averaging & merging of separate measurements.
  - Re-processing of raw data with various algorithms…
  - Smoothing, editing & disabling of data points.
  - Detailled info on raw data, FFTs,…

  A lot of functionality foreseen because it was not clear …
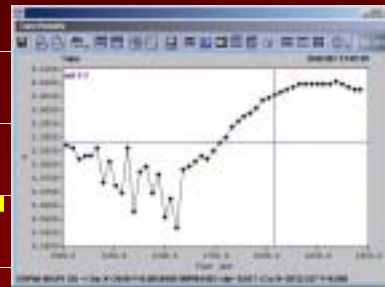
  ...why the multiQ was not used by operation so far !

  - Data quality ?
  - Missing functionality ?
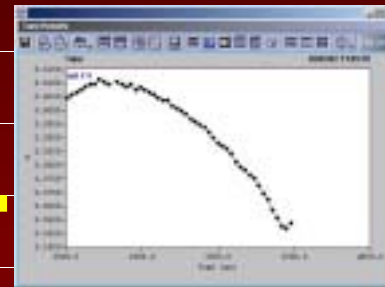 - Integration into control (trim) structure ?
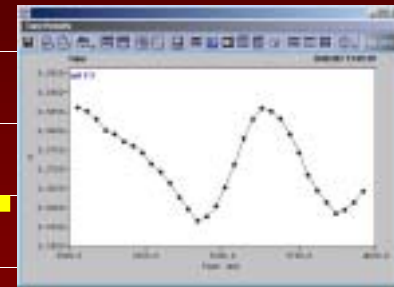 - ….

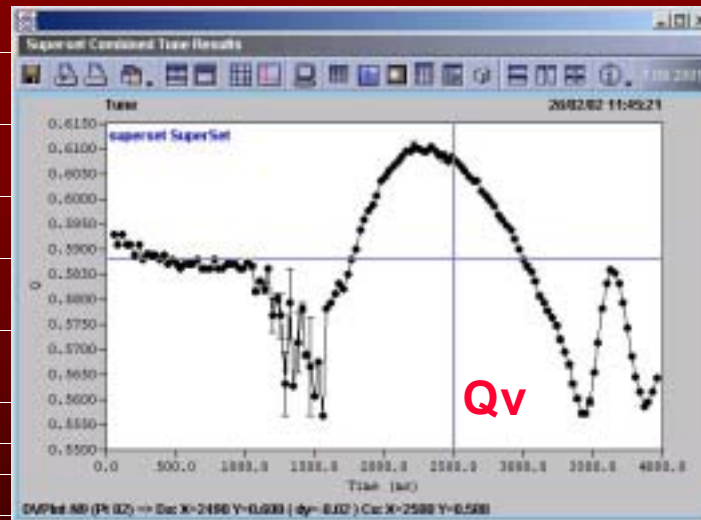# Data treatment

0-1500 ms   **+**   **1000-2500 ms**   **+**   **2000-3500 ms**   **+**   **3000-4000 ms**

=

Qv

0-4000 ms

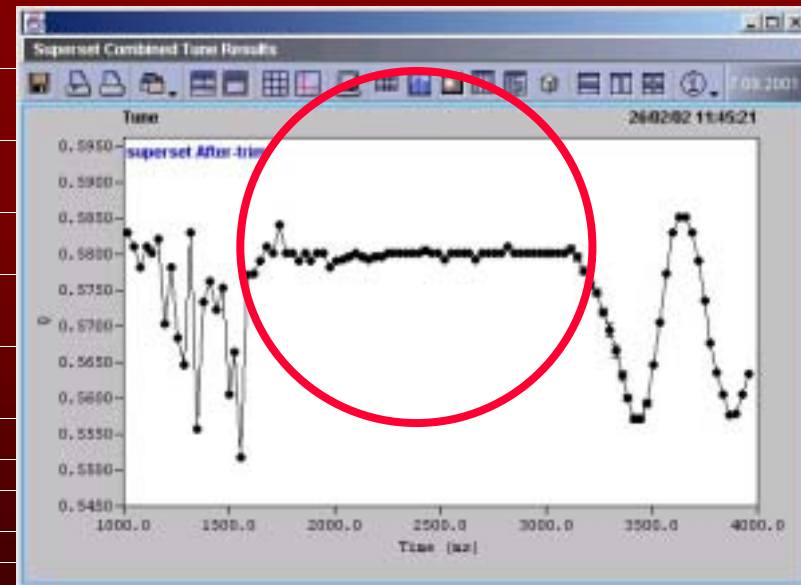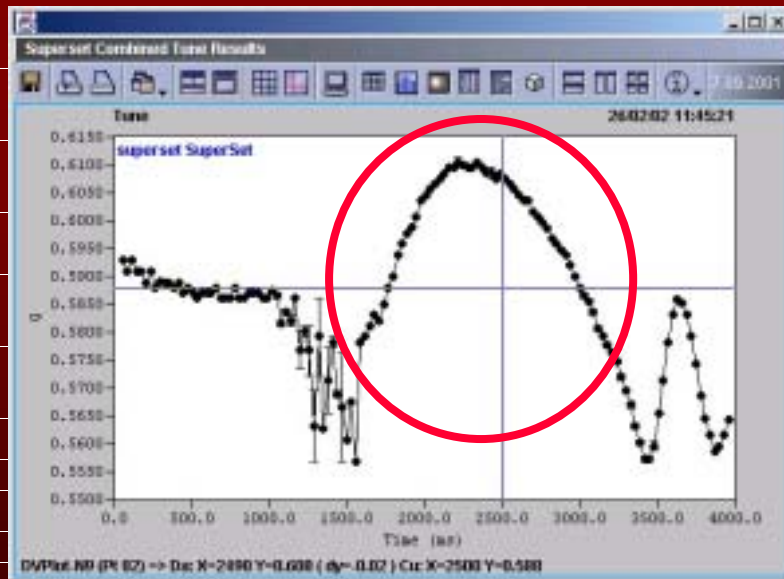Individual measurements can be combined & averaged to obtain the complete cycle info.

Key functionality !

Autotrim !

The complete cycle can be corrected in a single step !
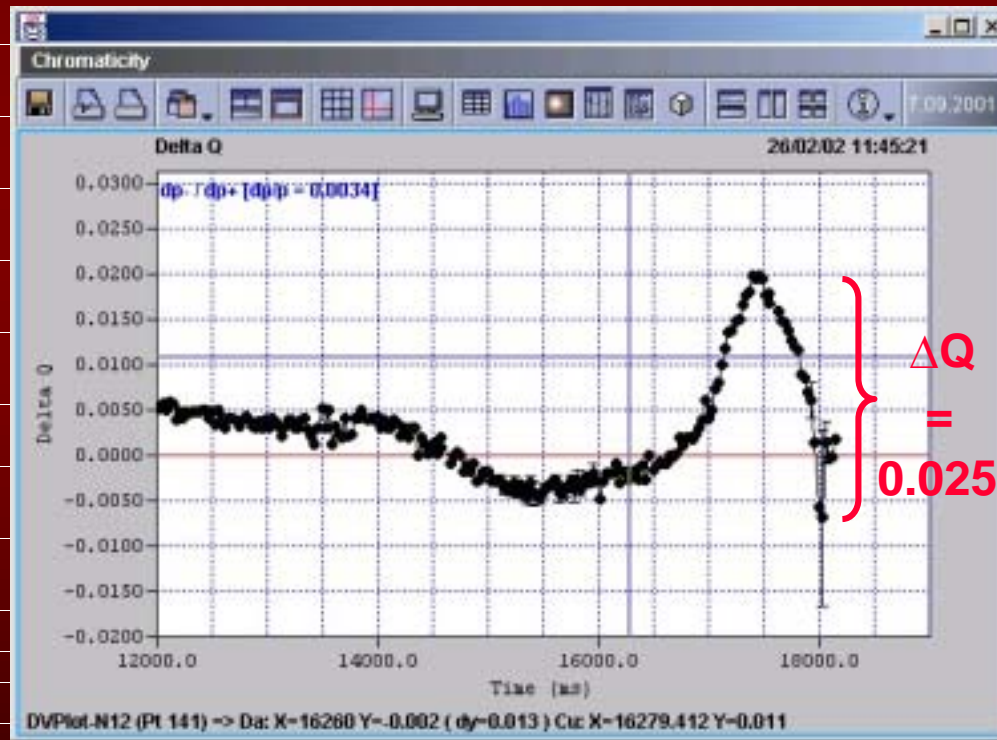
One iteration

Chromaticity (I)

The excellent data quality offered the possibility to measure and correct the chromaticity since …

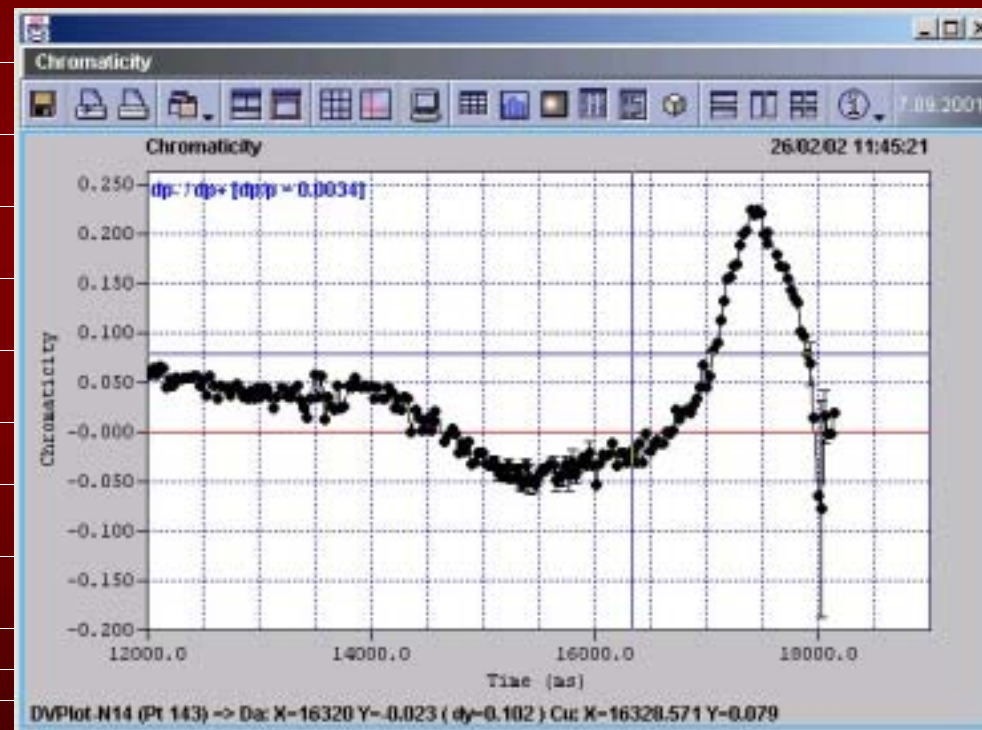…you just need two Q measurements for different radial steering !

Example :

Q difference during the ramp in SC537 (LHC) for 2 radial steerings.
[T = 12 - 18 seconds]

ΔQ = 0.025

Chromaticity (II)

Tune differences can easily be converted to Q' using the momentum offset measured with the SPS orbit program.

5 minutes !

Results & Observations

- <u>Measurements :</u> Reliable and reproducible.

- <u>Corrections :</u> Good convergence.
  2 or 3 iterations required for large trims → more studies in 2002.

- <u>Autotrim 'Drawback' :</u>
  Many points are inserted into the functions (some filtering is provided).
  Useless points must be removed by hand.
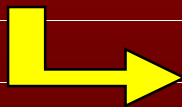
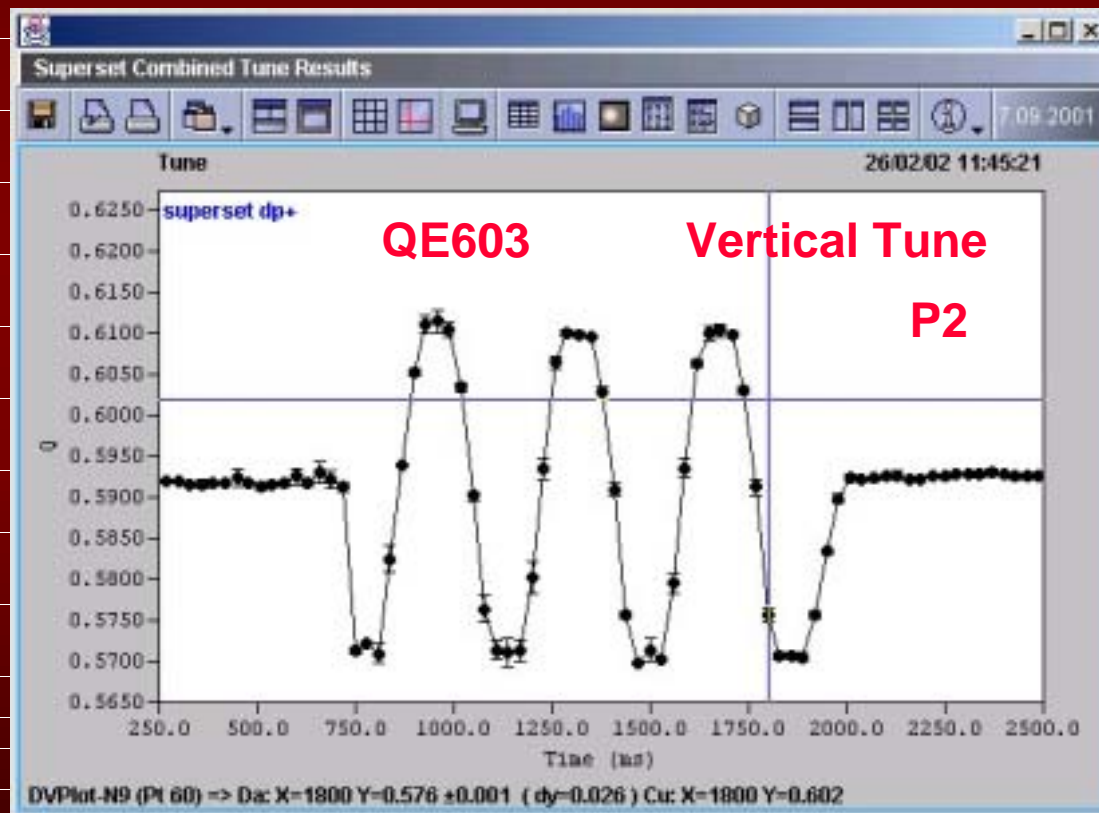 → May require an automated cleaning…

- <u>Transverse Damper :</u> no significant problems.
  Input signal was reduced to a safe level even for max. excitation.

Other possibilities (I)

<u>K-modulation test</u> : clean tune modulation signals are visible when the quadrupole strength is modulated
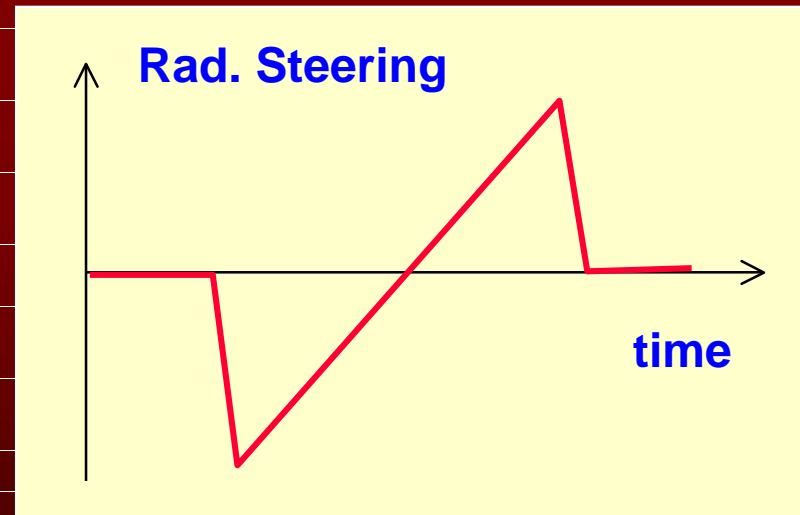
Will be used again
in 2002.

Other possibilities (II)

This system provides fast measurements of the Q dependence on any parameter that can be trimmed !

Example :

Q versus dp/p just requires a radial steering 'sweep'

Summary

- Q and Q' measurements are very reliable.

- Used operationally to set up (almost) all cycles.

- For 2002 :
  - spread the knowledge on how to use the system.
  - try to merge the Q measurement into the data handling JAVA application to simplify the sequence. Preliminary tests are encouraging…

- Longer Term :
  - merge all applications into one …