Studies of the losses in the PS during CT Extraction

Section meeting AB-ABP-LIS

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Acknowledgements

Thanks to O. Berrig, S. Gilardoni, Y. Papaphilippou, J. B. Jeanneret, R. De Maria, F. Schimdt.

Where did we left it…

- The ultimate goal is to have robust tools for beam loss studies in low energy synchrotrons and use them for the design of the collimation system in the new PS2 machine.

- Previously, it was shown that some high-order terms were absent in the thin lens conversion made by MADX to Sixtrack.

- In absence of a correct implementation (e.g. with PTC), the sextupole-like fringe field effects in the thin lens model will be approximated by means of thin lens multipoles giving the equivalent effect in chromaticity.

- In what follows, beam loss studies with Sixtrack + detailed Aperture Model will be discussed, as well as some features of PTC.

Tracking with Sixtrack (I)

- In order to evaluate the validity of the results, the reference used is the losses measured by the BLMs[*]

Measured Losses
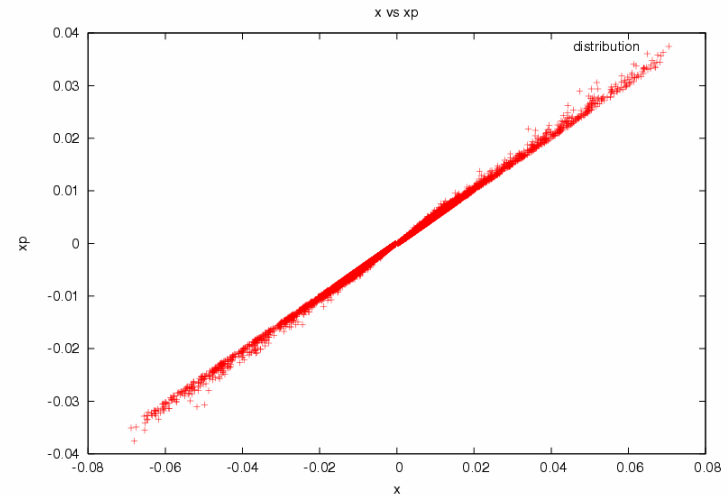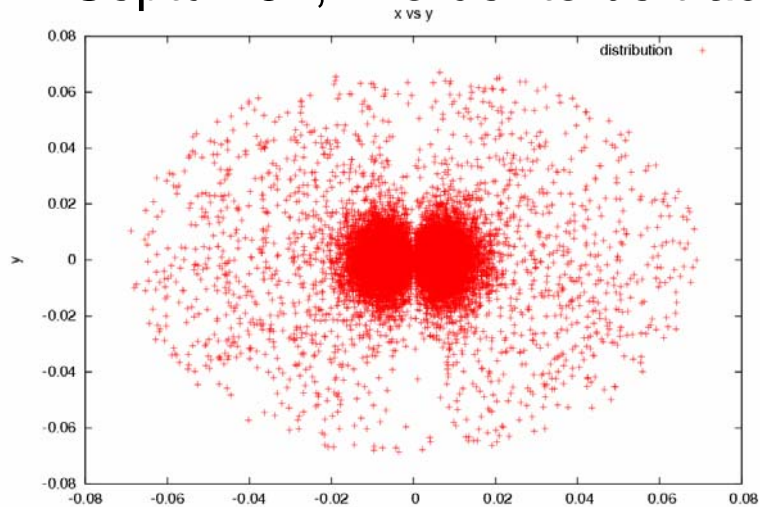
Losses A.U. vs Section

Legend: Losses -0.624
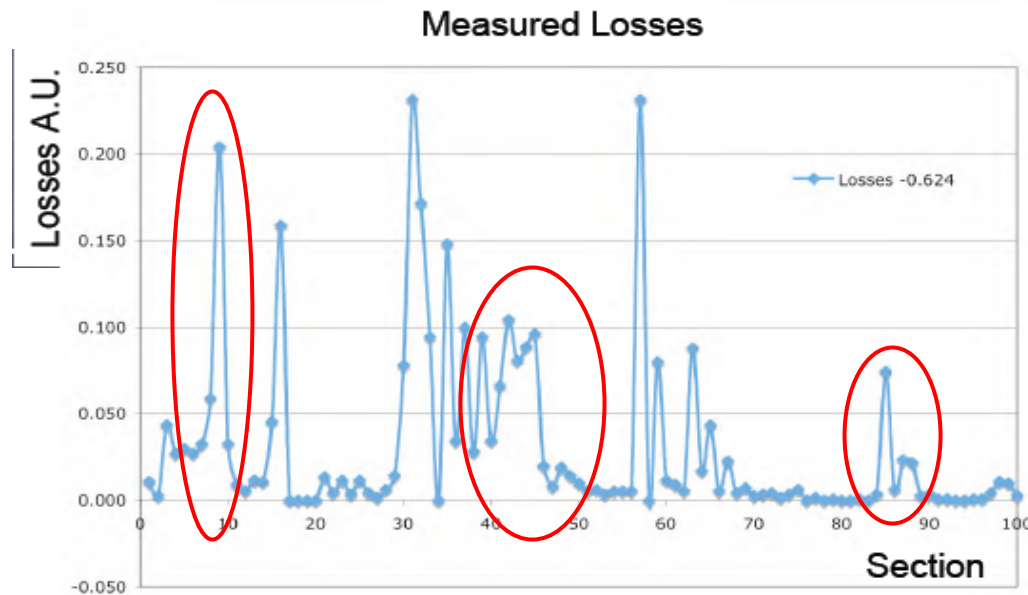
Unknown losses SS5-SS10
SS41-SS45
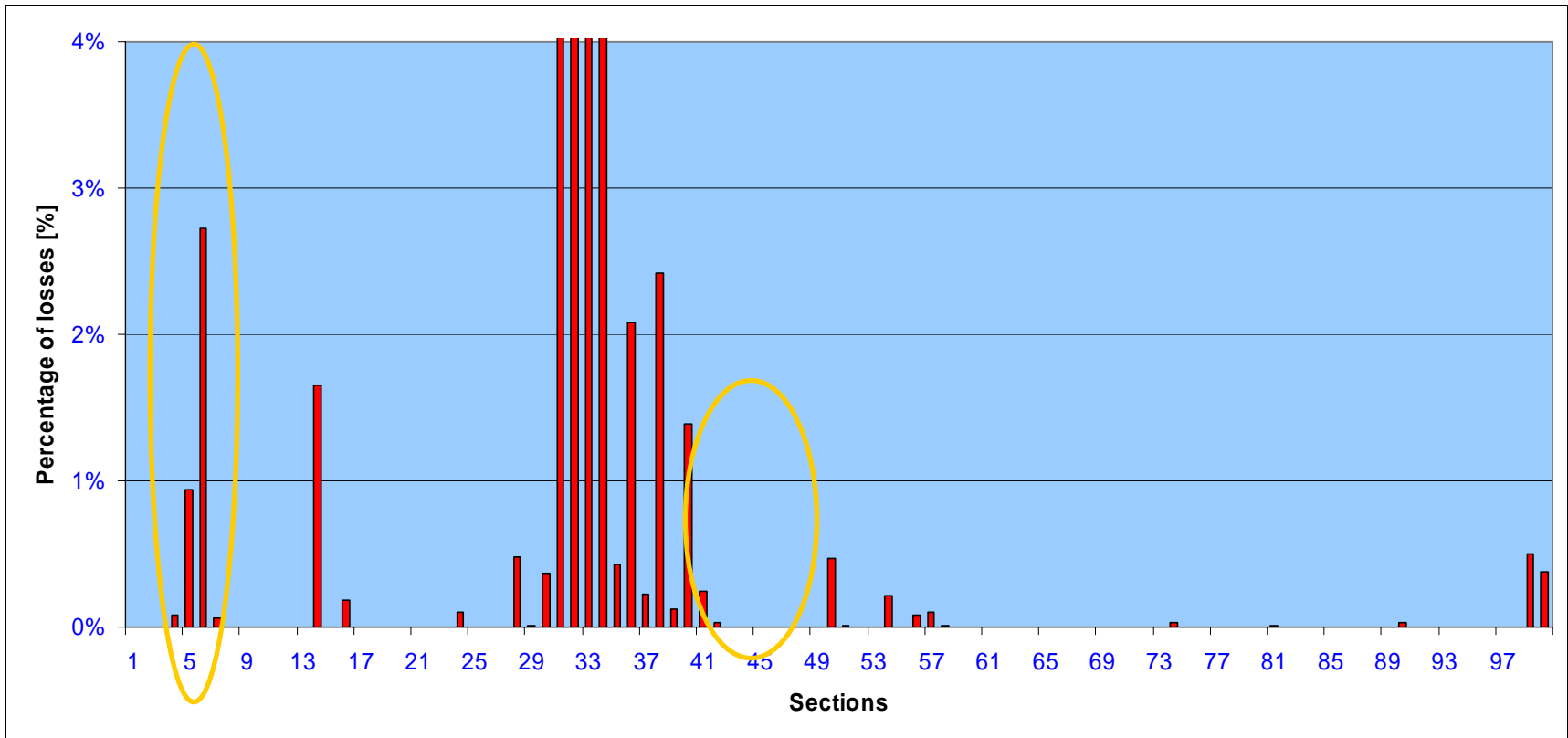SS85

[*] S. Gilardoni (APC meeting 06/10/2006)

Tracking with Sixtrack (II)

- Following Simone's studies (APC 06/10/06), a scattered particle distribution (MARS) was provided by him, coming from the blade of Septum31, in order to be tracked.
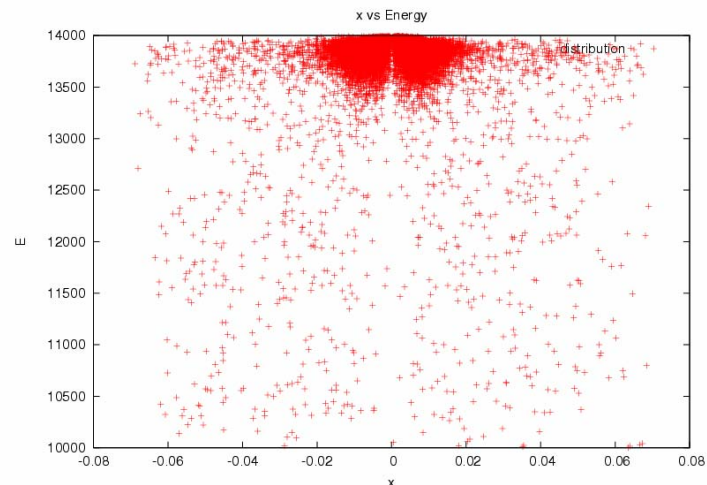
Tracking with Sixtrack (III)

- Beam losses obtained after tracking with Sixtrack (only Slow Bump)

- The loss pattern is very similar to the measured one
- Losses in sections 9, 41-45 and 85 do not appear. One may infer that the measured losses in these sections are not produced by the scattered particles in SEH31.

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Some comments regarding the simulation

- In this simulation only particles produced in scattered processes in Septum 31 are tracked. The rest of elements are considered as black absorbers.

- Some considerations have to be taken into account when interpreting these results (see also Simone's talk on APC 6/10/06).

  - The closed orbit used for tracking is an ideal and not the measured one.

  - It is not possible to include the real effect of the electrostatic septum's field in the scattered particles.

  - There is some uncertainty regarding the angle between the beam and the blade.

  - Possible activation of the magnets or others regions that could generate showers of particles cannot be included by this method. One would need a complete modeling of the PS with a scattering code like MARS.

Tracking with Sixtrack (IV)

- Losses in SS5-10 are a limiting factor for high intensity fixed target beams due to increased activation of the environing zones.

- One solution proposed by Simone was to switch off QKE05/25 and use QKE25/73 instead.

- The losses are indeed moved from around section 5 to section 75
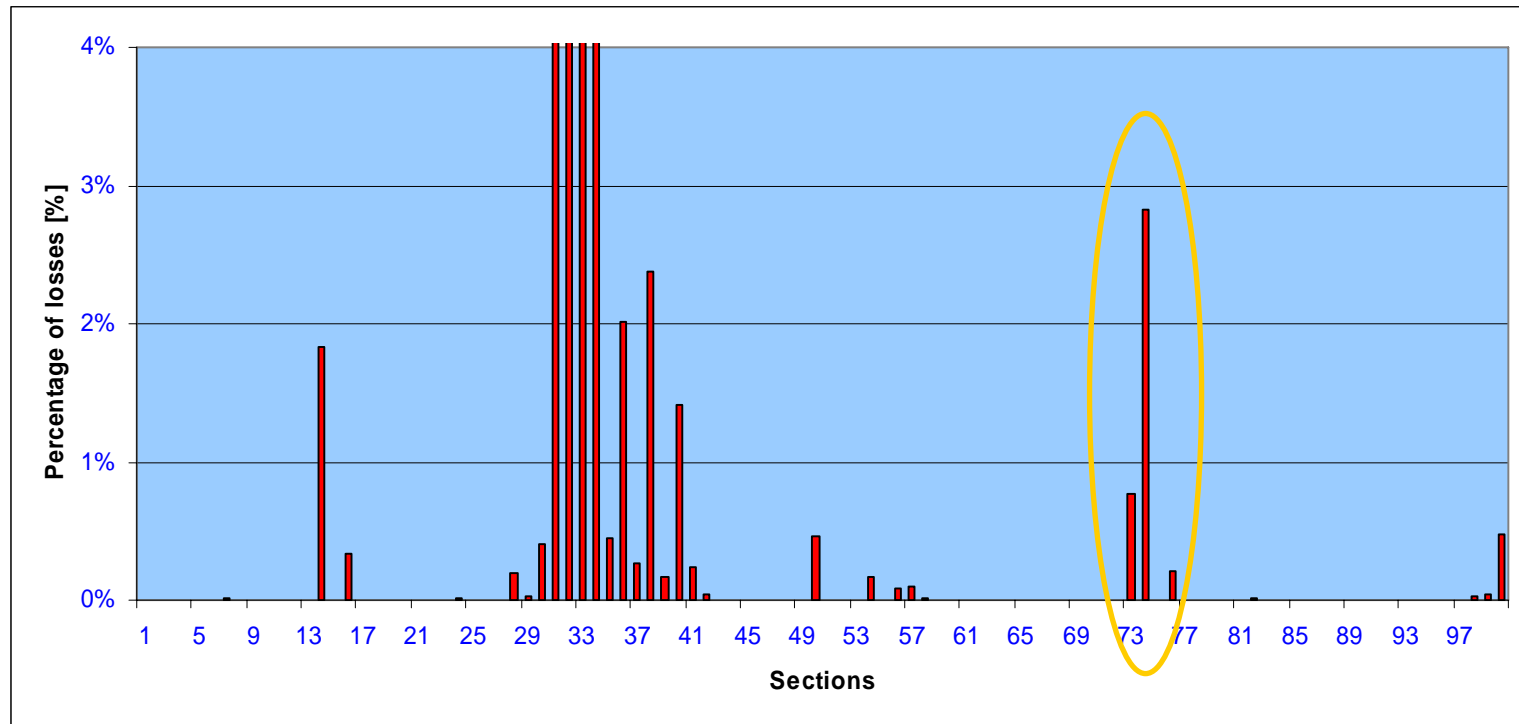
Tracking with Sixtrack (V)

- Another intermediate solution is to put half of the needed current in each QKE05/25/25/73, which reduces the losses in SS5-10 but not completely.
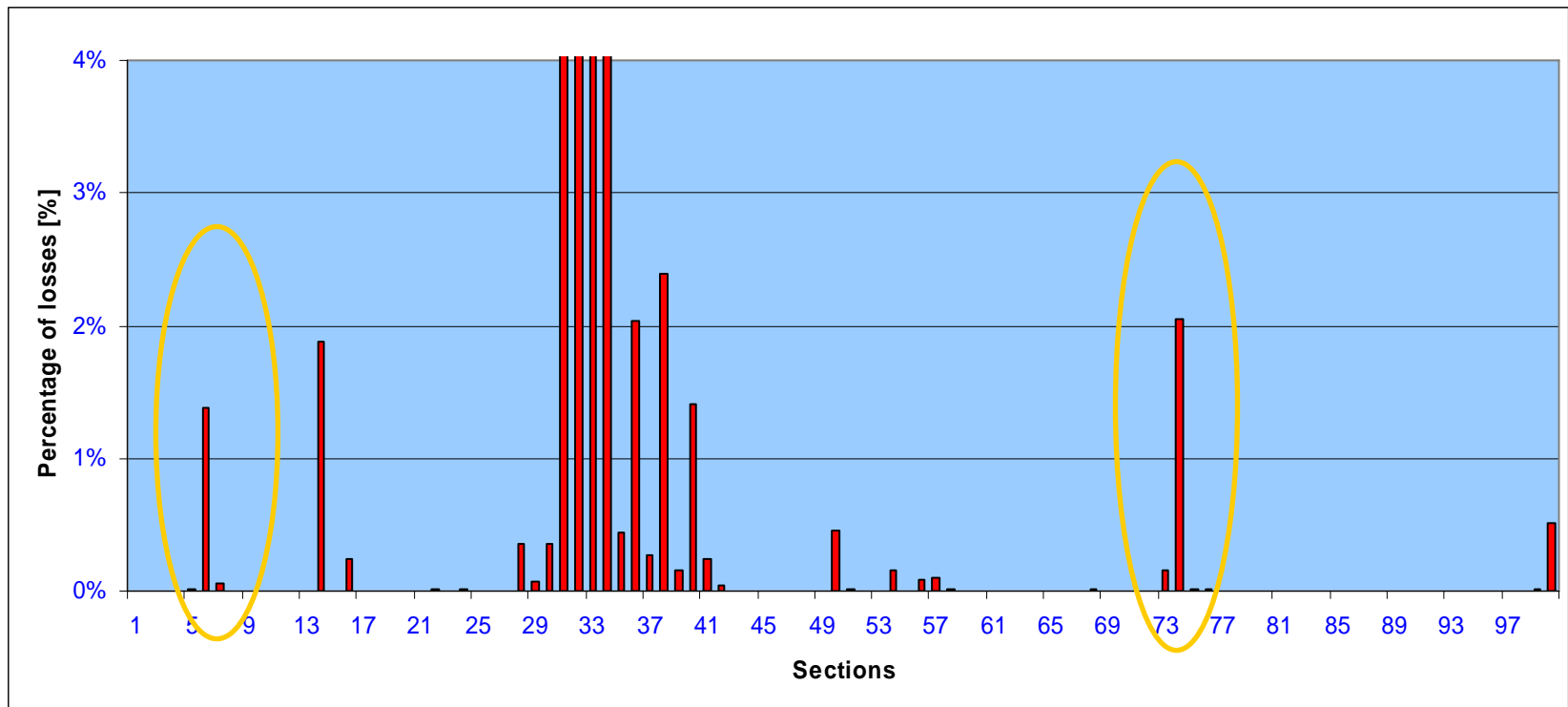
Next Steps with Sixtrack

- The next step, is to generate the scattered particles within Sixtrack (actually K2). For this:
  - Molybdenum (SEH31) has to be added to collimator's material list (Calculation of cross sections for different processes).
  - Revision of the scattering processes included in K2 for low energies. According J. B. Jeanneret, it should be fine for extraction but not sure for injection.
    - Multiple Coulomb Scattering (MCS)
    - Ionization
    - Point-like interactions (Not big differences expected)
      - Elastic proton-proton (pp) scattering
      - Inelastic diffractive pp scattering
      - Proton-nucleus (pn) inelastic scattering
      - Proton-nucleus (pN) scattering

Tracking with Sixtrack (VI)

■ Preliminary result with Sixtrack, modeling the septum as a collimator.
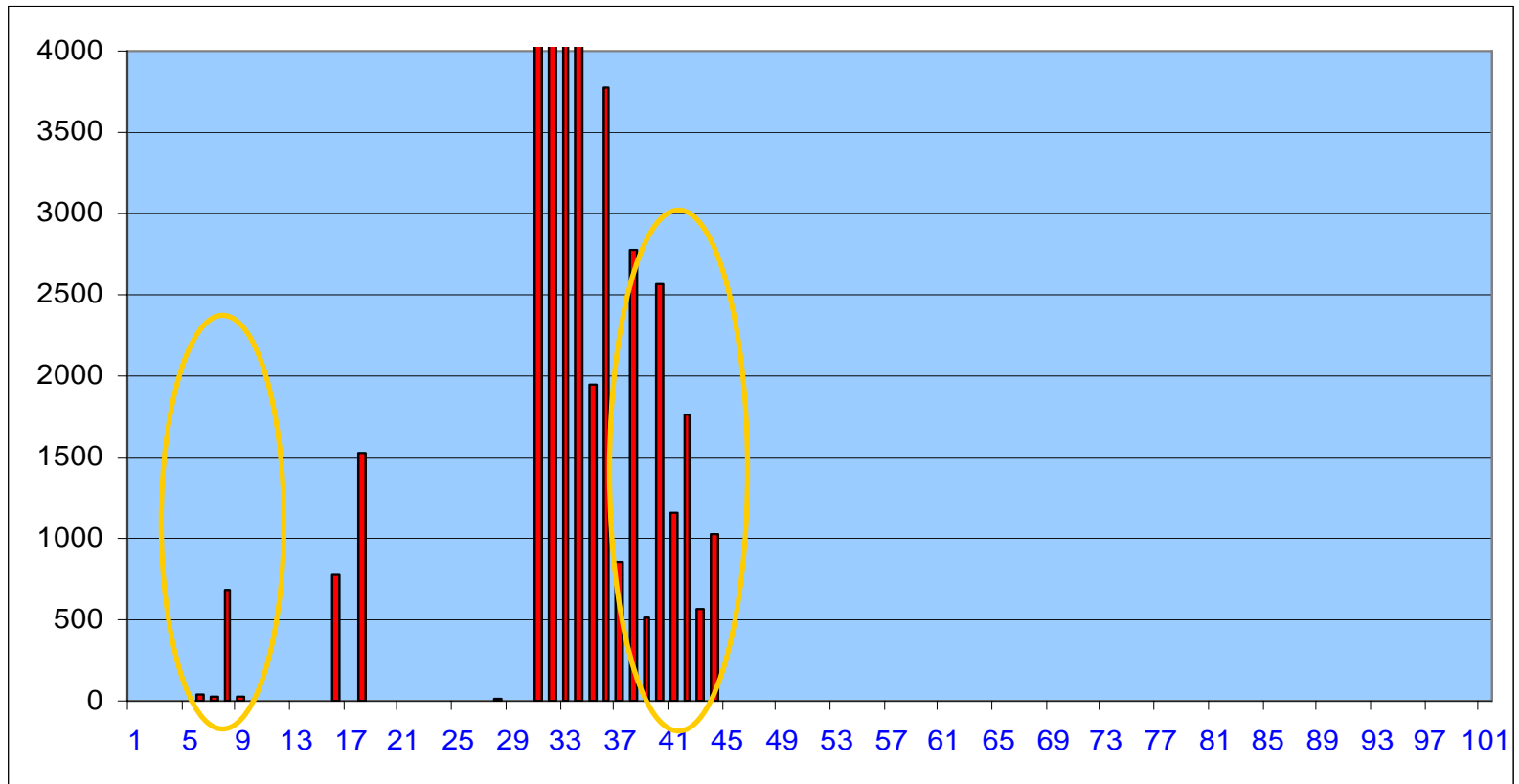
Tracking with PTC

- PTC track module is the symplectic thick-lens tracking tool in MAD-X.
- For beam loss studies, it is not directly useful, as it is necessary to place markers in all positions were tracking data is needed.
- In addition, it is not possible to follow the particle trajectory inside an element because of the thick lens nature of the code.
- F. Schmidt suggests
  - Get in contact with E. Forest as he is writing a thin lens version of PTC
  - Slice the magnets and place markers in between
- PTC it is not designed for large number of particles. For each particle one tracking simulation has to be launched.
- Large number of particles and large number of observations points implies running in parallel in several machines.
- The output from PTC cannot be directly used with the Aperture model.
- At present, a script is being developed for launching the simulations.