High Intensity and New CT

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SPS Studies Working Group

Summary

- Scenarios for high intensity beams
- Principle of Continuous Transfer
- New extraction: Phase space topology and Evolution of beam distribution

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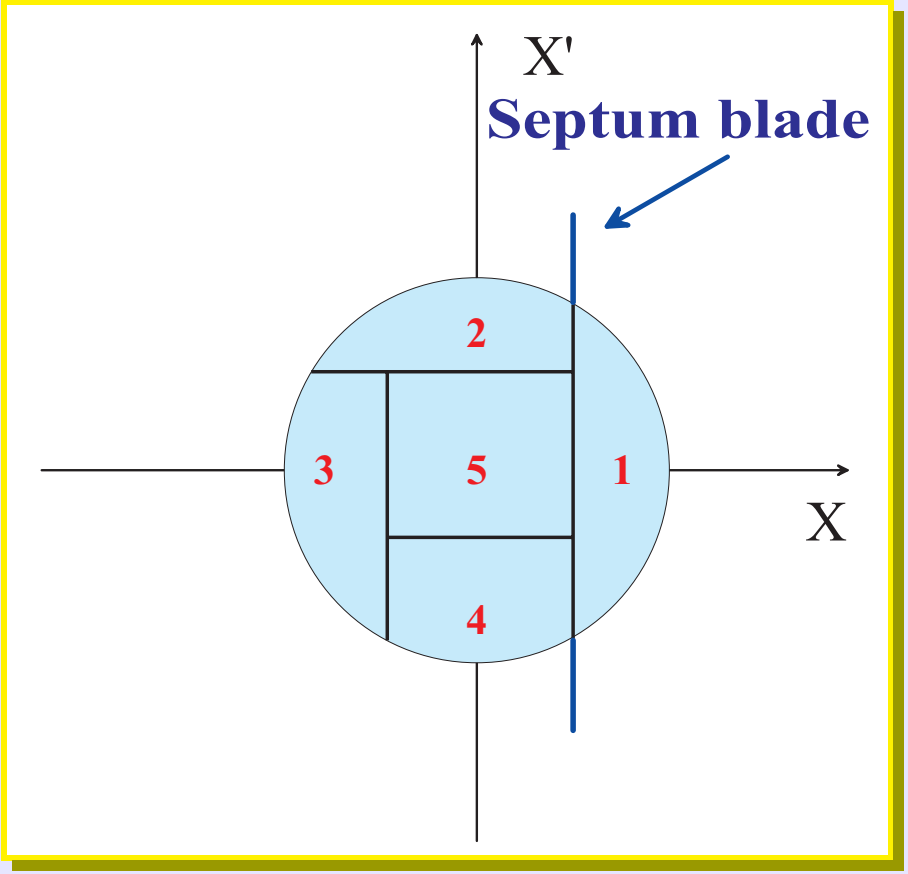
Scenarios for high intensity beams

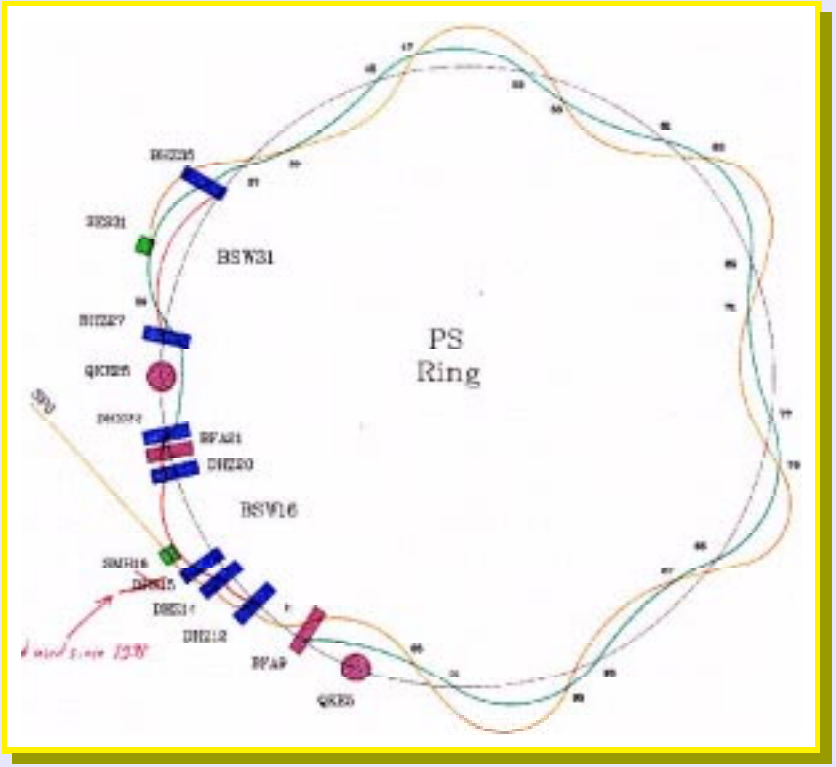
To increase the intensity delivered by the PS to the SPS for the CNGS target, three different scenarios have been identified:

- Double batch injection into the PS. Similarly to what is done for the LHC beam. It allows to fill the PS up to the space charge limit (about 4.8×10^{13} ppp).
- New H^- linac at 120 MeV. This would allow to increase the space charge limit in the PS Booster. It could be the first stage of the SPL.
- Use the proposed SPL machine to inject directly in the PS at 2.2 GeV. This would allow to increase the space charge limit in the PS and also to decrease the injected beam emittance by painting (it is an H^- machine).

Independently, a number of studies are under way to find out possible alternative schemes for the multi-turn extraction - Continuous Transfer needed to fill the SPS.

Principle of Continuous Transfer

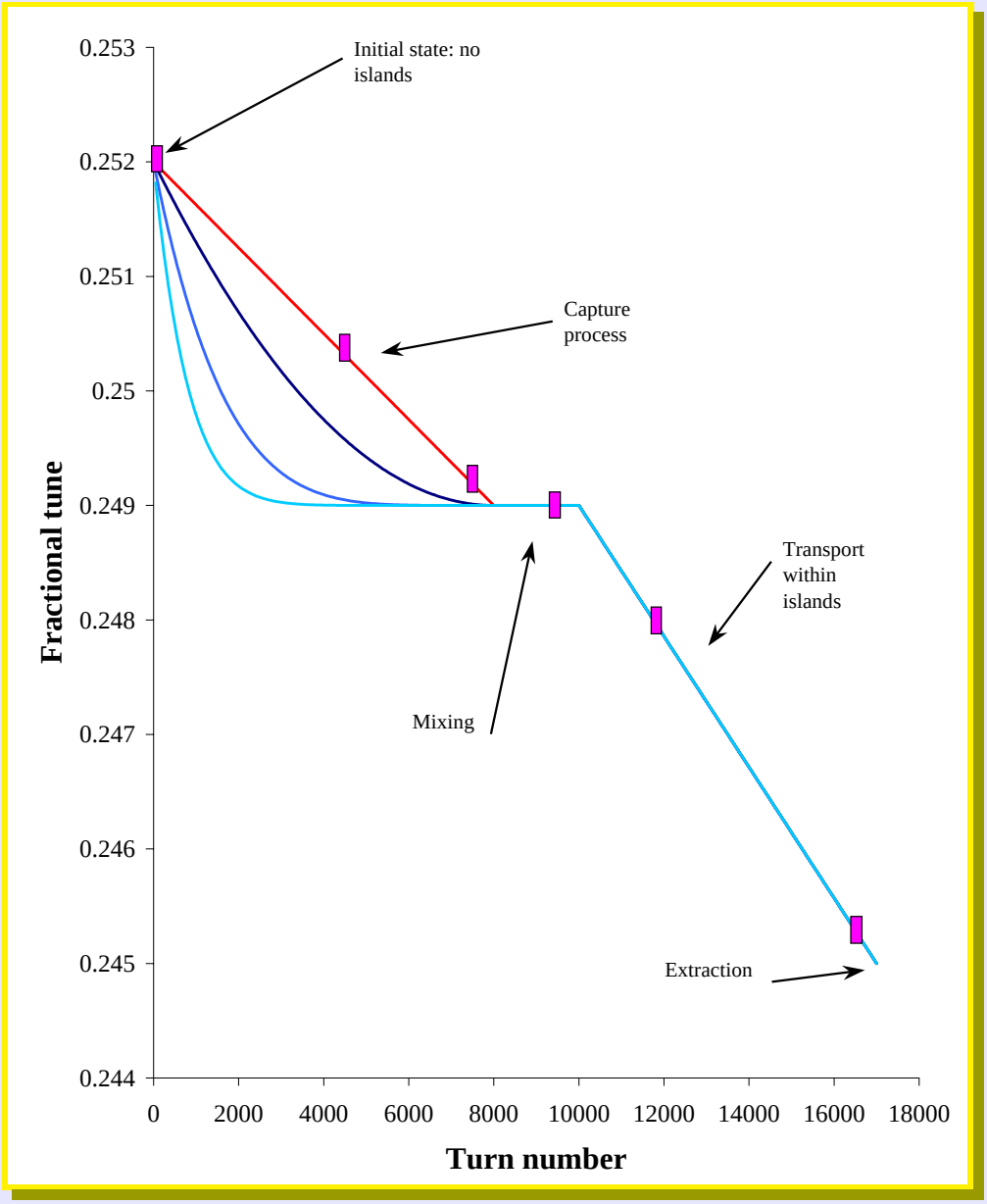




- Losses on electrostatic septum are unavoidable.
- Different pieces have different transverse emittance.
- The slices do not match the phase space structure.

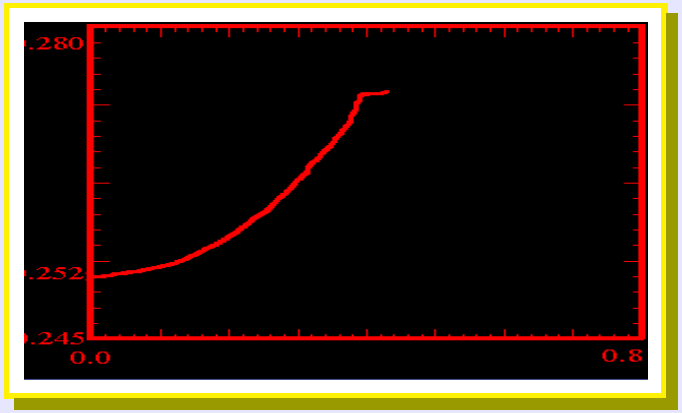
Tune evolution

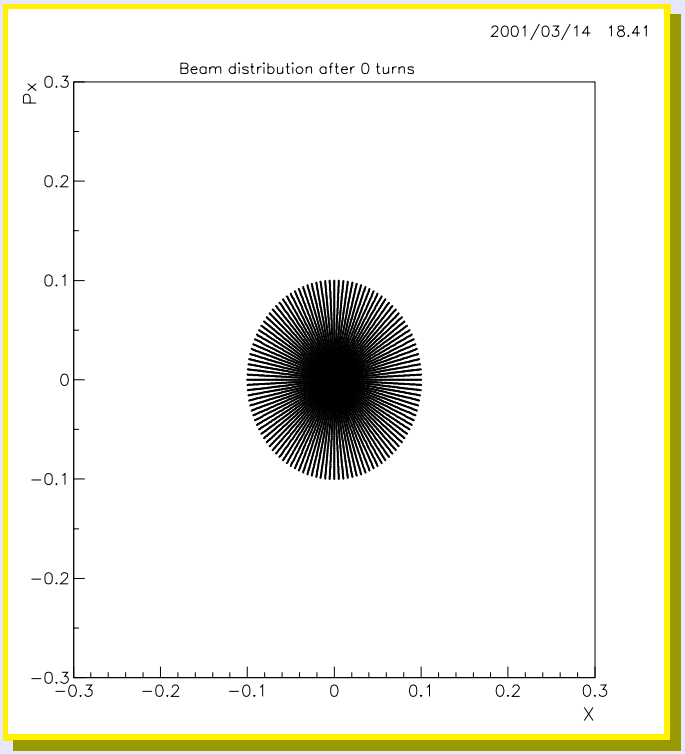
- The model: linear machine + sextupole + octupole.
- The red curve (linear tune variation vs time) has been used in numerical simulations.

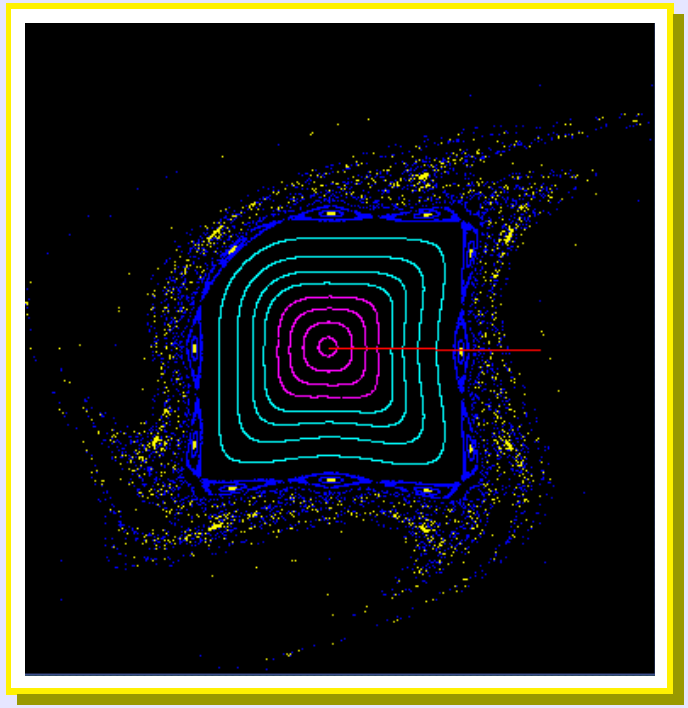


Phase space topology, beam distribution

- Parameters:
  - $\nu_H = 0.2520.$
  - Turn number: $0.$
- Scale of phase portrait: $[-1, 1], [-1, 1].$

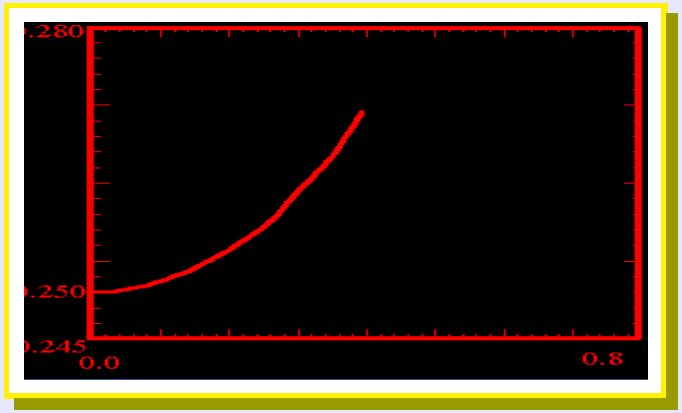


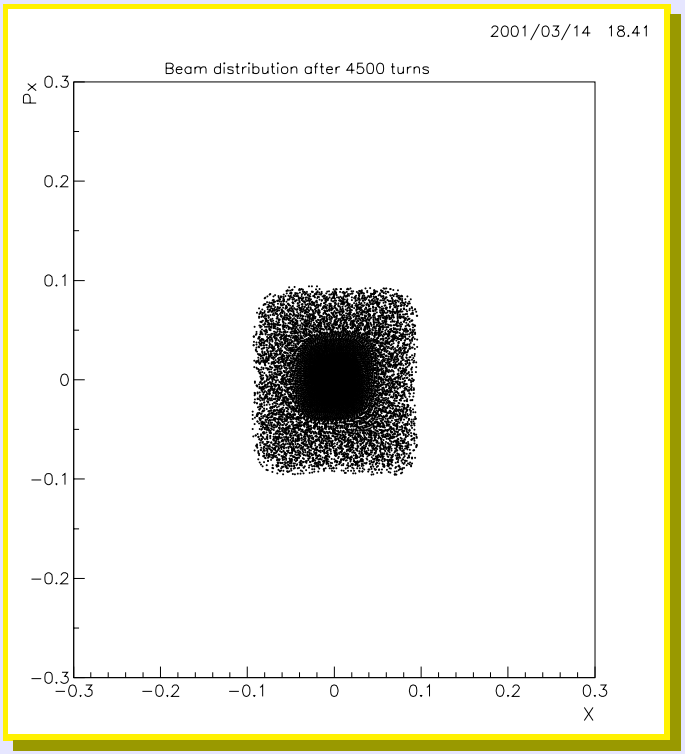


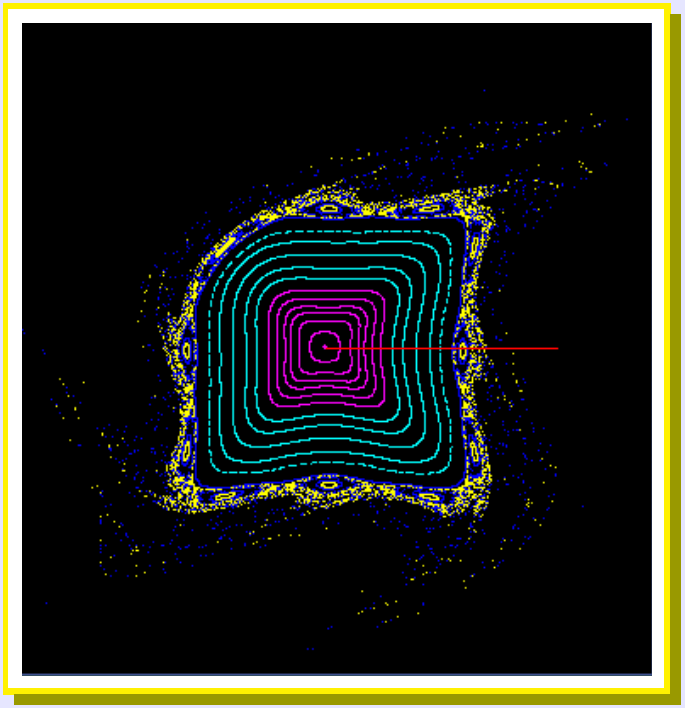


Phase space topology, beam distribution

- Parameters:
  - $\nu_H = 0.2503.$
  - Turn number: $4500.$
- Scale of phase portrait: $[-1, 1], [-1, 1].$

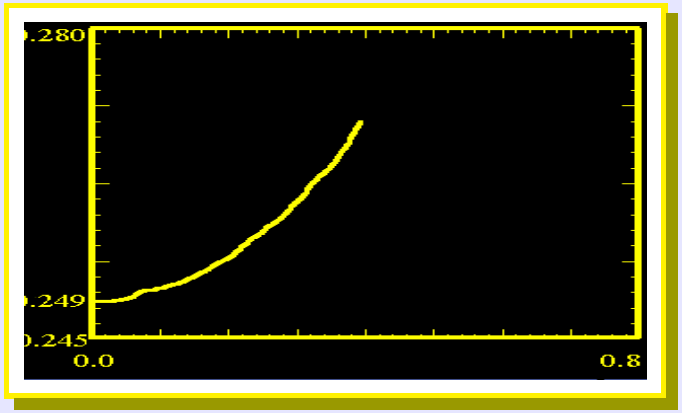


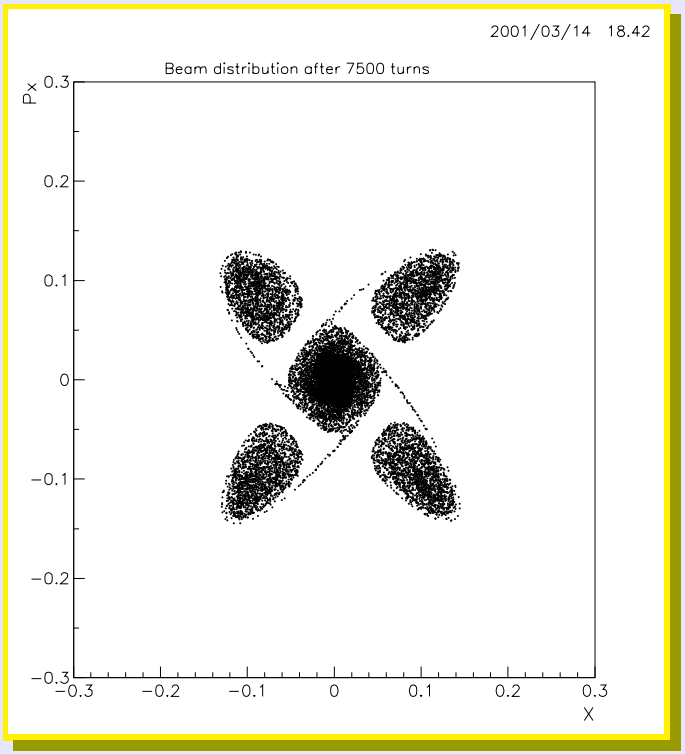


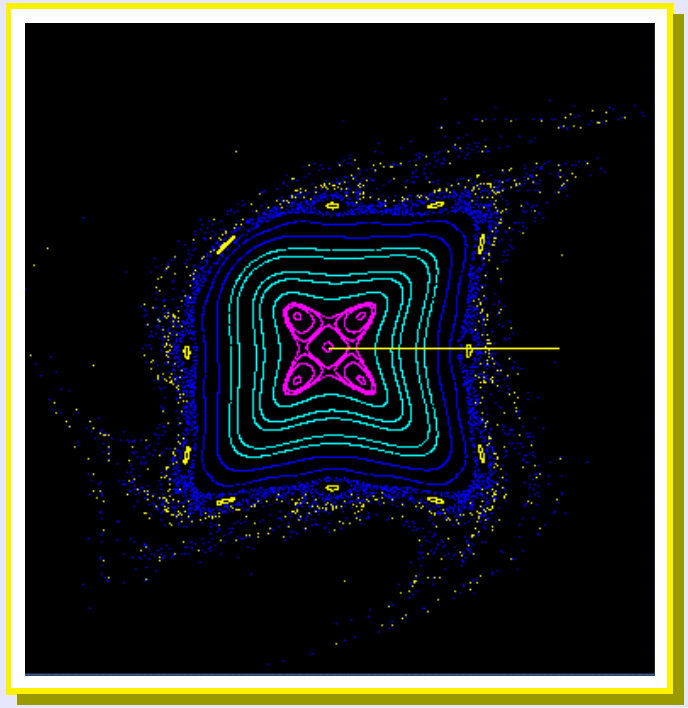


Phase space topology, beam distribution

- Parameters:
  - $\nu_H = 0.2492.$
  - Turn number: $7500.$
- Scale of phase portrait: $[-1, 1], [-1, 1].$

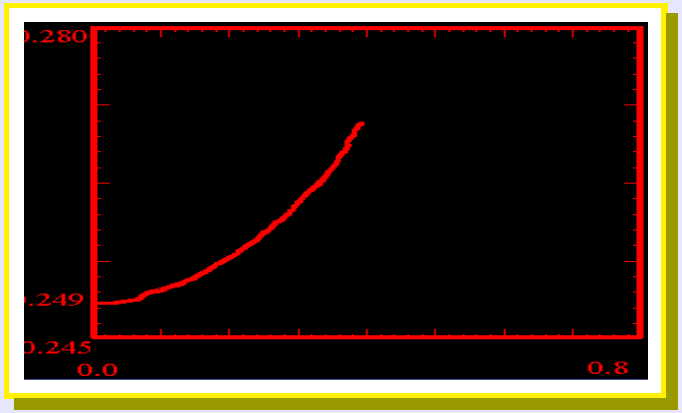


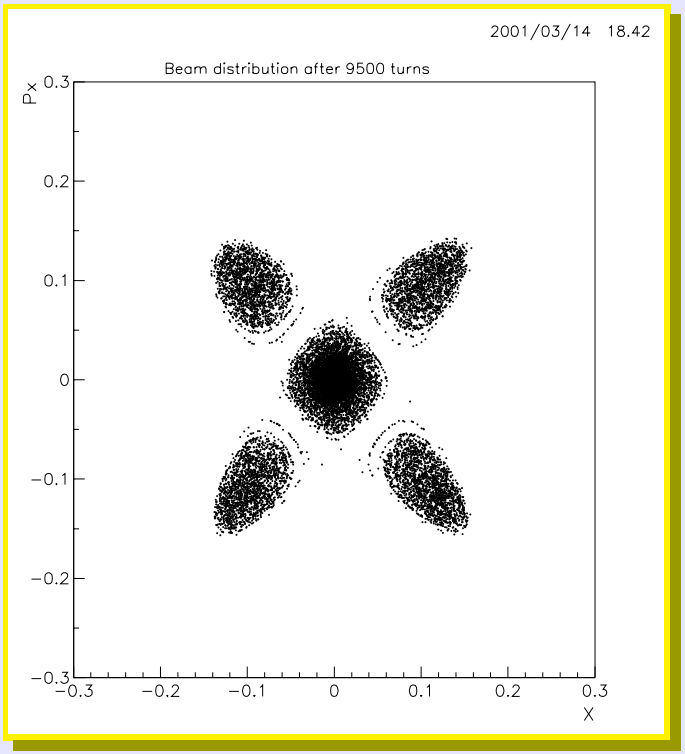


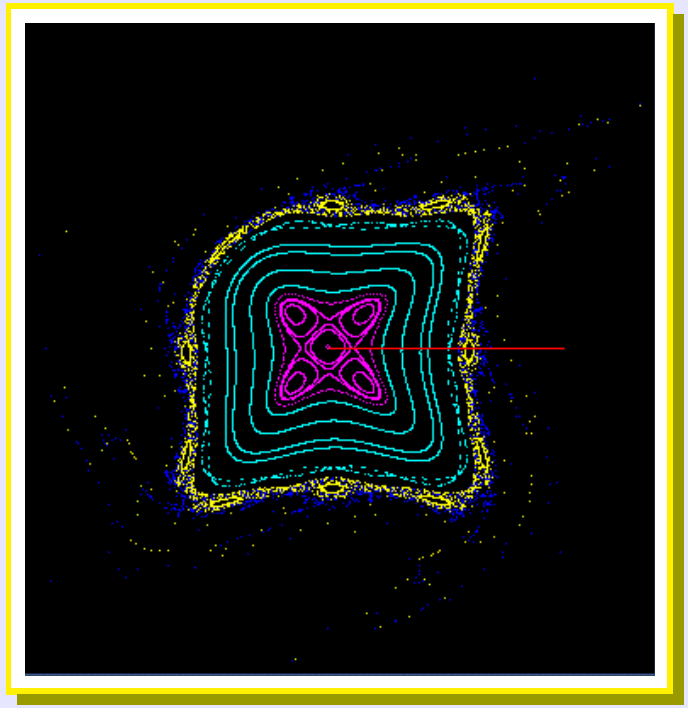


Phase space topology, beam distribution

- Parameters:
  - $\nu_H = 0.249.$
  - Turn number: $9500.$
- Scale of phase portrait: $[-1, 1], [-1, 1].$

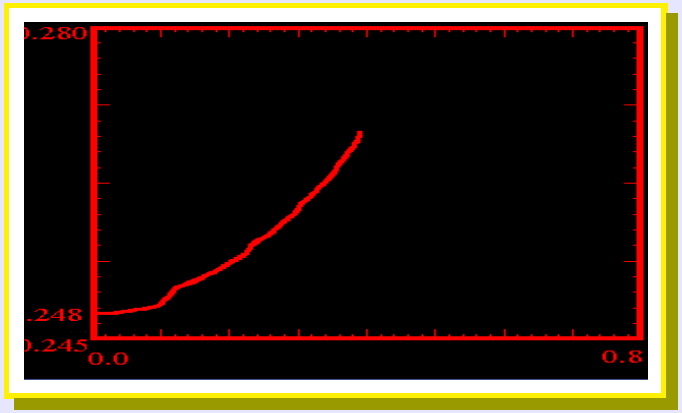


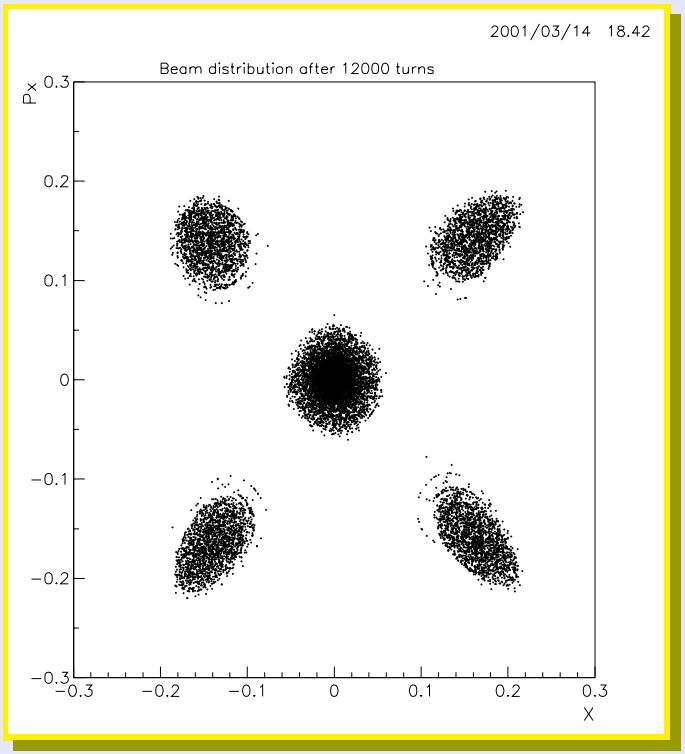


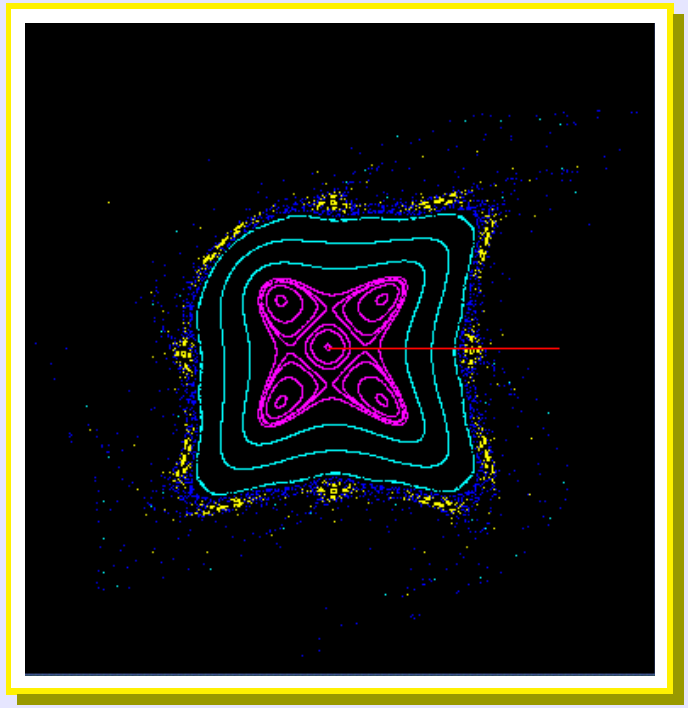


Phase space topology, beam distribution

- Parameters:
  - $\nu_H = 0.2479.$
  - Turn number: $12000.$
- Scale of phase portrait: $[-1, 1], [-1, 1].$

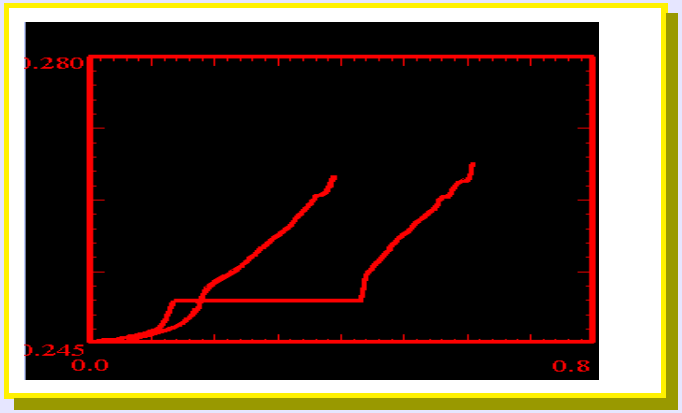


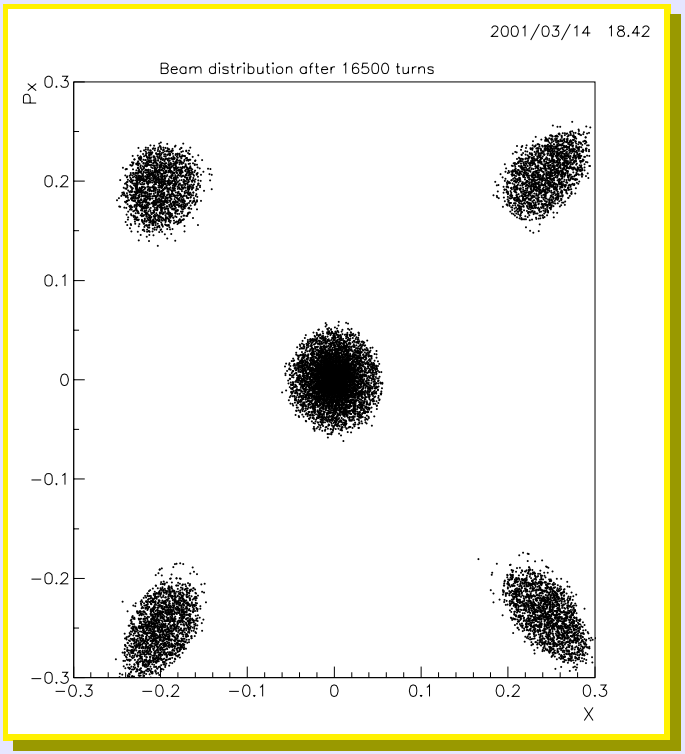


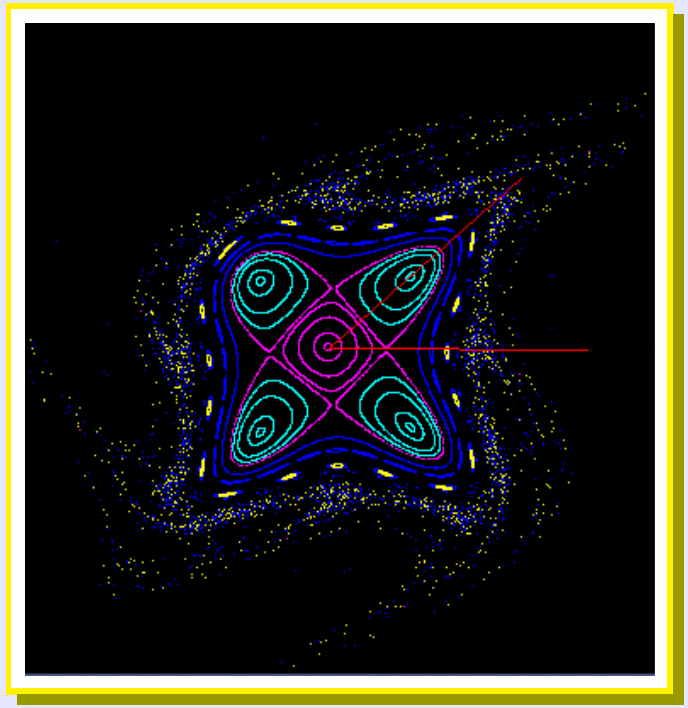


Phase space topology, beam distribution

- Parameters:
  - $\nu_H = 0.2453.$
  - Turn number: $16500.$
- Scale of phase portrait: $[-1, 1], [-1, 1].$







Outlook

What remains to be done:

- Capture and transport:
  - Intensive numerical simulations to explore parameter space.
  - Evaluate trapping efficiency, beam distribution vs parameters (tune, tune speed, k_2, k_3).
  - analyse a more realistic model (4D, realistic PS lattice).
- Extraction:
  - Check whether BFAs can be used to create a fast bump in section 16.
  - Find out solutions for the nonlinear elements located in the bump region.
- Measurements:
  - To start the tests of the new extraction mode, it is mandatory to reconstruct the phase space portrait.
  - The extraction kicker can be used to vary the amplitude of a pencil beam to perform a scan of the phase space. A system to sample (x, x') is then the key ingredient to visualise the topology.