New beam time structure at injection into the RCS

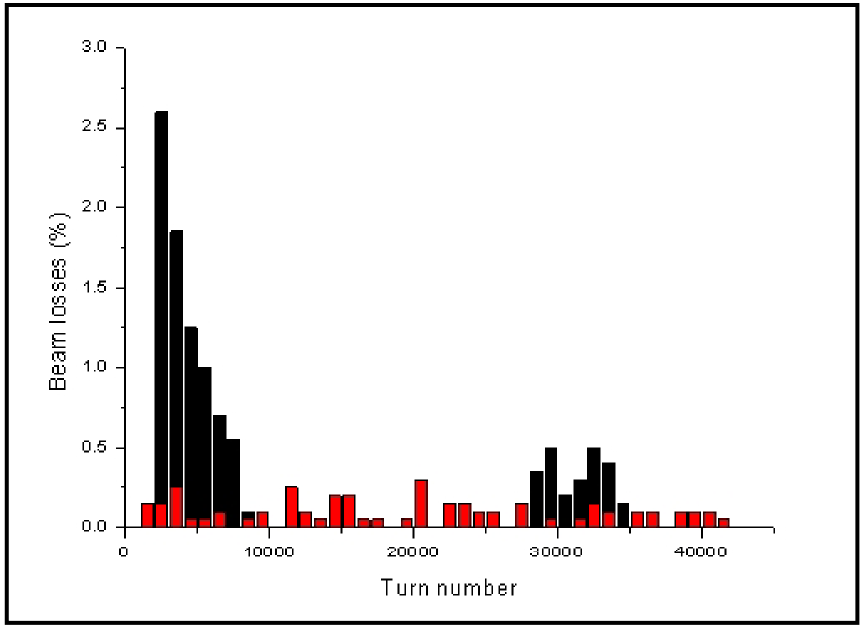
Introduction

The aim of this presentation is to propose a new time structure for the beam at injection into the RCS in order to decrease beam losses.

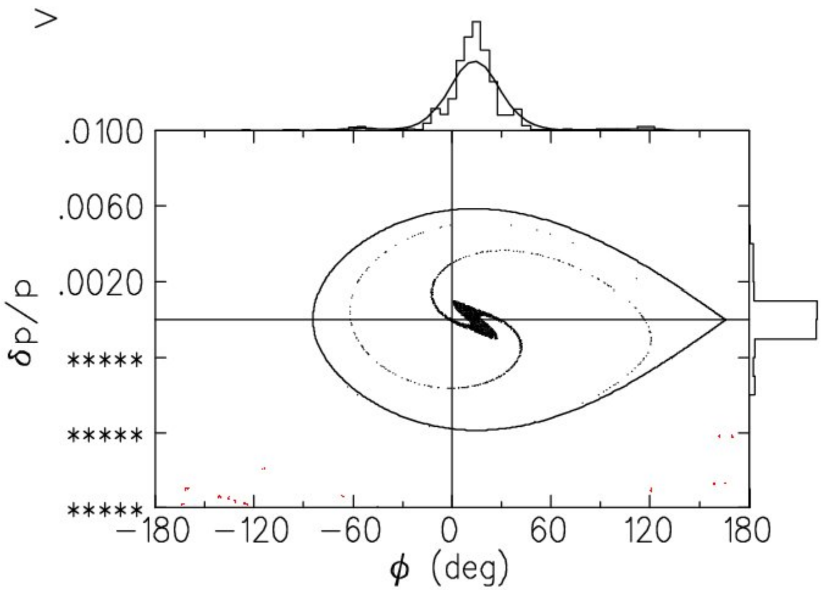
Beam losses during acceleration for the present baseline scenario :

- Unavoidable decay losses (small losses)
- Acceleration losses (~10 - 15% of the beam for both ions)

Present beam losses during acceleration



Location and intensity of losses during the cycle



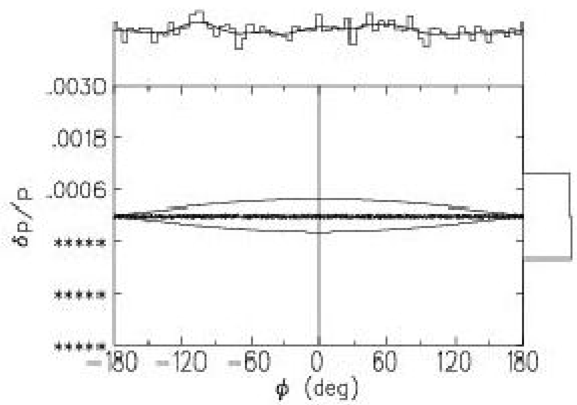
Particles which are outside the bucket do not have a stable longitudinal motion.

They move away from the reference trajectory and finally hit the vacuum chamber.

How to decrease acceleration losses ?

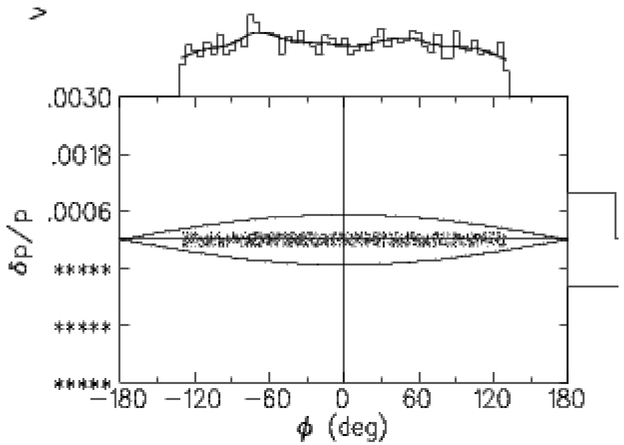
The proposed new scenario is to obtain a beam after injection which is shorter than the RCS circumference. This means that in the longitudinal phase space there are no particles close to fix points.

Previous beam



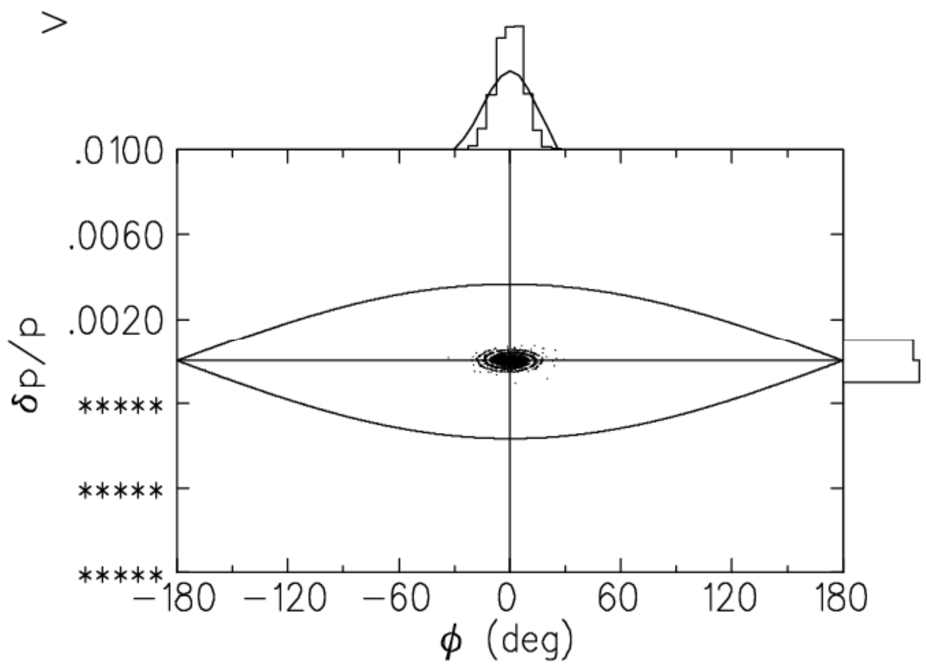
Phase spread of 360°
Momentum spread of 10^{-4}

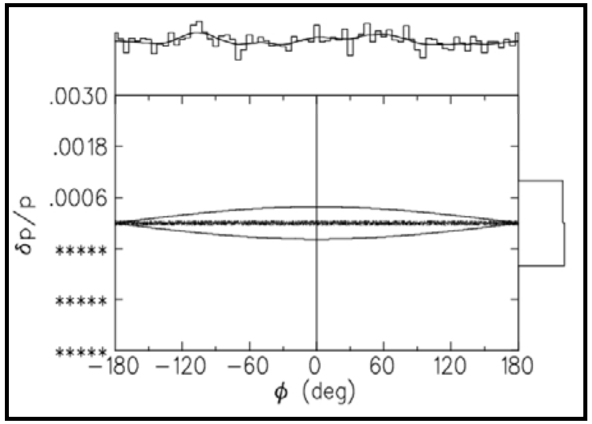
New beam

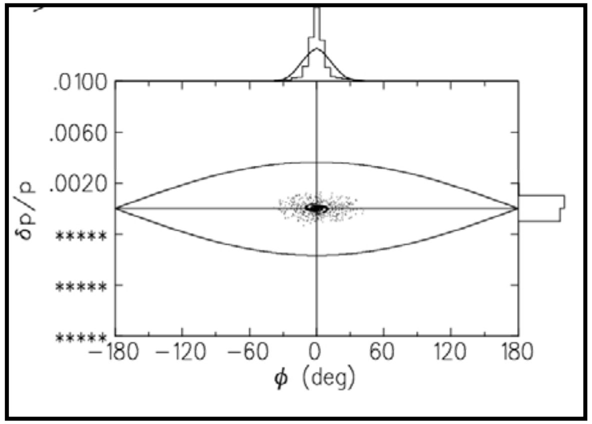


Phase spread of 260°
Momentum spread of $3.5*10^{-4}$

I have simulated the cycle with the new beam structure.







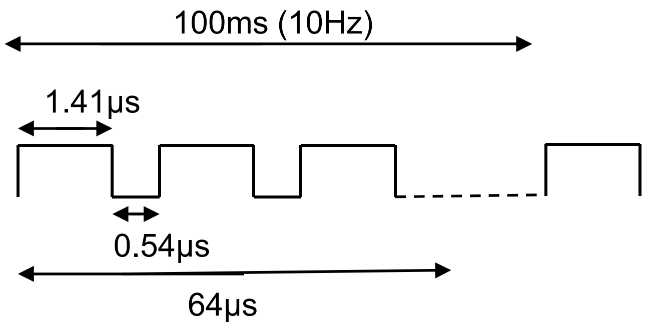
Pulse structure

Present pulse structure : 50µs pulses every 100ms (10Hz)

A phase spread of 260° after injection in the RCS corresponds to 1.41µs micro-pulses separated by 0.54 µs.

- Beam chopping

Cutting the beam to obtain a phase spread of 260° implies the loss of 28% of the beam in the chopper. In order to have the same number of ions per bunch after injection in the RCS, the ion source will have to deliver an 28% longer pulse (64µs instead of 50µs) → diminution of injection efficiency.



- Pulsed extraction of the ion source

Another possibility could be to pulse the extraction of the ion source. The feasability of thiis process has to be confirmed.

More detailed tests of the source have to be done to know the performances in that case (intensity, pulse length…).

Conclusion

A new scenario for beam structure has been proposed in order to avoid main losses occuring during RF cycle in the RCS.

This scenario allows an acceleration with a very good efficiency (96% for He(87%) and 98% for Ne (85.4%)).

Its advantage is obvious from the point of view of radiation protection but it has to be simulated more in details according to ion source capabilities to obtain a complete and finalized set of parameters.