Beam Transport in Toroidal Magnetic Field

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Here we report on the present status of the studies on beam transport in toroidal segments, and on the experimental setup for injection experiments. The planned experiments will provide proof of principal for complete stellarator type storage ring for high current ion beams[1].

To study beam dynamics and for initial tests two toroidal segments with longitudinal magnetic field up to 0.6T have been ordered. The curvature drift causes vertical particle motion which may be compensated by the space charge drift ie. E X B drift, which will be tested by rather simple experimental setup with single toroidal segment.

The following picture shows a single segment and the corresponding parameters are listed below.

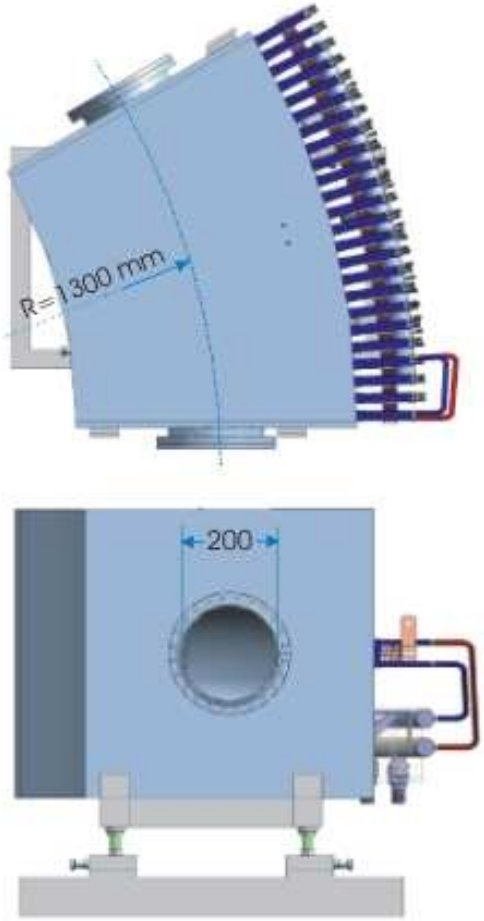


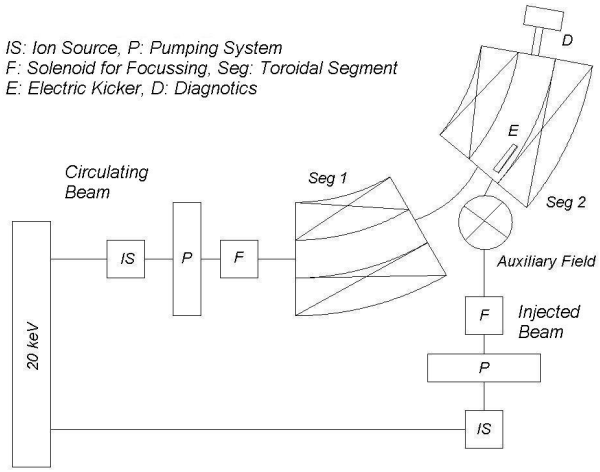
Figure 1: toroidal segment.

Magnetic field (B)	0.6 Tesla
Segment Angle	30 degree
Major radius of vessel	1300 mm
Minor radius of vessel	100 mm

The two toroidal segments allow flexibility in designing the experimental setup for injection as well as other schemes, eg. two segments arranged on a circle or arranged in S-shape.

Injection Experiments

Injecting ion beam into longitudinal magnetic fields poses difficult problems [2],[3]. But the task is to be tackled by making use of drift velocity itself. The diagram following shows the experimental setup.



Experimental setup

The Helmholtz coils (magnetic field 0.2T max) are to be installed in between the two toroidal segments, which will provide homogenous curved magnetic fields for smooth injection of proton beam. The injection angle is fixed at 35 degree with possibility of variation 5 degree.

The proton beam is extracted from volume source with maximum energy 20 keV with proton fraction of 45% and focussed with solenoid. The diagnostic consist of emittance scanner and mass spectrometer.

The experiments will provide opportunity to explore relations in plasma and beam physics. The installations are planned to start in May 2007.

References

[1] M. Droba, N.S. Joshi, O. Meusel, P. Nonn, U. Ratzinger, “Design Studies on a Novel Stellarator Type High Current Ion Storage Ring”, proceedings EPAC´06, p. 297-299.

[2] P. Gilad, et. al, “Injection and drift studies of high current relativistic electron beams in a toroidal-like system , Phys. Fluids, vol. 18, No.5, May 1975

[3] First studies of pure electron plasmas in the Columbia Non-neutral Torus, J.W. Berkery, et. al, AIP Conference Proceedings 862, p. 62-70,2006.