

# Experiments of Non-Neutral Plasma Confinement in Linear and Partial Toroidal Device

## Abstract

Non-Neutral Plasmas (NNP) confined in uniform magnetic field of cylindrical traps can be confined forever<sup>1,2</sup>. Toroidal non-neutral plasmas trapped in non-uniform B-field are poorly confined for few seconds<sup>3-4</sup> due to presence of plethora of instabilities. Recently, NNP in partial torus with the suppression of instabilities have shown the excellent confinement properties exceeding 100 S<sup>5</sup>. It would be interesting to compare and scale the confinement time with magnetic field and test the theoretical limit of magnetic pumping transport<sup>6</sup>. Recent upgrades of the experimental system, SMARTEX-C, a partial torus at IPR, have made the system to be capable of performing experiments at steady B-field of 1kG and at a vacuum of  $1.0 \times 10^{-10}$  mbar.

Scope of work: The project student has to work in a team to carry out experiments of long-time confinement with different physical parameters i.e. B-field and pressure. Student is also supposed to get involved into experiment related UHV vacuum practices, electronics/instrumentation activities, and also develop the analysis routines in Matlab/Python, to analyze the experimental data for investigation of the underlying physics of confinement of NNP in partial torus.

Outcome of the project: After completion of the project, scaling laws of confinement with collisional and non-collisional parameters will be known. General utilities for data analysis of the experimental results will be delivered.

References:

1. Malmberg, J. H. & deGrassie, J. S. Phys. Rev. Lett. 35, 577–580 (1975).
2. Malmberg, J. H. & Driscoll, C. F. Phys. Rev. Lett. 44, 654–657 (1980).
3. Marler, J. P. & Stoneking, M. R. Phys. Rev. Lett. 100, 155001 (2008).
4. Lachhvani, L. et al. Phys. Plasmas 19(2016).
- 5 Lachhvani, L., Pahari, S., Goswami, R. et al. Sci Rep 13, 19038 (2023).
6. S. M. Crooks and T. M. O’Neil, Phys. Plasmas, vol. 3, no. 7, pp. 2533–2537, Jul. 1996.

## Academic Project Requirements:

1) **Required No. of student(s) for academic project: 1**

2) **Name of course with branch/discipline: M.E./M.Tech Other**

3) **Academic Project duration:**

(a) **Total academic project duration: 26 Weeks**

(b) **Student’s presence at IPR for academic project work: 5 Full working Days per week**

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