TCABRJE - Joint Experiment on TCABR – Host Laboratory Experiment
04th to 15th May 2009
Laboratory of Plasma Physics
Institute of Physics – University of São Paulo
São Paulo – SP – Brazil

First Announcement

The Laboratory of Plasma Physics of the Institute of Physics of the University of Sao Paulo is one of the laboratories participating in the Co-ordinating Research Project on "Joint Research Using Small Tokamaks" of the IAEA – International Atomic Energy Agency. The Joint Experiments (JE) are organized by the participant laboratories in co-operation with the IAEA. The next to be held on TCABR is the fourth one and follows previous events on CASTOR, Prague, Czech Republic in 2005, on T-10 in the Kurchatov Institute , Moscow, in 2006, and on ISTTOK in Lisbon, Portugal, in 2007. The main objectives of this activity is to enhance collaboration between research groups and laboratories, promoting experiments and creating synergies to effectively contribute to the development of fusion science.

Characteristics of the TCABR: major radius R = 0.61 m, minor radius a = 0.18 m, toroidal magnetic field B_T = 1.07 T, maximum plasma current I_{pmax} = 100 kA, averaged maximum density electron density $n_e = 4.5\ 10^{19}\ m^{-3}$, maximum electron temperature T_e = 500 eV, maximum ion temperature T_i = 200 eV, discharge duration 100 ms, duty cycle $0.17\ 10^{-3}$ (one discharge every 10 minutes).

The scientific research program in development on TCABR is composed of the following main lines of research:

- Interaction of RF (RadioFrequency) electromagnetic waves in the Alfvén range with Tokamak plasmas
- Physics of the SOL and Plasma Edge in Ohmic and Improved Confinement Regimes
- Toroidal and Poloidal Plasma Rotation
- Development of Diagnostics
- Data Acquisition and Remote Control

For these studies the following equipments and diagnostics are available:

- Alfvén wave excitation system upgraded recently, composed of a RF generator in the range of frequencies between 3 MHz and 5 MHz, power of 200 kW, feeding two antennas separated toroidally by180 degrees with independent phasing, allowing a better definition of the spectra of excited modes in the plasma.

- Biasing system for getting improved confinement, composed of an movable electrode, fed by a power supply capable of applying to the edge plasma electrical polarization of duration of 0 – 60 ms, rise and decay times of 10 μs – 10 ms, voltages of ±600 V, and maximum current of 150 A
- Diagnostics

  Electromagnetic diagnostics

Microwave interferometer, 150 GHz
ECE radiometer
Spectrometer for plasma rotation measurements
Electrostatic probes for measuring edge plasma density, floating potentials, electron temperature, phase shifts, etc.
Multipin electrostatic probes
Bolometer array with 24 detectors
Mirnov coils: 2 sets of 22 coils displaced poloidally in two toroidal positions
Soft x-rays array composed of 32 detectors
Reflectometer
Soft x-rays array
Hard x-ray detector
H_α array and tomography
Thomson Scattering
Spectrometer system for plasma rotation measurements

Possibilities of investigation in the tokamak TCABR:

- Application of Alfvén waves associated with reflectometry for plasma diagnostics.
- Effect of the excited Alfvén wave spectrum on plasma peripheral transport and turbulence
- Comparative studies of the antenna phasing on Alfvén wave absorption, in particular regarding resonant radial deposition profiles and minimization of plasma edge absorption and uncontrollable density rise
- Influence of Alfvén waves on zonal flow generation
- Study of improved regimes of energy confinement with biasing
- Characterization of edge fluctuations and transport
- Regimes of suppression and excitation of MHD activity
- Measurement of edge and SOL plasma intermittency
- Search for zonal flow and GAM
- Measurement of time evolution and radial profile of plasma rotation
- Methods of analysis in the study of transport in tokamaks
- Investigation of turbulence-driven transport in tokamaks by considering the chaotic particle transport due to poloidal plasma flow and drift waves
- Study of coupling between magnetic and electrostatic fluctuations to explain alterations on the turbulent-driven transport observed during high MHD activity, spontaneous or induced by electrode biasing, in tokamaks
- Development of advanced Thomson scattering system for TCABR
- Data acquisition and remote control

Participants may propose experiments on other topics not listed above which will be considered after the pre registration. It is expected that five experiments including the respective data analysis can be performed during the JE. If necessary, they can be continued after the JE by remote collaboration. The output of the JE activity should be the publication of papers in indexed journals.

Financial Support

Partial financial support from RNF (Rede Nacional de Fusão – Brazil) and IAEA is available for participants from developing countries. Since the resources are limited, a selection, if necessary, will be made based on the pre-registration information.

Deadlines

Pre-registration and Financial support	February 28/2009
Award of Financial support	March 15/2009
Registration and Hotel reservation	April 10/2009
TCABR Joint Experiment	May 4-15/2009

Committees and Contacts

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Dr. Gunter Mank (IAEA)
Dr. Artur L. Malaquias (IAEA)

CRP International Scientific Committee: Mikhail, Guido, Edson
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TCABR Machine Support:

Dr. Juan Iraburu Elizondo (Head)
Ablicio Pires dos Reis (Engineer, Reflectometry)
Edson Kenzo Sanada (Tokamak Operation)
Nelson A.M. Cuevas (Chief Engineer)
Tarsis Germano (Soft X-Ray, Bolometry)
Ivan Cardoso
Nélio Nunes
Rogério Eduardo Capucci

Publications Related to the above topics:

1. NASCIMENTO, I.C., et al., Plasma Confinement Using Biased Electrode in the TCABR Tokamak, Nucl. Fusion 45 (2005) 796.
2. KUSNETSOV, YU.K., et al., Effect of electrode biasing on plasma parameters in the TCABR, Report on 10th IAEA Technical Meeting on H–mode Physics and Transport Barriers, St. Petersburg, 2005
3. HELLER, M.V.A.P.; CALDAS, I.L.; FERREIRA, A.A., et al., Tokamak turbulence at the scrape-off layer in TCABR with an ergodic magnetic limiter, Journal of Plasma Physics 73 (2007) 295.
4. SEVERO, J.H.F., et al. Plasma rotation measurement in small tokamaks using an optical spectrometer and a single photomultiplier as detector, Review of Scientific Instruments 78 (4) (2007) 043509.
5. NASCIMENTO, I.C., et al., Suppression and excitation of MHD activity with an electrically polarized electrode at the TCABR tokamak plasma edge, Nuclear Fusion 47 (2007) 1570.
6. ELFIMOV, A.G., et al., Identification of local Alfvén wave resonances with reflectometry as a diagnostic tool in tokmaks, Nuclear Fusion 46 (2006) S722.
7. RUCHKO, L.F., et al. , Application of microwave reflectometry to register Alfvén wave resonances in the TCABR tokamak, Review of Scientific Instruments 75 (2004) 655.
8. TSYPIN, V.S., et al., Viscous relaxation of drift-Alfven waves in tokamaks and its application for triggering improved confinement regimes, Physics of Plasmas 14 (1) (2007).
9. MIKHAILOVSKII, A.B. et al., Generation of zonal flows by kinetic Alfven waves, Plasma Physics Reports 33 (2) (2007) 117.
10. MIKHAILOVSKII, A.B.; LOMINADZE, J.G.; CHURIKOV, A.P., et al.,Generation of magnetoacoustic zonal flows by Alfven waves in a rotating plasma, Physics of Plasmas 14 (2007) 082302 .
11. MIKHAILOVSKII, A.B.; KOVALISHEN, E.A.; SHIROKOV, M.S., et al., Effect of the magnetic field curvature on the generation of zonal flows by drift-Alfven waves, Plasma Physics Reports 33 (2007) 407.
12. ELFIMOV, A.G; PIRES, C.J.A; GALVAO, R.M.O, Fast drift Alfven waves excited at the low-frequency band in tokamak plasmas, Physics of Plasmas 14 (2007) 104506.
13. VAN OOST, G., et al., Joint experiments on small tokamaks: edge plasma studies on CASTOR, Nucl. Fusion 47 (2007) 378.
14. VAN OOST, G., et al., Joint Experiments on the tokamaks CASTOR and T-10, Plasma and Fusion Science , Proceedings of the 17th IAEA Technical Meeting on Research Using Small Fusion Devices, Lisbon, Portugal, 22-24 October 2007. AIP Conference Proceedings, 996: 24-33,

2008, (ISBN-978-0-7354-0515-8, ISSN 0094-243X)
http://www.cfn.ist.utl.pt/17IAEATM_RUSFD/proceedings.html
15. ALONSO, M.P., et al., Multipoint Thomson scattering diagnostic for the TCABR tokamak with centimeter spatial resolution, Plasma and Fusion Science,Proceedings of the 17th IAEA Technical Meeting on Research Using Small Fusion Devices, Lisbon, 2007. AIP Conference Proceedings 996: 192 198, 2008 (ISBN-978-0-7354-0515-8, ISSN 0094-243X)
http://www.cfn.ist.utl.pt/17IAEATM_RUSFD/proceedings.html
16. BUDAEV,V.P. et al., The Characterization of Edge Plasma Intermittency in T-10 and TCABR Tokamaks, 34th EPS Conference on Plasma Phys. Warsaw, 2 - 6 July 2007 ECA Vol.**31F**, P-1.088 (2007).
17. GRYAZNEVICH, M., et al., Progress on Joint Experiments on Small Tokamaks, 34th EPS Conference on Plasma Phys. Warsaw, 2 - 6 July 2007 ECA Vol.**31F**, P-1.070 (2007)
18. ELFIMOV, A.G., Kinetic effect on low frequency Alfven continuum in tokamaks, Physics of Plasmas 15 (2008) 74503.
19. SEVERO, J.H.F., et al., Measurements of Temporal Evolution of Plasma Rotation in the TCABR Tokamak, Paper EX/P5-5, Presented at the 22nd Fusion Energy Conference, Geneva, 2008.
20. MACHIDA, M.; et al., Impurity line emissions in VUV region of TCABR tokamak, 17th IAEA Technical Meeting on Research Using Small Fusion Devices, Lisbon, 2007, Plasma and Fusion Science 996230, 2008.
21. MACHIDA, M., et al., Spectral line profile analysis using higher diffraction order in vacuum ultraviolet region,17th IAEA Technical Meeting on Research Using Small Fusion Devices, Lisbon 2007, Plasma and Fusion Science (2008) 996235.
22. GRYAZNEVICH, M., et al., Results of Joint Experiments and other IAEA Activities on Research Using Small Tokamaks, Paper OV/P1-1, Fusion Energy Conference 2008 Proc. 22nd IAEA Fusion Energy Conference, Geneva, Switzerland, 2008.
23. RODRIGUES, C.; GUIMARES, Z.O.; CALDAS, I.L., et al., Multifractality in plasma edge electrostatic turbulence, Physics of Plasmas 15 (2008) 082311.
24. GUIMARAES-FILHO, Z.O.; CALDAS, I.L.; VIANA, R.L., et al., Electrostatic turbulence driven by high magnetohydrodynamic activity in Tokamak Chauffage Alfven Bresilien, Physics of Plasmas 15 (2008) 062501.
25. MARCUS, F.A.; KROETZ, T.; ROBERTO, M., et al., Chaotic transport in reversed shear tokamaks, 3rd Workshop on Stochasticity in Fusion Plasmas, MAR 05-07, 2007 Julich GERMANY, Nuclear Fusion 48 (2008) 024018.
26. GUIMARAES, Z.O.; CALDAS, I.L.; VIANA, R.L., et al., Recurrence quantification analysis of electrostatic fluctuations in fusion plasmas, Physics Letters A 372 (2008) 1088.
27. MARCUS, F.A., CALDAS, I.L., GUIMARÃES-FILHO, Z.O.,MORRISON, P.J.,HORTON, W., KUZNETSOV, YU.K., NASCIMENTO, I.C., Reduction of chaotic particle transport driven by drift waves in sheared flows, Phys. Plasmas 15 (2008) 112304.
28. SANTOS, J.H., REIS, F.,FERNANDES, H. , NETO, A., DUARTE, A. , OLIVEIRA, F.,de SÁ, W.P., Fusion Talk: A Remote Participation Tools, Proceedings of the 17th IAEA Technical Meeting on Research Using Small Fusion Devices, Lisbon, Portugal, 22-24 October 2007. AIP Conference Proceedings, 996: 281-295, 2008, (ISBN-978-0-7354-0515-8, ISSN 0094-243X)
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TITLE OF THE EXPERIMENT IN WHICH YOU WANT TO PARTICIPATE
(From the list of possibilities please choose 5 options in order of priority):
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