Proposal and Attendance Form for NSTX Research Forum 2001

First Name and Initial(s)	Jean-Pierre
Last Name	Matte
Email address	matte@INRS-ENER.UQuebec.CA
Mailing address	1650 Boul. Lionel-Boulet
Phone number	(450)-929-8127
Institution	INRS-Énergie et Matériaux
Co-authors	

Please write a one-page abstract of your proposal to be presented in boxes below:

Title: Two-Dimensional Modeling Non-Local Parallel Electron Heat Transport In Divertors

ABSTRACT

In the divertors of magnetic confinement devices, such as Tokamaks and spherical tori, beyond the last closed magnetic surface, the plasma flows towards the neutraliser plate, and steep temperature gradients result. This is even more true in the case of detached plasmas. These facts modify the electrons' thermal transport and the shape of their energy distribution, which is non-Maxwellian. This has implications not only on heat transport, but also on the interpretation of emission spectra and probe measurements, and these diagnostics could be used to benchmark the code. These effects are kinetic in nature. They are not included in hydrodynamic codes such as B2 or UEDGE, but they influence the plasma dynamics.. It is proposed to address these issues using the electron kinetic code "FPI" [J.P. Matte et al., Phys. Rev. Lett. **49**, 1936 (1982); **53**, 1461 (1984) and **72**, 1208 (1994)], and to modify a hydrodynamic code to account for these. After using "FPI" to develop and benchmark formulas for non-local heat flow (using spatial convolutions of the Spiter-Härm heat flux) parallel to the magnetic field lines, and similar non-local convolution for the rates of ionisation and excitation, and for the interpretation of probe signals, and implementing these non-local formulas into the hydrodynamic code UEDGE, we would extend this approach to two-dimensional simulations, by including perpendicular transport. This extension to two dimensions would be done by modeling the cross-field transport by appropriate velocity dependent diffusion operators and drift terms. Given the present uncertainty for these, - and of the electron velocity distribution function on the last closed flux surface - they would be varied, and the consequences analysed. For each prescription for these, distinct convolution formulas would be developed for implementation into UEDGE.

On the other hand, ion kinetic effects, such as viscosity and charge exchange could be addressed in an analogous way, using the ion kinetic code "FP-ION" [M. Casanova et al., Phys. Rev. Lett. **67**, 2143 (1991); F. Vidal, J.P. Matte et al., Phys. Fluids B **5**, 3182 (1993) and Phys. Rev. E , **52**, 4568)]. This is not part of the present proposal. It is recommended that the electron and ion problems be treated separately, and in turn. Thus, in the proposed investigation of electron kinetic effects, the ions would be treated as a fluid, and in just the same manner as in the hydrodynamic code. Ion kinetics and convolution formulas for viscosity and ion heat flow in fluid codes could be the subject of an ulterior proposal.

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