Three-dimensional fluctuation imaging diagnostic for TEXTOR (abstract)[a)]

C. W. Domier,[b)] B. H. Deng, A. J. H. Donn,[c)] P. L. Hsu, N. C. Luhmann, Jr.,
E. Mazzucato, H. K. Park,[d)] M. J. van de Pol,[c)] and J. Wang
Department of Applied Science, University of California, Davis, California 95616

(Presented on 19 June 2000)

After more than 4 decades of fusion research, plasma transport in tokamaks remains an outstanding issue. The standard hypothesis, that the observed anomalous transport is caused by small scale turbulence, is consistent with experimental observations, but it is neither based on a self-consistent theory of plasma turbulence nor on an exhaustive set of turbulence measurements. One of the major obstacles to the development of a satisfactory anomalous transport theory is the inability of standard fluctuation diagnostics to provide the full spectrum of turbulent fluctuations. The result is a nearly complete reliance on numerical simulations. Unfortunately, in spite of the enormous capabilities of today's computers, this is extremely unsatisfactory since any theory or simulation of plasma turbulence can only be driven by direct experimental observations. The first step in achieving such data was the highly successful UC Davis Electron Cyclotron Emission (ECE) Imaging system, which was first developed for use on the TEXT-U tokamak and later modified for use on the Rijnhuizen Tokamak Project tokamak.[1] Here, correlation techniques are applied to spatially resolved second harmonic ECE signals to provide detailed information about the microturbulence associated with T_e fluctuations. The present work extends this work by developing a similar technique for spatially resolved n_e fluctuations via microwave imaging reflectometry. The result is a diagnostic capable of the simultaneous measurement of both T_e and n_e fluctuations (both turbulent and coherent) and profiles on toroidal devices such as tokamaks and stellarators. A 16 channel ECE imaging system has recently been installed on the Torus Experiment for Technology Oriented Research (TEXTOR) tokamak. A prototype millimeter wave imaging reflectometry system will be installed on TEXTOR in July 2000, which will operate in *V* band (50–75 GHz) and reflect from the *X*-mode cutoff. Data collected with this system will be utilized in the design of the full three-dimensional (3D) imaging system, which is scheduled for installation on TEXTOR in April 2001. System details and laboratory characterization results of the prototype reflectometric imaging system will be presented, along with a preliminary design for the full 3D system. [DOI: 10.1063/1.1323469]

[a)]This work is supported by the U.S. Department of Energy under Contract Nos. DE-FG03-95ER-54295, DE-FG03-99ER54531, and DE-AC02-CH0-3073, and by NWO and EURATOM.
[b)]Electronic mail: cwdomier@ucdavis.edu
[c)]Also with: FOM-Instituut voor Plasmafysica Rijnhuizen, Associatie EURATOM-FOM.
[d)]Also with: Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ.

[1] B. H. Deng, R. P. Hsia, C. W. Domier, S. R. Burns, T. R. Hillyer, N. C. Luhmann, Jr., T. Oyevaar, A. J. H. Donn, and the RTP Team, Rev. Sci. Instrum. **70**, 998 (1999).

