Curriculum Vitae
Dr. James L. Terry

Professional Statement

1. Specialization: Dr. Terry's primary research interest has been the diagnosis of magnetically confined plasmas with the goal of scientific understanding and optimization of plasma confinement, heating, and control. This has involved study of plasmas where the temperature ranged from 0.5 eV to 30 keV and the density ranged from 0.001-3x10^{21} m $^{-3}$. Generally, the diagnostic techniques he has employed have involved plasma spectroscopy (from the soft x-ray region to the infrared) and various particle tracers.

2. Research: Dr. Terry's research has for the most part been carried out on three magnetic confinement devices (tokamaks) located at MIT, Alcator A (1975-1982), Alcator C (1982-1988), and Alcator C-Mod (1993-present). However, he has also conducted successful experiments at the Lawrence Livermore Laboratories (2X-IIB magnetic mirror - 1977), the University of Kyoto, Japan (Heliotron E - 1983 and 1985), and the Princeton Plasma Physics laboratory (TFTR - 1988-92).

His thesis work resulted in two major findings: the first observation of asymmetries in the impurity distribution on a magnetic flux surface [**Terry**, *et al.*, "Observations of poloidal asymmetry in impurity-ion emission due to grad B drifts", PRL **39** (1977) pp. 1615-18], which is still a topic of experiment and theoretical investigation over twenty years later [see for example Ingesson, *et al.*, Plasma Physics & Controlled Fusion 42 (2000) pp. 161-80], and the first direct documentation that Alcator A plasmas were exceptionally clean (free of impurities) [**Terry**, *et al.*, "EUV impurity study of the Alcator Tokamak", Nuclear Fusion **18** (1978) pp. 485-91]. One of the implications of this latter result was that plasma purity facilitates good plasma confinement.

One continuing theme of Dr. Terry's research has been the elucidation of impurity transport in plasmas. He has published the first impurity confinement scaling relations found in plasmas of Alcator C [Marmar, Rice, **Terry**, Seguin, "Impurity injection experiments on the Alcator C Tokamak", Nuclear Fusion **22** (1982) pp. 1567-75, and Petrasso, Sigmar, Wenzel, Hopf, Greenwald, **Terry**, Parker, "Observations of centrally peaked impurity profiles following pellet injection in the Alcator-C tokamak", PRL **57** (1986) pp. 707-10], Heliotron E [Rice, **Terry**, Marmar, Motojima, *et al.*, "Transport of injected impurities in Heliotron E", Nuclear Fusion **24** (1984) pp. 1205-11], and Alcator C-Mod [Graf, Rice, **Terry**, Marmar, *et al.*, "Spectroscopic measurement of impurity transport coefficients and penetration efficiencies in Alcator C-Mod plasmas", Review of Scientific Instruments 66 (1995) pp. 636-8 and Rice, **Terry**, et al., "Impurity transport in Alcator C-Mod plasmas", Physics of Plasmas **4** (1997) pp. 1605-9]. The scaling relations discovered on Alcator A and Alcator C are definitive for ohmically heated, circular tokamaks. His work on Alcator C-Mod has also documented the extremely good confinement of impurities in the so-called "high-confinement" mode and the desirable poorer impurity confinement in a new high-confinement mode now under intense investigation at MIT [Greenwald, Boivin, … **Terry**, Wolfe, Weaver, Welch, Wukitch, "Characterization of enhanced D alpha high-confinement modes in Alcator C-Mod", Physics of Plasmas **6** (1999) pp.1943-9].

In the course of observations of emissions from Alcator C plasmas, he made the first quantitative study of hydrogen molecules in tokamaks [**Terry**, "The far UV emission spectrum of H2", Journal of Vacuum Science & Technology A **1** (1983) pp.831-6]. The molecules were observed to exist at the boundaries of the hot plasmas, where plasma ions interact with material surfaces. Molecules have remained a difficult and important subject of investigation [see for example Krasheninnikov, *et al.*, Physics Letters A **214** (1996) pp. 285-91], especially after the invention of the magnetic divertor, which "diverts" the high heat and particle fluxes at the plasma edge to surfaces removed from the hot plasma.

With colleague Dr. E. Marmar, Dr. Terry designed, constructed, and operated a high-speed pellet injector on the TFTR Tokamak at the Princeton Plasma Physics Laboratory. Its purpose was to use emission from a 1 km/s lithium pellet to probe the internal magnetic field structure of the hot (<5 keV) plasma. The internal magnetic field structure is one of the most important and one of the most difficult measurements in tokamak plasma research. The technique was used successfully on TFTR and constituted the first measurement of the internal field on that device [**Terry**, *et al.*, "Measurement of internal magnetic field pitch using Li pellet injection on TFTR", Review of Scientific Instruments, **61** (1990) pp. 2908-13 and Mauel, Navratil, … **Terry,** "Operation at the tokamak equilibrium poloidal beta-limit in TFTR", Nuclear Fusion 32 (1992) pp. 1468-73]. However in the course of those experiments, Drs. Terry and Marmar discovered that the lithium deposited on the chamber walls after the injection led to better overall *energy* confinement. Dr. Terry announced this completely new and unexpected result, the "lithium conditioning" of the vessel walls, at the 1990 International Atomic Energy Agency conference [**Terry,** *et al.,* "Impurity and deuterium pellet studies on TFTR", Plasma Physics and Controlled Nuclear Fusion Research 1990. Proceedings of the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research. IAEA. 1991, pp. 393-402]. The technique was studied and exploited by the MIT team and later by PPPL scientists. The optimized technique was instrumental in improving the TFTR plasma performance significantly and was instrumental in TFTR's then-record (1994) neutron power production (10.4 MW) and then-record ratio of fusion power to heating power [Hawryluk, Adler, … **Terry**, … Zweben, "Confinement and heating of a deuterium-tritium plasma", PRL **72** (1994) pp.3530-3 and Strachan, Adler … **Terry**, … Zweben." Fusion power production from TFTR plasmas fueled with deuterium and tritium", PRL **72** (1994) pp. 3526-9]. An international workshop on the subject was held in 1991 ["Impurity Pellet DT Workshop" Princeton, NJ, USA, April 29, 1991].

More recently, Dr. Terry has been responsible for discovering, diagnosing, and exploiting the phenomenon of volume recombination of plasma ions and electrons in Alcator C-Mod's divertor. His was the first and the most definitive observation [Lumma, **Terry**, Lipschultz, "Radiative and three-body recombination in the Alcator C-Mod divertor", Physics of Plasmas **4** (1997) pp. 2555-66 and **Terry,** *et al.,* "Volume recombination and opacity in Alcator C-Mod divertor plasmas", Physics of Plasmas **5** (1998) pp.1759-66 and **Terry,** *et al.,* "The experimental determination of the volume recombination rate in tokamak divertors", Journal of Nuclear Materials **266-269** (1999) pp.30-6]. It has subsequently been seen on most of the world's other major tokamaks. Its importance arises from the realization that plasma can recombine *before* interaction with material surfaces. This represents a highly desirable insulation of the multi-keV plasma from walls of the confinement device. He has led MIT's efforts in understanding the role of this recombination process in this insulation, and MIT efforts have led the world in this research area.

At the present time Dr. Terry has entered a new area of investigation, the study of turbulence at the plasma boundary. The plasma boundary plays a crucial role in determining the confinement of the core. Dr. Terry has a working experiment measuring edge turbulence [**Terry**, et al., "Visible Imaging of Edge Turbulence in the Alcator C-Mod Tokamak", to be published in the Journal of Nuclear Materials (2000)] and has begun a collaboration (with PPPL scientists) to expand these studies.

Principal Fields of Interest:

Plasma physics; atomic physics, atomic and molecular spectroscopy, plasma diagnostics, transport in magnetic confinement devices

Education:

School	Degree	Date
Denison University	B.S. (Physics with Honors)	1973
The Johns Hopkins University	M.S. (Physics)	1975
The Johns Hopkins University	Ph. D. (Physics)	1978

Title of Thesis for Most Advanced Degree:

Extreme Ultra-violet Emissions and Grad-B Drift Transport in Tokamak Discharges

Employment History:

Rank	Beginning	Ending
Research Scientist at the Massachusetts Institute of Technology	July 1978	present
Research Assistant in Physics at the Johns Hopkins University	1975	1978
Teaching Assistant in Physics at the Johns Hopkins University	1973	1975

Supervisory Activities, Committee Participation, Other Assigned Duties:

Activity	Beginning	Ending
MIT Plasma Science and Fusion Center (PSFC) Educational Outreach Committee	1986	1989

PSFC IAP Coordinator	1989	1989
PSFC Brochure Committee	1994	1994
PSFC Supervisor for Collaboration with Johns Hopkins University	1986	present
PSFC Supervisor for Collaboration with Los Alamos Nat. Lab.	1996	present
PSFC Supervisor for Collaboration with the University of Maryland	1995	1998

Professional Service:

Activity	Period
Amer. Physical Society Program Committee - Topical Conference on Atomic Processes in Plasmas	1991
Amer. Physical Society Program Committee - Division of Plasma Physics Meeting	1998
Referee for international scientific journals – *Physical Review Letters, Physics of Fluids, Physics of Plasmas, Review of Scientific Instruments, Nuclear Fusion, Physics Letters A, Physical Review A*	1979-present

Awards Received:

Award	Date
Sigma Pi Sigma - National Physics Honor Society	1972
Phi Beta Kappa	1973

Current Organization Membership:

Organization
American Physical Society

Theses Supervised:

	Total	Completed	In Progress
Master's	2	2	
Doctoral	5	2	3

Master's Theses

Allen, A.J., "Capture, Storage, and Analysis of Video Images from the Alcator C-Mod Tokamak", 1997, MIT

Ohkawa, H., “Determination of the Spectral Sensitivity of a VUV, Grazing Incidence Spectrograph”, June 1997, MIT

Doctoral Theses

Manning, H.L., “VUV Study of Impurity Generation during ICRF Heating Experiments on the Alcator C Tokamak”, 1986, Harvard University

Graf, M.A., “Impurity Injection Experiments on the Alcator C-Mod Tokamak”, 1990, MIT

Theses Advised:

	Total	Completed	In Progress
Master’s	1	1	
Doctoral	4	4	

Master’s Theses

Lumma, D., “Investigation of a Diagnostic Technique for Measuring Electron Densities Using Stark Broadening on the Alcator C-Mod Tokamak”, 1996, MIT

Doctoral Theses

Benjamin, R.D., “A Vacuum Ultraviolet Study of the Alcator C Tokamak Using a High Resolution, One dimensional Photon Counting Detector”, 1987, The Johns Hopkins University

Moran, T.G., “A Study of Atomic Hydrogen and Molecular Hydrogen Emission from a Magnetically Confined Plasma”, 1988, MIT

Kurz, C., “Tomography of the Light Emission from the Plasma Edge of Alcator C-Mod”, 1995, MIT

May, M. J., “The Measurement of the Intrinsic Impurities of Molybdenum and Carbon in the Alcator C-Mod Tokamak Plasma using Low Resolution Spectroscopy”, 1997, The Johns Hopkins University