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EDUCATION

Ph.D. 1976, Plasma Physics, University of Wisconsin–Madison
M.S. 1974, Nuclear Engineering, University of Wisconsin–Madison.
B.S. 1973, Physics, California Institute of Technology.

EXPERIENCE

Thomas Alva Edison Professor of Applied Physics, Columbia University, July 2004 to present.
Interim Dean, School of Engineering and Applied Science, Columbia University, July 2007 to June 2009.
Vice-Dean, School of Engineering and Applied Science, Columbia University, 1994-1995.
Chairman, Department of Applied Physics and Applied Mathematics, Columbia University, July 1988 to Dec 1994 and January 1997 to June 2000.
Professor of Applied Physics, Columbia University, July 1988 to June 2004.
Associate Professor of Applied Physics, Columbia University, July 1983 to June 1988.
Granted Tenure at Columbia University July 1984.
Assistant Professor of Applied Physics, Columbia University, July 1978 to June 1983.
Assistant Professor of Engineering Science, Columbia University, July 1977 to June 1978.
Project Associate, Physics Department, University of Wisconsin, August 1976 to July 1977.

HONORS AND AWARDS

Alfred P. Sloan Research Fellow in Physics 1984-86.
Fellow of the American Physical Society 1989-present.
Leadership Award from Fusion Power Associates in 2006.
American Physical Society John Dawson Award for Excellence in Plasma Physics, 2007.

EDITORIAL SERVICE ON ARCHIVAL JOURNALS

Associate Editor, Physics of Fluids, 1987-1990.
Associate Editor, Physics of Plasmas, 1994-2002

SERVICE ON NATIONAL ADVISORY COMMITTEES

1. Member of National Task Force for Post-TFTR Initiatives, September 1991-May 1992.
2. Member of Fusion Energy Advisory Committee Panel 3 on Alternate Confinement Approaches to Fusion, February - May 1992.
3. Member of Fusion Energy Advisory Committee Panel 5 on Strategic Planning for the US Fusion Program to the Year 2000, July-September 1992.
4. Member of the PBX-M Program Advisory Committee, 1992 to 1994.
5. Member of National Tokamak Physics Experiment (TPX) Council, 1992 to 1995.
6. Chairman of the TPX Program Advisory Committee, 1993 to 1995.
7. Chairman of the TFTR Program Advisory Committee, 1995 to 1997.
8. Vice-chairman of Scientific issues Subcommittee of the Fusion Energy Sciences Advisory Committee, December 1995 to 1997.
9. Member, Fusion Energy Sciences Advisory Committee Sub-panel on US Participation in ITER, 1997.
10. Member, ITER Special Working Group 2 on Revised Technical Guidelines, 1998-1999
11. Chairman of the NSTX Program Advisory Committee, 1996 to 2003.
12. Member, Fusion Energy Sciences Advisory Committee Sub-panel on Proof-of-Principle Experiments, Knoxville, August 1999.
13. Member, FESAC Panel on Burning Plasma Science, 2001.
14. Chairman, NCSX Physics Validation Review Panel advising OFES, March 2001.
15. Member: FESAC Panel on Burning Plasma Strategy, Austin, TX, August 2002.
16. Vice-chair, Next Step Options Program Advisory Committee; 2000-2004
17. Member, Burning Plasma Program Advisory Committee; 2003-2004
18. Chairman, Macro-Plasma Working Group for FESAC Priorities Panel, 2004.
19. Member, DOE Fusion Energy Sciences Advisory Committee, 1998-2008.
20. Chair, FESAC Panel on Progress Assessment on Long Term Goals, 2005-2006.
21. Member, FESAC Panel on Assessment of Major Experimental Facilities, 2005.
22. Member, US ITER Project Program Advisory Committee, 2005 – 2006.
23. Member, US Burning Plasma Organization Council. 2006-2007.
24. Member, K-STAR International Program Advisory Committee, 2006.
25. Member, US ITER Project Technical Advisory Committee, 2007-2012.
26. Member, FESAC Review Panel on NCSX, 2007.
27. Chair, Fusion Nuclear Science Facility Steering Group, 2009-2012
28. Member, FESAC Panel on International Collaborations in Fusion, 2011-2012.
29. Member, US Fusion Community Study Group on MFE Roadmap Planning, 2012-2014.
30. Member, Program Committee for a July 2017 and a December 2017 Community Workshop on U.S. Magnetic Fusion Research Strategic Directions.
31. Member of US DOE Committee of Visitors reviewing the Fusion Energy Sciences Program for the period 2014-2017.

MEMBERSHIP AND SERVICE IN PROFESSIONAL SOCIETIES

American Physical Society: Member: 1974-present; Fellow 1989-present
 Maxwell Prize Award Committee, 2000 and 2001
 Dawson Excellence in Plasma Physics Award Committee, 2008
 Simon Ramo Award Committee, Vice-Chair 1994, Chair 1995
 APS DPP Fellowship Committee 1995

University Fusion Association: Member 1980-present
 Executive Committee 1986-1988; 2000-present
 Secretary/Treasurer 1988-1989
 Vice-President 1990; 2003-2004
 President 1991; 2005-2006

OTHER PROFESSIONAL ACTIVITIES

Head of 5 person scientific delegation to USSR on official US-USSR exchange through DOE visiting Kurchatov Institute in Moscow and the Ioffe Institute in Leningrad, July 8-12, 1984.

Member of 5 person scientific delegation to USSR on an official US-USSR scientific exchange visit to the Kurchatov Institute in Moscow, Troitsk Institute in Troitsk, and Ioffe Institute in Leningrad 15-28 September 1991.

Consultant to Fusion Systems Corporation of Rockville, MD comparing ultraviolet light technology developed by Fusion Systems and the Mitsubishi Electric Company. December 7-23, 1988. Study was cited by Harvard Business Review on unfair Japanese trade practices.

Selected as one of 15 participants nationally in the Defense Science Study Group for a two year period 1992-93 managed by the Institute for Defense Analyses under contract for the Department of Defense through ARPA.

Appointed a Trustee of The Chubb Foundation, a charitable trust with about \$25 million in assets which provides undergraduate college scholarships: 1994-2004.

Appointed to Board of Directors of Fusion Power Associates, 1999-present and served as Chairman of the Board of Directors 2007 to 2009 and elected again for 2018 to 2020.

Chair of Organizing Committee for "Forum for Major Next-Step Fusion Experiments," Madison, WI, 27 April-1 May 1998.

Chair of Organizing Committee for UFA sponsored Workshop on Burning Plasma Science, Austin, TX, December 2000.

Co-chairman of the 2002 Fusion Summer Study at Snowmass, CO, 8-19 July 2002

SELECTED EARLY PUBLICATIONS

3. "Diffusion Coefficient Scaling in the Wisconsin Levitated Octupole, J.R. Drake, J.R. Greenwood, G.A. Navratil and R.S. Post, *Phys. Fluids* **20**, 148 (1977).
4. "Transition from Classical to Vortex Diffusion in the Wisconsin Levitated Octupole," G.A. Navratil, R.S. Post and A. Butcher Ehrhardt, *Phys. Fluids* **20**, 156 (1977).
5. "Diffusion Coefficient Scaling in a $\epsilon \rightarrow 1$ Plasma," G.A. Navratil and R.S. Post, *Phys. Fluids* **20**, 1205 (1977).
6. "Observations of Classical Diffusion in the Presence of Large Amplitude Density Fluctuations," G.A. Navratil and R.S. Post, *Physics Letters A*, **64A**, 223 (1977).
8. "Observation of the Effect of Shear on Vortex Diffusion in a Collisional Plasma," G.A. Navratil, R.S. Post, and A. Butcher Ehrhardt, *Phys. Fluids* **22**, 241 (1979).
12. "Production and Observation of the Dissipative Trapped Ion Instability," J. Slough, G.A. Navratil, and A.K. Sen, *Phys. Rev. Lett.* **47**, 1057 (1981).
17. "Multi-Point Thomson Scattering," F.M. Levinton and G.A. Navratil, *Rev. Sci. Instrum.* **54**, 35 (1983).
18. "Experimental Study of the Dissipative Trapped Ion Instability," G.A. Navratil, A.K. Sen and J. Slough, *Phys. Fluids* **26**, 1044 (1983).
19. "Experimental Study of High-Beta Tokamak Stability," M. Machida and G.A. Navratil. *Phys. Rev. Lett.* **51**, 992 (1983).
25. "Production and Identification of a Collisionless, Curvature-Driven, Trapped-Particle Instability." Robert Scarmozzino, Amiya K. Sen, and Gerald A. Navratil, *Phys. Rev. Lett.* **57**, 1729-32 (1986).
34. "Transition to the Second Region of Ideal MHD Stability," S.A. Sabbagh, M.H. Hughes, M.W. Phillips, A.M.M. Todd, G.A. Navratil, *Nuclear Fusion* **29**, 423 (1989).
42. "High Poloidal Beta Equilibria in the Tokamak Fusion Test Reactor Limited by a Natural Inboard Poloidal Field Null," by S. A. Sabbagh, R. A. Gross, M. E. Mauel, G. A. Navratil, M. E. Bell, *et al.*, *Physics of Fluids B* **3**, 2277 (1991).
45. "Study of High Poloidal Beta Plasmas in TFTR and DIII-D," by G. A. Navratil, R. A. Gross, M. E. Mauel, S. A. Sabbagh, *et al.*, *Plasma Physics and Controlled Fusion Research 1990*, (IAEA, Vienna, Austria 1991), Vol. 1, page 209.
46. "Limiter H-Mode Experiments on TFTR" by C. E. Bush, N. L. Bretz, E. D. Fredrickson,
50. "Operation at the Tokamak Equilibrium Poloidal Beta Limit in TFTR," M. E. Mauel, G. A. Navratil, S. A. Sabbagh, M. G. Bell, *et al.*, *Nuclear Fusion* **32**, 1468 (1992).
52. "Achieving High Fusion Reactivity in High Poloidal Beta Discharges in TFTR," by M. E. Mauel, G. A. Navratil, S. A. Sabbagh, S. Batha, M. G. Bell, *et al.*, *Plasma Physics and Controlled Fusion Research 1992*, (IAEA, Vienna, Austria 1993), Vol. 1, page 205.
55. "High Poloidal Beta Long Pulse Experiments in the Tokamak Fusion Test Reactor," J. Kesner, M. E. Mauel, G. A. Navratil, S. A. Sabbagh, M. Bell, *et al.*, *Physics of Fluids B* **5**, 2525 (1993).

62. "Deuterium-Tritium TFTR Plasmas in the High Poloidal Beta Regime," S. A. Sabbagh, M. E. Mauel, G. A. Navratil, *et al.*, *Plasma Physics and Controlled Fusion Research 1994*, (IAEA, Vienna, 1995) Vol. 1, p663.
63. "Passive and Active Control of MHD Instabilities in the HBT-EP Tokamak," T. H. Ivers, E. Eisner, A. Garofalo, D. Gates, R. Kombargi, M. E. Mauel, D. Maurer, D. Nadle, G. A. Navratil, M. K. V. Sankar, and Q. Xiao, *Plasma Physics and Controlled Fusion 1994*, (IAEA, Vienna, 1995) Vol. 1
65. "Observation of Wall Stabilization and Active Control of low- n MHD Instabilities in a Tokamak," T. H. Ivers, E. Eisner, A. Garofalo, R. Kombargi, M. E. Mauel, D. Maurer, D. Nadle, G. A. Navratil, M. K. V. Sankar, M. Su, E. Taylor and Q. Xiao, R. R. Bartsch, W. A. Reass and G. A. Wurden, *Physics of Plasmas* **3**, 1926 (1996).
66. "Demonstration of High-performance Negative Central Magnetic Shear Discharges in the DIII-D Tokamak," B.W. Rice, K.H. Burrell, L.L. Lao, G. Navratil, B.W. Stallard, E.J. Strait, T. S. Taylor, *et al*, *Physics of Plasmas* **3**, 1983 (1996).
68. "Higher Fusion Power Gain with Pressure Profile Control in Strongly-Shaped DIII-D Tokamak Plasmas," E. A. Lazarus, G. A. Navratil, C. M. Greenfield, E. J. Strait, *et al.*, *Physical Review Letters* **77**, 2714 (1996).
71. "Higher Fusion Power Gain with Profile Control in DIII-D Tokamak Plasmas," E. A. Lazarus, G. A. Navratil, C. M. Greenfield, *et al.*, *Nuclear Fusion* **37**, 7 (1997).
80. "Active Control of 2/1 Magnetic Islands in a Tokamak," by G. A. Navratil, C. Cates, M. E. Mauel, D. Maurer, D. Nadle, E. Taylor, Q. Xiao, W. A. Reass, and G. A. Wurden, *Phys. Plasmas* **5** (1998) 1855.
81. "Stabilization of Kink Instabilities by Eddy Currents in a Segmented Wall and Comparison with Ideal MHD Theory," by A. M. Garofalo, E. Eisner, T. H. Ivers, R. Kombargi, M. E. Mauel, D. Maurer, D. Nadle, G. A. Navratil, M. K. Vijaya Sankar, E. Taylor and Q. Xiao, *Nuclear Fusion* **38** (1998) 1029..
85. "Observation and Control of Resistive Wall Modes," E. J. Strait, M. S. Chu, L.L. Lao, R. J. LaHaye, J. T. Scoville, T.S. Taylor, A.D. Turnbull, M. Walker, A. M. Garofalo, J. Bialek, G.A. Navratil, S. A. Sabbagh, E. Fredrickson, M. Okabayashi, E.A. Lazarus, M. E. Austin, G. McKee, B. W. Rice, *Nuclear Fusion* **39** 1977 (1999).
86. "Stabilization of the External Kink and Control of the Resistive Wall Mode in Tokamaks," Garofalo, A.M., Turnbull, A.D., Strait, E.J., Austin, M.E., Bialek, J., Chu, M.S., Fredrickson, E., La Haye, R.J., Navratil, G.A., Lao, L.L., Lazarus, E.A., Okabayashi, M., Rice, B.W., Sabbagh, S.A., Scoville, J.T., Taylor, T.S., and Walker, M.L., *Physics of Plasmas* **6**, 1893 (1999) .
88. "Direct Observation of the Resistive Wall Mode in a Tokamak and Its Interaction with Plasma Rotation," A. M. Garofalo, A. D. Turnbull, M. E. Austin, J. Bialek, M. S. Chu, K. J. Comer, E. D. Fredrickson, R. J. Groebner, R. J. La Haye, L. L. Lao, E. A. Lazarus, G. A. Navratil, T. H. Osborne, B. W. Rice, S. A. Sabbagh, J. T. Scoville, E. J. Strait, and T. S. Taylor, *Phys. Rev. Lett.* **82**, 3811 (1999).
89. "Control of the Resistive Wall Mode in Advanced Tokamak Plasmas on DIII-D," Garofalo, A.M., Strait, E.J., Bialek, J., Fredrickson, E.D., Gryaznevich, M., Jensen, T.H., Johnson, L.C., La Haye, R.J., Navratil, G.A., Lazarus, E.A., Luce, T.C.,

- Makowski, M.A., Okabayashi, M., Rice, B.W., Scoville, J.T., Turnbull, A.D., Walker, M.L., *Nuclear Fusion*. **40**, 1491 (2000)
90. "The Feedback Phase Instability in the HBT-EP Tokamak," D. L. Nadle, C. Cates, H. Dahi, M. E. Mauel, D. Maurer, S. Mukherjee, G. A. Navratil, M. Shilov, E. D. Taylor, *Nuclear Fusion* **40**, 1791 (2000).
 91. "Suppression of Resistive Wall Instabilities with Distributed, Independently Controlled, Active Feedback Coils," C. Cates, M. Shilov, M. E. Mauel, G. A. Navratil, D. Maurer, S. Mukherjee, D. Nadle, J. Bialek, A. Boozer, *Phys. Plasmas* **7**, 3133 (2000).
 92. "Active Feedback Control of the Wall Stabilized External Kink Mode," G. A. Navratil, J. Bialek, A. Boozer, C. Cates, H. Dahi, M. E. Mauel, D. Maurer, M. Shilov, *IAEA Fusion Energy Conference 2000*, Sorrento, Italy, paper EXP3/16.
 94. "Modeling of Active Control of External MHD Instabilities," James Bialek, Allen H. Boozer, M. E. Mauel, and G. A. Navratil, *Phys. Plasmas* **8**, 2170 (2001).
 96. "Resistive Wall Mode Dynamics and Active Feedback Control in DIII-D," A. M. Garofalo, M. S. Chu, E.D. Fredrickson, M. Gryaznevich, T. H. Jensen, L. C. Johnson, R. J. LaHaye, G. A. Navratil, M. Okabayashi, J. T. Scoville, E. J. Strait, A. D. Turnbull, *Nuclear Fusion* **41**, 1171 (2001).
 98. "Sustained Rotational Stabilization of DIII-D Plasmas above the No-Wall Beta Limit," A. M. Garofalo, T. H. Jensen, L. C. Johnson, R. J. LaHaye, G. A. Navratil, *et al.*, *Phys. Plasmas* **9**, 1997 (2002).
 101. "Sustained Stabilization of the Resistive-Wall Mode by Plasma Rotation in the DIII-D Tokamak," A. M. Garofalo, E. J. Strait, L. C. Johnson, R. J. La Haye, E. A. Lazarus, G. A. Navratil, M. Okabayashi, J. T. Scoville, T. S. Taylor, and A. D. Turnbull, *Phys. Rev. Lett.* **89**, 235001 (2002).
 107. "Dynamical Plasma Response of Resistive Wall Modes to Changing External Magnetic Perturbations," M. Shilov, C. Cates, R. James, A. Klein, O. Katsuro-Hopkins, Y. Liu, M. E. Mauel, D. A. Maurer, G. A. Navratil, T. S. Pedersen, N. Stillits, R. Fitzpatrick, S. F. Paul, *Physics of Plasmas* **11**, 2573 (2004).
 108. "Scaling of the Critical Plasma Rotation for Stabilization of the n=1 RWM in DIII-D," R. J. Lahaye, A. Bondeson, M. S. Chu, A. M. Garofalo, Y. Q. G. A. Navratil, M. Okabayashi, H. Reimerdes, and E. J. Strait, *Nuclear Fusion* **44**, 1197 (2004).

RECENT PUBLICATIONS

109. "Dynamics and Control of Resistive Wall Modes with Magnetic Feedback Control Coils: Experiment and Theory," M. E. Mauel, J. Bialek, A. H. Boozer, C. Cates, R. James, O. Katsuro-Hopkins, A. Klein, Y. Liu, D. A. Maurer, D. Maslovsky, G. A. Navratil, T. S. Pedersen, M. Shilov, and N. Stillits, Proceedings of the 2004 IAEA Fusion Energy Conference, Vilamoura, Portugal and *Nuclear Fusion* **45**, 285 (2005).
110. "Measurement of Resistive Wall Mode Stability in Rotating High- β DIII-D Plasmas," H. Reimerdes, J. Bialek, M.S. Chance, M.S. Chu, A.M. Garofalo, P. Gohil, Y. In, G.L. Jackson, R.J. Jayakumar, T.H. Jensen, J.S. Kim, R.J. La Haye, Y.Q. Liu, J.E. Menard, G.A. Navratil, M. Okabayashi, J.T. Scoville, E.J. Strait, D.D. Szymanski and

- H. Takahashi, Proceedings of the 2004 IAEA Fusion Energy Conference, Vilamoura, Portugal and *Nuclear Fusion* **45**, 368 (2005).
111. “Control of the Resistive Wall Mode With Internal Coils in The DIII-D Tokamak,” M. Okabayashi, J. Bialek, A. Bondeson, M.S. Chance, M.S. Chu, D.H. Edgell, A.M. Garofalo, R. Hatcher, Y. In, G.L. Jackson, R.J. Jayakumar, T.H. Jensen, O. Katsuro-Hopkins, R.J. La Haye, Y.Q. Liu, G.A. Navratil, H. Reimerdes, J.T. Scoville, E.J. Strait, M. Takechi, A.D. Turnbull, I.N. Bogatu, P. Gohil, J.S. Kim, M.A. Makowski, J. Manickam, and J. Menard, Proceedings of the 2004 IAEA Fusion Energy Conference, Vilamoura, Portugal and to be published in *Nuclear Fusion* **45**, 1715 (2005).
 112. “Suppression of rotating external kink instabilities using optimized mode control feedback,” Alexander J. Klein, David A. Maurer, Thomas Sunn Pedersen, Michael E. Mauel, Gerald A. Navratil, Cory Cates, Mikhail Shilov, Yuhong Liu, Nikolai Stillits, and Jim Bialek, *Phys. Plasmas* **12**, 040703 (2005).
 113. “Critical β analyses with ferromagnetic and plasma rotation effects and wall geometry for a high beta; steady state tokamak,” G. Kurita, J. Bialek, T. Tuda, M. Azumi, S. Ishida, G.A. Navratil, S. Sakurai, H. Tamai, M. Matsukawa, T. Ozeki, M.S. Chu, M.S. Chance and Y. Miura, *Nuclear Fusion* **46**, 383 (2006).
 114. “Overview of the National Centralized Tokamak programme,” M. Kikuchi, H. Tamai, M. Matsukawa, T. Fujita, Y. Takase, S. Sakurai, K. Kizu, K. Tsuchiya, G. Kurita, A. Morioka, N. Hayashi, Y. Miura, S. Itoh, J. Bialek, G. Navratil, Y. Ikeda, T. Fujii, K. Kurihara, H. Kubo, Y. Kamada, N. Miya, T. Suzuki, K. Hamamatsu, H. Kawashima, Y. Kudo, K. Masaki, H. Takahashi, M. Takechi, M. Akiba, K. Okuno, S. Ishida, M. Ichimura, T. Imai, Hashizume, Y. M. Miura, H. Horiike, A. Kimura, H. Tsutsui, M. Matsuoka, Y. Uesugi, A. Sagara, A. Nishimura, A. Shimizu, M. Sakamoto, K. Nakamura, K. Sato, K. Okano, K. Ida, H.R. Shimada, Y. Kishimoto, H. Azechi, S. Tanaka, K. Yatsu, N. Yoshida, M. Inutake, M. Fujiwara, N. Inoue, N. Hosogane, M. Kuriyama and H. Ninomiya, *Nuclear Fusion* **46**, S29 (2006).
 115. “Cross-machine comparison of resonant field amplification and resistive wall mode stabilization by plasma rotation,” H. Reimerdes, T. C. Hender, S. A. Sabbagh, J. M. Bialek, ..., G. A. Navratil, *et. al*, *Phys. Plasmas* **13**, 056107 (2006).
 116. “Resistive wall mode stabilization by slow plasma rotation in DIII-D tokamak discharges with balanced neutral beam injection,” E. J. Strait, A. M. Garofalo, G. L. Jackson, M. Okabayashi, H. Reimerdes, M. S. Chu, R. Fitzpatrick, R. J. Groebner, Y. In, R. J. LaHaye, M. J. Lanctot, Y. Q. Liu, G. A. Navratil, W. M. Solomon, and H. Takahashi, *Phys. Plasmas* **14**, 056101 (2007).
 117. “Reduced Critical Rotation for Resistive-Wall Mode Stabilization in a Near-Axisymmetric Configuration,” H. Reimerdes, A. M. Garofalo, G. L. Jackson, M. Okabayashi, E. J. Strait, M. S. Chu, Y. In, R. J. La Haye, M. J. Lanctot, Y. Q. Liu, G. A. Navratil, W. M. Solomon, H. Takahashi, and R. J. Groebner, *Phys. Rev. Lett.* **98**, 055001 (2007)
 118. “Enhanced ITER Resistive Wall Mode Feedback Performance Using Optimal Control Techniques,” O. Katsuro-Hopkins, J. Bialek, D. A. Maurer, G. A. Navratil, *Nucl. Fusion* **47**, 1157 (2007).

119. “Experiments and modelling of external kink mode control using modular internal feedback coils,” T. Sunn Pedersen, D.A. Maurer, J. Bialek, O. Katsuro-Hopkins, J.M. Hanson, M.E. Mauel, R. James, A. Klein, Y. Liu and G.A. Navratil, *Nucl. Fusion* **47**, 1293 (2007)
120. “Design optimization for plasma performance and assessment of operation regimes in JT-60SA,” T. Fujita, H. Tamai, M. Matsukawa, G. Kurita, J. Bialek, N. Aiba, K. Tsuchiya, S. Sakurai, Y. Suzuki, K. Hamamatsu, N. Hayashi, N. Oyama, T. Suzuki, G.A. Navratil, Y. Kamada, Y. Miura, Y. Takase, D. Campbell, J. Pamela, F. Romanelli and M. Kikuchi, *Nucl. Fusion* **47**, 1512 (2007).
121. “Feedback suppression of rotating external kink instabilities in the presence of noise,” J.M. Hanson, B. De Bono, R.W. James, J. Levesque, M.E. Mauel, D.A. Maurer, G.A. Navratil, T.S. Pedersen, D. Shiraki, *Phys. Plasmas* **15**, 080704 (2008).
122. “A Kalman filter for feedback control of rotating external kink instabilities in the presence of noise,” Jeremy M. Hanson, Bryan De Bono, Jeffrey P. Levesque, Michael E. Mauel, David A. Maurer, Gerald A. Navratil, Thomas Sunn Pedersen, Daisuke Shiraki, and Royce W. James, *Phys. Plasmas* **16**, 056112 (2009).
123. “Comprehensive control of resistive wall modes in DIII-D advanced tokamak plasmas,” M. Okabayashi, I.N. Bogatu, M.S. Chance, M.S. Chu, A.M. Garofalo, Y. In, G.L. Jackson, R.J. La Haye, M.J. Lanctot, J. Manickam, L. Marrelli, P. Martin, G.A. Navratil, H. Reimerdes, E.J. Strait, H. Takahashi, A.S. Welander, T. Bolzonella, R.V. Budny, J.S. Kim, R. Hatcher, Y.Q. Liu and T.C. Luce, *Nucl. Fusion* **49** 125003 (2009).
124. “Model based feedback control of resistive wall modes using external coils,” J. M. Hanson¹, O. Katsuro-Hopkins, M. J. Lanctot, G. A. Navratil, H. Reimerdes, E. J. Strait, 2010 European Physical Society Conference on Plasma Physics, Dublin, Ireland, <http://ocs.ciemat.es/EPS2010PAP/pdf/P4.127.pdf>
125. “Validation of the linear ideal MHD model of three-dimensional tokamak equilibria”, M.J. Lanctot, H. Reimerdes, A.M. Garofalo, M.S. Chu, Y.Q. Liu, E.J. Strait, G.L. Jackson, R.J. LaHaye, G.A. Navratil, M.J. Schaffer, W.M. Solomon, and M. Okabayashi, *Phys. Plasmas*, **17**, 030701 (2010)
126. “HBT-EP External Kink Mode Control research program,” G. A. Navratil, J. Bialek, B. DeBono, J. M. Hanson, J.P. Levesque, M. E. Mauel, D. A. Maurer, T. S. Pedersen, N. Rath, D. Shiraki, Invited Paper at the 15th International Congress on Plasma Physics, Santiago, Chile 8-13 August 2010.
127. “A high-power spatial filter for Thomson scattering stray light reduction,” Levesque, J. P.; Litzner, K. D.; Mauel, M. E.; Maurer, D. A.; Navratil, G. A.; Pedersen, T. S., *Review of Scientific Instruments* **82**, 033501 (2011)
128. “The high beta tokamak-extended pulse magnetohydrodynamic mode control research program,” D. A. Maurer, J. Bialek, P. J. Byrne, B. De Bono, J. P. Levesque, B. Q. Li, M. E. Mauel, G. A. Navratil, T. S. Pedersen, N. Rath, and D. Shiraki, *Plasma Phys. Control. Fusion* **53**, 074016 (2011).
129. “Measurement and modeling of three-dimensional equilibria in DIII-D”, M.J. Lanctot, H. Reimerdes, A.M. Garofalo, M.S. Chu, J.M. Hanson, Y.Q. Liu, G.A. Navratil, I.N.

- Bogatu, Y. In, G.L. Jackson, R.J. LaHaye, M. Okabayashi, J.-K. Park, M.J. Schaffer, O. Schmitz, and E.J. Strait, *Phys. Plasmas* **18**, 056121 (2011).
130. “Feedback control of the proximity to marginal RWM stability using active MHD spectroscopy,” J M Hanson, H Reimerdes, M J Lanctot, Y In, R J La Haye, G L Jackson, G A Navratil, M Okabayashi, P E Sieck, and E J Strait, *Nucl. Fusion* **52** 013003 (2012).
 131. “High resolution detection and excitation of resonant magnetic perturbations in a wall-stabilized tokamak,” David A. Maurer, Daisuke Shiraki, Jeffrey P. Levesque, James Bialek, Sarah Angelini, Patrick Byrne, Bryan DeBono, Paul Hughes, M.E. Mauel, Gerald Navratil, Qian Peng, Dov Rhodes, Nicholas Rath, Christopher Stoafer, *Phys. Plasmas* **19**, 056123 (2012).
 132. “High-speed, multi-input, multi-output control using GPU processing in the HBT-EP tokamak,” N. Rath, J. Bialek, P.J. Byrne, B. DeBono, J.P. Levesque, B. Li, M.E. Mauel, D.A. Maurer, G.A. Navratil, D. Shiraki, *Fusion Engineering and Design* **87**, 1895 (2012).
 133. “High Resolution Detection and 3D Magnetic Control of the Helical Boundary of a Wall-Stabilized Tokamak Plasma,” J. Levesque, A. Angelini, J. Bialek, P. Byrne, B. DeBono, P. Hughes, M. Mauel, G.A. Navratil, Q. Peng, N. Rath, D. Rhodes, D. Shiraki, and C. Stoafer, **Proceedings of the 24th IAEA Fusion Energy Conference**, San Diego, CA, November 2012, paper EX/P4-19.
 134. “Probing Resistive Wall Mode Stability Using Off-Axis NBI,” by J. Hanson, M.J. Lanctot, H. Reimerdes, I.T. Chapman, Y. In, R.J. LaHaye, Y. Liu, G.A. Navratil, M. Okabayashi, E.J. Strait, W.M. Solomon, and F. Turco, **Proceedings of the 24th IAEA Fusion Energy Conference**, San Diego, CA, November 2012, paper EX/P4-27.
 135. “Multimode observations and 3D magnetic control of the boundary of a tokamak plasma,” J.P. Levesque, N. Rath, D. Shiraki, S. Angelini, P.J. Byrne, B.A. DeBono, P.E. Hughes, M.E. Mauel, G.A. Navratil, Q. Peng, D.J. Rhodes, and C.C. Stoafer, *Nuclear Fusion* **53** (2013) 073037.
 136. “Adaptive Feedback Control of Rotating External Kink Modes in HBT-EP,” N. Rath, P.J. Byrne, J.P. Levesque, S. Angelini, J. Bialek, B. DeBono, P. Hughes, M. E. Mauel, G.A. Navratil, Q. Peng, D. Rhodes, C. Stoafer, *Nuclear Fusion* **53** (2013) 073052.
 137. “*In situ* ‘artificial plasma’ calibration of tokamak magnetic sensors,” D. Shiraki, J. P. Levesque, J. Bialek, P.J. Byrne, B.A. DeBono, M.E. Mauel, D.A. Maurer, G.A. Navratil, T.S. Pedersen, and N. Rath, *Rev Sci Instrum* **84**, 063502 (2013).
 138. “Adaptive Control of Rotating Magnetic Perturbations in HBT-EP using GPU Processing,” N. Rath, S. Angelini, J. Bialek, P J Byrne, B. DeBono, P. Hughes, J. P. Levesque, M. E. Mauel, G. A. Navratil, Q Peng, D. Rhodes and C. Stoafer, *Plasma Physics and Controlled Fusion* **55** (2013) 084003.
 139. “Measurement of 3D plasma response to external magnetic perturbations in the presence of a rotating external kink,” Daisuke Shiraki, Sarah M. Angelini, Patrick J. Byrne, Bryan A. DeBono, Paul E. Hughes, Jeffrey P. Levesque, Michael E. Mauel, David A. Maurer, Gerald A. Navratil, Qian Peng, Nikolaus Rath, Dov J. Rhodes and Christopher C. Stoafer, *Phys. Plasmas* **20** (2013) 102503.

140. “Feedback-Assisted Extension of the Tokamak Operating Space to Low Safety Factor,” Jeremy M. Hanson, J. Bialek, M. Baruzzo, T. Bolzonella, A.W. Hyatt, G.L. Jackson, J. King, R.J. LaHaye, M.J. Lanctot, L. Marrelli, P. Martin, G.A. Navratil, M. Okabayashi, E. Olofsson, C. Paz-Soldan, P. Piovesan, C. Piron, L. Piron, D. Shiraki, E.J. Strait, D. Terranova, F. Turco, A.D. Turnbull, and P. Zanco, *Phys. Plasmas* **21**, 072107 (2014).
141. “Active and Passive Experiments to Control the Helical Boundary of Wall-Stabilized Tokamak Plasma,” G.A. Navratil, S. Angelini, J. Bialek, P.E. Hughes, J. P. Levesque, M. E. Mauel, Q Peng, D. H. Rhodes and C. C. Stoafer, presented at the **25th IAEA Fusion Energy Conference**, Saint Petersburg, Russia, October 2014.
142. “High-Speed Imaging of the Plasma Response to Resonant Magnetic Perturbations in HBT-EP,” Sarah Angelini, Jeffery P. Levesque, Michael E. Mauel, and Gerald A. Navratil, *Plasma Physics and Controlled Fusion* **57** 045008 (2015).
143. “Fast, Multi-Channel Real-Time Processing of Signals with Microsecond Latency Using Graphics Processing Units,” N. Rath, S. Kato, J. P. Levesque, M. E. Mauel, G. A. Navratil and Q. Peng., “Fast, Multi-Channel Real-Time Processing of Signals with Microsecond Latency Using Graphics Processing Units,” *Rev Scientific Instruments* **85**, 054114 (2014).
144. “Modeling of fast neutral-beam-generated ion effects on MHD-spectroscopic observations of resistive wall mode stability in DIII-D plasmas,” F. Turco, A. D. Turnbull, J. M. Hanson and G. A. Navratil, *Phys. Plasmas* **22** , 022503 (2015).
145. “Active and Passive Kink Mode Studies in a Tokamak with a Movable Ferromagnetic Wall,” J. P. Levesque, P.E. Hughes, J. Bialek, P.J. Byrne, M.E. Mauel, G.A. Navratil, Q. Peng, D.J. Rhodes and C.C. Stoafer, *Physics of Plasmas* **22**, 056102 (2015).
146. “Design and Installation of a Ferromagnetic Wall in Tokamak Geometry,” P.E. Hughes, J.P. Levesque, N. Rivera, M.E. Mauel, and G.A. Navratil, *Rev Scientific Instruments* **86**, 103504 (2015).
147. “Modeling of fast neutral-beam-generated ions and rotation effects on RWM stability in DIII-D plasmas,” F. Turco, A. D. Turnbull, J. M. Hanson and G. A. Navratil, *Nucl. Fusion* **55**, 113034 (2015).
148. “Improved feedback control of wall stabilized kink modes with different plasma–wall couplings and mode rotation,” by Q Peng, J P Levesque, C C Stoafer, J Bialek, P Byrne, P E Hughes, M E Mauel, G A Navratil and D J Rhodes, *Plasma Phys. Control. Fusion* **58**, 045001 (2016).
149. “Understanding the Stability Limits of the Low Torque ITER Baseline Scenario in DIII-D,” F. Turco, C. Paz-Soldan, T.C. Luce, J.M. Hanson, G. Navratil, A. Turnbull, W. Solomon, invited paper for the 2016 European Physical Society Plasma Physics Annual Meeting 4-8 July 2016 in Leuven, Belgium.
150. “Current density and rotation profiles govern the stability of the ITER Baseline Scenario in DIII-D; predictive transport simulations capture the confinement degradation due to direct electron heating,” F. Turco, T. C. Luce, J.M. Hanson, B. Grierson, G. Staebler, G.A. Navratil, C. Paz-Soldan, W. Solomon, A.D. Turnbull, A. Garofalo, 2016 IAEA Fusion Energy Conference in Kyoto, Japan on 17-22 October 2016.

151. “Stability of high-performance, negative central shear discharges,” J.M. Hanson, J. Bialek, M. Clement, J.R. Ferron, A.M. Garofalo, C.T. Holcomb, R.J. La Haye, M.J. Lanctot, T. Luce, G.A. Navratil, K.E.J. Olofsson, E.J. Strait, F. Turco, A. Turnbull, 2016 IAEA Fusion Energy Conference in Kyoto, Japan on 17-22 October 2016.
152. “Ferritic Wall and Scrape-Off-Layer Current Effects on Kink Mode Dynamics,” J. P. Levesque, M. C. Ablter, J. Bialek, J. W. Brooks, P. J. Byrne, C. J. Hansen, P. E. Hughes, M. E. Mael, G. A. Navratil, Q. Peng, D. J. Rhodes, and C. C. Stoaffer, 2016 IAEA Fusion Energy Conference in Kyoto, Japan on 17-22 October 2016.
153. “Validation of Conducting Wall Models Using Magnetic Measurements,” J.M. Hanson, J. Bialek, F. Turco, J. King, G.A. Navratil, E.J. Strait, and A. Turnbull, *Nucl. Fusion* **56**, 105022 (2016).
154. “Interaction of External $n = 1$ Magnetic Fields with the Sawtooth Instability in Low- q RFX-mod and DIII-D Tokamaks,” C. Piron, P. Martin, D. Bonfiglio, J. Hanson, N.C. Logan, C. Paz-Soldan, P. Piovesan, F. Turco, J. Bialek, P. Franz, G. Jackson, M.J. Lanctot, G.A. Navratil, M. Okabayashi, E. Strait, D. Terranova and A. Turnbull, *Nucl. Fusion* **56**, 106012 (2016).
155. “Stability of DIII-D high-performance, negative central shear discharges,” J.M. Hanson, J. W. Berkery, J. Bialek, M. Clement, J.R. Ferron, A.M. Garofalo, C.T. Holcomb, R.J. La Haye, M.J. Lanctot, T.C. Luce, G.A. Navratil, K.E.J. Olofsson, E.J. Strait, F. Turco, A.D. Turnbull, *Nucl. Fusion* **57**, 056009 (2017).
156. “Measurement of Scrape-Off-Layer Current Dynamics during MHD Activity and Disruptions in HBT-EP,” J.P. Levesque, J.W. Brooks, M.C. Ablter, J. Bialek, P.J. Byrne, C.J. Hansen, P.E. Hughes, M.E. Mael, G.A. Navratil, D.J. Rhodes, *Nuclear Fusion* **57**, 086035 (2017).
157. “GPU-based Optimal Control for RWM Feedback in Tokamaks.” by Mitchell Clement, Jeremy Hanson, Jim Bialek, and Gerald Navratil, *Control Engineering Practice* **68**, 15 (2017).
158. “H2 Optimal Control Techniques for Resistive Wall Mode Feedback in Tokamaks,” Mitchell Clement, Jeremy Hanson, Jim Bialek, and Gerald Navratil, *Nuclear Fusion* **58**, 046017 (2018).
159. “Shaping Effects on Toroidal Magnetohydrodynamic Modes in the Presence of Plasma and Wall Resistivity,” Dov J. Rhodes, A.J. Cole, D.P. Brennan, J. M. Finn, M. Li, R. Fitzpatrick, M.E. Mael, and G. A. Navratil, *Phys. Plasma* **25**, 012517 (2018).
160. “The Causes of the Disruptive Tearing Instabilities of the ITER baseline Scenario in DIII-D,” F. Turco, T.C. Luce, W. Solomon, G. Jackson, G.A. Navratil, J.M. Hanson *Nuclear Fusion* **58**, 106043 (2018).
161. “Integration of the High-BN Hybrid Scenario to a High Performance Pedestal, Stable Zero Torque Operation, and a Divertor Solution,” by F. Turco, G. A. Navratil, T.H. Osborne, T. Petrie, C.C. Petty, T. Luce, B.A. Grierson, *Proceedings of the 27th IAEA Fusion Energy Conference*, 22-27 October 2018, Gandhingar, India.
162. “Asymmetric Scrape-Off Layer Currents During MHD and Disruptions,” by J. P. Levesque, J. Bialek, J. W. Brooks, S. DeSanto, C. Hansen, M. E. Mael, G. A.

Navratil, and I. G. Stewart, *Proceeding of the 45th European Physical Society Conference on Plasma Physics*, 2-6 July 2018, Prague, CZ.

163. "Dynamics of MHD Instabilities Near a Ferromagnetic Wall," by P.E. Hughes, J.P. Levesque, and G. A. Navratil, *Nuclear Fusion* **58**, 126009 (2018).
164. "Mode Rotation Control in HBT-EP with a Feedback-Driven Biased Electrode," by J.W. Brooks, I.G. Stewart, J.P. Levesque, M.E. Mauel, G.A. Navratil, *Review of Scientific Instruments* **90**, 023503 (2019).

PATENTS

"Electrode Structures for High Energy High Temperature Plasmas," G.A. Navratil and G.R. Neil, Inventors. **US Patent No. 4,129,772**; Dec. 12, 1978

"Systems, Methods, and Media for Establishing Communications with a Graphics Processing Unit," Nicholaus Rath and Gerald A. Navratil, Inventors, US Patent Application 61/488,022, pending.

CONTRIBUTIONS TO CONFERENCES, SYMPOSIA, WORKSHOPS, AND SEMINARS

Recent Organizational Contributions

Member of Program Committee for the Annual "Workshop on Control of MHD Modes," 1996 to 2010 and 2013-present.

Member of the Program Committee for the 52nd American Physical Society Division of Plasma Physics Annual Meeting, Chicago, 8-12 November 2010.

Member of the Program Committee for the European Physical Society 39th Conference on Plasma Physics, Stockholm, 2-6 July 2012.

Member of the Program Committee for the 56nd American Physical Society Division of Plasma Physics Annual Meeting, New Orleans, 27-31 October 2014.

Member of the US Selection Committee for the 26th IAEA Fusion Energy Conference, 17-22 October 2016 in Kyoto, Japan.

Ph.D. Theses Supervised

1. "Production and Experimental Study of the Trapped Ion Instability," John Thomas Slough, September 1981. (with A.K. Sen)
2. "Experimental Observations of MHD Instabilities in the High-Beta Tokamak, Torus II," Munemasa Machida, January 1983.
3. "Measurements of High-Beta Tokamak Pressure Profiles with Multi-point Thomson Scattering," Fred Michael Levinton, March 1983
4. "Growth Rate, Saturation, and Radial Transport for the Trapped Ion Instability," Alan B. Plaut, April, 1986 (with A.K. Sen).

5. "Tomographic Analysis of the Evolution of Plasma Cross-Sections in HBT," Andrew K. Holland, April, 1986.
6. "Production and Study of a Collisionless Trapped Particle Instability," Robert Scarmozzino, April 1987 (with A.K. Sen).
7. "ICRF Heating and Antenna Coupling in a High Beta Tokamak," Richard Elet, December 1987.
8. "Identification of, and Transition to, the Second Region of Ideal MHD Stability in Tokamaks," Steven A. Sabbagh, April 1990.
9. "Stabilization of Plasma Instabilities using Halo Feedback and Ion Beam Suppressor," Akihisa Sekiguchi, January 1991. (with A. K. Sen).
10. "Experimental Study of External Kink Instabilities in the Columbia High Beta Tokamak," Thomas H. Ivers, February 1991. (with M. E. Mauel).
11. "Passive Stabilization of MHD Instabilities at High β_N in the HBT-EP Tokamak," David A. Gates, October 1993.
12. "Tokamak Mode Structure Measurements using Tomographic Reconstructions," Q. Xiao, February 1998.
13. "Magnetic Island Dynamics Induced by Rotating Magnetic Perturbations in Tokamak Plasmas" David Maurer, September 2000.
14. "Study of External Kink Stability in the Presence of Asymmetric Conducting Wall Structures," Yuhing Liu, May 2006.
15. "Optimized Feedback Control System Modeling of Resistive Wall Modes for Burning Plasmas Experiments," Oksana Katsuro-Hopkins, February 2007.
16. "Kalman Filtering for Active Feedback on Rotating External Kink Instabilities in a Tokamak Plasma," Jeremy Hanson, April 2009.
17. "Measurement and Model Validation of Three-dimensional High-temperature Tokamak Plasmas," Matthew J. Lanctot, October 2010.
18. "Multimode Structure of Resistive Wall Modes near the Ideal Wall Stability Limit," Jeffrey P. Levesque, July 2012
19. "GPU-based, Microsecond Latency, Hecto-Channel MIMO Feedback Control of magnetically Confined Plasmas," Nicholas Rath, November 2012.
20. "MHD Effects of a Ferritic Wall on Tokamak Plasmas," Paul E. Hughes, June 2016.
21. "Shaping Effects on Resistive Instabilities in a Tokamak Plasma Surrounded by a Resistive Wall." Dov Joseph Rhodes, April 2017 as co-sponsor with Andrew Cole.
22. "Optimal Control Techniques for Resistive Wall Modes in Tokamaks," Mitchell Clement, August 2017, as co-sponsor with Prof. George Tynan at UCSD.