

Uri Shumlak

Professor & Associate Chair, Department of Aeronautics and Astronautics
University of Washington, Seattle, WA

Degrees

Ph.D.: University of California, Berkeley, 1992

B.S.: Texas A & M University, 1987

Professional Positions

Associate Chair for Research: Apr. 2015 – present

Acting Chair: Sep. 2014 – Jan. 2015

Associate Chair for Research: Nov. 2010 – Jun. 2013

Professor: Sep. 2007 – present

Associate Professor: Sep. 2002 – Sep. 2007

Assistant Professor: Sep. 1999 – Sep. 2002

Research Assistant Professor: Dec. 1994 – Sep. 1999

National Research Council Associate: Dec. 1992 – Dec. 1994

Research Interests

Plasma Science, Computational Plasma & Fluid Dynamics, Innovative Confinement Concepts, Fusion Energy, Advanced Space Propulsion

Honors and Awards

University of Washington College of Engineering Faculty Innovator Award 2011

American Institute of Aeronautics and Astronautics Abe Zarem Award of Excellence 2003

University of Washington Aeronautics & Astronautics Professor of the Year 2002

American Institute of Aeronautics & Astronautics Senior Member 2001

University of Washington Aeronautics & Astronautics Professor of the Year 1999

National Research Council Associateship 1992

Selected Publications

1. S.D. Knecht, W. Lowrie, and U. Shumlak. Effects of a conducting wall on Z-pinch stability. *IEEE Transactions on Plasma Science* **42** (6), 1531 (2014).
2. G.V. Vogman, P. Colella, and U. Shumlak. Dory-Guest-Harris instability as a benchmark for continuum kinetic Vlasov-Poisson simulations of magnetized plasmas. *Journal of Computational Physics* **277**, 101 (2014).
3. E. Kansa, U. Shumlak, and S. Tsynkov. Discrete Calderon's Projections on Parallelepipeds and their Application to Computing Exterior Magnetic Fields for FRC Plasmas. *Journal of Computational Physics* **234**, 172 (2013).
4. U. Shumlak, J. Chadney, R.P. Golingo, D.J. Den Hartog, M.C. Hughes, S.D. Knecht, W. Lowrie, V.S. Lukin, B.A. Nelson, R.J. Oberto, J.L. Rohrbach, M.P. Ross, and G.V. Vogman. The Sheared-Flow Stabilized Z-Pinch. *Fusion Science and Technology* **61** (1t), 119 (2012).
5. E.T. Meier and U. Shumlak. A general nonlinear fluid model for reacting plasma-neutral mixtures. *Physics of Plasmas* **19** (7), 072508 (2012).
6. E.T. Meier, A.H. Glasser, V.S. Lukin, and U. Shumlak. Modeling open boundaries in dissipative MHD simulation. *Journal of Computational Physics* **231** (7), 2963 (2012).
7. G.V. Vogman and U. Shumlak. Deconvolution of Stark broadened spectra for multi-point density measurements in a flow Z-pinch. *Review of Scientific Instruments* **82** (10), 0034-6748 (2011).
8. B. Srinivasan and U. Shumlak. Analytical and computational study of the ideal full two-fluid plasma model and asymptotic approximations for Hall-MHD. *Physics of Plasmas* **18** (9), 092113 (2011).
9. U. Shumlak, R. Lilly, N. Reddell, E. Sousa, and B. Srinivasan. Advanced physics calculations using a multi-fluid plasma model. *Computer Physics Communications* **182**, 1767 (2011).
10. W. Lowrie, V.S. Lukin, and U. Shumlak. *A priori* mesh quality metric error analysis applied to a high-order finite element method. *Journal of Computational Physics* **230**

- (14), 5564 (2011).
11. B. Srinivasan, A. Hakim, and U. Shumlak. Numerical methods for two-fluid dispersive fast MHD phenomena. *Communications in Computational Physics* **10**, 183 (2011).
 12. J. Loverich, A. Hakim, and U. Shumlak. A discontinuous Galerkin method for ideal two-fluid plasma equations. *Communications in Computational Physics* **9**, 240 (2011).
 13. R.P. Golingo, U. Shumlak, and D.J. Den Hartog. Note: Zeeman splitting measurements in a high-temperature plasma. *Review of Scientific Instruments* **81**, 126104 (2010).
 14. E.T. Meier, V.S. Lukin, and U. Shumlak. Spectral element spatial discretization error in solving highly anisotropic heat conduction equation. *Computer Physics Communications* **181**, 837 (2010).
 15. W. Song and U. Shumlak. Ultrasonically-Aided Electrospray Source for Charged Particles Approaching Monodisperse Distributions. *Journal of Propulsion and Power* **26** (2), 353 (2010).
 16. U. Shumlak, C.S. Adams, J.M. Blakely, B.-J. Chan, R. P. Golingo, S.D. Knecht, B.A. Nelson, R.J. Oberto, M.R. Sybouts, and G.V. Vogman. Equilibrium, flow shear and stability measurements in the Z-pinch. *Nuclear Fusion* **49** (7), 075039 (2009).
 17. K.A. Munson, U. Shumlak, and B.A. Nelson. Extreme Ultraviolet Light Production from a ZaP Flow Z-Pinch Xenon Plasma. *Journal of Micro/Nanolithography, MEMS, and MOEMS (JM3)* **7** (1), 013003-1-9 (2008).
 18. W. Song and U. Shumlak. Charged Nanoparticle Source for High Thrust Level Colloid Thrusters. *Journal of Propulsion and Power* **24** (1), 139 (2008).
 19. U. Shumlak, B.A. Nelson, and B. Balick. Plasma Jet Studies via the Flow Z-Pinch. *Astrophysics and Space Science* **307** (1-3), 41 (2007).
 20. A. Hakim and U. Shumlak. Two-Fluid Physics and Field-Reversed Configurations. *Physics of Plasmas* **14** (5), 055911 (2007).
 21. A. Hakim, J. Loverich, and U. Shumlak. A High Resolution Wave Propagation Scheme for Ideal Two-Fluid Plasma Equations. *Journal of Computational Physics* **219**, 418 (2006).
 22. J. Loverich and U. Shumlak. Nonlinear full two-fluid study of $m=0$ sausage instabilities in an axisymmetric Z-pinch. *Physics of Plasmas* **13** (8), 082310 (2006).
 23. S.L. Jackson and U. Shumlak. Abel Inversion of a Holographic Interferogram for Determination of the Density Profile of a Sheared-Flow Z-Pinch. *Reviews of Scientific Instruments* **77**, 083502 (2006).
 24. M. Selwa, S.K. Solanki, K. Murawski, T.J. Wang, and U. Shumlak. Numerical Simulations of Impulsively Generated Vertical Oscillations in a Solar Coronal Arcade Loop. *Astronomy and Astrophysics* **454**, 653 (2006).
 25. R.P. Golingo, U. Shumlak, and B.A. Nelson. Formation of a sheared flow Z-pinch. *Physics of Plasmas* **12** (6), 062505 (2005).
 26. J. Loverich and U. Shumlak. A Discontinuous Galerkin Method for the Full Two-Fluid Plasma Model. *Computer Physics Communications* **169** (3), 251 (2005).
 27. R.P. Golingo and U. Shumlak. Spatial Deconvolution Technique to Obtain Velocity Profiles from Chord Integrated Spectra. *Reviews of Scientific Instruments* **74** (4), 2332 (2003).
 28. U. Shumlak, B.A. Nelson, R.P. Golingo, S.L. Jackson, E.A. Crawford, and D.J. Den Hartog. Sheared flow stabilization experiments on the ZaP flow Z-pinch. *Physics of Plasmas* **10** (4), 1683 (2003).
 29. U. Shumlak and J. Loverich. Approximate Riemann Solver for the Two-Fluid Plasma Model. *Journal of Computational Physics* **187** (2), 620 (2003).
 30. U. Shumlak, R.P. Golingo, B.A. Nelson, and D.J. Den Hartog. Evidence of Stabilization in the Z-Pinch. *Physical Review Letters* **87** (20), 205005 (2001).
 31. U. Shumlak and T.R. Jarboe. Stable high beta spheromak equilibria using concave flux conservers. *Physics of Plasmas* **7** (7), 2959 (2000).
 32. J.H. Degnan, et al. Compression of Plasma to Megabar Range using Imploding Liner. *Physical Review Letters* **82** (13), 2681 (1999).

33. U. Shumlak and T.R. Jarboe. Higher mode stability in spheromak equilibria. *Physics of Plasmas* **6** (11), 4382 (1999).
34. U. Shumlak and N.F. Roderick. Mitigation of the Rayleigh-Taylor instability by sheared axial flows. *Physics of Plasmas* **5** (6), 2384 (1998).
35. O.S. Jones, U. Shumlak, D.S. Eberhardt. An Implicit Scheme for Non-Ideal Magnetohydrodynamics. *Journal of Computational Physics* **130**, 231 (1997).
36. C.W. Hartman, J.L. Eddleman, A.A. Newton, L.J. Perkins, and U. Shumlak. Magnetic Confinement Fusion and the Continuous-Flow Pinch. *Plasma Physics and Controlled Fusion* **17** (5), 267 (1996).
37. U. Shumlak and C.W. Hartman. Sheared Flow Stabilization of the $m=1$ Kink Mode in Z-Pinches. *Physical Review Letters* **75** (18), 3285 (1995).
38. U. Shumlak, T.W. Hussey, and R.E. Peterkin. Three-Dimensional Magnetic Field Enhancement in a Liner Implosion System. *IEEE Transactions on Plasma Science* **23** (1), 83 (1995).
39. T.W. Hussey, N.F. Roderick, U. Shumlak, R.B. Spielman, and C. Deeney. A heuristic model for the non-linear Rayleigh-Taylor instability in fast Z-pinches. *Physics of Plasmas* **2** (6), 2055 (1995).
40. J.H. Degnan, et al. Electromagnetic Implosion of Spherical Liners. *Physical Review Letters* **74** (1), 98 (1995).
41. U. Shumlak, T. K. Fowler, and E. C. Morse. Rotational effects on the $m=1$ magnetohydrodynamic instability in spheromaks. *Physics of Plasmas* **1** (3), 643 (1994).

Patents

- “Plasma-Based EUV Light Source,” U. Shumlak, R.P. Golvingo, and B.A. Nelson, Utility Patent US 7,825,391 B2, November 2, 2010.
- “Plasma-Based EUV Light Source for Next Generation Lithography,” U. Shumlak, B.A. Nelson, and R.P. Golvingo, Foreign Patent Application through the Patent Cooperation Treaty filed April 2008 for Europe and Taiwan.
- “Plasma-Based EUV Light Source,” U. Shumlak, R.P. Golvingo, and B.A. Nelson, Utility Patent US 7,372,059 B2, May 13, 2008.

Grants & Contracts

PI since 1994 on numerous grants and contracts from AFOSR, DOE, ARPA-E, NASA, Boeing, etc. Total research funding to date: approximately \$15,000,000.

Professional Memberships

American Institute of Aeronautics and Astronautics (AIAA)
 American Physical Society (APS)
 Institute of Electrical and Electronics Engineers (IEEE)
 Society for Industrial and Applied Mathematics (SIAM)

Selected Professional Service

AIAA Plasmadynamics Conference, Session Organizer
 APS Division of Computational Physics, Conference Program Committee
 APS Division of Plasma Physics, Conference Program Committee
 APS John Dawson Award for Excellence in Plasma Physics Selection Committee, Chair
 DOD High Performance Computing Modernization Program Technical Evaluation Panel
 NASA High Energy Space Systems Review Panel
 University Fusion Association, President

Selected Consulting & Expert Witness

Advanced Energy & Aerospace Programs, MSE Technology Applications, Butte, MT
 Andrews Space & Technology, Seattle, WA
 Boeing Company, Everett, WA
 ClearSign Combustion, Seattle, WA
 Computational Sciences, Huntsville, AL
 OMAX Abrasive Waterjet Systems, Kent, WA