

## Ammar Hakim, Ph.D

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**Highlights:** Expert in computational fluid dynamics, electromagnetism, and plasma dynamics. Extensive experience with developing large-scale (100K+ lines of C++/MPI code) computational software designed to run on supercomputers. Expert in advanced numerical schemes, including shock-capturing discontinuous Galerkin and finite-volume schemes, with applications to reacting hypersonic flows and simulation of various fusion devices.

## Research and Professional Experience

### Research Scientist, Tech-X Corporation, Boulder Colorado, (2006-present)

- Developed finite-volume and discontinuous Galerkin finite-element algorithms for the solution of viscous fluid flow equations including chemical reactions, Maxwell equations of electromagnetism, and two-fluid plasma equations.
- Created a new C++ library to represent unstructured meshes. Library uses C++ templates extensively to allow use of mixed elements (triangles, quadrilaterals, hexahedra, pyramids and tetrahedra). Implemented a powerful sequencing mechanism for iteration over mesh in a dimension and element independent manner.
- Numerical algorithms and mesh library resulted in a new commercial product slated for release in summer of 2011. Worked on user documentation and comprehensive set of example problems.
- Led development of U.S. Department of Energy (DoE) Scientific Discovery through Advanced Computing (SciDAC) project FACETS, a project to perform full-scale reactor modelling for the U.S. fusion energy program. Press release at <http://www.scidac.gov/fusion/fullscale.html>. Project website <https://facetsproject.org>. Wrote core parallel C++/MPI framework and performed first simulations in collaboration with experimentalists.
- Presented invited talks at several conferences and published results in computational physics and plasma physics journals.
- Wrote proposals and won grants from Department of Defence and Department of Energy for computational physics projects.

### Research Associate, University of Washington, Seattle (2001-2006)

- Developed fluid algorithms for the solution of two-fluid plasma equations and applied them to simulating compact fusion devices and plasma instabilities.
- Developed solvers for radiation transport equation in the coupled ocean and atmosphere system. These were applied to study of inverse problems to determine the optical properties of ocean water from remote-sensing and in-situ measurements.

## Education and Training

Doctor of Philosophy, University of Washington, Seattle (April, 2006)

Master of Science, University of Washington, Seattle. (April, 2002)

## Peer Reviewed Publications

- A H Hakim, J R Cary, J Candy, J Cobb, R H Cohen, T Epperly, D J Estep, S Krasheninnikov, A D Malony, D C McCune, L McInnes, A Pankin, S Balay, J A Carlsson, M R Fahey, R J Groebner, S E Kruger, M Miah, A Pletzer, S Shasharina, S Vadlamani, D Wade-Stein, T D Rognlien, A Morris, S Shende, G W Hammett, K Indireskumar, A Yu Pigarov, H Zhang. “Coupled whole device simulations of plasma transport in tokamaks with the FACETS code”, Accepted for publication in *SciDAC 2010: J. Physics: Conf. Series*, 2010.
- B. Srinivasan, A. Hakim and U. Shumlak, “Numerical Methods for Two-Fluid Dispersive Fast MHD Phenomena”, Accepted for publication in *Communications in Computational Physics*, 2011.
- J. Loverich, A. Hakim, U. Shumlak, “A Discontinuous Galerkin Method for ideal Two-Fluid Plasma Equations”, *Communications in Computational Physics*, **9** (2) 240–268, 2011. arXiv:1003.4542.
- J. Loverich, A. Hakim, “Two-Dimensional Modeling of Ideal Merging Plasma Jets ”, *Journal of Fusion Energy*, **29** (6) 532–539, 2011. arXiv:1007.5271.
- John R. Cary, Ammar Hakim, Mahmood Miah, Scott Kruger, Alexander Pletzer, Svetlana Shasharina, Srinath Vadlamani, Alexei Pankin, Ronald Cohen, Tom Epperly, Tom Rognlien, Richard Groebner, Satish Balay, Lois McInnes, Hong Zhang, “FACETS - a Framework for Parallel Coupling of Fusion Components”, The 18th Euromicro International Conference on Parallel, Distributed and Network-Based Computing. Pisa, Italy (2010). arXiv:1004.1611.
- A. Hakim, “Extended MHD Modelling with the Ten-Moment Equations”, *Journal of Fusion Energy*, **14**, 055911 (2008).
- A. Hakim, U. Shumlak, “Two-Fluid Physics and Field Reversed Configurations”, *Physics of Plasmas*, **14**, 055911 (Invited paper, 2007).
- A. Hakim, J. Loverich, U. Shumlak, “A High Resolution Wave Propagation Scheme for ideal Two-Fluid Plasma Equations”, *Journal of Computational Physics*, **219** (1), 418–442 (2006).
- A.H. Hakim B.D. Piening and N.J. McCormick. “Near-asymptotic angle dependence of ocean optical radiance”, *Applied Optics*, **43** (2004).
- A.H. Hakim and N.J. McCormick. “Ocean optics estimation for absorption, backscattering, and phase function parameters”, *Applied Optics*, **42** 931-938 (2003)

## Recently Funded Projects

- “Plasma Jet Modeling for Magneto Inertial Fusion”, *Department of Energy, Phase II Small Business Innovative Research Grant*, Investigator (2010-2012).
- “Hypersonic reacting flow modeling for in-atmosphere flight”, *Department of Defence, Phase I Small Business Innovative Research Grant*, Investigator (2010-2011).
- “Three-Dimensional Fast-Multipole Solvers For Magnetic Fields For Use In High-Current Pulsed Power Application Systems”. *Department of Defence, Small Business Innovative Research Grant*, Principal Investigator (2009-2010).