DPP17-2017-000364

Abstract for an Invited Paper
for the DPP17 Meeting of
the American Physical Society

Maxwell Prize Talk: Scaling Laws for the Dynamical Plasma Phenomena

D. D. RYUTOV, LIVERMORE, CA 94550, USA, Retired

The scaling and similarity technique is a powerful tool for developing and testing reduced models of complex phenomena, including plasma phenomena. The technique has been successfully used in identifying appropriate simplified models of transport in quasistationary plasmas [1, 2]. In this talk, the similarity and scaling arguments will be applied to highly dynamical systems, in which temporal evolution of the plasma leads to a significant change of plasma dimensions, shapes, densities, and other parameters with respect to initial state. The scaling and similarity techniques for dynamical plasma systems will be presented as a set of case studies of problems from various domains of the plasma physics, beginning with collisonless plasmas, through intermediate collisionalities, to highly collisional plasmas describable by the single-fluid MHD. Basic concepts of the similarity theory will be introduced along the way. Among the results discussed are: self-similarity of Langmuir turbulence driven by a hot electron cloud expanding into a cold background plasma [3]; generation of particle beams in disrupting pinches [4]; interference between collisionless and collisional phenomena in the shock physics [5]; similarity for liner-imploded plasmas [6]; MHD similarities with an emphasis on the effect of small-scale (turbulent) structures on global dynamics [7]. Relations between astrophysical phenomena and scaled laboratory experiments will be discussed. 1. B.B. Kadomtsev. Sov. J. Plasma Phys. 1, 296, 1975. 2. J.W. Connor, J.B. Taylor, NF, 17, 1047, 1977. 3.D.D. Ryutov, R.Z.Sagdeev. Sov. Phys. JETP, 31, 396, 1970. 4. S.V. Lebedev, A. Frank, D.D. Ryutov, to be published; 5. D.D. Ryutov, N. L. Kugland, H.-S. Park, et al, PPCF, 54, 105021, 2012. 6.D.D. Ryutov, M.E. Cuneo, M.C. Herrmann et al, PoP, 19, 062706, 2012. 7. D.D. Ryutov, B.A. Remington. PoP, 10, 2629, 2003.