

Martin D. Kruskal: Asymptotics and Nonlinear Science

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I present a personal account of my work with Martin Kruskal, who died last December, [1, 2]. I emphasize the years 1955 -1974, when there was a focus of effort on simulations of the Fermi-Pasta-Ulam nonlinear lattices and the KdV class of equations, that: led to the discovery of the soliton [3] and the invention of the inverse scattering transform by Kruskal and colleagues [6]; and when the first workshop bearing the title "Nonlinear Physics and Mathematics" was held. The latter began the development of nonlinear science as a sub-discipline.[4]. I also review the synergistic use of computers and graphics for the study of problems in nonlinear science.[7] Martin's work was imbued with an asymptotical spirit which has influenced my approaches in computational fluid dynamics, from vortex and contour dynamics [5] to recent work in accelerated inhomogeneous flows.[8, 9].

References

- [1] Zabusky, N. J and Miura, Robert Martin D. Kruskal, (1925-2006). Obituary, Physics Today, May 2007
- [2] Miura, R., et al Martin D. Kruskal, (1925-2006). Obituary, SIAM News, April 2007
- [3] N. J. Zabusky. Computational Synergetics and Mathematical Innovation. J. Computational Physics, 43, 195–249, 1981.

- [4] Zabusky, N.J. FermiPastaUlam, solitons and the fabric of nonlinear and computational science: History, synergetics, and visiometrics. *Chaos* 15, 015102 (2005) .
- [5] N.J. Zabusky. Vortex dynamics of fluids (NL2471) *Encyclopedia of Nonlinear Science*, ed. Alwyn Scott. New York , London: Routledge, 2005.
- [6] Clifford S. Gardner, John M. Greene, Martin D. Kruskal, and Robert M. Miura. "Korteweg-deVries equation and generalizations. VI. Methods for exact solution", *Commion Pure and Applied Mathematics*, 27, (1974), pages 97–133.
- [7] N.J. Zabusky. Visiometrics (NL3496) *Encyclopedia of Nonlinear Science*, ed. Alwyn Scott. New York , London: Routledge, 2005.
- [8] Hawley, J. and N.J. Zabusky, N.J. " Vortex paradigm for shock-accelerated density-stratified interfaces 1989. , *Phys. Rev Letters* 63, 1241-1244.
- [9] Zabusky.,N. J. Vortex paradigm for accelerated inhomogeneous flows: Visiometrics for the Rayleigh-Taylor and Richtmyer-Meshkov environments. *Ann. Review of Fluid Mechanics*, 1999, 31, 495-535.
- [10] Zabusky, N.J and Zeng, S. Shock cavity implosion morphologies and vortical projectile generation in axisymmetric shockspherical fast/slow bubble interactions *J. Fluid Mech.* (1998), vol. 362, pp. 327346, 1998