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Experimental Observation in a Turbulent BEC: Characterization and Universal Scaling Properties

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One of the out-of-equilibrium states of great interest in superfluids is the state of turbulence. In this state, the proliferation of vortices or waves, creates one of several known states of turbulence. From equilibrium, with energy injection, there is evolution establishing a cascade of energy that causes migration of energy to high moments, resulting in a dependence of power law type in the energy spectrum. The reason the system evolves this way has to do with its quest for equilibrium, reaching possibly a stationary state. If the energy injection is ceased, the system evolves in time.

Observing the high moment component in the distribution allows us to verify its dependence by determining whether it is a non-thermal state. We detected in our experiment regions of excitation, where exponential (rather than Gaussian) dependence reveals the presence of non-thermalizing states. Such out-of-equilibrium states exhibit universal behavior when scaled. This universal behavior is of great interest, especially if associated with turbulent states. (Financial support from FAPESP, CNPq and CAPES. This work had the participation of A. Garcia, G. Telles, L. Machado, S. Couto, L. Madeira, G. Roati, P.Castilho, P. Tavares, A. Cedrin and G. Roati)

Vanderlei Salvador Bagnato, born in 1958, received a PhD from MIT (1987) and a double major in Material Science Engineering and Physics (Universidade Federal de São Carlos - Brasil – 1981). He received the title of "Livre – Docente" by the University of São Paulo in 1989 and Full Professor in 1993. His research activities are based on laser cooling and trapping of neutral atoms and applications of optics and lasers for health science. Among many achievements, he pioneered work in the field of atomic and molecular physics with worldwide recognition. Cold atomic collisions, techniques to better cool atoms, and fundamentals of Bose-Einstein condensation are common topics among his many published works. Some of his research highlights include quantum turbulence involving atomic superfluids, time and frequency metrology with the construction and evaluation of the first atomic clock developed in Latin America, and the first pilot plant for the production of high precision microscopes. Recently the research group under his guidance implemented the clinical use of Photo-Dynamic-Therapy for the treatment of cancer and microbiological control in Brazil for the first time. A strong synergy between basic research and industry is one of the characteristics of the work carried out by Bagnato, resulting in the development of advanced-technology industries in the field of optics. He has published over 600 papers in international journals with more than 18,000 citations. During his academic career, he has supervised more than 100 graduate students and he is presently supervising 13 graduate students in several areas of research, as well as many undergraduates. He is also currently a Fellow of the Hagler Institute for Advance Studies. He is a member of the following academies: National Academy of Science NAS - (USA), Pontifical Academy of Science (Vaticano), TWAS, Brazilian Academy of Science (ABC) and Latin America Academy of Science (ACAL).

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