Contribution ID: **45** Type: **Poster**

Shear-Induced Decaying Turbulence in Bose-Einstein Condensates

Monday 2 September 2024 17:00 (2 hours)

In this talk, we experimentally consider the problem of decaying turbulence in a Bose-Einstein condensate (BEC) superfluid. We begin with a shear layer comprised of quantum vortices formed between a stationary BEC and a stirred-in persistent current. This structure breaks down rapidly (<150 ms) through vortex pairing which we characterise through simple crystal structure analysis [1,2]. Subsequently decaying turbulence is established, through the progressive clustering of the vortices [3], which follows a power law decay with time, similar to decaying turbulence in other two-dimensional systems under the classical Kelvin-Helmholtz instability (KHI) [4,5]. We extend this investigation using a point-vortex model that matches experimental conditions [6]. from this, we observe a convergence of the power-law exponent to a fixed value.

[1] H. Aref, On the equilibrium and stability of a row of point vortices, Journal of Fluid Mechanics 290, 167–181 (1995).

[2] D. Hernández-Rajkov et al., Connecting shear flow and vortex array instabilities in annular atomic superfluids, Nature Physics. (2024)

[3] A. W. Baggaley and N. G. Parker, Kelvin-Helmholtz instability in a single-component atomic superfluid, Physical Review A 97, 053608 (2018).

[4] D. A. Schecter, D. H. E. Dubin, K. S. Fine, and C. F. Driscoll, Vortex crystals from 2D Euler flow: Experiment and simulation, Physics of Fluids 11, 905 (1999).

[5] Y. Pomeau, Vortex dynamics in perfect fluids, Journal of Plasma Physics 56, 407–418 (1996)

[6] M. T. Reeves et al., Turbulent Relaxation to Equilibrium in a Two-Dimensional Quantum Vortex Gas, Physical Review X 12, 011031 (2022)

References

Short bio (50 words) or link to website

I am a PhD student at the University of Queensland, Bose-Einstein condensate laboratory. My research is primarily related to 2D quantum turbulence and quantum vorticity.

Relevant publications (optional)

S. Simjanovski, G. Gauthier, M. J. Davis, H. Rubinsztein-Dunlop, and T. W. Neely, Optimizing persistent currents in a ring-shaped Bose-Einstein condensate using machine learning, Phys. Rev. A 108, 063306 (2023). https://journals.aps.org/pra/abstract/10.1103/PhysRevA.108.063306

Career stage

Student

Authors: Dr GAUTHIER, Guillaume (The University of Queensland); Prof. RUBINSZTEIN-DUNLOP, Halina; SIMJANOVSKI, Simeon (The University of Queensland); Dr NEELY, Tyler (University of Queensland)

Presenter: SIMJANOVSKI, Simeon (The University of Queensland)

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