Erice, September 2022

PHYSICAL EFFECTS OF GLOBAL AND LOCALIZED TWIST PHASE ON QUANTUM VORTEX DEFECTS

MATTEO FORESTI

Dept. Management, Inf. & Prod. Eng., U. Bergamo, Italy
E-mail: matteo.foresti@unibg.it

ABSTRACT

Twist is a well-known quantity in classical vortex theory, but its physical effects have not been studied in the context of quantum vortex defects in Bose-Einstein condensates. Here we introduce the concepts of *global twist phase* and *localized twist phase* to analyze the physical effects induced by the different phase presence on defects [1]. These effects are studied by making use of Kleinert's multi-valued gauge theory [2, 3] under the zero helicity condition for the Gross-Pitaevskii equation. In the presence of global twist we show that secondary defects must be produced consistently with the zero-linking number requirement. If however a twist phase remains localized in the healing region of the defect the system is proved to be unstable [4], converting twist into writhe in analogy with the writhe instability of supercoiled elastic strings.

This is a joint work with Renzo Ricca.

[1] Foresti, M. & Ricca, R.L. 2020 Hydrodynamics of a quantum vortex in the presence of twist. *J. Fluid Mech.* **904**, A25.
[2] Kleinert, H. 2008 *Multivalued Fields in Condensed Matter, Electromagnetism and Gravitation.* World Scientific, Singapore.
[3] Ricca R.L., Foresti M. 2022 Multi-valued potentials in topological field theory. In *Knotted Fields* (edited by R.L. Ricca & X. Liu), to appear, Springer.
[4] Foresti, M. & Ricca, R.L. 2022 Instability of a quantum vortex by twist perturbation. *J. Fluid Mech.,* to appear.