QuanTalks

IISc Quantum Technologies Initiative (IQTI)
Seminar Series

Title

Visualization study of quantum fluid dynamics in superfluid ^{4}He

Speaker

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Date & Time

Friday, 1st October 2021, 6:30 PM IST

Meeting Link

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Abstract

Helium-4 in the superfluid phase (He II) is a two-fluid system that exhibits fascinating quantum fluid dynamics with important scientific and engineering applications. It supports the most efficient heat-transfer mechanism (i.e., thermal counterflow), and it also allows the generation of flows with extremely high Reynolds numbers for turbulence modelling. However, the lack of high-precision flow measurement tools in He II has impeded our progress in understanding and utilizing its hydrodynamics. In recent years, there have been extensive efforts in developing quantitative flow visualization techniques applicable to He II [1]. Two types of techniques based on the use of either particle tracers (i.e. micron-sized frozen particles) or molecular tracers (i.e. He2* excimer molecules) have been developed. I will discuss our contributions in this field and will highlight some recent progresses in the study of counterflow and quasiclasscial turbulence in He II [2-5] as well as the application of our molecular-tagging technique for accelerator cavity quench-spot detection [6]. We will also briefly introduce our on-going work on developing the next generation flow visualization techniques [7] and our effort on imaging quantized vortices in a levitated drop of He II.

References: *[1] W. Guo, D.P. Lathrop, M. La Mantia, and S.W. Van Sciver, PNAS, 111, 4653 (2014). [2] A. Marakov, et al, Phys. Rev. B, 91, 094503 (2015). [3] B. Mastracci and W. Guo, Phys. Rev. Fluid, 4, 023301 (2019). [4] S. Yui, et al., Phys. Rev. Lett, 124, 155301 (2020). [5] Y. Tang, S. Bao, and W. Guo, PNAS, 118, e2021957118 (2021). [6] S. Bao and W. Guo, Phys. Rev. Applied, 11, 044003 (2019). [7] X. Wen, Phys. Rev. Lett., 124, 134502 (2020).*

Biography

Dr. Wei Guo obtained his B.S. degree in Physics from Wuhan University in 2002 and received his Ph.D. in physics from Brown University in 2008. After graduation, he worked at Yale University as a postdoc in 2008-2010 and as a research scientist there in 2010-2012. He joined Florida State University in the summer of 2012. His research interests include quantum fluid dynamics, cryogenic heat and mass transfer, cavitation and bubble dynamics, and cryogenic particle detector and accelerator physics. His work has been supported by federal funding agencies, such as the National Science Foundation, US Department of Energy, NASA, Army Research Office, as well as national labs and industrial partners. He is also a recipient of the JSPS Invitation Fellowship award.