MECHANICAL ENGINEERING SEMINAR

Monday, June 19, 2023 at 14:30, D. Dan and Betty Kahn Building, Auditorium 1

Universal alignment in turbulent pair-dispersion

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When a group of particles is released into a turbulent flow, they tend to be carried away from each other, making the typical separation distance between pairs of particles grow with time. This process, which dominates the spreading and mixing of matter in the oceans and the atmosphere, is called pair dispersion. In 1926, Richardson predicted that the mean squared distance between particle pairs in turbulence grows super-diffusively, with a time exponent of 3. However, since its discovery nearly a century ago and despite its central role in turbulence theory, Richardson's law evaded unequivocal experimental confirmation ever since. Among the issues that make its verification difficult are having too small Reynolds numbers, an intrinsic intermittency of the process, and an innate dependence on initial distances and velocities. To overcome these issues, our work reveals a new and property of turbulent pair dispersion: the average of the angle that is formed between the separation and the relative velocity vectors is a conserved quantity in turbulence and it has a universal value. We confirm these predictions through experimental and DNS resutls. This novel discovery allows identifying whether Richardson's regime exists and at which scales in future experiments, independently of the flow parameters. It thus allows confirming Richardson's theory, with significant consequences for predicting dispersion and mixing of in the oceans and in the atmosphere.

Dr. Ron Shnapp obtained his PhD from Tel Aviv University, under Prof. Alex Liberzon in 2019. He then joined the Weizmann institute as a postdoctoral fellow under Prof. Victor Steinberg. Winning the Rothschild fellowship he then joined ETHZurich as a postdoctoral fellow under Prof. Markus Holzner. In 2023 he joined the Ben Gurion University as a senior lecturer.

Seminars Coordinator: Assoc. Prof. Matthew Suss.