PRINCETON
Mechanical & Aerospace Engineering

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3:30 PM

Particle-Laden Turbulent Flow Fundamental Understanding of Particle Dynamics and Applications to Modeling Collisions and Rain Formation

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Turbulent multiphase flows encompass some of the most important open questions in modern fluid mechanics. The dynamics of solid particles, liquid droplets and gas bubbles hold significant gaps in our fundamental understanding and, at the same time, are of great relevance in many industrial and environmental applications. There are multiple examples of the relevance of these problems, but I will focus on the formation of rain in warm clouds as a classical example where the poor basic understanding hinders progress in accurate modeling and prediction of the underlying geophysical, or engineering, process.

I will discuss laboratory experiments in which we probe the inertial effects in the dynamics of heavy particles in a homogeneous isotropic turbulent flow. The interaction of the inertial particles with the turbulent vortical structures results in accumulation of droplets in regions of high strain and the modification of the drift velocity of droplets due to gravity. Both of these effects lead to a higher probability of collisions due to smaller inter-droplet distance and higher relative velocities. We have found evidence of strong coupling of the particle dynamics with the underlying turbulence, and through this coupling of a significant enhancement of the relative velocity leading to collisions. A novel formulation for the collision kernel is proposed that, unlike previous efforts, is based on measurable droplet statistics.

Dr. Aliseda is an Associate Professor in Mechanical Engineering at the University of Washington in Seattle, WA, USA, where he has been on the faculty since 2006. Prior to the UW, he spent seven years at the University of California, San Diego, where he obtained his PhD and did postdoctoral research in Mechanical and Bio Engineering. His current interests focus on turbulent- multiphase flows, including energy conversion and environmental problems such as cloud microphysics, liquid atomization and marine renewable energy, as well as on biomedical flows involving ultrasound contrast agents and the biomechanics basis of vascular disease. Recently, he spent a year on sabbatical at the Kavli Institute for Theoretical Physics at UCSB and the Laboratoire des Ecoulements Geophysiques et Industriels (LEGI) in Grenoble, France.

Social Period outside of Maeder Hall, following the seminar

ALL VISITORS ARE WELCOME