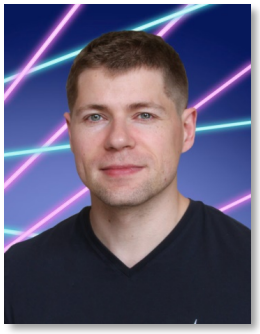
Mechanical Engineering Department Seminar

3:30pm September 26, 2018
1130 Mechanical Engineering
111 Church Street SE, Minneapolis, MN 55455

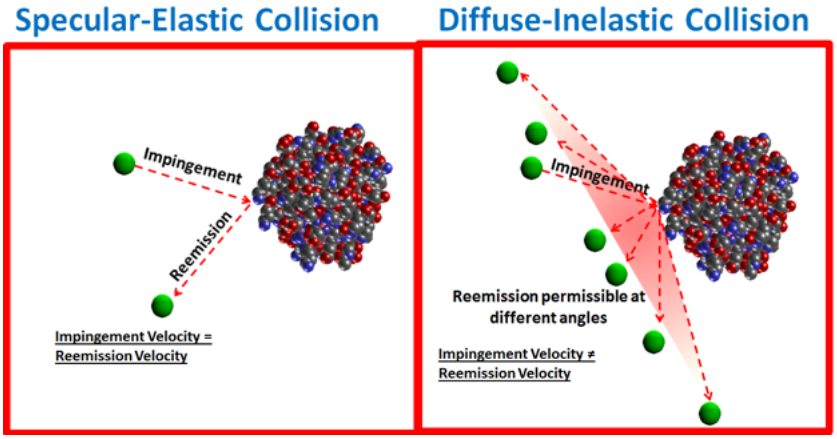


Understanding and Harnessing Drag Force Outside the Continuum Limit

Chris Hogan

Associate Professor and Director of Graduate Studies; Mechanical Engineering - University of Minnesota

Drag force (along with lift) is commonly introduced to engineering students in their introductory fluid mechanics course; it describes the rate of momentum force from a fluid to an object immersed in that fluid. Commonly, the first relationship introduced describing drag force is Stokes's Law, an elegant algebraic equation describing a drag force acting on a sphere. While it is generally taught that this relationship only applies in the low Reynolds number limit, often neglected is the fact that it also only applies in the low Knudsen number (continuum) limit, in which the Knudsen number, i.e. the ratio of the mean free path of the fluid (gas) to the size of the sphere/particle, is extremely small. The description of drag force outside the continuum limit remains quite incomplete, particularly down at the molecular scale, though there are a number of natural and engineered gas phase environments where particles are dispersed in gaseous medium (aerosols) and the particles are small relative in size to the mean free path or similar in size to it. This talk focuses on the Hogan group's work in developing approaches to determine the drag force outside the continuum limit (beginning with the free molecular regime and working into the Knudsen dependent regime) and in testing of these theoretical approaches experimentally. Additionally discussed are the development of analytical screening methods for chemical warfare agents, the development of gas phase manufacturing processes, and measurements and calculations of nucleation and growth rates of particles in gas phase environments, all of which are facilitated by an understanding of non-continuum and molecular scale drag.



Bio: Chris Hogan is an Associate Professor and the Director of Graduate Studies in the Department of Mechanical Engineering at the University of Minnesota. He received his PhD from Washington University in Saint Louis in 2008 and was a Post-doctoral Associate at Yale University before joining the University of Minnesota in 2009. His research work focuses on gas phase chemical physics, aerosol science, and particle technology. He has published more than 85 papers on these topics. 5 PhD students have graduated from his group (two are now in tenure-track faculty positions), he has worked with 5 post-doctoral associates (also two in tenure-track faculty positions), and 6 MSME students have completed their MSME Plan A or MSME Plan B under his supervision. He has taught ME 3332 (fluid mechanics) four times, ME 3333 (heat transfer) twice, ME 4031W (basic mechanical measurements laboratory) twice, ME 5113 (Aerosol Science) once, ME 8113 (Advanced Aerosol Engineering) four times, and CSE 1001 three times at the University of Minnesota.