

# DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING

## WILLIAM MAXWELL REED SEMINAR SERIES

### “Aerosol Particles Beyond the Speed of Sound- Applications in Manufacturing, Space Flight, and Public Health”

**Chris Hogan, Ph.D.**  
Department of Mechanical Engineering  
University of Minnesota

#### Abstract:

Aerosol particles are ever-present in both natural environments, and in engineered systems. In large part, control over aerosol particle transport hinges upon control of particle inertia, i.e. the propensity of particles to maintain a particular trajectory whilst the surrounding fluid moves in a distinct direction. Increasing the inertia of increasingly small particles typically involves increasing particle initial velocities, such that when fluid velocities slow down, particle-fluid velocity differences are maximized. While inertial principles have long been exploited in a wide variety of aerosol instruments, including impactors, virtual impactors, and aerodynamic particle spectrometers, application of inertially-governed aerosol systems wherein the particle Mach number (based on its velocity difference with the fluid) approaches or even exceeds unit value are much more limited. This presentation will overview current understanding of aerosol particle behavior in high-speed systems, and subsequently discuss ongoing studies of high speed particle behavior. Specifically, the drag force on particles as a function of both the Knudsen number and the Mach number, derived from direct simulation Monte Carlo, will first be discussed. Subsequently, results from ongoing studies of crater formation due to microparticle impacts at up to 1 km s<sup>-1</sup> speeds with high-speed flight-relevant materials will be presented. Also discussed will be insights from atomistic simulations into the changes in crystallinity and defect density experienced by particles during high-speed impacts, relevant to aerosol deposition of coatings, and the optimization of virtual impactor aerosol concentrators operating near the sonic limit, capable of submicrometer particle concentration enhancement.

#### Speaker Bio:

Chris Hogan is the Carl and Janet Kuhmeyer Chair Professor in the Department of Mechanical Engineering at the University of Minnesota, Twin Cities, where he will also begin an appointment as Department Head in July 2024. His research group focuses largely on fundamental and applied research in aerosols, including the development of theories to describe transport and reactions in aerosols, the design of new measurement principles and instruments for aerosols, and the evaluation of HVAC control technologies. He has published more than 160 peer reviewed papers focusing in these areas, and is the editor-in-chief of the Journal of Aerosol Science.

**Date:** Friday, March 22, 2024  
**Place:** Whitehall Classroom Building 110

**Time:** 3:00 PM EST  
**Contact:** Dr. Jonathan Wenk

Attendance open to all interested persons