MASTER IN AEROSPACE SCIENCE AND TECHNOLOGY

Multiphase flow, Phase Change and Heat Transfer in Reduced Gravity Environments

Speaker: J. Iwan D. Alexander (Case Western Reserve University, Cleveland, Ohio USA)
Course related: Science in Microgravity (SIM)
Duration: 6 sessions – 20 hours

Tuesday 5 May, 2009

Session 1: *Introduction* (1 hr)
Multiphase flow in reduced gravity (3 hrs)
Time: 16.00h
Location: Building C3 - Room 309

Wednesday 6 May, 2009

Session 2: *Isothermal multiphase flow in reduced gravity continued* (3 hrs)
Time: 16.00h
Location: Building C3 - Room 309

Friday 8 May, 2009

Session 3: *Liquid Interfaces: Dynamics and Stability* (4hrs)
Time: 16.00h
Location: Building C3 - Room SA2G

Tuesday 12 May, 2009

Session 4: *Application: Liquid propellant acquisition and management* (3hrs)
Time: 16.00h
Location: Building C3 - Room 309

Wednesday 13 May, 2009

Session 5: *Phase Change: Low gravity Boiling* (1.5 hrs)
Phase Change: Solidification (1.5 hr)
Time: 16.00h
Location: Building C3 - Room 309

Friday 15 May, 2009

Session 6: *Applications to Space Exploration technology* (3hrs)
Time: 16.00h
Location: Building C3 - Room 309

Abstract

The course will introduce the student to multiphase flow and phase change behavior under reduced gravity conditions (ranging from near weightlessness to planetary gravity such as Mars or the Moon). The objective is to provide the student with an understanding of typical near-weightless environments in spacecraft that would be associated with planetary orbits and the consequences for multiphase systems and also to understand the implications for such systems under the reduced gravity of planetary surfaces. The material will cover computational simulation and predictive model development, issues that affect experiment design and applications related to space exploration technology.

Biography

Dr. Alexander is a professor of Mechanical and Aerospace Engineering at Case Western Reserve University and is the director of the National Center for Space Exploration Research on Fluids and Combustion (NCSER) and since 2007 has been the faculty director of CWRU's energy research initiative, the Great Lakes Institute for Energy Innovation. His undergraduate work was in Geology and Oceanography (B.Sc., U. Wales, Swansea, 1977) and his Ph.D. research (Washington State, 1981) involved the stability of layered fluids deformed at constant strain rates associated with the geological problem of the buckling of layered strata.

Dr. Alexander's research interests now cover a number of topics ranging from the physics and mechanics of fluid interfaces, computational fluid mechanics and energy transport to crystal growth and solidification. This work has produced over a 120 refereed papers. For the last fifteen years his research has included theoretical studies, computational simulations and experiments, particularly those processes associated with materials preparation and also with fluid surface dynamics. He was also involved with 5 space experiments, three involving semiconductor crystal growth, one liquid diffusion experiment and an acceleration measurement experiment. Dr. Alexander serves on a number of national committees, is an AIAA associate fellow and has chaired two Gordon Research Conferences (Gravitational Effects in Physical-Chemical Systems and Thin Film and Crystal Growth Mechanisms), and is internationally recognized for his work on microgravity fluid processes.

As the NCSER's director, he is directly involved in implementing the center's vision to become a focal point for fluids and combustion research on fluid and transport processes in space exploration technologies and advanced human support systems under weightless and reduced gravity to provide a knowledge base for the design of future space exploration systems and technologies. Under his leadership Case Western Reserve University recently established the 'Great Lakes Institute for Energy Innovation'. The purpose of the institute is to develop, through farsighted energy research and energy-use strategies, innovative energy technology platforms that will provide low cost, reliable and sustainable energy resources and by implementing short-term solutions today, build and sustain tomorrow's industries.

Dr. Alexander was awarded NASA's Exceptional Service Medal in August 2008.