Boulder Fluid Dynamics Seminar Series

Tuesday, October 28, 2014
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

The motion induced between parallel plates with offset centers of radial stretching and shrinking

Patrick Weidman, *University of Colorado, Boulder*

The flow between parallel plates separated by distance h is investigated where the upper and lower plates respectively stretch and shrink at the same rate a and the centers of stretching/shrinking are horizontally offset by distance $2l$. A reduction of the Navier-Stokes equation yields two ordinary differential equations dependent on a Reynolds number $R=ah^2/\nu$ and a free parameter γ measuring the strength of a uniform pressure gradient acting along the line connecting the stretching/shrinking centers. The flow is described by two functions of the plate-normal coordinate $\eta=z/h$: the first $f(\eta)$ has an analytical solution while the second $g(\eta)$ must be resolved numerically. Three cases are considered: $\gamma=0$, $\gamma=O(1)$ and $\gamma=O(R)$. The small-R solutions and the large-R asymptotic behaviors of the wall shear stresses are found. Analytical results presented in graphical form are compared with corresponding asymptotic behaviors.

Turbulent Combustion: From a Jet Engine to an Exploding Star

Alexei Poludnenko, *Naval Research Laboratory*

Turbulent reacting flows are pervasive both in our daily lives on Earth and in the Universe. They power modern energy generation and propulsion systems, such as gas turbines, internal combustion and jet engines. At the same time, they also have tremendous destructive potential being the primary driver of the majority of gaseous explosions. On astronomical scales, thermonuclear turbulent flames are at the core of some of the most powerful explosions in the Universe, known as Type Ia supernovae. These are crucibles, in which most of the elements around us from oxygen to iron are synthesized, and in the last 15 years they have been used as cosmological distance probes to discover the existence of dark energy. Despite this ubiquity in Nature, turbulent reacting flows remain poorly understood still posing a number of fundamental questions. In this talk I will give an overview of the numerical and theoretical work at the Naval Research Laboratory over the recent years aimed at studying both chemical and thermonuclear turbulent flames. I will highlight several surprising phenomena that have emerged in the course of this work, in particular, in the context of the intrinsic instabilities of high-speed turbulent flames. Finally, I will briefly discuss the implications of this work for the development of accurate, predictive turbulent flame models required for the design of practical combustion applications.