

## **Announcing the Final Examination of Jun Huang for the Degree of Doctor of Philosophy in Physics**

Date: Monday, Nov. 2, 2015

Time: 9:30 a.m.

Room: PSB 445

### **Dissertation title:**

**CONVECTIVE HEAT TRANSFER DRIVEN BY THE BUOYANCY FORCE AND THE MAGNETIC BODY FORCE ON QUASI-ONE-DIMENTIONAL MAGNETIC FLUID IN HORIZONTAL FIELD AND TEMPERATURE GRADIENTS**

### **Abstract:**

In this work we studied the convective heat transfer in a magnetic fluid in both zero and applied magnetic fields. The natural convection is observed in a quasi-one dimensional magnetic fluid in a horizontal temperature gradient. The horizontal non-homogeneous magnetic fields were applied across the sample cell either parallel or anti-parallel to the temperature gradient. The temperature profile was measured by eight thermocouples and temperature sensitive paint. The flow velocity field and streamlines were obtained by optical flow method. Calculated Nusselt numbers, Rayleigh number, and Grashof number show that the convective flow is the main heat transfer mechanism in applied fields in our geometry. It was found that when the field gradient is parallel with temperature gradient, the fields enhance the convective heat transfer while the fields inhibit it in anti-parallel configuration by analyzing the temperature difference across the sample, flow patterns, and perturbation Q field in applied fields. Magnetic Rayleigh number and magnetic Grashof number show that the thermomagnetic convections dominate in high magnetic fields. It is shown that the physical nature of the field effect is corresponding to the magnetic body force which is perpendicular to the gravity in our experiments. When the direction of the magnetic body force is same with temperature gradient in parallel configuration, the body force increases the convective heat transfer; while it has opposite effect in anti-parallel configuration.

Our study will not only shed light on the fundamental mechanisms for thermomagnetic convection but also help to develop field-controlled heat transfer devices.

### **Outline of Studies:**

Major: Physics

### **Educational Career:**

M. S. University of Central Florida, USA, 2010

B. S. Jilin University, China, 2001

### **Committee in Charge:**

Dr. Weili Luo (Chair)

Dr. Enrique Del Barco

Dr. Alfons Schulte

Dr. Alain Kassab (External Committee Member)

Approved for distribution by Dr. Weili Luo, Committee Chair, on Oct 23, 2015.

The public is welcome to attend.