Grant title: National Science Foundation RUI: Experimental Study of Dipolar Solid Helium

Funding Agency: National Science Foundation (NSF)

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Description: With its two protons and two neutrons, helium-4 is one of the simplest atoms next to hydrogen. This simplicity, however, belies a complex behavior at low temperatures due quantum mechanical effects. One of these effects is that helium will not freeze, needing to be squeezed to over 25 times atmospheric pressure to form a solid. Another consequence of the quantum nature of helium is the possibility that the solid phase can display superfluid properties (i.e. flow without friction). This is an idea that, although very strange, is predicted to occur under the right conditions. This project exploits the electronic properties of solid helium to develop a new route to creating solid helium. This new method will give us direct control over key properties of the solid that other solid helium experiments do not have. In the low temperature physics lab at Sacramento State, we will explore this new solidification method and use it to search for superfluidity of solid helium.

Students: The grant will fund two students each summer, as well as provide some travel money for them to attend national conferences. Typically there are several students working in the lab during the academic year as well, either for a senior project or for a special topics project.

Impact: The Sacramento State Low temperature Physics Lab (which has been dubbed the coolest place in Sacramento), is truly unique among undergraduate only institutions. The lab will make use of a state-of-the art cryogen-free refrigeration system along with additional cooling stages built at Sac State to nearly eliminate the need for liquid helium (an expensive, non-renewable consumable). This will make the lab truly amenable to undergraduate research. Additionally, as a new method to create solid helium, this project could open a large range of experiments, and gives the field new set of tools to study this immensely interesting quantum solid. This will provide undergraduate students the opportunity to work at the cutting edge of low temperature physics research.

Lab website: http://webpages.csus.edu/nsm-phys-lowtemplab/
Follow the lab on twitter: @SacStateLowTemp