

Closing Report on Faculty Research Grant: “**Development of an ultrasonic sensor array for the PICASSO dark matter experiment**”

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*1) Description of grant supported activity*

IUSB has produced the first 75 transducers of a 300 transducer array for the PICASSO32 experiment. The first four of 32 modules are now outfitted with our sensors and are being calibrated in the monoenergetic neutron beam at the University of Montreal, prior to installation underground at the Sudbury Neutrino Observatory site. IUSB has also produced an environmental chamber for transducer ageing and calibration. We have also developed written procedures for both the construction and testing protocols, based upon ASTM standards. The PICASSO32 detector should be the best positioned experiment to confirm or refute the controversial reported dark matter signal by the DAMA experiment in Italy, and the work at IUSB will play a major part in the development of this detector.

*2) Were you able to complete the project? Describe and difficulty you had.*

We accomplished the goals of mass producing an inexpensive, externally mounted, ultrasonic sensor which has more sensitivity than commercial units which sell for about \$150/sensor. Our sensors cost ~\$15/sensor, an order of magnitude less than the commercial units. Since the 2kg detector will require 300 sensors, this represents both a major scientific contribution to the experiment and a major financial contribution. We overcame the major difficulty of developing sensitivity at higher frequencies ( ~100kHz .)

*3) Did, or will, the project result in a specific product -- a manuscript, composition, syllabus, etc? If so, please describe and indicate state of development*

There were several specific products:

- 1) The first batch of mass produced and tested transducers has been delivered to the Montreal group, which is now evaluating the relative performance of our transducers.
- 2) An education major, Rey Brandt, successfully completed training in scientific techniques, and has become quite useful to the group. He produced the transducers with the PI and has done most of the work in constructing an innovative fast aging environmental chamber which cycles transducers to two setpoints (10°C and 60°C )once per hour. Rey will deliver talks on his work in the near future.
- 3) Two grant applications (1 submitted July 2005 and one submitted in September 2005) to the NSF were prepared based upon this work. The first, a CAREER grant proposal for \$590,000 over years was just declined yesterday. The second, an NSF RUI proposal entitled “RUI: Superheated Emulsions for the Detection of Dark Matter.” requesting \$280,000 was submitted in September and will be decided upon by ~ April, 2006. A copy of the one page scientific summary of this grant application, and the full scientific description are appended to this report.
- 4) A new collaboration between the group at IUSB and the University of Chicago has been formed which will attempt to develop bubble chambers using superheated CF<sub>3</sub>I for dark matter searches. I will be a CO-PI on a grant application to be submitted to the NSF.

I would like to thank the R&D committee for the support through the faculty research grant which helped make this work possible.

Sincerely,

Ilan Levine