

Closing Report Faculty Research Grant: “**Moderately superheated fluid detectors**”  
Ilan Levine, Assistant Professor of Physics and Astronomy 1 August, 2007

1) *Description of grant supported activity:*

IUSB has produced all 300 of the transducers for the PICASSO32 experiment and is completing a retrofit improvement to the devices permitted by delays in another part of the PICASSO program external to IUSB. The final version of this detector is now being assembled and taking data. The full assembly installation will be complete in the Fall. IUSB’s environment chamber for transducer ageing and calibration has been used to discover two important effects for the experiment. First, the transducers do have a temperature dependence in their sensitivity which is now accounted for in data analysis. Second, we showed that the couplant used to connect transducers to the detector was inappropriate due to aging instability and we found a new couplant to use which does not suffer from this defect. We have also become deeply involved in the COUPP dark matter search experiment (A collaborative experiment between the University of Chicago, Fermi National Accelerator Laboratory (Fermilab)), producing various pieces of equipment for the experiment such as encapsulated transducer/preamplifier packages, encapsulated cameras and IR lighting, encapsulated temperature sensors, and high pressure feed-through connectors. COUPP is now an official experiment at Fermilab which brings in financial, engineering and scientific support from the Department of Energy. Several grant applications were submitted and two of them have been awarded (to IUSB) by the National Science Foundation. One for PICASSO for ~\$282,000 over three years and the other for \$44,000 for COUPP work over the next two years.

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

We completed all the work outlined in the grant proposal and accomplished other things we didn’t anticipate getting involved in.

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*

- 1) All 300 of the transducers for PICASSO were manufactured and delivered. They are now being reprocessed to lengthen their expected lifetime.
- 2) PICASSO has asked us to take on production of specialty mine-rated power distribution cables for the detector enclosures. We have completed  $\frac{3}{4}$  of these cables.
- 3) We discovered an unexpected systematic temperature dependence of both the acoustic response of ultrasonic transducers and that the aqueous acoustic couplant had to be switched to a silicon-based gel.
- 4) I gave two invited colloquia on dark matter.
- 5) My students and I gave PICASSO related talks at the 2006 Meeting of the Division of Particles and Fields. A student (Nathan Vander Werf) delivered a talk about his PICASSO work at the 17<sup>th</sup> Annual Argonne Undergraduate Research Symposium.
- 6) Equipment for the COUPP experiment was produced for several of the detector units.
- 7) Two grants from the NSF were won for a total of more than \$326,000.
- 8) A paper by the COUPP collaboration is under preparation which will map out sensitivity to dark matter which is unprecedented.

I thank the R&D committee for the support which helped make this work possible.

Sincerely,

Ilan Levine