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Subject: Letter of support for LEVINE

To: Research and Development Committee, IUSB
From: Steve Shore, Chair, Physics and Astronomy
Date: 31 Oct. 2002
Subj: Support letter for Research Grant application
by Dr. Ilan LEVINE

This letter is in support of the Faculty Research Grant proposal by Dr. Ilan Levine, Physics/Astronomy, entitled "A Radon Assay and Counting Facility at IUSB" To begin with a summary recommendation, I urge the committee to grant this request. It will mean the establishment of a major R&D facility at IUSB that will play a key support role for one of the most important physics experiments of the last fifty years. It will also provide incredible opportunities for our students to be on the front line of a vital, continuing international collaboration working at the boundaries of modern physics.

Let me try your patience for a moment to explain why I am so enthusiastic about this research.

Understanding the fundamental nature of matter is the dream of physicists. It has motivated theory and justified the construction of accelerators from CERN to Fermilab. But there is a basic limit to the search: of the three fundamental forces, the electroweak interaction which along with the strong force governs the structure of the nucleus and the origin of the elements and matter in the universe, cannot be effectively studied with laboratory sources. About 30 years ago, Davis (at Brookhaven, Nobel Physics Prize 2002) and Bahcall (at Princeton) realized the Sun could be used to study this using a particle, the neutrino, emitted in the hydrogen fusion reaction that generates the light emitted by the star. The experiment was intended to confirm the nuclear energy source for the solar luminosity. But measurements that extended over a period of two decades, produced a mysterious result, one unanticipated by the so-called "standard model" for the electroweak force: although the Sun indeed emits neutrinos, confirming the basic theoretical picture, it emits only about 1/3 the number theoretically required for its brightness in photons.

Amid the more insane (at the time, 1980's) suggestions, it was hypothesized that the neutrino is actually able to change state among the three known varieties or flavors, flipping gender as it propagates through the matter in the outer solar envelope before streaming freely through space to Earth-based detectors. This test cannot be performed using controlled sources and requires almost unimaginable precision to detect the few captures of these particles by deeply buried underground detectors. This is where the Sudbury Neutrino Observatory

(SNO) has made its spectacular discovery. In August 2002, the SNO collaboration -- in which Levine played a leading role -- announced its result. For the first time, it can be stated unambiguously that the neutrino has mass, it changes states, and the "standard model" must be revised. When so successful a theory (look at the moniker!) fails, we have learned something fundamental.

Levine's work helped make this possible. The reduction of the natural background from cosmic and environmental sources not only dictated the experimental venue, more than 1.5 km underground, but pushed the requirements for a clean environment past any limits previously required for even the most delicate accelerator measurements. Yet the effort, as outlined in Ilan's proposal, was successful far beyond expectations. Now, with the audacity of explorers gazing at a new world, the collaboration is attempting to reduce the backgrounds to a mere 10% of their current levels.

This herculean effort will succeed only if the development work can be carried out by those few who have the commissioning and operations experience. Levine is one of those happy few and his proposal seeks the funding to establish the laboratory here in the Physics department and enlist the aid of our students in the effort. The spin-offs will also be substantial, in additional collaborations and national and international funding (the SNO project has been upgraded to a Canadian national facility with long term -- decade timescale -- funding), in support for other international astroparticle experiments (Ilan has been asked to join a new one even since arriving at IUSB), and even on a mundane level as a resource for environmental radiation work in the region. His other (external) recommender, Dr. Tony Noble (SNO Collaboration Associate Director) will address more detailed issues of the infrastructure support that will come from SNO, and Levine's continuing role in the project. I hope my background information has helped put this unique opportunity for IUSB in a broader perspective. I urge you to support this work.