Title – Directional Recoil Identification From Tracks (DRIFT)

List of participants – G.J. Alner, H. Araujo, A. Bewick, S. Burgos, M.J. Carson, J.C. Davies, E. Daw, J. Dawson, J. Forbes, T. Gamble, M. Garcia, C. Ghag, M. Gold, S. Hollen, R.J. Hollingworth, A.S. Howard, J. Kirkpatrick, V.A. Kudryavtsev, T.B. Lawson, V. Lebedenko, J.D. Lewin, P.K. Lightfoot, I. Liubarsky, D. Loomba, R. Lüscher, J.E. McMillan, B. Morgan, D. Muna, A.S. Murphy, G.G. Nicklin, S.M. Paling, A. Petkov, S.J.S. Plank, R.M. Preece, J.J. Quenby, M. Robinson, N. Sanghi, N.J.T. Smith, P.F. Smith, D.P. Snowden-Ifft, N.J.C. Spooner, T.J. Sumner, D.R. Tovey, J. Turk, E. Tziaferi and R. Walker

Brief Description of Program - In this era of precision cosmology, we now know the age of the Universe, the geometry of space, its total energy density and contributions to it from various types of matter and energy. Measurements suggest that ordinary matter (protons and neutrons) represents only a fraction of the total matter density in the Universe. The rest, whose effect we can only see gravitationally, appears to be dark. The goal of detecting and identifying dark matter is arguably the most important problem in 21st century cosmology. Current particle physics models suggest that the dark matter is composed of relic weakly interacting massive particles (WIMPs) left over from the Big Bang. Efforts to directly detect WIMPs are hampered by small interaction probabilities and large backgrounds which mimic expected dark matter signals. Fortunately, a number of unique dark matter signatures exist which, *if exploited*, can be used to discriminate against backgrounds and decisively identify WIMP interactions. These are based on the predicted behavior of the WIMP flux as the Sun-Earth system moves through the galaxy. The largest and most robust of these signatures is a day-night modulation of nuclear recoil directions in the lab frame. Of current experimental searches for dark matter only one, the Directional Recoil Identification From Tracks (DRIFT) project, is equipped to detect this directionality signature. Yet, directionality is considered by many astrophysicists to be a *necessary* condition for proof of the discovery of WIMP dark matter. The DRIFT technique also boasts a phenomenal background rejection capability. Based on a new technology (the Negative Ion Time Projection Chamber (NITPC)) which was invented and verified by the collaboration DRIFT also provides good sensitivity to WIMPs at low cost. The intellectual merit of this proposal resides in DRIFT's unique and powerful capabilities being brought to bear on one of the most important questions in science today.

A rough estimate of your space requirements and specific or unusual technical issues involved in your proposal – The current footprint of one DRIFT module (1 m^3 with 0.167 kg target mass) is approximately 3m by 3m including electronics and gas handling equipment. The height is 2.7 m but we have utilized underfloor shielding to reduce this to 2.3 m. We have been operating one module in the Boulby mine for the past year and are in the process of commissioning a second one due to be deployed in early 2006. With funding from the NSF we hope to expand the array to 3 modules and operate these for a period of 3 years. At this point the default plan is to deploy the modules in Boulby but the future of this facility is uncertain and the collaboration wishes to explore other options.

The technical issues associated with DRIFT involve size and safety. Each DRIFT vacuum vessel is a cube 1.7 m on a side weighing approximately 2 tons. DRIFT operates at high voltage (currently -40 kV) and uses carbon disulfide as a target gas. Carbon disulfide is poisonous and flammable. Nevertheless DRIFT underwent a thorough safety review to operate in Boulby and has had no accidents of any sort in the ~5 years we have operated these detectors in Boulby. Internet access to the experiment has proven invaluable in terms of monitoring its behavior.

Estimate of when you will require access to the underground facility – Unknown.

Any other general requirements or questions for the experiment, research, or outreach activities. – We are sending this same LOI to both Homestake and to DUSEL.