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Alignment with the McDonald Institute Research Strategy

This document provides guidelines to help interpret the vision and scientific goals for the McDonald Institute research program in the context of the appointments process for any McDonald Institute-funded researchers or technical staff.

General Guiding Principles:

The overall scientific objectives of the McDonald Institute are as follows:

- Expand on the scientific culture at Queen's University and its partner institutions by building a powerful and integrated team working on all aspects of particle astrophysics including the SNOLAB experimental program, astroparticle and astrophysics theory, related observational astrophysics, cosmology, detector development and low background techniques.
- Create an integrated research team with the critical mass and skills required to prepare and lead the next generation of increasingly challenging experiments. This will attract international scientists and technology along with the capital and operational funding necessary to allow one or more global-scale next-generation detectors to be hosted at SNOLAB.
- Maximize the scientific output from the suite of experiments that are currently operational or under development at SNOLAB by hiring key additional personnel, strengthening international collaborations, and engaging the broadened scientific community in the undertaking.

Hence, when considering alignment, it is important to keep in mind that we want to build the community in such a way that this will contribute to making the SNOLAB program a success. This does not imply that only experiments currently planned for SNOLAB are relevant. However, research taking place on other projects should be developing the technology or expertise with a clear long-term goal of preparing for potential future experiments at SNOLAB.

In the case of research taking place in cross-disciplinary research areas, such as radio-analytic chemistry, these positions need to both add value to the host department and provide identifiable benefit to the scientific programs at SNOLAB.

These positions will be primarily aligned with the physics program at SNOLAB, and include working on experiments in dark matter, supernovae monitoring, neutrinoless double beta decay, solar/geo-neutrino physics experiments, and any other physics experiments that require the advantages of a deep underground laboratory. It also includes research programs which are developing the technologies that are required for an identified or potential future experimental program. Some examples of these include:

- Working on the technology for or contributing directly to any of the physics programs currently at SNOLAB or planned for SNOLAB,

  and/or,

- Working on experiments or technology developments currently outside of SNOLAB but where the overarching goal is to gain expertise and develop the technology for a future program for which there is the potential for a future generation version to take place at SNOLAB. Examples of this could be EXO → nEXO, or DarkSide-20k with the goal of bringing the next generation detector to SNOLAB. Other examples could include the development of SiPM's for a variety of programs including those relevant to a SNOLAB program such as nEXO and/or a future LAr detector, or the development of low background techniques,

  and/or,

- Detector development, which could include the development of semiconductor devices at cryogenic temperatures, the development of SiPM and other novel light detection technologies, and their applications in medical physics or particle astrophysics. This area of alignment could include technology development programs advantageous to both non-McDonald Institute related offshore programs (e.g. accelerator based, short/long baseline, or underwater/under-ice detectors) and identifiable components of the McDonald Institute program.

The theory positions are generally broader in scope as the research interests are not necessarily tied to a particular experimental program. However, the clear intent for these positions is that these individuals would work closely with the Canadian Astroparticle Physics community to help with the development of SNOLAB research programs, interpretation of model dependent results, and bring theoretical insight into the particle astrophysics program. Hence their experience will include having worked on some topics of interest to the Astroparticle Physics Community in areas such as neutrino physics, dark matter, neutrinoless double beta decay, and similar, and potentially, how these relate to the field of astronomy/cosmology.

There may also be positions in cross-disciplinary areas where for example, the focus may be to develop new analytical tools and chemical procedures required by the next generation of particle astrophysics experiments to measure radioactivity at extremely low levels, and to purify complex materials of radio-impurities and other sources of backgrounds. It may also include the development of means to produce or purify detector materials such that they meet a variety of other experimental requirements, such as optical transparency, light output, or isotopic content. Other contribution areas could be the development of instrumentation for low-background studies, or detector development and characterization. This includes the development of quasi mono-energetic neutron beams ideal for the calibration of dark matter detectors, the measurement of detector thresholds, the production of special short-lived radioactive calibration sources peculiar to the needs of particle astrophysics experiments, the development and testing of sensitive neutron spectrometers, and the training of students with hands on experience in accelerator and nuclear physics.