The astroparticle physics group at the University of Alberta would like to announce multiple graduate student positions available at the Master’s and/or PhD level in experimental astroparticle physics. Up to two exceptional candidates will be considered for full support from the McDonald Institute without teaching obligations for up to 5 years. The McDonald Institute is the Canadian hub for astroparticle physics research that seeks to bring together Canadian and international researchers at all levels to deliver world-leading science. Successful candidates will have the opportunity to take advantage of the McDonald Institute network, including spending one semester at one of the member institutions.

The UofA is home to a large particle physics group and has a leading role in four major large-scale international experiments in neutrino physics and dark matter, namely SNO+, DEAP-3600 and PICO at SNOLAB and IceCube at the South Pole. Applicants are invited to express their interest in individual projects.

**SNO+** aims to establish the Majorana nature of the neutrino by searching for neutrinoless double beta decay using tellurium in liquid scintillator. SNO+ started taking data in 2017 with ultra-pure water, and now the inner volume is being filled with liquid scintillator. Data taken in the current period will be used to study solar, reactor and geo-neutrinos, and will be crucial in understanding the intrinsic background levels of the scintillator. The next phase will begin in 2019 as tellurium is loaded into the detector. The UofA is largely involved in the preparation towards this phase via calibration and development of analysis techniques.

**IceCube** is a cubic kilometer neutrino telescope, located at the South Pole, capable of observing neutrino interactions across a very large energy range. At the highest energies, IceCube has established the existence of an astrophysical neutrino flux and has observed first indications of its origin. Towards the low-energy side, the DeepCore subarray has now collected the largest sample of atmospheric neutrinos ever recorded, using them to study neutrino oscillations in appearance and disappearance modes, sterile neutrinos and non-standard interactions. A major detector upgrade is being planned that will greatly improve the performance and potential of the experiment across all energies. The UofA is actively involved in DeepCore and upgrade activities.

**DEAP-3600** is a direct dark matter search experiment consisting of ~3200 kg of liquid argon, contained in an ultrapure acrylic cryostat and viewed by 255 photomultiplier tubes. The detector has been in operation since late 2017; has released its first physics result and is now in a long multiyear run to set the world’s best limits in liquid argon. Liquid argon shows promise to set the ultimate dark matter limits in liquid noble gases and we have joined the international argon dark
matter consortium, which is planning a 20 megagram detector in Gran Sasso in Italy and a subsequent detector of approximately 300 megagrams, probably in Sudbury. UofA is central to the data analysis of the current experiment and will undertake significant hardware responsibility for the future generations.

**PICO** is a direct dark matter search experiment currently operating at SNOLAB in Sudbury, Ontario. The experiment uses a fluorine rich liquid to operate a bubble chamber with world leading sensitivity towards spin carrying dark matter particles. The Alberta group has been constructing the optical data acquisition, the thermal insulation system and took leadership of the quality control of the purity of the active liquid. We are looking for strong students who are interested in the construction and operation of a complex particle physics detector and who want to take an active role in the analysis of the dark matter search data.

**The Scintillating Bubble Chamber (SBC)** is a new technology that combines the bubble chamber technique (as PICO) with scintillation light. The SBC is planned to be built at UofA, and it will use liquid argon as target material for dark matter searches and coherent neutrinos. The goal is to perform the commissioning next year and to work on R&D for acoustic/light reading and circulation of the liquid for purification purpose. The integration of an electric field for particle directionality is also under investigation.

**To apply:**

Candidates should submit a formal application following the instructions here: https://www.ualberta.ca/physics/graduate-studies/information-for-prospective-students-and-applicants

To be considered for the McDonald Institute support applicants should hold an exceptional GPA and provide an excellent recommendation letter. Contact Prof. Juan Pablo Yanez (j.p.yanez@ualberta.ca) for any questions related to this opportunity and to formally apply for consideration for the McDonald Institute Scholarship.