Contact: Martin Connors, Course Coordinator
Email: martinc@athabascau.ca
Phone: 1-800-269-4730
Supervisor: Martin Connors
Research Expertise: Space Physics, Astronomy, Computation, Instrumentation

Main Research Areas: Auroral Electric Currents; Near-Earth Asteroids
In both of these areas, a comprehensive research program based on observation and computing is carried out. Observation starts with instrument design, and new instruments along with existing ones are used to gather data relevant to scientific questions. Computation and theory aid in the analysis of data. Most auroral research focuses on "substorms", which are sudden enhancements of auroras and of their associated electrical currents. Spacecraft data, most recently from THEMIS and AMPERE, is intensively used, and we have high expectations from the Canadian e-POP satellite. In the field of astronomy, Trojan asteroids associated with Earth have been of most interest. Observation largely consists of surveys done with small telescopes (new state of the art one being commissioned), and computational projects are also undertaken. Most work, including instrument development, is based on linux computers. Some areas may be able to be undertaken as Computing projects by arrangement with SCIS.

Suggested Topic Areas
Relation of auroral luminosity to magnetic observations at Athabasca. Single station observations of auroras or magnetic fields are generally regarded as insufficient. However, when the two are combined, more information should be able to be obtained. This project would use observations from our two observatories in the Athabasca region to attempt to develop a predictive ability for substorms based on patterns in auroral and magnetic field development.

Stereo Sky Imaging. Using our two observatories, and/or field work, methods of inverting images to obtain distances and brightness of sky phenomena ranging from clouds to aurora will be developed.

Instrument Control Using Small Microcomputers. With the advent of "Raspberry Pi", a new frontier in capability vs. cost of small computers is being attained. Through experimentation with these computers and various interfaces, notably USB, instrument control for scientific data gathering will be implemented. This project requires an advanced working knowledge of linux although it can be done based on a Windows computer interfaced to an "RPi".

Asteroid Imaging and Data Reduction. Based on images obtained with our and/or other telescopes (some available online), searches for asteroids can be done, and their orbits determined.

Variable Star Imaging and Data Analysis. Based on images from out telescopes, analysis of changes in brightness of variable stars can be done. It is preferred to do this in linux with a large degree of automation, however the patient student could also do this work under Windows.

Computation of Asteroid Orbits. Using linux software, the analysis of interesting asteroid orbits can be done, determining their behavior into the future. The main focus in the past has been resonant asteroids and in particular Trojans.

Computation of Exoplanet System Development. Based on recent discoveries of exoplanets (other "solar systems") there is large scope for investigating the history of many types of planetary configurations. This work generally requires a linux computer available for a large amount of calculation.

Past/ongoing student projects

Study of variable stars using Digital Single Lens Reflex Cameras. Recent improvements in camera technology have led to significant enhancements in performance with a decline in price for the cameras (though not so much for lenses). We are quantifying the role DSLR cameras can play in variable star research. This work has used the student's own camera and telescope as well as AU facilities.

Computational study of chaos in Trojan asteroids. The recently discovered Earth Trojan 2010 TK7 has a chaotic orbit. We investigated an idealized case of chaotic motion in the "Three Body Problem" with perturbations from a fourth object. The small influence of the fourth body can drastically change the behavior of the Trojan asteroid.