Understanding the galactic warp

Richard Dubinsky

In photographs, they look like rounded clouds in the night sky, but galaxies are massive collections of stars, planets and other matter, swirling around in a spiral. Their evolution has interested astronomers for many years, and now a new theory, by former York student Dr. Kim Papp, is helping to unravel their mystery.

Dr. Papp received his Doctoral Degree recently from York for a theory on the warping of disc galaxies, such as our own. The Earth is on the outer boundary of the *Galaxy*, or the Milky Way. The Milky Way also refers to the luminous band of stars extending across the sky, usually seen on clear nights in remote areas. This band of stars corresponds to an edge on view of our spiral galaxy. Our sun happens to be located at the inside edge of a warp.

There are five current theories explaining the galactic warp. The earliest idea came from Kahn and Woltjer who believed that disc galaxies are moving through a medium in the universe. This movement creates differential pressures, causing one end of a galaxy to move up and the other downwards (warping).

Lynden-Bell proposed that each galaxy had an axis of symmetry but the actual rotation is off this axis. This effect creates resonances that cause material to be thrown off the galactic plane.

Another explanation for the observed warp was proposed by Avner and King followed later by Hunter and Toomre. Their idea was that Magellanic Clouds (small orbiting galaxies) passed closely to our galaxy, causing bending as a result of tidal forces.

Binney suggested that galaxies are formed when a prolate system (similar to a squashed football) surrounds a circular disc. This gives way to deformation and some degree of warping. This theory can be ruled out because warped galaxies do not conform to these conditions.

The most recent theory is known as the Papp Postulate. According to Dr. Papp, galactic warps are due to the collapse of gas clouds. There are two flattened regions in a galaxy, a massive outer region which has a spherical envelope, and an inner region without such an envelope. These regions are rotating and inclined to each other. However, their centres of symmetry are not identical. This phenomenon occurs for all spiral galaxies and the motion of the outer region is always characteristic of a warp of bending. The warp will be caused by gravitational pull since the inner regions will coalesce at different rates than the outer region which remains stable. In his theory, Dr. Papp proposes that the spiral structure of galaxies are caused by this warp. This was first suggested by Dr. Kimmo Innanen of York.

"Our sun orbits on the edge of such a warp," stated Dr. Papp, however he went on to say, "our region of the galaxy is extremely stable and there will probably be little change in the future." Warping of galaxies is not a strong effect. However, it is believed to be involved in galaxy formation.

An understanding of the warping may help explain Quasars, star formation and the evolutionary cycle of galaxies.

Dr. Papp came to York University specifically to study with his advisor, Dr. Innanen, a well known space scientist. They have been collaborating with Dr. Vandervoort from the University of Chicago where Dr. Papp will continue his research.

Typical galaxy showing the spiral and flattened nature of its form.

Since coming to York, Dr. Papp has also been involved in several other theoretical problems dealing with stellar dynamics.

Dr. Chris Purton from York and Dr. Sun Kwok, presently at the Hertzberg Institute in Ottawa, worked with Dr. Papp on the study of the effect of heavy elements (metals) on planetary nebulae, or old stars. Their results indicated that the more metal a star has, the more likely it is to become a nebula. An extended study indicated that stars with high metal concentrations are less likely to become supernovae (exploding stars).

Dr. Papp has also worked on the determination of the mass of galaxies near our own: these would include Andromeda, Magella Clouds, NGC 1465 and others. He has discovered that the masses of these galaxies are greater than previously thought.

Dr. Papp's work, although theoretical, has contributed significantly to the understanding of our universe. by careful examination, computation, and thought, we now have a much clearer understanding of galactic dynamics and general space science.

York profs say:

Radioactive wasted stored safely

Emily Di Trani

Recent problems with the storage and disposal of radioactive wastes at U of T do not appear to be a controversy at York. Strict regulations set out by the York University Radiation Safety Committee governing the use, storage and disposal of radioactive materials seem to have the issue under control.

Recently the radioactive storage and disposal issue reached serious proportions at U of T which led the Canadian University Press to report that, "a new radioactive storage facility may be built at the University of Toronto following the discovery of dangerous storage conditions of both chemical and atomic wastes."

Radioactive waste at York is collected every two weeks by the University of Toronto Protection Staff. Afterwards, U of T buries the waste at Chalk River on a large land reserve. Until the radioactive waste is collected by U of T, it is stored in York's radioactive waste collection. Solid radioactive waste is stored in garbage containers which only Dr. J. Motsch, a radiation safety officer, has access to.

Radioactive liquid waste is stored in containers which consist of celite, an absorbant clay that contains the liquid radioactive waste. Dr. Motsch explains that "no radioactive chemicals are to be poured down the sink, (at York)."

Radioactive animal carcasses and animal wastes are placed in poly bags which are stored in cold rooms or freezers until their collection. Solid radioactive waste is stored in garbage containers lined with poly bags; sharp objects, hypodermic needles for example, are stored separately in puncture-proof containers.

Says Motsch, "every implement that is touched (by radioactive material) that cannot be decontaminated is thrown into a radioactive waste container."

York does not deal with radioactive gases. Says Dr. Motsch, "I have not yet come across a gas...that has been radioactive... we have no permit for radioactive gas."

The use of radioactive materials at York is organized in a hierarchical manner. The Atomic Energy Control Board issues York the license allowing the university to use radioactive materials. The regulations state "the Atomic Energy Control Board has authorized the Committee to approve, subject to later review by the Board, the proposed uses of radioactive isotopes and the qualifications of the users of such isotopes in the university within the terms of the consolidated license issued by the Atomic Energy Control Board to York University."

Says Committee Chairman Megaw, "If we (York) were doing anything that the Atomic Energy Control Board didn't like, they would just withdraw our permit and we wouldn't be able to get any radioactive materials."

York's Radiation Safety Committee then has the power to grant or deny a permit, which is valid for two years, to the professor who applies for it. The professor requires the permit in order to proceed with experiments involving radioactive material. If he does receive the permit, as Dr. Megaw explains, "he is entirely responsible for the safety of everyone working under him or with him."

Regulations also state "the grant or contract holder for a particular piece of research, (the professor) has overall responsibility for ensuring that the scientists or technicians working with radioactive isotopes are competent and have been trained in the operation concerned... all users of radioactive isotopes have the responsibility of ensuring that unacceptable levels of contamination, whether of air or surfaces in the laboratory and unacceptable levesl of radiation do not occur."