



MEDICAL PHYSICS AWARDED BY ARC

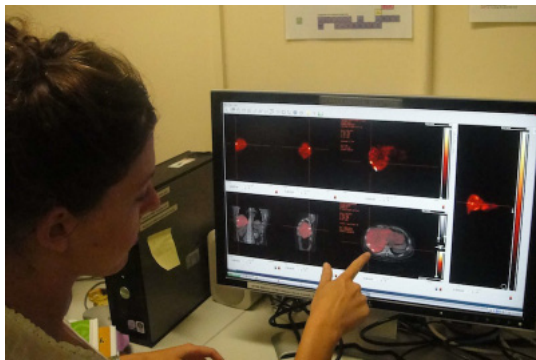


Image: Dr Kathy Willowson with liver cancer scans

Research into tumour targeting cancer technology will receive \$265,000 over four years as part of an ARC Linkage Grant. The study: *A phenomenological approach to improve radioembolisation treatment of cancer* will research liver cancer treatment and is being conducted by Professor Dale Bailey from the Faculty of Health Sciences and Professor Clive Baldock and Assoc. Professor Zdenka Kuncic, both from the School of Physics,

“The treatment uses radioactive microspheres that, when injected, seek out and target tumours directly in the liver without harming healthy tissue. However, we really need improved methods for determining the delivered radiation dose, which is the aim of this project.”

This means that in future, patients with this type of cancer will benefit from improved outcomes from this form of targeted radiation therapy. There is also potential for treating other sensitive cancer sites as well says Professor Kuncic.

“We hope to make a big impact in the area of targeted cancer therapeutics”, says Professor Kuncic. “By using physics-based strategies and our knowledge of how radiation interacts with living cells to develop quantitative tools which will improve clinical outcomes”, .

Partner organisations include Sirtex Technology Pty Ltd - with Dr Stephen Jones from Sirtex Medical, and the Royal North Shore Hospital. The University of Sydney received a total of \$6.709 million for 19 successful ARC Linkage Project grant applications. For more information on The Institute of Medical Physics at the School of Physics visit: www.physics.usyd.edu.au/research/medphys/index.shtml

MILKY PUZZLE

by Dr Sanjib Sharma, Post Doctoral Fellow, School of Physics

Astronomy in the past decade or so has changed from being a data starved science to a data intensive one, thanks to the technology revolution that has led to the development of large and powerful telescopes both here on earth and in space. In the context of understanding the formation of the Milky Way this means that astronomers can collect more data about the stars in our galaxy and understand how it is was formed. This has led to cataloguing the stars of the Milky Way through surveys like the two micron all sky survey (2MASS) and the Sloan Digital Sky Survey (SDSS).

To date the 2MASS has catalogued about half a billion stars and the SDSS has catalogued about quarter of a billion stars, spanning about one third of the sky. However both these were photometric surveys, which means that astronomers can at most, map out the spatial distribution of stars. This is not enough to test the various competing theories of galaxy formation. There is also the kinematic information in the form of radial velocity and transverse velocities (proper motion), which needs to be exploited. To get radial velocity we need to have spectroscopic surveys that can calculate the velocity of stars using shift in spectral lines.

To get proper motions we need to have an astrometric survey, which can record the accurate position of stars in the sky and repeat it again a few years later. Such surveys are being planned in the near future. The most ambitious among them being GAIA.

GAIA will chart a three-dimensional map of our Galaxy, in the process revealing the composition, formation and evolution of the Galaxy. GAIA will provide unprecedented positional and radial velocity measurements with the accuracies needed to produce a stereoscopic and kinematic census of about one billion stars in our Galaxy and throughout the Local Group. This amounts to about one percent of the Galactic stellar population.

Another big survey which is being planned is HERMES, which will measure the chemical abundance of about a million stars within about 1-2 kpc from the sun. This should help unravel the formation of the galactic thin and thick disc as, over time, the galaxy evolves and its stars get mixed in their position and velocity.

This then makes it difficult to determine their origin. However the chemical abundance of a star is invariant with time and so serves as a fingerprint with which we can trace the history of the galaxy.

(continued on page 2)

TWO FREE PUBLIC TALKS AT SYDNEY

1. PUBLIC CANCER LECTURE

Professor David Thwaites will give a free public lecture entitled: *New Technology in Radiation Oncology: What advances can this bring for cancer treatment (and is it worth the \$\$\$s)?*

There have been great advances in radiotherapy and around 50% of cancer patients will benefit from having radiotherapy as part of their treatment. Professor Thwaites will discuss how technology is enabling more complex treatments, yet improving technology is also more expensive and pricing has become an issue. Therefore health technology assessment, evidence-based medicine and efficient utilisation approaches must be considered before adopting new technology. The lecture will also discuss some novel physics and technology developments in radiotherapy within the context of costs and evidence-based medicine.

Professor Thwaites recently took up the position of Professor of Medical Physics in the School of Physics, having previously been the Professor of Oncology Physics at the University of Leeds and Head of the Department of Medical Physics and Engineering in Leeds Teaching Hospitals. He has also advised a number of other countries' health authorities on aspects of medical physics and radiation oncology, including Australia's Department of Health and Ageing.

The talk will be held on Tuesday 28 June at the Lecture Theatre 101, Faculty of Law Building, Eastern Ave, Camperdown Campus from 6.00pm - 7.00pm. Refreshments follow.

2. PLAYING WITH PARTICLE PHYSICS

In a 27 kilometre-long circular tunnel beneath the Franco-Swiss border sits the world's largest and most expensive physics experiment: the Large Hadron Collider (LHC). This extraordinary feat of science and engineering aims to uncover some of the remaining secrets of our Universe, giving us a glimpse at the earliest moments after the Big Bang, and illuminating the very nature of the fundamental forces and particles that make up our world.

International Science School (ISS) guest lecturer, Professor Allan Clark is Director of the Department of Nuclear and Particle Physics at the University of Geneva, where he works with the LHC's ATLAS detector group. In this talk he will outline the Standard Model, currently our best physical theory of matter and forces, before delving into the unknown to share some of the mysteries that remain in particle physics where our science breaks down and how colliding particles together at close to the speed of light inside the Large Hadron Collider may help us find the answers.

The talk will be held on Thursday 7 July 2011 from 6.00pm to 7.30pm at the Eastern Ave Auditorium, Eastern Ave, Camperdown Campus. This event is free and open to all, with no ticket or booking required. Entry is on a first come, first served basis. For more info: sydney.edu.au/sydney_ideas

MILKY PUZZLE (CONT.)

The question now is do we have our theoretical machinery ready to make use of such surveys. In other words is it possible to take a theoretical model of the galaxy and then generate a synthetic catalogue of stars and compare it with observations in an efficient way. This is what Professor Joss Bland-Hawthorn asked me when I joined University of Sydney. Sadly the answer was no. There was no way to generate a huge catalogue of stars over a wide area of the sky and continuously distributed in space. The closest approximation to an all-sky model are the supercomputer N-body simulations that purport to show how the galaxy formed, but these have very low resolution. A typical simulation particle is equivalent to 100,000 or 1,000,000 stars. So we began working on a code named Galaxia, which would act like a framework to compare theory with observations. This would have to generate huge, billion-star surveys efficiently and should be able to sample both analytic and N-body models. Galaxia as it stands now can generate a synthetic catalogue of stars in accordance with a given model of the galaxy for a billion star surveys in a matter of few hours on a single CPU.

For smaller surveys the time required is proportionately less. Currently we have been using it to understand the formation of the stellar halo, which surrounds the disc of the Milky Way. Although the stellar halo contains only about one percent of the total stars in the Milky Way it holds crucial information about its formation. Under the currently popular Lambda cold dark matter paradigm of structure formation the stellar halo that surrounds the disc of the Milky Way is thought to have been formed in part by accretion of satellite galaxies.

These satellite galaxies while orbiting the potential of the Milky Way get tidally disrupted leaving behind signatures in the form of structures like streams and clouds. Identifying and comparing these structures in simulations and catalogues of observed stars, and comparing them, we can check if our current theory of the formation of the stellar halo is correct or not. Moreover we can also put constraints on the accretion history of our galaxy.

In my opinion, we astronomers have just got our first tool to assemble the puzzle of the Milky Way. There is still a long way to go before we can unravel the full story, but who knows, with this new data we might solve one mystery but then discover a new and even deeper one.

For more information the Sydney Institute of Astronomy (SIfA) at the School of Physics visit: www.physics.usyd.edu.au/sifa/

