1157th General Monthly Meeting

New Earths, Dark Energy and Giant Telescopes

Professor Matthew Colless
Director of the Anglo-Australian Observatory

Date: Wednesday, 7th November, 2007
Time: 6:30 for 7:00 pm
Venue: Conference Room 1, Darlington Centre, City Road (City Road, side entrance to the Forum Restaurant)

ABSTRACT

Professor Colless will give a broad review of some of the most exciting research being carried out in Australian astronomy today, including the discovery of planets around other stars and probes into the fundamental physics of dark matter and dark energy. He will also consider future directions in research, such as powerful new international facilities involving Australian astronomers including the Square Kilometre Array, the Giant Magellan Telescope and telescopes in Antarctica.

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BIOGRAPHICAL NOTES

Matthew Colless is Director of the Anglo-Australian Observatory, operating the largest optical telescope in Australia at Siding Springs Observatory. He is a Sydney University graduate with a PhD from Cambridge and has held positions in the UK and USA before joining the Australian National University in 1993. From 1997 to 2001 he worked on the largest project ever carried out with the Anglo-Australian Telescope, the 2dF Galaxy Redshift Survey international collaboration, involving more than 30 scientists from 11 institutions, which has been described as "undoubtedly Australia's largest contribution to astronomical research ever".

DARK ENERGY, NEW EARTHS, GRAVITY WAVES AND GIANT TELESCOPES:
THE FUTURE OF AUSTRALIAN ASTRONOMY

Report on the General Monthly Meeting
by Jim Franklin

It is one of the great scandals of our time that we have no idea what most of the universe is made of. Professor Matthew Colless gave an entertaining and very wideranging overview of what

astronomers know about the composition of the cosmos, how they know it, and what new instruments will tell us. Work in the last decade has shown that less than 5% of the universe is ordinary matter (planets, stars, gas clouds, neutrinos, etc). 17% is dark matter, detected gravitationally but of unknown nature (probably some kind of exotic sub-atomic particles). And fully 77% of the universe is "dark energy" which has completely unknown form.

The key parameter for the universe is its energy density. This number determines the geometry of space-time and whether the universe will eventually collapse (high energy density), or whether it will expand forever (low energy density). Professor Colless explained in a very lucid fashion how this parameter has been measured using: "standard candles" given by supernova, the "standard ruler" of baryonic acoustic oscillations in the cosmic microwave background radiation, the "standard scale" from gravitational lensing of distant galaxies and the growth rate of cluster density perturbations. Remarkably, all these independent lines of enquiry have shown that universe's energy density is very close to the critical value for a flat expanding universe.

Professor Colless then surveyed progress in discovering planets around other stars. Over 250 exoplanets are now known. The Anglo-Australian Telescope has some of the world's best instrumentation and has discovered 25 exoplanets (10% of the total). Improved equipment means that the rate of discovery is increasing - last year the AAT discovered 6 more exoplanets in only 32 nights of observing. Almost all known exoplanets are "hot Jupiter" gas giants. AAT is now leading the hunt for rocky planets, similar in size to the Earth.

Current astronomy is essentially limited to observations of electromagnetic radiation. Prof Colless described work being done at the Parkes radio telescope to observe gravitational radiation by measuring timing anomalies in pulsars. This could open an entire new window on the universe.

Great discoveries require great telescopes. Prof Colless described the new instruments that he hopes will form the backbone of future Australian astronomy. The Square Kilometre Array will be the world's largest radio telescope. Site selection for this $2.5 billion international project has been narrowed to a choice between Western Australia or Southern Africa. Australia is also participating in the Giant Magellan Telescope, a 21.5 m effective aperture optical instrument to be built by an international consortium in Chile. (Australia has great astronomers but no great optical sites.) However, Australia does have the Australian Antarctic Territory which is probably the best observing site on the planet. Prof Colless described the PILOT project, a 2.4 m telescope at Dome C in Antarctic that would have a similar performance to the Hubble Space Telescope at a tiny fraction of its cost.

The future for Australian astronomy is bright.