Report of August 2011 Meeting
Royal Society
Southern Highlands Branch

Speaker: **Dr Michael Burton**
School of Physics, University of New South Wales

Topic: **Heading towards the world's largest telescope - the Square Kilometre Array**

What do the kinetic energy of a falling snow-flake and radio telescopes have in common? Well, as Professor Michael Burton pointed out in his talk on the Square Kilometre Array (SKA), the energy of a falling snowflake is about 30 micro joules and this is greater than all of the radio energy ever collected by all the radio telescopes in the world! These instruments are very sensitive! Radio astronomy looks at a part of the electromagnetic spectrum at wavelengths from 1 m to 1 km. Observations in the visible spectrum are badly affected by dust but this is not the case in the radio spectrum. Thus by combining information from optical, infrared and radio telescopes we can get a much more complete picture of what's going on in the universe. But because of the long wavelengths of radio waves, these instruments have to be very big. For example, the Parkes telescope with its 64 m diameter dish has an area of about 1000 m^2. This telescope can resolve galaxies but in order to increase the resolution to look inside galaxies, much larger instruments are needed.

The largest radio telescope in the world at the moment is the Very Large Array (VLA) in New Mexico. This instrument has 27 dishes each of 25 m diameter, with a total area of 10,000 m^2. These antennas are configured in a Y-shape that can deliver an effective maximum baseline of 32 km. Data from each array is integrated using interferometry techniques effectively giving a telescope of this aperture. This substantially increases the effective resolution of the instrument. The VLA is capable of looking at radio sources such as pulsars, quasars and give insights into the formation of galaxies. If we are to be able to look further back through the history of the universe to the dust from which galaxies form, we need instrument orders of magnitude bigger than the VLA and that's where the SKA comes in.

The SKA will be the largest telescope ever built with a collection area of 1,000,000 m^2 and a baseline of at least 2,000 km. The SKA will be able to peer far back into the history of the universe to observe the first black holes and stars, to search for Earth-like planets, to test aspects of general relativity, and to explore the origins of cosmic magnetism.

The total cost of this project will be about $3 billion and the telescope is expected to be in full operation by 2025. Because of the cost of the project, up to 20 countries will be involved in the investment. About $450 million has been invested so far with prototype technologies being constructed in potential locations for the final instrument in southern

Africa and Western Australia. The core instrument (where most of the dishes are located) needs to be sited in a “radio quiet” location. It needs to be flat, open, geologically stable and well away from man-made sources of radio waves. Final site selection is expected to be complete next year. The telescope will come on-line over a period of about 10 years, with the low and mid-frequency capabilities completed by 2023 and the whole instrument by 2025.

Australia is well placed to be selected as the final site, given our leadership in radio astronomy and the “radio quietness” of outback Australia. If Australia is chosen, the core instrument will be located at the Murchison Radio Observatory about 500 km north-east of Geraldton and will have dishes extending from Western Australia to New Zealand, giving a total baseline of 5,500 km.

Donald Hector
(As recorded in Royal Society of NSW bulletin 345)