Astronomy from Antarctica, July 2011

A report on an ASV talk by **Professor Jeremy Mould**, Swinburne University Of Technology

A vital goal of astronomy is to understand the evolution of galaxies. Unless we can explain the creation and function of galaxies, our cosmology is not much better than the clockwork visions of antiquity. Right from the start in the early 1900s, when those bothersome nebulae revealed their true nature, the various shapes of the galaxies puzzled the astronomical community. Hubble's tuning fork model was the first attempt to explain galactic evolution. Theories to their formation and evolution came and went, and even today we find ourselves with the chicken and egg conundrum: what begets what? What was here first, the stars, the black holes or the galaxy nebulas?

If we could only look back to what is called 'the end of the Dark Age' of the Big-Bang Universe, we might be able to tell. But to have even a chance do so needs telescopes situated in perfect seeing conditions, capable to detect light to microwave level, right down to their diffraction limit.

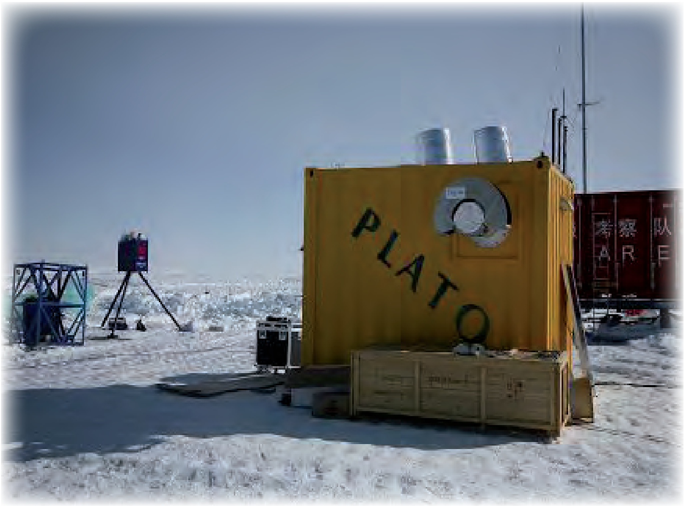
Astronomical observatories are normally placed on mountain tops, away from population centres, to rise above tropospheric disturbances and the man-made electromagnetic noise. But mountains create their own air turbulence and are exposed to huge temperature variations. Space observatories are extremely expensive, not easily accessible and normally have a limited life-time. What is the alternative? How about Antarctica? Low background noise, wide field of view, constant (cold) temperature and, with almost zero moisture content in the atmosphere, capable of resolution to diffraction limits.

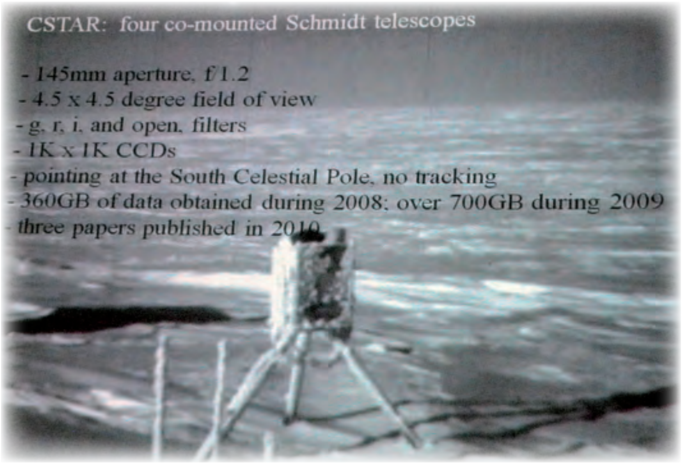
Jeremy Mould showed a series of slides from a current international collaboration between America, Australia and China (in alphabetical order) of a feasability study project in Antarctica called PLATO (**Pla**teau **O**bservatory, with instruments contributed from Australia, China, New Zealand, the United Kingdom, and the United States of America). PLATO is a fully-robotic observatory designed for operation in Antarctica. It generates its own electricity (about 1kW), heat (sufficient to keep two 10-foot shipping containers comfortably above 0C when the outside temperature is at -70C), and connects to the internet using the Iridium satellite system (providing 30MB/day of data transfer). At the elevation of "Dome A" it is feasible to greatly simplify or even eliminate the adaptive optics normally needed to remove the effects of air turbulence. Dome A (short for Dome Argus) is probably the only place on Earth that can routinely observe at the

terahertz frequencies crucial to the understanding of the interstellar medium, and the life cycle of stars. Project instrumentation is primarily designed to take measurements that will allow an informed decision on the placement of future telescopes.

PreHEAT (**H**igh **E**levation **A**ntarctic **T**erahertz) and FTS measure the sky opacity in the sub-mm spectral region, SNODAR (**S**urface layer **NO**n-**D**oppler **A**coustic **R**adar) helps us understand the Earth's atmospheric turbulence between 8 and 200 metres above the ice, and HRCAM and the PLATO webcameras will give statistics on cloud cover.

In addition, CSTAR, an array of four 14.5 centimetre Schmidt telescopes, each having a different filter in the optical band), Nigel, and Gattini will provide valuable information on the photometric conditions at Dome A and the sky brightness in a number of wavelength bands. DASLE is an array of sonic anemometers placed along a fifteen metre tower measuring wind velocity and direction).

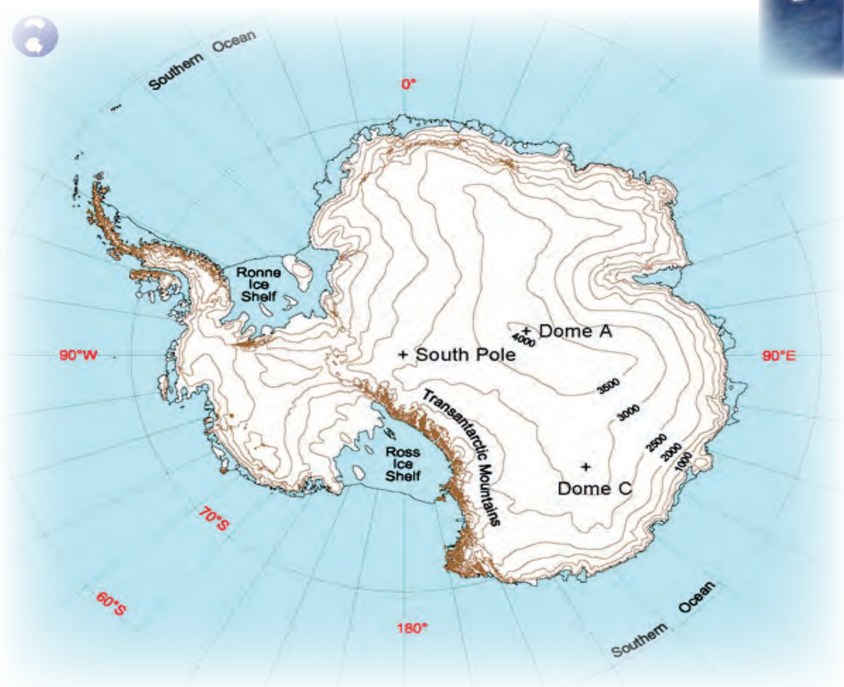


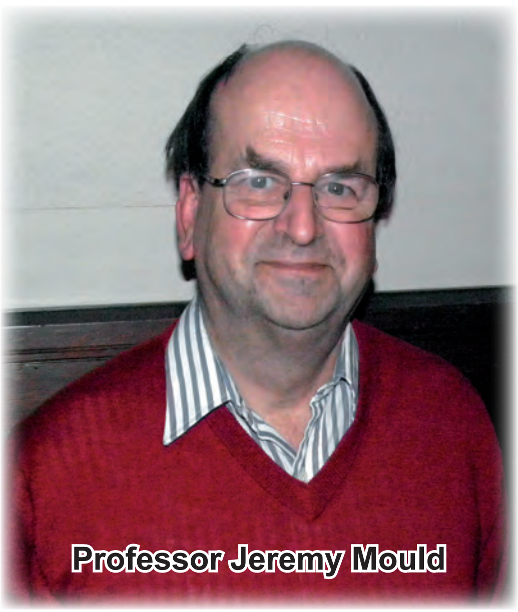


The PLATO observatory is designed for yearly servicing by the traverse (see traverse) at the end of each year. This includes replacing its four diesel engines and refilling the fuel and oil tanks. It was first serviced in 2008 and continues to run, uninterrupted since January 2009. Bulk data stored in cold-verified flash memory are also retrieved traverses each summer.

The PLATO control system monitors up to 140 analog channels, multiple video sources, and distributes electrical power and heating to 96 current-monitored channels via a priority-based allocation algorithm.

Much of Jeremy’s talk concerned the mind-boggling logistics of getting things on site, where the well equipped Chinese contingent played a big part.




Professor Jeremy Mould