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Campbelltown Rotary Observatory

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Abstract: Donations (in cash and kind) amounting to $200,000 from companies in the south-western Sydney region have allowed the construction of a teaching, research and public access Observatory at the University of Western Sydney in Campbelltown. The Observatory will also serve as the home of the Australian Optical SETI Project (OZ OSETI for short). Two fibre-glass domes will be installed at the site. The main 4.5 m fibre-glass dome will house a 0.4 m telescope while the smaller 2.9 m dome will house a 0.3 m telescope. Both telescopes are fork-mounted Schmidt-Cassegrains working at f/10. An outside observation area will be used for tripod-mounted telescopes for public use and teaching purposes. The expected completion date for the project is July 2000.

Keywords: astronomy teaching—SETI: optical search—public access

1 Introduction

The University of Western Sydney in Campbelltown is a new university located in one of Sydney's fastest growing population areas. Like every other university in Australia it needs to attract more science students in an environment that is getting more competitive every year. The competition for science students is further aggravated by the fact that students are turning away from science. Astronomy coupled with a 'Life in the Universe' teaching program provides an excellent way of attracting students back to science and also for boosting full-time as opposed to part-time students in physics departments.

For these reasons it was decided to build an observatory in the grounds of the University of Western Sydney, Macarthur. The observatory is located on one of the highest hills in the 200 hectare property of the university which is about 60 km from central Sydney. Measurements taken of light pollution levels indicate that the site is relatively dark compared with Sydney.

The major sources of funds (cash and kind) for building the Observatory came from the private sector, philanthropists, the Campbelltown City Council and the Rotary Club of Campbelltown. Other sources of funds came from the NSW Government and the University of Western Sydney in Campbelltown.

2 The Observatory

The observatory was constructed to the specifications drawn by the author in consultation with Colin Blumson. It consists of two fibre-glass domes which sit directly on reinforced concrete floor slabs. The domes were designed and manufactured by Colin Blumson Domes of Yandina in Queensland. The larger dome is 4.5 m in diameter and 3.3 m in height. It has an open width of 1.2 m—see Figure 1. The cover is slid across the top of the dome by electrical means. The dome sits on a metal ring with wheels and is rotated by hand. The smaller dome is 2.9 m in diameter and 2.9 m in height. It has an open width of 0.9 m and is rotated by hand. When funds are available it is hoped to rotate the domes electrically and from the computer.

The metal piers for the telescopes will be screwed down to cylindrical concrete columns that are 0.75 m in diameter and go down a depth of 3.5 m into the ground. The columns and the piers are vibration isolated from the floor slab. An adjacent rectangular concrete floor slab (7 m by 4.7 m) will be used as an observation area. It will allow tripod-mounted teaching telescopes to be set up. This observation area will be used for a Dobsonian and a couple of 0.2 m refracting telescopes. The main features of the observatory are given in Table 1.

With the latest advances in technology it is now possible to purchase state-of-the-art computerised telescopes that a decade or two ago would not have been affordable by small university departments. For about $50,000 the observatory has purchased Meade 0.4 m and 0.3 m LX200 Schmidt–Cassegrain telescopes and associated equipment. The telescopes will be mounted in alt–azimuth mode because of their ease of use in this

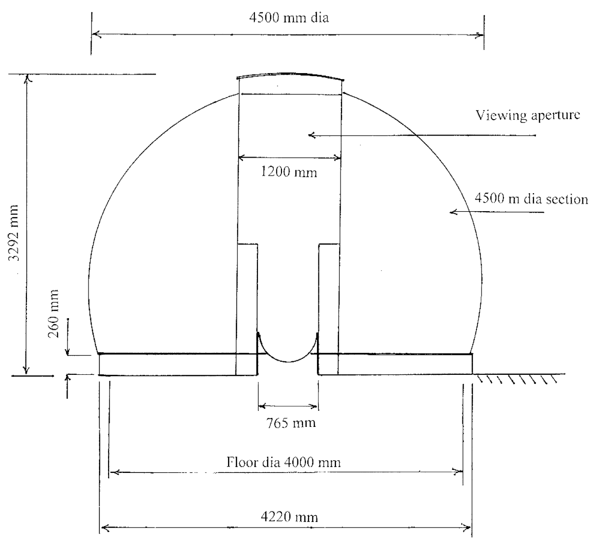

Figure 1—Dimensions of the 4.5 m dome.

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Table 1. Main features of the Campbelltown Rotary Observatory

Optics: 0.4 m Schmidt–Cassegrain f/10 0.3 m Schmidt–Cassegrain f/10
Mounts: Alt–azimuth
Buildings: Concrete slab construction Concrete columns 0.75 m diameter depth 3.5 m Metal piers
Domes: Fibre-glass hemispherical domes 4.5 m diameter 3.3 m height 2.9 m diameter 2.9 m height
Site: UWS Campbelltown NSW Latitude: –34° 04′ 20″ Longitude: 150° 46′ 50″ Altitude: 113.5 m

mode of operation. The alt–azimuth mounting also takes up much less space in the dome, thus enabling more students and members of the public to be admitted into the room during a teaching session. The 0.4 m telescope is fully computerised and has a pointing accuracy of less than one arcminute. This high accuracy of the telescope provides a tremendous advantage in a semi-rural observatory setting because it will allow relatively faint objects (e.g. Messier and NGC) to be picked up quite easily. The software package that will be used on the telescope will enable nineteen million objects to be searched and targeted. It will allow a zoom-in on telescopic fields of less than one arcsecond. The software also includes the complete Hubble Guide Star Catalogue.

3 Education and Research Programs

The observatory programs will be used both for education and special research projects that are suitable for small telescopes.

3.1 Education Programs

The education programs will serve three audiences: (a) university students, (b) schools and teachers in the region and (c) the general public. At the university level the observatory will be used to complement the very popular ‘Astronomy and Life in the Universe’ course. This is the first SETI (search for extraterrestrial intelligence) based examinable course offered at the undergraduate level in any university in Australia. The course was designed by the author to boost student numbers and hence increase full-time students in the physics department at a time of shrinking budgets. The popularity of the course has meant an additional 100–150 students being taught by the department. This has increased the viability of the department. The course outline is given in Table 2. It consists of two one-hour lectures and one two-hour tutorial/lab exercise per week. The course runs over a 13 week period.

Table 2. Outline for ‘Astronomy and Life in the Universe’ course

The Drake equation
Origin of the Universe
Galaxies
Stellar evolution
Sun-like stars
Formation of planetary systems
Detection of extrasolar systems
Origin of life and rise of intelligence
Interstellar molecules
Comets and meteorites
Life on Mars
Search strategies
Hydrogen radio and the water hole
Optical SETI and intelligent probes
Designing and sending messages
Receiving and decoding messages
Protocols: what if the message comes?
Social implications of a message from ETI

The course begins with the Drake equation (Drake & Sobel 1992) and explores the cosmological, biological and technological terms in the equation. The Drake equation states that the number of technologically advanced civilisations in the galaxy N is equal to the product of the rate at which solar-type stars form in the galaxy R, the fraction of the stars that have planets f_p, the number of planets per star system suitable for life n_e, the fraction of those habitable planets on which life actually arises f_l, the fraction of those life forms that evolve into intelligent species f_i, the fraction of those species that develop adequate technology and then choose to send messages out into space f_c, and the lifetime of that technologically advanced civilisation L; in short

$$N = R \times f_p \times n_e \times f_l \times f_i \times f_c \times L \,.$$

This equation is illustrated by a series of lectures which discuss the astrophysics of sun-like stars, the origin of life and the possibility of finding life on other planets, the implications of finding life molecules in comets and meteorites, search strategies both radio and optical, intelligent probes and the problems associated with designing and sending messages to ETI and decoding messages from ETI. The course closes with a couple of lectures on the social implications (Harrison 1997) of a message from ETI.

The course is also given to the top 10% of HSC students doing the Pathways program at the university. The Pathways program conducted at the University of Western Sydney in Campbelltown was highly commended by the recent McGaw Report (NSW Government 1997) on the reforms for the Higher School Certificate. Students who pass the course are given a credit towards their first year program if they enrol at the University of Western Sydney in Campbelltown.

A highly modified and simpler course bearing the same name is also conducted for the general public through the university’s Continuing Education Program.

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It will be available to the public on-line towards the middle of the year 2000.

Plans are now underway to use the observatory for complementing the primary and secondary school science syllabus. The new science syllabus has pockets of astronomy sprinkled across the syllabus from primary school to Year 10. It is hoped to develop a coherent hands-on course for teachers so that they can teach the astronomy sections of the syllabus with confidence. It is also planned to run in service training courses for the HSC Astronomy Option (Bhathal 1993).

3.2 Research

The observatory will be used for two major research programs, namely optical SETI and variable stars. Ever since Cocconi & Morrison (1959) first published their paper on 'Searching for interstellar communications', the search for extraterrestrial intelligence has been carried out by radio telescopes. After almost forty years nothing has been found and Fermi's question 'Where are they?' still remains unanswered. Two years after Coconni & Morrison's paper appeared in *Nature*, a now almost forgotten paper written by Schwartz & Townes (1961) suggested that the search should not just be confined to the microwave region of the electromagnetic spectrum, but should be extended to the infrared and optical regions. Another firm advocate of extending the search into the optical spectrum has been Arthur Clarke (2000), the well known science fiction writer whose science fiction has in some cases become science fact. Apart from a few sporadic experiments not much research has been done in the optical region (Kingsley 1993). The Australian Optical SETI (or OZ OSETI for short) Project will have its home at the observatory and will search for nanosecond laser pulses around 550 nm. A detector using very fast PMTs and fast amplifier/discriminators and counters will be used to carry out the search on about a hundred G-type stars between 10 and 1000 light-years from Earth. The search will also examine some southern globular clusters and a few galaxies. Phase 1 of the search program will concentrate on circumpolar stars. Preliminary experiments to test strategy and equipment are being carried out with a 0.3 m telescope at present. The specialised detector will be transferred to the 0.4 m telescope when the observatory is completed. It is also hoped to obtain time on national facilities to carry out the search with larger telescopes (e.g. the 1.85 m telescope at Mount Stromlo Observatory). The 0.4 m and 0.3 m telescopes (separated by about 20 m) will be used simultaneously for the search. This will ensure that a spurious signal can be discounted readily.

The observatory will also be used to study southern variable stars with custom built photometers (Hall & Genet 1988). The observatory has joined the American Association of Variable Star Observers (AAVSO) and will contribute to the work of the organisation through student projects and observations made by members of the local amateur astronomical society.

As part of the ongoing program on the history of astronomy in Australia it is proposed to remeasure the double stars in H. C. Russell's program (Bhathal 1991). These stars were originally measured in the 1840s by John Herschel in South Africa. Qualitative and quantitative studies will also be carried out on the variable stars studied by John Tebbutt in the nineteenth century.

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