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Cover picture: *The late Darragh O'Donoghue, who passed away on 25 June 2015 (See Obituary inside).*

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News Note: Prof. Michael Feast Honoured

The Minister of Science and Technology (DST), Mrs. Naledi Pandor acknowledged the 2015 National Research Foundation (NRF) Awards recipients at a ceremony held at the Coastlands Umhlanga Hotel and Convention Centre in Durban on Thursday, 27 August 2015.

The award recipients, who are top researchers in South Africa, were celebrated for their continued pioneering work in advancing knowledge creation and innovation. The Awards recognised the significance and impact of their recent research outputs as judged by their peers through the NRF rating system.

Speaking at the function Minister Pandor noted that “South Africa’s progress towards a knowledge intensive economy rests on our ability, as a country, to develop a diverse – both in terms of race and gender- cohort of young researchers with high-end skills”.

“We congratulate today’s awardees, especially Professor Michael Feast for receiving the lifetime achievement award. We are confident that today’s awards will motivate you to do even more to grow the outputs of our national system of innovation and to train more researchers. Your continued contribution to our National System of Innovation will play a significant role in ensuring that the vision of South Africa set out in the National Development Plan is indeed achieved,” concluded Minister Pandor

Left: Prof Michael Feast

Prof Feast's award was based on a lifetime of extraordinary contributions, of international standard and impact, to the development of science in and for South Africa over an extended period of time, and for the manner in which his work has touched and shaped the lives and views of many South Africans.

Professor Feast is quite possibly the only academic to have published papers in Nature 66 years apart: the first in 1948, when he was just 21, and most recently last year when he was 87. "Feast is a truly stellar academic," says Professor Danie Visser, deputy vice-chancellor for research and internationalisation, who nominated him for the award. "He is listed in the international Who's Who, he has had a minor planet named after him (Asteroid no. 10985 Feast, discovered from Mt Palomar in October 1977) and has represented South African astronomy at the highest international level. Yet he remains one of the most unassuming and universally liked of researchers."

In addition, at the Awards Ceremony, a number of scientists were awarded an 'A' rating. These are aimed at researchers who are unequivocally acknowledged by their peers as leading international scholars in their respective fields for the high quality and impact of recent research outputs. Acquiring an NRF rating generates considerable acknowledgement and respect for the individual researchers as well as their institutions. Amongst the awardees were the following members of the South African Astronomical community:

Professor George Ellis, Department of Mathematics and Applied Mathematics, UCT.

Professor Andrew Taylor, Department of Astronomy, UCT and UWC

Professor Brian Warner, Department of Astronomy, UCT.

Professor Patricia Whitelock, Astronomer, SAAO.

News Note: The SALT Science Conference 2015

Press release by Dr Nicola Loaring, SAAO Outreach Astronomer

The Southern African Large Telescope (SALT) Foundation and South African Astronomical Observatory (SAAO) are delighted with the success of the SALT Science Conference 2015 held in Stellenbosch from the 1st to the 5th June. The programme was jam-packed with talks, poster presentations, practical workshops and discussions showcasing SALT's capabilities. Over ninety astronomers and education professionals attended the conference representing over twenty nationalities. Delegates from astronomical institutes in seven countries attended the conference to foster scientific collaborations and enhance partnerships with the South African astronomical community. Education and outreach professionals also contributed to the conference programme in recognition of the pivotal role that SALT has played in the advancement of astronomy and science education and in skills development within South Africa.
Construction of the SALT telescope, just outside Sutherland in the Karoo, was completed in 2005. Following initial testing and performance verification the telescope started full science operations in late 2011. The event was formally opened by the Minister of Science and Technology, Naledi Pandor. She envisages South Africa as a centre for research excellence in astronomy:

"Our aim is to position Africa as a global centre of research excellence for multi-wavelength astronomy, with optical, radio and gamma-ray telescopes working together to achieve common scientific goals".

(above)*The Conference photograph*.

She was keen to emphasize the importance of South Africa's experience in developing SALT in paving the way for South Africa's successful bid to host what will be the largest telescope ever built, the Square Kilometre Array (SKA) radio telescope, due for completion in 2024:

"South Africa pursued the SKA project by using the lessons learnt from SALT as the basis for our planning and partnerships. The links we developed through the SALT project allowed us to build on existing networks and partnerships to secure the iconic SKA, an extremely important strategic initiative that puts science and technology to work for the benefit of all Africans".

As well as acknowledging the key role that SALT has played for science and technology development in South Africa, educators at the conference also stressed how the wonder and beauty of astronomy can be used to inspire

and encourage young learners to take up science and mathematics (STEM) subjects at school. Since its inception, the SALT project has placed a strong focus on education and public awareness programmes and Sivuyile Manxoyi, head of the SALT collateral benefits programme, summarised the work of the outreach department at the SAAO during his conference presentation:

"We have been very successful in training and supporting teachers and curriculum advisors in the teaching of Natural Science and particularly the theme 'Earth and Beyond'. Through programmes such as the national astronomy quiz we have succeeded in using astronomy to inspire curiosity and critical thinking among learners. Through our exciting job shadowing programme, we are spreading career information pertaining to astronomy and related science".

For the remainder of the conference the focus shifted to the practicalities of optimizing the use of the telescope and showcasing the recent exciting and varied science conducted using SALT observations. Dr Steve Crawford, SALT Science Data Manager pointed out:

"Since the start of science operations, SALT has been producing exciting science at a comparable rate as similar telescopes at the same stage in their operations, but at a fraction of the cost. This is a huge compliment to the SALT staff and the astronomers working with the observatory".
SALT operations staff also held several training workshops during the conference to help potential SALT users apply for telescope time and to help them analyse SALT data products using software tools developed by the SALT team.

In terms of science, the areas covered ranged from planetary science, through stellar astrophysics to studies of galaxies and the distant universe. A large portion of the conference focused on the variable universe, a niche area for SALT's unique capabilities. SALT's imaging instrumentation is

tailored towards achieving high time resolution observations of varying objects and transient (short-lived) objects.
Dr Petri Vaisanen, Head of SALT Astronomy Operations commented:

"Listening to the talks at the conference from an operational point of view, it was extremely gratifying to see so many scientists, from students to professors, getting results from SALT. People are finding out exciting things about the Universe from analysis of the data we have been dishing out to them under the Sutherland night skies for years, it makes the work worthwhile".

Dr David Buckley, chair of the conference scientific organising committee and SALT Scientist added:

"SALT has really come of age. This is demonstrated by the breadth and quality of the science results presented. Over the past couple of years there has been a steady improvement in the efficiency and productivity and SALT's community of users have learned how to best exploit it to their advantage. This has resulted in a ramping up of science publications showing that SALT is beginning to make a significant contribution in forefront astronomy, partly due to some of the competitive advantages that it has".

The conference finished with considerations and prospects for future SALT science. Dr Marsha Wolf from the University of Wisconsin, US, detailed the proposed extension of SALT 's capabilities into the near-Infrared region of the electromagnetic spectrum. If implemented this would allow astronomers to observe even more distant objects than is presently possible with SALT. This is because the light from distant galaxies is "redshifted" into the near-Infrared as a consequence of the expansion of the Universe. Extending into the near-Infrared will also allow observations of objects that are enshrouded in gas and dust which are not possible using visible light alone.

Prof. Bruce Bassett, joint Professor at SAAO, UCT and AIMS in Cape Town introduced methods that he has developed employing computer algorithms to automate the classification of transient objects. The volume of data that astronomers will need to analyse will increase significantly once the SKA comes online and automating data analysis wherever possible will be crucial in order to fully exploit SALT and SKA in the future.

One of the key take home messages from the conference was the importance of using SALT together with other ground based and space based observatories such as the SKA radio telescope and the European Space Agency's Euclid satellite mission. Dr David Buckley, commented:

"The meeting was well attended by SALT users, both within South Africa and abroad. Importantly many graduate students whose early careers are taking full advantage of SALT attended. The future for SALT looks assured, particularly with planned new developments and synergies with emerging facilities in South Africa and globally".

The prospects for SALT and astronomy in general within South Africa are brighter than they have ever been. Exciting times lie ahead, however, to fully understand the wonders of our Universe. It is now clear that astronomers will have to adopt a multi-wavelength approach and peer at the skies with a combination of telescopes!

Darragh O'Donoghue 1957 – 2015

Patricia Whitelock and Lisa Crause

Darragh O'Donoghue was a truly remarkable man and an extremely talented scientist. He contributed enormously to astronomy, South Africa and, most profoundly, to the lives of his many colleagues and friends around the world.

In 1977 he came to Cape Town, from Durban where he had studied physics as an undergraduate, to do a PhD at UCT. His close friend and colleague, Mark Cropper, who was a student there at the same time, fondly remembers his arrival in a VW Beetle, with a guitar. He was quite the hippy at that stage and probably slept in that car until he got himself settled.

He joined the SAAO in 1997, after more than a decade as a postdoc at UCT. Scientifically, he made seminal contributions to studies of white dwarfs, cataclysmic variables, hot stars and pulsating variables. He was a leader of the Edinburgh-Cape Blue Object Survey and as such was one of the co-discoverers of an entirely new class of pulsating subdwarf B stars. These he went on to investigate and characterise in detail, with over 30 papers co-authored on the subject between 1995 and 2015. The referee's report for the group's latest EC Survey paper was, in fact, received the day after he died.

High speed photometry has been a critical tool for investigating a range of variable stars. Darragh designed one of the first high-speed photometers ever used and many years later he ensured that this type of work would be one of the unique capabilities of the Southern African Large Telescope (SALT). As a result, both of the telescope's first-light instruments – SALTICAM and the Robert Stobie Spectrograph (RSS) – possess high-speed capability.

Darragh was also a founding member of the Whole Earth Telescope (WET), a collaboration of over 50 international astronomers who did pioneering work on asteroseismology. He was a co-director of WET for some while and was influential in their choice of instrumentation.

His contributions to SALT have been immense, starting with a complete redesign of the secondary optics used on the Hobby-Eberly Telescope (HET), SALT's older twin. This optical assembly, known as the spherical aberration corrector (SAC), was to yield sharper images and a larger field of view for SALT. It is a wonderful tribute to Darragh's optical design capability that the HET's long-awaited Wide Field Upgrade centres on replacing the original HET SAC with a scaled up version of Darragh's SALT corrector. It seems a bitter-sweet coincidence that, after extensive delays in that project, the Wide Field Corrector is currently due to be installed on the day of his funeral.

Darragh also designed SALT's first-light acquisition/imaging camera; SALTICAM. As the head of the SAAO Instrumentation group at the time, he then oversaw the instrument's construction in the SAAO workshops.

Following Bob Stobie's death in 2002, Darragh took over as one of the two South African representatives on the SALT Board and rapidly gained the respect and deference of the other Board members. He was determined that SALT would be the very best telescope it could possibly be and worked tirelessly at all levels to that end.

When it became clear that SALT was not functioning properly, Darragh took up the challenge and meticulously tested all aspects of the system and later established that the issue lay with the mechanical design of the SAC/payload interface. He then led the campaign that included the repair, re-alignment and comprehensive optical testing of the SAC, and afterwards delighted in the telescope finally producing the sharp images that his design allowed.

Whatever Darragh chose to do, he did it with 100% of his effort; there were never any half measures. This applied to science, technology and all of his many other pursuits. This was vividly demonstrated when he took on the task of defending a former director of SAAO against unwarranted charges. He applied his characteristic dedication to understanding the National Research Foundation conditions of service and the King III report on Corporate Governance. This he did to great effect and ultimately achieved an excellent outcome, not just for that specific case – but for the sake of academic freedom in South Africa.

Following the successful conclusion of the SAC repair work, and his extraordinary foray into the legal world, Darragh received the Gill Medal from the Astronomical Society of Southern Africa for exceptional services to South African astronomy in 2011.

During the sabbatical year granted by the SALT Board in appreciation for his Image Quality effort, Darragh spent time working with Chris Clemens at the University of North Carolina in 2012. Work done during that time led to them designing and patenting a compact, revolutionary type of spectrograph based on the critical enabling technology of curved volume phase holographic gratings. A spectrograph incorporating such a grating was to be tested on the 1.9m at Sutherland during the coming year. If this new instrument works as anticipated, it will revolutionise spectroscopy, not just in the field of astronomy. We anticipate that curved grating spectrographs will be one of Darragh's many great legacies.

We have lost a treasured friend and a delightful colleague who was kind, thoughtful, tenacious, playful and incredibly smart; the world is a vastly emptier place without him. He is survived by his wife Liz and two daughters, Andrea and Alex, who were his pride and joy and who were with him at the end.

The Moonwatch programme – Part 8

Greg Roberts

Abstract: This part deals with the satellite tracking done in Cape Town and covers the Kinetheodolite setup at the then Royal Observatory and manned by part time amateur observers. It also covers the activities of Roberts at his Kenilworth tracking site. The activities of Bill Hirst and his station at Bergvliet are described.

Cape Kine-Theodolite

The Askania-Werke Cinetheodolite/Kinotheodolit model Kth 58 appears to have been constructed around 1937 and was almost certainly used for tracking of missiles launched from the Peenemunde Rocket Range where the V1 and V2 rockets were developed during World War II. At the conclusion of the war several of these were moved to the United Kingdom and used on missile test ranges at Aberporth in Wales, Larkhill on Salisbury Plain and West Freugh in Scotland. It was soon realised that, if they could track missiles they would also be useful for the tracking of artificial satellites. Five units were acquired on imitative of P. Nuttall-Smith of the Royal Aircraft Establishment and converted for use in satellite tracking. They were ready for use in late October 1957.

In 1960 the Royal Aircraft Establishment ended its operational tracking of satellites but agreed to make three “Kines” available on extended loan. One was supplied to the Met Office in Malta where it was used 1960 to 1968, a second to the Royal Observatory Edinburgh, Scotland where it was used 1961 to 1969 and the final one (no 40/872) to the Royal Observatory, Herstmonceux Castle, Sussex where it was in regular use during the period 1964 to 1966.

Fig 1. *The Cape Kinetheodolite (photo: G. Roberts).*

The Herstmonceux kine was dismantled in Jan 1967, reconditioned and moved to the Royal Observatory at the Cape, South Africa in August 1967 along with Walter Grimwood who remained in charge of the instrument until he retired in 1980. Walter started his astronomical career in the early 1930s and was initially employed by H.M Nautical Almanac Office. Along with George A Harding he was appointed as a "Junior Assistant" in 1937/1938.

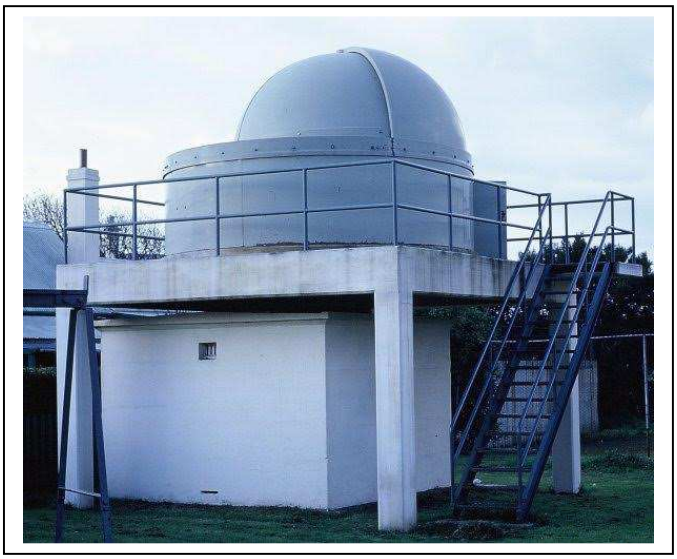

Fig 2. *The Cape Kine dome (photo: G. Roberts).*

The Kine was installed on a pillar on top of the concrete roof of an old seismograph hut, and the same fibreglass cupola used in England was placed over it on a separately constructed platform. The seismograph hut was very strongly constructed and was built on a sound 10 ft x 10 ft concrete raft, dating from 1919-1920.

The Kine weighed 90 kg and had overall dimensions of 900 x 600 x 700 mm (without tube). It was equipped with a 600mm focal length f/4.5 telephoto lens, the field of view was 3.5 by 2.8 degrees. Photographic images were recorded on 35 mm film stored in a cassette capable of holding 50 metres of film, but only 33 metre film lengths were used at the Cape.

On either side of the central camera two smaller refractors with magnification 8x and field of view 7.5 degrees were mounted. One telescope was used for keeping the Kine on target in the horizontal plane (azimuth) and the other was used to track in the vertical plane (elevation), so it required two observers. Each observer had to try to keep the satellite centred on their telescopes' cross wires. When photographs were taken at usually 10 second intervals, they had to report whether "on" or "off" - meaning satellite on the cross wires or not. This was necessary as in many instances the satellite was too faint to be recorded photographically. At the same time the azimuth and elevation bearings were photographically recorded as well as the time of observation to 0.1 seconds. A tape recorder was running so everything audible was recorded - sometimes amusing for the ladies to listen to the next day when reducing the observations - especially when things went wrong!

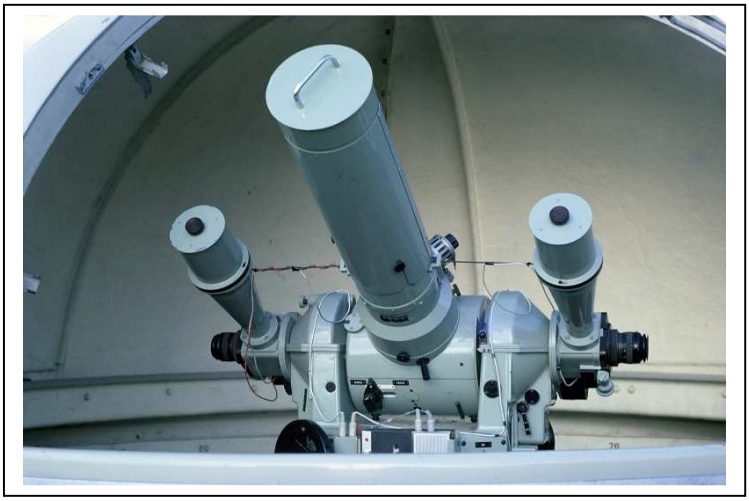

Fig 3. *The Cape Kine in 1968 (photo: G Roberts)*

The Cape Kine was manned by part-time observers, paid at a nominal hourly rate, operating in morning and evening shifts. In addition, there was a full time staff of two ladies who supported the operation and processing of observations made, etc.

Fig 4. *The Cape Kine time unit in 1968 (photo: G Roberts).*

Joyce Le Roux was the first lady assistant to work in the Kine department. With the increased work load, it was decided another assistant was needed, so Audrey Neethling joined the staff in November 1967. Joyce trained Audrey to mix the photographic chemicals, and what to do in the dark room, such as loading and unloading the Kine camera, getting things ready for the observing sessions and processing the data on the films that they developed. Audrey used to have to drive into town once a week to collect the predictions from the British consulate. Audrey said "I was a mug. I hated driving and I was never paid for my petrol! I never even tried to find out if I could put in a claim!"

Joyce and Audrey worked together for a couple of years. When Joyce resigned to get married, Alison French replaced her. She was only there for less than a year before going back to the UK with her husband. Joyce was then re-employed because she had not got married after all.

In 1968 Audrey asked Wally if she could do satellite tracking with him. When asking the director for permission, dr Stoy said “NO!”, probably because he did not want a woman driving home in the middle of the night. Stoy retired at the end of that year, so as soon as he left, and before the new director arrived, Audrey was put on the observing rota.

Apparently the author was the first person Audrey worked with, and claims to have been very nervous because she hardly knew him. Subsequently she observed with Grimwood's sons, Peter and Ian. When Audrey met her future husband, Brian Hultzer, he asked if he could also be taken on as tracker. He and Audrey worked as an observing pair. That was in early 1969 and they got married in 1971 and later divorced in 1976. Audrey thinks she was still working for Wally at that stage.

The Kine project was only supposed to run for a few years. As the deadline approached for closing it down, it was decided that rather than lose Audrey, she would be transferred to a different department in the Observatory.

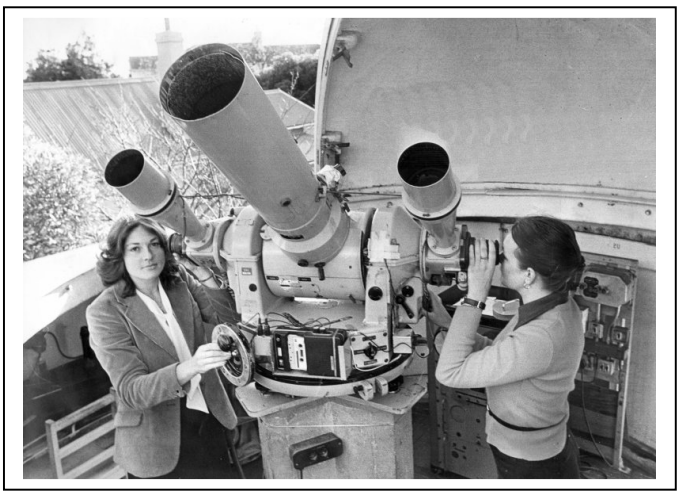

Fig 5. *Isobel Bassett and and an unknown person with the Cape Kine.*

Isobel Bassett was taken on to replace Audrey on a temporary basis. However the operation of the Kine was extended several years beyond the original date and Isobel stayed till it closed down. She also was later transferred, still as a temp, to another department of SAAO. Despite broken service, Joyce has always been on permanent staff.

Occasionally the satellite predictions from the UK failed to arrive, which meant no tracking was possible. Eventually this problem was solved by Hirst, who used the computer at the University of Cape Town. The author, who was now on the Observatory staff, also used their Nova computer to produce satellite predictions.

There were many Kine observers, but names have been forgotten with the advancing years. Some of the names recalled are Neil Harding (son of George Harding), Richard Cousins for several years, later joined by his wife Gwenda, Greg Roberts, later joined by his wife Maureen for the early morning sessions (see later), Richard Sessions who lasted several years , Audrey Neethling (later Hultzer) and husband to be (Brian) and Peter and Ian Grimwood.

Whilst the Kinetheodolite had a possible accuracy of 0.002 degrees, more typical accuracy was 0.02 degrees. As mentioned earlier, the camera was not always able to record the fainter satellites, so had to rely on the accuracy of the observers in tracking on "target"- not always an easy task with a fast moving target and sometimes unskilled observers reporting

"on" when actually "off". Another problem was that the side telescopes used were too small to see some of the fainter satellites. A skilled observer might just be able to glimpse the satellite, whilst someone else would not. In some instances the more skilled observer would then take over the operation of keeping both telescopes on target – quite a difficult task but sometimes achievable!

The Cape theodolite was closed down in 1981 after making some 40 000 invaluable observations. By then it was more than 40 years old. It was worn out and numerous parts had to be replaced. The Kine was returned to the UK where it was either used for spare parts or more likely placed in a museum.

With the closure of the Kine, the staff were transferred to the South African Astronomical Observatory. Grimwood retired and remained in South Africa where his death in April 1982.

0413 KENILWORTH

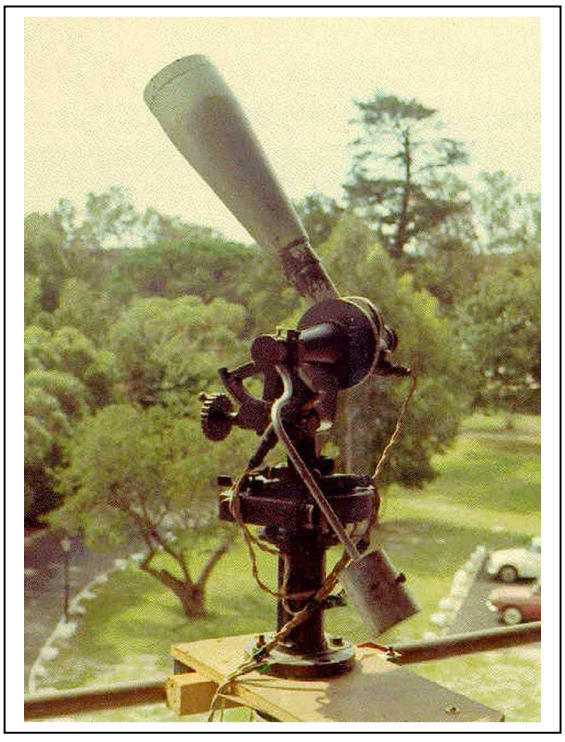

Fig 6. *Station 0413: G. Roberts' Apogee telescope on balcony of his flat in Kenilworth in 1968.*

As reported in Part 7 of this series the author was transferred by his then employer (MOBIL Oil) from Durban to Cape Town in March 1968. By April he had established himself and his wife in a block of flats in Rosmead Avenue, Kenilworth and had set up his 5-inch Apogee mount on the balcony of his third floor flat and started tracking satellites again as Station 0413 with the following coordinates:

longitude 18d 28' 45.5" E
latitude 33d 59' 31" S

This was not the ideal tracking site as it had a limited view of the sky from east through to north, which meant that most of the observing had to be done in the morning to avoid the satellites being in the Earth's shadow and hence invisible. It also meant that the satellites were fainter than optimum due to the poor phase angle. A major complication was lack of suitable time signals. All sorts of mechanical timers were tried which turned out to be not that accurate, which degraded the quality of optical positional observations. Despite this, a large number of satellites were observed in the face of the wet Cape winter from a location so close to Table Mountain.

Early in April, one late afternoon, there was a knock on the door of the author's flat. He opened to find Mr. Wally Grimwood from the Royal Observatory with the question: "Are you interested in part-time employment on the Kinetheodolite that had recently been set up at the observatory for satellite tracking?" Naturally Roberts jumped at the opportunity of being paid to pursue his hobby!

Subsequently he tracked two to three evenings a week, most times with Richard Cousins, son of Dr Alan Cousins of the Observatory staff. Very few morning duties were then being scheduled as the part-time observers were not that keen, but Roberts "persuaded" his wife Maureen to join him in the early morning hours. One or two mornings a week were added to the evening sessions. Roberts made things more interesting by providing predictions for satellites of interest to himself and the other organizations he was observing for. These satellites were observed when there were no passes of the satellites required by the Kinetheodolite. This considerably swelled the number of observations made.

This was probably not too popular with the ladies associated with supporting the work of the Kine. It meant a lot of extra work for them with all the film processing and extra measuring required!

One evening a very slow moving satellite was telescopically observed from station 0413. It was observed to be slowly moving through the Pleaides open cluster and was followed for over an hour. It was primarily as a result of a paper entitled “Space Surveillance Technical Memorandum No 68-4”, issued by the 1st Aerospace Control Squadron, Ent Air Force Base, Colorado on "A Preliminary Analysis of Molniya orbits" by Bruce R Bowman, 2d Lt, USAF Orbital Analyst. It was sent to Roberts with the comment "I'm sure you will find it very informative"! This indeed acquired his interest in tracking high altitude faint satellites which has lasted to the present day. This aspect of tracking had previously been ignored by the amateur tracking fraternity and about a year later MOONWATCH added it to their stable.

According to the limited records that Roberts still has, covering 8 months of the period April 1968 to March 1969, a total of 3 629 satellite passes were observed and positions derived, of which 1392 were Moonwatch targets and 2 237 were "other satellites". January 1969 was the record month when 1 010 satellite transits were observed and measured. Besides observing satellites for Moonwatch, a large number were observed for the Western Satellite Research network, as part of their optical surveillance program. Many "firsts" and "last" observations were secured of satellites, including one made of the 100-foot diameter Echo 1 balloon satellite, shortly before it re-entered the Earth’s atmosphere and burned up.

Fig 7. *Cape Kine (photo: G Roberts).*

It was a very busy year with tracking from his apartment as well as working part time on the Kine. This

continued until March 1969 when Roberts accepted an appointment as an astronomer at the Republic Observatory in Johannesburg.

0414 CAPE TOWN

Mr William (Bill) P. Hirst , born October 1905, former Chief Chemist at the Shell Company of South Africa, was an avid amateur astronomer. He was the author of frequent contributions to the Monthly Notes of the Astronomical Society as well as being well known for his orbital work on asteroids and comets at the Royal Observatory. Hirst was appointed the Station Leader with Dr Evans as his Deputy (more details were given in the article dealing with Cape Town Moonwatch at the then Royal Observatory).

In February 1963 Hirst resigned as team leader of Cape Town Moonwatch and moved to Johannesburg. In 1964 he accepted a position as Head, Moonwatch Division, SAO, in the United States and served in this capacity for nearly four years until retirement on July 31 1968. He was succeeded by Al Werner and Bill returned to South Africa August 1968. By the end of 1968 he was in full operation tracking from his home in Bergvliet with the station name 'Cape Town' at the following coordinates:

longitude 018d 26m 55s (341 d 33m 05s)
latitude -34d 02m 54s
altitude 23 metres

During the period July-December 1968 he made a total of 22 observations. In January 1969 he was appointed a lecturer in Astronomy at the University of Cape Town and held this position until the age of 83 (1988).

The February 1969 Moonwatch newsletter gave details of how Bill set up his Moonwatch station at Bergvliet using a 5-inch Apogee, observing a batch of 111 observations of Moonwatch observations.

During 1969 he made a total of 119 observations, increasing this to 151 in 1970 and to 216 in 1972. They had a consistently high quality of around 2 minutes of arc in position and better than 0.2 seconds timing accuracy.

Bill continued observing till the end of Moonwatch in 1975. He was the sole Moonwatch observer in South Africa during the period 1970 to 1975.

The closure of Moonwatch however, did not stop Bill from observing. He reported observations to the Earth Satellite Research Unit at the University of Aston (which operated until March 1988). By the end of 1979 he had made 12 179 satellite observations over the previous ten years, with 791 made in 1979 alone. It is not known when he made his last observation. Bill Hirst passed away in 1994.

Galileo's Finger

Brendan Ardagh and Keegan Crankshaw

Abstract: To construct a simple, low cost "star pointing" pointing device using Open Source software, recycled printer stepper motors and parts in addition to other readily available material. The article describes a simple prototype that will eventually be developed into a laser cut kit for easy assembly by learners, the general public with an interest in technology and astronomy and amateur astronomers.

Introduction

We developed this as a side project for an Intel design competition held at the University of Cape Town. Using a 2 axis motorized laser pointer that is controlled via Stellarium (free PC planetarium program). Once a star has been identified on Stellarium, the laser pointer indicates the same star in the real night sky. As an open source tool it will, hopefully, be used as an

easy way to teach the basics of astronomy and get learners, or anyone else, really interested in science and technology.

Construction

The base components consist of a simple alt-azimuth type mount with an attached laser pointer and an Intel Galileo (Micro-controller development board – see Fig. 1) to drive the components. The base is made from a plank of pine, cut to form a platform for the laser mount and the controlling boards. Two different circles cut from the pine plank are used as a horizontal gearing system, the larger mounted on an old hard drive bearing (see Fig. 2) and the smaller onto one of two stepper motors. A precision timing belt (elastic bands knotted together!), allows the stepper to drive the main azimuthal movement (see Fig. 3).

On the larger of the two pine circles an old printer 'axel' is mounted providing a mounting point for the laser pointer. This axel is driven by a second stepper motor mounted just below the axel, for the altitude movement. The two stepper motors are driven by EasyDriver stepper motor drivers hooked up to an Intel Galileo (see Figs. 4 and 5).

The software interface and ultimately the star tracking is done by Stellarium, open source software that is freely available online. Stellarium outputs slew or goto commands in a serial protocol standard to most telescopes (Meade LX200 protocol and the Celestron NexStar protocol), meaning that an additional piece of software needs to interpret the commands (see Fig. 6). A custom python script interprets the commands from Stellarium, effectively acting as a dummy telescope and sends the appropriate commands via USB to the Galileo's finger which then makes the necessary movements. The device itself is orientated by the operator to face north, and the system moves to a known home position, from this there is necessary information to allow Stellarium to track the movements.

The design itself can be produced using totally recycled parts from a normal printer (A now almost obsolete device), we have posted the design online so that anyone could find and make it hopefully promoting engineering and astronomy in a simple and effective way (see Fig. 7).

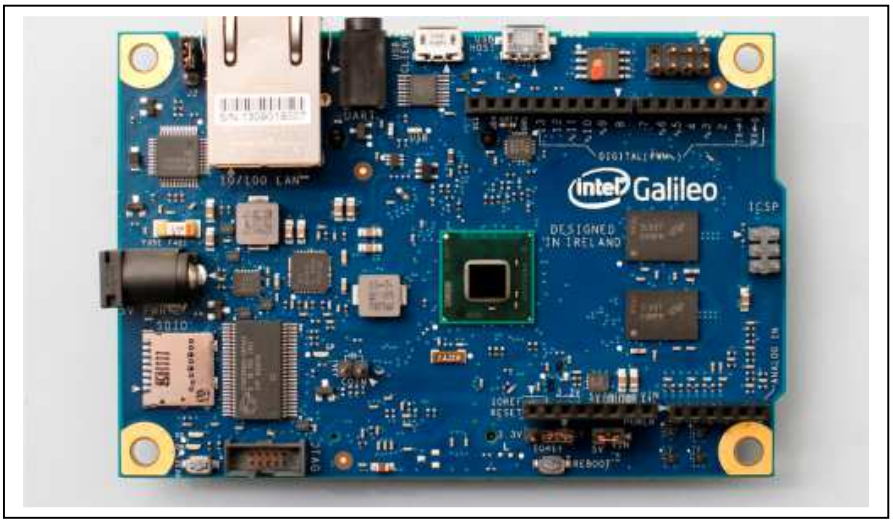

Fig 1. *The Intel Galileo circuit board*

The name Galileo's Finger was inspired by both the development board and the story of Galileo's finger which was stolen from his corpse many years after this death (See editor's notes at the end of article).

Fig. 2 *(left) The HD bearing mounted on the pine board.*

Fig. 3 *(right) Showing the large and small wheels. Note the groove to carry the precision drive belt (knotted elastic band!)*

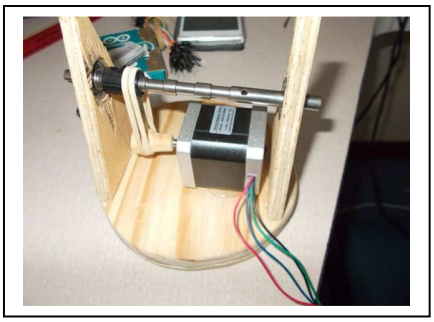

Fig. *4 (left) Clearly showing the altitude axle connected by another precision drive belt (another knotted elastic band!) to the stepper motor.*

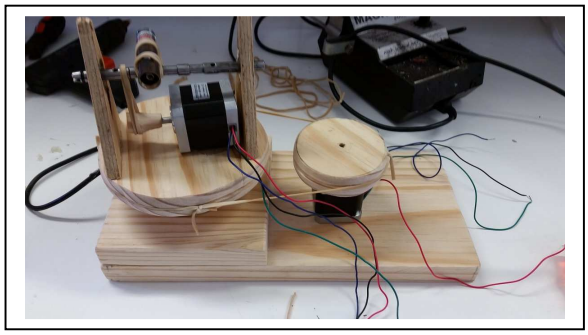

Fig 5. *(right) The partly completed Galileo's Finger*.

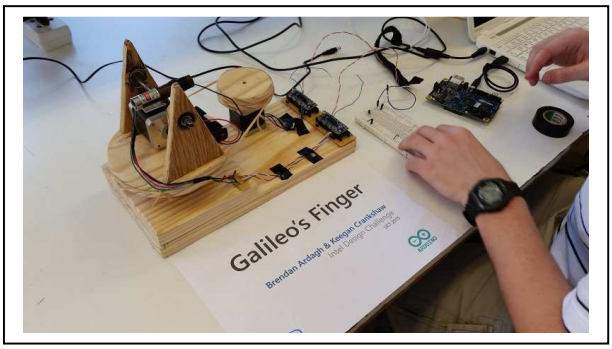

Fig 6*. (left) Assembling the electronics*

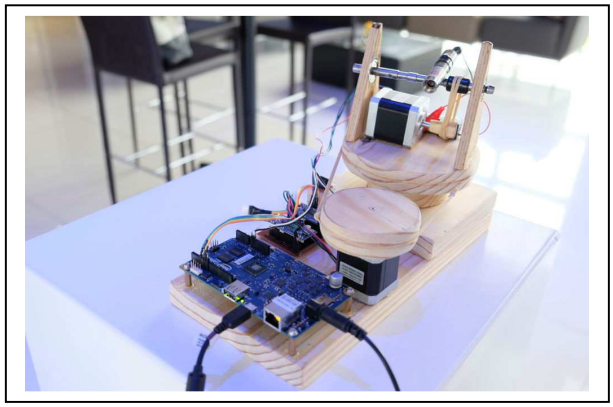

Fig 7. (right) *The completed Galileo's Finger*

Fig 8. (above) *Trying out Galileo's Finger on UCT's Jamieson Plaza.*

Editor's Notes

1 Galileo's Finger

Galileo Galilei's finger is on display at the Museo di Storia del Scienza in Florence, Italy.

The finger was detached from Galileo's body by Anton Francesco Gori (Florence, 1691-1757, literateur and antiquary) on 12 March 1737 when Galileo's remains were transferred from a small closet next to the chapel of Saints Cosmas and Damian to the main body of the church of Santa Croce where a mausoleum had been built by Vincenzo Viviani.

Subsequently the finger was acquired by Angelo M. Bandini, the librarian of the Biblioteca Laurenziana and was exhibited for a long period in this library.

Then, in 1841, it was brought to the Tribuna di Galileo, which had just been opened in the Museo di Fisica e Storia Naturale on the via Romana.

Along with the instruments of the Medici and Lorraine dynasties, it eventually became the property of the Museo di Storia del la Scienza.

The museum says the finger "exemplifies the celebration of Galileo as a hero and martyr of science.

Fig 9. *Galileo's Finger in the Museo di Storia del Scienza in Florence, Italy*

Extracted from NASA – Solar System Exploration – Astronomy Displays

2 Extension to 3-D printing

Having seen some repairs being done on Galileo's Finger during a demonstration of using a 3-D printer, it seems that, excluding the electronic components, it is possible to build Galileo's Finger entirely using a 3-D printer. Even proper precision drive belt gears could be made using proper drive belts. An ideal project for those members with the time and expertise!

3 Laser Safety

Those building and using Galileo's Finger are reminded that extreme caution should be exercised, especially when using it in, or near, a built up area. Best used in remote areas!

4 Web link

www.hackaday.io/project/4846-galileos-finger

Colloquia and Seminars

These form an important part of a research facility, often as a sort of pre-publication discussion or a discussion of an individual's current research, and as such it is virtually impossible to "publish" this material. However by recording the topics discussed in the form below does indicate to those, who are unable to attend, what current trends are and who has visited to do research: it keeps everyone 'in the loop' so to speak

Also included in this section are the colloquia/seminars at the SAAO, UWC and the Astrophysics, Cosmology and Gravity Centre at UCT, ACGC. Also included are the SAAO Astro-coffees which are 15-20min informal discussions on just about any topic including but not limited to: recent

astro-ph papers, seminal/classic publications, education/outreach ideas and initiatives, preliminary results, student progress reports, conference/workshop feedback and skills-transfer.

SAAO

Title: Science programs with ASTROSAT
Speaker: Professor K.P. Singh (Tata Institute for Fundamental Research)
Date: 17 June
Time: 11h00
Venue: 1896 Building

Abstract: ASTROSAT, India's first astronomy satellite, has been built for simultaneous observations in a broad range of wavelengths: visible, near-ultraviolet (NUV), far-UV (FUV), soft X-rays to hard X-rays. There are five principal scientific payloads to be carried aboard the satellite: (i) a Soft X-ray Telescope (SXT), (ii) three Large Area Xenon Proportional Counters (LAXPCs), (iii) a Cadmium-Zinc-Telluride Imager (CZTI), (iv) two Ultra-Violet Imaging Telescopes (UVITs) one for visible and near-UV channels and another for far-U V, and (v) three Scanning Sky Monitors (SSMs). It will also carry a charged particle monitor (CPM). All the instruments have been integrated after being tested individually for the launch and space environment, and the entire satellite is now being tested in a thermo-vac chamber. ASTROSAT is due to be launched by India's Polar Satellite Launch Vehicle (PSLV) in the first week of October 2015, in a circular 600 km orbit with an inclination of ~6 degrees, from the Sriharikota launching station. A description of the instruments and their capabilities will be presented.

Title: The evolving relation between star-formation rate and stellar mass in the VIDEO Survey since z = 3
Speaker: Russell Johnston
Date: 18 June
Time: 11h00
Venue: SAAO Auditorium

Abstract: Quantifying the interplay between star formation and stellar mass is a crucial component to understanding the build up of galaxies over cosmic time. There have been many investigations of this relationship, using both observations and simulations, with the aim of shedding light on how it connects with the underlying physical processes governing galaxy evolution.
In this talk I will present recent work where we have examined the star formation rate (SFR) – stellar mass (M*) relation of star-forming galaxies in the XMM-LSS field to z ~ 3.0 using the near-infrared data from the VISTA Deep Extragalactic Observations (VIDEO) survey. Combining VIDEO with broad-band photometry, we have used the SED fitting algorithm CIGALE to derive SFRs and M* and have adapted it to account for the full photometric redshift PDF uncertainty.
We have also compared our results to a range of simulations where I will show that the analytical scaling relation approaches, that invoke an equilibrium model, a good fit to our data. Within a simplified framework, such a model does not include the modelling of e.g. halos, cooling, or galaxy mergers, suggesting that a continual smooth accretion regulated by continual outflows may be a key driver in the overall growth of SFGs.

Title: Equilibrium Model for Galaxy Evolution
Speaker: Sourav Mitra (CET Fellow, UWC)
Date: 9 July
Time: 11h00
Venue: SAAO Auditorium

Abstract: Galaxies strongly self-regulate their growth via energetic feedback from stars, supernovae, and black holes, but these processes are among the least understood aspects of galaxy formation theory. We present an analytic galaxy evolution model that directly constrains such feedback processes from observed galaxy scaling relations. The equilibrium model, which is broadly valid for star-forming central galaxies that dominate cosmic star formation, is based on the ansatz that galaxies live in a slowly-evolving equilibrium between inflows, outflows, and star

formation. Using a Bayesian Monte Carlo Markov chain approach, we constrain our model to match observed galaxy scaling relations between stellar mass and halo mass, star formation rate, and metallicity across cosmic time. We will show that this simple analytic framework captures the basic physical processes required to model the mean evolution of stars and metals in galaxies, despite not incorporating many canonical ingredients of galaxy formation models such as merging or disk formation.

Title: The local Dark Matter density
Speaker: Frederic Hessman (Institut für Astrophysik, Goettingen)
Date: 6 August
Time: 11h00
Venue: SAAO Auditorium

Abstract: The analysis of the vertical velocity dispersion of disc stars is the most direct astronomical means of estimating the local dark matter density, rho_DM. Current estimates based on the mid-plane dynamic density use a local baryonic correction that ignores the non-local effects of spiral structure and significantly underestimates the amount of dynamically relevant gas; the additional gas plus the remaining uncertainties make it practically impossible to measure rho_DM from mid-plane kinematics alone. The sampling of inhomogeneous tracer populations with different scale-heights and scale-lengths results in a systematic increase in the observed dispersion gradients and changes in the nominal density distributions that, if not properly considered, can be misinterpreted as a sign of more dark matter. If the disc gravity is modelled using an infinite disc, the local variation in the vertical gravity due to the globally exponential disc components results in an underestimation of the baryonic contribution by as much as ~40%. Given only the assumptions of stationarity, an axially and vertically symmetric disc, doubly exponential tracer and mass-component density profiles, a phenomenologically justified model for the R-z cross-dispersion and a realistic gravity model, it is possible to solve the full vertical Jeans equation analytically for the vertical dispersion and hence test the robustness of

previous attempts at measuring rho_DM. The amount of DM thus needed to model SDSS/SEGUE G dwarf star kinematics turns out to be significantly less than estimated before.

Title: Maximising Astronomy's Human Capacity Development Impact
Speaker: Eli Grant (OAD - Office of Astronomy for Development)
Date: 16 July
Time: 11h00
Venue: SAAO Auditorium

Abstract: The International Astronomical Union's Strategic Plan (2012) put forward a number of theories about how Astronomy can positively impact human capital development (HCD) in low- and middle-income countries. This talk gives a brief overview of these theories, how they fit with economic human capital accumulation models, and how impact might be conceptualised and measured. Current Astronomy HCD initiatives in Sub-Saharan Africa are then examined and strategies for increasing long-term impact are proposed.

Astro-Coffee

Title: The Namibian bid to host the Cherenkov Telescope Array
Speaker: Dr Michael Backes, University of Namibia
Date: 25 June
Time: 13h00
Venue: SKA office - 2nd Floor Auditorium (CT)

Abstract: The Cherenkov Telescope Array (CTA) is the next generation instrument for very high energy (VHE) gamma-ray astronomy. Being successor to the vastly successful instruments H.E.S.S. in Namibia, MAGIC on the Canary Island of La Palma, and VERITAS in Arizona, USA, it is expected to outperform the former by a factor of 10, both in sensitivity as well as in the accessible energy range. To achieve these goals, the best

possible operational conditions must be met and thus a world-wide site investigation campaign was launched.

Based on the experience of successfully hosting the H.E.S.S. telescopes since 2002, proposals were submitted to host CTA in Namibia. Thorough investigations of the atmospheric and climatic conditions were carried out to estimate the average annual observation time. The scientific performance was estimated by means of Monte Carlo simulations, taking both the altitude and the local geomagnetic field into account.

Eventually, the proposed site in Namibia was singled out as the scientifically best site in the world to host the CTA and in April 2014, the decision was taken to engage into official negotiations with the Republic of Namibia and with ESO, being patron to the competitor site in Chile.

Details of the bidding process as well as the current status will be presented.

Title: Why is the radio continuum from a star-forming galaxy a power law with spectral index -0.7?
Speaker: Dr Josh Marvil CSIRO Astronomy & Space Science and the Australian Telescope National Facility.
Date: 14 July
Time: 12h00
Venue: SKA office - 2nd Floor Auditorium (CT)

Abstract: For local star-forming galaxies, the observed radio continuum spectral index typically falls within +/- 0.1 of -0.7. This narrow distribution is often attributed to an approximately constant ratio between their constituent synchrotron and free-free emission components as well as the constancy of their spectral shapes.

However, simple astrophysical models predict non-power law shapes for the constituent components and do not predict a ubiquitous ratio between their contributions to the total integrated spectrum.

I will summarize the results of an investigation into the detailed spectral shapes of these constituent components, as well as their relative contributions to the total spectrum, using observations with high spatial and spectral resolution.

UWC

Title: Revealing the Physics and Evolution of Galaxies and Galaxy Clusters with SKA Continuum Surveys
Speaker: Isabella Prandoni (INAF, Bologna)
Date**:** 8 July
Time**:** 14h00
Venue: Room 1.35, Physics Department

Abstract: The SKA will survey the Universe at radio frequencies, revolutionizing our view of Fundamental Physics, Astrophysics and Cosmology. In this talk I will present a summary of the work done so far by the SKA Continuum Science Working Group. I will provide an overview of the science enabled by radio continuum surveys in the SKA era, focusing on galaxy/galaxy cluster physics and evolution studies, and other relevant continuum science in the >2020 scientific framework. I will outline a number of reference radio-continuum surveys for SKA1 that can address such topics, and comprehensively discuss the most critical science requirements that we have identified. I will highlight what should be achieved by SKA1, to guarantee a major leap forwards with respect to the pre-SKA era, considering the science advances expected in the coming years with existing and upcoming telescopes (JVLA, LOFAR, eMERLIN, and the three SKA precursors: MWA, ASKAP and MeerKAT). In this exercise it is important to take in due account also the other waveband facilities coming online at the same time (e.g. Euclid, LSST, etc.), which tackle overlapping scientific goals, but in a different manner. In this respect particular attention has been payed to ensure that the proposed reference surveys are able to exploit the existing synergies with such facilities, so as to generate strong involvement from all astronomical communities, and

leave a lasting legacy value. It is clear that a certain degree of freedom is allowed to some of the observational parameters. It is very important to best fine-tune such parameters taking into proper account existing commensality with SKA1 surveys addressing other science areas (HI galaxy science, magnetism, cosmology).

NASSP

Title: Stellar Streams and the Milky Way : Modelling and Methodology
Speaker: Dr Nathan Deg UCT
Date**:** 25 August
Time**:** 16h00
Venue**:** RW James, Lecture theatre D (James D)

Abstract: Stellar streams are the remnants of tidally disrupted globular clusters and dwarf galaxies. These objects provide powerful constraints on the Milky Way potential. In order to fully unlock the ability of stellar streams to model the Milky Way it is necessary to model streams both accurately and efficiently. This talk will focus on the methodology of modelling the Milky Way using stellar streams as well as comparing three different methods of stellar stream modelling.

ACGC

Title: Large-scale cosmic structure probes the Standard Model and beyond
Speaker: Amol Upadhye (U. Wisconsin-Madison)
Date**:** 30 June
Time**:** 12h00
Venue**:** M111 Maths Building, UCT

Abstract: Over the next decade, cosmological measurements of the large-scale structure of the Universe will be sensitive to the combined effects of massive neutrinos, dark energy evolution, and fifth forces from modified gravity. The redshift-space matter power spectrum is a key repository of

this information. I use higher-order perturbative methods for computing the power spectrum to investigate these effects in redshift space on quasi-linear scales. Through comparison with N-body simulations I establish the validity of a Time-Renormalization Group (Time-RG) perturbative treatment that includes dynamical dark energy and massive neutrinos. Then I study the dependence of the power spectrum on the neutrino mass and dark energy parameters. Finally, I discuss ongoing work applying these results to the forecasting and analysis of large-scale structure probes, such as intensity mapping surveys, as well as extending higher-order perturbative calculations to modified gravity models.

Title: Dark energy from the megaparsec to the micron
Speaker: Amol Upadhye (University of Wisconsin-Madison)
Date**:** 7 July
Time**:** 12h00
Venue**:** M111 Maths Building, UCT

Abstract: Dark energy can differ from a cosmological constant through either the evolution of its energy density or through coupling to ordinary matter, which results in a fifth force. Upcoming cosmological surveys will be able to constrain both effects at the largest scales, while stars and laboratory experiments already provide small-scale tests of coupled dark energy. My talk will consist of two parts. First, I describe ongoing work to understand the effects of dark energy on the formation of large-scale cosmic structure. Using higher-order perturbation theory as well as N-body simulations, I compare the cosmological constant to dark energy with a rapidly varying equation of state. Though surveys will also probe scale-dependent growth due to fifth forces, we must first understand the effects of massive neutrinos on large-scale structure. Towards that end, I include massive neutrinos along with evolving dark energy in a redshift-space generalization of Time-RG perturbation theory. Part II of my talk discusses my previous work using stars and laboratory experiments to constrain dark energy couplings to Standard Model particles. By considering f(R) gravities as scalar dark energy models, I show that

chameleon screening stabilizes neutron stars in the strong-gravity regime and suppresses the scalar monopole radiation expected in variable stars. I demonstrate that the Eot-Wash torsion pendulum experiment excludes fifth forces predicted by a range of chameleon and symmetron models. Finally, I constrain dark energy couplings to photons, which allow for the production of dark energy particles through oscillation in a strong magnetic field.

Title: Radio Polarimetry and Cosmic Magnetism
Speaker: Bryan Gaensler, Canadian SKA Director (Dunlap Institute for Astronomy and Astrophysics, University of Toronto
Date**:** 21 July
Time**:** 12h00
Venue**:** M111 Maths Building, UCT

No Abstract given

A meeting to remember – great privilege, good memories

Magda Streicher recounts a memorable trip to Cambridge

When one is invited to address any society's meeting, one usually accepts the invitation, regarding it as a great privilege to have been asked. And so it was with me, and once I had accepted and the necessary bookings had been made and the tickets bought, there was no turning back. I was fortunate to be accompanied by my two daughters, who no doubt came with me just to make sure I would be okay all the way. Of course it was also beneficial for them to have their mother looking after their needs!

Fig 1. *Magda and daughters making plans.*

As a member of the Webb Society in England for the past 10 years, I became friends with English members through e-mails and contributions to their journals, and I was able to host a couple of members of that society, Bob (President) and Angela Argyle, when they slept over on our farm one night during one of their visits to South Africa. Of course I showed Bob and Angela the wonderful deep-sky objects of the southern hemisphere with great fanfare! He was certainly impressed.

Fig 2. *On the meridian at Greenwich.*

Last year, on a follow-up visit to South Africa, Bob asked me to be a speaker at their annual general meeting this year. As is customary, it would be held in June at the faculty of Astronomy and Science at Cambridge University. Having accepted it also gave me the opportunity to fulfil some of my dreams: a musical concert in one of Vienna's splendid opera theatres and a visit to Prague in order better to understand Johannes Kepler. With the thought of being able to combine these with the UK visit my plan started taking shape. On the agenda was also a stop at Greenwich Observatory to meet the time.

Cambridge is a beautiful student city with a rich history and stately old buildings. On the square there is a distinctive golden clock that was built

in the early 1800s. It comprises circles indicating hours, minutes and seconds. Particularly striking for me was a dragon-like creature on top of the clock that pulls the second hand down with its foot.

Fig 3. *The Cambridge Clock.*

The English always speak about their lovely summer, but oh dear, I literally shivered and shook from the cold – or was it because I was due to appear as a guest speaker in a lecture theatre in one of the world's best Universities and on top it full of people?

The reception was wonderful and conversations flowed. I had to dig into the depths of my memory to try to produce my best English as I shared my programme of telescope work and observation with them in great style and with much enjoyment. Apparently – so I heard before the start of the day's programme – the audience had been looking forward with much anticipation to this speaker from the south that was to discuss the wonderful Southern Treasures with them. Anyway, I was well prepared and spent much of my time talking about the Magellanic Clouds and nebulae discovered by Karl Henze, how to select the areas and create valuable observations. I used sketches of the areas as well as the beautiful photographs Dale Liebenberg had made available to me as illustration material. Something I realised afterwards was what an attraction the sketches had been and how many questions had been asked based on them

The other four speakers were very well known personalities: Wolfgang Steinicke, who spoke about John Herschel's observations when he visited the Cape of Good Hope; Andrew Crumey from Oxford, who spoke on modelling the visibility of deep-sky objects; Olivier Thizy, whose

introduction to astronomical spectroscopy I know many of you would have loved to hear; and lastly the main speaker Dr Mike Irwin, head of the astronomy and science faculty at Cambridge University share with us M31 and its Environs. The society's president, Bob Argyle, spoke about the legacy of Kenneth Glyn Jones before closing the meeting.

Fig 4. *The speakers at the conference: (l-r) Andrew Crumey, Mike Irwin, Wolfgang Steinicke, Magda, Bob Argyle and Olivier Thizy*

The grounds of the Observatories house the famous Northumberland Equatorial Telescope, the only remaining large instrument, from as early as 1838. The Duke of Northumberland had indicated his wish to donate a large telescope and was encouraged to do so by the director, G.B. Airy. The lens was an achromatic doublet of 11.6 inches with a focal length of 19 ft 6 inches made in Paris, France. Bob proudly showed us the Thorrowgood Telescope (1864), which is his work instrument for his most valued work on double stars.

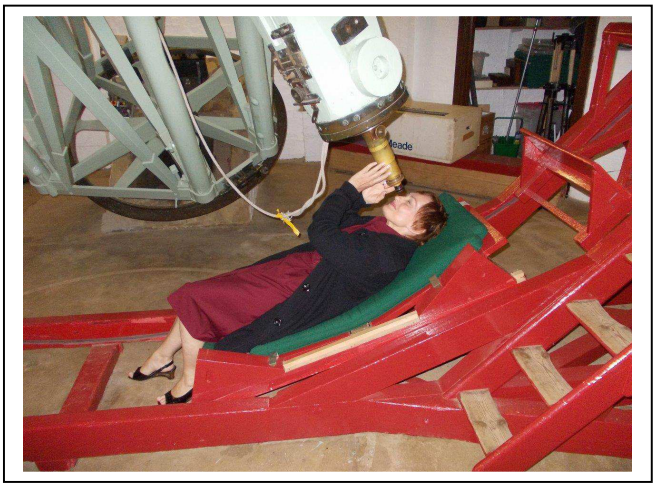

Fig 5. *The Northumberland telescope.*

The evening ended with the speakers and members being treated English style and my getting the opportunity to learn much more about various aspects of astronomy at a high level. It had been a wonderfully busy day, and a happy one, and I had been far more at ease than I had thought I would be.

What made my day was when I was told, "You were the star today." Not only did I make many new friends, but the main thing still remains, for me, the great privilege of having been invited to attend and to speak in the first place.

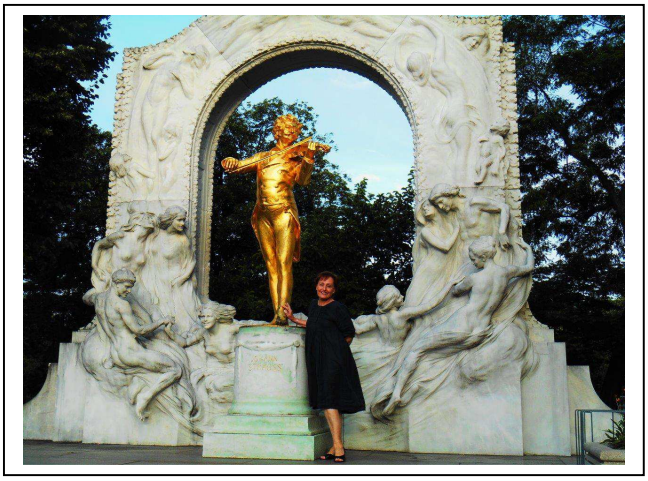

Fig 6. *At the Strauss statue in Vienna*.

What can I say about Vienna, the Music City? I was not disappointed. The Kursalon Wien put on a wonderful concert with its 15-strong orchestra creating magic with their violin melodies of Johann Strauss and Wolfgang Mozart. The most beautiful opera houses bring nostalgia and music together as one. Fifty percent of Vienna is covered with parks, making it one of the greenest cities in the world. Unfortunately the observatory is in the middle of the city, which greatly restricts observation. The building is, however, used for high-level astronomical research.

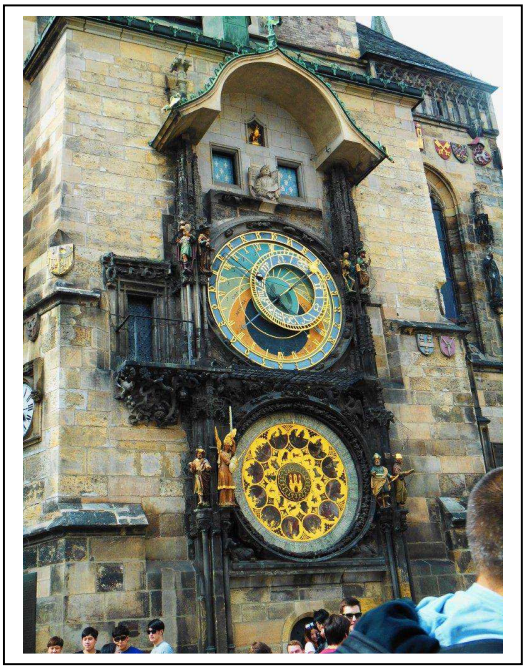

Fig 7. *The astronomical clock in Prague.*

One of the oldest cities is Prague, which dates back to about the 9th century. The historical Prague astronomical clock is special, I must admit. The clock was created by Mikulas in 1410 and perfected by the master Hanus in 1490. In 1864 Josef Manes created the astronomical clock and calendar panel, not for the exact time but to imitate the supposed orbits of the Sun and Moon about the Earth. It shows the movement of the Sun and Moon through the 12 signs of the zodiac, which was of great importance in the 16th century. The astronomical clock also displays various figures, including Vanity, Avarice, a Turk and a skeleton named Death. Around the calendar dial are the figures of an angel, a philosopher, an astronomer and a chronicler. But oh dear, when the clock struck the hour the square was filled with people, and I hardly had any space to watch the twelve apostles peep out of a window that opens to display them.

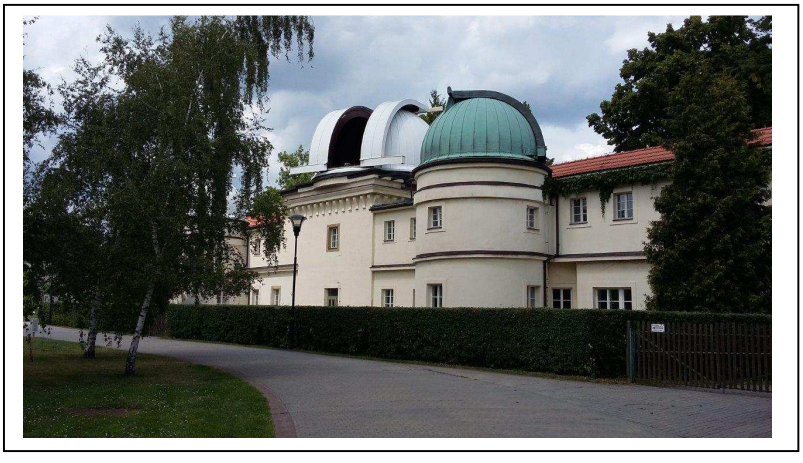

Fig 8. *The Petrin Observatory in Prague.*

The next stop was the observatory on Hradcana, a lovely tree-rich hill overlooking the city of Prague. Standing next to the Petrin observatory looking around the green fields and trees I wondered for a moment where Kepler would have been standing as he watched the conjunction of Jupiter and Saturn in the beginning of

December 1603. The Kepler museum is situated in the house where he lived. It contains a wealth of information about his observations as well as history of his private life and friendship with Tyco Brahe.

Fig 9. *The Kepler Museum*

With a pair of feet that could hardly walk anymore I still simply had to go to the old Tye Church to see the last resting place in the church floor of Tyco Brahe with his statue in front of the altar to the side of the first pillar. While he, too, had the idea that the Earth is the centre of the universe he was still shown due respect with this last special resting place.

On my way back the following day I was left pondering about music, history, astronomers and speeches in faraway places.

The **Astronomical Society of Southern Africa** (ASSA) was formed in 1922 by the amalgamation of the Cape Astronomical Association (founded 1912) and the Johannesburg Astronomical Association (founded 1918). It is a body consisting of both amateur and professional astronomers.

Publications: The Society publishes its electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly as well as the annual *Sky Guide Africa South.*

Membership: Membership of the Society is open to all. Potential members should consult the Society's web page assa.saao.org.za for details. Joining is possible via one of the local Centres or as a Country Member.

Local Centres: Local Centres of the Society exist at Bloemfontein, Cape Town, Durban, Harare, Hermanus, Johannesburg, Pretoria and Sedgefield district (Garden Route Centre). Membership of any of these Centres automatically confers membership of the Society.

Sky & Telescope: Members may subscribe to Sky & Telescope at a significant discount (proof of membership is required). Please contact the Membership Secretary for details.

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