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Front cover: Artist's conception of one of the SKA dishes.

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Obituary – Halton (Chip) Arp

Halton Christian Arp (March 21, 1927 – December 28, 2013) was one of the most interesting and controversial astronomers of the last century. He was born in New York to an artist father. Following irregular schooling, he entered Harvard, where he graduated in 1949. He then went to Caltech as a graduate student and obtained his PhD in 1953. His thesis under Walter Baade was on a massive study of novae in M31 which was highly significant for the use of novae as distance indicators.

In 1955-1957 he was attached to Indiana University as a Research Assistant. Much of this time was spent at the Royal Observatory, Cape of Good Hope, where he worked with the McClean telescope on photographic and photometric observations of the Small Magellanic Cloud, including its Cepheids. He also made observations of the globular clusters ω Cen and 47 Tuc. Michael Feast writes "Possibly Arp's most enduring work in SA was that on the colour-magnitude diagram and Cepheids in the young globular cluster NGC 1866. This was done in Pretoria [at the Radcliffe Observatory] where he spent a significant amount of time, some of it staying with me. The observational part was published with David Thackeray".

In 1957 he became a staff member of the Palomar Observatory, then by far the leading observational facility of the world. His best remembered contribution to astronomy is his "Atlas of Peculiar Galaxies", (*Astrophys.*

J.Suppl. Ser. 14, 1-20. 1953). This led to widespread interest in galaxy evolution and interactions.

Soon afterwards Arp came to the conclusion that quasars were ejecta from galaxies and that their redshift-derived motions were not of cosmological origin but instead were the result of high velocities caused by the ejection process. This view was not accepted by the vast majority of quasar researchers but was supported by a group of "dissidents", some of them quite famous astronomers. As a result he ran into difficulties with his colleagues at Palomar.

In 1983 Arp joined the Max Planck Institute for Astrophysics in Munich, and lived in that city for the rest of his life.

A 1975 interview can be recommended for further information about his interests and career (Interview with Dr Halton Arp". By Paul Wright: www.aip.org/ohlist/4490.html) [ISG (with input from MWF)].

Obituary – John Dobson

John Lowry Dobson was born on September 14, 1915, in Beijing, China and died on January 15, 2014 in Burbank, California. He was arguably one of the best known amateur astronomers in the world for two reasons. Firstly, having made the night skies available to many people around the world with his simple telescope design, affectionately referred to nowadays as a "Dobbie", and secondly for his founding of "Sidewalk Astronomy".

After taking a degree in chemistry at the University of California, Berkeley, in 1943, he joined the Vedanta Society Monastery where he became a monk of the Ramakrishna Order, his main role there, being to reconcile astronomy with the teachings of Vedanta. He left the order in 1967 and founded the San Fransisco Sidewalk Astronomers with the aim of popularizing astronomy. He also started teaching people how to build their own telescopes, the now well known Dobsonians: a simple, robust Newtonian reflecting telescope.

In 2005, the Smithsonian magazine listed John Dobson as among 35 individuals who have made a major difference during the lifetime of that periodical. He firmly believed that access to astronomy led to a proper understanding of the Universe.

Dobson was a most interesting character, and further details can be found in Willie Koorts's article in the Oct 2010 MNASSA, when he turned 95. See www.mnassa.org.za/html/Oct2010/2010MNASSA..69..Oct..170.pdf

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Designing the largest radio telescope on Earth: the final race

SKA Headquarters, Jodrell Bank Observatory, UK

The Square Kilometre Array (SKA) Project enters a new era and takes a major step towards the start of the construction of the world's largest radio telescope, after the announcement of the teams who will be responsible for its final design. In total, more than three hundred and fifty scientists and engineers, representing 18 nations and drawn from nearly one hundred institutions, universities and industry have the challenging task to work on the critical detailed design phase which will usher in the most sensitive and powerful telescope ever devised.

"This is a level of engagement only seen in revolutionary projects!", said Professor Phil Diamond, Director General of the SKA Organisation. "That we have been able to pull together a team of some of the world's best experts, most prestigious institutions and major companies reflects the

passion and ambition of the scientific and engineering communities to work on an inspirational world-class project of the scale of the SKA."

The funding made available by the partners for this detailed design phase is € 120 Million. The SKA is a global endeavour and one of the largest and most ambitious scientific projects in history. From 2018 onwards, thousands of large dishes and literally millions of radio receivers, will be deployed in desert regions in Africa and in Australia, eventually making the SKA one of the true giants of the astronomical and scientific world.

During 2013 the SKA Organisation sent out invitations to research organisations and industry partners around the globe to participate in the analysis and design of the components of the SKA during its three year detailed design phase. This request for proposals included a conceptual design of the telescope, a work breakdown structure, a statement of the work required and additional reference documents. As with other projects of this magnitude, such as the development of the Large Hadron Collider or major space programmes, the SKA has been broken down into various modules called "Work Packages". Each of these Work Packages will be managed by a consortium of international experts.

"Each element of the SKA is critical to the overall success of the project, and we certainly look forward to seeing the fruits of each consortium's hard work shape up over the coming years", said Professor John Womersley, Chairman of the SKA Board. "Now this multi-disciplinary team of experts has three full years to come up with the best technological solutions for the final design of the telescope, so we can start tendering for construction of the first phase in 2017 as planned. The Directors of the SKA Board feel that the consortia selected represent some of the world's very finest scientists and engineers."

Each consortium has provided detailed management and verification plans, schedules, milestones and budgets for the various elements with which they have been tasked. The strategic aim of the SKA Organisation, which is coordinating the global effort, is that the work undertaken within each of the consortia is focused on these specific elements of the SKA project and that their work will span the entire pre-construction period and meet critical design reviews along the way.

Analogous to a jigsaw puzzle, the consortia teams will be called upon to ensure that their various elements integrate and interface as seamlessly as possible.

With a collecting area of one square kilometre (one million square metres), the scale of the SKA represents a significant step forward in engineering. When operational, the SKA telescope will provide a monumental increase over current scientific capabilities and be able to address some of humankind's greatest questions, such as our understanding of gravity, the nature of dark energy, the very formation of the Universe and whether or not life exists elsewhere.

Below is a brief technical description of each of the Work Packages and links to the SKA website for more information on the Work Packages and the selected Consortia:

Brent Carlson of the National Research Council of Canada (NRC), and is the CSP Consortium Lead Systems Engineer. *"This is an exciting and challenging project that will engage world experts in its design and construction. This is a telescope that will tell us fundamental things about the nature of the universe, and to be involved in it is indeed a great privilege."*

- **Dish (including phased array feeds) (DSH)** The "Dish" element includes all activities necessary to prepare for the procurement of the SKA dishes, including local monitoring & control of the individual dish in pointing and other functionality, their feeds, necessary electronics and local infrastructure. DSH includes planning for manufacturing of all components, the shipment and installation on site of each dish (including feeds and other components) and the acceptance testing. The Dish Consortium is led by Dr. Mark McKinnon of CSIRO (Commonwealth Scientific and Industrial Research Organisation) in Australia, *"Starting the SKA detailed design is exciting because we are taking the first steps towards making the vision of SKA a reality. The Dish Consortium faces many design challenges, but our team has the expertise to address them."*

- **Low Frequency Aperture Array (LFAA)** The "Low Frequency Aperture Array" (LFAA) element is the set of antennas, on board amplifiers and local processing required for the Aperture Array telescope of the SKA. LFAA includes the design of the local station signal processing and hardware required to combine the antennas and the transport of antenna data to the station processing. The local monitoring & control including the software of the aperture array are included. LFAA includes the different types of stations necessary as defined by the baseline reference design. The Low Frequency Aperture Array Consortium is led by Jan Geralt Bij de Vaate of ASTRON (Netherlands Institute for Radio Astronomy) in the Netherlands.

- **Mid Frequency Aperture Array (MFAA)** The "Mid Frequency Aperture Array" element, part of the SKA Advanced Instrumentation Programme, includes the activities necessary for the development of a set of antennas, on board amplifiers and local processing required for the Aperture Array telescope of the SKA. MFAA includes the development of local station signal processing and hardware required to combine the antennas and the transport of antenna data to the station processing. The Mid Frequency Aperture Array Consortium is led by Jan Geralt Bij de Vaate of ASTRON (Netherlands Institute for Radio Astronomy) in the Netherlands. *"The fully sampled field-of-view, of the order of 100 square degrees, will make the SKA*

Mid Frequency Aperture Array effectively a 10-gigapixel ultra wide field spectroscopic camera," says Dr. Steve Torchinsky, the MFAA Consortium Project Scientist.

- **Telescope Manager (TM)** The Telescope Manager (TM) when complete will be responsible for the monitoring of the entire telescope, the engineering and operational status of its component parts. The TM consortium is led by Professor Yashwant Gupta of the NCRA (National Centre for Radio Astrophysics) in Pune, India.

- **Science Data Processor (SDP)** The Science Data Processor (SDP) consortium will focus on the design of the computing hardware platforms, software, and algorithms needed to process science data from the correlator or non-imaging processor into science data products. The data rates involved in this will exceed that of the entire global internet traffic. The SDP consortium is led by Professor Paul Alexander of the University of Cambridge, UK. *"We are thrilled to be* *able to build on the decades of expertise we have in the University to contribute to this project, which is the exemplar "big data" project of this generation."*

- **Central Signal Processor (CSP)** The CSP is the central processing "brain" of the SKA. It converts digitised astronomical signals detected by SKA receivers (antennas & dipole ("rabbit-ear") arrays) into the vital information needed by the Science Data Processor to make detailed images of deep space astronomical phenomena that the SKA is observing. It will also design a "non-image processor" in order to facilitate the most comprehensive and ambitious survey yet to find new pulsars and precisely time known pulsars. The CSP consortium is led by David Loop of the National Research Council of Canada, Canada.

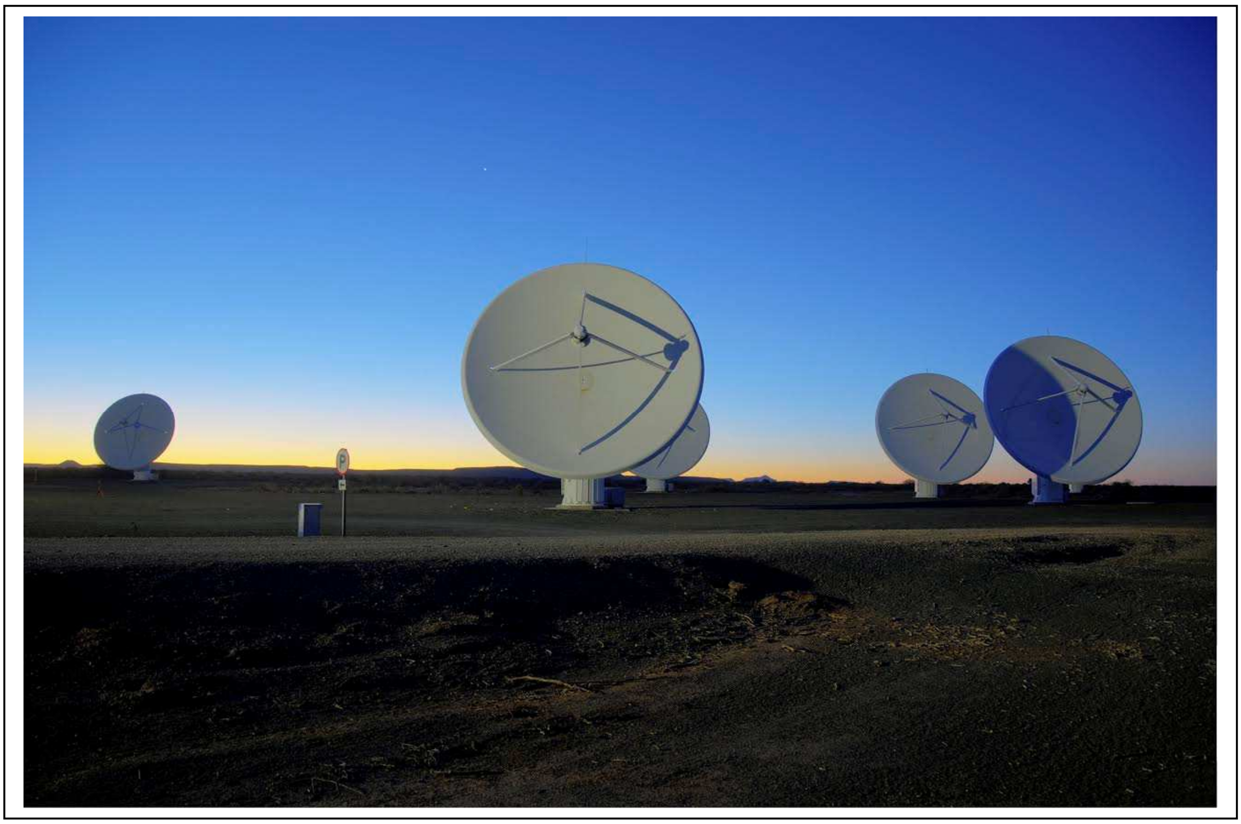
- **Signal and Data Transport (including synchronisation) (SaDT)** Signal and data transport is the backbone of the SKA telescope. The Signal and Data Transport (SADT) consortium is responsible for the design of three data transport networks. These include the Digital Data Backhaul (DDBH) that transports signals from the radio telescopes to the Central Signal Processor (CSP), and data products from the CSP to the Science Data Processor (SDP) and from the SDP to the regional SKA Data Centres. The total data rates are very high, approximately 80 Tb/s for the DDBH links and another 80Tb/s (Terabits per second) for the CSP links. The SaDT Consortium is led by Professor Richard Schilizzi of the University of Manchester, UK.

- **Assembly, Integration & Verification (AIV)** The "Assembly Integration and Verification" element includes the planning for all activities at the remote sites that are necessary to incorporate the elements of the SKA into existing infrastructures whether these be precursors or new components of the SKA. AIV does not include design of new components of the SKA. The AIV consortium is led by Dr. Richard Lord of SKA South Africa.

- **Wideband Single Pixel Feeds (WBSPF)** The "Wideband Single Pixel Feeds" element, part of the SKA Advanced Instrumentation Programme, includes the activities necessary to develop a broadband spectrum single pixel feed for the SKA. The WBSPF Consortium is led by Professor John Conway of Chalmers University, Sweden, *"Wide band Single Pixel Feeds are a relatively mature*

technology that can be developed further within this programme to provide the SKA the capability to cover wide frequency increasing the discovery space for the SKA."

- **Infrastructure (including power) (INFRA)** Infrastructure (INFRA) for the SKA requires two consortia, each managing their respective local sites in Australia and Africa. INFRA-AUS and INFRA-SA have the huge task of taking care of all SKA Infrastructure on continent wide scales. This includes all work undertaken to deploy and be able to operate the SKA in both countries such as roads, buildings, power generation and distribution, reticulation, vehicles, cranes and specialist equipment needed for maintenance which are not included in the supply of the other elements. Infrastructure does not include access rights to the land, environmental protection or monitoring. Infrastructure does not include protection from external sources of interference. Infrastructure includes the provision of any site wide safety systems necessary for personnel and equipment safety. The INFRA-SA Consortium is led by Ms Tracy Cheetham of SKA South Africa, *"The INFRA SA Consortium is looking forward to working with multi-faceted international organisations represented in each Consortium to ensure the successful design and delivery of SKA1. Our Consortium is thrilled to be part of a global mega-science project and excited by the design challenges presented by the SKA. We hope to add great value with the experience gained on the design and construction of the SKA pathfinders."*



The INFRA-AUS Consortium is led by Dr. Michelle Storey of CSIRO (Commonwealth Scientific and Industrial Research Organisation) in

Australia, *"The SKA is a complex global project with challenging infrastructure demands and we will benefit from the extensive experience and skills of all of our partners. This includes Aurecon who will be leading the technical activity in the Australian Infrastructure Consortium. We're absolutely delighted to have a role in developing this next generation telescope.* In addition to playing a leading role in the above Work Packages, SKA SA and its industry and institutional partners are playing strong roles in many of the other Work Package consortia. These include: Dishes; Telescope Manager; Science Data Processor; Central Signal Processor and Signal and Data Transport. SKA SA is also providing site support for the Mid Frequency Aperture Array prototypes, and has much to contribute through its experience in building and operating KAT-7 at the South African SKA site, its design and construction of the SKA precursor, MeerKAT, and its strong culture of systems engineering.

Background on the SKA

The SKA project is an international effort to build the world's largest radio telescope, with a square kilometre (one million square metres) of collecting area. The scale of the SKA represents a huge leap forward in both engineering and research & development towards building and delivering a radio telescope, and will deliver a correspondingly transformational increase in science capability when operational.

Deploying thousands of radio telescopes, in three unique configurations, which will enable astronomers to monitor the sky in unprecedented detail and survey the entire sky thousands of times faster than any system currently in existence. The SKA telescope will be co-located in Africa and in Australia. It will have an unprecedented scope in observations, exceeding the image resolution quality of the Hubble Space Telescope by a factor of 50 times, whilst also having the ability to image huge areas of sky in parallel. With a range of other large telescopes in the optical and infrared being built and launched into space over the coming decades, the SKA will perfectly augment, compliment and lead the way in scientific discovery.

The SKA Organisation, with its headquarters at Jodrell Bank Observatory, near Manchester, UK, was established in December 2011 as a not-for-profit company in order to formalise relationships between the international partners and to centralise the leadership of the project. Ten countries are currently members of the SKA Organisation - Australia, Canada, China, Germany, Italy, New Zealand, South Africa, Sweden, the Netherlands and the United Kingdom. India is an Associate Member. Further countries have expressed their interest in joining the SKA Organisation in the coming years.

Note: Images (credit SKA South Africa unless otherwise stated) are included to show recent developments at SKA in SA, and are not directly linked to the article. Editor. For further information see *www.ska.ac.za*

Jacob Karl Ernst Halm (1865-1944)

I.S. Glass (SAAO)

Abstract: J.K.E. Halm was Chief Assistant at the Royal Observatory, Cape of Good Hope, from 1907 to 1927. Though barely remembered today, he made several contributions to the advance of astrophysics. Of the staff at the time, he was the most conversant with contemporary trends and the most capable as a theoretician. In what follows, an outline is given of his life and work.

Introduction

Jakob Karl Ernst Halm was born in Bingen am Rhein, Grand Duchy of Hesse, on 30 Nov 1866, the son of Carl Karl Joseph Halm and Sabine Dietrich. He went to school in Bingen and studied afterwards for four years at Giessen (1884-85), Berlin (to 1887) and Kiel (to 1889). He obtained his PhD at Kiel (Halm, 1890) for work on linear differential equations.

Among other interests, Halm was an accomplished amateur violinist and this brought him into close contact with Karl N.A. Krüger, the director of Kiel Observatory. Under him, he became Assistant Editor of the journal *Astronomische Nachrichten*.

Strassburg

In 1889 Halm was appointed an Assistant at the University Observatory in Strassburg, at that time in Germany, though now part of France. Here he worked with the Meridian Circle and the heliometer. He made over one third of the observations for the Strassburg AG Zone (i.e., part of the original Astronomische Gesellshaft Katalog).

On 7 August 1894 he married in Basel Johanna Bader (born 23 Aug 1865) of that city.

Edinburgh

In 1895 Halm was invited by the Astronomer Royal for Scotland, Ralph Copeland, to become a First-Class Assistant at the newly constructed Royal Observatory in Edinburgh at a salary of £300 per annum and the right to an official residence.

At first he was involved in setting up the new instruments of the Observatory. Later he made micrometrical observations of comets and double stars with the 15-inch refractor in order to determine their orbits. He also made meridian observations of zodiacal stars. However, his papers from around 1900 show a growing interest in solar theory.

One of his most important contributions was to use the heliometer (split-lens telescope) to feed a spectrograph with sunlight from both sides of the solar disc simultaneously, at different solar latitudes. With this he studied the differential rotation of Sun between 1901 and 1906 (see Halm, 1904) and was awarded the Brisbane medal of the Royal Society of Edinburgh. His work was criticized by W. Adams of Mt Wilson Observatory but he was able to defend himself successfully (Halm 1905). In the course of his measurements he found a displacement of certain spectral lines near the edge of the solar disc, not due to rotation or other obvious effects (see Halm 1907). This was later confirmed by others including Adams, though Halm's suggestion that it was a pressure effect was not sustained. It does not seem to be explained satisfactorily even now.

The director of the Observatory, Ralph Copeland, was ill for much of the time that Halm spent at Edinburgh (he died in 1905), so that much administrative work fell on his shoulders. He also had to take over Copeland's professorial duties at the University of Edinburgh.

In order to become a civil servant, Halm had to become a naturalized British citizen. On 3 June 1901 he applied to C. T. Ritchie, one of His Majesty's Principal Secretaries of State. He swore an Oath of Allegiance on 7 June 1901 and registered at the Home Office on 11 June 1901. Unfortunately, due to Copeland's illness, the process of becoming a civil servant was never completed and this ultimately led to a lower final pension than he should have got.

Royal Observatory, Cape of Good Hope

On the recommendation of Sir David Gill (just then retiring) and F.W. Dyson, then Astronomer Royal for Scotland, Halm was appointed Chief Assistant of the Royal Observatory under Sydney Samuel Hough and arrived the Cape on 30 June 1907.

At that time, the first glimmerings that eventually led to the discovery of the structure of the Milky Way galaxy were becoming apparent. Gill's collaboration with Kapteyn on the *Cape Photographic Durchmusterung (CPD)* and subsequent repeat observations had led to the discovery of two "star streams", or preferential groups of proper motions, shared by certain stars [now known to be a reflection of halo and disc populations or old and young stars]. Halm worked with Hough on studying the properties of these streams using radial velocities in addition to the proper motions. He (Halm, 1911) identified a third stream associated with "Orion"-type stars.

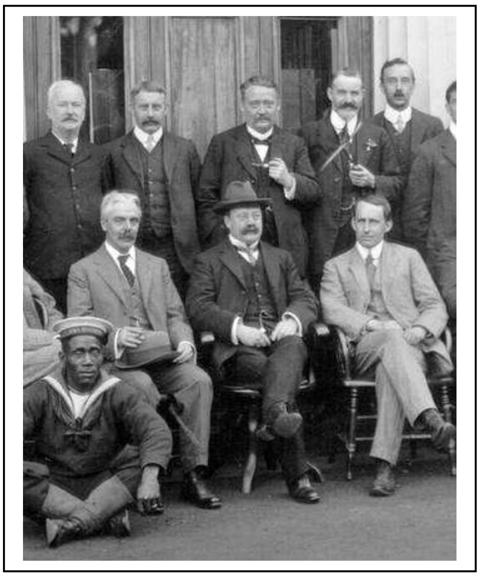
Figure 1. This cartoon of Halm is from the Cape Times of 19 September 1908, by "MAC" (Herbert Wood MacKinney)

Halm's most interesting and prescient paper, "Further considerations relating to the systematic motions of the Stars" was published in 1909. According to him, stars appeared to obey a Maxwellian distribution, or equipartition of energy, so that the less massive stars moved more rapidly than the massive ones. This conclusion was based on the then limited knowledge of stellar masses derived from a number of binaries.

The other important and more famous conclusion of this paper is that there is a distinct relation between spectral type and mass for stars. This was the first indication of the *mass-luminosity relation*, later elaborated by others.

Eddington, in his book *Stellar Movements and the Structure of the Universe,* (1914) was obviously taken by the Maxwellian idea but showed that the stars could not interact sufficiently to lead to equipartition of energy and that, therefore, Halm's theory was incorrect. Nevertheless, his remarks and his ideas were milestones along the road to understanding stellar evolution.

In 1915 Halm published an important paper concerning reciprocity failure in photographic emulsions (i.e., the deviation of the image density from a linear response to the amount of light it is exposed to) and derived what is now known as the Kron-Halm catenary equation.



Left: Visit by British astronomers to the Royal Observatory, Cape, in August 1914. Halm is in the middle of the back row. In the front row are Dyson, Hough and Eddington. On the ground is a Krooman from west Africa.

In 1917 Halm was the first person to make an estimate of "total to selective extinction" of starlight. He determined that the interstellar extinction in magnitudes is a factor of 1.22 times greater in the blue (i.e. the wavelengths to which old photographic plates were sensitive) than in the visible.

In 1919 he was able to arrive at a figure of 2.1 mag, based on star counts, for the maximum extinction per kiloparsec due to dust in the interstellar medium. His interest had arisen from efforts around this time made to calibrate the photometry of stars in the CPD and the Cape Astrographic Zone catalogues.

Hough became ill with cancer and left for England in March 1923. He died the following July and was replaced by Harold Spencer Jones, who had been Chief Assistant at the Royal Greenwich Observatory. During Hough's illness and on other occasions when he had been on leave, Halm took over the running of the Observatory. From their correspondence during these periods, it is clear that Halm discussed his ideas with Hough on a regular basis. His loss must have been a blow.

After the arrival of H.S. Jones as HM Astronomer at the Cape, Halm worked with him on determining the solar parallax (distance of the Sun) through observations of Mars.

Halm reached the retirement age of 60 on November 30 1926 but was allowed to stay on until April 25 1927 in order to complete 20 years of service. He was unable to have his service at Edinburgh recognized as pensionable. His pension amounted to £251-7-8 per annum and he received an "additional allowance" of £643-6-3, presumably once-off.

According to Anon (1944), ASSA presented him with a set of astronomical drawing instruments as a retirement gift.

Private life in Cape Town

Halm played viola with the Chamber Music Union, a small group of musicians who gave concerts of chamber music before the Cape Town Orchestra was founded. According to Jones (1945) he was equally at home playing his much-treasured Amati violin.

He is also known to have played bowls.

During the First World War, jingoistic feelings ran high at the Royal Observatory and Halm was subject to much unpleasantness from two of the staff members, Joseph Lunt and John Power. Though conscription did not apply in South Africa, ten sons of Observatory staff members had served in the War. Halm's son did not do so and this was a cause of resentment, especially after Power's son was killed. During his absences Hough put Halm, as Chief Assistant, in charge of the Observatory and this was resented by these individuals, who conducted a campaign against this arrangement, even involving J.W. Jagger, a prominent politician at the time. Hough did not hesitate to confirm Halm's loyalty and deny some of the wilder accusations that had been made. The relevant correspondence can be found in the SAAO Archives volumes (see references below). Curiously, at the start of section B2 of the latter, somebody has written "Correspondence previous to April 16, 1919 was destroyed accidentally or otherwise"!

According to Jones (1945) his entire sympathies were with the British cause.

The Halm's children were Eric Adolphus Halm (born Strassburg 25 May 1895; who married Grace Lydia Dyer and had two daughters as well as a son who died as a baby), Florence Stella (Born in Edinburgh 15 May 1897) and Violet Jessie (married Parker), born in Edinburgh 6 April 1902. His present-day descendants include members of the Davies and Burgers families. E.A. Halm went to school at SACS and later studied at the

University of Cape Town, where he held a Minor Bursary. Later in life he became a headmaster in Ladysmith, Natal. He was also Deputy Director of Education in Natal (retired 1955).

Sundials

Halm designed a universal sundial and ASSA published a booklet on it.

At the National Botanic Garden of Kirstenbosch there is a sundial presented by him. The following rather exaggerated account was found on the SANBI website:

"The Kirstenbosch sundial is reputed to be the most accurate sundial in the southern hemisphere. It was constructed by J.R. Miller at the Royal Observatory in Cape Town and presented to Kirstenbosch in 1920 by Dr. J.K. Halm, a scientist at the Royal Observatory. Dr. Halm's daughter was employed as a plant recorder at Kirstenbosch. It bears the inscription HORAS SIGNO UMBRA MOVENTE FLORES GIGNO LUCE FOVENTE, 'I show the hours by moving shadow, I bring forth flowers by sunlight nurtured.' It is orientated to the latitude of Kirstenbosch: 33° 59` south. Its limitation is that the sun disappears behind the mountain in the late afternoon."

Stellenbosch

After his retirement in1927 Halm moved to Stellenbosch. In a letter written shortly afterwards to Jones from an address in Ida's Valley he mentioned that he was about to be offered a lectureship at the University and had bought a Whippet car (then a popular brand made by Willys). He had already found congenial musical and artistic company.

One of his students was Arthur Bleksley, later a well-known science populariser, who did research on pulsating variables.

In 1935 Halm gave a Presidential Address to ASSA that received widespread attention. He believed that many features of the earth could be explained by an ongoing expansion. However, since the advent of plate tectonic theory, the expansion hypothesis is no longer considered plausible.

Honours etc

Halm was the first president of the Cape Astronomical Association (1912). He was president of the Astronomical Society of South(ern) Africa 1924-25 and 1934-35. He was a Fellow of the Royal Astronomical Society 1906-1940.

Halm died 17 July 1944 and was buried in the Champagne graveyard, Wellington, Western Cape.

Tributes

[The following letter was among memorabilia shown to me by a member of the family. Theo Russo was a "Higher Observatory Officer" at the Royal Observatory when I first worked there at the end of 1971.]

Theo Russo to Mr E. Halm, 18 Nov 1970 "… As a young lad from school in January 1925 I first entered service at the Royal Observatory, and your father was then Chief Assistant. I remember him very well, and had a great regard and affection for him. He took an extremely kindly interest in the four juniors then employed here, and gave much of his free time after hours to give us tuition in Astronomy and Spherical Trigonometry…"

Obituaries were written by Anon (1944), Bleksley (1944), Jones (1945) and Pilling (1944).

Acknowledgment

I thank Halm's Davies descendants for some of the information used in the preparation of this article.

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Notes: (1) The correspondence referred to in the body of the paper can be found in SAAO Archives volumes "A Establishment External 1915 – 1927 (? last figure obliterated)" and "B Establishment External 1910-1920".

(2) Some forty papers by Halm are listed by the NASA-ADS Data Service but some early papers published in the Transactions and Proceedings of the Royal Society of Edinburgh and elsewhere are not included. See also Poggendorff, J.C., (various dates*), Biographisch-Literarisches Handwörterbuch*, Leipzig, Barth, entries concerning Halm.

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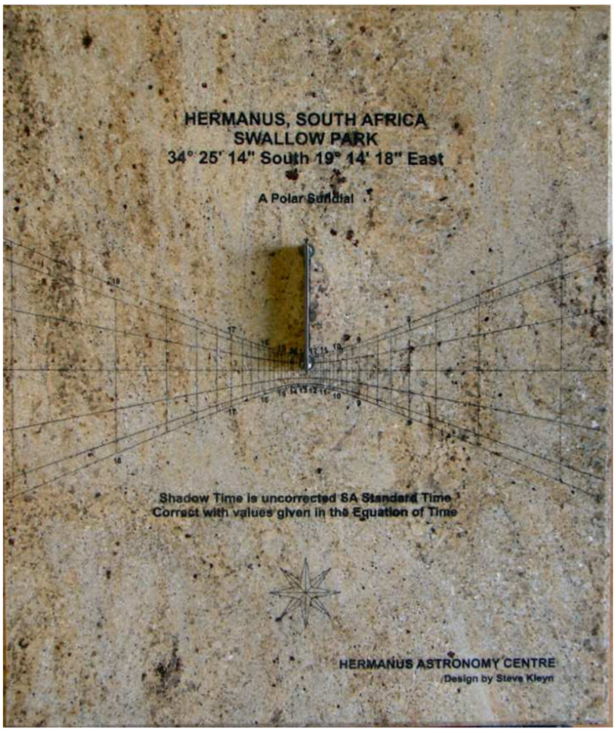
The Swallow Park Sundials

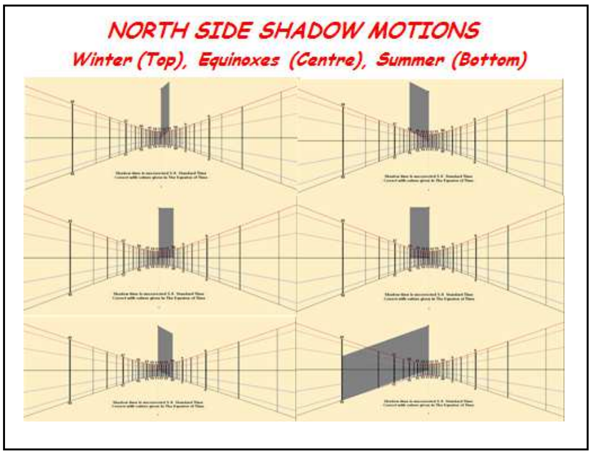
Pierre de Villiers

The Hermanus Astronomy Centre recently erected a pair of back-to-back sundials in Swallow Park in the centre of Hermanus as part of the upgrading of this historical public park by the Ward committee. Since these two are intended to be the first of many different design sundials to be erected in Hermanus by the HAC, the designs were purposefully chosen to be “unusual” to illustrate the point that even unfamiliar designs and orientations give the same end result. Their location in a freely accessible public park dictated material choice to be as vandal-proof as possible: Engraved polished granite for the sundial faces, gnomons as small as possible in stainless steel and explanatory plaques firmly epoxied onto a sandstone-dressed plinth that matches the style of the benches and other structures in the park.



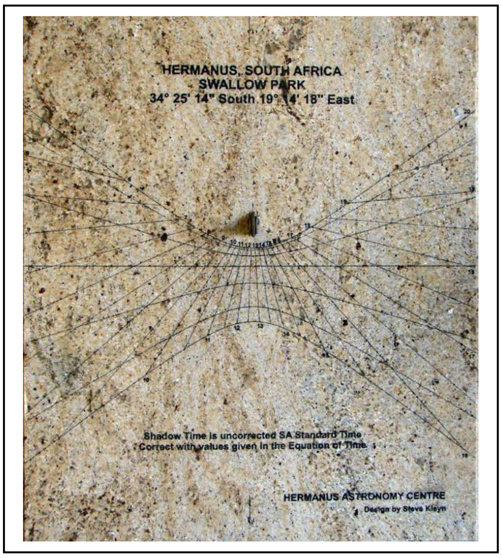
Left: Fig 1.

The Northern, South facing sundial is a Polar design, with the sundial’s face mounted at the sundial’s Latitude of 34 ^{o} 25’ 14”, which has a number of implications: Its gnomon or style must be rectangular, the Sun will always describe full circles around the gnomon and the hour lines are therefore parallel as the Sun’s shadow moves from West to East right to left in Fig. 1. The hyperbolic declination lines trace the gnomon’s tip shadow at various times of the year. Fig. 2 illustrates the winter, equinox and summer shadow motions move along the solstice and equinox declination lines. Steve Kleyn, who designed the sundials, included two intermediate declination lines between the solstices and equinox. This has the interesting implication that one can infer the approximate date by interpolating between two adjacent declination lines. “Clever” are some comments I’ve heard!

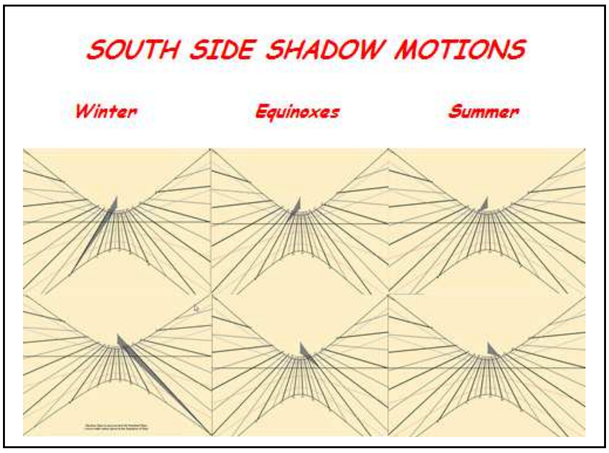


Right: Fig 2.

The Southern, North facing sundial is an even rarer Declining design, Fig. 3, in which the gnomon is once again pointing to the South Celestial pole, whose shadow is cast onto a plane inclined at 15 ^{o} to the horizon. Even though this sundial will not cast a usable shadow throughout the year, the declining angle was chosen to maximise the amount of usable shadow throughout the year. This sundial also has two intermediate declination lines between the solstices and equinoxes, but the hour lines are no longer parallel because the sundial plane is not parallel to the Earth’s rotation axis. It is however still possible to deduce the approximate date by interpolating the gnomon tip shadow between adjacent declination lines. The longer shadows cast on this sundial enables one to read the time more accurately than on the Polar design, where the bunching of the hour lines near noon make accurate readings rather difficult. Fig. 4 show the gnomon’s shadow motion along the solstice and equinox declination lines..



Left: Fig 3.



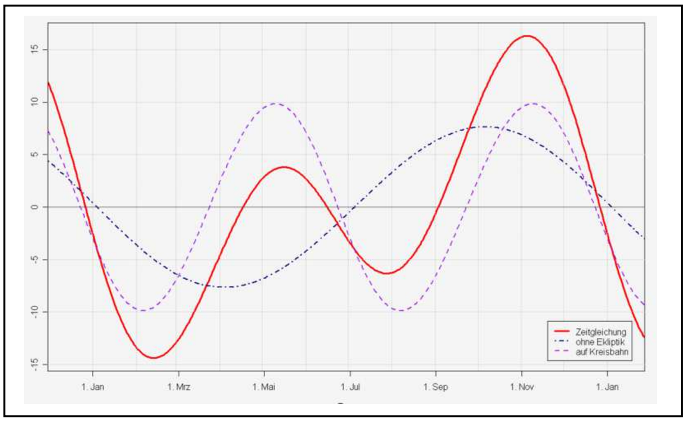
Left: Fig 4

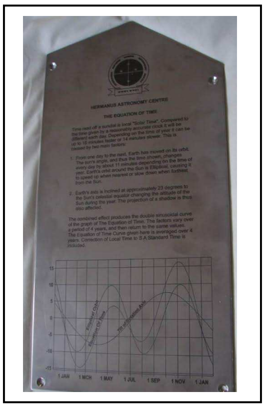
On the East and West sides of the plinth there are stainless steel plaques explaining the origin of the Equation of Time, or time correction value, and graphically depicting it as follows:

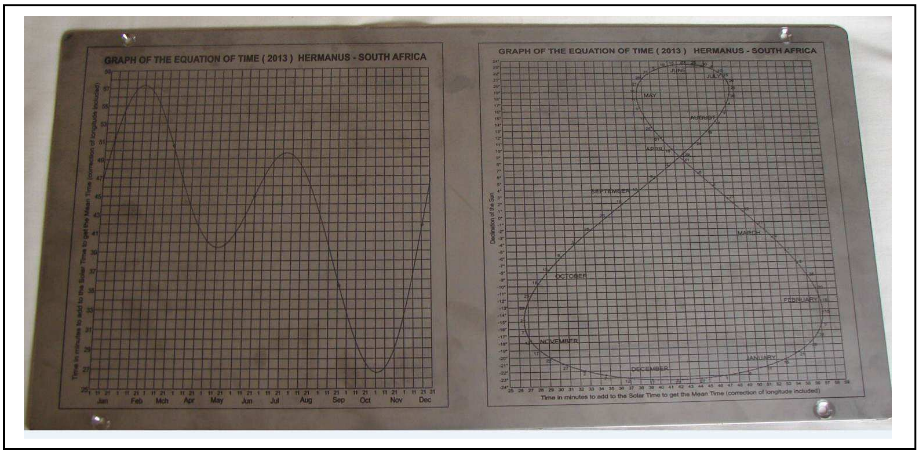
"Time read off a sundial is local "Solar Time". Compared to the time given by a reasonably accurate clock it will be different each day. Depending on the time of year it can be up to 16 minutes faster or 14 minutes slower. This is caused by two main factors:

1. *From one day to the next, Earth has moved on its orbit. The Sun's angle, and thus time shown, changes every day by about 11 minutes depending on the time of the year. Earth's orbit around the Sun is elliptical, causing it speed up when nearest and slow down when furthest from the Sun.*
2. *Earth's axis is inclined at approximately 23 degrees to the Sun's celestial equator changing the altitude of the Sun during the year. The projection of a shadow is thus also affected.*

The combined effect produces the double sinusoidal curve of the graph of The Equation of Time. The factors vary over a period of 4 years, and then return to the same values. The Equation of Time Curve given here (Fig. 5, right) is averaged over 4 years. Correction of Local Time to SA Standard Time is included."





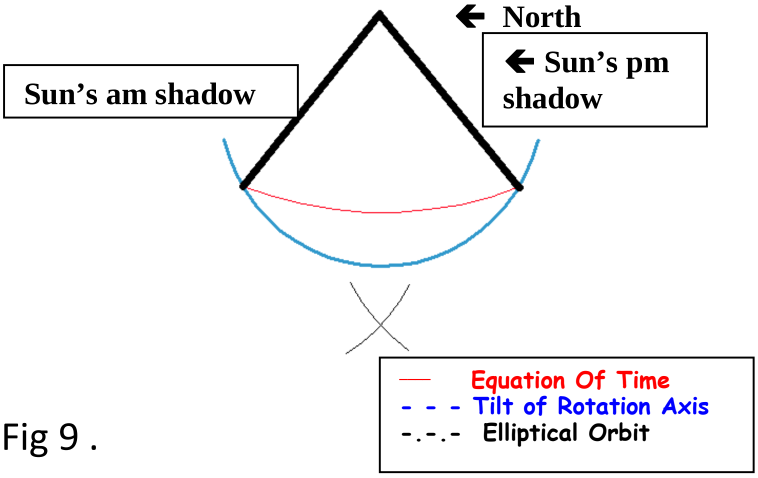


Above left: Fig. 6 shows the plaque on the plinth
Above right: Fig 7.

Immediately below both sundials there are two different graphs from which the Equation of Time can be read off as function of date, see Fig. 7 (previous page). A conventional XY-graph and a much more interesting analemmic version, which also shows the declination (celestial equivalent of latitude) of the Sun.

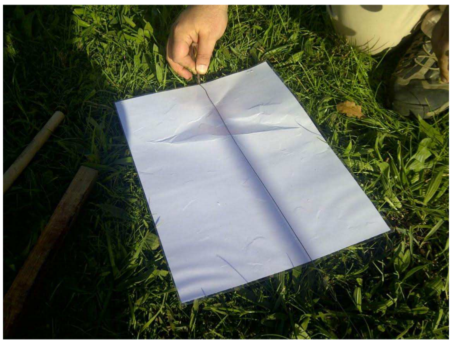
Even though the construction materials of sandstone plinth dressing, polished and engraved granite sundials and stainless steel plaques were dictated by external factors the combination form a complimentary contrast which is aesthetically pleasing.

Left: Fig 8.
It is fantastic to note that the sundials are 100% Hermanus “indigenous”: The design is by Steve Kleyn of the Hermanus Astronomy Centre, the granite and stainless steel are from local suppliers (Southern Granite and Exclusive Works) and the engraving on both the granite and stainless steel by LES Engravers.
The *in situ* determination of North was done by the “broom stick” Boy Scout method depicted in Fig. 9.



Right: Fig 9 .

Left: Fig 10. Steve's use of the Broomstick method.



Right: Fig 11 Indicates a measurement accuracy of better than 10mm at ϕ3.5m for the East point.

Below, left: Fig. 12. The final epoxying and screwing into place by Steve Kleyn and Chris Theron who proudly survey their handiwork!

Above right: Fig 13. Steve Kleyn with the Mayor of Hermanus, Ms Nicolette Botha-Guthrie's, reaction to what can only be described as an aesthetically pleasing, utilitarian and educational structure – a precursor of more to come.

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 in this section are the colloquia/seminars at the SAAO, NASSP, UWC and the Astrophysics, Cosmology and Gravity Centre at UCT, ACGC. 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 [Editor].

SAAO

Title: Long-term monitoring of the optical polarization in the TeV blazar PKS 2155-304
Speaker: Nikki Pekeur (Visiting from North-West University)
Venue: SAAO Auditorium
Date: 12 December 2013
Time: 11h00

Abstract: Blazars are radio-loud active galactic nuclei (AGN) that are characterized by intense and rapid variability across the electromagnetic spectrum. The observed emission from these objects is generally believed to originate from synchrotron processes in its relativistic jet. Multi-band polarimetric measurements are therefore an important tool to investigate the nature of the components that are responsible for the observed variability. In this work, a study of the temporal evolution of the optical

polarization of the archetypal blazar PKS 2155-305 is presented. The source was monitored with the HIgh Speed Photo-Polarimter (HIPPO) of the SAAO and the SPOL imaging spectropolarimeter of the Steward Observatory between 2008 and 2013. Fluctuations in both the internight and intranight polarization is investigated. The frequency dependence of the polarization during an increased state of activity is also examined.

Title: MeerLICHT: Simultaneous optical-radio observations of astrophysical transients
Speaker: Patrick Woudt
Venue: SAAO Auditorium
Date: 23 January
Time: 11h00

Abstract: ThunderKAT is the MeerKAT Large Survey Project (LSP) for incoherent (synchrotron) radio transients. A nominal amount of 3000 h has been allocated for dedicated MeerKAT observations of X-ray binaries, tidal disruption events, cataclysmic variables, supernovae and gamma-ray bursts over the first five years of science operation of MeerKAT. In addition, ThunderKAT will make use of a dedicated 'transient data spigot' to search all MeerKAT LSP imaging data for astrophysical transients on time scales in excess of 0.1-1 sec, monitoring the transient radio universe in real time for unusual events (e.g. Fast Radio Bursts, Thornton et al. 2013).
In this talk I will present details of the MeerLICHT project: time-scales, optical design and the primary science case for simultaneous optical-radio observations of astrophysical transients. MeerLICHT is the [simultaneous and real-time] optical extension of ThunderKAT's commensal search for radio transients. The MeerLICHT telescope, to be housed in Sutherland, will be a fully robotic 0.65-m telescope with an instantaneous field of view of 2 square degrees, matching the field of view of MeerKAT. The telescope will receive its pointing input from the MeerKAT telescope, ensuring simultaneous optical-radio coverage for all night-time MeerKAT observations.

Title: X-ray Transients from Supersoft to Halo Black-Hole Systems
Speaker: Phil Charles
Venue: SAAO Auditorium
Date: 23 January
Time: 11h00

Abstract: I will discuss the nature of X-ray transient outbursts from both HMXBs and LMXBs. In the former, we have identified an X-ray flash that, in spite of its high luminosity, we interpret as a white dwarf compact object. Whereas in the latter, there is growing evidence for a new class of high latitude, very short period, black-hole systems.

ACGC

Title: **Gravitational Waves: a portrait of the early universe**
Speaker: João Morais (CENTRA, Instituto Superior Técnico, Lisbon - Portugal)
Venue: M111, Maths Building, UCT
Date: 10 December 2013
Time: 12h00

Abstract: The cosmological gravitational waves (GWs), when detected, could provide us with an invaluable picture of the dynamics of the early universe. By implementing the method of the Bogoliubov coefficients to compute the energy spectrum of the GWs as would be measured today, we can look for imprints of the early evolution of the universe. In particular, we can look for potential signs of a primordial bounce. We apply these ideas to modified theories of gravity: (i) generalised theories of the kind f(R); (ii) a loop quantum Cosmology setup where the modification with respect to GR is due to the quantization of space-time.

Title: **Gamma-Ray Constraints on Self Annihilating Dark Matter**
Speaker: Chris Gordon (University of Canterbury - New Zealand)
Venue: M111, Maths Building, UCT
Date: 21 January
Time: 12h00

Abstract: One of the main candidates for dark matter (DM) is the weakly interacting massive particle (WIMP). The WIMP model predicts that DM particles should pair annihilate into standard model particles. This allows the DM to be a thermal relic of the big bang and the weak scale interaction strength leads to the observed dark matter abundance. The standard model particles produced by the WIMP annihilation typically have weak scale energies and so by a process of pion decay, bremsstrahlung, or inverse Compton scattering, can lead to gamma-ray emission. This residual gamma-ray emission is being searched for with the Fermi Large Area Telescope (LAT) and HESS telescope. Regions, such as Milky Way satellite galaxies, galaxy clusters and the inner Galaxy are the most promising targets. The Fermi-LAT is starting to rule out the lighter WIMP models which have a thermal relic cross-section. There are some excess gamma rays observed in the Galactic Center but these are probably due to an unresolved population of millisecond pulsars.

Title: **Geometry of Abelian Higgs Vortices**
Speaker: Prof. Nicholas Manton (University of Cambridge - UK)
Venue: M111, Maths Building, UCT
Date: 4 February
Time: 12h00

Abstract: Vortices in the Abelian Higgs model are related to magnetic flux vortices in superconductors, but they can also be regarded as solitonic particles in two dimensions. The first order BPS equations for vortices in the plane or on a curved surface reduce to Taubes' equation, a nonlinear scalar PDE that is close to Liouville's equation. Solutions have an elegant,

geometry-preserving character, as observed by Baptista. Moving vortices on a surface have an effective mass that depends on the local curvature. They behave approximately as point particles, but the effect of their finite size has recently been clarified by Dorigoni, Dunajski and the speaker.

UWC

Title: Detecting planets around evolved pulsating stars using the timing method
Speaker: Enrico Olivier (UWC)
Venue: Room 1.35 of the Physics Department, UWC
Date: 6 December 2013
Time: 14h00

Abstract: I met up with the EXOTIME group at the Osservatorio Astrofisico di Torino during October this year to learn more about their data analysis method. The primary goal of the EXOTIME project is to use the timing method to detect exoplanets around evolved pulsating stars such as subdwarf B (sdB) stars and white dwarfs. This talk will cover the timing method, the EXOTIME project itself and the wider context of the project in exoplanet and stellar research. I will also discuss one of the project's southern targets, the sdB star EC09582-1137 originally discovered by Dave Kilkenny.

Title: Testing Bell's Inequality with Cosmic Photons
Speaker: **Jason Gallicchio** from the University of Chicago
Venue: Room 1.35 of the Physics Department, UWC
Date: 13 December 2013
Time: 14h00

Abstract: A practical scheme to use photons from causally disconnected cosmic sources to set the detectors in an experimental test of Bell's inequality will be discussed. In current experiments, with settings determined by quantum random number generators, only a small amount of correlation between detector settings and local hidden variables, established less than a millisecond before each experiment, would suffice to mimic the predictions of quantum mechanics. By setting the detectors using pairs of quasars or patches of the Cosmic Microwave Background, observed violations of Bell's inequality would require any such coordination to have existed for billions of years -- an improvement of 20 orders of magnitude.

AIMS

Title: **Dark Matter and Pulsar Model Constraints from Galactic Center Fermi-LAT Gamma Ray Observations**
Speaker: Chris Gordon (University of Canterbury - New Zealand).
Venue: The Hall, AIMS research centre
Date: 27 January
Time: 12h00

Abstract: Employing Fermi-LAT gamma ray observations, several independent groups have found excess extended gamma ray emission at the Galactic Center (GC). Both, annihilating dark matter (DM) or a population of about 1000 unresolved millisecond pulsars (MSPs) are regarded as well motivated possible explanations. However, there is significant uncertainties in the diffuse galactic background that need to be accounted for. We have performed a revaluation of the DM and MSP models for the extended gamma ray source at the GC by accounting for the systematic uncertainties of the Galactic diffuse emission model. We also marginalized over point source and diffuse background parameters in the region of interest. We showed that the excess emission is significantly more extended than a point source. We found that the DM (or pulsars population) signal is larger than the systematic errors and therefore proceeded to determine the sectors of parameter space that provided an acceptable fit to the data. We found that a population of order 1000 MSPs with parameters consistent with the average spectral shape of Fermi-LAT measured MSPs was able to fit the GC excess emission. For DM, we found

that a pure tau+tau- annihilation channel is not a good fit to the data. But a mixture of tau+ tau- and b bbar with a σv of order the thermal relic value and a DM mass of around 20 to 60 GeV provides an adequate fit.

Title: **Three applied statistical problems**
Speaker: **Ian Durbach** (University of Capetown, Department of Statistical Sciences).
Venue: The Hall, AIMS research centre
Date: 12 February
Time: 12h00

Abstract: This talk briefly describes three applied problems. The first involves estimating the ages of long-living trees in arid areas in order to infer recruitment events – mass births generally triggered by abiotic factors and occurring at intervals of several years – using a combination of distribution fitting, simulation and bootstrap resampling. The second describes an application of Bayesian change-point models (or product partition models) to retrospectively identify changes in time series, in the area of consumer behavior. The third investigates the extent of the "wisdom of the crowd" in sports betting data, and shows how this is dependent on the loss function used to evaluate individual bets.

Astro-coffee

Title: Latest pulsar results from LOFAR
Speaker: Joeri van Leeuwen
Date: 16 January
Venue: 2nd Floor Auditorium SKA SA building, Pinelands
Time: 13h00

Abstract: The Dutch/European Low Frequency Array LOFAR provides exceptional collecting area and bandwidth. In the commissioning phase and the first cycle of open-time observing, LOFAR collected much high-quality data. I will describe some of the initial results, on low-frequency behaviour in M87; deep LOFAR epoch of reionization observations toward the north celestial pole; recombination lines; and our ionosphere. I will then present in some more detail the results from our two complementary pilot pulsar surveys, and several other LOFAR pulsar projects -- mostly on neutron-star magnetospheres. Finally I will sketch the current dedicated and open-time projects, focusing on the search for new pulsars and fast transients.

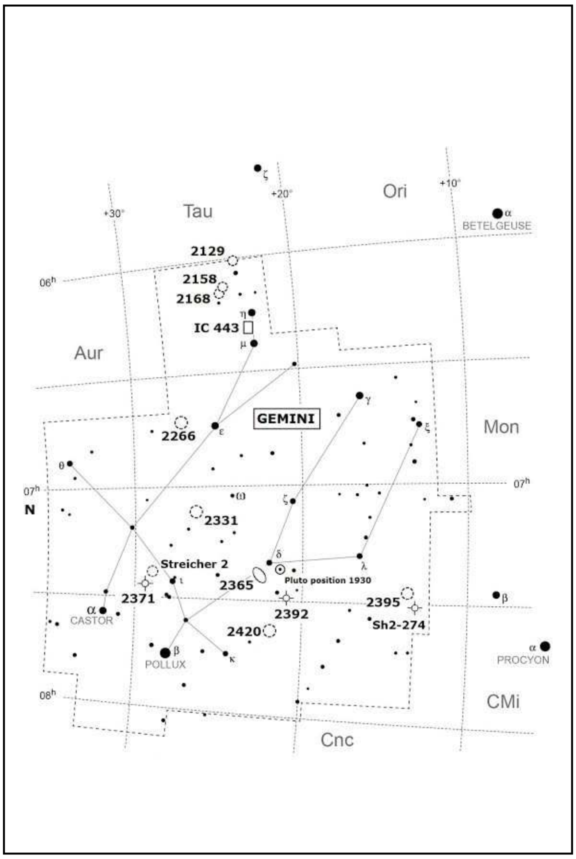
Title: Mapping the distant universe with emission line galaxies and quasars
Speaker: Jean Paul Kneib Professor - ERC Advanced Grant Laureate - Project "Light on the Dark"
Laboratoire d'Astrophysique Ecole Polytechnique Fédérale de Lausanne (EPFL)
Date: 21 January
Venue: 2nd Floor Auditorium SKA SA building, Pinelands
Time: 13h00

Abstract: In this presentation, I will explain why and how astronomers will map the distant Universe (0.7<z<3) using Emission Line Galaxies (ELG) and Quasars in order to probe cosmology using BAO and RSD techniques. I will show results from recent pilot project conducted on SDSS/BOSS and VLT/FORS demonstrating the feasibility of targeting these new tracers. Finally, I will present how these new tracers are implemented in the new Sloan Cosmology project eBOSS and how they will be used in future cosmology project such as DESI and PFS.

Sky Delights: Two of a kind

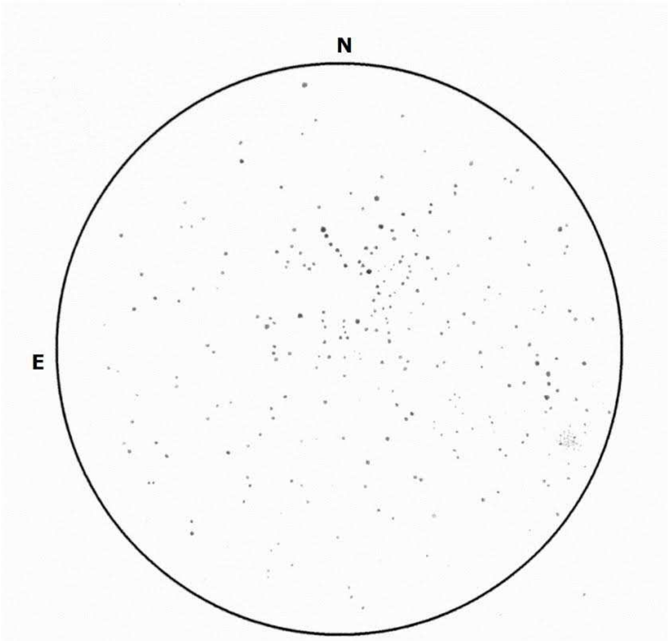
Magda Streicher

Twins of any kind are always fascinating, and a twin constellation is no exception. Not that it's in any way comparable with twins as we know them on earth. These heavenly twins are not identical, but do share some of the most splendid deep-sky objects. When the constellation makes its appearance in the east, we see the twins comfortably standing on their heads, somewhat low against the northern horizon as seen from the southern hemisphere. Writing about the Gemini constellation is one big joy ride through space, as it is extremely rich in a variety of exceptional deep-sky objects, although it is a pity that some are on the fainter side.



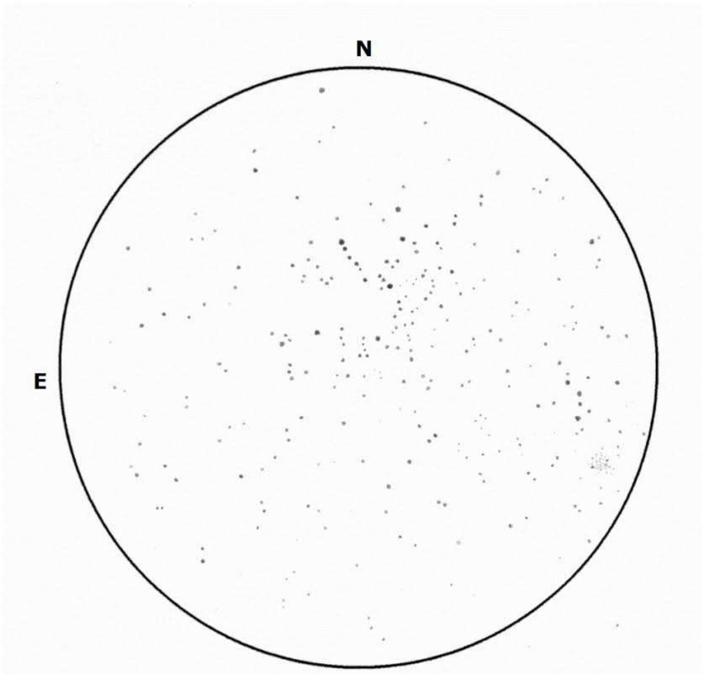
The constellation comes into view towards the end of year, with the western twin displaying its head star, the well-known double alpha Geminorum, better known as Castor. William Herschel analysed measurements of this star taken over a period of a century and proved that Castor's two bright components are orbiting each other, confirming the first evidence that gravity operates outside our solar system. The visual binary was discovered in 1678, with the components being magnitude 2 and 2.9 respectively, and the separation 6" with a revolution period of around 467 years. Each of the components itself is a spectroscopic binary, making Castor a quadruple star system with its six individual stars gravitationally bound together. Castor is quite close to our solar system at only 51 light years distant.

To trace the twins from head to foot is fun, and obviously easier when they are both higher up towards the night sky. This zodiacal constellation was also known in antiquity as the Sons of Zeus, named Castor and Pollux, and is a most striking constellation, worth getting to know better.



NGC 2168 and NGC 2158 - Clusters - Gemini

Appearing to be kneeling at the heavenly twins' feet is a well-known and favourite open cluster, none other than **NGC 2168**, perhaps better known as Messier 35, situated 2.5 degrees north-west of the magnitude 3.3 eta Gemini. This outstanding star cluster, which, in dark sky conditions, can be seen even with the naked eye, is splendid in appearance. The various stars clustering give it a very interesting impression with the way the stars are positioned, and a little imagination, you might even make out the shape of a fly or an insect of sorts. Through a telescope, however, the eye will immediately be drawn to a prominent, bright star string with a yellow-coloured magnitude 7 star at its north-eastern end that may also be seen as a double star, with an orange-coloured magnitude 9 companion Star strings and dark voids can easily been seen, and with higher magnification one can see dozens of faint pinpoint stars filling in the gaps. This is a bright, colourful cluster – and believe it or not, it is nearly 20 light years in diameter, which is fascinating, and about 2 800 light years away. The bonus, however, is to spot the small, faint companion cluster, **NGC 2158**, situated barely half a degree south-west from M35. This faint smudge of light is more than six times



NGC 2168 and NGC 2158 - Clusters - Gemini

further distant than its companion M35. However, with care and higher magnification it can be resolved in a tight, star-rich grouping.

One and a half degrees further west is the cluster **NGC 2129**, a lovely object, one of the author's favourites. Two bright super-white stars dominate the heart of the grouping in a north-south direction that stands out against a field of fainter stars. Strange, but true, is the fact that this cluster has also played the game with an outstanding twin impression. It is divided by a dark void that runs from south-west to north-east between the two magnitude 7–8 luminaries. The eastern part of the cluster seems slightly more crowded with fainter stars. Tom Campbell sees the letter D in the overall shape of the cluster, which was best, viewed at 122 magnifications during his observation. The cluster is very young, its age having been estimated at only 10 million years.

Further south-east, between the stars eta (magnitude 3.3) and mu (magnitude 2.8) Geminorum, faint nebulosity fills the field between them in a soft haze. Closer to the point is **IC 443** (Sharpless 248), a nebula not seen without a huge amount of effort. You need pitch-dark skies, nebula filters, and a dark cloth over your head with a lot of good luck and faith, and even then you could not be sure of spotting this filter haze. The brighter north-eastern shell of the nebula is more popularly known as the Jellyfish Nebula and might be the remains of a supernova occurrence thousands of years ago. The nebula spans nearly a degree between the two stars, but I suggest you rather admire the two beautiful stars, which both display a lovely orange colour. Deep photography of the nebula reveals what has to be one of the most beautiful nebulae, like delicate lace.

Down the left leg of the son Castor, and about a degree and a half north of magnitude 3 epsilon Geminorum, is the small open cluster **NGC 2266**. This is a story-telling cluster. It contains stars of various magnitudes, giving the impression of a feathery hat. Brighter stars mark the rim from north-east to south-west ending in the brighter magnitude 8.9 star towards the south-western tip. A handful of faint stars spreads out randomly to the north-east like feathers. It is apparently a very old cluster which is rather faint but very beautiful.

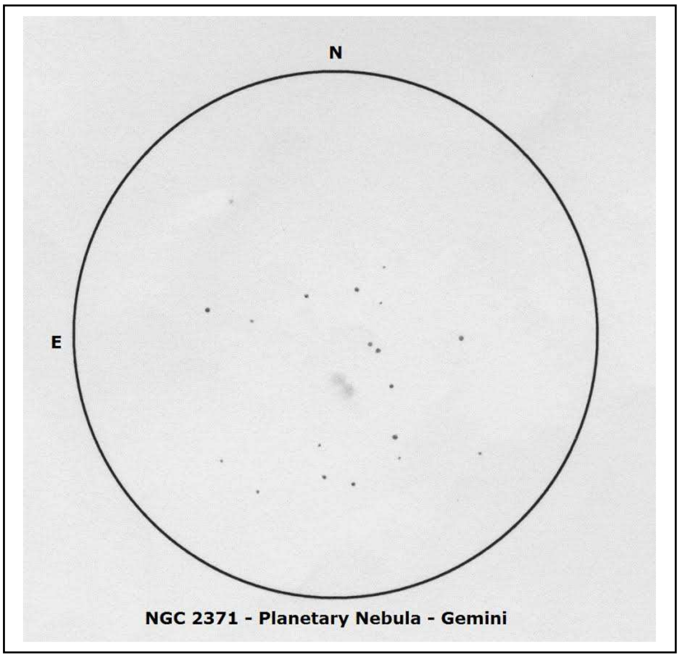
Another cluster worth a visit is **NGC 2331**, about 5 degrees east of **NGC 2266**. A rather loose grouping with quite a mixture of stars in terms of magnitude, but what impresses most is a small, really pretty half-circle of faint stars situated in the northern part. Most of the stars seem to enjoy the company of a visible double. A triangle of stars is seen towards the south, with fainter members in between.

At the bend of brother Pollux's knee is a special spot between its host stars. The controversial planet Pluto was discovered on a photographic plate by the young Clyde W. Tombaugh on 18 February, 1930 at the position RA: 07h21m02s - DEC: +21°55'24", barely 15' south-east of delta Geminorum. To pinpoint this famous spot, first find the easily seen magnitude 11 double stars just 5' south-east from delta Geminorum. Another 8' east will bring up a triangle of three faint stars which were the silent companions to planet Pluto on the night of its discovery (see Fig. 1). But things change in the world of science and poor little Pluto has now been demoted to only the status of a dwarf planet; however, fortunately for Pluto, it is still the largest object in the Kuiper Belt. Pluto was named by an 11-year old girl, Venetia Burney of Oxford, who suggested the name from the Roman god of the underworld.

The galaxies in Gemini are all mostly faint, but a relatively easy one to find is **NGC 2365**. While still in the neighbourhood of delta Geminorum and 30' towards the north-east, the galaxy shares this historic star field. The rather faint spiral is not much more than a faint glow in a north to south direction, but still worth a try if you can shift the bright delta Geminorum to the side of the field of view.

Approximately 2.3 degrees south-east of delta Geminorum is one of the best-known, much-discussed and well-loved planetary nebulae, **NGC 2392**, better known as the Eskimo Nebula, discovered by the great William Herschel in 1787. It is also sometimes referred to as the Clown face Nebula, which indeed shows lovely character in displaying a double shell around a bright inner part. It is easy seen with the use of a telescope, although from the southern hemisphere there could be some low horizon disturbances. But it is a worthwhile object to observe, with its number of dark patches that truly resemble a face of sorts. The soft flimsy outer edge clearly hints at the furs on the Eskimo's hat. The nebula is about 4 200 light years distant and the remnant star will eventually collapse to form a white dwarf. My good friend Dana Patchick had this to say about the Eskimo Nebula: *"It is tough to top the view for sheer frightening detail that was seen of the 'Eskimo' in the Mount Wilson 60" reflector one fine evening. I say 'frightening' because it reminded me of looking into the maul of the 'planet killer' for those of you that remember that Star Trek episode, The Doomsday Machine'."*

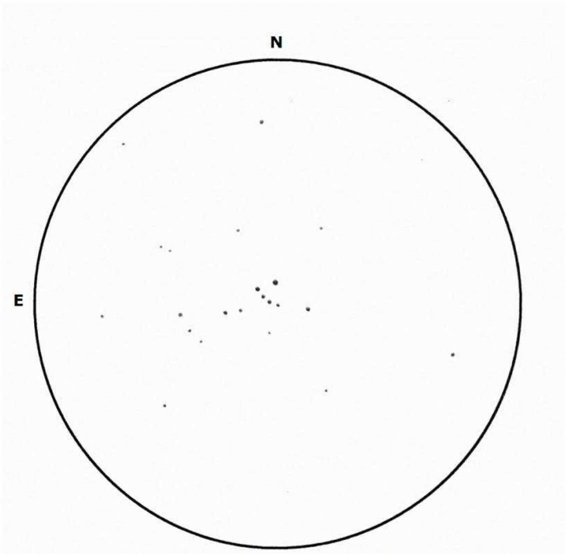
In a slender triangle to the east with the Eskimo Nebula and delta Geminorum the rich open cluster NGC 2420 displays several stars packed into a rather small area. First impression is the brighter curved string of stars towards the southern part of the cluster. If you ever see a small impression of the constellation Corona Borealis then this is a match to beat. The bulk of many fainter stars spread outwards into the north-eastern part of the grouping. This cluster could contain as many as 50 members or perhaps more.



Another twosome shares half a degree field of view only 1.3 degrees north of the constellation Canis Minor. The open cluster **NGC 2395** displays a loose overall shape in a triangular point towards the north, with faint stars scattered randomly throughout. A very short string pointing south-west seems to be connected to the group. The partner in this twosome is the indicated object **Sh2-274**, also known as Abell 21, perhaps not so familiar, but the "Medusa Nebula", situated only 35' south-east, certainly rings a bell. The faint crescent-shaped haze filters out in a soft filamentary nebulosity towards the north-west. With a sharp eye in excellent dark skies and a somewhat larger telescope, dark voids maybe glimpsed.

Another favourite object is the planetary nebula **NGC 2371-2**, which can be found in a triangle to the south-west with alpha and beta Geminorum, or, if you prefer, the well-known stars Castor and Pollux. With the Gemini standard this object is a double-lobed planetary nebula which had the appearance of two separate objects, for which two entries were, therefore, given. When intensive photos are studied, one gets the impression of the nebula hidden inside a chocolate paper wrapping. Unwrap this heavenly chocolate and two circular patches of nebulosity straddling their magnitude 13.3 central star, the remains of a sun-like star. The lobes of nebulosity appear almost within touching distance with averted vision. The western lobe is slightly brighter and with the help of an OIII filter the nebulosity of both lobes extends into a see-through haze.

To end with a reference to another favourite, this time an asterism, none other than **Streicher 2**, barely a half a degree south-west of NGC 2371-2. This asterism displays an exquisite and dainty little grouping. It is quite outstanding against the background star field with the brighter magnitude 9.7 star towards the north. The first impression is a few stars from north-east to south-west in an uneven curve. Another short string can be seen towards the east.



STREICHER 2 - Asterism - Gemini
RA: 07h23m.1 - DEC: +29o17'

When next you are lonely, take out your close friend, the telescope, or a pair of binoculars, and bond with the twins this summer, while realising that they will always remain part of the great unknown.

OBJECT	**TYPE**	**RA**	**DEC**	**MAG**	**SIZE**
NGC 2129	Open Cluster	06h01m.1	+23°17’.3	6.7	6’
NGC 2158	Open Cluster	06h07m.5	+24°05’.8	8.6	5’
NGC 2168 Messier 35	Open Cluster	06h08m.9	+24°20’.4	5.1	28’
IC 443	Supernova Remnant	06h16m.9	+22°46’.5	12	40’
NGC 2266	Open Cluster	06h43m.2	+26°58’.2	9.5	6’

NGC 2331	Open Cluster	07h07m.2	+27°21'.7	8.5	18'
NGC 2365	Galaxy	07h22m.5	+22°05'.1	12.4	2.7'x1.5'
STREICHER 2	Asterism	07h23m.1	+29°16'.9	2.5	5.5'
NGC 2371 NGC 2372	Planetary Nebula	07h25m.6	+29°29'.4	11.3	55"
Sh2-274 Medusa	Emission Nebula	07h26m.2	+13°20'.7	13	615"
NGC 2395	Open Cluster	07h27m.2	+13°35'.2	8	12'
NGC 2392	Planetary Nebula	07h29m.2	+20°54'.7	9.9	48"
NGC 2420	Open Cluster	07h38m.5	+21°34'.4	8.3	10'

ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

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 own electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly as well as its 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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