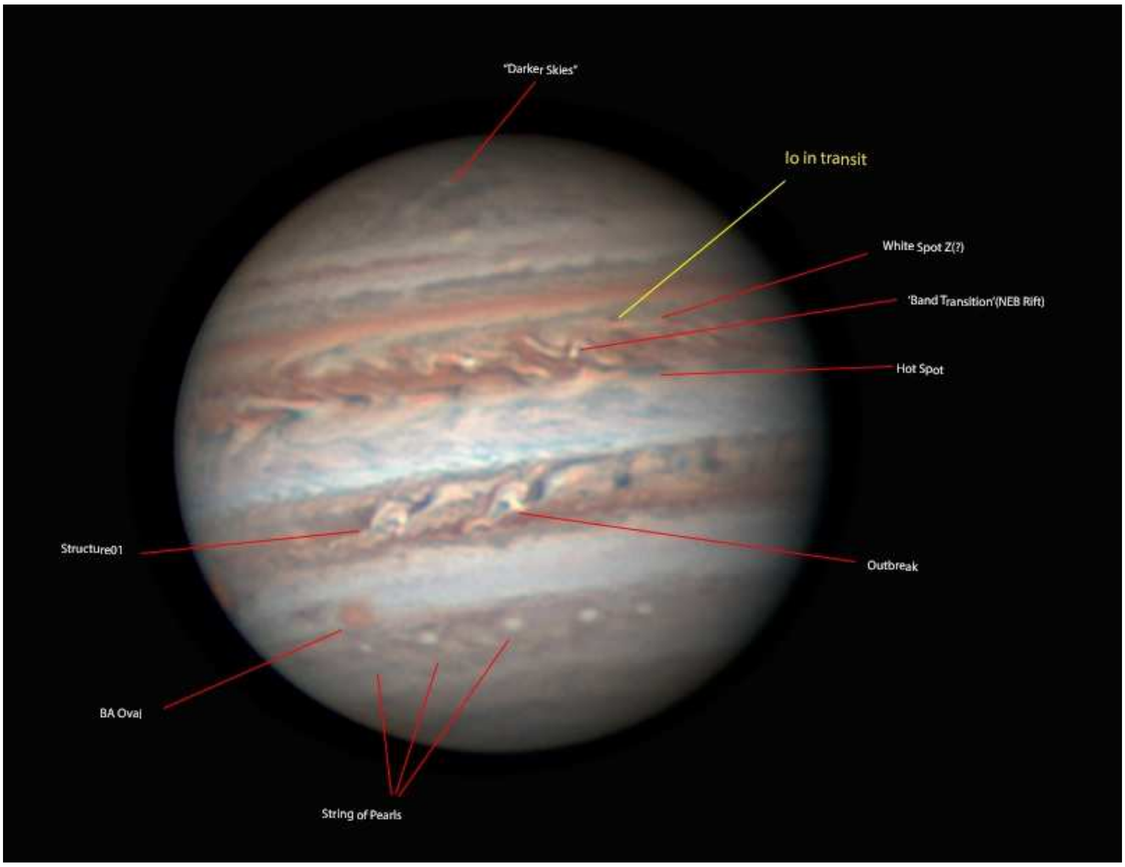
ISSN 0024-8266

mnassa

monthly notes of the astronomical society of southern africa

Volume 76 Nos 3 & 4 April 2017



In this issue:

News notes, New Director at SAAO, Pro-Am Interaction with NASA Juno mission, Six hours with our Home Star, Colloquia and Seminars

Cover: Image of Jupiter taken by Clyde Foster on 2 February 2017. See article on page 68.

mnassa

Vol 76 Nos 3 & 4 April 2017

Editorial

Recently I have received many submissions, for which I am really grateful, but they come in a variety of formats and styles. There is a style sheet available, but I know that many don't like using it for a variety of reasons, most commonly because they forget about it and simply write an article!

The simplest format for me to edit is a simple text or a plain, unedited MS Word file. Images of 150 - 250kB are fine and it would be most helpful if the image details are separate as well – these can then be used these for appropriate captions.

The ASSA will be holding **Symposium 2018** from 8 – 11 March 2018. For details see the webpage at:

http://symposium2018.assa.saao.ac.za/

It is regularly up-dated so it would be good to check it regularly and if anyone is thinking of attending, please complete the pre-registration from and if you would like to give a presentation, add that in the "comments" box.

News

New Director Appointed for SAAO

The NRF has announced that Dr Petri Väisänen has been appointed as the new Director: South African Astronomical Observatory with effect from 1 January 2018. From 1 September 2017 Dr Väisänen will assume the position of Director Designate and commence the hand-over processes from the current Director, Prof Ted Williams, whose contract will come to an end at 31 December 2017.

Dr Väisänen has been as SAAO and the NRF for more than 12 years, and served as a member of the SAAO Executive Committee and as *ex officio* member of the Southern African large Telescope (SALT) Board. Since 2015, he has been the Head of Astronomy Operations at SALT.

Dr Väisänen is an astronomer with extreme experience in different observational and data reduction and analysis methods across multiple wavelength regions and multiple observatories. He has an international reputation and enjoys membership of many international organizations, such as the International Astronomical Union, the International Society of Optics and Photonics, and has an NRF rating since 2008.

He brings with him a wealth of experience with a broad view and knowledge of many aspects of large telescope operations. His post-PhD career has been spent at observatories, first European Southern observatory in Chile, and their premier 8-m class VLT facility at Paranal, and then SAAO, hired to join the first complement of astronomers for the then newly built SALT in 2004/5. Here he was part of the team that devised the operational philosophy of the telescope.

Over the years at SAAO, he has established and led a research group concentrating on strongly star-forming galaxies, studying their history and future, and what can be learnt from them regarding the transformation of galaxy populations on the cosmic scale.

Due to his passion for education and skills development, he has been active in student supervision and teaching throughout his career, and has been involved in planning and teaching at workshops around the African continent in Ethiopia, Ghana, Rwanda, and Uganda.

News Notes

A robotic all sky monitor to observe one star for one year

For a period spanning 200 days from April 2017 extending up to January 2018 astronomers will observe beta Pictoris, the second brightest star in the constellation Pictor to detect rings from the planet beta Pictoris b. Beta Pictoris is a star located 63.4 light years from our Solar System with luminosity that is equal to that of the Sun. What is curious about beta Pictoris is, in 1981 its brightness diminished making astronomers think there must have been a huge object passing in front of the star, then the giant planet Pictoris b, was discovered in 2008.

The bRing instrument and the team that installed it.

In anticipation, a small robotic all sky monitor with two camera systems, the beta Pictoris b Ring project - bRing for short, will be dedicated to looking at beta Pictoris at the SA Astronomical Observatory in Sutherland, Northern Cape. The first light image of bRing proves that the instrument is ready for observations.

This year, the planet will move again in front of the star and pass almost directly between the star and us. If the planet has a ring system, we may be able to see the shadows of giant rings surrounding the planet, if and when they move into our line of sight.

The images taken by the cameras will be analyzed on a set of computers inside bRing and will monitor any changes in the brightness of beta Pictoris. If a change in brightness is detected, this will allow the triggering of a host of observations using larger telescopes and more advanced instrumentation to study the details of the suspected ring system in-depth. Blaine Lomberg, UCT and SAAO PhD student, will trigger observations with the High Resolution Spectrograph on the Southern African Large Telescope (SALT) to see if a transit of the ring system is detected to determine the composition of the rings.

Dr. Steve Crawford who is among the team who worked on the installation of bRing in Sutherland says, “In addition to monitoring beta Pictoris, bRing will also provide regular monitoring of the southern sky and the conditions of the night sky at the Sutherland observatory. These data will be available to astronomers in South Africa allowing them to search for new phenomena and also monitoring the performance of their own observations.”

The bRing project, is funded by NOVA and Leiden University, enabled by a collaboration grant from the Netherlands Organization for Scientific Research (NWO) and National Research Foundation (NRF), the two funding institutions of South Africa and the Netherlands. Later in the year the second station will be installed in Australia led by astronomers from Rochester University.

The design, construction, installation and operation of bRing has been made possible by funding from NWO and NRF. South African astronomers will host the bRing instrument that was built by Leiden astronomers Matthew Kenworthy, Remko Stuik, John I. Bailey III and Patrick Dorval and hosted by the South African astronomer Steve Crawford and Blaine Lomberg of SAAO.

SAAO helps to reveal seven new Earth-sized planets

A new system of seven Earth-sized planets orbiting a star 40 light years away has been discovered using data from South African Astronomical Observatory (SAAO) telescope, as well as other instruments around the world. Three of these planets are located in the star’s "habitable zone”. This means that they could have liquid water on their surface, which increases the chances of them hosting life. This new planetary system now holds the record for the largest number of Earth-sized planets found.

SAAO’s 1-m telescope was used to take observations of the planetary system over several nights in June and July 2016. The 1m telescope is equipped with a special camera, called the Sutherland High Speed Optical Camera (SHOC), which can take up to 70 images per second.

Head of Instrumentation at SAAO, Dr. Amanda Sickafoose, had this to say about SAAO's involvement in this exciting work:

”This is a remarkable discovery. To find multiple, possibly habitable exoplanets orbiting the same star is exciting. This system is quite different from our Solar System, which also raises new questions. The SAAO is proud to have played a small role in this advancement in our understanding of planetary systems."

Other telescopes used in this research include NASA’s Spitzer Space Telescope and ground-based telescopes in Chile, Morocco, Hawaii and the Canary Islands.

The planets were observed as they moved in front of their host star, called TRAPPIST-1, blocking out its light. By carefully measuring the amount of light blocked out as each planet passes in front of the star, astronomers were able to determine the sizes of the planets and the way in which they orbited TRAPPIST-1.

The researchers, led by Michaël Gillon of the University of Liège in Belgium, also report that the three planets in the habitable zone are likely to be rocky planets, like the Earth and Mars, Venus and Mercury, making this the system with the highest number of rocky planets in the habitable zone of their parent star.

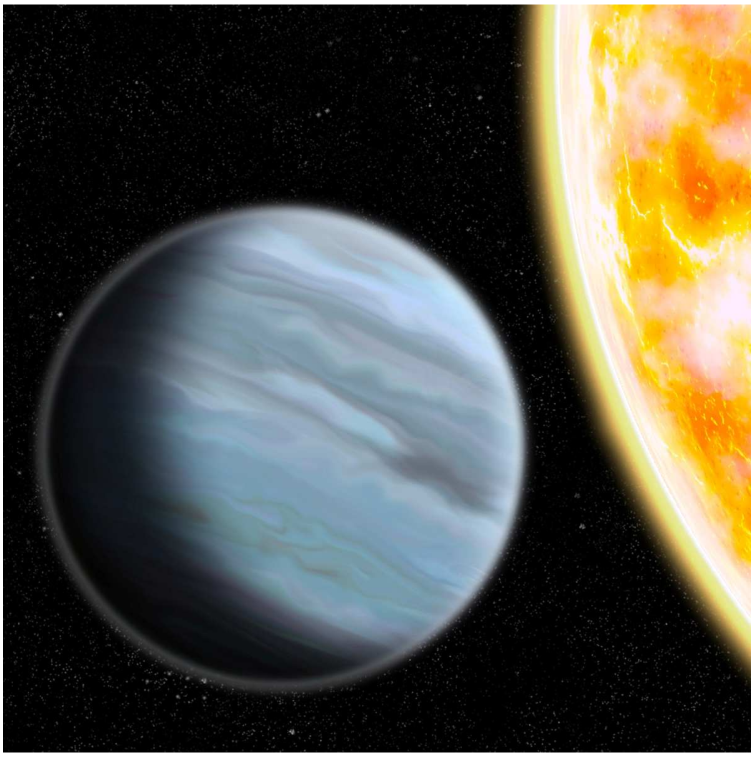
All seven planets orbit TRAPPIST-1 at a distance smaller than the orbit of Mercury, the closet planet to our Sun. The planets are able to orbit so near to TRAPPIST-1 is because it is a small, red dwarf star with temperatures much cooler than the Sun. The full details of this new discovery have been published in the journal *Nature.*

New highly inflated exoplanet spotted around nearby star

Researchers at the South African Astronomical Observatory and others from around the world, found a new exoplanet orbiting a star 320 light years away. The planet, called KELT-11b, is a gas giant similar to Jupiter and Saturn.

However, KELT-11b is very different from the gas giants in our solar system. The new exoplanet orbits its host star – called KELT-11 – so closely that it completes an orbit in less than five days. KELT-11b has only a fifth of

Jupiter's mass, but is 40% larger in radius. This means that this new bloated planet has about the same density as Styrofoam!



An artist's rendering of the planet and star.

Credit: Walter Benjamin.

This puffed up planet also has a very large atmosphere, providing researchers the opportunity to study its atmospheric properties in detail. These studies will be useful for developing tools to assess Earth-like planets for signs of life in future.

The KELT (Kilodegree Extremely Little Telescope) project consists of two small, robotic telescopes. One of the telescopes, KELT-North, is located in Arizona in the USA while the other telescope, KELT-South, is located in Sutherland, South Africa. The exoplanet was first discovered with the KELT-South telescope and thereafter monitored by many telescopes around the world operated by researchers at universities as well as telescopes operated by amateur astronomers.

The KELT telescopes scan the sky every night, measuring the brightness of about five million stars. Astronomers search for stars that seem to dim slightly at regular intervals, which can indicate a planet is orbiting that star and eclipsing it. Much larger telescopes are then used to measure the gravitational "wobble" of the star - the slight tug a planet exerts on the star as it orbits - to verify that the dimming is due to a planet, and to measure the planet's mass.

Dr. Rudi Kuhn of SAAO, who helped in the construction of KELT-South, had this to say: ”This is a very exciting discovery. The planet KELT-11b orbits one of the brightest stars known to host an exoplanet and is one of the most inflated planets ever discovered. This enables us to make some very detailed observations of the atmospheric composition of the exoplanet using much larger telescopes, like the Southern African Large Telescope (SALT). This will help us understand how these giant planets are formed, why they have such small orbits as well as what might happen to them in the future.”

Pro-Am interaction on the NASA Juno mission to Jupiter

Clyde Foster, Shallow Sky Section, ASSA

Introduction

The Juno spacecraft that is current in orbit around Jupiter was launched 5 August, 2011, and entered a polar orbit at Jupiter on 5 July, 2016. On route to Jupiter, the spacecraft’s speed was boosted to 140 000 km/h by a slingshot flyby of Earth in 2013 making it one of the fastest ever object launched from Earth. The primary objectives of the mission, supported by the onboard instrumentation, are to measure Jupiter’s composition, gravitational and magnetic fields and the polar magnetosphere. The original mission plan was to undertake 3 orbits of its initial 53 day insertion orbit, before an engine burn would take it into a 14 day orbit for 34 orbits before being de-orbited and burn up in the Jovian atmosphere. However, problems were experienced with the planned main engine burn in December 2016, and it is expected that the spacecraft will continue in its current 53 day orbit configuration for the remainder of the mission [1].

Junocam

The Junocam (or JCM) [2] is the visible light camera on board Juno. Although not originally one of the mission’s core scientific instruments, it has the capability for scientific use. It has 3 visible light filters as well as an

Infra-red filter. The camera has a 58 degree field of view and is used to capture closeup images of Jupiter during close approach (perijove) on each of its elliptical orbits. It was also expected to capture limited images of Jupiter's moons Metis and Adrestea. The Junocam has other mission objectives including

- Public science and outreach to increase public engagement
- Engagement with amateur and professional infra-red astronomers.

Amateur Astronomical involvement

Although the author was aware of the Juno mission, and potential amateur involvement early in 2016, he felt that his image quality was not of a sufficient standard to add value. Towards the end of 2016, with improvement in this regards, and at the request of a number of international contacts in the Jupiter field, the author started uploading, and having the images approved, on the NASA Junocam website.

1. The Junocam and the Juno NASA team have requested all amateur astronomers to upload telescopic images and data for Jupiter.

2. A key objective prior to each perijove (closest approach) flyby is for the mission team to identify features that will be under the flightpath of the spacecraft and which should be selected for imaging during flyby. Perijove 5, PJ5, was on 27 March, 2017.

3. Due to the extremely dynamic nature of the Jovian atmosphere, and the fact that professional Earth based telescopes cannot regularly be deployed to planetary imaging due to other projects and priorities, amateur astronomers capable of high resolution imaging can play an important role. This includes providing up to date images and data that can be used for the Junocam perijove planning sessions.

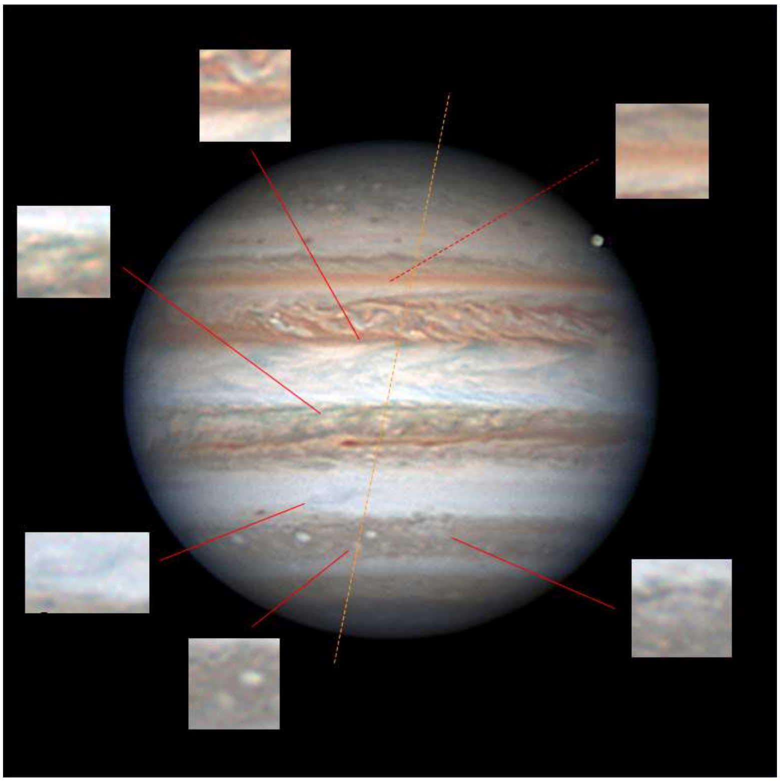


Fig. 1 *Jupiter. This image, taken, 10h prior to the PJ5 flyby indicating a number of features targeted for imaging. Europa is at the upper right. The approximate path of the spacecraft is shown in yellow*. *From bottom left, clockwise: the String of Pearls, STB Spectre, Double SEB, the Big Red Stripe and an interesting band point.*

4. One and a half to two weeks prior to each perijove, the best amateur images are consolidated into full "strip maps" of Jupiter. These are similar to the maps produced on a regular basis by the European JUPOS team.

5. The NASA Juno team, taking into account the planned flight path of the spacecraft for the specific perijove and any current mission objectives, select a number of features, referred to as Points of Interest (POI's) that could be targeted for imaging by the Junocam. These are then posted on the voting tab of the Junocam website, where the amateur community, and indeed the public, can, by commenting and voting, have a say in motivating and selecting a limited number of imaging targets [3]

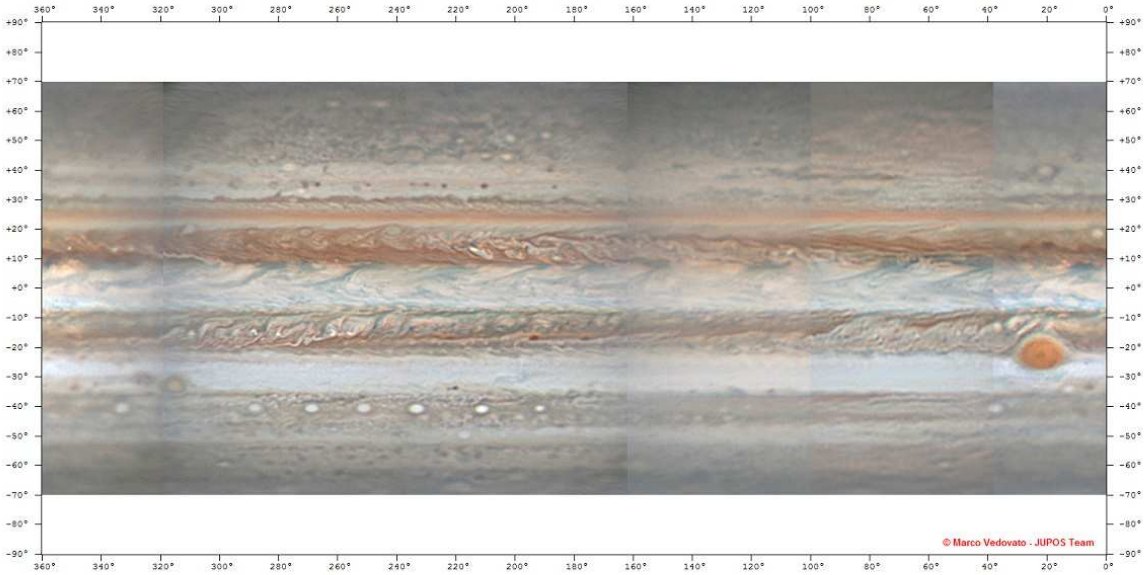


Fig. 2. *Jupos strip map of Jupiter which is generated approximately every two weeks from the best amateur based images and provides a comprehensive record of the dynamic changes on the planet.*

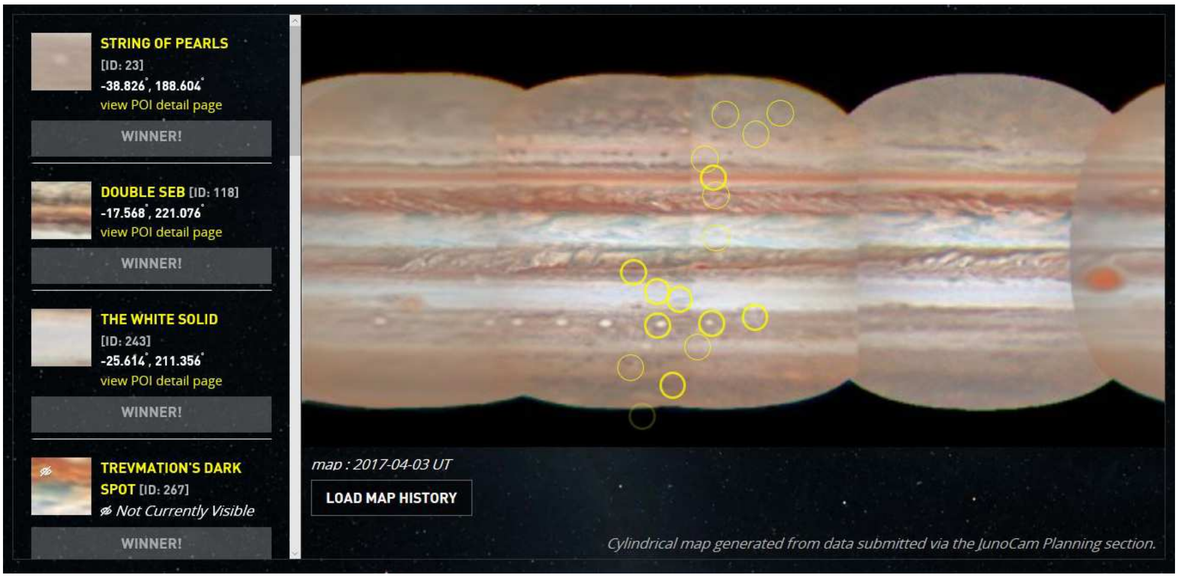


Fig. 3 *A screenshot from the Juno website indicating the PoI that are used to select the imaging targets for the Junocam during flyby. The "Winners" are the features that have been selected for imaging by the voting process.*

6. As the perijove is approached, the amateur astronomical community is requested to capture images and data that can assist in putting the close up images from Juno into perspective.

7. As an amateur astronomer, it is exciting enough in its own right to image the planet as close as possible to the perijove in order to compare ones Earth based images with those of the Juno spacecraft. More so considering the spacecraft flies over the cloud tops of Jupiter at a distance of just over 4 000 km, whilst for perijove 5, the distance of the Earth was 667 million km. See Figs 4a and 4b below.

Fig. 4a. *Image of the South Equatorial Belt Spectre and String of Pearls as captured by the Juno spacecraft during the PJ5 flyby* from a distance *of just over 4 000 kms*.

Fig 4b. *Image of the same region as Fig 4a, as imaged from Earth by the author at a distance of 667 million km 10h prior to the PJ5 flyby.*

8. Amateur images are used in the Jupiter observing community to report back on the perijove events and findings. [4].

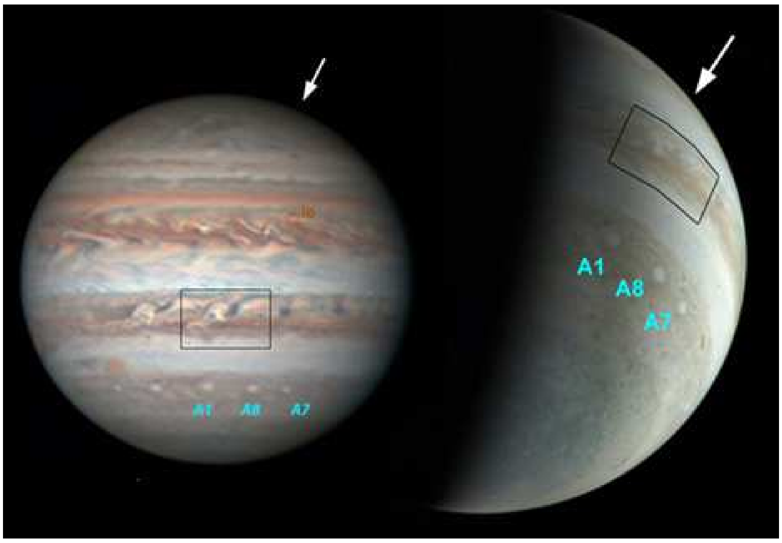


Fig. 5a *Right. Image of Jupiter captured by the author 11h prior to PJ4 flyby, on 1 January 2017. Left. Is an image captured by Juno during PJ4 flyby. The arrows indicate the approximate flight path of the spacecraft.*

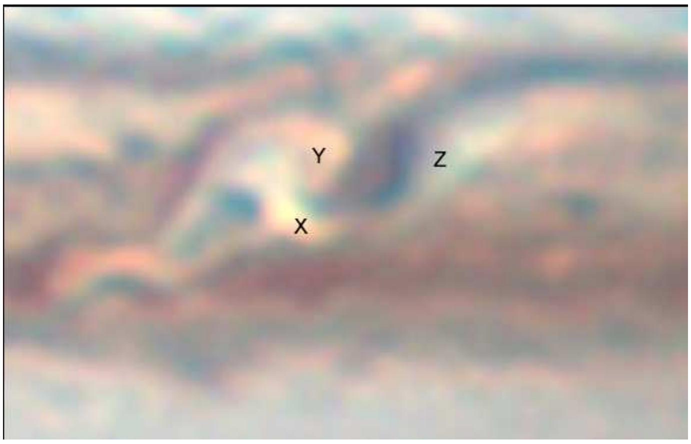


Fig 5b. *An exploded view of the South Equatorial belt region from an image by the author taken 11h prior to PJ4 flyby*

Fig 5c. *A Juno capture from the PJ4 flyby showing the same features as Fig 5b (features marked x, y and z)*

Conclusion

This is one of a number of opportunities where the amateur astronomical community is able to interact with and support professionals in the space and astronomical arena. These "Pro-Am" projects can certainly bring a new level of excitement for the amateur astronomer in today's world.

References

1 https://www.nasa.gov/mission_pages/juno/main/index.html

2 https://www.missionjuno.swri.edu/junocam

3 https://www.missionjuno.swri.edu/junocam/voting,

4 https://britastro.org/node/9274.

Six Hours in the Life of our Home Star

Johan Moolman

From our privileged vantage point here in the south eastern quadrant of Sol's third rock, we are blessed with abundant sunshine days – ample time to bask in the glory of our sun's rays and to observe its different "surface" and atmospheric phenomena.

Observing and photographing our home star from a Pretoria balcony on January 20^{th} (and on other occasions) had been a rewarding experience, revealing a number of interesting, albeit familiar, features. The following is a short discussion of these solar features.

The Photosphere

This visible "surface", from which we receive most of our light, is a smooth, thin layer of gas, about 3400 times less dense than the air we breathe. Less than 500km deep with a temperature of about 5800K [1], it is marked with Sunspots – visible traces of complex magnetic activity - which are cooler at 4240 K. The dark core is referred to as the umbra, surrounded by a lighter, outer region, the penumbra.

Fig. 1 *Sunspots*

Photographs reveal a mottled appearance, the granulations, dark-edged regions, about the size of Texas, each lasting around 10 to 20 minutes, which are the surface effects of convection just below the photosphere. Super-granulations which can include +/- 300 granulations, are around 30 000km in diameter and can last for days. These represent regions of slow rising currents. Limb Darkening – the dimmer area at the solar disc's edge - is caused by absorption of light in the photosphere. Faculae, best seen at the sun's limb, are intimately related to sunspots [2]. These are bright patches in the upper photosphere, with a higher temperature than their surroundings and occur in areas where there is an enhancement of the relatively weak magnetic field. They are more or less coincident (at a lower level) with Plages which are seen in the chromosphere (see below).

Fig. 2 *Supergranulations, limb darkening and faculae granules*

The Chromosphere

This is a roughly 2 000 km thick layer of solar atmosphere just above the photosphere, with its upper regions blending gradually with the corona. Being a 1 000 times fainter than the photosphere, it is only visible to the naked eye during a total solar eclipse – appearing as a thin, pink layer.

H-alpha filters create essentially an artificial eclipse, rejecting all but a narrow band of H-alpha light, revealing a whole range of solar phenomena that had been hidden from our ancestors for millennia. Filters with narrower wavelengths create greater contrast: a passband of 0.7 to 0.5 Å reveals surface detail and prominences, while 0.9 to 0.2 Å nicely reveal detail in prominences, with surface detail lost due to lower contrast [3]

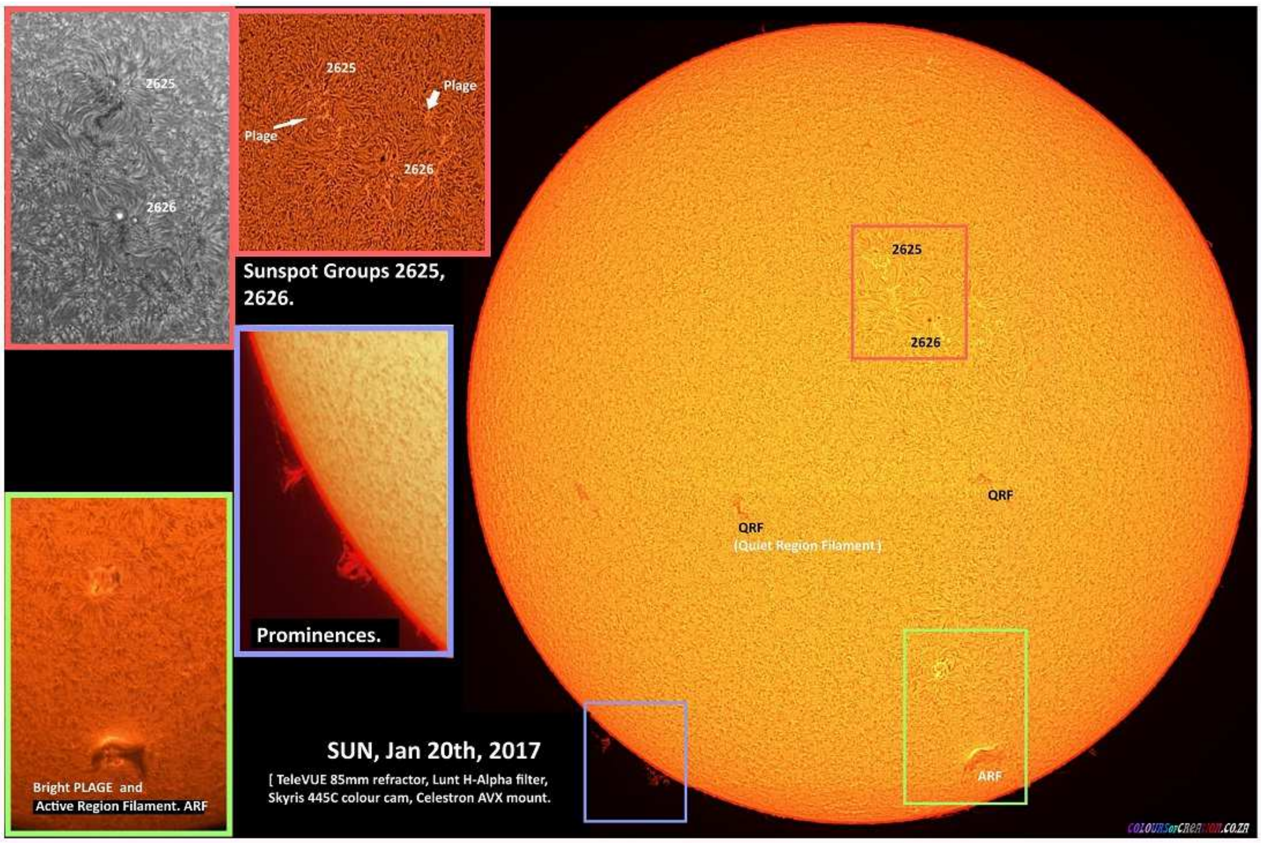
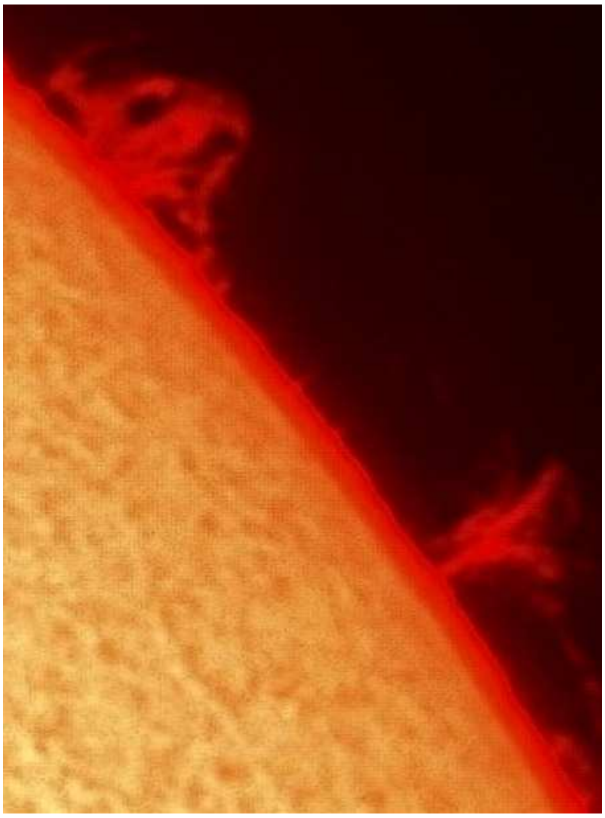


Fig 3 *Full solar disc in H-alpha.*

Spicules



This red/orange “fur” rims the solar disc and represents jets of hot gas from 3 000 to 10 000 km above the surface. Lasting about 15 minutes, more than 300 000 are active in the chromosphere at any given time.

Fig. 4 *Spicules and Prominences*

Prominences and Filaments

Prominences are composed of ionized gas, trapped in magnetic arches that stretch through the photosphere and chromosphere into the lower corona [1]. The origin of the material in prominences/filaments controversial with theories ranging from *photospheric material* that is dragged up into the corona to the idea that *chromospheric material* evaporates into the corona and condenses to form the cool filaments [4]

Fig. 5 *Filaments*

When seen from above against the bright solar disc, prominences form darker absorption features, called filaments [2]. The latter resemble “bushy eyebrows and sinuous snakes” with small dark anchor points.

Prominences can last for days and may stretch more than halfway across the sun. Filaments are divided into three types, according to their location on the solar disc: quiescent-, intermediate-, and active region filaments [4] Quiescent Prominences, being among the most stable solar features, can be long-lived and persist for months, exhibiting an intricate internal structure with branching, resembling “hedgerows” or “bushes” (see Fig 4).

Structural changes can be evident in as little as ten minutes, with some material being flung out into the corona, where it may hang for many days, before recollecting and settling down again in the chromosphere [1].

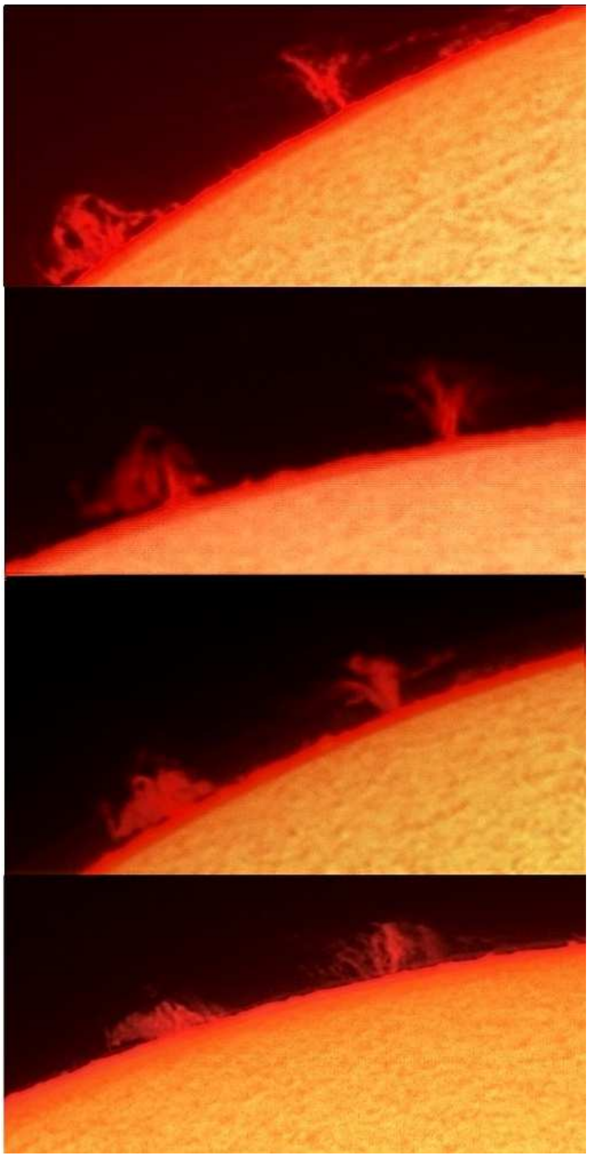


Fig. 6 *A series of images taken over a period of 6 hours, clearly showing the changes in prominences*.

Active region filaments appear in well-developed active regions with strong magnetic fields and can further be distinguished from quiescent filaments by the almost continuous flow of material along their axis [2]. They are short-lived, low-lying and unstable.

Fibrils (and **Spicules**)

Fibrils and Spicules are evident in H-alpha as the solar disc’s dark, mottled and swirly appearance. This appearance is due to a combination of spicules, appearing dark against the disc, and bundles of fibrils, hot plasma confined in magnetic tubes [3].

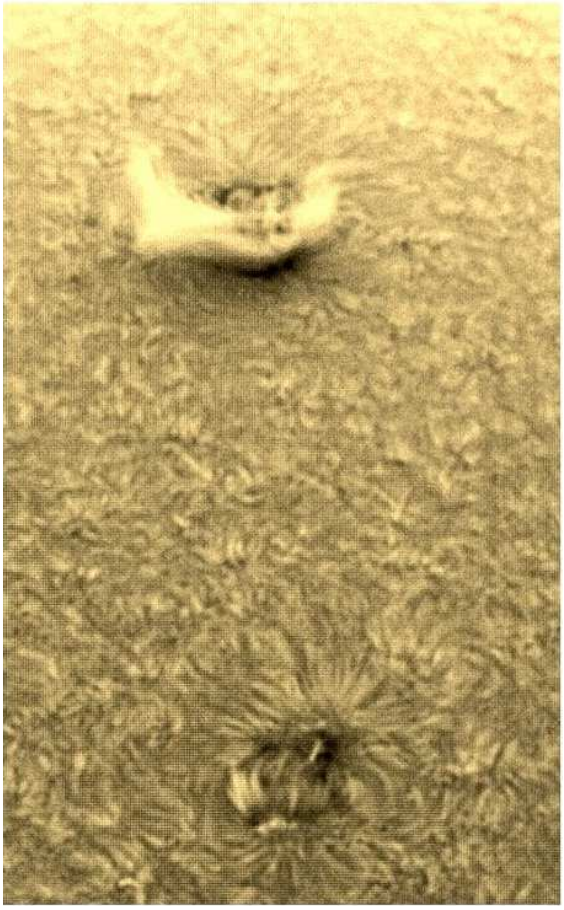


Fig. 7 *Fibrils and Spicules*

Fibrils form an ordered pattern around active regions, aligned in the direction of localized magnetic fields.

Whereas fibrils are predominantly horizontal strands of gas (up 2 200 km wide) in the lower chromosphere, spicules are predominantly vertical, narrow (1 000 km wide) jets of gas. They are closely related with the chromospheric network, being located in regions of enhanced magnetic field at the boundaries of super-granules [2].

Plages

Plages are bright patchy features, approximately coincident with photospheric Faculae, marking the sites of active regions and sunspot groups, previously known as bright floccule [2].

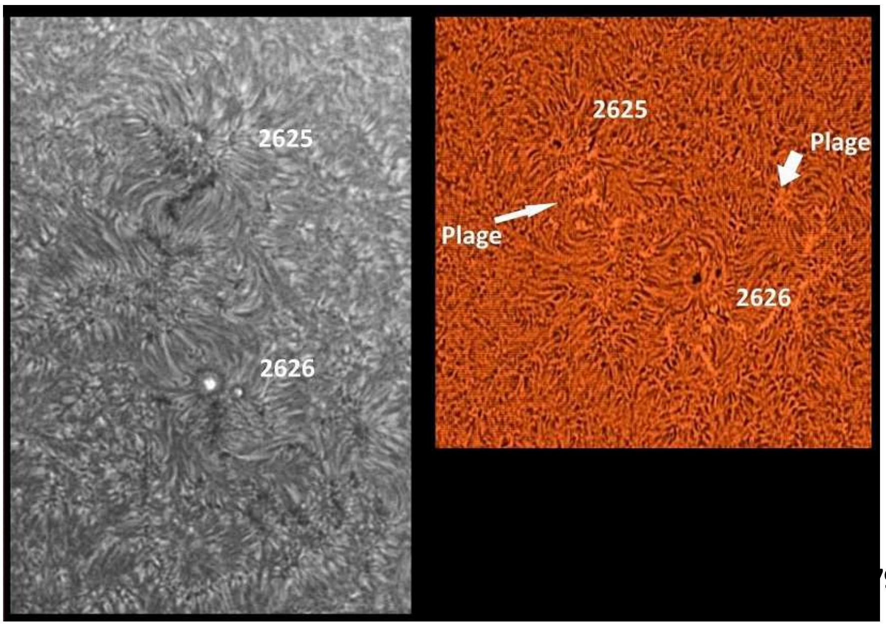


Fig. 8. *Showing the colour, converted to black and white: plages appear as dark patches and sunspots light*

When there are no accompanying sunspots in white light views, these plages are known as emerging flux regions**,** where magnetic flux tubes are just breaching, preceding the formation of sunspots.

Conclusion

Unfortunately, photon shields – also known as clouds - moved in mid-afternoon, putting an end to any grandiose dreams of an extended imaging session beyond six hours. No big disappointment, as by then the Sun had been quite generous, proving very rewarding of the few hours spent in its presence.

Equipment used

H-alpha photos: TeleVue 85mm refractor, Lunt H-alpha filter system, Celestron Skyris camera, Celestron AVX mount.

White light views: TeleVue 127mm refractor, Herschel ceramic wedge, Celestron Skyris camera. Multiple images stacked in Registax, pp in Paint.Net and Picasa.

References

1. Seeds Foundation of Astronomy, Ninth Edition, Michael A Seeds.
2. Collins internet-linked Dictionary of ASTRONOMY, 2006. John Daintith, William Gould.
3. Observer's Guide to the H-alpha Sun. Bob King, Sky and Telescope, September 2015. Note that 1 Ångström (1 Å) = 0.1 nm
4. The Formation and Magnetic Structures of Active-Region Filaments Observed by NVST, *SDO*, and *HINODE*. X L Yan *et al*, The Astrophysical Journal. August 2015.
5. Photographs: www.coloursofcreation.co.za. Higher resolution photos.

Seeing the sky all over again

Doug Bullis, Grahamstown

Finding a great dark site is a terrific reason to buy a new telescope. Of course, a new telescope is a terrific reason to find a great dark site. The reason for doing so was the acquisition of an Intes Alter MN84 Maksutov-Newtonian, simply MN84 from now! This scope is rather exotic. Only 20 were ever made and this was the only one to turn up on the commercial astro-classifieds in the last fifteen years; it turned out to be the same MN84 offered in 2012. So in late February it was installed at the Weltevreden Farm, a remote veld outpost west of Nieu Bethesda. There's not a single human-originated light in view anywhere. The transparency is such that the Dark Doodad in Musca and the globular NGC 2808 are visible without optical aid.

Fig. 1 *Intes Alter MN84 Maksutov-Newtonian*

This telescope was bought specifically for dwarf galaxies, the most elusive of visual objects. Their surface brightness profile is a nearly imperceptible rise to a diaphany so subtle that galaxies easily shine through from the far side. The MN84 maximizes the light from the objective into a given exit pupil. It also has the Intes brand's extraordinarily sharp optics.

On the list were the nine dwarf galaxies visible at this time of year. First up is the Fornax Dwarf. It's an easy spot; the trademark soft oval of a dwarf spheroidal galaxy. A mag 8.3 star on the galaxy's edge is a potent distraction in lesser skies, but in Karoo skies the galaxy pops right out looking like a very dim cotton ball with a diamond on top. Fornax is a challenge object because it has four faint globulars visible in telescopes as small as 150 mm. They range from mag 12.6 to 13.8 and only a few arcmins in diameter. The Fornax globulars are often held up as evidence of dark matter because their orbits cannot be accounted for without the presence of 12 times as much mass as the luminous galaxy.

The Phoenix Dwarf galaxy nearby is an easy find because it lies under a plow-shaped star group centered on mag 7.9 HD 11219. Spotting it is not difficult, but a detailed examination is difficult because the galaxy is embraced by a squashed pentagon of mag 10.2–11.5 stars. Astrophotographic images reveal a patchy surface brightness, evidence of large-scale star formation within the last billion years.

Nearby is Carina, the least-concentrated dwarf in the sky. It lies in a rich field 1° WSW of Tau Puppis. Its brightest stars are in the mag 18 range. Tackling Carina requires years of practice on ultra-faint extended objects, only to come up with failure. The reason is for this is simple: the rule of thumb to find these of dwarf galaxies is that if its surface brightness, S, is above 25 mag arcsec^2 you can glimpse it under zero-polluted skies. Most dwarfs are elliptical enough so that you can use the formula:

$$S = M_V \times 2.5 \log_{10}A$$

where S is the surface brightness, m is the object's integrated visual magnitude, and A = πab with a and b the object's dimensions in arcsec. Carina's dimensions are M_V = 11.3, a = 1380 and b = 900, so for the Carina dwarf galaxy, S = 27.78, so not too difficult.

Sextans A and B (part of the NGC 3109 Group) have been so often reported that it suffices here to note Sextans A reveals three OB patches in the MN84 at 145x, one more than before.

The Sextans Dwarf is on par with Carina for elusiveness. Its surface brightness is 26.1 mag arcsec^2. Even so, rapidly panning the field at 40x in the MN84 shows hints of a fleeting diaphany: one of those uncertain observations which may or may not be moments of scintillation when the atmosphere acts as a weak lens. In searches for very faint Magellanic globulars near S = 25, staring at the field for several minutes one can usually catch a few glimpses, lasting a few seconds. These usually come in sets like ocean waves, which accords with the atmosphere's wavelike behaviour when moving sheets of air interface.

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: Preparing for Science with the James Webb Space Telescope
Speaker: Prof Tom Ray, Dublin.
Date: 14 March
Time: 11h00 – 12h00
Venue: SAAO Auditorium

Abstract: The James Webb Space Telescope (JWST) is due for launch next year. With much more light gathering power than Hubble, and the ability to operate well into the infrared, it will explore such topics as the re-ionization of the Universe, the formation of galaxies at high redshifts, the birth of stars and planets, and exoplanet atmospheres. After giving an overview of JWST's main instruments, and the type of science they are capable of, I will concentrate in particular on what they can tell us about the first million years in the lifetime of a star and the early stages of planet formation. *Also Presented Astro-coffee on 16 March*.

Title: NIR monitoring observations of the TeV gamma-ray binaries
Speaker: Akiko Kawachi.
Date: 30 March
Time: 11h00 – 12h00
Venue: SAAO Auditorium

Abstract: Five binary systems have been confirmed to emit TeV gamma-rays modulating with orbital phase. All of them are high-mass X-ray binaries and emit the high-energy radiations by the interaction of the accelerated outflow of the compact star with the stellar wind (and/or) the gas disc of the massive star. But the parameters of the binaries are rich in variety and any common model for orbital variability is difficult to be derived. We have performed the NIR photometric monitoring observations of 4 binaries using the IRSF/SAAO in order to study the parameters of the massive stars and perturbations caused by the binary interactions. Regular brightening at the periastron have been observed for the pulsar-Be star binary, PSR B1259-63 and a hint of periastron flare was detected for another Be-star system, HESSJ0632+057. Since the variability detected/expected is very small, we have tried to improve the observation methods for higher photometric precision. The summary of the observations and results are presented.

Title: Fundamental and Precision Cosmology: Deep and Wide-Field Surveys to Unlock the Dark Side of the Universe
Speaker: Jean-Paul Kneib - Ecole Polytechnique Federale de Lausanne
Date: 23 March
Time: 11h00 – 12h00
Venue: SAAO Auditorium

Abstract: In the last century our observations of the Universe have revealed deep mysteries that remain challenging enigma for our understanding of fundamental physics. What is Dark Matter that embraces the visible structures in the Cosmos? What is the putative Dark Energy that accelerates the expansion of the Universe?
In my presentation, I will in the first part, present new high precision measurements on the Dark Matter mapping of massive galaxy clusters using the Hubble Frontier Fields observations. These and future similar observations may ultimately help us uncover physical properties of the Dark Matter.
In the second part, I will present extended-BOSS the current Sloan spectroscopic surveys as well as other projects that will help us constrain in particular the nature of Dark Energy and the mass of neutrinos.
Finally, I will present recent technology developments of high-density fiber positioner systems for the coming and future generation of wide field spectroscopic surveys that are planned to significantly improve in precision cosmological measurements.

Title: **Jitter radiation for GRBs and blazars**
Speaker: Prof. Jirong Mao (Yunnan Observatories, Chinese Academy of Sciences)
Date: 31 March
Time: 11h00 – 12h00
Venue: SAAO Auditorium

Abstract: Synchrotron radiation is the radiation of relativistic electrons in the large scale and ordered magnetic field. Relativistic electrons radiation

in random and small-scale magnetic fields is different to the synchrotron radiation. We propose a special case which is described as jitter radiation. The random and small-scale magnetic fields can be generated by turbulence. Jitter polarization can be calculated. The radiative transfer of jitter polarization is also considered. This physical scenario can be applied to the GRB and blazar studies.

Astro-Coffee

Title: A pulsar, by any other name.
Speaker: Dr David Buckley, SAAO/SALT
Date: 22 February
Time: 13h00
Venue: 2nd floor auditorium SKA office, Pinelands

Abstract: This talk will discuss the recent discovery of a spinning white dwarf in the binary system AR Scorpii which shows all of the usual hallmarks of a pulsar (see http://www.nature.com/articles/s41550-016-0029). Initial observations established that it pulses at the ~2 minute spin and beat periods, from the UV to radio wavelengths, and its luminosity is dominated by synchrotron emission, powered by the spin-down of the strongly magnetic white dwarf. More recent polarimetric observations undertaken at the SAAO have strengthened the arguments that the white dwarf in AR Sco is analogous to a pulsar, with optical polarization behaviour similar to that seen in the Crab pulsar and with pulsation and spectral energy distribution characteristics consistent with strong MHD interactions between the white dwarf magnetic dipole and the M-dwarf companion. These interactions include the penetration of the white dwarf's magnetic field into the M-star's photosphere, leading to a significant spin-down torque from Ohmic diffusion. In addition "pumping" of the M-star coronal loops and the generation of strong currents in the out-flowing relativistic wind, results in pulsed and polarized emission across a wide wavelength range. Further multi-wavelength observations

have been undertaken of this fascinating system, and further are planned in the future, including with MeerKAT.

Title: Cosmological Results From Two-Season ACTPol Data
Speaker: Dr Simone Aiola, Princeton University
Date: 22 February
Time: 13h00
Venue: 2nd floor auditorium SKA office, Pinelands

Abstract: The sensitive bolometric polarimeter at the focal plane of the Atacama Cosmology Telescope (ACTPol) allowed us to map the Cosmic Microwave Background (CMB) both in temperature and polarization at arcminute resolution. In this talk, I will present the cosmological results derived from the two-season night-time data. I will show the strength of the polarization data in constraining the standard LCDM parameters, which will soon overcome that of temperature data (Louis et al. 2016). I will present the recent measurement of the CMB lensing power spectrum, showing how we can infer the sum of neutrino masses in the universe (Sherwin et al. 2016). I will conclude with an overview of our recent measurement of the kinetic Sunyaev-Zeldovich effect via pair-wise estimator, which is also sensitive to neutrinos and late-time physics (De Bernardis et al. 2016).

UWC

Title: SETI efforts and how we can do better
Speaker: Michael Garrett - Jodrell Bank Centre for Astrophysics, University of Manchester
Date: 22 March
Time: 11h30
Venue: Rm 1.35 New Physics Building, UWC

Abstract: I will consider whether SETI (Search for Extraterrestrial Intelligence) is a worthwhile scientific pursuit and discuss ways we can

improve the likelihood of success. Recent progress in conducting traditional SETI searches (e.g. Breakthrough Listen) will also be presented, along with some results associated with artefact SETI. I will argue that SETI events are probably quite rare, and that the single most important area of parameter space to expand upon is field-of-view. As a comparison to learn from, I will consider recent progress in detecting and localising , FRBs (Fast Radio Bursts). I argue that an "all-sky" radio telescope operating at cm wavelengths would be useful for both SETI and many other areas of radio astronomy research. The desire for an "all–sky" SETI capability can be traced back to Arthur C. Clarke's novel Imperial Earth – as digital processing and computing continue to improve, it will soon be possible to build serious prototypes at cm wavelengths. These can be seen as precursors to SKA Phase 2. *Also given at Astrocoffee 23 March.*

Title: Size and degree of polarization of radio sources in surveys with microJy sensitivity
Speaker: Jeroen Stil - University of Calgary
Date: 24 March
Time: 14h00
Venue: Rm 1.35 New Physics Building, UWC

Abstract: Radio lobes formed by jets emitted by active galactic nuclei (AGN) fill a large volume of space around their host galaxies, creating huge cavities in the local intergalactic medium. The amount of work delivered by the expansion of these bubbles is large enough to affect the dynamics of the intergalactic medium and thus put a break on accretion of matter on galaxies. The pressure inside radio lobes is made up by relativistic particles and magnetic fields, each contributing roughly equal amounts. The extent of these radio lobes and the properties of their magnetic fields are therefore an important aspect of the long-term evolution of the intergalactic medium. Polarized synchrotron emission from the lobes is also the best available probe of magnetic fields in the surrounding intergalactic medium. Faint radio sources represent AGN of lower luminosity that may interact differently with their surroundings. Observing

the polarization of these faint sources requires high sensitivity that is currently only available in narrow, deep surveys that detect a handful of sources. I will present a stacking analysis of a medium-sensitivity, medium-wide radio survey (ATLAS) that confirms a conclusion by Rudnick & Owen (2014) that polarized sources at microJy sensitivity are resolved at 10" resolution, corresponding to physical sizes of ~150 kpc, for a much larger sample. This finding affects the design of future polarization surveys of the sky with the Square Kilometre Array and its pathfinders.

Title: From tiny dwarfs to giant clusters: Modelling galaxies across cosmic time using semi-analytic models
Speaker: Robert Yates - Max Planck Institute for Extra-terrestrial Physics
Date: 31 March
Time: 14h00
Venue: Rm 1.35 New Physics Building, UWC

Abstract: In this talk, I will present L-GALAXIES, a semi-analytic model of galaxy evolution that runs on the Millennium simulation suite. This model allows us to efficiently study the full range of galaxies in the Universe, from tiny 'dwarfs' to the largest 'galaxy clusters', as they evolve over cosmic time. In particular, I will focus on the chemical evolution of such galaxies, describing how their constituent stars explode and pollute their surroundings with heavy elements. I will compare results from L-GALAXIES to our latest observations of the iron abundance in the hot gas around galaxy clusters, and the oxygen abundance in the cold, star-forming gas within nearby dwarfs. I will conclude with an unveiling of the latest version of L-GALAXIES, which will allow us to study a whole new range of galaxy phenomena on even smaller, sub-galactic scales in the very near future.

AIMS

Title: Cosmological Results From Two-Season ACTPol Data
Speaker: Simone Aiola from Princeton University
Date**:** 6 March
Time**:** 12h00
Venue: Upstairs Hall

Abstract: The sensitive bolometric polarimeter at the focal plane of the Atacama Cosmology Telescope (ACTPol) allowed us to map the Cosmic Microwave Background (CMB) both in temperature and polarization at arcminute resolution. In this talk, I will present the cosmological results derived from the two-season night-time data. I will show the strength of the polarization data in constraining the standard LCDM parameters, which will soon overcome that of temperature data (Louis et al. 2016). I will present the recent measurement of the CMB lensing power spectrum, showing how we can infer the sum of neutrino masses in the universe (Sherwin et al. 2016). I will conclude with an overview of our recent measurement of the kinetic Sunyaev-Zeldovich effect via pair-wise estimator, which is also sensitive to neutrinos and late-time physics (De Bernardis et al. 2016). *This talk also presented at Astro Coffee, 7 March*

NASSP

Title: The Universe in Full Color : Multi-Wavelength Studies of the Cosmic Star Formation History
Speaker: Mattia Vaccari from UWC
Date**:** 22 February
Time**:** 12h00
Venue: Astronomy Seminar Room, 5th Floor RW James Bld

Abstract: The coming of age of multi-wavelength astrophysics over the past decade has allowed us to probe deep and wide into the distant

universe at all wavelengths thanks to the combination of ground-based and space-based instrumentation.
This giant leap in observational capabilities has provided much further insight into how different wavelengths can be used to reliably trace star formation rates and thus place stronger constraints on the cosmic star formation history and on computer simulations trying to reproduce it.

I will provide a general introduction to the subject and then discuss some recent results of our research in this field, and particularly how long-wavelength (infrared, millimetre and radio) observations are being used to improve upon ultra-violet/optical estimates.

I will conclude by outlining future lines of research in the field by UCT/UWC/IDIA researchers and students, and in particular how machine learning techniques can be effectively combined with more traditional approaches to fully exploit the upcoming data deluge from projects such as MeerKAT, LSST and SKA.

Title: Earth-sized radio telescopes: (astro)physics with the SKA, VLBI and the Event Horizon Telescope
Speaker: Dr Roger Deane from Rhodes University
Date**:** 8 March
Time**:** 16h15
Venue: Astronomy Seminar Room, 5th Floor RW James Bld

Abstract: The technique of Very Long Baseline Interferometry (VLBI) enables radio antennas across the planet to be used as a single, Earth-sized telescope. While it requires additional overhead and post-processing, VLBI provides a dramatic 2-3 order of magnitude improvement in angular resolution when compared to current connected-element radio interferometers. Over the course of the next decade, sensitivity-enhanced VLBI arrays, which will include the Square Kilometre Array and the Event Horizon Telescope, are set make major contributions to astronomy and fundamental physics through this angular resolution advantage. I will

describe a range of my VLBI-related science programmes, including observations of black hole shadows, binary supermassive black holes and MeerKAT-VLBI complements to the MeerKAT Large Survey Projects

Title: ACT and HIRAX
Speaker: Prof. Jon Sievers from UKZN
Date**:** 15 March
Time**:** 12h00
Venue: Astronomy Seminar Room, 5th Floor RW James Bld

Abstract: The Atacama Cosmology Telescope (ACT) is a 6m telescope observing the cosmic microwave background (CMB) from high in the Chilean Atacama desert. The Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX) is a planned 1,024-element radio array that will observe baryon acoustic oscillations (BAOs) from the Karoo. Both ACT and HIRAX observe the signatures of the fluctuations that give rise to structure in the universe. ACT sees the universe when it was just a few hundred thousand years old. HIRAX watches the universe as dark energy begins to dominate. Overviews of both experiments will be presented, along with we have learned from ACT and what we will learn from HIRAX and further ACT observations.

Title: Cosmology in the Era of Mega Data
Speaker: Dr Michelle Lochner from AIMS/SKA
Date**:** 22 March
Time**:** 12h00
Venue: Astronomy Seminar Room, 5th Floor RW James Bld

Abstract: Upcoming instruments like the Square Kilometre Array (SKA) and the Large Synoptic Survey Telescope (LSST) will usher in a new era of "Mega Data" in astronomy. In this talk, I will highlight some of the challenges presented in particular by LSST, and how modern techniques in machine learning and statistics can be used to solve them. I will show how machine learning can be used to automatically classify the thousands of

supernovae LSST will discover, and how it could be used to classify the 10 million transients LSST is expected to detect per night. I will also discuss how MeerKAT and LSST could be used in concert to get the most out of cosmology, especially by combining the HI information from MeerKAT with the photometric galaxy information from LSST using sophisticated statistical techniques.

Title: How will HI-vision change the way we see our Universe?
Speaker: Dr Michelle Cluver from UWC.
Date: 20 March
Time: 12h00
Venue: Astronomy Seminar Room, 5th Floor RW James Bld

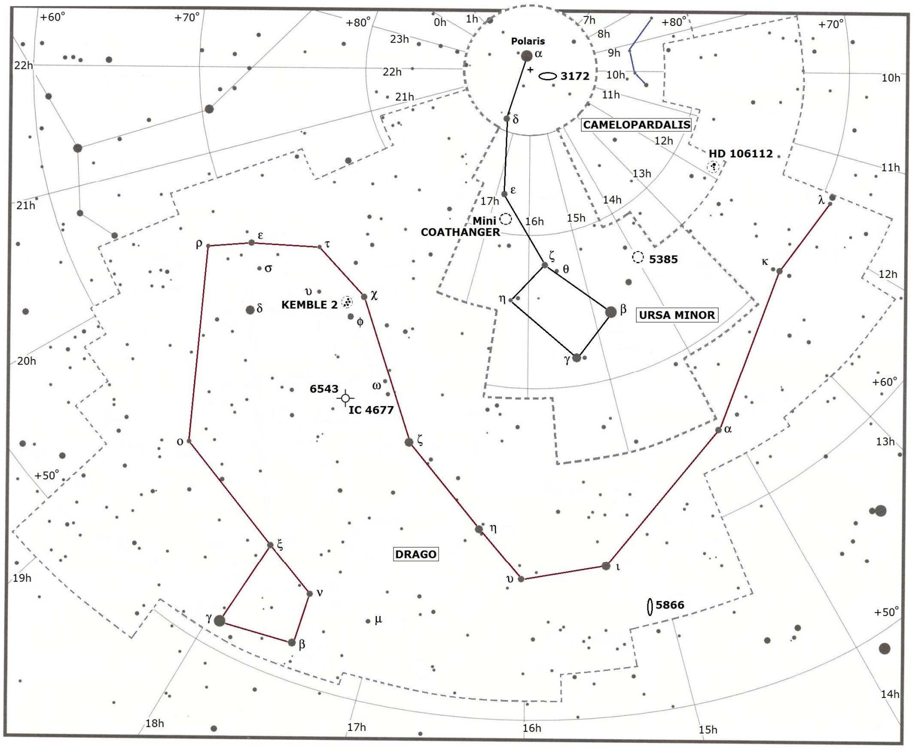
Abstract: New telescopes and the latest technology they employ unavoidably change the way we see and think about the Universe. But, revealing unexpected science still requires looking in the right places. In this talk I will discuss how I think MeerKAT and ASKAP will likely revolutionise our understanding of HI and its role in galaxy evolution. We need to develop new ways of interrogating, viewing and disseminating our findings.

Deep Sky: The beast and the beautiful

Magda Streicher

Images of dragons were used for various reasons in the cultures of antiquity, some for more fear-inspiring purposes than others. The Draco constellation has a Greek origin. It is also seen as the shield of Hercules, but to be more kind, this winding figure is also seen as the ancient possessor of the North Pole Star by the name Polaris. From the southern hemisphere, it is possible just to glimpse the head of the dragon figure, but still located very low on the horizon.

Fig. 1 *Sky Map the constellation Draco*



It is an enormous constellation, but one object that is truly exceptional within it is the so-called Cats Eye Nebula, or **NGC 6543**. Even at first glance the beauty of this planetary nebula can be clearly seen. While at a northern Astro camp the first response was that this is one of the most beautiful nebulas of its kind. It is slightly oval, with a hint of a frosty blue play of light, not consistent in hues, but with contrasts. The edges appear lighter, with a slightly darker interior.

Towards the western edge of the planetary nebula a bright spot indicates the catalogue-numbered **IC 4677** close to a 9.7 star. The planetary nebula well represents its nickname in a real sense; although it is 3 300 light years distant. And with suitable imagination one can see the association with the heavenly cat's eye. NGC 6543 is almost exactly at the north pole of the ecliptic. A Hubble picture is the only way to appreciate the real depth of its beauty. The galaxy NGC 6552 is situated only 10' east.

At the curve of the Drago's long slender neck a starry crown can be seen. **Kemble 2** appears in the second edition of Uranometria 2000.0 and was discovered by Lucian J Kemble. Five prominent yellow-coloured stars, together with a few faint ones, stand out beautifully in the star-field. The impression is clear that it could pass for a, but also be seen as the queen's crown, with the name quite fitting.

The brightest star, magnitude 6.7, is listed as HD 172922. See Fig. 1.

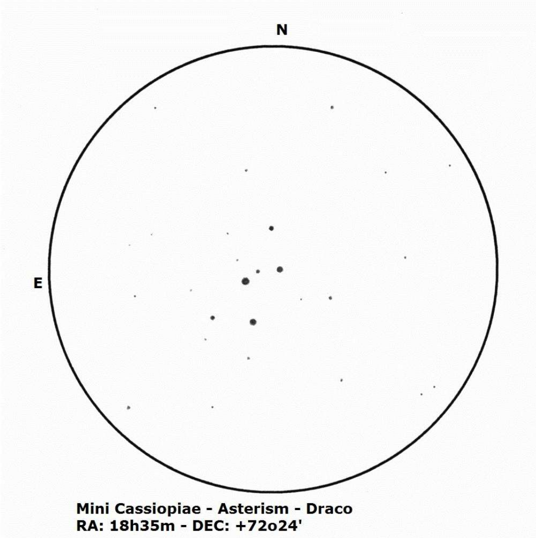


Fig. *2 Mini-Cassiopeia - Asterism – Draco*

NGC 5866 (or perhaps M102), is situated in the southern part of Draco, an ordinary, nearly edge-on galaxy, but the subject of some controversy. The galaxy is small but bright, with a much brighter tiny elongated nucleus. This lovely streak of light also hosts a thin dust lane which can be seen with care and higher magnification. The small companion NGC 5867 is situated on the south-western edge. But what is the story revolving around this object and the more well-known Messier 101 in Ursa Major? Mechané announced his discovery of M102 as an error, declaring it to be the same object as the preceding number M101, the galaxy in Ursa Major. Mechainé's original description of M102 matches far better the appearance of NGC 5866 in Draco than M101 and should have been easily seen by Mechainé and Messier. M101 is a large, irregular open spiral galaxy gradually extending its light to the exterior, quite different from an edge-on galaxy.

The constellation Camelopardalis appears to be hiding itself on the northern edge of Draco and is completely out of view for observers in the southern hemisphere. A mere 1.2 degrees from the northern boundary with Drago in Camelopardalis, arguably one of the brightest asterisms, **HD 106112**, named for the bright star in the *Henry Draper Catalogue*. What a splendid grouping of colourful stars in a close north-south direction that stands out beautifully in the star-field. The well-known Sue French first mentioned it in one of her *Sky and Telescope* magazine columns.

Our friends in the north can be rightly proud of their north star, Polaris, but the constellation Ursa Minor is impoverished as far as deep sky objects are concerned.

Yet it is necessary to turn our gaze in that direction, as it remains the northern-most constellation, after all! **NGC 5385** can be more describe as an asterism, special in that they tell a story, and one such grouping in the constellation Ursa Minor I have named ***skier*** – 12 relatively faint stars in a tight grouping, but quite interesting. The starry ***skier*** is bent over backwards to the west and flat on its skis comprising five stars in a row from east to west. Although faint, this grouping is prominent against the background of even fainter stars. This lovely grouping is situated one degree east from the boundary with Camelopardalis. Ursa Minor is recognisable by a block of stars consisting of beta, gamma (a double star), eta and zeta Ursae Minoris.

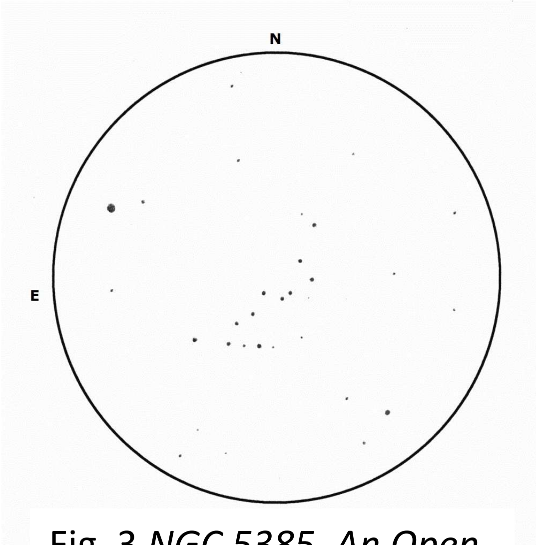


Fig. 3 *NGC 5385. An Open cluster in Ursa Minor. Nicknamed the Skier*

The famous **"Mini Coat Hanger"** is an asterism which, over and over, is a treat to observe and compares very well with "Older Brother Coat Hanger" which can be found in Vulpecula and is also labelled Brocchi's Cluster (Collinder 399). This mini hanger is situated 2 degrees south of epsilon Ursa Minoris and it was Tom Whiting who dubbed it the Mini Coat Hanger. The grouping, composed of ten magnitude 9 stars, gives the impression of an old-fashioned coat hanger with a metal hook.

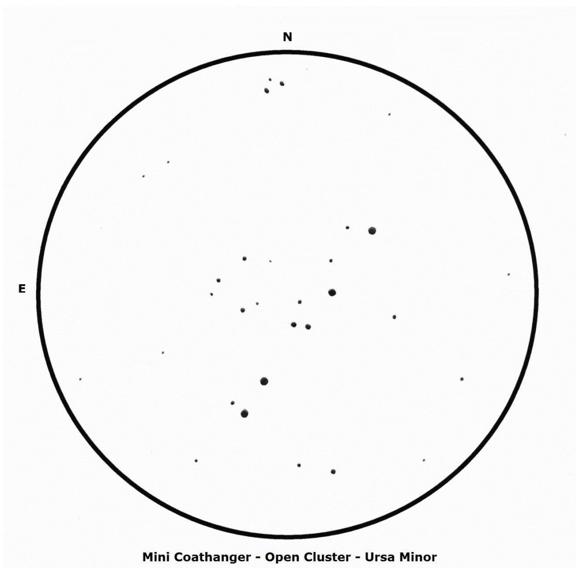


Fig. 4 *The Mini Coathanger an Asterism in Ursa Minor*

Seven stars make up the hanger, with three more stars forming the hook. The Mini Coat Hanger has a clear shape which appears from north to south and is well defined against the background star-field. There is a faint magnitude 15.2 galaxy classified as UGC 10447 situated on the edge of the neck of the hanger which is towards the west.

Last but not least is **NGC 3172**, the closest galaxy just south of the northern celestial pole. Although faint, it can claim the name Polarissima Borialis. Slightly round in shape, it slowly brightens up towards the middle. It is situated only a degree south from the North Star Polaris.

The northern hemisphere, though some distance from us, nonetheless presents the observer, (and the reader in the southern hemisphere) with a few magnificent objects.

OBJECT	TYPE	RA	DEC	MAG	SIZE
NGC 3172	Galaxy	11h47m.2	+89°05'.7	13.2	1.0'x0.7'
HD 106112	Asterism	12h11m.2	+77°28'.4	7	18'
NGC 5385 Skier	Asterism	13h52m.5	+76°11'.2	10	7'
NGC 5866 Messier 102	Galaxy	15h06m.5	+55°45'.8	10.7	6.0'x5.0'
Mini Coat Hanger	Asterism	16h29m.0	+80°15'.0	9	16'
NGC 6543 IC 4677	Planetary Nebula	17h58m.5	+66°37'.8	9.8	20"
Kemble 2	Asterism	18h35m.0	+72°15'	6.2	12'

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.

Internet contact details: email: assa@saao.ac.za Home Page: http://assa.saao.ac.za

Council		
President	Dr Pierre de Villiers	pierredev@hermanus.co.za
Vice-President	Prof Matie Hoffman	HoffmaMJ@ufs.ac.za
Vice-President	Case Rijsdijk	particles@mweb.co.za
Mem. Secretary	B. Olivier	membership@assa.saao.ac.za
Hon. Treasurer	Adv A J Nel	ajnel@ajnel.co.za
Hon. Secretary	Lerika Cross	Lerika@icon.co.za
Scholarships	Dr Claire Flanagan	Claireflan55@gmail.com
Members	C Stewart	Mwgringa@mweb.co.za
	Dr Ian Glass	glass.ian@gmail.com
Centre Chairs	Prof M Hoffman (Bloemftn)	HoffmanMU@ufs.ac.za
	Johan Smit (Pretoria)	johanchsmit@gmail.com
	Eddy Nijeboer (Cape)	eddy47@xsinet.co.za
	P Dormehl (Durban)	peterd@astronomydurban.co.za
	J Jooste (Johannesburg)	astronomersinc@hotmail.co.za
	Dr P de Villiers (Hermanus)	pierredev@hermanus.co.za
	Steffan Devos (Natal Midlands)	sdevos@webbis.co.za
	C Rijsdijk (Garden Route)	particles@mweb.co.za
Section Directors		
Shallow Sky	Clyde Foster	clyde@icon.co.za
Deep Sky Double/Variable Stars	A Slotegraaf Dave Blane	auke@psychohistorian.org theblanes@telkomsa.net
Photometry, Spectroscopy	Percy Jacobs	percymj@iafrica.com
Cosmology	Frikkie de Bruyn	Debruyn1@telkomsa.net
History	Chris de Coning	Siriusa@absamail.co.za
Dark Sky	Vacant	
Astrophotography	Allen Versveld	Allen.versveld@gmail.com
Instrumentation	Chris Stewart	Chris.stewart@alcatel-lucent.com
Observing and Outreach	K Coronaios	elephantcastle@lantic.net

ISSN 0024-8266

mnassa

monthly notes of the astronomical society of southern africa

Volume 76 Nos 3 & 4 April 2017

CONTENTS