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CAPELLA

CAMBRIDGE ASTRONOMICAL ASSOCIATION

Newsletter 180 May / June 2017
Registered Charity No. 800782

CAA / CYA Open Afternoon Saturday 25th March

We had a good day, at the open day. We made about 150 Mars Rover models. There was a steady flow of people all afternoon.

There were queues of people wishing to look through the 8" scope to see the Clanger on Saturn.

A lot of people were interested in Young Astronomers, and in the loan telescope program.

The pizza and beer at the end of the afternoon was most welcome.

Article and photo's Paul Drake



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Cambridge Astronomical Association & Cambridge Young Astronomers

Chairman's Report for the AGM of the CAA 17th April 2017

As we approach the end of another successful year for the CAA it is time for a brief report as to the activities of the club and its situation. This is, in essence, largely unchanged from previous years as will be shown in the details in the treasurer's report as regards the size of our membership.

We have had a full programme of speaker meetings, young astronomers groups and our annual star party and coach trip - though I carelessly missed those latter two by being on holiday at the wrong time. However, all were well attended and enjoyed by many members.

We have been pushing hard to get our newsletter editions out on time but need YOU the membership to support this by helping us with contributions (big or small it doesn't matter) to help us fill the pages. Thanks go to Richard White for all his efforts in editing and layout and David Davies for both his regular articles, and for proof-reading the whole thing. We have enacted a decision to stop offering the "£10" membership with a printed copy of the newsletter, reasoning that almost everyone now just looks at it on-line from the website and if there is anyone who can't then I am sure they know someone who can print one out for them.

Stargazing Live day came, and went, with a complete wash out, and that was sadly rather the pattern for the Wednesday night observing sessions for the year. Precious few were clear, but we made the best of what we got! Perhaps this rotten run of weather explains why we seem to have a surplus of loan-telescopes at the moment; so if you want to book one, you are in luck with no long waiting lists - and I'd be pleased not to have them in my shed!

Finally as I write this I am eagerly awaiting the up-coming steam engine trip, on 24th April. Thanks again to Brian for this, and all the rest of his amazing hard work to keep things rolling forward!

Paul

Members Contributions

Accounts for AGM by Mick Jenkins

Cambridge Astronomical Association			
Receipts & Payments for year as at 30/03/17			
Note	2015/16	2016/17	
1 Receipts	£	£	
2 Members subscriptions	2,307	2,050	
3 Events	2,927	6,119	
Donations	507	524	
Library	77	30	
Telescope Hire	140	115	
Visitors	64	32	
Miscellaneous	1,440	744	
TOTAL RECEIPTS	7,462	9,614	
1 Payments			
Speakers Expenses	675	426	
Refreshments	520	579	
4 Events	2,935	7,202	
Donations	359	584	
Library	0	30	
Capella, website and admin costs	1,633	1,017	
Astronomy Equipment	393	1,080	
TOTAL PAYMENTS	6,515	10,918	
Excess of receipts over payments	947	(1,304)	
Balance Sheet as at 09 March 2017			
	31.3.16	30.03.17	
Assets	£	£	
Cash in hand	295	225	
Current Account	8,809	7,574	
Deposit Account	4,629	4,630	
Total Assets	13,733	12,429	
Represented by			
Balance at start of year	12,786	13,733	
Excess of receipts over payments	947	-1,304	
Balance at end of year	13,733	12,429	

Figures are subject to approval by the CAA Committee

1 Receipts are shown in the accounts according to the date they were received.
Payments are shown in the accounts according to the date they were paid.

2 Number of members (households):	31-03-16	30-03-17
Honorary members	2	2
Postal Capella	32	15
Download (manual payment)	99	120
Download (Standing Order)	442	419
Total Households	575	556

3/4 Events in 2016/17
Astronomical Imaging Course Summer 2016
Star Party Oct 2016
National Sace Centre trip Oct 2016
Steam Trip Day Sept 2016

Mickey Pallett, CAA Treasurer, 30/03/17

Speaker Meetings

Prof MacCallum
Friday 19th May 2017 8pm
"Was Einstein 100% right"

No detail yet. Please keep an eye on the CAA website.

Friday 16th June 2017
Speaker : Dr. Ann Bonell
"Live Long and Prosper"

No detail yet. Please keep an eye on the CAA website.

These speaker meetings will be in the Hoyle building of the Institute of Astronomy, Madingley Road, Cambridge. Doors will open at 7.30 pm. and the talks will begin at 8:00 p.m. For security reasons, entry will not be possible after 8:10pm. As usual, the library will be open before and after the lecture. Refreshments will be available after the lecture. These meetings are free to members. Non-members are charged £1

Members Contributions

Tracking down a White Dwarf
By Paul Fellows and Paul Leyland March 2017

The brightest star in the night sky, Sirius, low in the south at the moment just to the left of Orion and the lead star of Canis Major, the big dog is an interesting object in many ways. As I have said, it is the brightest star that we see in the night sky, twice as bright as the next one, Canopus which is only visible from the southern hemisphere, so it far outshines all the others that we see from Cambridge. It is also one of the nearest, at just 8.6 light years from us, partly explaining why we see it so bright. Comparing it to our sun though it is two times more massive, twice as hot at just under 10,000 degrees Kelvin giving it its white-hot appearance, and puts out much greater total power - about twenty five times that of the sun overall.

In 1844 Friedrich Bessel was tracking the motion of Sirius across the sky (Its so called "proper motion", which we can see and measure because it is so close to us) and came to the conclusion that it was wobbling back and forth slightly - guessing correctly that this was because of an as-yet undetected companion object. The timescale of the wobble suggested that the companion was orbiting Sirius with a period of around 50 years, but the amount of wobble also suggested it needed to be quite a massive object, yet still very dim. About 18 years later during a test of the 18.5 inch refractor at the Dearborn Observatory, Alvan Clark observed this faint companion for the first time. It was clearly a star and now we give it the name Sirius B, or more affectionately "The Pup", given that the main star Sirius A has often been tagged as "The Dog Star".

Once tracked down, this new companion could be studied, and the orbits worked out in detail. It does indeed orbit in 50.1 years as Bessel estimated but with quite an elliptical orbit, so that the distance between the pair varies considerably. We can also determine the masses of the two stars, and find that they are around 2.1 solar-masses for Sirius A, but interestingly Sirius B weighs-in at 0.98 solar masses. This large mass, much too large for a planet, explains why the wobble was detectable at all, in that with only a 2::1 ratio of mass the two stars really orbit their common centre.

Continued overleaf

However, with the mass of Sirius B being almost equal to that of our Sun, how come it is so dim? It is about 500 times less bright. The answer turns out to be that it is a what we call a white dwarf star. These are the core remnants of dead stars, and indeed they are in some sense dead. They are no longer generating energy from nuclear processes, and are just shining from the residual heat from when the original star was active. We can infer that originally Sirius B was created as a much larger star with about five solar-masses, and as such would have "burned" hot and rapidly, consuming all of its stocks of hydrogen fuel. It would have then evolved through the red-giant stage and begun consuming Helium in its core, fusing that to Carbon and Oxygen, before finally blowing away its remaining atmosphere and leaving behind just the Carbon-Oxygen rich ash core. Stars like this live fast and die young. We estimate that the system formed about 240 million years ago, and that the initial stages of Hydrogen fusion in Sirius B lasted only about 120 million years, before its collapse to the white dwarf. This would have been at an immense temperature to begin with of hundreds of millions of degrees. At present the temperature of the surface is at 25,000 degrees, which is still very hot compared to most stars, but is now doomed to cool over eternity and gradually fade.

Just think what a sight the combined Sirius system would have been during the age of the Dinosaurs! Sirius B in its initial main-sequence stage would have far outshone the star we see in the sky today, and during its red-giant phase would have been even brighter still. Indeed, this has echoes in something of a controversy which goes back to reports from around 150 AD when Ptolemy described Sirius as reddish in colour. Other reports of the time also suggested this. Is it possible that Sirius B was in its red giant phase only 2000 years ago? This doesn't fit with theory which suggests a much longer timescale for change, but as all good scientists know, if the theory is at odds with the facts then it is the theory that needs to change. However, checks of Chinese and other records from the second century BC onward all record the colour as blue-white, or white. Perhaps then Ptolemy was looking at it through too much atmosphere, or perhaps too much red wine?

I had never seen Sirius-B, it lies close to its much brighter partner, and that does make for a difficult observation, but one of our members Paul Leyland came up with a plan to track it down. His idea was to try to use high-frame rate imaging and capture a video of the star, and then use some professional grade software tools that he has, to see if we could pull the pup out of the glare. To do this we used my 14" Meade LX600 at F/5 (1000 mm focal length) and the Meade DSI pro II imager that I have for deep-sky long exposure imaging. Therefore rather than capturing 10s of seconds or several minutes for each frame, we turned it way down, to the minimum end of its range, at 0.5 milli-seconds per frame (1/2000th). At this level, the power of Sirius was just about avoided being saturating out, which is what we needed or else the sensor would just be flooded and all we would get would be a mess.

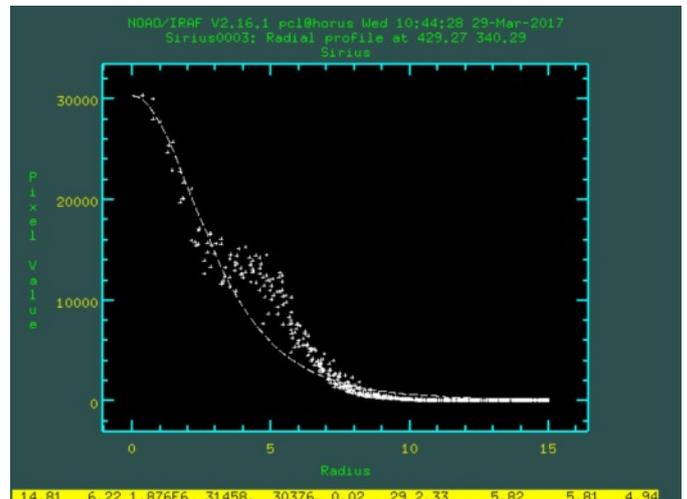
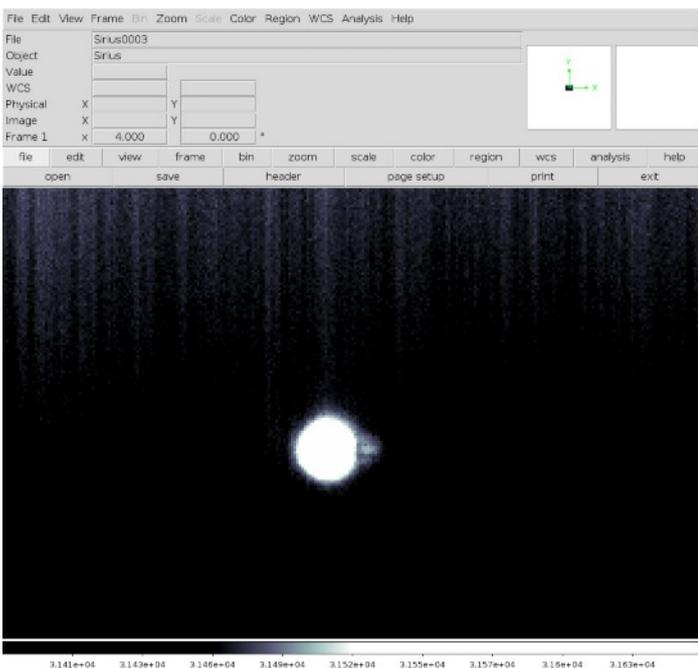
Anyway, we set it going and collected about 700 frames, totalling about 2 gigabytes of data, and Paul set-to with his software tools.

We also took a sighting shot of a galaxy NGC 2903 in Leo, and Paul was able to use this to determine the size of the field of view of the set up, (12.1 x 9.3 arc-minutes) and the relationship between the size of a pixel in the data and the angle on the sky. (0.96 arc-seconds per pixel).

The result.... you can see for yourself, we located Sirius B in the image, and were also able to measure the angular separation of it from the main star, at ~7 arc-seconds. The graph shows the brightness curve as a function of distance from the central point of the image, which shows the usual Gaussian curve, plus the bump of the secondary star pulling the numbers up again at that point.

According to the text books, the orbit is such that the separation between them varies from 3 to 11 arc-seconds over the 50

year orbit, and the last time it was at a minimum was in 1994, when it would have been rather harder to find. We are now, in 2017 some 23-years on, coming towards the widest separation point, so now is a good time to go for this!



Members Contributions

Short write up by the Chairman

Why can't we see the flag?

I am often asked by people who come along to observing sessions and see the moon in all its glory for the first time, questions, along the lines of "Can we see the flag?", or the footprints, or the bits of equipment left behind by Apollo.

Of course the answer to this is "no", but I can see why people ask. Often the answer is followed by a supplementary "What about Hubble?" because surely that is so-much better with all the lovely images that it creates that it must be able to. Again, the answer is "no" and that does tend to be met with puzzlement by people.

Well, lets have a little look at the numbers for a moment.

The disc of the moon covers, roughly, an angle of half a degree on the sky. People often would guess that it would be larger if you ask them, putting it at perhaps a few degrees - the first part of over-estimating how well we see it - but the correct measurement is just about 0.5 degrees - just fitting in the field of view of amateur telescopes at low-magnification. In angular measurement, degrees are divided into 60 "minutes". "So lets convert" over to these with the moon's apparent size being 0.5 degrees = 30 minutes. Actually because the distance to the moon varies as it moves around its elliptical orbit this varies from 29.3 to 34.1 minutes but lets call it 30 for our purposes as it makes the maths easier. Now convert to "seconds" - being 60ths of a minute. (These are often called arc-seconds to make it clear that we are talking about angles, not time). This makes the apparent size of the moon 1800 arc-seconds.



How big is the moon physically though? Well Wikipedia tells me that it has a diameter of 3474 kilometres. I'm going to round that up to 3500, and then because I can, round it up a bit more and call it 3600 - you will see why in a moment. Its close enough for our purposes.

What we can therefore do is work out how many arc-seconds of view match what distance on the moon. We have 1800 arc-seconds covering an object that is (I'm saying) 3600 kilometres.

That's 2 kilometres per arc-second of view.

So what? Well the resolution, the smallest angular separation, that a piece of optical equipment, be it your eye, or a giant telescope, is limited by a number of factors.

The most important factor is the diameter of the optics. Small telescopes are not able to achieve high precision, larger is better. There is a simple formula for this "Dawes' limit" which says

angle (in arc-seconds) = 116 / diameter (in millimeters).

and you can plug in some numbers for typical amateur telescopes and see what pops out when we convert this to the size of the smallest object that we can hope to see on the moon.

Diameter (mm)	angular limit (arc sec)	Smallest object on the moon (m)	
70	1.657	3314	Typical Small refractor
100	1.160	2320	
150	0.773	1547	
200	0.580	1160	CAA 8" Telescope
300	0.387	773	
350	0.331	663	CAA 14" telescope
2400	0.048	97	Hubble
10000	0.012	23	Ten Meter class telescopes
50000	0.002	5	Future giant 50meter scopes

As you can see, even Hubble, with its 2.4 meter mirror can only just see details at around 100meters across on the moon.

Of course, Hubble manages to do so well, not only because it has a large mirror, but because it is in space, above the effects of the atmosphere.

At ground level the turbulence in the air that we have to look through limits the performance of the telescopes considerably and we find that even on the best of nights when the stars are twinkling the least, we struggle to get better than around 2.5 arc-seconds of clarity.

Lucky-imaging (catching the brief moments of stable air) and adaptive optics, or building your observatory on a mountain top can help. The largest optical telescopes in the world on the ground have 10 meter mirrors, and there are plans for 30meter and larger ones, but even a fifty meter mirror will still have no chance of seeing the flag!

The moon is further away and bigger than people think!

Members Contributions

Short write up by the Editor

Nigel Henbest speaker meeting 12th March The Secret Life of Space

Well what a seminar “The Secret Life of Space” was. We went through the history of man’s endeavours at warp speed. Nigel



covered many subjects such as “who invented the first telescope” which was a big surprise. I am sure many were totally fascinated by Nigel’s discussion on the Antikythera device with at least 30 bronze meshing gears. The mechanism is an ancient analogue computer and orrery used to predict astronomical positions and eclipses for calendrical & astrological purposes as well as the Olympiads, the cycles of the ancient



The Antikythera device found on a shipwreck off a Greek island. It has been remodelled to show its surprising features.

Olympic Games. It is thought to have been designed and built probably in 205 BC. After the knowledge of this technology was lost at some point in antiquity, technological artefacts approaching its complexity and workmanship did not appear again until the development of mechanical astronomical clocks in Europe in the fourteenth century. Nigel then went on to cover Einstein, Stanley Rey, Lynden-Bell, Keplar, the Big Bang & Dark Energy. A crammed lecture that gave us so much food for thought.

A clear; well presented and fascinating seminar. One that we will all remember for the huge eons it covered and big surprises it revealed. It was one of the most informative seminars I’ve seen.

Don’t forget the Introduction to Astronomy

Wednesdays 26th April to 31st May 2017 at 8pm

- **26th April** - Things that go bump in the night
- **3rd May** - The inner solar system
- **10th May** - The outer solar system and beyond
- **17th May** - The Sun and other stars
- **24th May** - Gas dust and the Milky Way
- **30th May** - Galaxies and the Universe

The course is open to anyone 16 and over. The cost is £6 covering the entire 6 week course.

Should you wish to attend only some of the evenings please pay £2 at the door for each session

Introduction to Imaging

Run by the CAA and presented by some of our members who have learned to do imaging over the years (Often the hard way). This course attempts to clear away the fog and help people who would like to have a go and do some imaging of their own for the first time, or to improve their techniques and learn more about the subject

- **Part 1: 7th June** : Capturing the sky with a digital camera
- **Part 2: 14th June** : Deep sky photography
- **Part 3: 21st June** : Imaging with a webcam
- **Part 4: 28th June** : Advanced imaging

The course is open to anyone and the costs for the whole course is £6 for the whole session. Should you wish to attend only some of the evenings please pay £2 at the door for each session. If you book both this course and the Introduction to Astronomy course which precedes it then you can pay just £10 for the combination.

Members Contributions

Last quarter Moon seen at sunrise 19th April

By David Davies

This is an image I took in the early morning of 19th April after waking at 6 am and looking out of the window to see a lovely Spring morning with a clear blue sky, the Sun about to rise and a beautiful last-quarter Moon hovering above the garden almost due south. I couldn't resist it; I got up and dressed, opened up the observatory, woke up the computer and my APM 107mm refractor and captured some video. I managed to capture this image just before the Sun had fully risen.

The picture is a composite of two frames distilled from stacking the best 250 frames from 1000-frame videos captured with a ZWP ASI224MC colour camera.



CAA News

Subscriptions are due now. The rates for this year will remain at £4 for those of you paying by regular standing order, and £5 if you choose to pay just year-by-year in cash, cheque or via electronic banking.

A word about paying the fees for subscriptions, star parties and trips using electronic internet banking. You can of course, do this by logging into YOUR internet banking service and making a payment direct to our account using these details:

Account Name: CAMBRIDGEASTRONOMICALASS : Account number : 10679844 : Sort Code : 20-17-22

When you do this you will be asked for a "reference" - please put SUBS or STARPTY or TRIP followed by your name. Note that you can only use up to 18 characters in most Internet banking systems so you will have to abbreviate it.

For example STARPTY PMFELLOWS will fit! **Full details are on the website.**

We don't have access to your bank details or take anything from your account, and this keeps you safe.

Capella Editor's notes to members.

Thanks to our members Paul Leyland, Mick Jenkins and David Davies. for their interesting contributions.

Come on please don't be shy!! Remember you are all invited to contribute anything as a suitable article with photos for Capella. It is carefully typeset, abridged if necessary and published every alternate month. Not every item can be published in the month that you submit it but we will always try to incorporate your articles where possible. So it could be yours in the next one.

Please try to submit at least 4 weeks in advance of publication.

I would ask that any information you wish to include must be in standard text or preferably formatted as a Word document. If you embed any pictures for your story, please also send separate good quality JPG files smaller than 10mb. You can contact me by email on any content or publication issue at richard@rwhitestudios.co.uk

Loan Telescopes.

Now is a good time to book a telescope especially as the instruments have been augmented thanks to the IoA.

We have a pool of nine telescopes and one set of giant binoculars in our loan programme and all are designed to be extremely easy to use, but of course we will be happy to show you exactly what to do.

Please remember that two of the telescopes will not fit in a standard sized car - the long focus planetary telescope and the Behemoth. The Behemoth, especially, is not a one person telescope! As well as being big it is also heavy, and really does need two people to shift it.

The other telescopes will fit across the back seats of most cars, and are recommended for first time users of our loan telescopes.

Visit our website (www.caa-cya.org) and click to book an instrument, or alternatively please ring Mickey Pallett on 01480 493045.

CYA Meetings 7-11 Year Group

Comet Halley
Saturday 29th April 2017 at 10:00am

Today is International Astronomy Day. As part of this special day you are invited to bring a friend along absolutely free (normally, we would expect them to pay, even if they are just visiting). For this month's event we will be looking a comet Halley and what we know about it, from past encounters to space probes which have visited this famous comet. Even though the comet is on the outskirts of our solar system and can't be seen by the largest telescope in the world, but we've a trick up our sleeves to show how you can see something of this comet without using a telescope!

Variable Stars
Saturday 27th May 2017 at 10:00am

For most stable stars, it's a balancing act between gravity trying to squish the star smaller, while radiation pressure (energy coming out) tries to make the star larger. But for some stars this balancing act goes skew whiff, and the star changes in size and brightness - sometimes in a few short hours. There are other reasons why star change in brightness, some can be seen with binoculars or even the naked eye.

Man back on the Moon and other Manned Missions
Saturday 24th Jun 2017 at 10:00am

Returning man to the surface to the Moon is a long term goal of several space agencies of a few countries although NASA is not one of them. This mission which will be extremely challenging is just one manned mission, other missions to Mars and even to an asteroid are being considered. What will happen to man in space once the International Space Station ends its useful life around 2024 / 2028?

Meetings for the 7 -11 yr Group other than special visits are normally held in the Hoyle Building at the Institute of Astronomy, Madingley Road from 10.00am to 12.00 noon. Which are free to CYA members. Non members fee £1.00

If leaving a CYA member unaccompanied a contact telephone number of a responsible person MUST be left.
No children aged 7 or under can be left unaccompanied.

11+ group meetings

“X-ray and Gamma Ray Astronomy”
Monday 1st May 19:15pm

Thanks to our atmosphere we don't get bombarded with x-rays and gamma rays, which is good! However, to study them we need to go into space, which is bad (expensive)! Since the Explorer 11 satellite was launched in 1961 and only picked up fewer than 100 cosmic gamma-ray photons, things have moved on dramatically.

“Rovers”
Monday 5th June at 19:15pm

Surprisingly, 13 rovers have been launched to the Moon and Mars, while some have been very successful and roved widely, others have been less fortunate. Still more are planned to go to the Moon, Mars, even Venus and maybe on asteroids.

Chairman: Paul Fellows
Treasurer & Membership Secretary: Mickey Pallett
Secretary: Michael Jenkins

Committee: Dave Allen, Kevin Black, Paul Drake, Clive Gilchrist, Clive Holt, Barry Warman, Christopher Wright and Brenda Field.

Capella Editor and DTP Setter: Richard White richard@rwhitestudios.co.uk
Members should send stories for inclusion where possible by email to Richard. Alternatively send them to Brian Lister Tel: 01223 420954 (evenings) or email bt1@cam.ac.uk

President: Jim Hysom

Vice President: Carolin Crawford

Vice Chairman: Brian Lister

Cambridge Young Astronomers (both groups): Brian Lister Tel: (evenings) 01223 420954 or email bt21@cam.ac.uk

Telescopes for hire to members: Mickey Pallett Tel: 01480 493045 or book on -line.

Loan Telescope maintenance: Dave Allen, email day.vid@hotmail.co.uk

Library: Kevin Black Tel: 01223 473121