TRANSIT

The November 2012 Newsletter of

Cleveland & Darlington Astronomical Society

NEXT TWO MEETINGS at Wynyard Planetarium

Friday 9 November 2012, *7.15 for 7.30 pm*

Extrasolar planets

Dr Pete Edwards, *Durham University*

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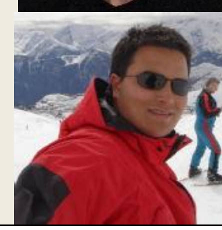
Friday 14 December 2012, *7.15 for 7.30 pm*

Searching for the most distant objects in the Universe

Prof. Andrew Levan, *Warwick University*



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Editorial

Rod Cuff

A warm welcome to four more new members this month – Graham Hadley, Eric Horsley, Alan Kennedy and Peter Melling. Good to have you with us!

I'm afraid this is a thinner edition of *Transit* than usual – no one except the excellent and sadly distant Rob Peeling has come up with any articles. No doubt people are busy with telescopes and binoculars out in the dark on the rare occasions when clouds and rain don't intervene – do please write and tell the rest of us what you're doing …

I've seized the opportunity to include (with permission) another article from one of the blogs maintained by members of the American Association of Variable Star Observers (AAVSO). Because our next talk, this coming Friday, by Dr Pete Edwards from Durham University, is on extrasolar planets, it seemed appropriate to include Mike Simonsen's article on the discovery of an Earth-sized planet in our nearest star-system neighbour.

There's one piece of good CaDAS news to report (Jürgen and George & John Gargett will have to look away at this point) is that CaDAS retained the Thomas Wright Trophy in our annual three-cornered astronomy quiz on 19 October at Durham AS's HQ. It was a narrow thing this year – the CaDAS team of Michael Roe, John Crowther and I squeezed home in front of the Durham team (the names above may give you a clue …) by just two points. The Durham University Students' team was, alas, rather further behind. Our thanks go especially to John Crowther, who was press-ganged from the audience at the last moment (in fact, he *was* the CaDAS audience – the Cleveland & Darlington turnout was disappointing, to say the least) when the team's third planned member failed to turn up, though a misunderstanding. Even more thanks go to Neil Haggath, whose hard work in planning the questions, fairly spreading them around the teams, setting up the hardware (PC, projector, red buttons for each team to press) and simply managing to get there from Birmingham at all, was and is very much appreciated by everyone involved. At the time of writing, Neil is out in Australia getting ready to see the imminent total solar eclipse, and I'm sure we all wish him very much better meteorological luck than he had in Thailand for the Transit of Venus …

Alas, I can't be at this month's normal meeting, but I know from past experience that Dr Edwards will give everyone there an excellent talk.

Please keep your contributions to *Transit* coming in!

Rod Cuff, info@cadas-astro.org.uk *1 Farndale Drive, Guisborough TS14 8JD*
(01287 638154, mobile 07775 527530)

OBSERVATION REPORTS AND PLANNING

Skylights – November 2012

Rob Peeling

Hours of darkness

GMT	Astronomical twilight
1 November	18:35 to 05:10
30 November	18:03 to 05:54

The Moon

	Last Quarter	New Moon	First Quarter	Full Moon
	7 November	13 November	20 November	28 November
Rise	23:00 (6th)	06:54	12:43	16:01
Set	13:21	15:54	23:54	07:43 (29th)

The planets

Jupiter is in Taurus to the east of the Hyades and will be visible more or less all night throughout November. There have been many reports of turbulent activity in the two equatorial belts, and some of my new friends in Reading AS have produced dramatic images. Towards the end of the month it is sufficiently high in the night sky to catch an entire planetary rotation for anyone able to stay up all night. The **Great Red Spot** (pale pink at the moment) is said to be easy to pick out against the South Equatorial Belt. Seeing this is my target for November. Good nights with the Spot transiting the face of the planet at a convenient time are:

Date	Transit time	Date	Transit time	Date	Transit time
2	20:49	14	20:41	24	18:55
4	22:27	16	22:19	26	20:33
7	19:56	17	18:10	28	22:11
9	21:34	19	19:48	29	18:02
11	23:12	21	21:26	30	23:49
12	19:03	23	23:04		

Neptune is now setting early in the evening but **Uranus** is still well placed in the evening sky. It is to the east of the Circlet of Pisces. Look about 1½ widths of the Circlet off to the left (east) with your finder or binoculars. In an otherwise barren area of sky you should see two brightish (5th/6th-magnitude) 'stars' with a somewhat fainter one over the westernmost of the pair. The eastern object is really a star, 44 Piscium, and the one with the companion over it is Uranus.

Meteors

There are two showers to look out for in November. The first is the **Taurids**, which peak on 4–7 November. The Taurids are slow and bright and are derived from Comet Encke.

The **Leonids** reach maximum on 17/18 November. However, the Moon is waxing towards full and will be prominent in the sky at midnight on both nights.

Deep space

This month, the **Pleiades** and **Hyades** should be grabbing your attention. Also try to find **M33, the Triangulum Galaxy**. It is a bit elusive with light pollution, but the core can be quite bright. However, here are some other objects in **Andromeda** and **Perseus** to have a look for in November.

Start from Alpheratz, which is the star at the north-east (top left) corner of the Square of Pegasus. Move out to the east (or left) and miss out the first star in the 'line' marking Andromeda and look at the second and brighter star – the same star that many of us use to star-hop to M31, the Andromeda Galaxy. This star is **Mirach** and is distinctly orange/red-hued. It is also a wide double. However, take a medium-power lens and look close-by to the north of Mirach in the same field of view. You will find a faint, grey patch, which is Mirach's **Ghost**. The ghost is an **elliptical galaxy, NGC 404**, discovered by William Herschel in 1784.

Now move out along Andromeda to the next bright star, which appears slightly yellowish to the naked eye. This is the famous **double star, Almaak or γ (gamma) Andromedae**. The bright primary is distinctly orange in the telescope. Only about 10 arc seconds away is the secondary, which is bluish (greenish to some people – the colour of double stars is a very subjective thing). Use a medium- or high-power eyepiece to get the best from it.

Also look for the **open cluster NGC 752**, lying between the short side of the triangle of Triangulum and the line between β and γ Andromedae. This is an easy binocular object and also bright enough to spot with the naked eye. I have seen it through the moderate light pollution at home. With averted vision, it is fairly easy to see from the Planetarium as a cloudy splodge.

The **planetary nebula M76** has a reputation as one of the dimmest and more difficult Messier objects to find. I am not sure I hold with this view, as the position is quite well marked by a marker star and I've had much greater problems seeing some of the other Messier objects – M74 in Pisces particularly comes to mind. Start from γ Andromedae and look upwards to the north and east to find a pair of 4th-magnitude stars, 51 And & φ (phi) Per. Centre your finder on φ Per, the lefthand (eastern) star of the pair. With a low-power lens, look east of φ Perseii for a yellowish 7th-magnitude star (it will also show in the finder). M76 lies close by and nearly due north of the yellowish marker star. Try medium power if you can't spot it with low power. Once found, try high power with or without nebula filters and see if you can see how it separates into two patches of light, explaining why this single Messier object is recorded by *two* NGC numbers, 650 & 651.

M34 is a bright open cluster in Perseus. Scan with either binoculars or a finder down a line from γ Andromedae towards Algol, the demon star. M34 is slightly more than half-way down this line and should be visible.

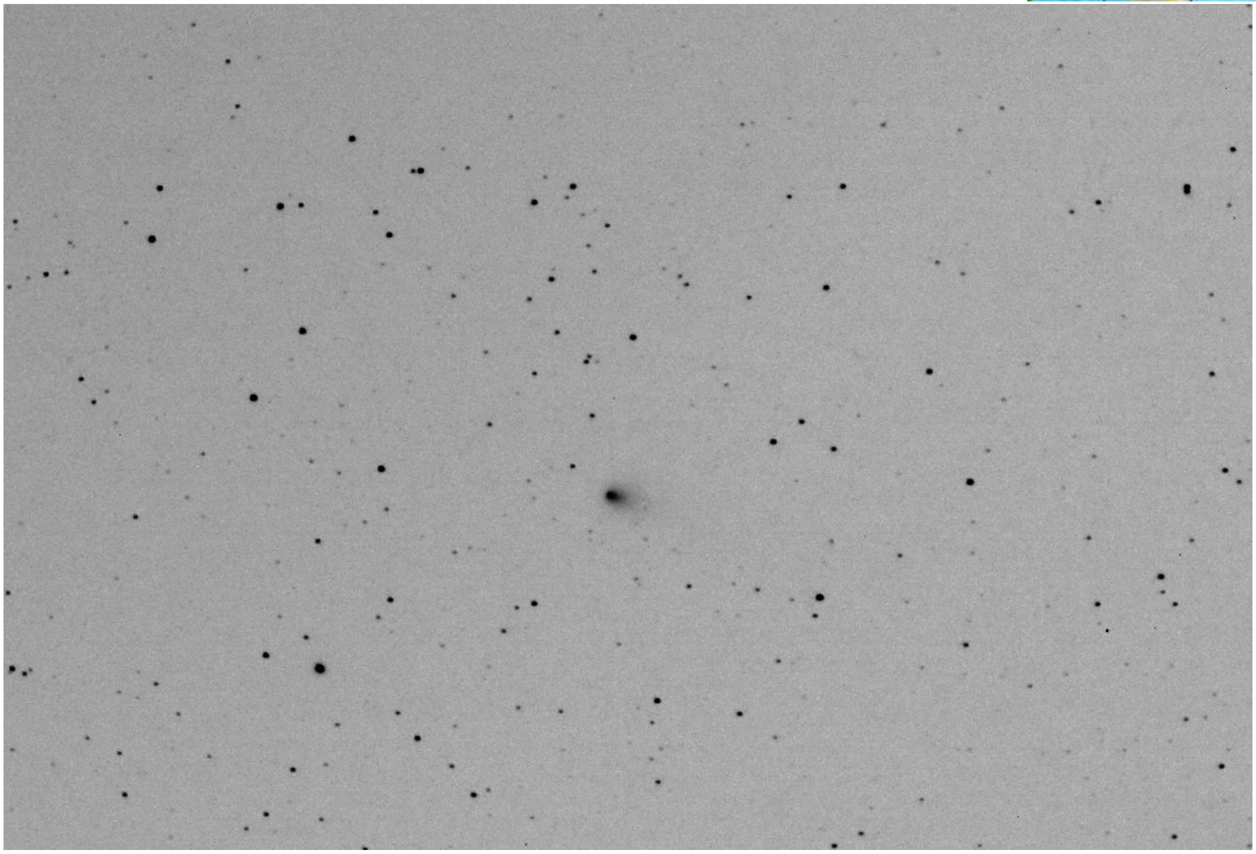
Comet 168P Hergenrother

Keith Johnson

Here's a quick five-minute single unprocessed frame of Comet 168P Hergenrother captured on 12 October 2012.

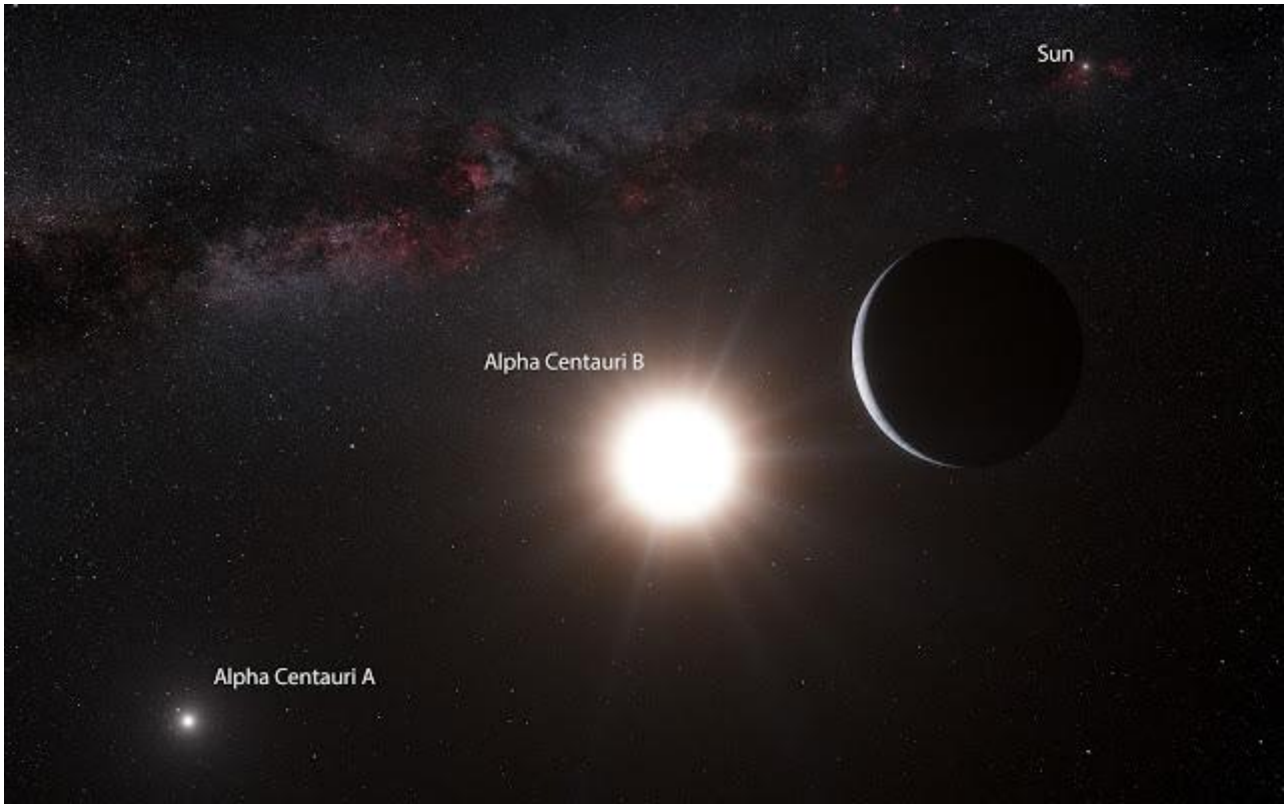
Equipment

- Imaging – 80mm ED refractor
- Modified Canon 1000D DSLR
- Guiding – LVI autoguider, ZS66 ED refractor, HEQ5 Pro. Mount



Earth-sized planet found orbiting Alpha Centauri B

Sinoastronomy ***(Mike Simonsen)***[1]



This artist's impression shows the planet orbiting the star Alpha Centauri B, a member of the triple star system that is the closest to Earth. Credit: ESO/L. Calçada/N. Risinger (skysurvey.org)

October 17, 2012

One of the most exciting exoplanet discoveries in decades was announced yesterday in an online ESO press conference. The discovery was to be officially announced in an article in the journal *Nature* today, but due to the excitement surrounding this discovery ESO and *Nature* agreed to lift the embargo a day early. I think they realized they weren't going to be able to keep the lid on it for another day. The fact that an Earth-sized planet had been discovered orbiting one of our nearest stellar neighbours, Alpha Centauri B, was a headline dying to be exploited by the press.

The planet was detected using the HARPS instrument on the 3.6-meter telescope at ESO's La Silla Observatory in Chile. HARPS can measure the radial velocity of a star with extraordinary precision. A planet in orbit around a star causes the star to move towards and away from an observer on Earth. Because of the Doppler effect, this radial velocity change

[1] This content distributed by the AAVSO Writer's Bureau.

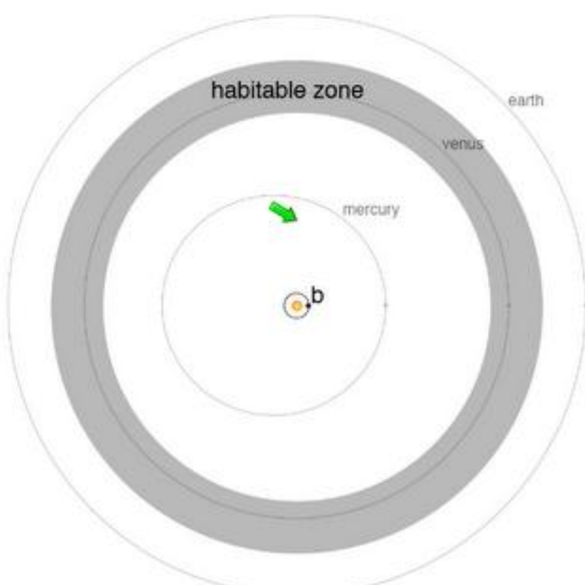
induces a redshift of the star's spectrum towards longer wavelengths as it moves away and a blueshift as it approaches. This tiny shift of the star's spectrum can be measured with a high-precision spectrograph such as HARPS and used to infer the presence of a planet. Of course it's not quite as simple as that.

How do they do that?

Alpha Cen B is a spectral type K1V star only slightly less massive than our Sun, and cooler. There are a lot of competing signals combined in the light from Alpha Cen B, inducing a radial-velocity "jitter". In the process of filtering out these additional sources of noise the team of astronomers was able to learn quite a bit more about the star itself. They determined that the star has spots like our Sun. As a star rotates, spots will appear to move from one side of the stellar disk to the other, introducing a periodic signal. This will correspond to the rotational period of the star. The radial velocities of Alpha Centauri B show a clear signal at 38.7 days, the rotational period of the star. They also learned the star has a solar-like star-spot cycle with activity increasing and then decreasing over the four-year period of the observations.

Additionally, the team had to filter out the effects of the radial velocity changes due to the star being a member of a binary system, as well as the fact that on some occasions of poor seeing the light from Alpha Cen B was contaminated with light from the primary, Alpha Cen A. As if that wasn't enough, they also had to remove the effect of the changing velocity of the Earth in the direction of the star as it orbits the Sun before the signal of a small rocky planet orbiting the star could be detected.

"Our observations extended over more than four years using the HARPS instrument and have revealed a tiny, but real, signal from a planet orbiting Alpha Centauri B every 3.2 days," says lead author of the paper, Xavier Dumusque (Geneva Observatory, Switzerland, and Centro de Astrofisica da Universidade do Porto, Portugal). "It's an extraordinary discovery and it has pushed our technique to the limit!"



Alpha Cen Bb and the habitable zone around the host star. Credit: Greg Laughlin from EPO press conference

Why is this important?

The technical achievement alone makes this an extraordinary discovery. It is the lowest mass exoplanet ever discovered, and now the closest known. This is a major step forward in detecting Earth twins. Unfortunately, the planet orbits so close to its parent star (0.04 AU) that its surface temperature is estimated to be approximately 1500 Kelvin, so the chance of the planet supporting any kind of life is doubtful. But the precision required to obtain this result would also allow astronomers to detect a planet four times the mass of Earth in the habitable zone of a Sun-like star (habitable super-Earths) with periods in the range of 200 days.

The fact that this planet was discovered orbiting a star in the Alpha Centauri system sparks the imagination. How many science fiction books have speculated about the existence of planets around our nearest stellar neighbour? Now it is science fact. There is at least one planet in the Alpha Centauri system, and probably more.

"This is the first planet with a mass similar to Earth ever found around a star like the Sun. Its orbit is very close to its star and it must be much too hot for life as we know it," adds Stephane Udry (Geneva Observatory), a co-author of the paper and member of the team, "but it may well be just one planet in a system of several. Our other HARPS results, and new findings from Kepler, both show clearly that the majority of low-mass planets are found in such systems."

The Kepler mission has found 2300 candidate planets by searching for exoplanet transits among the 10,000 or more stars it monitors continuously. The majority of planet candidates detected by this transit method are very distant from us. In contrast, the planets found by HARPS are around stars close to the Sun, this new discovery being the closest yet. This makes them better targets for many kinds of additional follow-up observations such as characterizing the planet's atmosphere.

What next?

Astronomers will now continue with extensive Doppler monitoring of Alpha Centauri B to try to detect additional planets, perhaps some in the habitable zone. This will become increasingly difficult, as the separation between the Alpha Cen binary components is decreasing over the next several years. They may also try to observe it from space to see if they can detect the transit of the star across the face of Alpha Cen B. The eclipse will be too shallow to observe from the ground. There is about a 10% chance of success, with the odds being higher if the orbital plane is in line with the binary plane, estimated at 11% inclination with respect to Earth.

How does this fit into variable star science?

The study of variable stars is really the study of the secret lives of stars: how they are formed, how they live out their lives and what changes occur internally and externally as they evolve. We learn about the environments surrounding them, including planets and other companions, and their affect on these partners; and finally, how they end their lives slowly fading away, stripped of their atmospheres or violently exploding, seeding the universe with the materials to build more stars, planets and us.

At almost every phase in its life, a star varies in its light output. If the variation is large enough and occurs on human timescales, we, the observers of the AAVSO, can record and study these changes, and we have now for over 100 years.

In that time we have learned about all kinds of variations in stellar output and how to interpret it. Some stars vary as they pulsate, actually changing size physically, growing and then shrinking again, sometimes with a precise period, sometimes irregularly. We've seen stars that appear to vary because star spots are transported across the face of the star as it rotates. We've witnessed stars being eclipsed by unseen companions in extremely close orbits around their centre of gravity, and now we can see the incredibly small changes in the light of a star as a planet crosses in front of it from our point of view.

Alpha Centauri B exhibits all of these phenomena at the same time. It rotates, it pulsates, it has spots, it's a member of a binary system, and now we know it has a planet, perhaps several, and there is a chance we can see them transit the face of our close stellar neighbour if we turn our satellites on them. It is becoming apparent that the more we look, the more we will find planets around stars everywhere. It has also become obvious that the closer we look, the more we will find that every star is a variable star to one degree or another at one time or another in its life. Alpha Centauri B is another interesting and exciting member of the variable star zoo.

THE TRANSIT QUIZ

Answers to October's quiz

1. What name has been given to the point at which the Mars Curiosity mission landed in Gale Crater? **Bradbury Landing, in tribute to the science-fiction author Ray Bradbury, who wrote memorable stories about life on a colonised Mars.**

2. There's been a lot of excited speculation this month about the discovery of a comet, still far out, that could be a spectacular naked-eye object in November 2013. What's the comet's name? **Comet Ison.**

3. Recent measurements show that the Sun is much rounder than expected – something is countering the centrifugal force from its rotation, which should make the equator bulge out, as the Earth's does. If the Sun was scaled down to the size of a beach ball, the difference between its pole-to-pole and equatorial diameters would be less than the width of – what common comparison object? **A human hair (see Space Daily, 20/8/2012).**

4. Who first discovered, in 1913, that the 'Andromeda Nebula', as it was then called, was approaching us, at about 300 km per second? **The American astronomer Vesto Slipher. It was a further 10 years before Edwin Hubble showed that the 'nebula' was not within our galaxy but was a completely separate galaxy itself.**

5. Viewed through a telescope, Neptune appears to be what colour? And Uranus …? **Blue and green respectively.**

6. M76, nicknamed the Little Dumbbell Nebula, is in Perseus. But what constellation holds the (bigger!) Dumbbell Nebula? **Vulpecula (the Little Fox).**

7. This month, 'Space for Human Safety and Security' is the official focus of … what? **World Space Week.**

8. What is the nickname, given to it by Sir William Herschel, of the very red star μ (Mu) Cephei? **The Garnet Star.**

9. What can you say about these 'pairings'? Gamma Aurigae and Beta Tauri; Gamma Scorpii and Sigma Librae; Delta Pegasi and Alpha Andromedae? **Each pairing shows the earlier and later name of the same star, which was 'switched' to a different constellation by the International Astronomical Union.**

10. What is the name of the brightest star in the Pleiades cluster (see Keith's lovely picture of the cluster in September's issue)? **Alcyone, magnitude 2.9.**

November's quiz

This month's quiz is all about astronomers or scientists who have given their name to the specified object or class of objects in the sky. How many do you know? For extra points, do you know more than just their surname?!

1. Dark 'globules'.
2. The Coathanger (Collinder 399).
3. A Chain in Virgo.
4. The star with the greatest proper motion known.
5. Sunlight shining through lunar valleys just before and after a total solar eclipse.
6. One of the most massive binary stars known (each component is around 50 solar masses), in the constellation of Monoceros.
7. A complete circle of light as seen from Earth when a massive object is exactly between us and a quasar.
8. The main gap in Saturn's A-ring.
9. A reflection nebula in Monoceros that changes its appearance from time to time (as an aside, it was the first object photographed with the 200-inch Hale Telescope at Mount Palomar, in 1949).
10. The supernova of 1604, in Ophiucus.