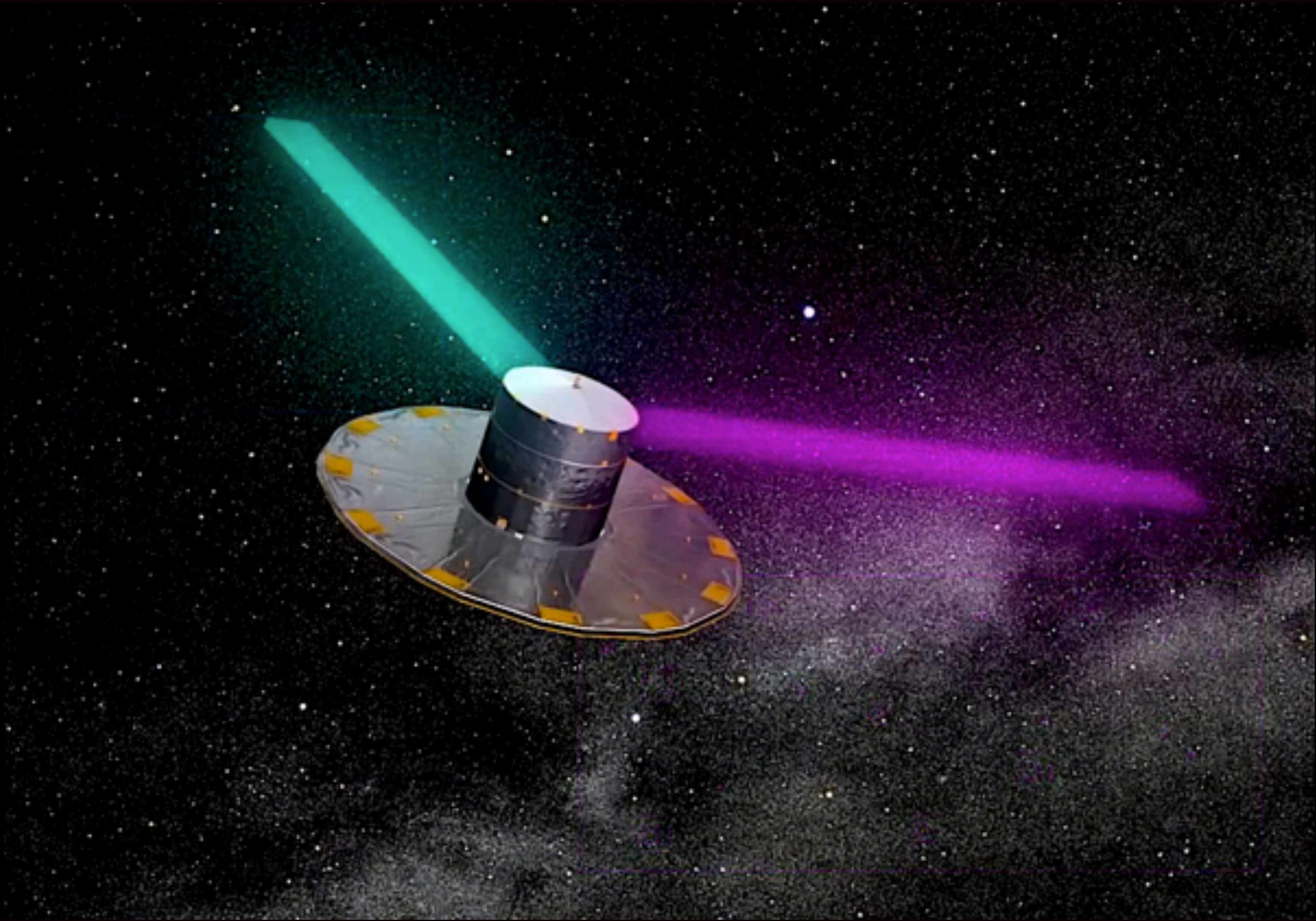
Nightfall

Astronomical Society of Southern Africa

Aha! So there really ARE flying saucers!!



Well . . . not exactly.

Reminder

In Nightfall, anything printed in **THIS CYAN COLOUR** is a weblink to a video or online resource.

NIGHTFALL

Astronomical Society of Southern Africa
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Produced by Atelier Books LLC
Postnet 18, Private Bag X1672
Grahamstown 6140, South Africa
email: *assa.nightfall@gmail.com*

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Corona Australis infra-red dark cloud by Marc Schafer, Winterberg Observatory, East Cape

In this issue

Image on previous page: This image of the Corona Australis dark cloud was acquired 6 October 2020 by astro-imager Marc Schafer at his Winterberg Observatory under Bortle 1 skies some 30 km south of Tarkastad. Acquired with an Intes-Alter MN84 astrograph on a Celestron CGX GoTo EQ Mount guided with an MGEN LACERTA Auto Guider. Marc's camera is simplicity itself: a NIKON D750 DSLR operating at ambient temperature. This Corona Australis IRDC image was processed from 49 stacked images of 181s each for a total exposure 2hr 27min 24sec. Marc processed them using DeepSkyStacker 3.3.4, Adobe Photoshop with Astronomy Tools v1.6, and Lightroom.

Despite what Marc's image might suggest, the three glowing reflection nebulae at the blobby tip of the Corona Australia IRDC is not about to devour the scintillating but vulnerable-looking globular cluster above it. The globular cluster is NGC 6723, which is technically in Sagittarius (by 15 whole arcminutes). While the Corona IRDC is only XX light years from us, NGC 6723 lies some 8.7 kpc (28,400 light years) further out. That places the cluster on the opposite side of our galaxy only a little further out than the solar circle (~8 kpc) and some 17.3° below the Galactic plane. The globular's metallicity [Fe/H] of –0.93 dates it as an intermediate-age globular at 12.5 billion years, while the dark Corona Australia blob of gas and dust is only a few million years old.

Infra-red dark clouds like Corona Australis only acquire their 'infrared' moniker as they infall into the thick gas and dust of the Galactic plane. There they heat up from gravitational collapse into star forming densities (three clusters of them underway here) plus the friction of all those gas and dust particles racing past each other. The Corona IRDC might actually a visitor from beyond our galaxy. It is one of hundreds of cosmic high-velocity clouds (CHVCs) that meander in the halos and intergalaxy regions of galaxy systems like our Local Group. CHVCx are relatively short-lived (1 to 10 million years). They evolve into and out of spherical shape from tidal friction, shock turbulence from stars, and magnetic fields. If a CHVC happens to fall into a galaxy disc like Corona Australia is doing, their shape elongates into a reverse teardrop, dense at the thin tip (as we see here) and lumpily diffuse further out. As the originally round cloud infalls it 'spaghettifies', first into blobby clumps and then into dense cores. As cores compress from their original 10 to 100 atoms per cc into millions of atoms per cc, their temperatures rise into deuterium fusion and then hydrogen ignition states. When this happens to hundreds or more protostellar cores over a few million years, we will soon see a bright young cluster in our eyepieces. 'Soon' means a few million years, however.

this is what we see when we look at Virgo

Image: Markarian's Chain by Fernando Pena, APOD 10 Oct 2020.

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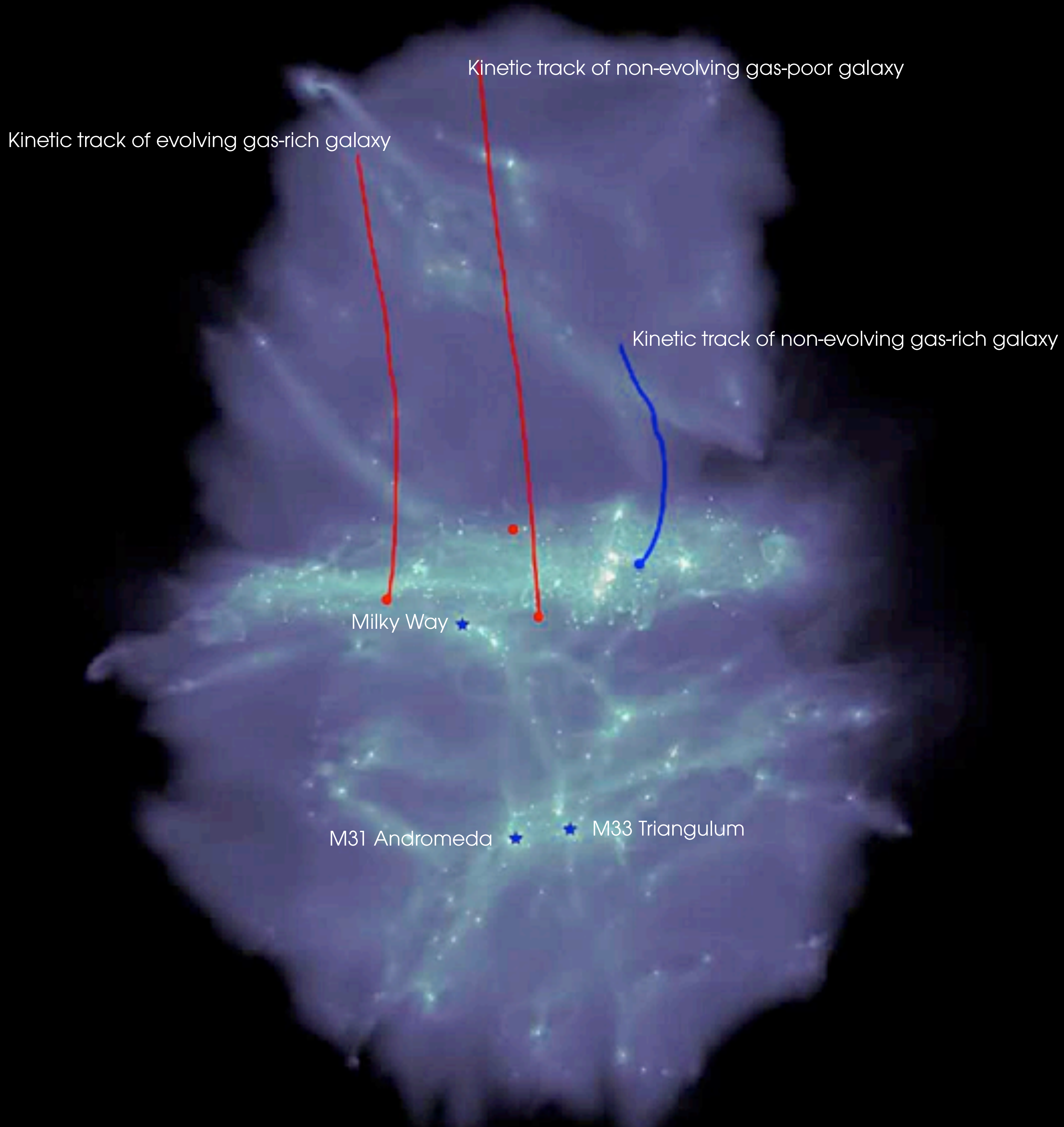


Read how it works here.

When everybody else sees this

We see this

Video by Mr. W.P. Koorts (wpk@saao.ac.za), South African Astronomical Observatory

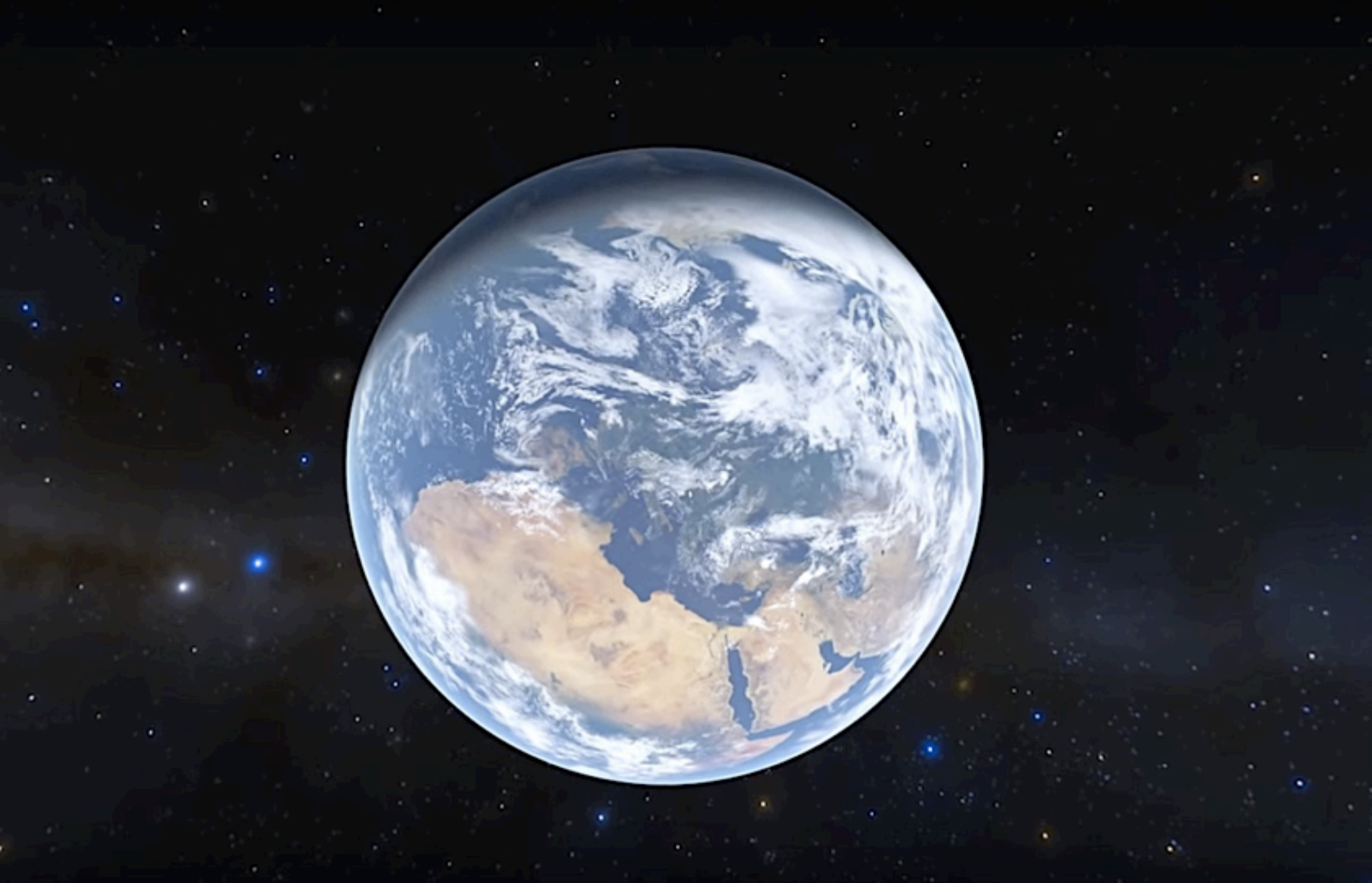
THERE IS STILL TIME TO REGISTER

The SAAO Virtual Symposium is just around the corner...

The virtual platform will be launching next week, giving you plenty of time to get familiar with it. This is not just any old webinar! In the meantime, read on for more about some of the excellent speakers that will be contributing to the programme, including our Keynote from the IAU.

DOWNLOAD THE PROGRAMME

REGISTER HERE



Where do you go if you can’t come back?

Magda Streicher

Mistaken Identity

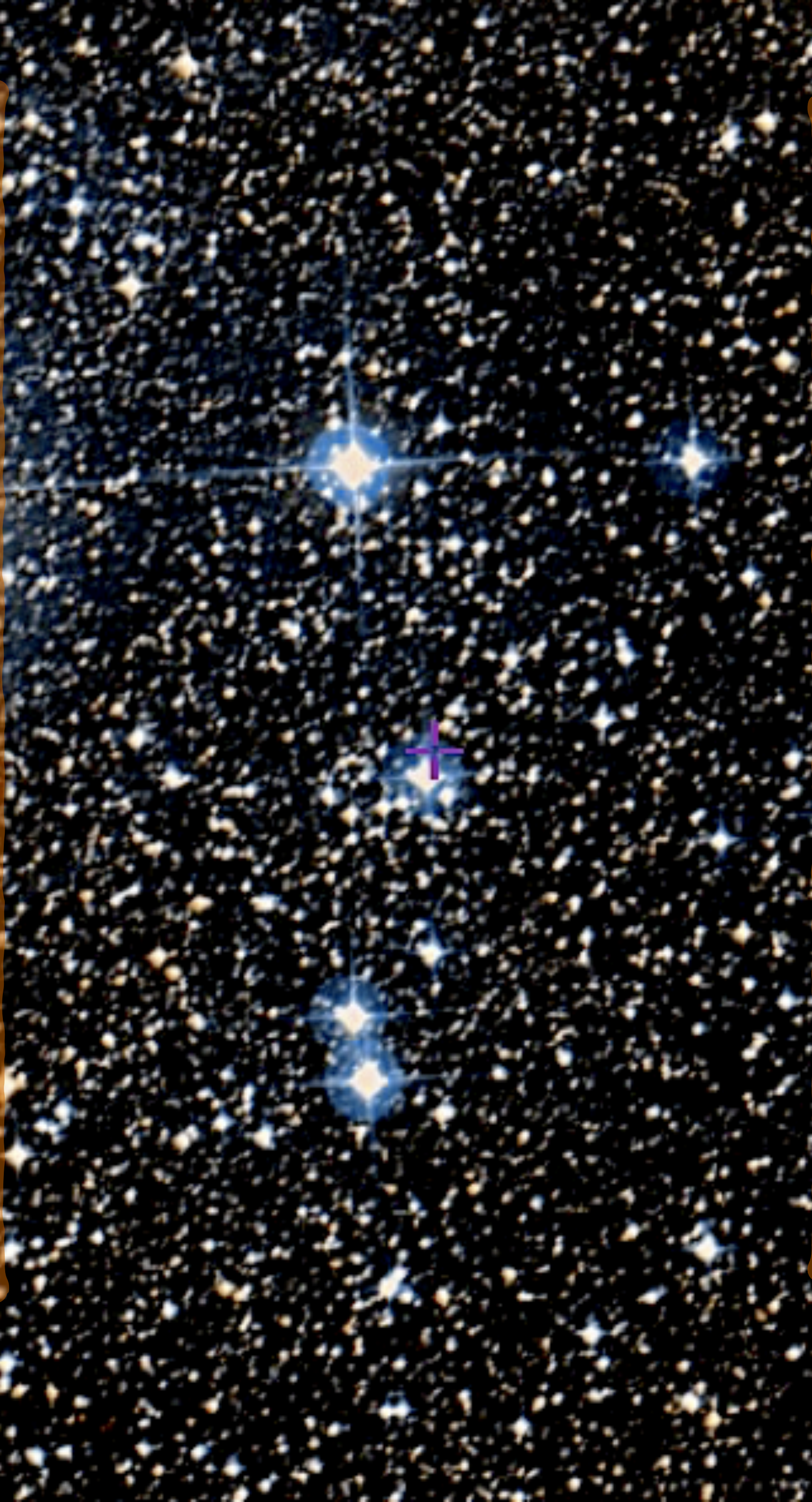
Helen Sawyer Hogg was a Canadian astronomer mostly remembered today as one of the pre-eminent experts on our galaxy's globular clusters. This photo taken in her office during her later career reveals a gentle woman who fulfilled her work in astronomy with pride

Arthur Robert Hogg was an Australian astronomer who became interested in galactic open clusters during their heyday of interest in the 1950s. This pencil sketch was drawn by Kathryn van Schalkwyk.

Star clusters are jewel-boxes of joy. Some are tight little balls of sparkle. Others, like the Southern Pleiades, are big sprawling louts lounging all over the living-room sofa. Some are specked with blues and reds—the famed Jewel Box Cluster just to the east of the star Mimosa in the Southern Cross is the most-visited cluster like this. Others are faded and wan looking, seeming to lack energy and verve. That is not the fault of the cluster, it is because the cluster is obscured by veils of space dust between us and it.

And then there are the clusters which really open our eyes in ways we don't expect. Hogg 15 was one such cluster for me. One day while perusing a star chart of the southern skies, my eye was caught by the name 'Hogg 15', which was plotted a handful of arc minutes east of NGC 4609, and well inside the dark shape of the Coalsack Nebula.

The Coalsack is relatively nearby at 180 pc or 590 light years. It is aggregation of gas and dust filaments and clumps with many gaps in between through which we can see the stars of the Milky Way beyond. It looks dark because there are no nearby stars to illuminate it. *See this beautiful video that pans all across it*.



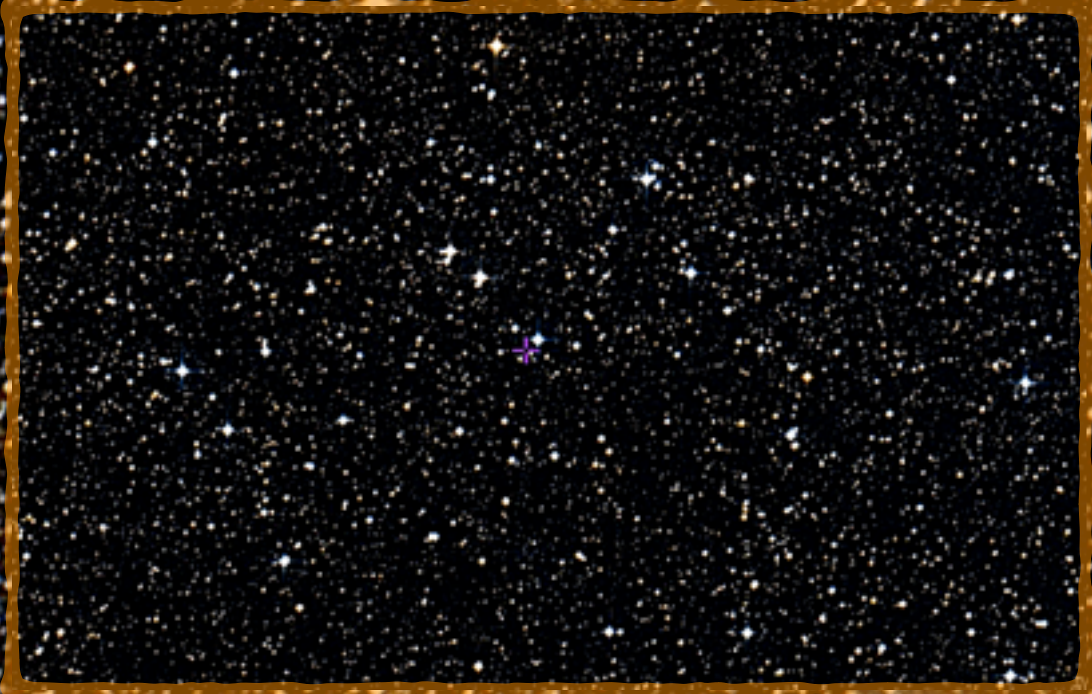
Naturally I assumed that both clusters, NGC 4609 and Hogg 15, were quite close to us. I also assumed that the cluster was named after one my of favourite astronomers, Helen Hogg. Canada lost one of its most famous and best-loved astronomers with the death of Professor Helen B. Sawyer Hogg in Richmond Hill, Ontario on 28 January 1993. She acquired her astronomy degrees in the USA, but the large portion of her astronomy career was passed working in Canadian observatories.

With a little homework I soon found that there are 23 open clusters with the name Hogg. I looked all 23 up on Simbad astronomy database and the Aladin websites. I was thrilled to bits to find that all 23 were easily visible from our southern skies.

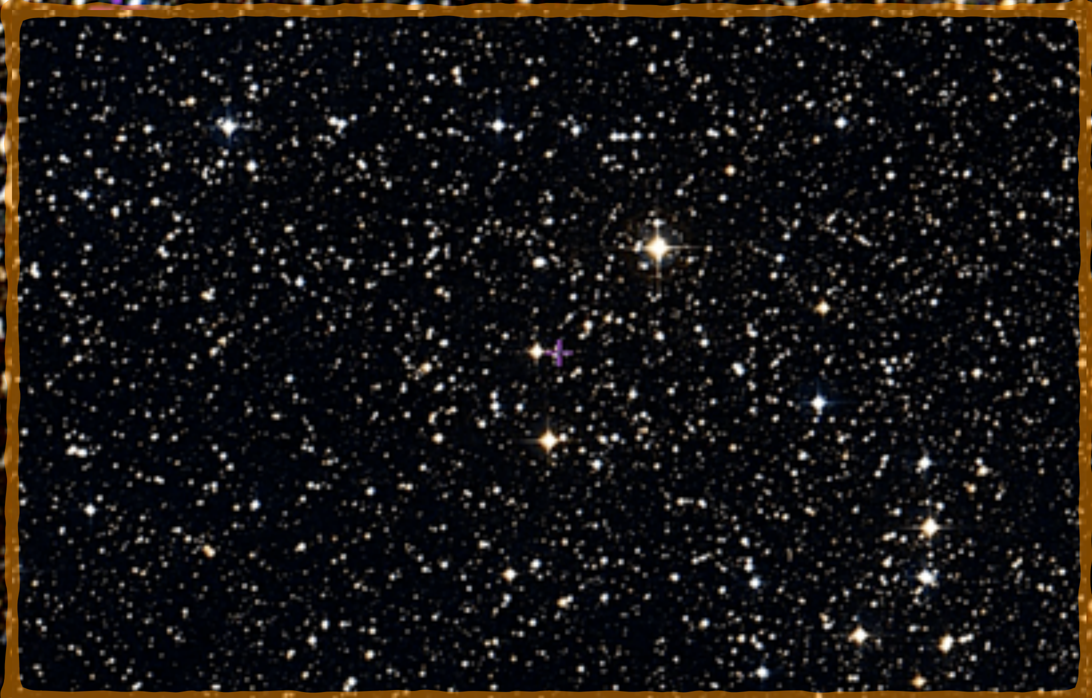
That was all it took for me to embark on a mission to observe and sketch every single one. I rubbed my hands with glee, knowing I had many a good night of discovering ahead of me. I was like a child with 23 new toys to play with.

Centre left: Hogg 11 in Carina.

All charged up and excited with this new project, my first target couldn't be any other than Hogg 1 in the constellation Vela. The WikiSky and Aladin star maps presented a relatively busy star field with a few outstanding stars mixed into many scattered strings of fainter stars. It was a rather disappointing field of view. The brightest star had a magnitude of 10 and rather lovely yellow colour, but that was the end of the excitement.

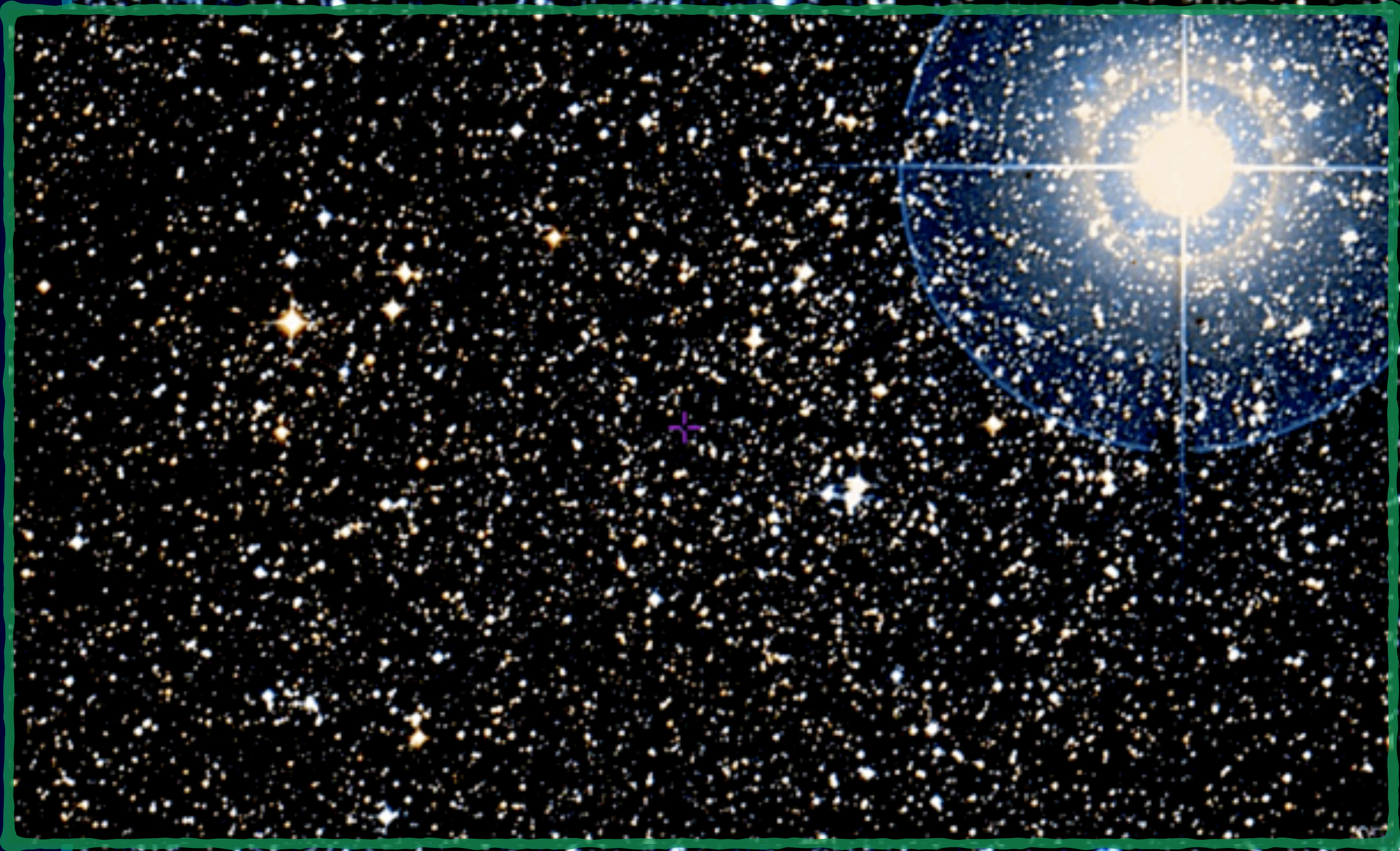


Crossing my fingers in hopes for a more positive observation, I sought out Hogg 2. It also lies in the constellation of Vela, just east of the magnitude 8.9-star HD 85625. Much to my dismay, Hogg 2 also was a bit of a letdown. The object in the centre of my eyepiece looked more like an asterism of three faint stars in a tight triangle. There were a few brighter stars in the field of view that didn't really look like part of a cluster. So I again looked around for more exciting fate. Lucky for me, NGC 3033 was a 25′ west. In its centre is a lovely bright yellow magnitude 6 star surrounded by fainter members.



Fortifying myself with another cup of coffee, I still had much motivation simmering on the cold stove of the night. I searched the coordinates for Hogg 3 and Hogg 4. These were plotted just a few arc-minutes apart in the northern part of Vela. But *again* a disappointment. Only three faint stars in a triangle gave me a clue of what might possibly be Hogg 3. Nearby and to the north a few brighter stars were alleged by my star charts to be Hogg 4.

The search field is situated only 10′ east of the magnitude 3.5 Phi Velorum, so there was no mistaking the stars in the sky versus the dots on my charts. I would never think of them as clusters without the star atlas telling me so. Even as asterisms they were slim pickings. With a name with the reputation of Helen Sawyer Hogg attached to them, I expected these clusters to shine like the brilliant nearby quartet Gamma Velorum, one of the great showcases of the cluster realm. Well, maybe a little fainter, but still a lot brighter than what I was seeing.



Hogg 5 was next on my wishful Helen Hogg tour as my telescope swung in the direction of the more southerly constellation Carina. Carina is one of my favourites because of its rich variety of nebulae, clusters, and peppery star fields. As I let my eyes wander among its beauties before seeking out Hogg 5, the thought dawned on me, 'Now wait! Carina is a *southern* constellation. How could an astronomer who lived in the likes of Victoria, British Columbia and Toronto, Ontario discovers star clusters in Carina!? Observers in Canada can't even SEE Carina!'

A wave of uneasy doubt came over me about these so-called Hogg 'clusters'. How did Helen Sawyer Hogg actually spot and name so many clusters she couldn't see from Canada? She was known as an active participant in observatory photographic sessions, climbing ladders to reach the prime focus observing cages to remove and replace the old-style glass emulsion plates used in those days. (Glass because film wasn't rigid enough for astronomical work, and film was also hard to make in the 20- to 30-cm focal plane image areas in large observatories.) But did she actually look through an eyepiece up there?

So I did the only sensible thing: I asked a librarian.

Since a Canadian observatory would be the most logical place to inquire, I emailed the library at Toronto University. The inquiry was graciously answered by a woman named Christine Clement:

Your message regarding Helen Hogg and open clusters was forwarded to me by our librarian. I was Helen's graduate student in the 1960s. I believe that Helen may have done some bibliographic work on open clusters, but most of her lifelong astronomical research was devoted to globular star clusters. In particular, she studied the variable stars in these clusters. Her early papers were published at the Harvard College Observatory where she worked under the supervision of Harlow Shapley while she was enrolled in a graduate program at Radcliffe College. In those days, women could not be officially enrolled at Harvard and so, if they studied at Harvard, they obtained their degrees from Radcliffe. Helen's maiden name was Sawyer and so the author name on her early papers was Helen B. Sawyer. In the early 1930s, she moved to the Dominion Astrophysical Observatory in Victoria, British Columbia, Canada and then in 1935 at the David Dunlap Observatory just north of Toronto. Although she was married to Frank Hogg in 1930, she continued to publish under her maiden name and used the name Helen Sawyer Hogg. However, some bibliographies listed her as Hogg rather than Sawyer Hogg.

This was an informative answer, but it didn't directly address how the Hogg clusters got their name. The part that read, 'Helen may have done some bibliographic work on open clusters, but most of her lifelong astronomical research was devoted to globular star clusters' confused me even further. Bibliographic work has nothing to do with looking at plates or staring through eyepieces to find objects that haven't been noticed before.

Clearly, *someone* named Hogg identified and named these things. Why not google 'Hogg' and 'astronomer, southern hemisphere' and see what happens? My heart skipped a beat with delight in my own ability to ask the obvious question!

Alas, when the results came back my heart skipped back down again. As my eyes quickly scrolled down the list, every single citation referred to Helen Sawyer Hogg. G-r-r-r. But … on a more careful examination, there was one brief entry—an obituary, no less—to someone named Arthur Robert Hogg. A mere page and a half in the *Quarterly Journal of the Royal Astronomical Society*, vol. 7, p. 327, 1966, there wasn't a word about clusters on the first page. I was nearly at the end of my rope 2/3 of the way down the second half-page when I finally spotted the lines, '*photographic atlas of open clusters from the 74-inch telescope photographs*'. That could only mean the 74-inch telescope at Mt. Stromlo in Australia.

Slim pickings to be sure, but at least something on the plate where I had nothing before. I dug in for a long web crawl and finally hit pay dirt when I tracked down and emailed a radio astronomer named Dr David Hogg. He turned out to be *Helen Sawyer Hogg's son*! This Dr Hogg had kept the family science flame going by pursuing a career in physical science. He began as a radio physicist with an interest in solar storms and the sun-earth connection, which evolved into an all-around radio astronomer. Slim thread though it was, I nevertheless inquired what light he could shed on this merry-go-Hogg.

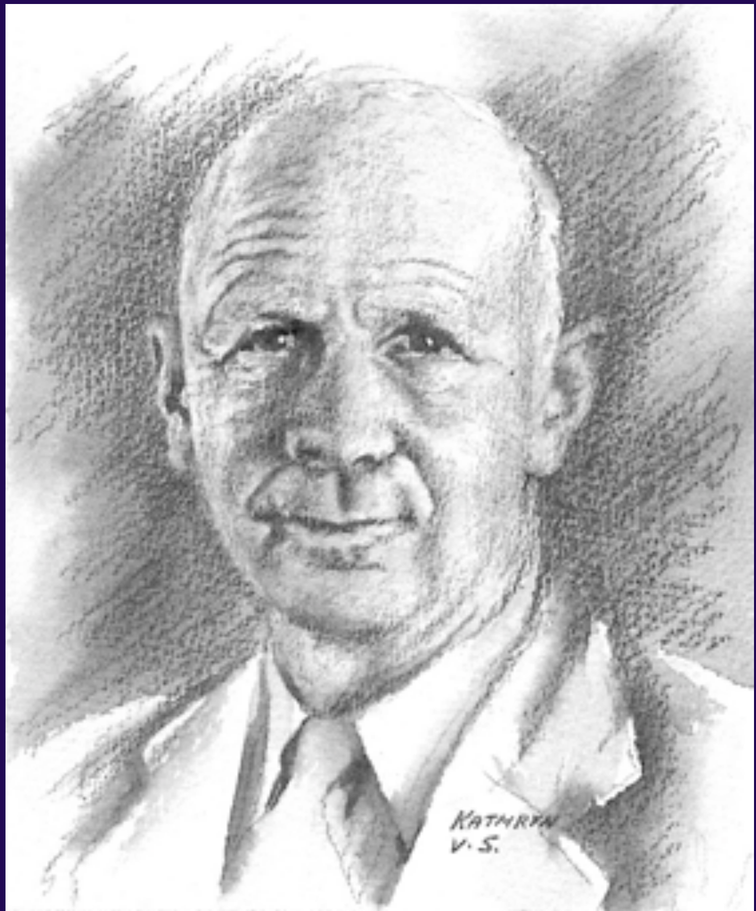
I salved my dashed expectations by heading over to the nearby open cluster NGC 2972 barely 15′ to the north. N2972 is a lovely, tight cluster containing a handful of faint stars in a rather wobbly capital A shape.

David responded that he was delighted to share some information about his mother:

I start, however, by asking you about a point of confusion. My mother concentrated almost exclusively on globular clusters rather than open clusters. The positions of these objects given in the standard catalogues are of the cluster centres, rather than of individual stars. I worked one summer as her night assistant at the David Dunlap Observatory, and I still have fond and vivid memories of the soft summer nights, and of steering the telescope while mother was high up on the structure at the Newtonian focus. In addition to steering the telescope it was my task to put new photographic plates into a basket which she raised up on a strong rope, and to take the exposed plates to the darkroom for subsequent developing. She was especially interested in nurturing the professional careers of women in astronomy, and I am sure my mother would have been pleased to know you. But in this case I believe the astronomer you are looking for is the Australian astronomer Arthur Robert Hogg, born in 1903 and deceased in 1966.

Dunlap telescope in the 1940s.

Aha! So that was it! The Hogg clusters were named by Arthur Robert Hogg, not Helen Hogg.



I busied myself researching about him. Wikipedia has an excellent article about his life and career.

Here is a very good account of Arthur Hogg's career written by S.C.B. Gascoigne and published by the Australian Academy of Science.

Hogg's main astronomical interest lay in galactic clusters. This was a very active subject in the 1950s. Stars in galactic clusters are presumed to have been born at the same time, from material of the same chemical composition. Using this, measures of magnitudes and colours of individual cluster stars can be made to give an age and distance of the cluster, an estimate of the amount of interstellar absorbing material in the line of sight, and an approximate figure for the chemical composition. Star clusters were essential clues to our understanding of the evolution of the galaxy. That is who so many astronomers have classified clusters according to their own search criteria. Arthur Hogg was well-known among them, having published ten papers in the field. He measured colour-magnitude diagrams for five galactic clusters and wrote a review article for the 1964 Report of the I.A.U. He published a photographic atlas of galactic clusters south of -45°. This collection of 98 charts was taken on the 74-inch reflector. It was intended for reference and as a basis for further work. It proved its utility when one of the clusters, NGC 3680, which might otherwise have remained unnoticed for years, was found to be very old and is now dissolving into the galaxy field population. His search of the plates revealed the existence of 23 hitherto unknown low-mass and often very old star clusters.

In the early 1950s Arthur Hogg's talents at instrument-making contributed to the Australian National Committee on Astronomy's site search to build the largest optical telescope in the southern hemisphere the Angle-Australian Telescope with the British Astronomical Association. Obviously, the first issue to address was where to put it.

Hogg was appointed head of the site-finding group. After an exhaustive search all across the remoter spots in Australian. One of the critical factors in siting a new observatory is the seeing. For photographic work, sub-one arc-second seeing is a requisite—and it has to be reliable that way for the maximum number of nights in a year. Hogg had a special talent for designing instruments targeted to accomplish a specific type of observation. For the Anglo-American Telescope site search he designed and built a transistorised photoelectric photometer compact enough to attach to a small telescope. It was used extensively for measuring atmospheric absorption. Measurements of seeing are sensitive to wind vibration, so Hogg devised a simple yet strong porta-dome shield for the measuring runs.

Hogg's site-finding crews evaluated 20 possible locations, remaining at each one for weeks to acquire astro-images and assess the weather, roads, rainfall records, and access to electricity and water. The site eventually chosen was near Mount Stromlo not far from Canberra. Over the years astronomical observatories popped up nearby like those in Sutherland around SALT. Stromlo is a mecca for amateurs to go see under the skies long ago favoured by their professional colleagues.

Arthur Hogg was a highly regarded astronomer and instrument maker. He honed his skills on the 74-inch telescope at Mount Stromlo, near Australia's capital Canberra. First light was in 1955 just as he was becoming interested in open star cluster research. Plates from this telescope were the ones he examined when classifying the previously unnoticed and unnamed Hogg clusters of today.

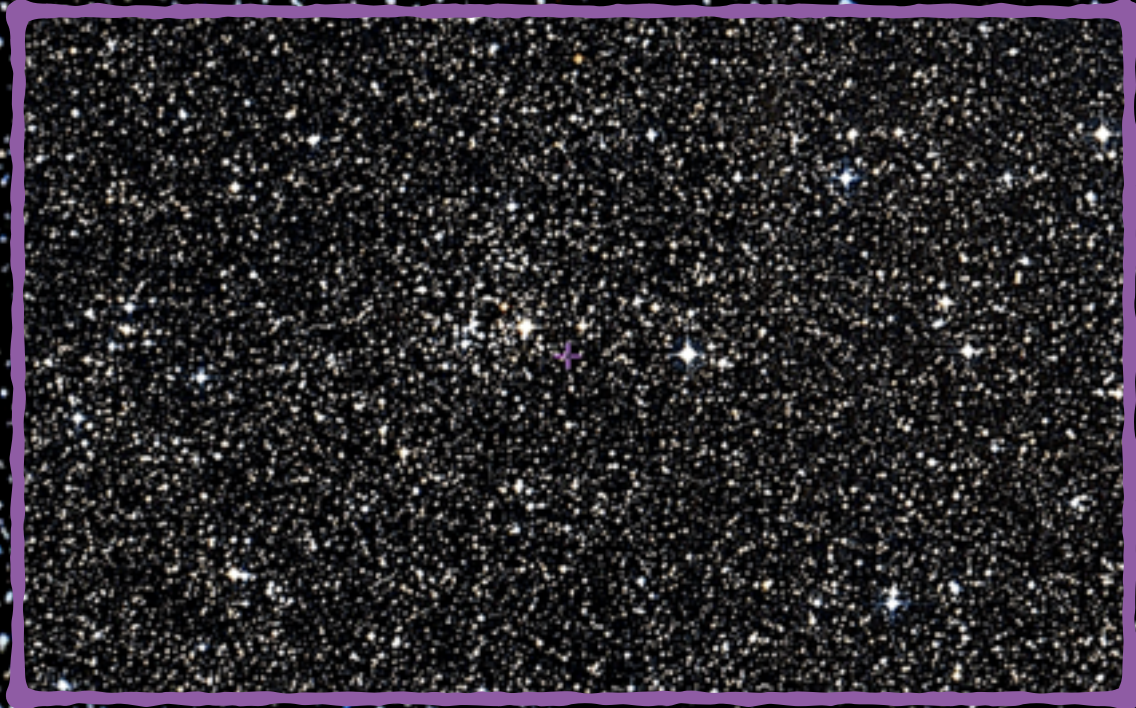
Unfortunately, Mt. Stromlo was a bit too near to Canberra. Light pollution was relentlessly closing in from the left side of this 1991 photo of the dome at 'night'. Like the 100-inch Hooker telescope above Los Angeles, Mt. Stromlo was about to be inundated by Canberra's gigantic lake of light.

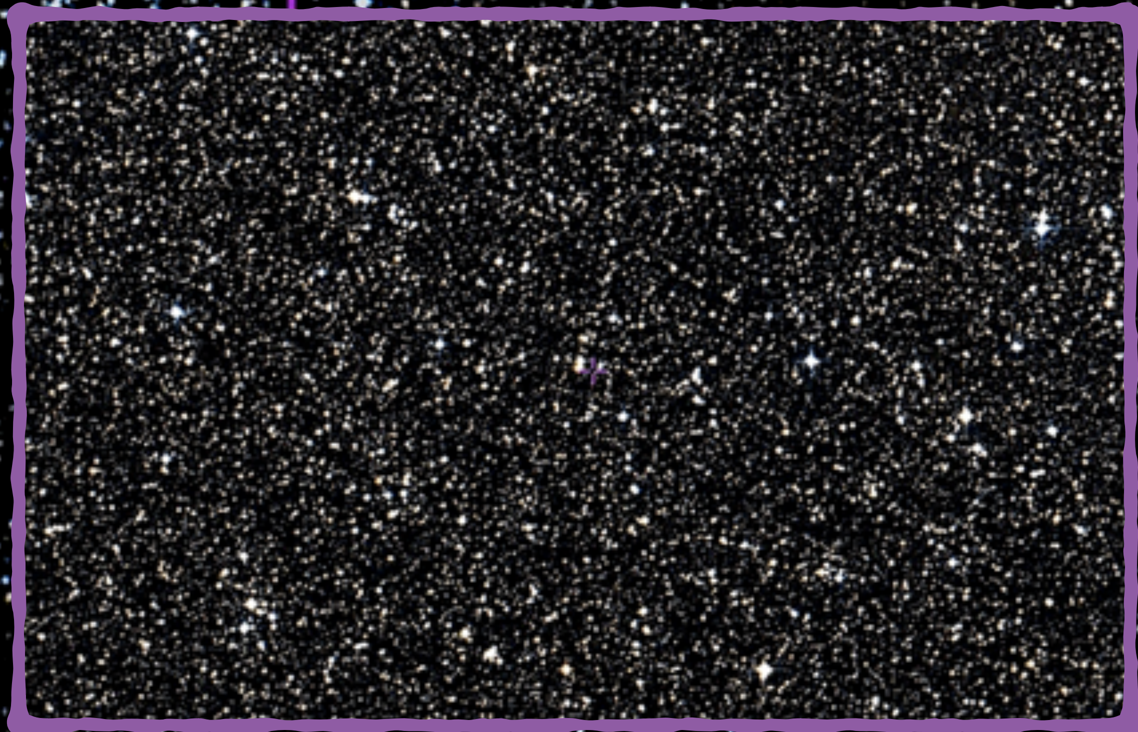
So there was nothing else to hinder me as I pressed onward
into the self-appointed task observing all the Hogg clusters.
It turned out to be a visual delight.

The southern section of the Milky Way certainly has a spectacular charm. From start to finish the search for the Hogg clusters was fascinating. Sometimes the stars were in obvious groupings, while other times there were only a few stars. It took imagination to call them clusters. I always enjoy the beauty of the starry skies, especially since sharing it with Helen Sawyer Hogg and Arthur Robert Hogg.

Hogg 5 is situated in an appealingly rich Carina star field just a few arc-minutes from the cluster Trumpler 12. From the sky position and comparative magnitudes of their stars, Hogg 5 could be an extension of Trumpler12.

And here is a little teaser for you: If you have trouble spotting the clusters in these photos, there is a web link at the end of this article that takes you to my very own little movie of the Hoff clusters—with the clusters identified!

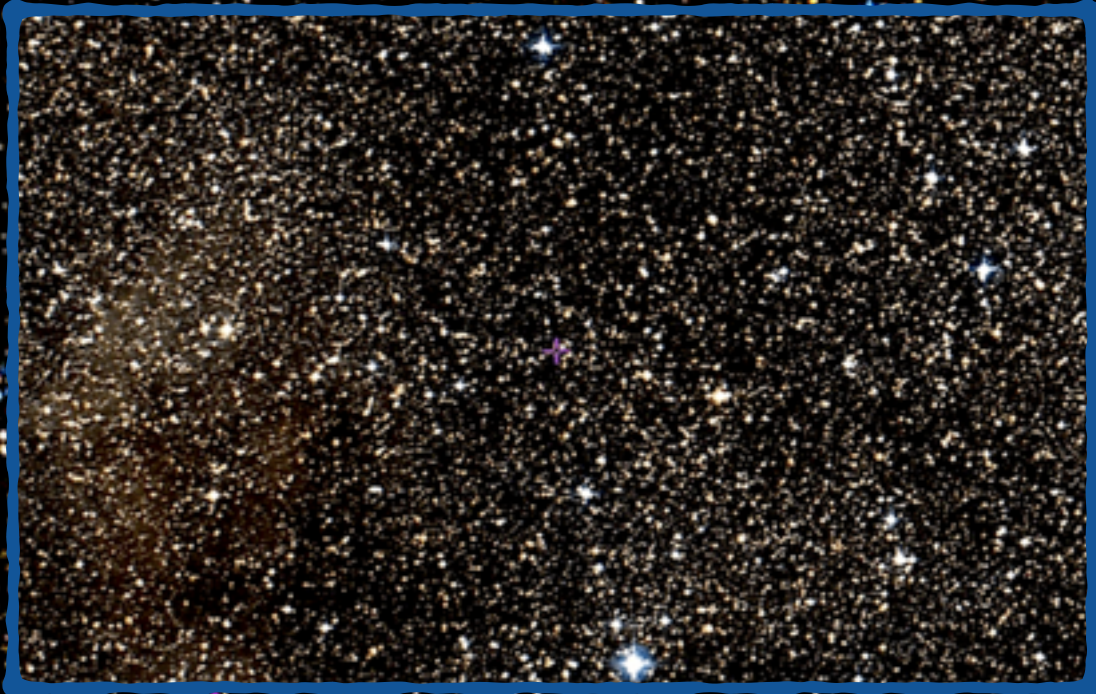




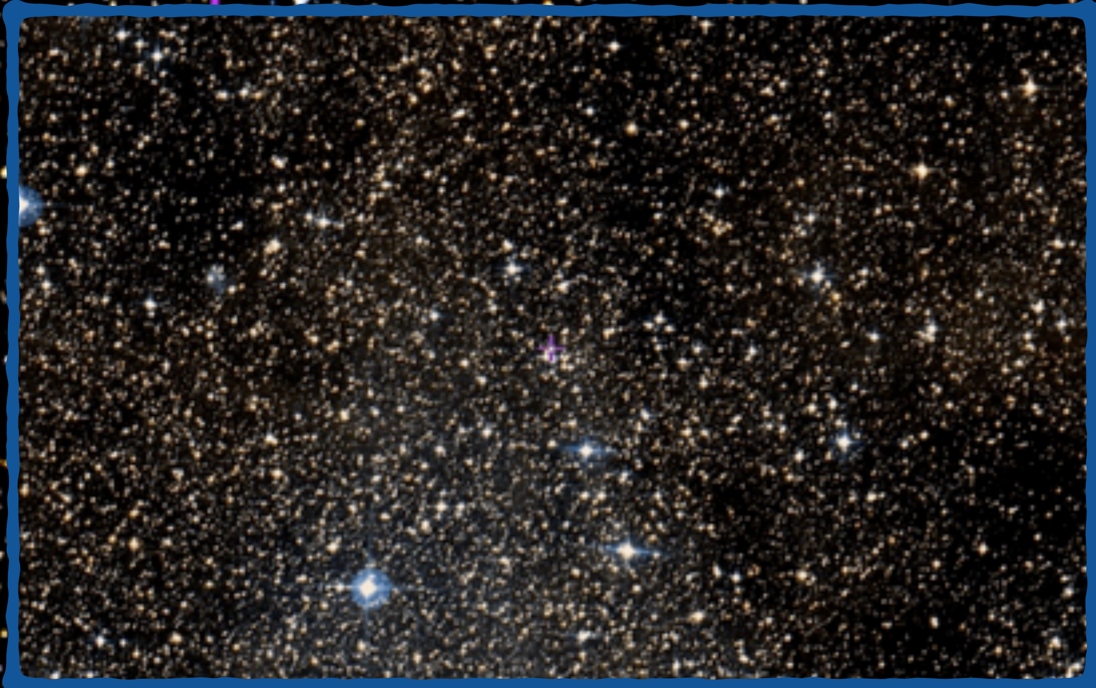
Hogg 6, only 5' south Hogg 5, hiding among a few brighter stars. There is a prominent double star amid the sparse and faint members.

Hogg 7 is situated only 2° from the lovely Carina Nebula and contains only an asterism of three faint stars according to the position from Deep Sky Survey. The entire group is 1.5’ in extent with a bright magnitude 7 star at the western end.

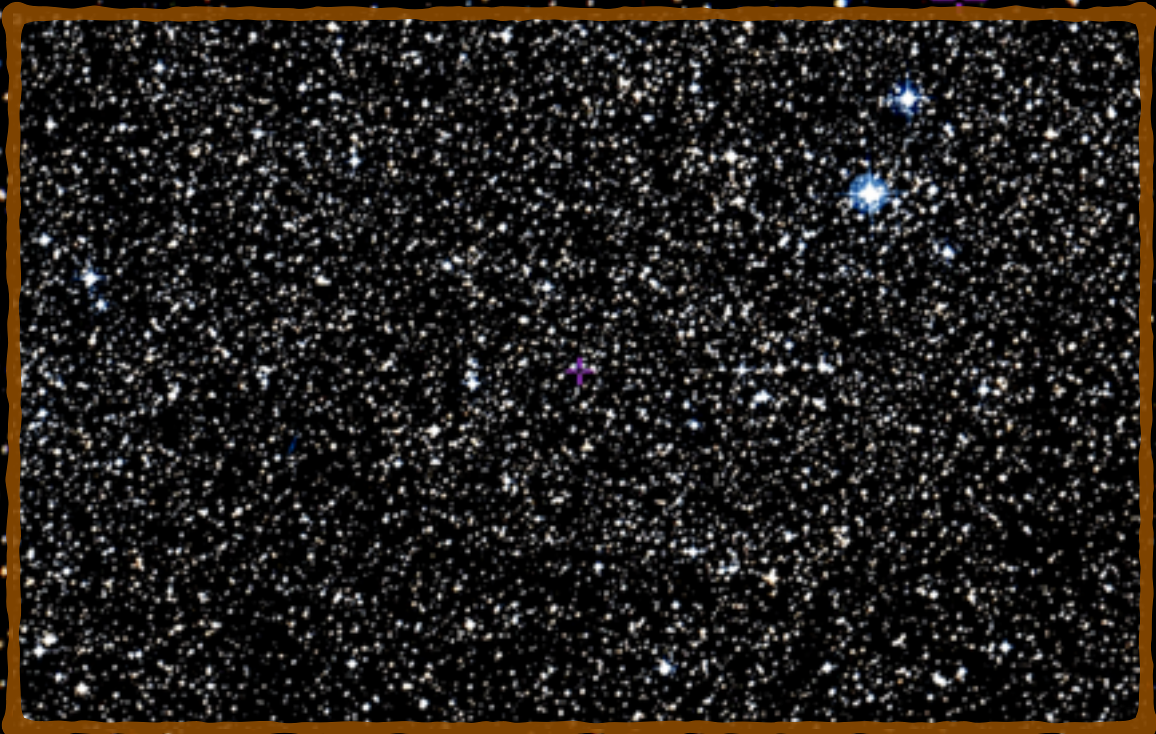
In the same image field, Hogg 8 just to the south displays a lovely long string of faint stars in a north to south direction, quite outstanding against the star field just below the centre section of the image.



I rejoiced at my first glimpse of the exceptional group Hogg 9. It is a tight square of four faint corner stars standing out beautifully against a moderately sparse star field. The cluster Trumpler 17 is situated 20’ south-west. Tr 17 is an exquisite grouping of approximately 25 stars of varied magnitudes.



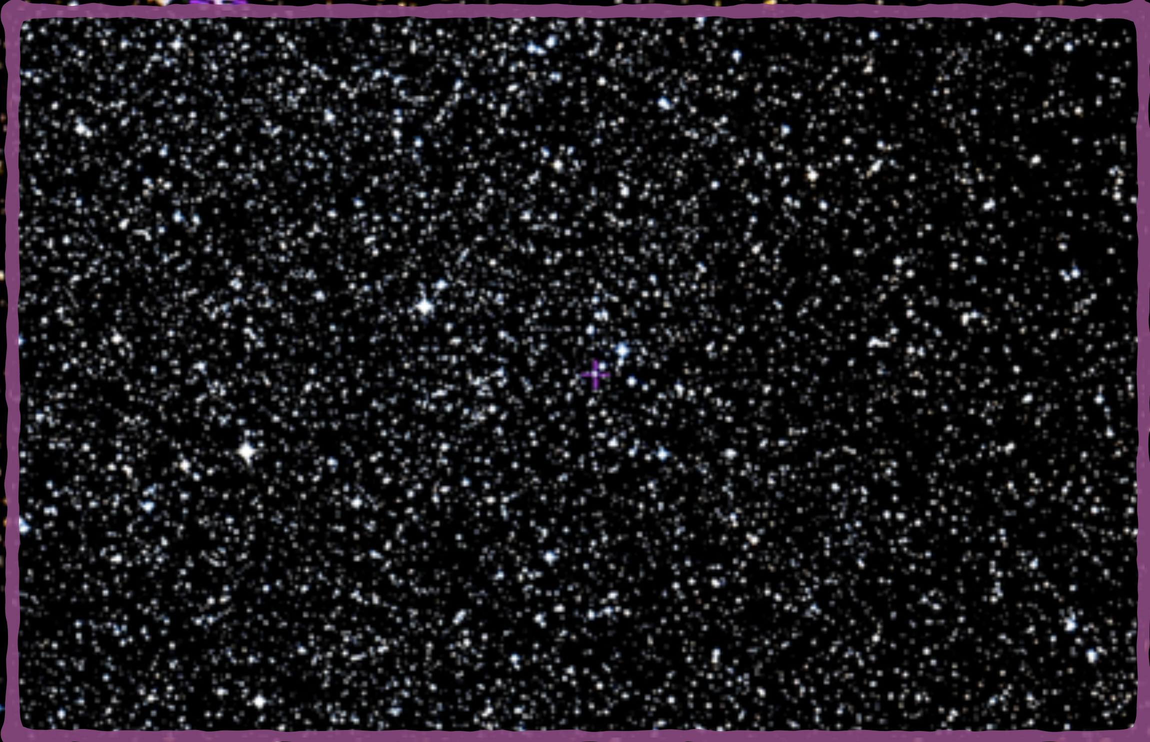
Hogg 10 and Hogg 11 are both contained in Collinder 240, a scattering of stars 32’x23’ in size. The identity of NGC 3572 has sometimes been confused, since it is unfortunately labelled NGC 3572a and includes y Carinae, Hogg 10 and Hogg 11. Two clumps of faint groupings towards the southern edge, slightly more outstanding in this busy star field, are probably the clusters referred to. Here Hogg 10 is left centre and Hogg 11 is to its right in a line.



Hogg 12 is situated in the star field that contains Trumpler 18 and NGC 3590, which appears much tighter with a variety of magnitude stars, but is still small in extent. Hogg 12 comprises only three tightly grouped stars with a few fainter stars that form a short north-south string.

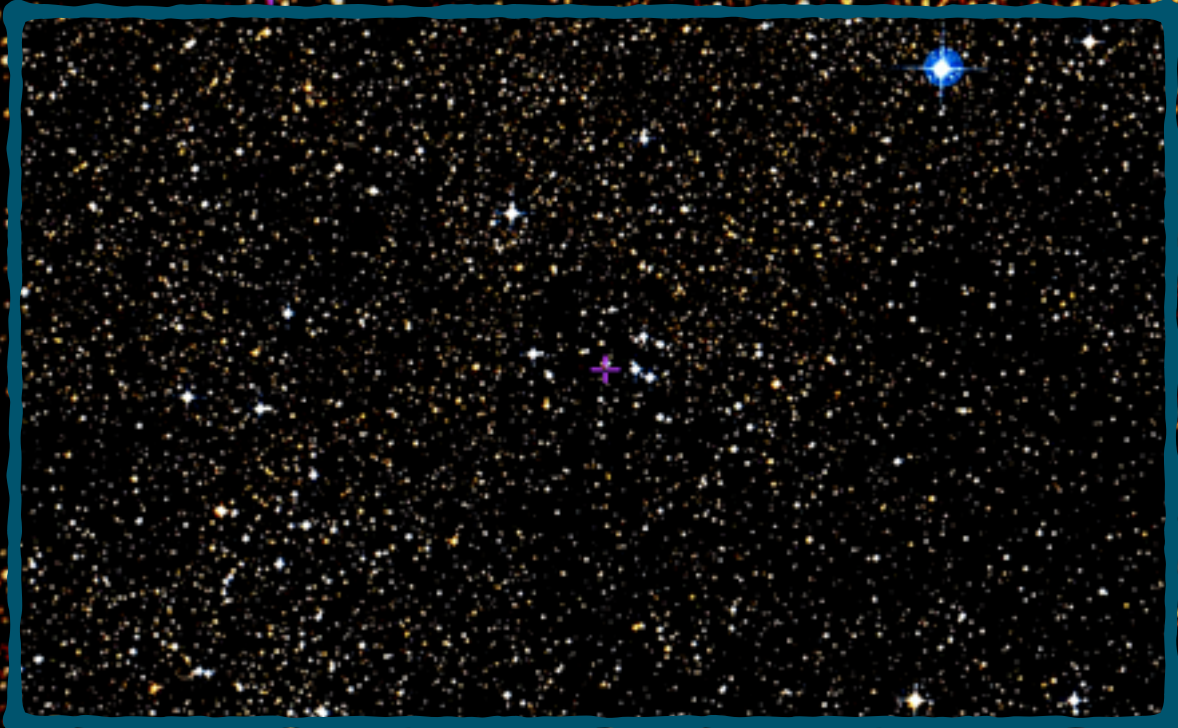
I had let myself venture into what looked like a faint cluster project, but it turned out rather more challenging as I searched for inconspicuous star groupings in a Milky Way field jam-packed with stars. I did not want to disappoint the memory of Arthur Hogg, so I continue to Hogg 13 in Carina. This very interesting star field consisted of various strings and small groupings. Two possible groupings in the immediate surroundings of the charted position can be found – a tightly packed group in a north-south direction, and a long, loose string of six magnitude 11 stars just west. Either could be the cluster. Hogg 13 involved a bit of guesswork.

Hogg 14 lies in our southern heritage constellation Crux, located just 20' north of the slowly dissolving cluster NGC 4439. The centre of Hogg 14 consists of a magnitude 10 star with a few fainter stars surrounding it. It is very hard to be certain about it.

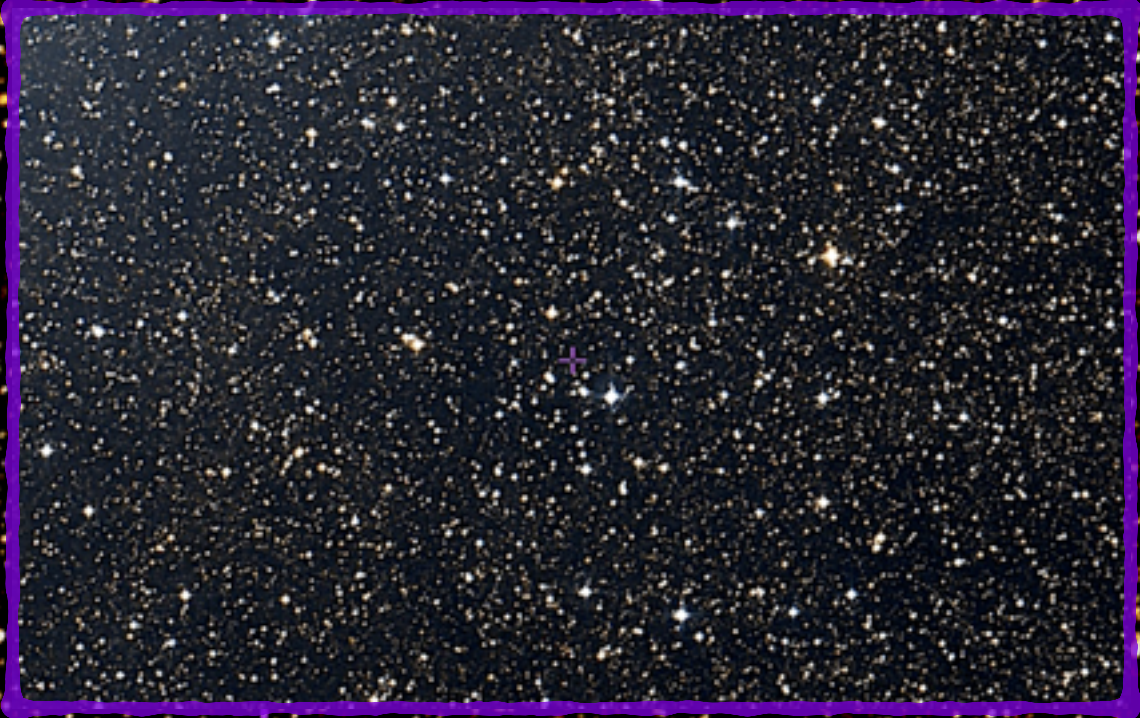


Hogg 15, also indicated as Van den Bergh-Hagen 139, is one of the few clusters known to lie in the inner arm, much further behind the Coal Sack and the adjacent cluster NGC 4609. The postulated age of Hogg 15 is in very good agreement with the results obtained from integrated spectroscopy and confirmed as a highly reddened young open cluster. Be sure to observe the lovely cluster NGC 4609, which in appearance forms a sort of oblong bow-tie shape.

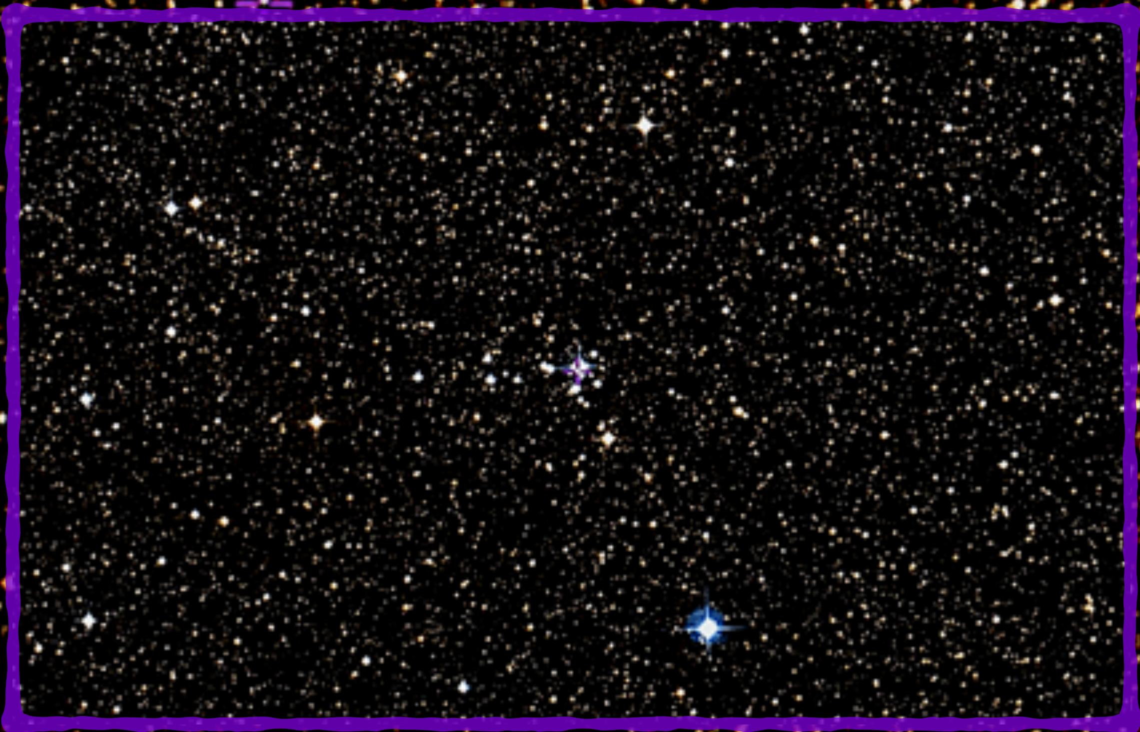
I had to edge over into Centaurus to locate Hogg 16. It is an otherwise unremarkable group of four magnitude 10 stars in an almost perfect square shape. With high magnification another two very faint stars situated close to the eastern and southern stars can be seen. The open cluster NGC 5168 is visible 20’ towards the northern half of the star field.

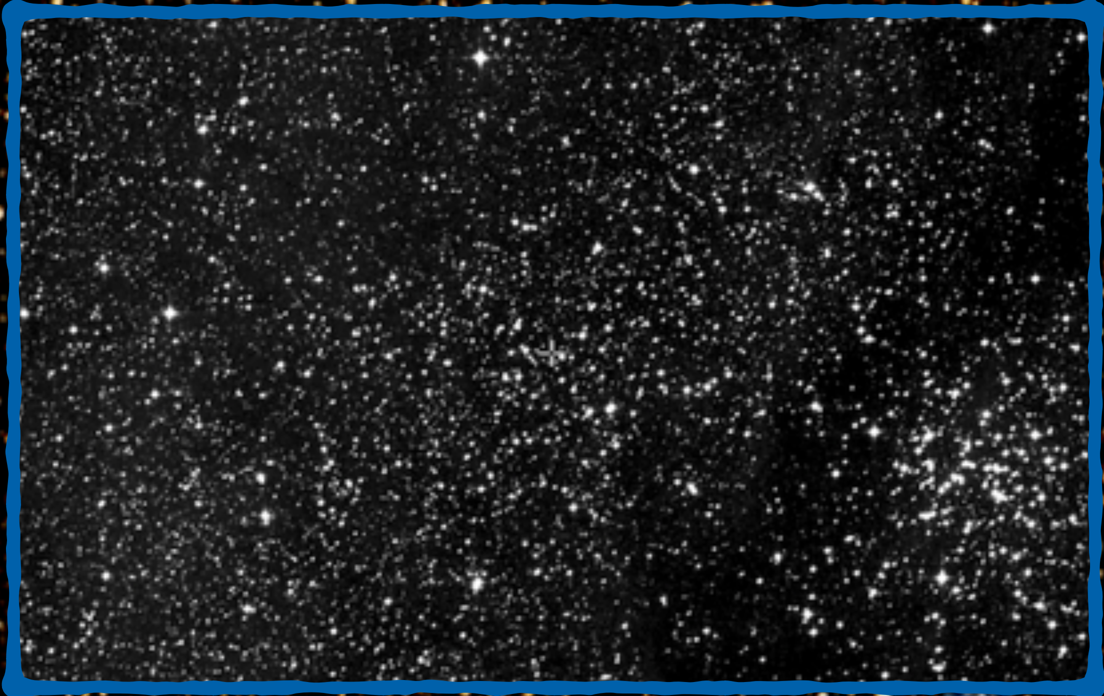


Still in the constellation Centaurus, Hogg 17 appears as a combination of star strings comprising an exceptional field of view. The heartbeat of Hogg 17, however, is a magnitude 9 white star encircled with faint, more or less 13 magnitude members that form a clear zigzag pattern.



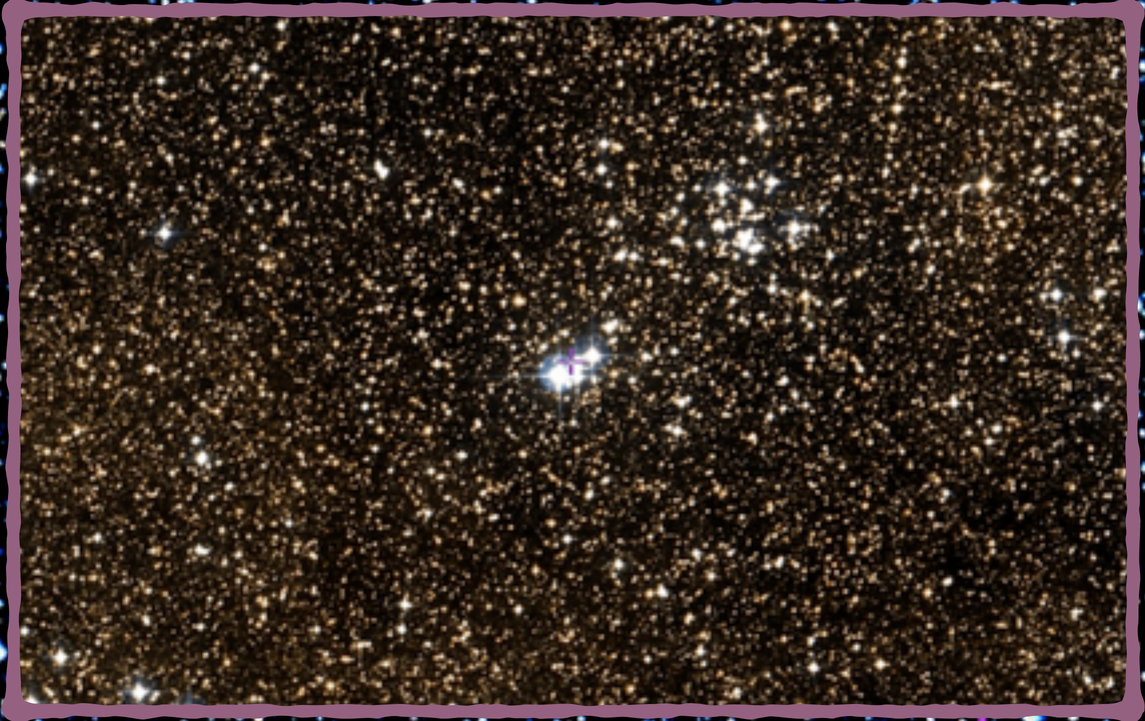
The constellation Lupus plays host to Hogg 18, a lovely tight grouping of a handful of varied magnitude stars standing out quite well from the star field and pleasing to the eye. The magnitude 8.7 centre star is HD 130534.





Hogg 19 could well be part of the very bright and striking open cluster NGC 6134 in the constellation Norma. The position of Hogg 19 is barely a few arc-minutes towards the east of NGC 6134 and appears only as an extension in this busy star field.

In the constellation Ara, Hogg 20 and Hogg 21 are situated south of the open cluster NGC 6200. Hogg 20 displays a tight string of a few very faint stars on the southern edge of NGC 6200. Hogg 21 is situated 18' further south-east and consists of five faint stars in a small bold arrow shape in an east-west direction.



A few bright stars of varied magnitudes indicate Hogg 22 hanging on for dear life to a faint string of stars less luminous that extends northwards, ending in the open cluster NGC 6204. There has been some uncertain as to Hogg 22's membership. Some sources list the stars of Hogg 22 and NGC 6204 as all being in the same cluster, but in the eyepiece Hogg 22 distinctly appears to be a separate physical system.

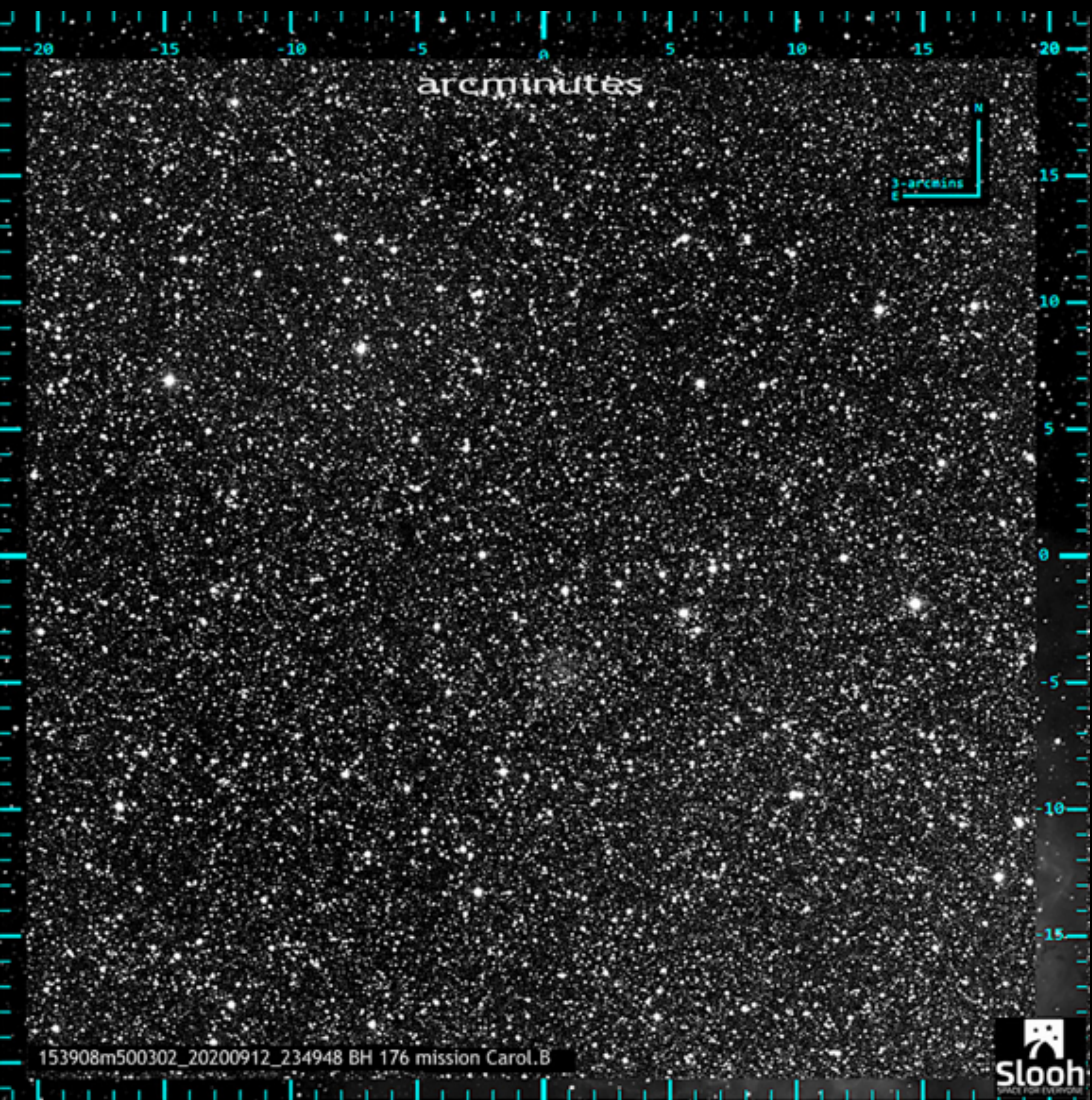
In the constellation Crux the open cluster Van den Bergh-Hagen 133 is a noteworthy string of varied magnitude stars only 14' north of Hogg 23. To search for Hogg's group in this field filled with faint stars in strings and tight groups is quite a challenge. South-east of Van den Bergh-Hagen 133 and the cluster Harvard 5 a sparse group of faint stars surrounding two brighter stars give the impression of small group inside a triangle. The cluster-vs-field memberships of these objects are among the most confusing in the lexicon of star groupings. After a careful examination the Franklin-Adams catalogue, Hogg 23 might also be an asterism of two stars surrounded by several fainter ones. Why Arthur Hogg called this a cluster mystified me.

I was motivated to search for the Hogg clusters because so little was known about them and they are so rarely observed. So far as I could learn from my research in the world of star cluster enthusiasts, no one had ever observed and described all 23. That fact practically dared and double-dared me to be the first to give it a try. In retrospect, if I had to go back to that first dare-and-double-dare, would I again go to all this effort and vexation to look at so many objects that don't look at all like what they are?

From start to finish the project was fascinating. Some of the clusters are obvious groupings. Others barely pass muster even as asterisms. Yet I find endless joy even in the least promising views amid the starry skies above our beloved South Africa.

Today the joy is all the more because I now know the difference between Helen Sawyer Hogg and Arthur Robert Hogg. They were two giants in the rarefied world of star cluster astronomy.

Now that I have a foot firmly planted on the shoulders of each one, the view, my friends, is utterly wondrous!



CAROL BOTHA'S LYNGA 7

Nightfall contributing writer Carol Botha has been opening new vistas for her ASSA colleagues. Forsaking the joys of South Africa's ever-present tremulousness thanks to the Jet Stream, our subtropical humidity, the frigid winds, and practically inescapable light pollution, Carol now sits in her comfy office surrounded by panoramic computer monitors, and a web link to the Slooh network of 17.5-inch Richey-Chretien astrographs located in Chile and the Canary Islands. In the process she has captured spectacular star fields that hide objects very observers have ever seen or photographed. One of them is this faint but distinct snap of the old Galactic thick-disc globular cluster Lynga 7. This cluster's location and colour spectrum suggest that it originated in a dwarf galaxy that the Milky Way shredded multiple billions of years ago. Spot it? (It lies at x = –5, y = 0 on the grid.) At 26,000 light years from the Sun, it is a faint fuzzy indeed.


Carol's Space
carolbotha


Wim Filmalter

Nothing more, nothing less

A weight was lifted off my shoulders recently, when I read an abstract on Astronomy Hobbyists

I never knew how to classify what I do, as neither professional nor amateur astronomer was the perfect fit.

Now that I am a professed Astronomy Hobbyist I am free to ooh and wow as much as I want, yet I feel quite important, seeing that research has been done on the likes of me!

Doing outreach is one of the most rewarding aspects of being an Astronomy Hobbyist. Whether I am out in the field or part of an online community, I always seem to find myself gravitating towards outreach and trying to get others to become passionate about Astronomy.

For years I parked my ‘Caddy Classroom’ at the Taal Monument in Paarl during the Orion Observation Group’s Star Gazing Picnics. On this specific evening our theme was Orion. Willie Koorts wrote a brilliant article for a magazine and I used some of the illustrations depicting all the asterisms that one could possibly find in Orion.

Astronomy Hobbyists also address light pollution by spreading awareness, giving advice and setting an example. Here, even a full moon had to compete with the haze of city illumination. In contrast a small reserve in the foreground has no artificial illumination.

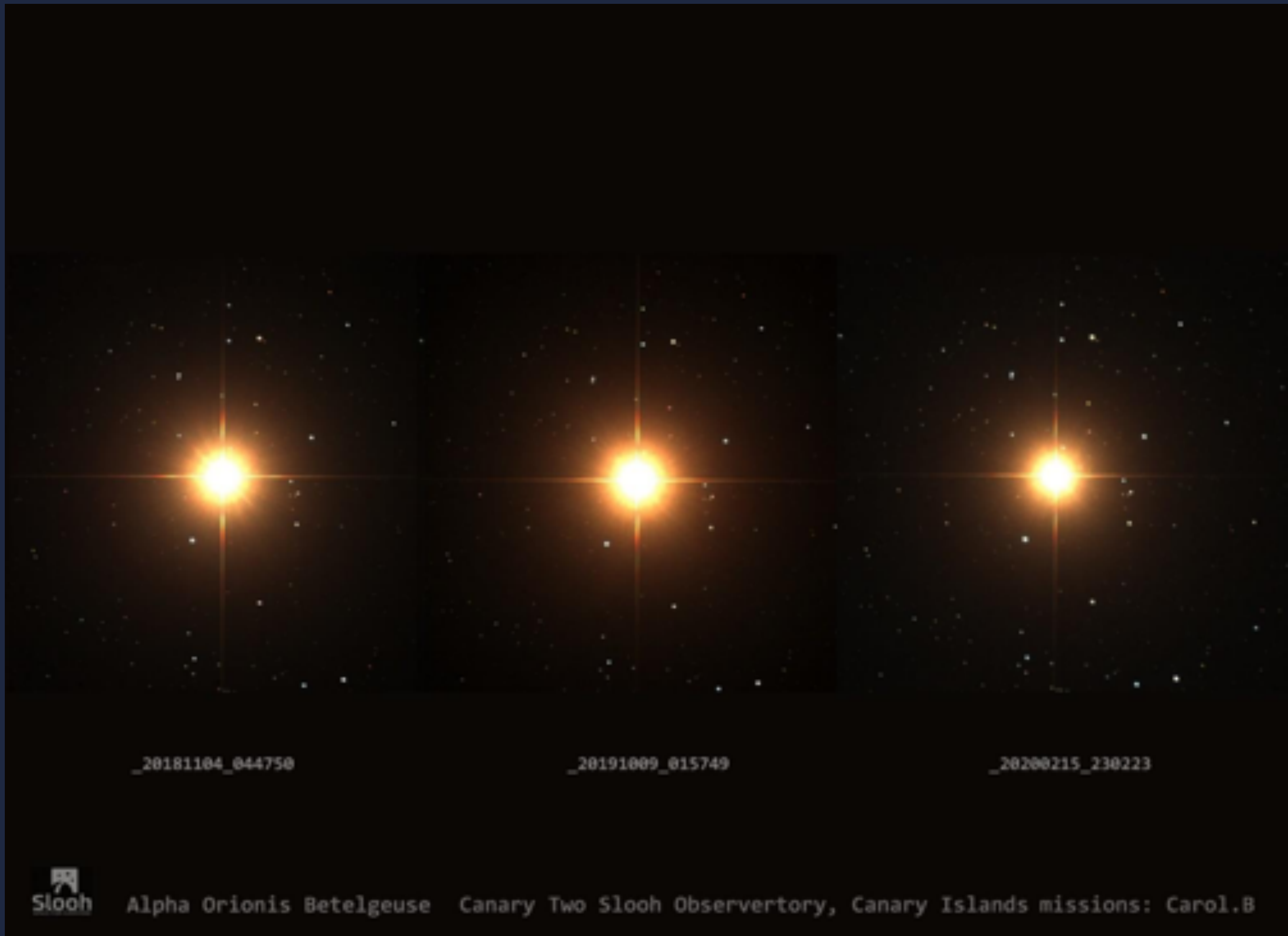
BREAKING NEWS

On tenterhooks I watched as reports flooded in about the rapid dimming of Betelgeuse. I must have been one of the few who hoped the star would hang on for a few more years.

I compared several of my missions on Slooh and the dimming was obvious. I was really worried. Imagine having to tell a star party audience that there used to be a beautiful star before Orion dislocated his shoulder.

In January 2019, Betelgeuse was still its normal self but by Sept 2019 the star was definitely dimming more rapidly than usual. Would this be the final countdown.

In February 2020 Betelgeuse settled down. I was relieved that my crib notes were still relevant.



HOW ARE WE SUPPOSED TO PRONOUNCE BETELGEUSE?

We could go with *Betel –juice,* like in the movie, *Bet'-uhl-jooz, Betle-juice* or maybe something like *Yaduljowza, Yettle-geeze* or *Bat al-jawzā*

Then someone came up with an excellent suggestion:

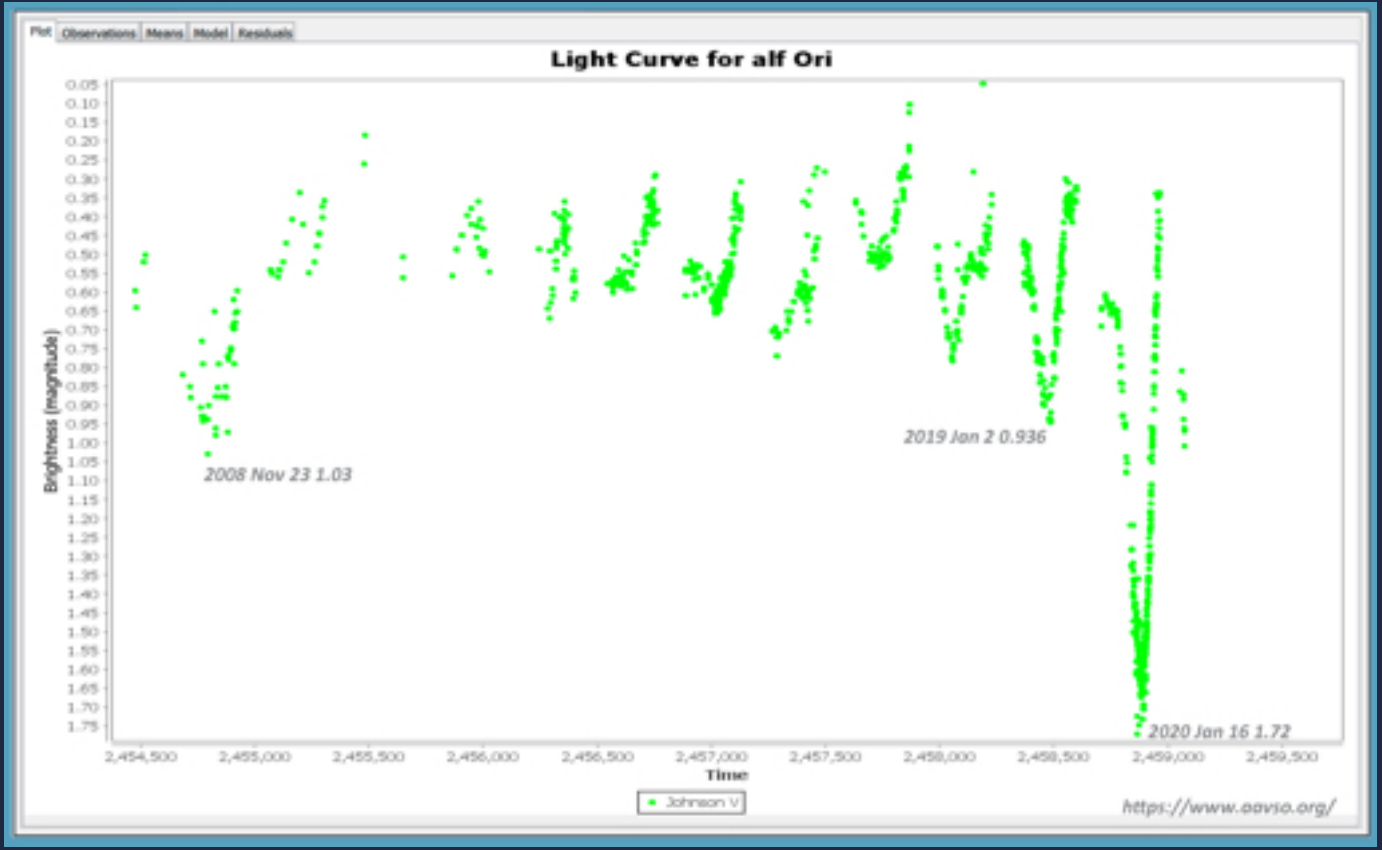
Why not pronounce it ALPHA ORIONIS!

Just a cosmic sneeze

Hubble found that Betelgeuse underwent dimming due to a traumatic outburst, some calling it a cosmic sneeze or cosmic tantrum.

The ejection and cooling of dense hot gasses moved through the star's atmosphere. A dimming in brightness was observed especially in Betelgeuse's southern hemisphere.

In a century and a half Betelgeuse has never thrown such a fit. Other hotter luminous stars display this kind of behaviour.



In comes Stereo. Observations between late June and early August 2020 claimed Betelgeuse was dimming again!

The pandemic has had some advantages. AAVSO offered free courses. I took the plunge and enrolled for the 'How to use V-Star' course.

Even though I passed the course with full marks and have now heard of a polynomial fit, I'm still a total novice.

Astronomical Transient Report

2020nlb

2020nlb, a Type Ia Supernova in M85, had been detected by ATLAS on 2020.06.25 at 09:59:50.

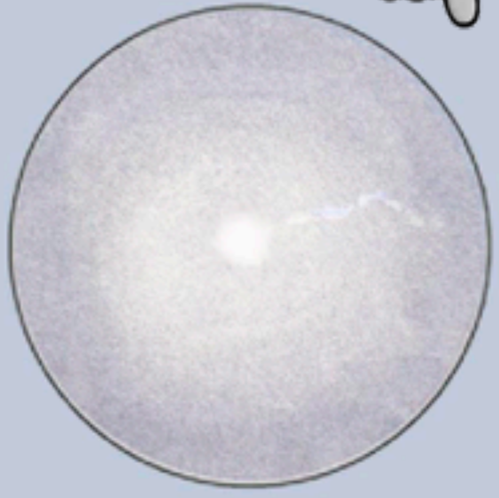
A follow-up TSN Classification Report No 6976 was sent in by Dr Steven Williams: The SPRAT spectrograph on the 2m Liverpool Telescope showed SN 2020nlb as a Type Ia supernova. Overall, the spectrum showed some similarities to a sub-luminous Type Ia supernova"

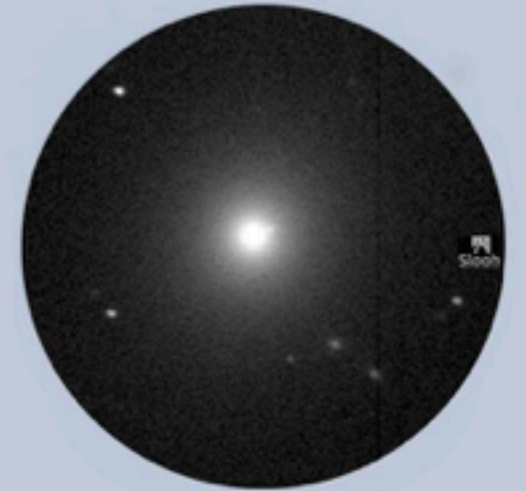
I wondered whether I would be able to observe this optically using Slooh's telescopes and set up missions on Canary Two

The increase in magnitude seemed clearly visible when compared to my previous observations of M85.

What a thrilling exercise! It felt as though I had discovered this myself!

Look I saw a Smoking Gun!





Object **MESSIER 87 (NGC 4486, Virgo A,Smoking Gun)**

Constellation **Virgo**

RA 12h 30m 49s | Dec +12° 23′ 28″

Notes

Type EOp Elliptical galaxy
Mag 9.12 7.94
Dist 53,49 million light years
Apparent size 7.2′ × 6.8′

I came across M87 while doing a Messier Marathon and gave it no more thought other than it had to fill the blank space on my poster.

Then I read about the curious ribbon-like jet protruding from M87. Up until then I only noticed the glowing ball without any structure

My first observation of the ‘jet’ was in April 2019, which coincided with the release of the first ever image taken of a black hole. The structure that was imaged is 100 billion km wide,about the size of the solar system!

My jet does not come close to the bluish-greenish feature seen on professional astronomical images but with my specs on I can see it protruding from the galaxy to the northeast The jet blasts out into space to the extent of 5000.00ly.

Sources

Simbad, Stellarium, Aladin Sky Atlas,The Messier Objects by Stephen James O'Meara
My sketch was inspired by a Hubble image

Observer	Carol Botha
Location	Canary Islands N28° 17′ 58.92″ W016° 30′ 29.736″ Altitude 2372 metres
Date/Time	20200118_205316
Instrument	PlaneWave Instruments CDK17 (Corrected Dall-Kirkham) Aperture: 17" (432mm) Focal Length: 2938mm (115.71") Nominal Focal Ratio: f/6.8
CCD Camera	Finger Lake Instruments Model: FLI PL16803 CCD Chip: Kodak KAF-16803
Filters	Astrodon Tru-Balance Generation II E-Series
Seeing (1-5)	4 *as provided by the telescope feed*

Observation using Slooh’s robotic telescopes https://slooh.com/

Blue Stragglers

In my bonnet

I felt myself drawn to the term **Blue Straggler Stars**. Although I would not be able to identify them off the cuff without consulting published works, learning that they appear younger than their siblings in old open and globular clusters, sounded intriguing.

On my astronomical journey some of my close astronomy friends, mentors and global legends are leaving or have left the main sequence but there is a constant transfer of knowledge to me. I feel rejuvenated, like a blue straggler. These stars, whom I syphoned knowledge from, would maybe not feature brightly from day to day anymore but they remain heavyweights.

Being in this rejuvenated state I pretend to shine brightly alongside young stars and gain from new experiences. Very soon, this accumulation of knowledge will again alter my path. I would not like to see myself suffer from swollen head syndrome but as I become a yellow straggler, I hope I can at least transfer my enthusiasm to someone starting off on this wonderful path of discovery.

Bless my astro friends

I think it was my friend Daz who mentioned Blue Stragglers, a term coined long before the Zombies of Zone One.

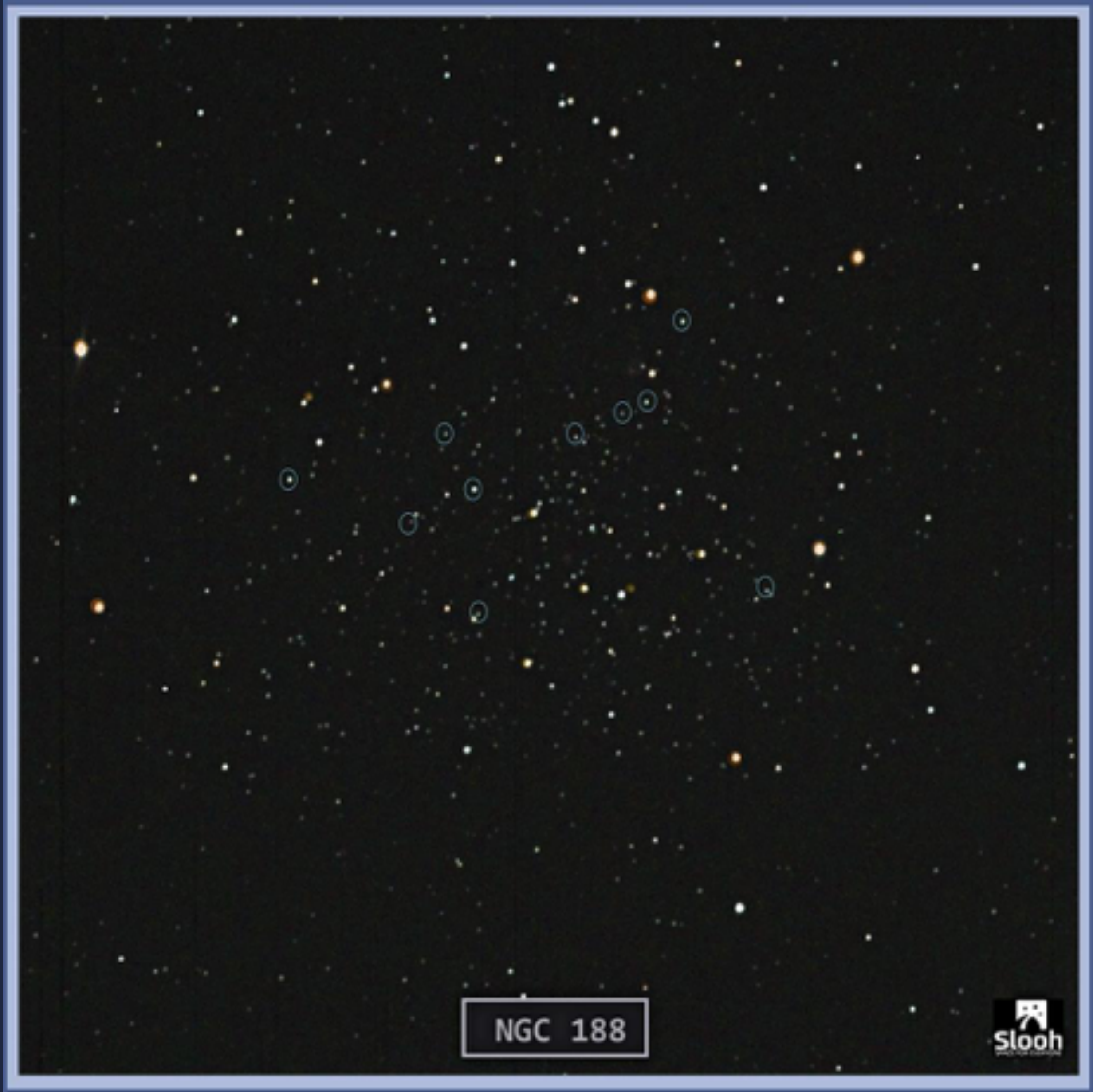
Blue stragglers were first discovered by Allan Sandage in 1953 while performing photometry of the stars in the globular cluster M3.

It was however University of Texas astronomer, Natalie Gosnell, who really got me excited about these stars.

I came across a survey she and her team conducted of the open star cluster NGC 188 using the Hubble Telescope.

The Mystery of Born Again Stars was discussed in a Hubble Hangout on YouTube.

Bless the internet!



By studying an optical image by K Germany,F Haase. NOAO/AURA, I was able to find some of the Blue Stragglers and draw circles on my own image of NGC 188!

During the survey 21 Blue Stragglers were found. 7 had white dwarf companions.

Collinder 261

I'm a very old
cluster
in Musca

While other stars in this cluster aged to become red giants as expected, some stars appeared to be getting a second lease on life.

Blue Stragglers could form when stars collide

Or

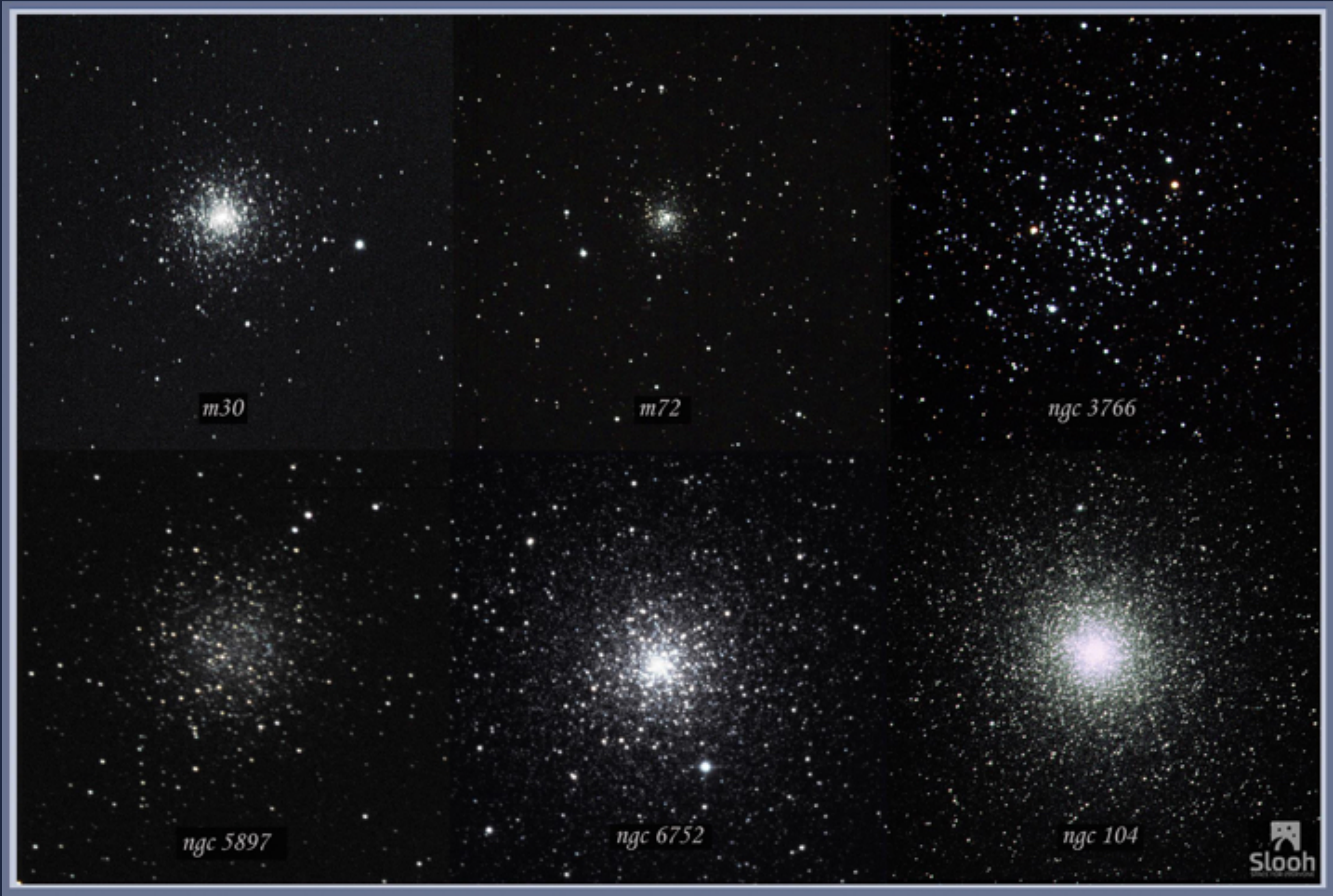
stars in binary systems could lose orbital energy, spiral towards one another and merge

OR

53

Blue Straggler Stars and counting

In many cases, the transfer of mass from one star to another could be the main cause. The more massive star evolves and as it expands the less massive star steals some of the mass that is blown its way. Feeling energised, the smaller star syphons off more and more of the older companion's mass until the magnificent red giant becomes a white dwarf and its companion, now Mr Big Shot, shines on brilliantly and deceives us all that it is still in the prime of its life.



I'm on a mission to observe open and globular clusters that are known to have blue straggler stars

The core of our favourite globular cluster 47 Tucanae (ngc 104) is home to many blue stragglers!

Once apon a time on an excursion to Britstown

Oh My! I met up with 'this' Dumbbell on Slooh recently

In 1764 Messier described this as "nebula with a star"

My gut feeling told me that this would be the perfect night to set up a mission on Slooh's Canary One half-meter telescope.

I wanted to see the star!

Most articles state that M 27 (NGC 6853) in Vulpecula is a typical planetary nebula.

Compared to the tiny faint fuzzy bluish-greenish planetary nebulae I've eagerly observed, this one is far from typical!

This Dumbbell shows me what I've been missing when observing very faint planetary nebulae.

If it's fainter than faint that makes you tick ...

Meet one of our Neighbours:

Sculptor Dwarf Galaxy

My first attempts at capturing this galaxy were hampered by weather.

I was over the Moon
when I got my first look
at this object.

Expecting to see a teeny tiny object, it appeared as if I had captured nothing. After a bit of processing, I realised that the cloud of very faint stars was in fact the galaxy!

At about 300,000 light-years away, it is in fact one of our neighbouring galaxies .This spheroidal galaxy has low luminosity, very little dust and a large number of ancient stars. A nice one to dig into with averted vision!

The Moon was bright during this mission but I'm hanging on to this image in case I miss my next chance when new moon comes around.

You'll need more than these for Phoenix

NGC 625 ESO 29-SC11)

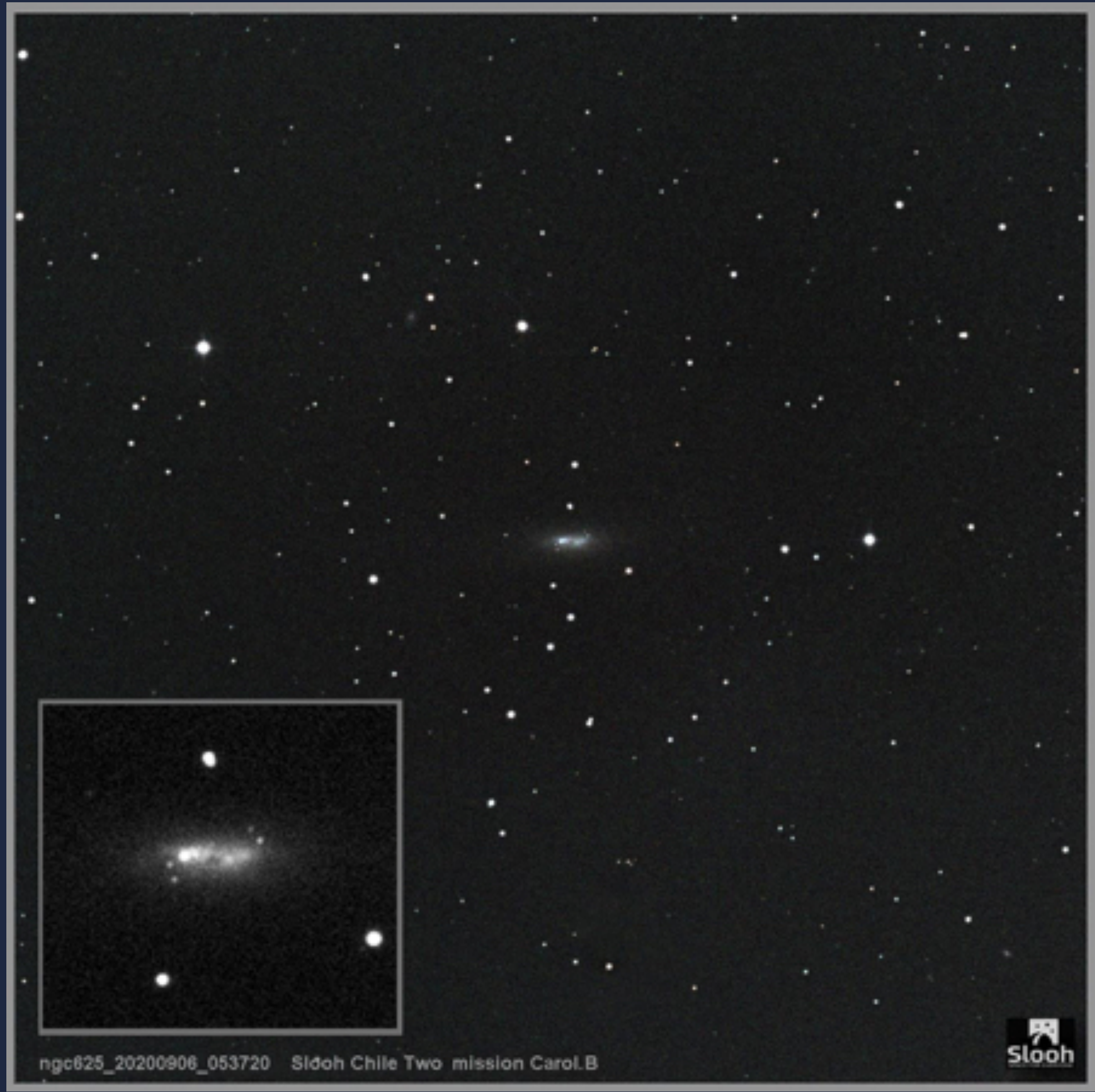
Other than Roberts Quartet, I can't recall observing deep sky objects in Phoenix. I can see why! The objects in this constellation are very faint.

The barred spiral galaxy, NGC 625, looks so tiny in Chile Two which has a field of view of 43' 00" x 43' 00".The enlarged insert shows a bit more detail.

NGC 625 is a member of the Sculptor Group of galaxies and is located near the south galactic pole

Astronomers have been studying the starburst phenomenon in this galaxy intensively. It has ideal features for such observations: low mass and a low foreground reddening sightline to the major star formation region.

At least the Phoenix sleeve in my obs folder will not be empty anymore.



If you want to go even fainter, there is another galaxy to the NE in this fov: 15.22mag ESO297-10 (Aladin Sky Atlas)

I happened to be online when a fellow Slooh member shared his image of a mission to Merope (23 Tauri). During that specific mission I noticed a hint of a nebula below the star. I followed up with my own missions.

IC349 showed up beautifully on Slooh's Canary Four Telescope.

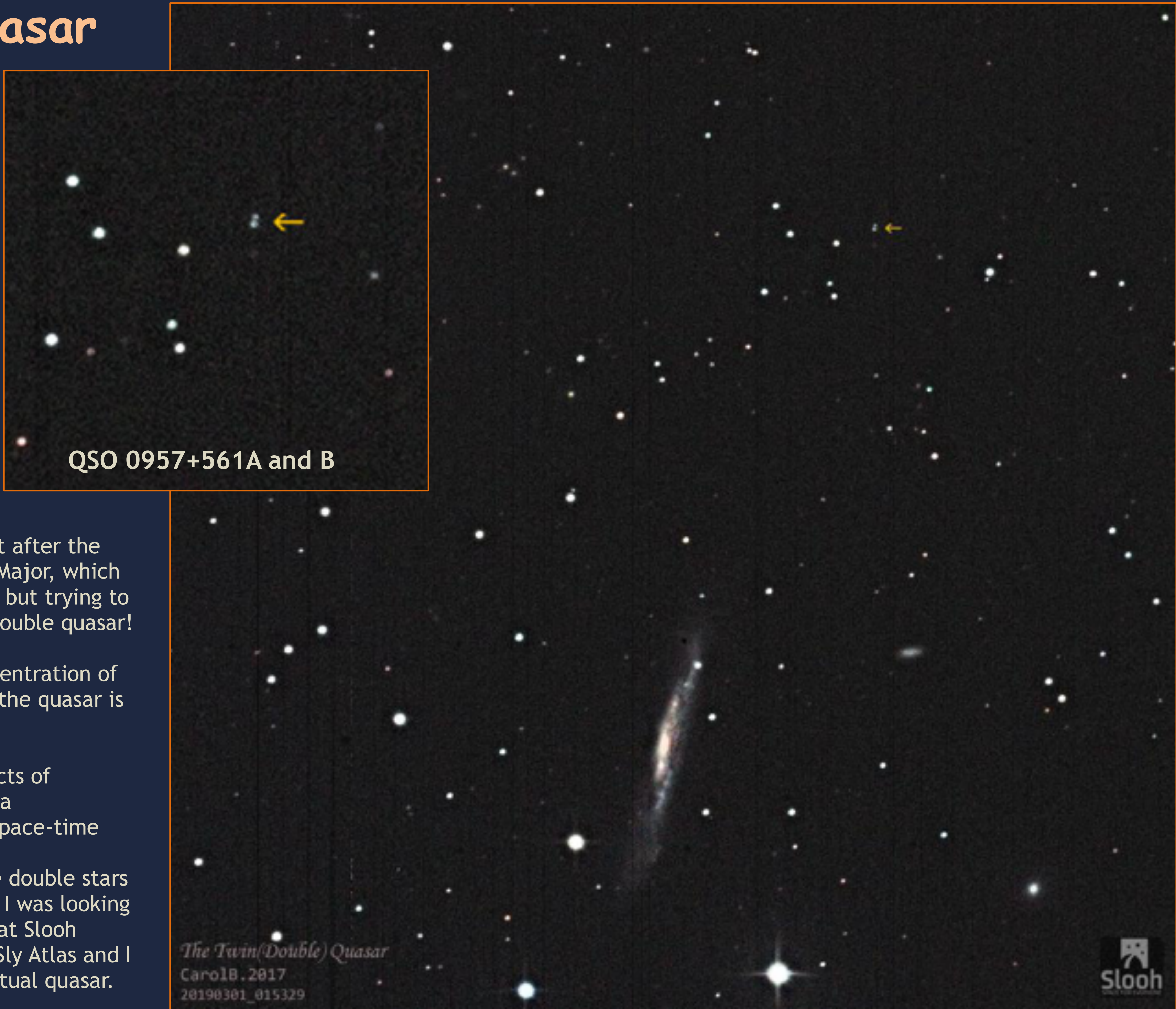
The Pleiades cluster is moving through an interstellar cloud. Starlight is reflecting off the dust particles and although ranked fifth brightest star in the cluster, the brightest part of the nebula surrounding The Pleiades is around Merope.

I used a Hubble image to do the sketch.

Double Quasar

Gravitaional lensing

warped space-time!



On this occasion I was not after the galaxy NGC 3079 in Ursa Major, which looks lovely in this image but trying to find something called a double quasar!

An intervention of a concentration of mass between Earth and the quasar is causing double imaging!

Now I have seen the effects of gravitational lensing and a consequence of warped space-time

At first I thought the nice double stars in the vicinity were what I was looking for. Bernd of the A-team at Slooh introduced me to Aladin Sly Atlas and I was able to locate the actual quasar.

As an Astronomy Hobbyist I sometimes have time to make a pit stop at the Moon on my way to deep skies.
On 6 Sept 2020 I watched the occultation of Mars by the Moon in real time


The Moon and Venus
from my home during
lockdown 2020
carolbotha

Along comes a Comet

All deep sky work was halted when Swan arrived in the Northern Hemisphere.

Special missions were set up on Slooh to capture the head and magnificent tail bit by bit.

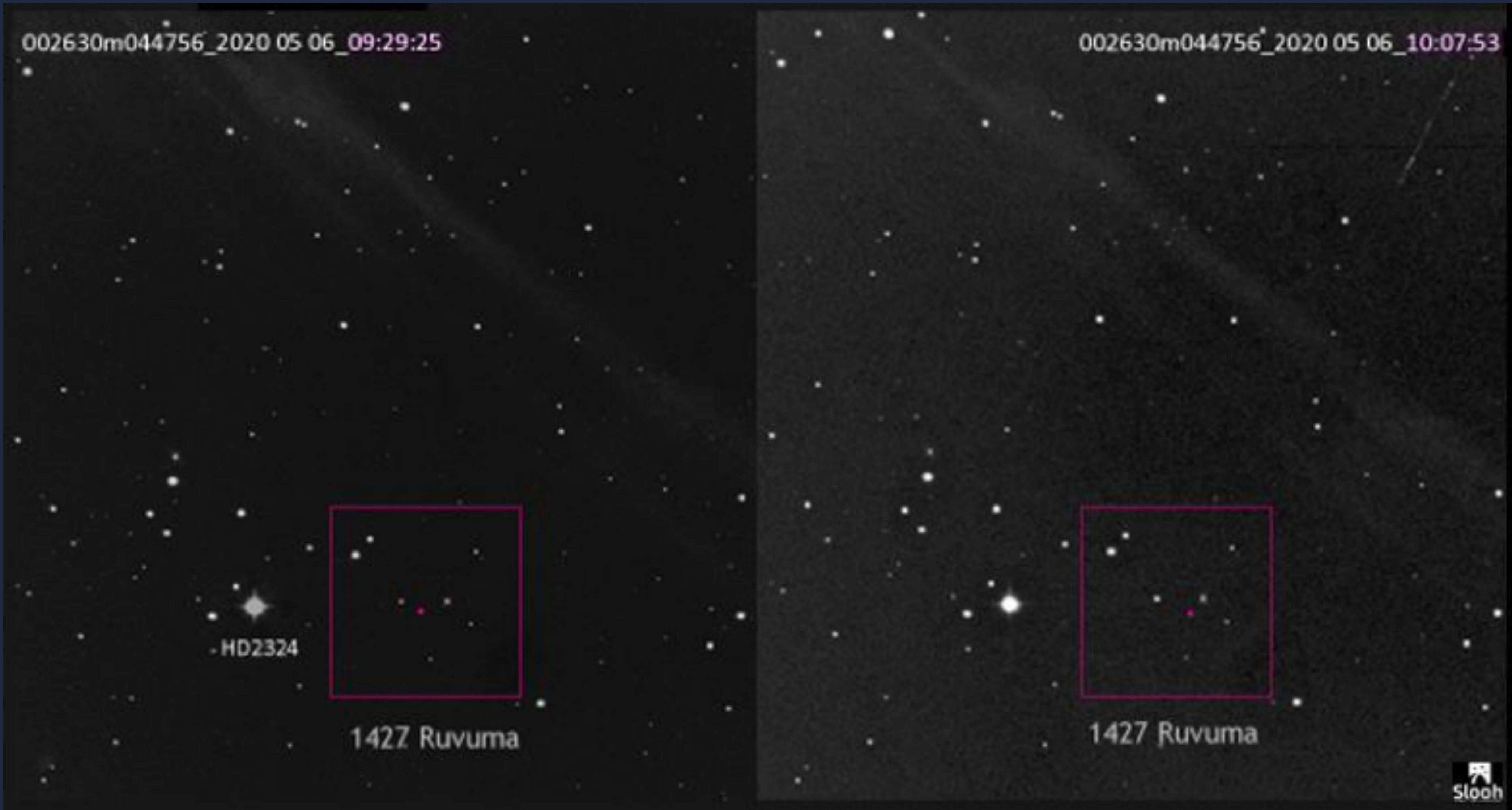
Obviously this one could not fit into the telescopes' field of view.

I stitched these panels together to give an artistic representation.

Along comes Tim Cooper

Timothy Cooper, Specialist Collaborator of the Shallow Sky Section of ASSA (Astronomical Society of Southern Africa), showed some interest in my artistic interpretation of Comet Swan ;-) After studying the original png files he showed special interest in one of the images and wrote the following report.

"The outburst you refer to is actually a disconnection event caused by changes in the magnetic field in the solar wind and probably occurred sometime around May 3. On this image also you have caught a couple of faint galaxies, and asteroid 1427 Ruvuma, which was discovered in 1937 by Cyril Jackson at the Union Observatory in Johannesburg. Nice catch!"



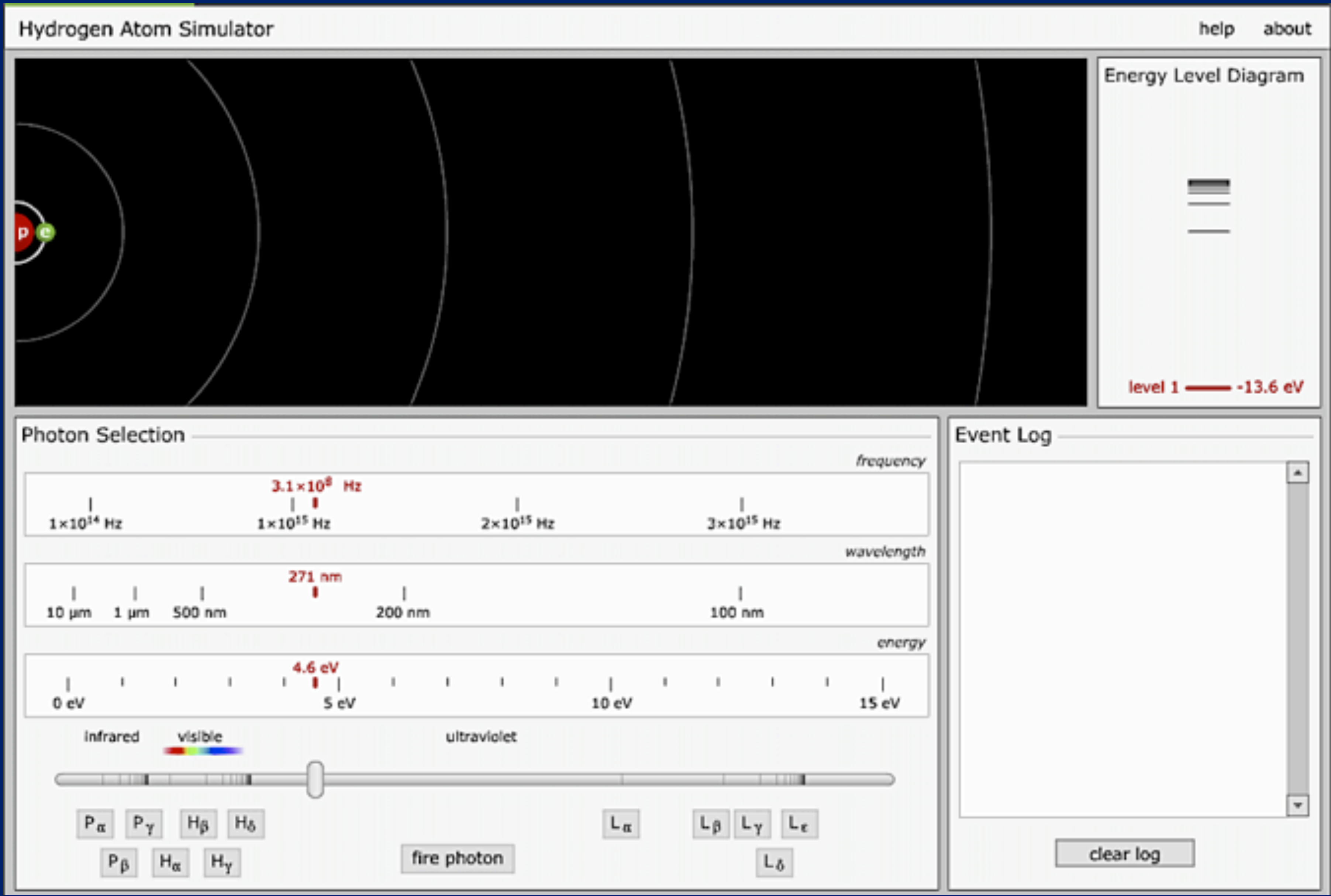
Astronomy Hobbyist

Observer of the Deep Sky

Member of
Astronomical Society of
Southern Africa,
Orion Observation Group
and
Slooh Space Ambassador

Special note of thanks to Wim Filmalter for his image contribution, to Tim Cooper for guiding me back on the scientific tracks where it comes to comets and asteroids, to Douglas Bullis and all who share their knowledge with me.

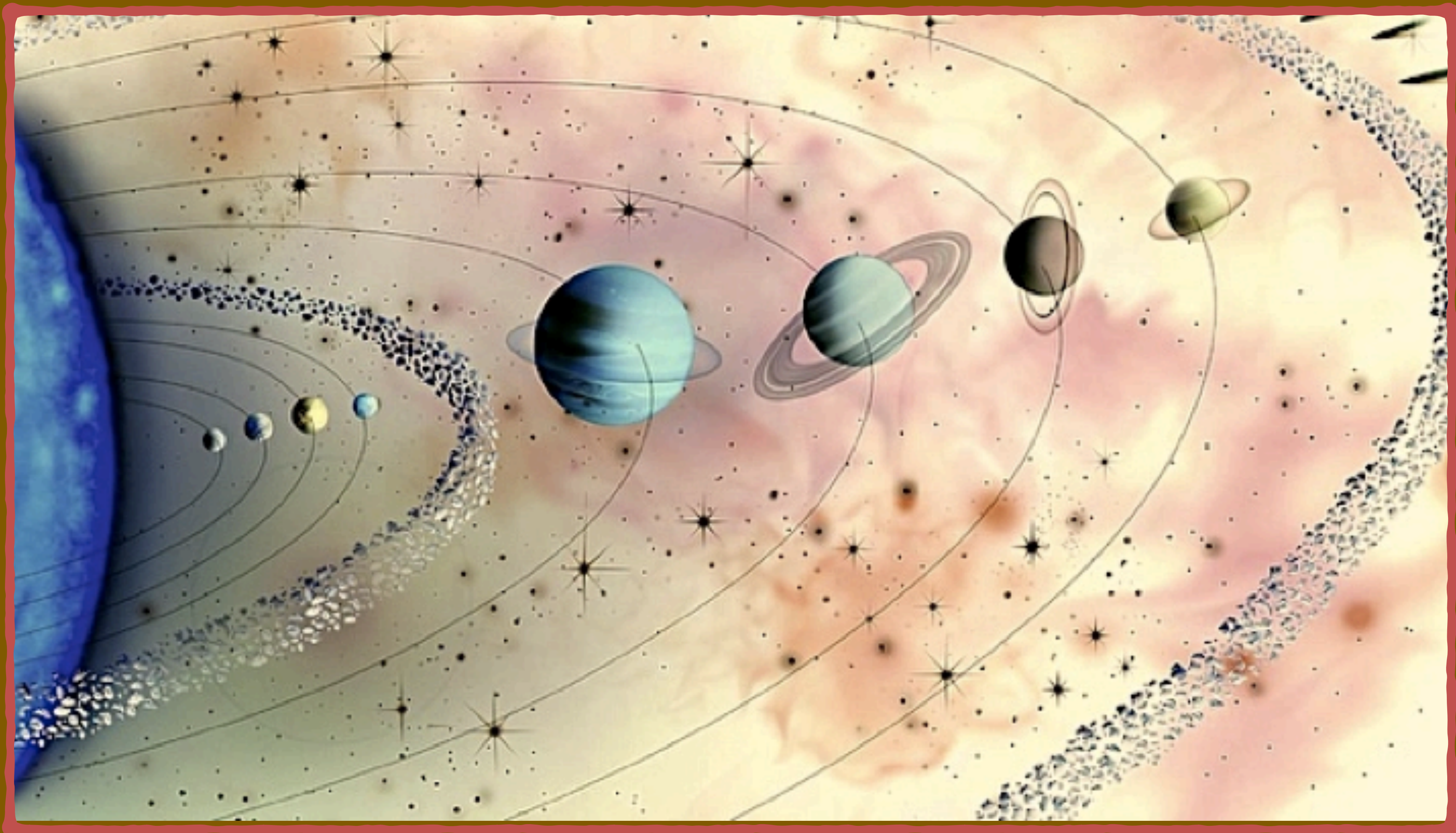
What is life like for a hydrogen atom?



Click on fire photon and enjoy the show.

It's Not a Rock, It's a Retired Supernova

Martin Heigan



A pretty pebble on the beach is the history of the universe sitting in your hand.

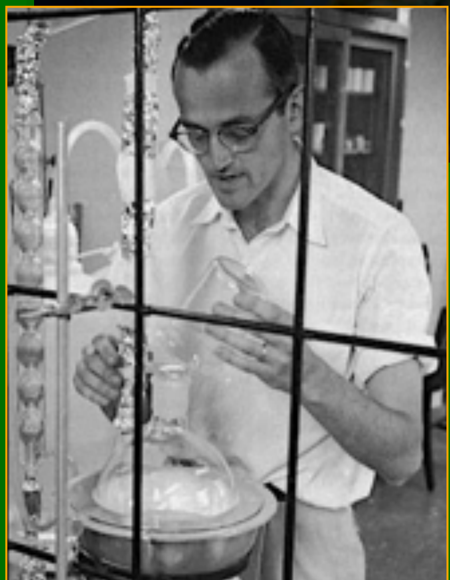
If we're made of star stuff, what makes the stuff?

AMETHYST IS A VARIETY OF QUARTZ (SiO_2) whose violet colour derives from impurities of iron and other trace elements. Slight differences in the proportions of these impurities effect crystal lattice structures which diffract incoming light into interference patterns whose complex interaction result in the mournful hues we admire.

THE GREEN MINERAL PYROMORPHITE in these crystals is lead chlorophosphate $Pb_5(PO_4)_3Cl$. It occurs commonly in ores that contain lead. Metallic lead is poisonous. Even bonded with other elements in a crystalline mineral like pyromorphite, it should be handled with care.

Lead is dangerous because the body needs metals like iron in the blood to distribute oxygen throughout the body. The body assumes that lead is no different from any other metal, but in fact lead destroys cells and blocks the signals of neuroreceptors in the brain. The term 'lead poisoning' at one time was synonymous with convulsions and coma leading to death.

Even minute amounts of lead in fuel or paint can permanently damage nerve endings, which is why lead has been banned from chemical products that can enter the body through the skin or lungs. Until it was banned, lead pigment was commonly used in white paints. If a child's crib was painted white, the lead could (and did) rub off and damage the child's nerves. 'Lead poisoning' was a not infrequent entry in coroner's reports of crib deaths that occurred for no apparent reason.



DURING EARLY EFFORTS trying to date the Earth using the uranium / lead isotope method, the scientist Clair Patterson discovered high amounts of toxic lead were all too common in the air and water due to the use of lead-based fuel and house paint. The body does not distinguish lead from iron in the blood. After a lifetime of persistence, Clair Patterson eventually won a landmark court case in which the use of lead in everyday products was banned. This is why we now ask for 'unleaded' at the fuel pump, even though no lead-containing petrol has been sold for automotive use for decades.

IT'S HARD TO IMAGINE this, but a century ago astronomers didn't know the stars were made out of hydrogen. In 1920, Sir Arthur Eddington first proposed that the nuclear fusion of hydrogen into helium powered the Sun. Twenty years later, Nobel laureate Hans Bethe used new nuclear physics data to calculate that nuclear fusion could in fact make the Sun shine.

Only in 1923 did a graduate student named Cecilia Payne deduce through astro-chemistry that hydrogen was not merely a component of stars, hydrogen was three-quarters of a star's mass and the commonest atom in the universe. Ninety percent of the universe's primordial hydrogen is still here, all around us and as far as we can see. A good portion is inside stars, but the rest of it lies in a thin gas averaging only 1 atom per cubic metre, spread throughout the universe.

That hydrogen filled the universe wasn't discovered until the advent of radio telescopes in the 1950s. Hydrogen emits so weakly that it is visible only in the very cool environs of the 21 cm line in the radio spectrum.

Ancient supernova remnant Simeis 147 in Taurus by Martin Heigan. The red traceries we see are hydrogen alpha emitting at 656.28 nm in air; it occurs when a hydrogen electron falls from its third to second lowest energy level. The blue emission patches are doubly ionised oxygen (OIII) emitting two lines, at 495.9 nm and 500.7 nm.

Astronomers were puzzled because they knew that hydrogen atoms repel each other. How then can we have stars? Even in bright nebulae the temperatures and densities of the hydrogen are far to low to explain the cores of stars burnings at 15 million Kelvin and more? In the 1970s astronomers discovered molecular hydrogen in ultra-cold molecular clouds. With a lot of deduction and an enormous number of equations, they finally worked out the mechanics of star formation and star clusters. The connection between the energy source of stars and the chemistry of the galaxies is called astrochemistry and is significant branch in astronomy.

The hydrogen, helium, carbon, neon, oxygen, and silicon on Earth came from dense layers of these elements during the terminal stages of a star that exlodes as a supernova. The other elements were made during the explosion. Iron comes from white dwarf supernovae.

Although tiny at a mere 3 mm in length, this beautiful blue zircon crystal – technically named zirconium silicate ($ZrSiO_4$) – can help determine the age of Earth to approximately 4.5 billion years since the Earth's crust cooled and crystal lattice structures locked into permanence. The method used is called radiometric U-Pb (uranium-lead) dating.

Zircon crystals trap uranium atoms in its crystal structure but systematically exclude lead atoms. Once the crystal structure is formed, nothing is able to get in or out. Over time the isotopes of uranium gradually transmute into other elements in a process called chain decay. First, a uranium atom transmutes to a thorium atom, a process whose half-life is a few billion years. Thorium is unstable. In less than a month it turns into protactinium, which is even more unstable. Within a minute protactinium atoms transmute into a sequence whose chain ends when the uranium atoms finally reach the stable element lead (Pb). which does not decay at all. Since isotope decay rates and transmutation paths are the same anywhere in the universe, it is easy to calculate the age of a zirconium crystal using radiometric U-Pb dating.

Zircon crystals are extremely hard and durable, making zircon the oldest geological time-capsule in the Earth's crust. Nothing can get in or out of the zircon crystal structure. By comparing the uranium-lead composition of zircon silicate crystals on Earth with younger zircon samples from the Moon and fallen meteorites, crystallographers calculate that the Earth is 4.54 billion years old, with an error margin of 50 million years. While that might seem quite an error bar when we consider that it nearly bridges the 65-million-tear era between the dinosaurs that walked the earth with the mock-up dinosaurs that delight children in theme parks, it is, by cosmic standards a perfectly normal one-percent error bar.

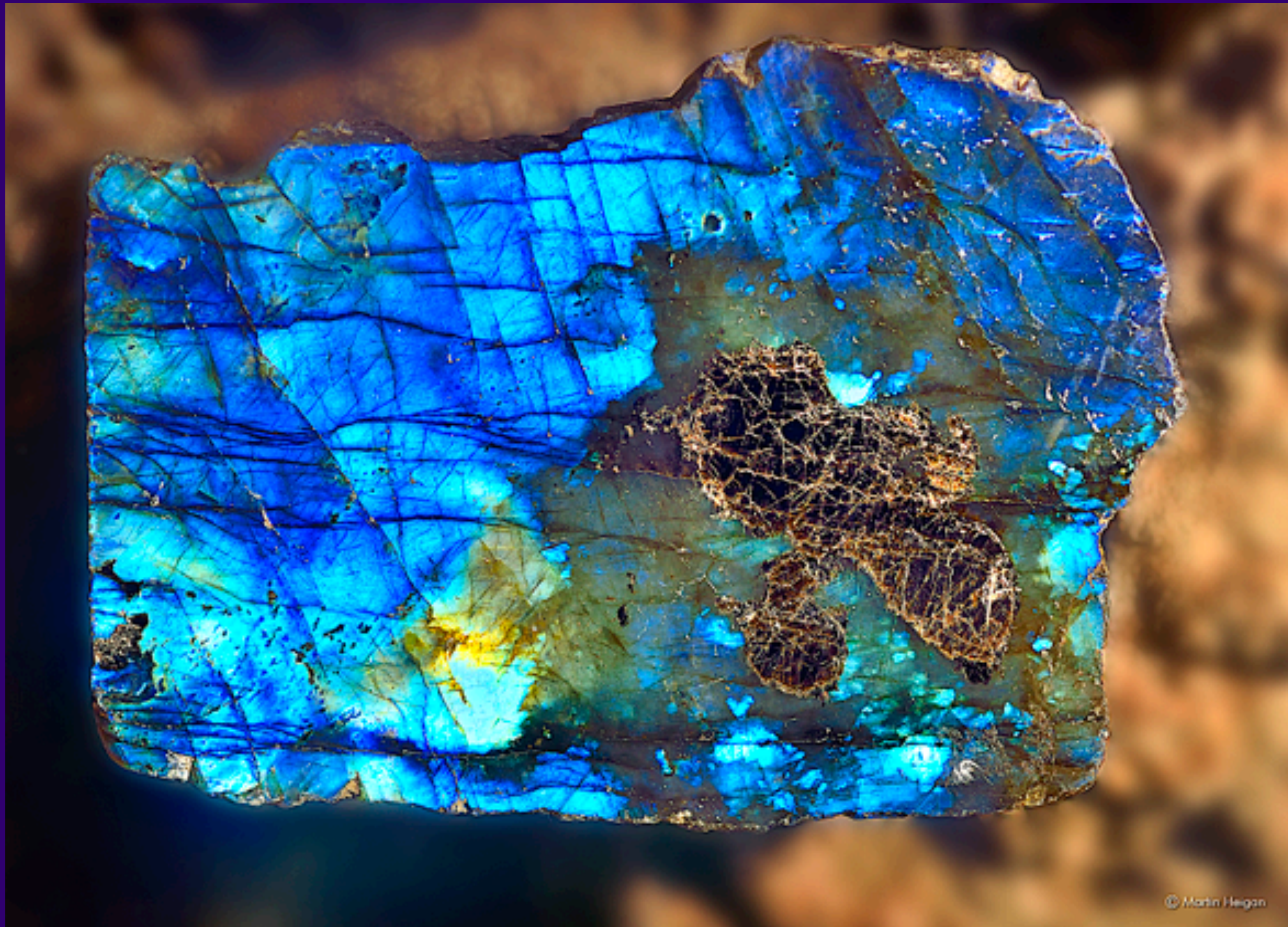
Labradorescent Labradorite

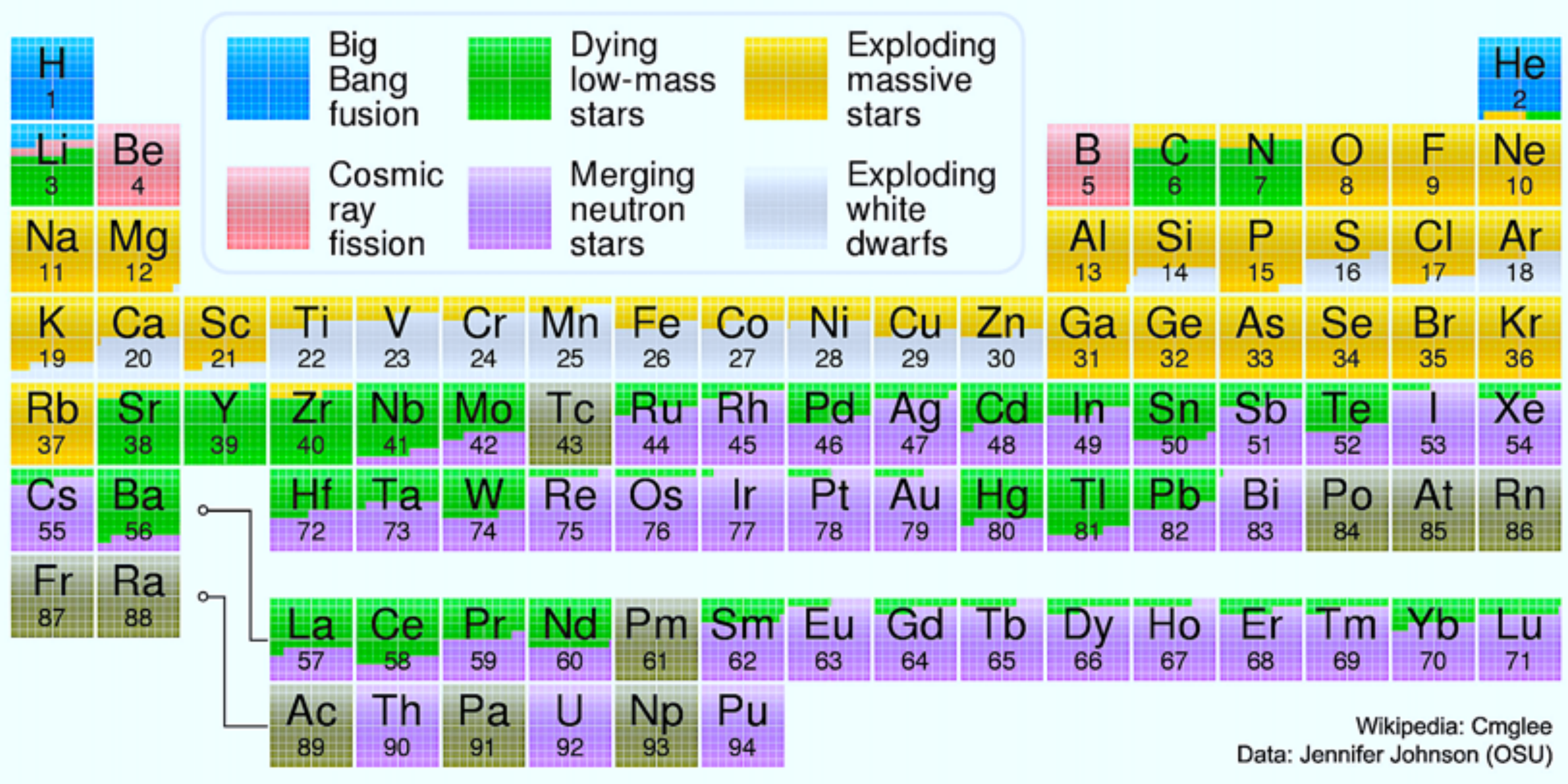
Labradorite $[(Na,Ca)_{1-2}Si_{3-2}O_8]$ is one of my favourite minerals. This specimen is from Madagascar. At 85mm x 56mm x 18mm it is somewhat smaller than shown at the right.

In minerological circles, labradorite is a feldspar mineral of the plagioclase series. It is treasured for its remarkable play of its colours, a property known as *labradorescence*, a subset of *chatoyant* properties. Chatoyance is a series of internal reflections that give star sapphires their characteristic 'stars'.

This stone is composed in aggregate layers that refract light as iridescent flashes of peacock blue, gold, pale green, or coppery red.

***Labradorescence* is not a display of colours reflected from the surface of a specimen. Instead, light enters the stone, strikes a twinning surface within the stone, and reflects from it. The colour seen by the observer is the colour of light reflected from that twinning surface.**





Stellar chemistry of the elements in the universe. Jennifer Johnson, OSU.

It took the dogged work of Margaret and Geoff Burbidge, Fred Hoyle, and Willy Fowler in the 1950s to show conclusively that elements beyond helium were fused in stars and dispersed into the universe during stellar death. One of their triumphs, listed in Fowler's Nobel Prize citation, was to show that it was possible to fuse helium into carbon, skipping over the in-between elements of lithium, beryllium, and boron.

Although the broad picture was in place by 1960, key breakthroughs have been piling up, such as the discoveries that the explosion of white dwarfs produces iron and that the earliest generations of solar-mass stars produced lead. Observations of the composition of stars, the gases that dying stars blow off, and the flashes of light produced by decaying radioactive elements were combined with the predictions of sophisticated computer models of the expected fusion inside stars to produce the tables of data that here have been converted into splotches of teal, orange, and yellow.

The cloud of uncertainty hangs most strongly over the elements in the middle, such as tin, molybdenum, and my favourite element, arsenic. Elements that aren't key to powering stars or that aren't produced in extreme explosions are probably made in small amounts in a variety of places, so it is difficult to find their 'smoking gun.'

The mineral pyrite or iron pyrite, is an iron sulphide with the chemical formula FeS_2.

Fluorite undergoes fluorescence in UV light. This fluorite (CaF2) specimen from Namibia was photographed in the shade, illuminated with a small UV light just out of view to show the fluorescence.

Fluorite (also called fluorspar) is the mineral form of calcium fluoride, and belongs to the halide mineral group.

Many specimens of fluorite have a strong enough fluorescence to allow the observer to take it outside in sunlight, and then move it into shade to see the colour change with a UV light. That is how this image was made.

Only a few minerals have this type of fluorescence. Fluorite typically glows a blue-violet colour under ultraviolet light.

As stars with different masses and compositions have formed and died, they have enriched the Milky Way's gas with a wide and ever-changing abundance of elements. A star's atmosphere is a preserved sample of its natal gas, a fossil record etched onto the surfaces of the stars. It is the history of the nucleosynthesis of its stellar ancestors. If we can decode a star's chemical fingerprint, we can know about the stars that came before it and are now part of it.

Fluorite specimen size: 90mm x 80mm x 70mm

A macro photo of a Brown Zircon crystal from Madagascar.

Radiometric U-Pb (Uranium-Lead) dating is used to determine that tiny zircon crystals like this zirconium silicate (ZrSiO4) date the age of Earth to approximately 4.5 billion years since the crust cooled and the crystals froze into immutability.

Zircon crystals trap uranium atoms in its crystal structure but simultaneously repel lead. Once the crystal structure is formed, nothing is able to get out or change within. Over time the isotopes of uranium transmutate into other elements in what is referred to as a decay chain. A uranium atom first transmutates to a thorium atom—a process that takes several billion years. Thorium is much less stable. In less than a month it turns into protactinium. Within a minute protactinium atoms transmute again, and so on. At the end of the chain, the uranium atoms finally decay into the stable element lead (Pb), and will then remain stable forever.

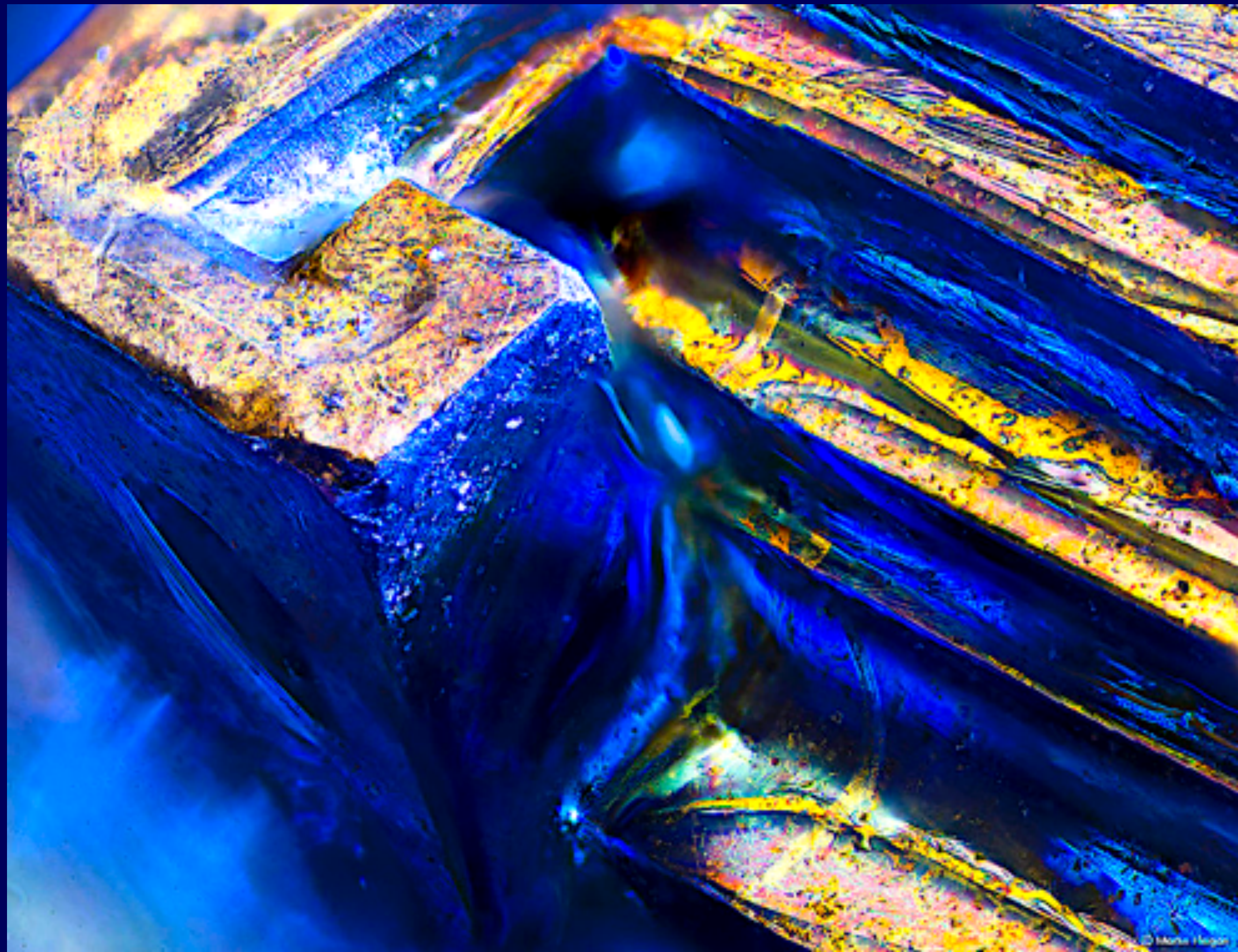
As the decay rate and times of the transmutation are constant in the universe, it is possible to calculate the age of the crystal with radiometric dating. Zircon crystals are exceptionally durable, making them the oldest geological time-capsules that have survived in Earth's crust since it cooled into solid form. As nothing can get in or out of the zircon crystal structure, it is the most accurate tracer of geological dating.

By comparing the dating of zircon silicate crystals on Earth, from Moon samples and fallen meteorites, scientists have been able to calculate that Earth is 4.54 billion years old. The error margin is 50 million years, which is small considering the enormous time scale involved.

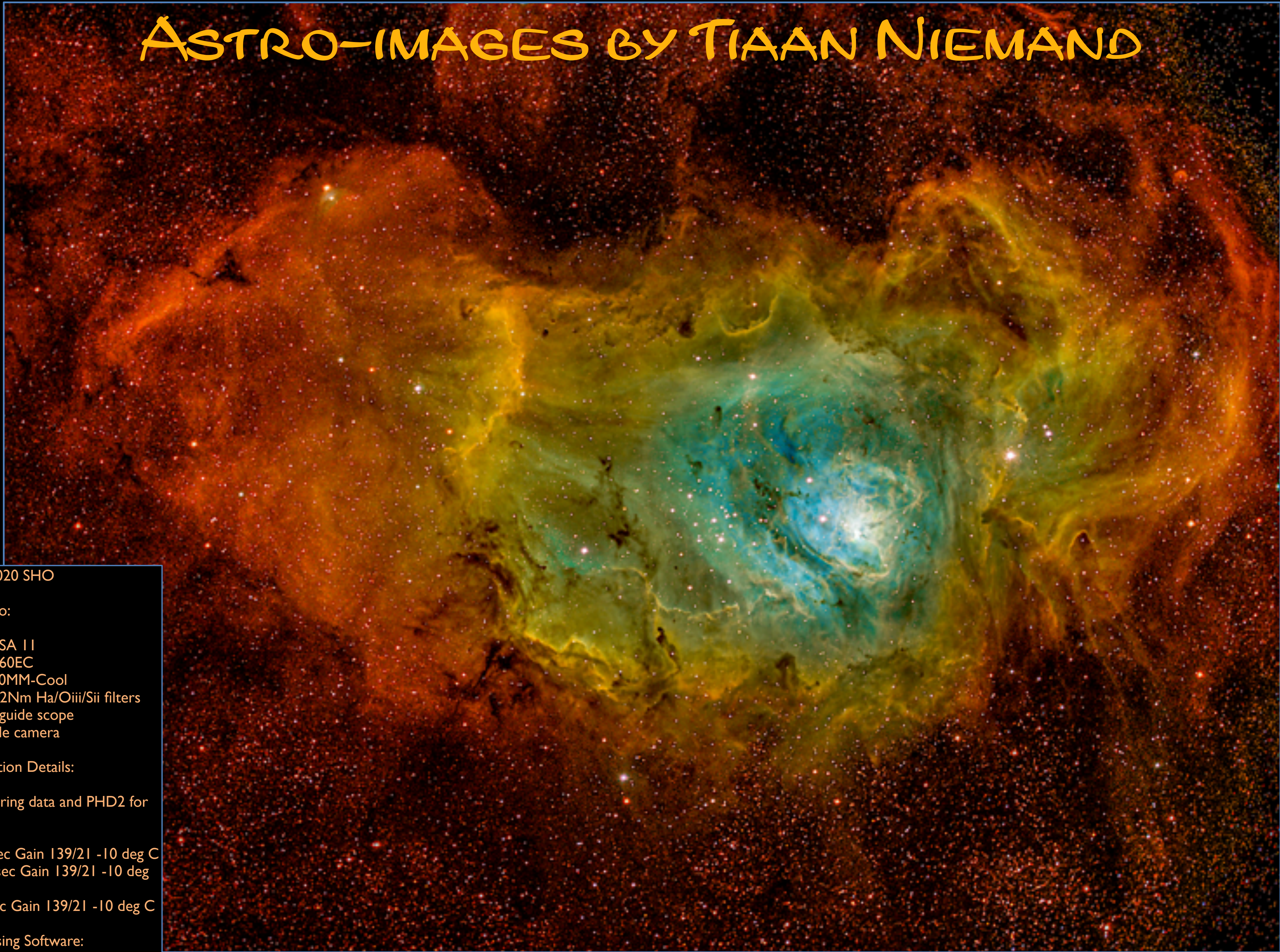
A close-up 10:1 photomicrograph of the beautiful iridescent rainbow reflections from a bismuth crystal.

> "Bismuth is a chemical element with the symbol Bi. Bismuth is the most naturally diamagnetic of all metals. Only mercury has a lower thermal conductivity. The spiral stair-stepped structure of bismuth crystals occurs because of a higher growth rate around the outside edges than on the inside edges. The variations in the thickness of the oxide layer that forms on the surface of the crystal causes different wavelengths of light to interfere upon reflection, thus displaying a rainbow of colours". (Source: Wikipedia.)

Bismuth is a toxic metal in a family of toxic metals that includes lead, arsenic, and antimony. In the Earth's crust, bismuth is about twice as abundant as gold. Like gold, it is forged in the explosions produced when two neutron stars merge. The fact that there is so much of it in the Earth's crust testifies to just how many neutron star mergers have occurred over the approx 10 billion year lifetime of all the small dwarf galaxies that ended up being absorbed by their most massive colleague, the very large and very hungry Milky Way.




RECONNECTION by Teun van der Zalm



M8 13 June 2020 SHO

Equipment info:

Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:

SGP for capturing data and PHD2 for guiding

35 Ha @ 60sec Gain 139/21 -10 deg C
34 Oiii @ 60sec Gain 139/21 -10 deg C
56 Sii @ 60sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4

My journey in astronomy started in 2010 when I bought a cheap six-inch K-way Newtonian reflector. I had no idea how to use it. All I wanted to do was look at the planets and moon, so why should I bother reading up on how to use a telescope? It was quicker and easier to just put it outside and fiddle with it until I got my desired target into the eyepiece field. I took a week to figure out why the eyepiece field moves the opposite direction as the telescope tube.

I used that telescope for six years—I even got around to reading the manual. Then I became interested in astro photography. The K-way wasn't exactly up to that.

In 2016 I was weighing my options to acquire a telescope with the capacity to take long exposure images. The desire was there, but the budget was not.

Then I got lucky. I came across a second-hand, barely used Meade LXD75 SN10. My first imaging setup was a Canon 1200D mounted on the Meade SN10. The Meade SN10 looks impressive and gives wonderful eyepiece views, but it is a heavyweight that pushes its mount to the limit. Even visually it wobbles a bit. Adding any other gear would use it over the stability threshold and I really didn't want to show my friends all my pretty pictures of Figure-8 loops.

Two years went by. I scoured the Internet for mount and telescope combinations that could improve my imaging. Then I got lucky for the second time. In 2018 I was assisting at an astronomy event. I learned that one of the coolest imaging setups anyone could want had just come onto the local market. I had plenty of time to learn how use this dreamy setup —but the the money to buy it I most assuredly did not have. But … thanks to the generosity of my Dad, in September 2019 I had my dream-world imaging setup.

It is a Celestron RASA 11-inch on an iOptron CEM60EC mount. The telescope came with a ZWO ASI 1600mc-cool (colour) and ZWO ASI 1600mm-cool (monochrome) camera. I added a complete set of LRGB and 12nm Ha/OIII/SII imaging filters from Astronomik.

This is not a sightseeing telescope. At f/2.2, the RASA has such a steep light cone that even the best eyepieces would give terrible views. They would have horrible spherical aberration and pillow-shaped fields. Put an astrograph on the RASA, though, and the 11-inch is faster than most 35mm DSLR lenses.

For the present I am shooting narrowband using the monochrome camera. The severe light pollution (Bortle 8) around me leaves RGB imaging out of the picture for right now. That is why all my pictures are nebulae and not star clusters or galaxies. Monochrome has the advantage of producing ultra-tiny star points because the light goes directly from telescope to sensor. Multiband imagers require a light-absorbing Bayer filter mask on the sensor in order to produce realistic colours for the human eye's colour sensitivities. Those inevitably spread out star images from point to dots. One of the first upgrades on my shopping list is a light pollution filter for the colour camera so I can shoot LRGB star fields and galaxie

The guide system is an Orion 50mm guide scope and a QHY5II-m self-guiding camera, more than sufficient for my needs.

The iOptron mount has enough capacity to hold the RASA with all my camera gear without being overloaded. When properly balanced and polar aligned it has such good tracking that I shoot exposures as long as five minutes unguided.

Capturing data is easy. I use Sequence Generator Pro (SGP) to control all the gear. With SGO individual users can create a personal profile that saves the information for each individual component in the system. During the 2020 winter imaging season I left my telescope outside, only covering it during the day with a sail/braai cover. That vastly simplified night to night imaging.

One of my first images with the RASA was the Horsehead Nebula in Orion. I took 5 x 1 minute exposures of H-alpha and OIII which achieved detail that I could not get with my Meade SN10 setup even after two hours of chasing photons. The iOptron mount has enough capacity to hold the RASA with all my camera gear without being overloaded. When properly balanced and polar aligned it has such good tracking that I shoot exposures as long as five minutes unguided.

the gear, wait for the camera to cool down, check whether the guide system is tracking properly, set and forget. The rest of the imaging night is automated. I go back inside and do what I want for the evening, going outside occasionally to check if everything is still running OK.

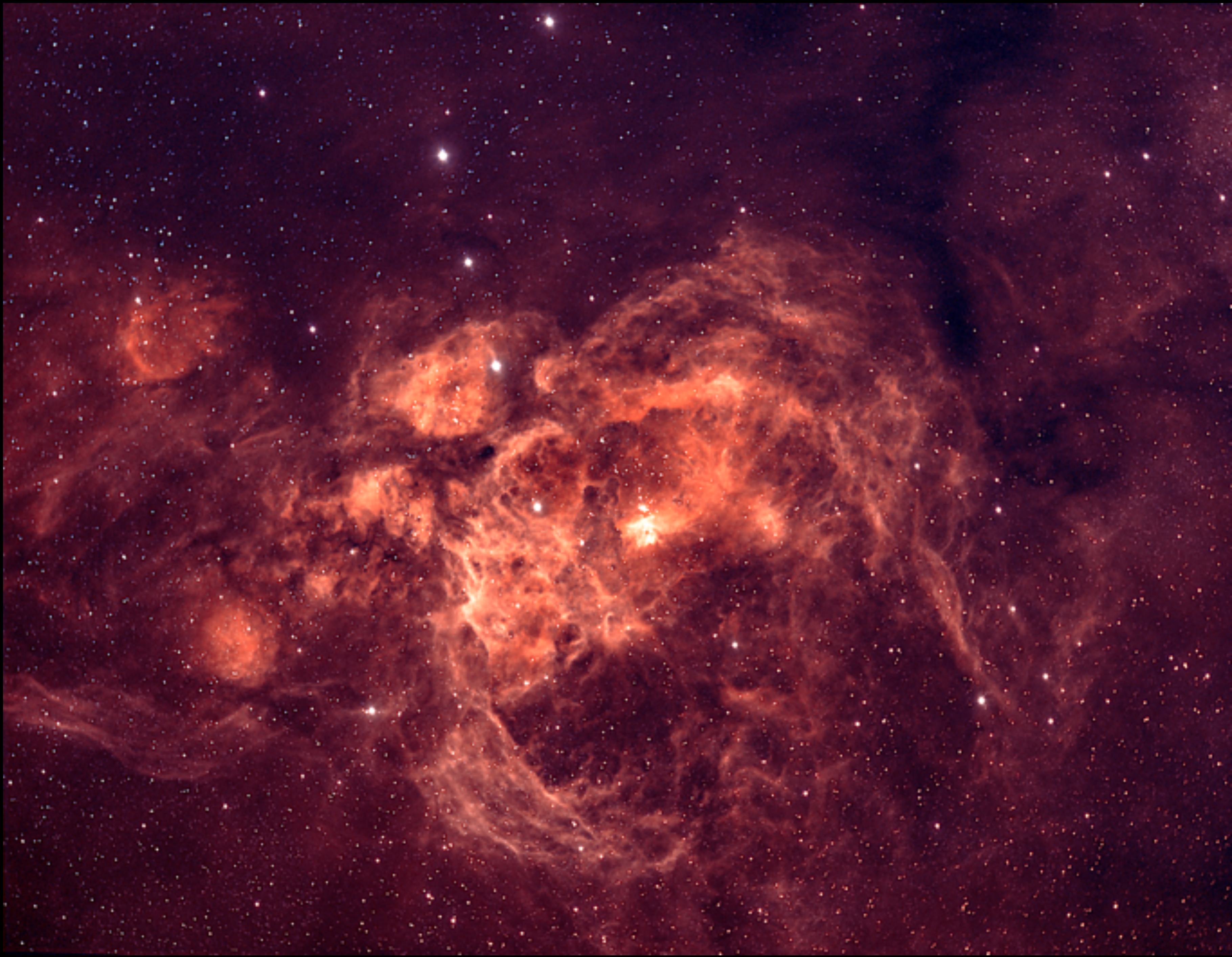
The benefit to using a cooled camera is it saves time on dark frames. I will build a dark library every few months.

When it comes to image processing I am still not all that clued up on what exactly is the 'right' process. (Are we ever, though?) When I started I downloaded all the free software available, such as Deepskystacker and GIMP, and to watch the Youtube videos that showed me what other people are doing. After that it was up to me to learn by making mistakes and zeroing in on what works best.

In 2018 a good friend gave me a laptop with the Nebulosity processing app installed on it.. All the images in this article were processed using Nebulosity to do all my image calibration and stacking. The final images are polished using Photoshop.

Naturally there are a few things I would like to improve. First and foremost is refining my processing skills by learning how the software works inside. I would like to add camera lenses that couple with my ZWO ASI 1600 colour camera using a special adapter. Using the ZWO instead of a modified DSLR would improve wide field and Milky Way images.

Last on the wish list is to build a back-yard observatory to make everything more convenient.



Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:
SGP for capturing data and PHD2 for guiding

75 Ha @ 180sec Gain 139/21 -10 deg C
45 Sii @ 180sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JH,B Bortle 8

NGC 6537 Scorpius, the Lobster Nebula Ha & SII

Image on previous page: NGC 6537 in Scorpius is known as the Lobster Nebula and WAP (War And Peace) Nebula. Tiaan Niemand's H-alpha image reveals twisted reddish gas filaments in the characteristic bubble shape of a 'blister' nebula. Blister nebulae and their interior star clusters are formed when two massive gas clouds collide at high velocities. The gas in the middle is squashed so fast and so hard that a massive star cluster is formed.

Cloud-collision clusters quickly ignite into ultra-massive stars so hot that they radiate mainly in the ultraviolet band. UV radiation is the most destructive light in the universe. At temperature well in excess of 10,000 K, the photon pressure is strong enough to hurl the cluster's remaining gas outward at supersonic speeds, forming a 'blister. (The bubble-like shape of the Orion Nebula is also a blister formation.)

The star cluster is so successful at ejecting its gas that within a few million years it loses most of its mass. That forces the stars in the centre to shrink into a tighter ball—as we see happening in the image to the right. During the same period, the massive O stars start going supernova. Stars born in violence ironically wither into a whimper.

Left: The star cluster Pismis 24 in the core of NGC 6357 hosts three of the most massive stars in the Milky Way. The brightest star in the centre is Pismis 24-1. Astronomers were puzzled by the first photometric measurements of the cluster. Calculations showed that Pismis 24-1 had a mass of over 200 times the Sun's mass. Astronomers quickly realised that 24-1 was a very tight binary system of very high-mass O supergiants, orbiting so close to each other they could not be distinguished by traditional spectroscopic measurements.
Low-population star clusters acquire such high-mass stars when the clusters are formed by two massive clouds colliding nearly head-on at supersonic speeds relative to each other. The gas in the compression front reaches very high densities in the very short time of less than 100,000 years. The result is a cluster with a few ultra-mass stars, a large proportion of high-mass B and A stars, and a rather modest proportion of stars in the Solar-mass range. The extreme temperatures and ultra-violet radiation of the O supergiants heats the surrounding gas to incandescent temperatures, and sculpts the nebula's dust clouds into pillars and filaments as seen here. Image source: ESA/Hubble.

Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:

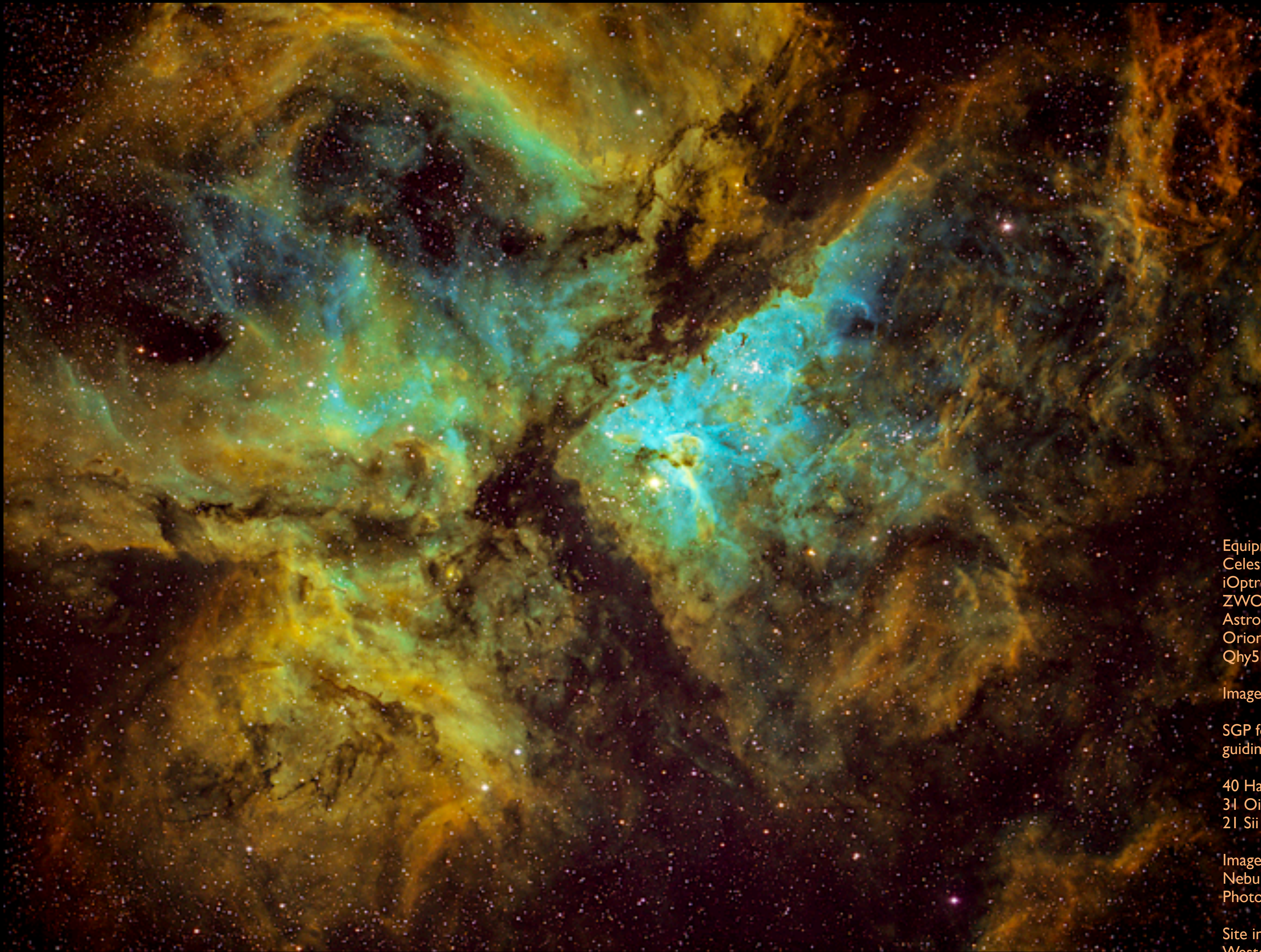
SGP for capturing data and PHD2 for guiding

40 Ha @ 120sec Gain 139/21 -10 deg C
31 Oiii @ 120sec Gain 139/21 -10 deg C
21 Sii @ 120sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JHB, Bortle 8

Carina Nebula in HOO palette



Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:

SGP for capturing data and PHD2 for guiding

40 Ha @ 120sec Gain 139/21 -10 deg C
31 Oiii @ 120sec Gain 139/21 -10 deg C
21 Sii @ 120sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JHB, Bortle 8

Carina Nebula in SHO palette

Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:

APT for capturing data and PHD2 for guiding

76 Ha @ 10 X 1 minute gain 139 @ -10°C
67 Oiii @ 10 x 1 minute gain 139 - @ 10°C
82 Sii @ 10 x 1 minute gain 139 -10°C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JHB, Bortle 8

NGC 6334 Bear Claw / aka Cat's Paw Nebula SHO palette

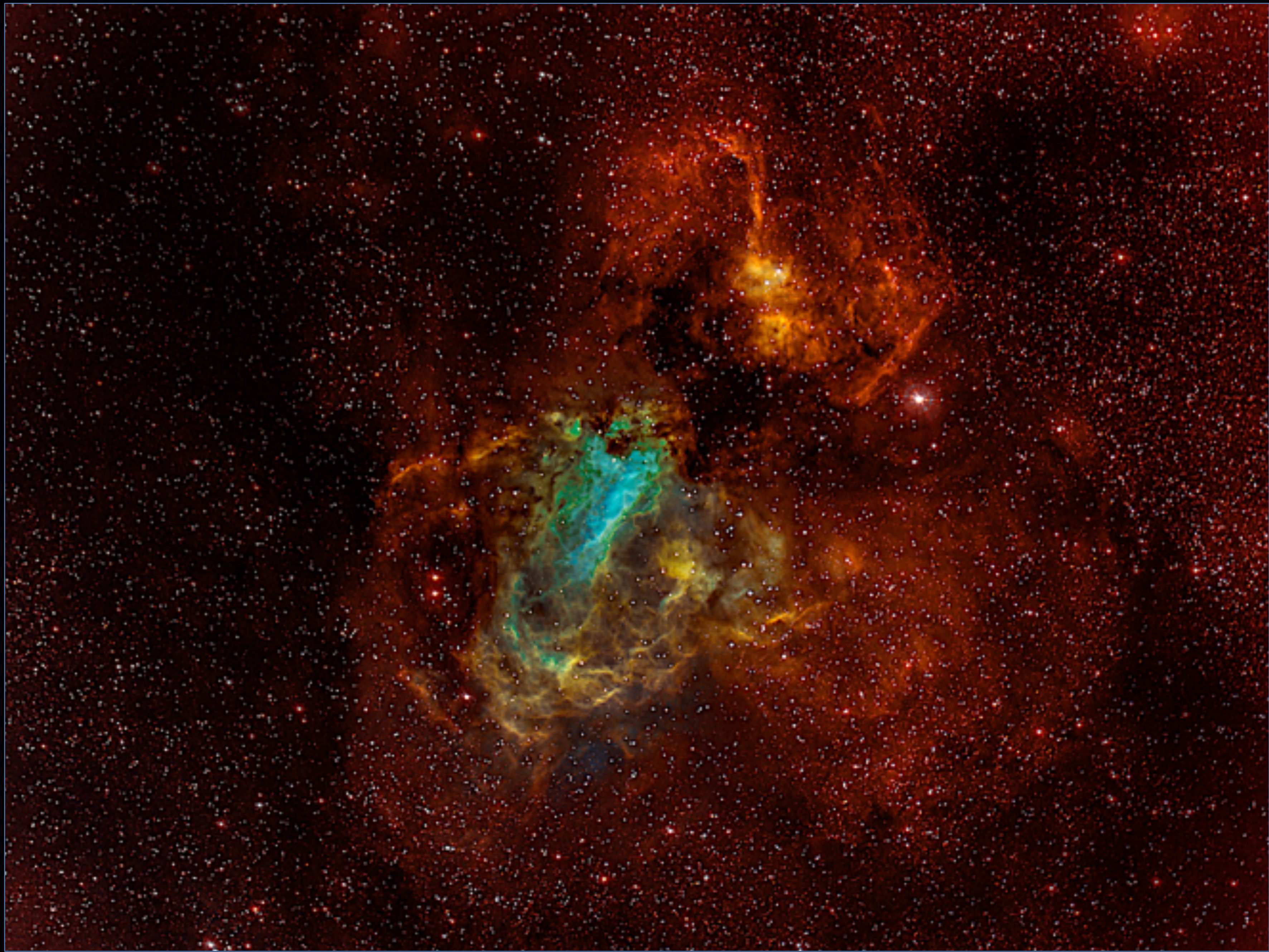
Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:
SGP for capturing data and PHD2 for guiding

40 Ha @ 90sec Gain 139/21 -10 deg C
40 Oiii @ 90sec Gain 139/21 -10 deg C
40 Sii @ 90sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JHB, Bortle 8



M17 NGC 6618 SHO palette

Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

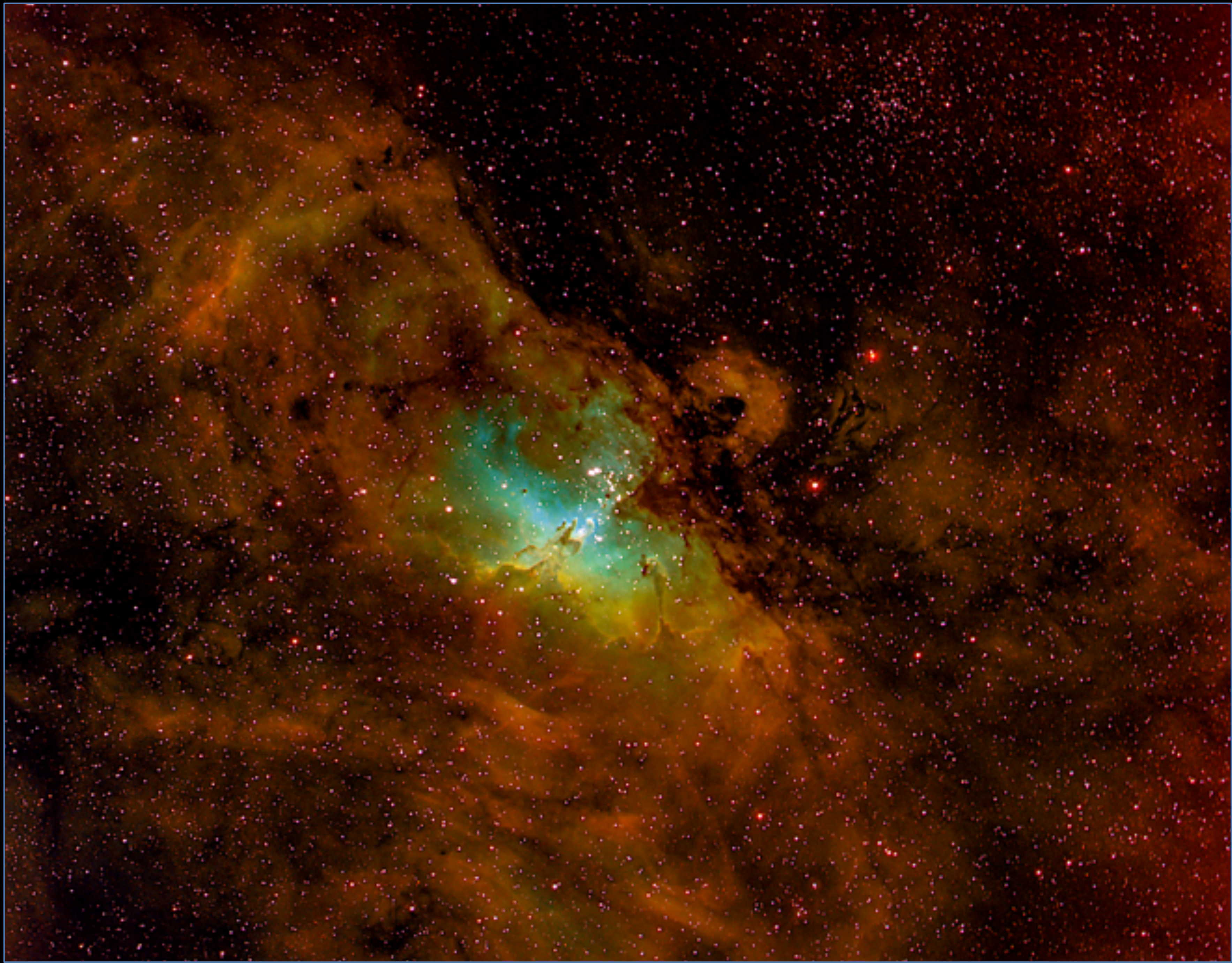
Image Acquisition Details:
SGP for capturing data and PHD2 for guiding

30 Ha @ 120sec Gain 139/21 -10 deg C
31 Sii @ 120sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JHB, Bortle

Prawn Nebula IC 4628 Ha-SII



Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

Image Acquisition Details:

SGP for capturing data and PHD2 for guiding

40 Ha @ 120sec Gain 139/21 -10 deg C
31 Oiii @ 120sec Gain 139/21 -10 deg C
21 Sii @ 120sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

Site information:
Westdene JHB, Bortle 8

M16 NGC 6611 SHO

Equipment info:
Celestron RASA 11
iOptron CEM60EC
ZWO ASI1600MM-Cool
Astronomik 12Nm Ha/Oiii/Sii filters
Orion 50mm guide scope
Qhy5II-M guide camera

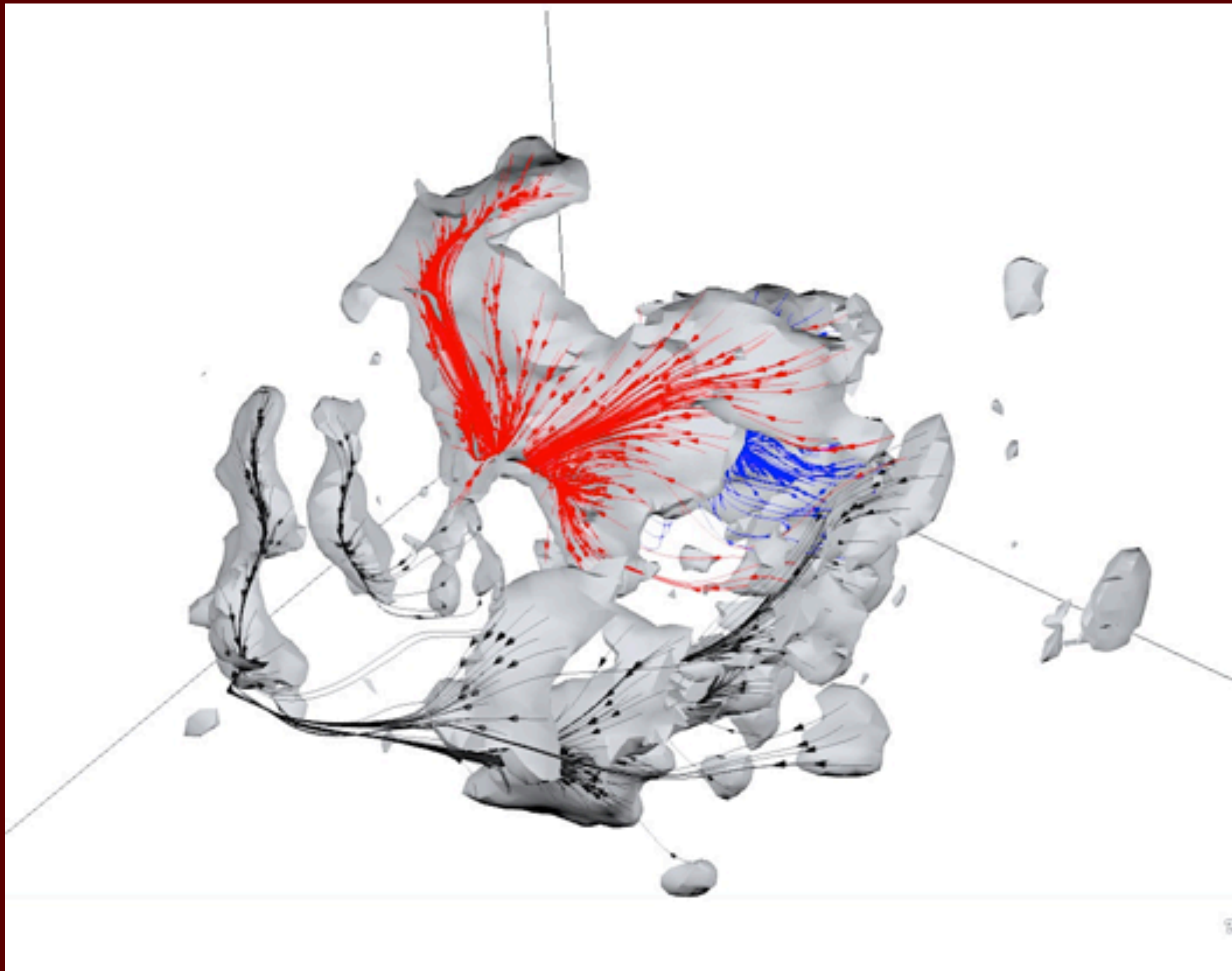
Image Acquisition Details:
SGP for capturing data and PHD2 for guiding

60 Ha @ 60sec Gain 139/21 -10 deg C
60 Oiii @ 60sec Gain 139/21 -10 deg C

Image Processing Software:
Nebulosity V4.4
Photoshop CC

M20 NGC 6611 Trifid Nebula HOO palette

Where do galaxies get their gas?



This interactive 4-D simulation by Daniel Pomarède shows how primordial hydrogen gas from the beginning of the universe flows through the Shapley Supercluster, Great Atrractor, and Perseus-Pisces galaxy superclusters. Galaxies like our rather modestly-sized Milky Way will form trillions of stars like our Sun. That's a lot of gas, but even then the universe has used up only about 10 percent of its total supply. Source: Pomarède et al, Cosmicflows-3: The South Pole Wall, Astrophysical Journal 897 (2020). arxiv.org/pdf/2007.04414.pdf. Be sure to click on the linked image and rotate it with your cursor.

From Leicester to Sutherland in Search of a Shadow

a Ph.D researcher's observing assignment to SAAO

ROSANNA TILBROOK

Rosanna Tilbrook is one of those lucky astronomers whose job has a perk we all would love — she is sent on assignment to remote high-altitude observatories where the atmosphere is clear enough and calm enough to make the most exacting measurements in star brightness that the Earth's atmosphere permits.

Rosanna is a Ph.D student at the University of Leicester in England, where she looks for new, previously undetected exoplanets that circle Sun-like stars in the nearby Orion Spur in the Milky Way's spiral arm system. Since only a small number of planets orbiting any planet-hosting star are fortuitously aligned so they pass between their parent star and Rosanna's telescopes, she has to monitor thousands of star points looking for dips of a few hundredths of a magnitude but take their time to do it—long leisurely hours in many cases. Due to atmospheric tremulousness (star twinkle) there are a great many opportunities for spurious or improbable detections. Rosanna must confirm-and-repeat, repeat-and-confirm across many observing nights. 'It is an achingly tedious job', she says.

'I have to look closely and act fast. The stars are mostly Sun-sized or smaller, but they are so far away that while the transit dip can dim the star so minutely over such a long time span, monitoring the signal strength demands constant attention.' It can be rather tiring even though she hardly moves a muscle.

While Rosanna's main research facility is the NGTS multi-telescope array in Atacama, Chile, she must confirm the more promising detections using a different instrument and different detectors, preferably in a different location.

Last April she lucked out in a big way — she was granted an observatory time slot at the 1-meter Elizabeth Telescope at the SAAO observing complex high up on 'the Hill' in Sutherland, here in South Africa.

Below is her hour-by-hour description of what it is like to be an astronomer at Sutherland. =ed.

Rosanna Tilbrook at sunset, just outside of the Elizabeth Telescope dome at SAAO Sutherland. Behind her is Lesedi, another 1.0m telescope. The dark band just below the orange and pink of the sunset is the Earth's shadow, rising into the sky to darken the rest of the night.

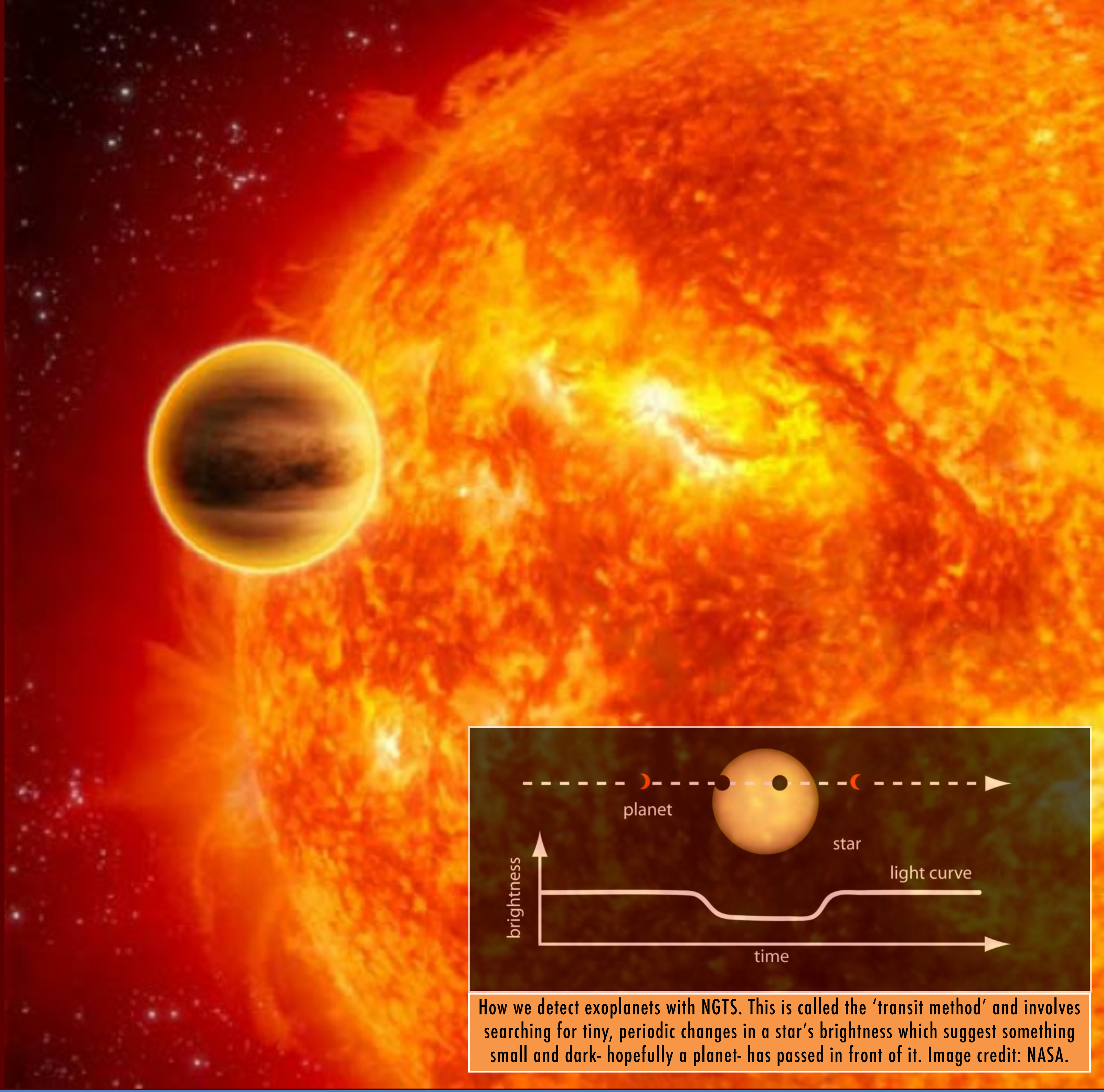
Contrary to what people might think, the day-in, day-out life of an astronomer isn't much different than any office worker's day. It's just broken into two parts.

We spend the sunlit part of our day in offices, tapping away at a computer. Tea breaks are enlivened by meeting with other astronomers working on sometimes vastly different projects.

It's true that some of us work on some pretty exotic stuff like black holes and exploding stars or musing about the ultimate fate of the universe, for most of us the daily routine is pretty much your average 9 to 5.

That is, until we are assigned to monitor the actual telescopes recording our observational data. Then our 'night life' begins.

Most of my research involves looking for new planets in our galaxy with a telescope called the Next Generation Transit Survey, or NGTS. NGTS detects planets by monitoring the light of thousands of stars and measuring tiny periodic changes in their brightness. If these changes are of the right size, shape, and duration, we can infer that a planet has transited and briefly blocked some of the star's light. However, it is also possible that something else may be mimicking the characteristic signatures of a planet detection, so we need to take follow-up data with other telescopes to confirm our discovery. This is where I come in.



How we detect exoplanets with NGTS. This is called the 'transit method' and involves searching for tiny, periodic changes in a star's brightness which suggest something small and dark- hopefully a planet- has passed in front of it. Image credit: NASA.

So what's it like to use a one-metre telescope a third of the way around the world?

As a result of these requirements, one of my follow-up observations took me on the 18-hour journey from my home in the drizzly UK to SAAO, the South African Astronomical Observatory, to use the 1.0 metre Elizabeth Telescope for two weeks of confirmation observations.

SAAO is a four-hour drive from Cape Town, and about fifteen minutes away from the town of Sutherland in the semi-arid, serenely featureless South African karoo. The remoteness of the SAAO facility, like many other observatory sites these days, means there's no local hotel or AirBnB to stay in, so the SAAO observatory has its own specially built accommodation a short drive from the telescopes. This was 'home' while I collected my data.

In the South African karoo you really are isolated!

The biggest adjustment to life at an observatory is being semi-nocturnal. An observer's 'day' starts around 1:00 in the afternoon, when a hot 'breakfast' is served. Since different observers have different body clocks, the SAAO hostel keeps cereal and snacks on-hand 24/7.

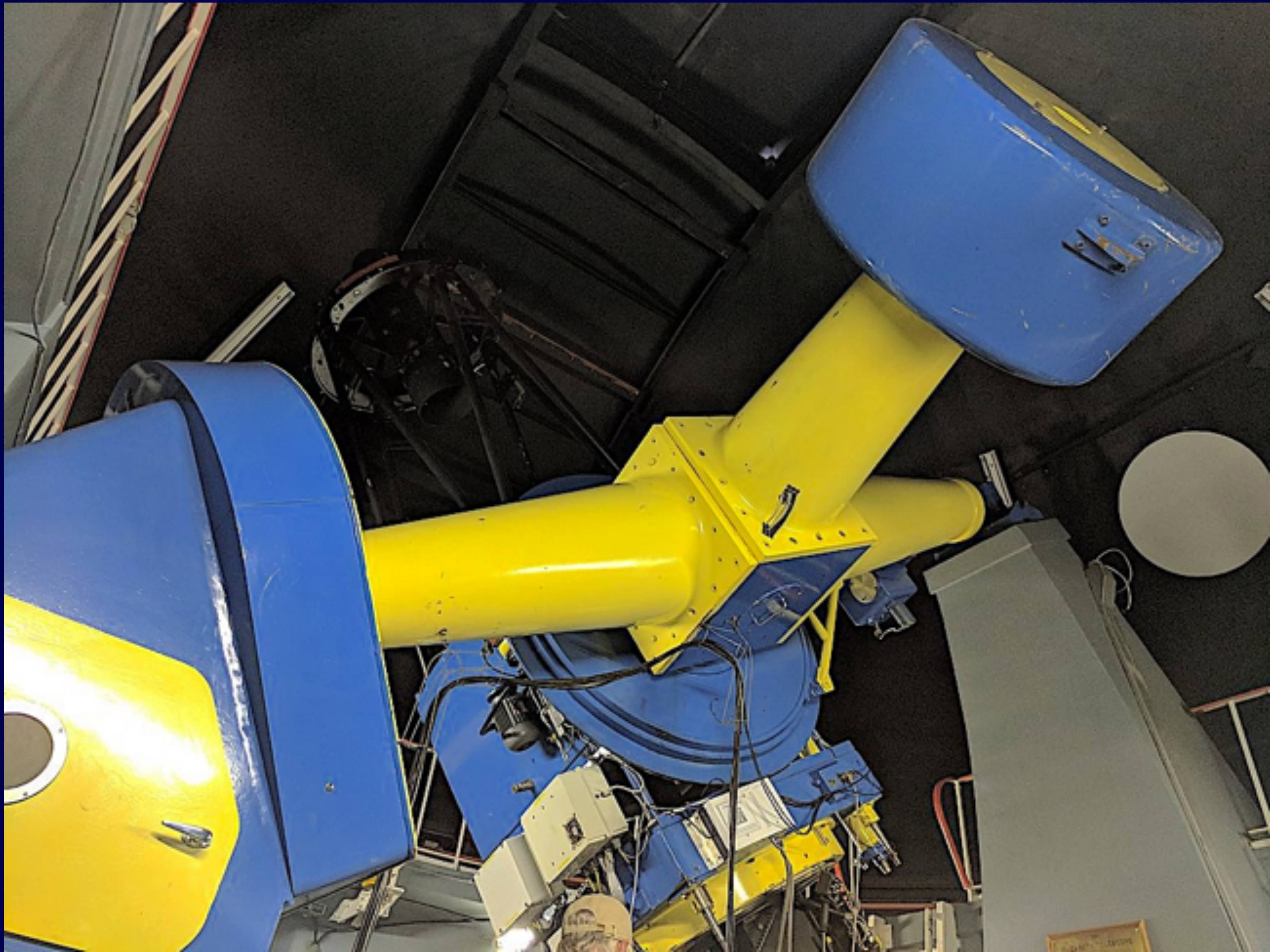
It can be hard to stay alert during a long night at the telescope, so afternoons are a good time to catch up on some work. Sometimes I'll go for a walk and catch some sun; you don't get to see much of it when you're observing! Lunch is a hot meal at about 6pm, when all the astronomers eat together. Astronomers come from all over the world to use the SAAO telescopes, so you get the opportunity to meet lots of interesting people working on all kinds of cool astronomy.

After lunch, it's time to go to the telescope. SAAO has a website containing detailed up-to-date weather information for the observatory. I check that first to make sure conditions will be clear enough to observe. While it is true that I could just poke my head out the window to see if it's cloudy, I am not kitted out with humidity gauges and anemometers to tell me what the seeing and airmass will be over the next few hours.

If the weather looks like it will be clear for the night, I fill my backpack with a laptop, notebooks, a spare jumper, a few extra snacks (okay okay, I admit it—the bag is 50% snacks!). Not to mention the all-important 'night lunch' — a thoughtful care-package of sandwiches, drinks, and nibbles which the chefs at SAAO prepare each evening for every astronomer on duty that night. While you wouldn't exactly call it candle-light dinner fare, trust me, there is nothing better at 3:00 in the morning than a cheese toastie and a hot chocolate!

Once I get to the telescope I head to my 'office' for the night. This is a small warm-room on one side of the dome. Although it may sound unromantic, using a telescope these days doesn't mean that I sit peering through an eyepiece all night long. Instead, the light is collected by a CCD camera equipped with multiple filters that an astronomer might specify in the original observing-time proposal. The astronomer sits in a control room with computers and button pads to control the telescope. The warm room is usually located well apart from the telescope area to keep light and heat from entering the telescope where it could contaminate the data.

The drive up the mountain is short but beautiful as the sun sets over the South African karoo. Occasionally I'll see springbok or dassies on the way up. One time there was even a lion on the loose near the observatory.

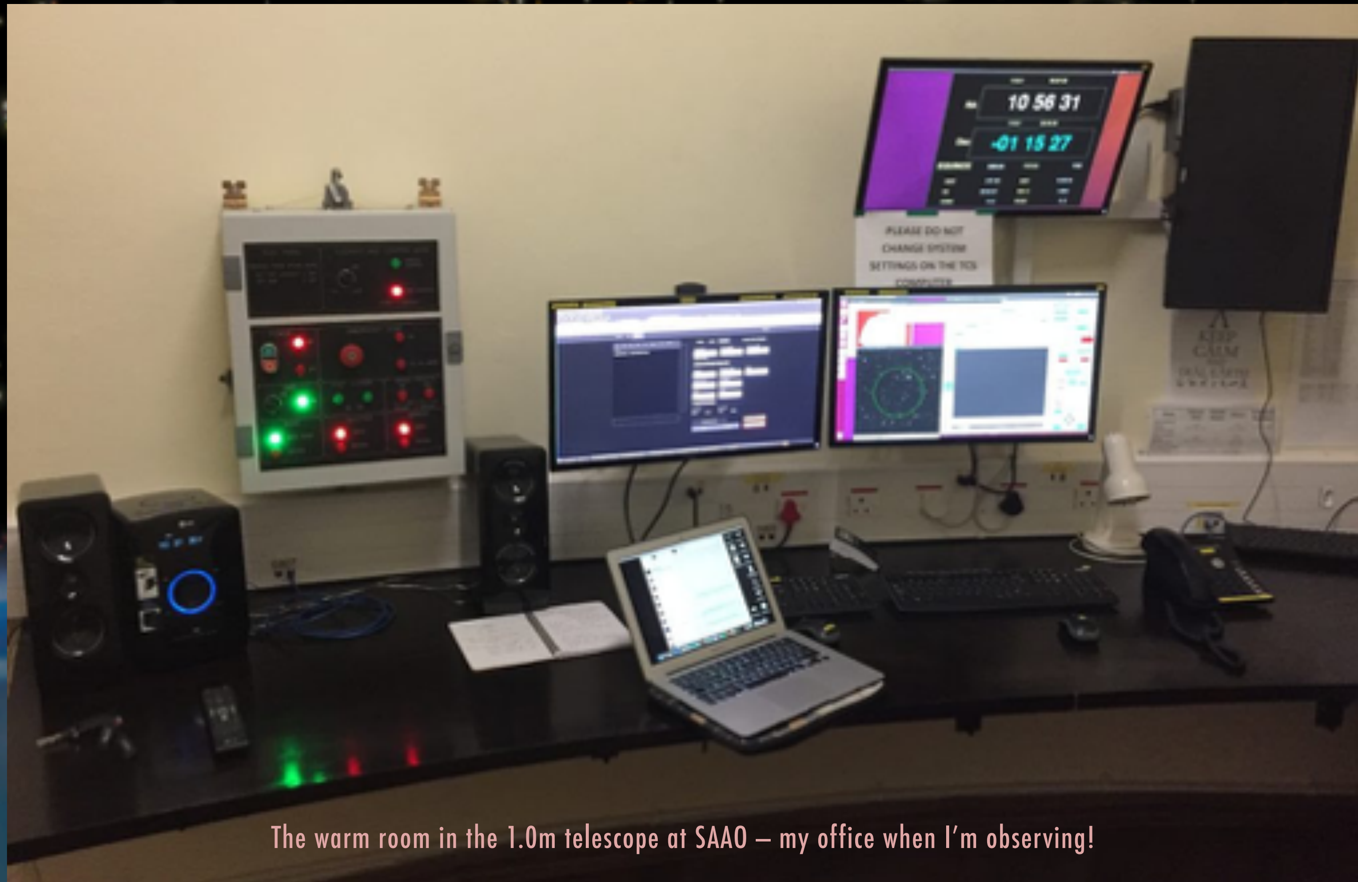


The sturdy mount of the 1-meter Elizabeth Telescope at Sutherland. (The scope itself is a bit hard to see on the opposite side.) The Elizabeth Telescope is used by numerous U.K. and European varsity astronomy departments for their PhD students researching their theses. See the article '*A Day (and Night) in the life of a Visiting Astronomer*' by Rosanna Tilbrook in this issue.

At the start of the evening I switch the camera on, even though I won't be taking data for awhile. The detector needs to cool down to a chilly -50 degrees Celsius, which keeps instrument noise to a minimum. While I wait, I have a few minutes to stand outside and watch the glorious African sunset.

The first thing o do when I start my actual data collecting runs is snap a few images with the telescope shutter closed, and then some others of the twilight sky before the stars appear. These bias and flat frames are important for calibrating the science images I will take through the night. Bias and flat frames help me calibrate any tiny fluctuations in each pixel of the camera. Ignoring these could degrade the precision of the measurements—especially in planet-transit astronomy where the planet shadow can be smaller than the pixels in the camera.

As the sky darkens, I do a practice run through my list of targets. I log the target positions into the telescope's computer memory using my pre-prepared finding charts. These have to be accurate to a second of arc or less. I then find a nearby bright star to use as a guide star, which the telescope locks onto to help it to stay pointed at the exact same square arcsecond in the sky as the Earth rotates beneath it. The guide star is also used to check the atmospheric conditions such as the seeing (how 'twinkly' the stars are) and transparency (how much humidity and dust are between the telescope and the target). I need to know these data when I later calculate the quality of the specific images that I collect. On nights when the seeing is sub-arcsecond, my data is really clean and I don't need to do much 'sigma correction', which is numerical value for each data set. Sigma 1 is about 66% accurate; sigma 5 is 99.9995%.



The warm room in the 1.0m telescope at SAAO – my office when I'm observing!

After I've found my target and guide star, it's pretty much a case of setting the exposure time and number of exposures and hitting go! Planet transits usually take a few hours, so I'm able to basically let the telescope do its thing whilst I get on with some work, or, later in the night, watch some TV or a movie (and eat all those snacks). I'll keep an eye on the weather and guiding to make sure the data is okay; occasionally when the conditions get really awful, I'll have to guide by hand, which means moving the telescope by tiny increments every few seconds. It's not the best way of stabilising the telescope and if the weather doesn't improve it typically means it's time to call it a night.

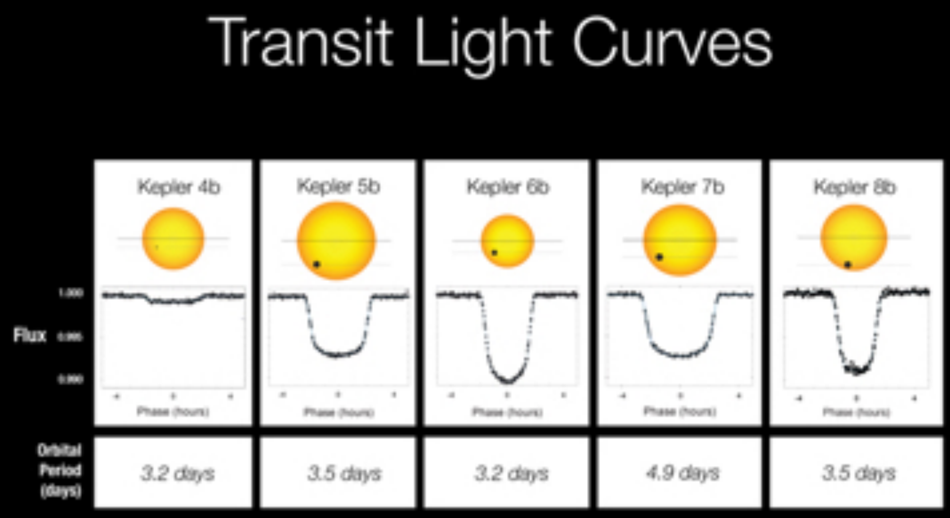
Sometimes, if I'm feeling brave, I'll step out of the comfort of the telescope dome and into the inky outside world to look at the stars myself. A clear night sky, viewed with your own eyes, is completely breathtaking, and I implore everyone to try stargazing (properly, away from a city or town) at least once. Due to the lack of extra light around you, the Milky Way becomes immediately visible as a river of stars and dust overhead, and as your eyes adjust to the low light the picture only gets more beautiful as more stars become visible. Being in the southern hemisphere, you'll also notice two fuzzy blobs—they look like clouds—to the side of the Milky Way, which are in fact dwarf galaxies. Each blob contains billions of stars and are hundreds of thousands of light years away, and yet it feels like you could reach out and touch them.

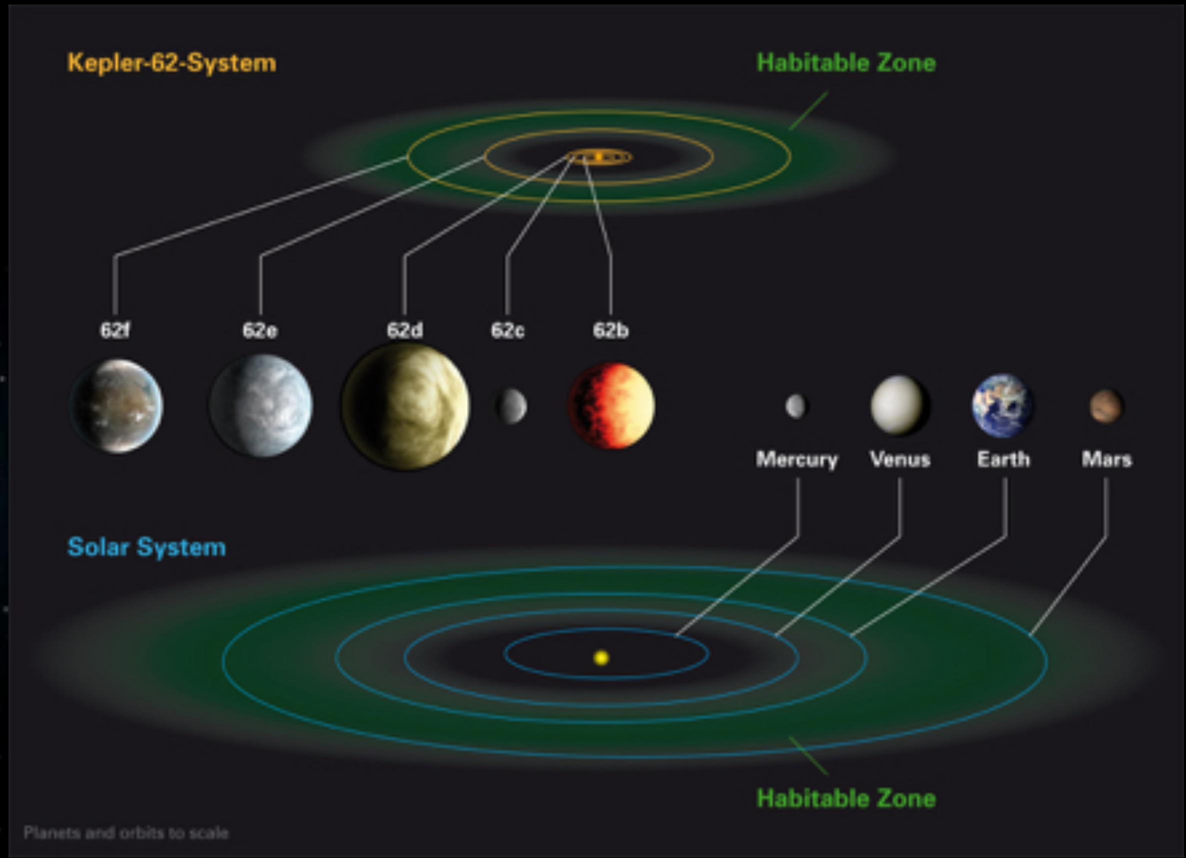
I feel extremely fortunate to be able to visit parts of the world where the night sky is so magnificently clear, and yet, I also find leaving the dome and stepping into the silent, pitch black all alone. It's somewhat terrifying. When I'm observing I don't get to stargaze as often as I would like.

Then it’s back in the dome and back to work. If the night goes smoothly, I’ll be taking data until just before sunrise. As the sky gets lighter, the data quality decreases as the stars start to fade away into the background of the morning sky. I make sure to shut everything down, including closing the shutter and the telescope dome, before packing up and heading out. The drive back down the mountain is a slow one as I’m not allowed to put my headlights on in case other astronomers are still working. All I can use are my hazard lights until I get closer to the hostel.

When I finally get back to my room, I’m pretty exhausted. If I’ve had to shut down early due to the weather, I’ll need to fight off sleep a little longer and stay up to keep my body clock in line with my new nocturnal lifestyle. If everything’s gone to plan and I’ve managed a full night at the telescope, I can collapse into bed just as the birds are starting their morning chorus. If I’ve managed to get good data, I’m a happy astronomer!

And if I haven’t, there’s always tomorrow night …



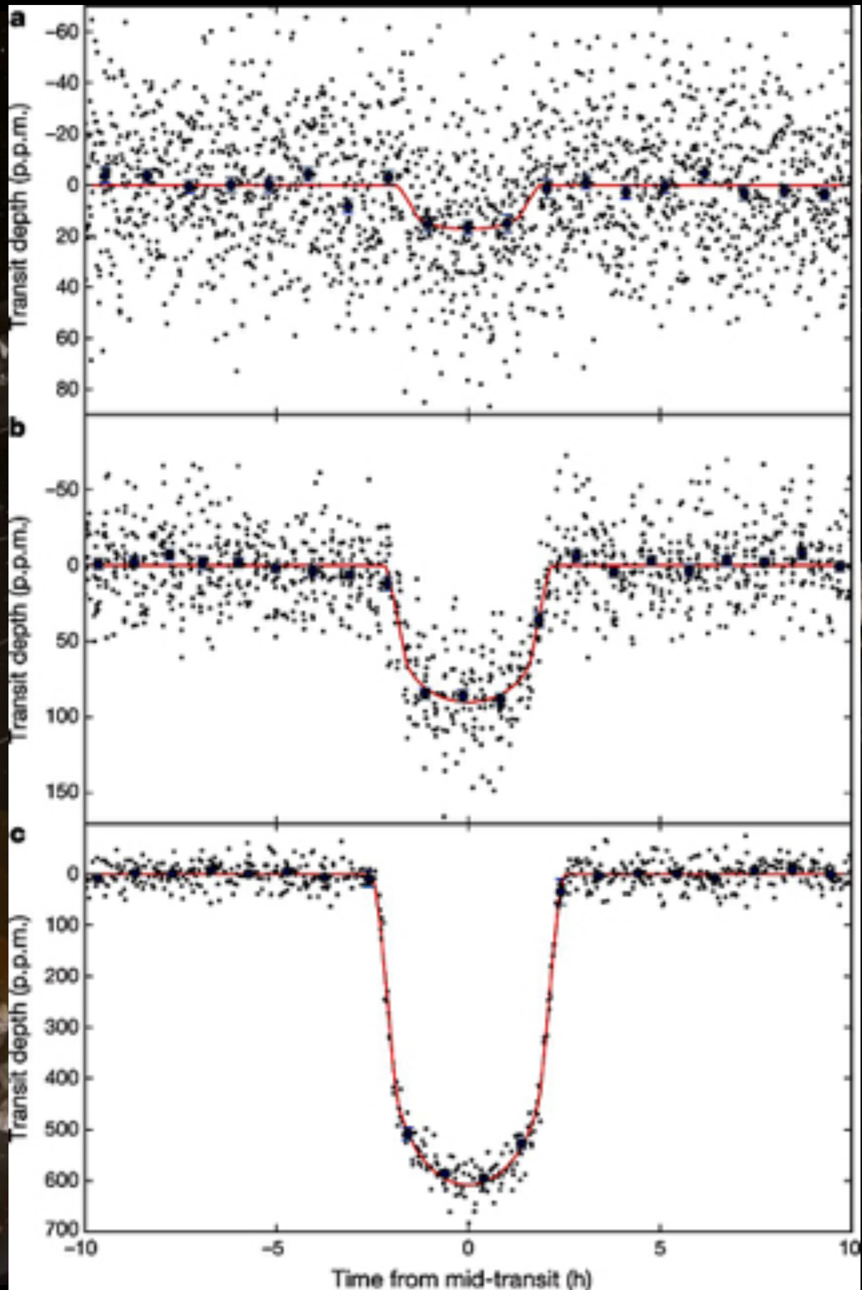


Exoplanet transits come in many shapes and sizes

Since the discovery of the first exoplanets, it has been known that other planetary systems can look quite unlike our own. Until fairly recently, we have been able to probe only the upper range of the planet size distribution, and, since last year, to detect planets that are the size of Earth or somewhat smaller. Hitherto, no planets have been found that are smaller than those we see in the Solar System. Here we report a planet significantly smaller than Mercury. This tiny planet is the innermost of three that orbit the Sun-like host star, which we have designated Kepler-37. Owing to its extremely small size, similar to that of the Moon, and highly irradiated surface, the planet, Kepler-37b, is probably rocky with no atmosphere or water, similar to Mercury.

The three panels to the right show the transits of planets Kepler-37b (a), Kepler-37c (b) and Kepler-37d (c). The signal-to-noise ratios of the transits of the planets are 13 (a), 49 (b) and 282 (c).

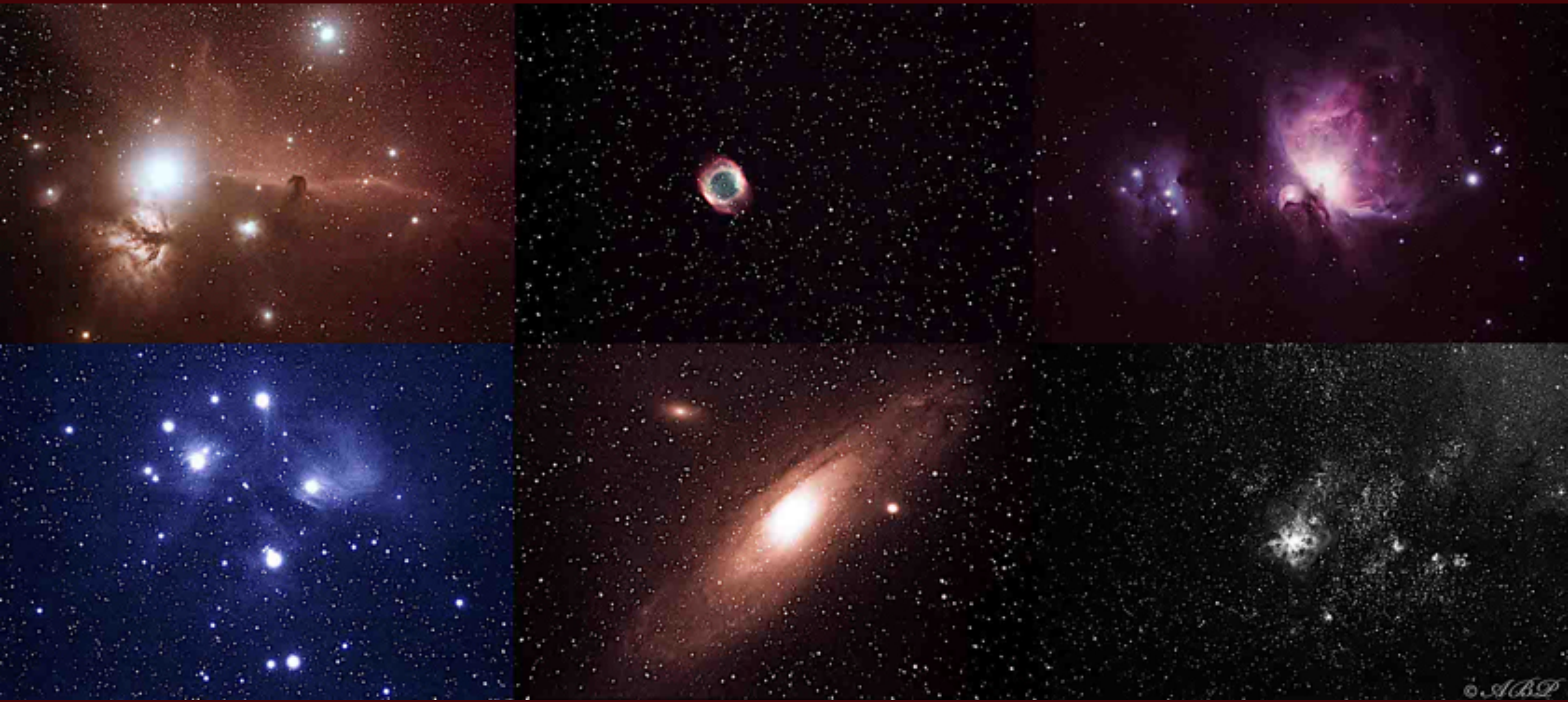
Source: Thomas Barclay at al, A sub-Mercury-sized exoplanet. Nature 494(7438):452-4, Feb 2013.




FIRST WE FIND ROCK.
THEN WE FIND WATER.
THEN WE FIND ...

How did the Magellanic Clouds get here?

Angus Burns Astrophotography



When I was nine years old, one night I looked up.

Why astrophotography?

I have been fascinated by astronomy since the age of nine, inspired almost from the beginning by Carl Sagan. When I was twelve I was privileged to see Halley's Comet. Memories like that long outlast the events themselves. Today at 46 my childhood wonderment has turned into an immersive, all-consuming passion as rewarding as life itself.

About nine years ago I acquired my first true astronomy kit, a Celestron SE8 OTA mounted on a CGEM equatorial. These literally opening up the universe for me—and for many friends and my family as well. Astronomy for me is as much social as it is inspiring. I explore the universe from near to far, introducing not just myself but many others to the wonderment of discovery.

Over the years my array of telescopes includes a Celestron 9.25" EDGE HD scope, a Skywatcher 80ed Pro, and a Celestron Nexstar Mak90 SLT telescope.

I still have my beloved Celestron SE8, my original passport to the universe.

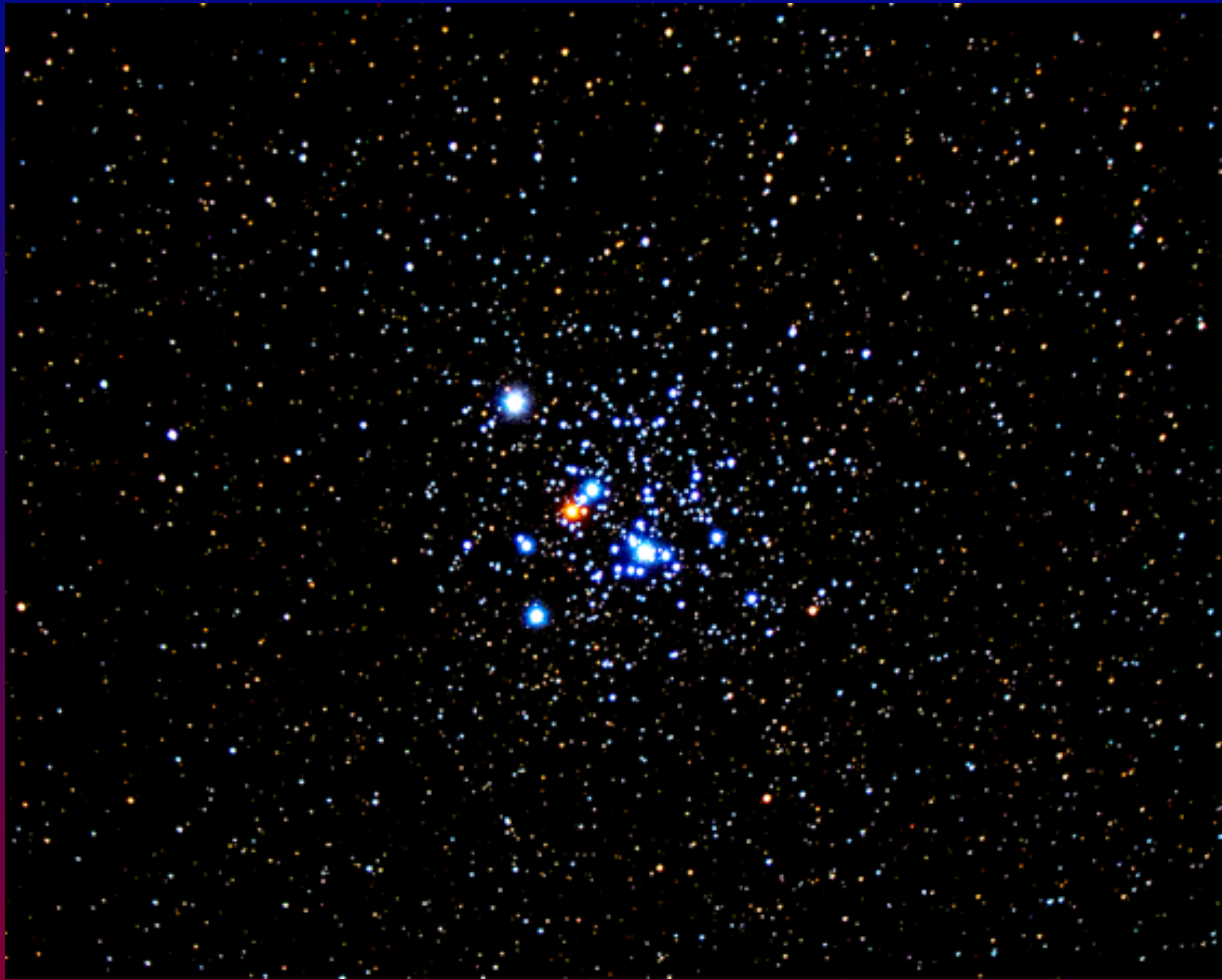
Jewel Box Cluster

I used my Celestron SE8 to capture this 14 million year old delight to the eyes near Mimosa, the easternmost star in Crux, the Southern Cross.

The cluster was first spotted as a 'starry haze' by Nicolas de Lacaille during his great Cape of Good Hope years of discovery in 1751 and 1752. He recorded it in his catalogue of southern objects *Cœlum Australe Stelliferum*.

The cluster's current nickname was dubbed by John Herschel in 1834 who called it '… a superb piece of fancy jewellery'.

Today we know it more prosaically as NGC 4755. The multiple sapphires of bright blue in this jewel box are all B-class giant stars of 8 to 20 solar masses, which also means they are still young. It will be many millions of years before they inevitably demise as core-collapse supernovae. Class B stars live between 15 and 35 million years on average. At 14 million years these are still converting hydrogen into helium in their cores—albeit at prodigious and unsustainable burn rates. Over time this set of sapphires will turn to rubies as the B stars age through the red giant and numerous blue-loop phases. There's plenty of glitter yet to shine.



The intense blue stars in the cluster are blue supergiants and some of the intrinsically brightest stars in the Milky War spiral arms. The three stars in a tight line near the centre are colloquially known as 'The Traffic Lights' because of their slightly varying hues. The subtly reddish star DU Cru is an M2 red supergiant. An M class star in a B class star cluster is by definition not a cluster member, because M supergiants are in the age range of several hundred million years. Is is also a stunningly bright ruby between 320,000 and 640,000 times the Sun's luminosity, which translates to tens of thousands of times brighter than the Jewel Box's blue beauties.

M7

The Ptolemy Cluster M7 is my favourite star cluster.

This single 2 minute image was captured from Newcastle KZN with a Canon60Da coupled to a Skywatcher 80ed Pro on my Celestron CGEM mount. The collected photons were processed at ISO 1600 using Light Room and CC 2019.

The cluster's name derives from its first recorded entry in the historical record by the 2nd-century Greek-Roman astronomer Claudius Ptolemy, who described it as a 'nebula' in his *Almagest* in 130 ACE.

This image approximates the view in my 80mm Skywatcher ED. I see about 25 stars that look plausibly to be cluster members. M7's stars tend to stand out markedly in visual views against the grainy matte of more distant field stars.

The same cluster in my 8-inch Celestron shows about 80 stars, plus the faint, remote globular cluster, NGC 6453.

M7 has been measured as about 800 light years from the Sun and is embedded in the Orion Spur that looks deceptively like a bridge between the Orion Arm inside the Solar circle and the Perseus Arm much further out. The Perseus Arm also hosts the Rosette Nebula imaged on the next page. This image does not go deeply enough to also capture the petite remote globular cluster NGC 6453, but in my 8-inch that little globular holds it own in mystical beauty compared with the mammoth scatter of Ptolemy's brilliant wonder.

Rosette Nebula

Captured from Newcastle KZN with a Canon 60Da through a Skywatcher 80ed Pro on a Celestron CGEM.
50 x 2 mins @ ISO 1000 stacked in DSS and further processed in Light Room and CC2019.

The Rosette Nebula is literally a picture-perfect example of a simple, yet also complex, moment in the phase-transition of a dense, cold cloud of molecular hydrogen into a beautiful star cluster 'in the clear' like the Jewel Box Cluster above. It takes anywhere between ten and thirty million years for a rich, dense cloud of molecular hydrogen gas to collapse, initiate star making, clear out its unused birth gas, and 'relax' into those speckled beauties we marvel in a the eyepiece.

The Rosette looks like it has a hole in the middle. But it's not really a 'hole', it's a pocket of less-dense and cooling gas that is being expelled from its birthplace, atom by atom, ion by ion, dust particle by dust particle. They are being driven away by the intense light pressure and gas flow generated by the bright stars of NGC 2244 the 'Christmas Tree Cluster' glittering in the heart of the picture.

The fact that those bright stars are hot O-class supergiants tells us that the Rosette is only 5 to 6 million years old. Those hottie stars are fiercely blasting away not just the gas in the round hole, they are also fragmenting the thin ribbons of dust that can be seen a bit further out. In a hundred thousand more years they will scatter into diffuse dust particles mixed with gas. The glowing nebula will be pushed outside the gravitational reach of the cluster. Losing that much gas also means losing half the cluster's mass. The O stars will supernovae across the next few million years. The end of all this will be a beautiful open cluster like the Pleiades.

Lagoon Nebula

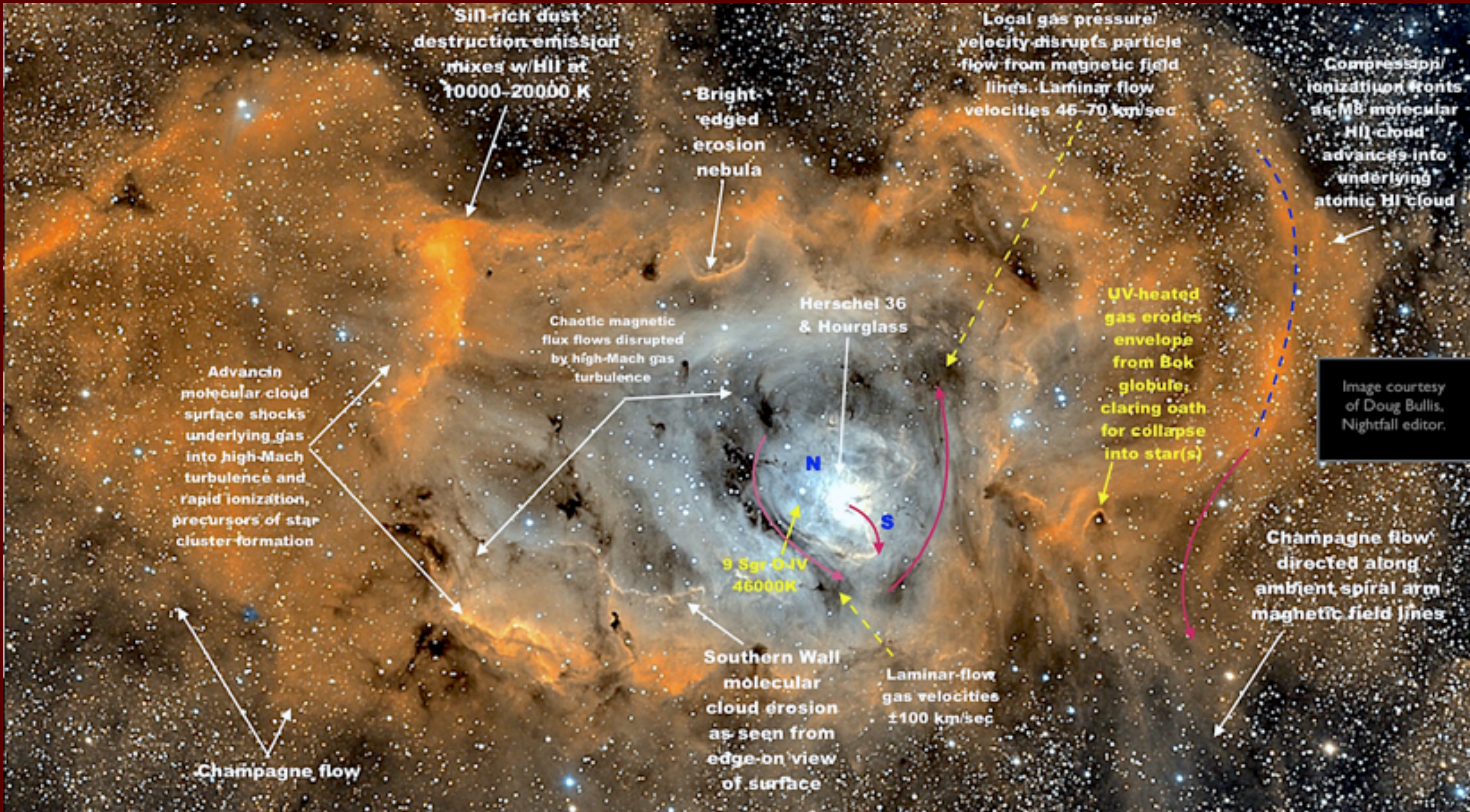
Captured from Newcastle KZN with a Canon 60da through a Celestron 9.25” Edge HD on a CGEM.
20 x 2 min x ISO1000 stacked in DSS and further processed in Light Room and CC 2019.

The Lagoon Nebula structure is one of three multi-stage ‘conveyor belt’ star forming regions that both hobbyist and professional astronomers study to learn the intricacies of how galaxies are built. The other two are the M42 Orion Nebular Cluster and the Carina Nebula. All three are forming not out of a giant ball of self-gravitating cold gas (which would produce collect-and-collapse clusters like the Pleiades), but out of a long, clumpy filament of multiple dense cores which are rotating into a gas-rich portion of one of the Milky Way’s spiral arms.

Here we see three such cores all forming star clusters in sequence. The most obvious is NGC 6530, the glittery bright star spray in the upper centre of the image. NGC 6530 is larger than it looks—the three brightest stars on either side don’t look it, but they also are part of N6530. The reddish gas that surrounds the stars is part of the cluster’s original natal or baby gas, just now being warmed by the radiation of the cluster’s brightest stars.

Even at the ripe young age of about 2 million years, N6530 is the oldest star cluster forming gas mass in the M8 complex. The next-oldest is the bright diffuse Hourglass Nebula just across the ‘lagoon’. The Lagoon is in reality a giant river of cool gas and magnetically aligned dust which flows anti-clockwise in the orientation of this image as it follows the field lines of the Hourglass Nebula to its left. The Hourglass is a a hot, nearly explosive star-forming complex less than a million years old.

So far the Hourglass has produced just one supermassive, super-hot O star, Herschel 36. Hubble Space Telescope images show this small but frantically energetic region as a cosmic cacophony of tornado-like ‘gas pumps’ feeding dense gas and dust into the newly emerging younger brother to next-door NGC 6530. Completely unseen amid all this is the youngest new star cluster of all, nearly 1000 protostars still too dim to be seen in the visual band, but bright in X-ray.



The Lagoon Nebula region features so many star-formation processes that Doug Bullis, Nightfall's editor, suggested that we drop this image in with my own photograph to help explain the bizarre astronomy that occurs when too much gas meets too much gravity.

When a 'conveyor belt' of gas cores falls into the dense arm of a spiral galaxy, gravity shrinks out stars — one star cluster per dense collapsing core. So far, the Lagoon has produced three of these—and may yet produce more.

There is also a lot of dust mixed with the gas in a collapsing core—roughly 1 tiny dust particle for every 10,000 hydrogen atoms. Every element on Earth exists among those minute particles of dust smaller than a baking-flour particle. Since dust doesn't shine it reveals itself here as dark blobs and filaments. The reddish hues are ionised hydrogen-alpha gas heated both by the gas compression of adiabatic heating and by the fierce radiation from stars. The blue-green glow comes from doubly ionised oxygen originally emitted in the ultraviolet band but was absorbed by dust and re-emitted at 500.7 nm.

M 20

Captured from Newcastle KZN with a Canon 60da through a Celestron 9.25" edge HD on a CGEM
20 x 2 mins at ISO 1000 stacked in DSS and further processed in Light room and CC 2019sed in Light room and CC 2019.

When we observe the Trifid visually we are really seeing on the upper surface on several large bubbles presently being inflated by the heat of several hundred young relatively low-mass stars in their early main-sequence hydrogen-core burning. The bright 'binary star' we see in an eyepiece is actually four hot young O and B stars in almost a straight line.

These are the hottest, largest stars in the cluster, and formed very rapidly—just as they will demise fairly rapidly in core-collapse supernovae starting about 3 million years from now. Most of the rest of the Trifid's stars are lower mass than the Sun and will live multiple billions of years before they become white dwarfs. By then the cluster will have long since lost its grip and the Trifid stars will wander the lonely reaches of the Galactic spirals.

The Trifid's properties of a handful of large massive stars amid a legion of much lower mass stars are not typical of traditional collect-and-collapse star clusters that shrink out as brutally cold molecular cloud cores collapse until their density levels reach over a million atoms per cubic cm. That is the trigger density above which they can collapse into stars.

Instead, the Trifid is the progeny of two large, dense molecular hydrogen clouds that collided 4 to 5 million years ago at a grazing angle. The initial shock-compression front of the sideswipe encounter formed three massive O stars within 100,000 years. After the squashed cloud fronts pass through each other the gas pressure subsides. Star formation slows into a million year 'shrink-out' of many modest-sized stars. These ionise the surrounding gas weakly in hydrogen-alpha shell 3 to shell 2 electron transitions.

Watch this ESO/Hubble video cross-fade between the Trifid seen in visual and IR wavebands. The sequence ends with the field moving to a your star-forming region on the outskirts of the main nebula's outskirts, where one of the colliding clouds is now impacting a pocket of nearby dense Galactic gas, producing numerous low-mass protostars still too young and faint to be seen visually. These protostellar cores emit copious X-ray radiation from magnetic fields erupting out of them in polar jets — this is how infant stars 'burp'.

Tarantula Nebula

Captured from Newcastle KZN with a Canon 60Da through a Celestron SE8 OTA on a CGEM.

45 x 2 mins @ ISO 1000 stacked in DSS and additional processing in Light Room and CC 2019.

In star-cluster studies, the term 'conveyor belt' refers to multiple episodes of cluster formation sequenced over a long epoch of a giant molecular cloud's collapse. The Tarantula Nebula is a classic example.

A single star cluster formation episode extends across three phases: cloud collapse, star ignition, and gas clearance. Throughout all of these the interplay of gas composition and density, dust mass and opacity, supersonic turbulence, and magnetic fields all play roles that change over time. A handy rule of thumb is that a single cluster episode is ten to fifty million years long, and a giant molecular filament made of multiple cores can produce a few to a few dozen star clusters of different sizes.

The cycle is complete when the brightest, most massive stars have gone supernova and the last traces of dusty gas are gone. A large cluster-forming region like the Lagoon Nebula or Tarantula Nebula can have a life span comprising many generations.

Star clusters that contain very massive stars profoundly affect their environment. They both mix and disrupt their natal clouds of gas and dust, leaving enduring traces for us to ponder in the composition and patterns of their debris.

Clotty dust threads like those shown here reveal the dense patterns of turbulent shocks that permeate hot, tumultuous star forming regions like the Tarantula Nebula. The twisted mess of multiple loops and filaments give the Tarantula its name.

While high-resolution images show the centre of the nebula to be a large cavity filled with several thousand stars, this image reveals it to be only the most recent star formation episode surrounded by the remnants of earlier episodes going back many 25 million years. Earlier star clusters lie on the near and far sides of the R136 cavity. While R136 is only about two million years old, the star cluster Hodge 301 out on the periphery is 20 to 25 million years old.

M27
Dumbbell Nebula

10 x 2min exposures at ISO 1000 captured with a Canon 60Da through a Celestron SE8 scope on a CGEM.
Further processed in Light Room and CC 2019.

The Dumbbell was the first planetary nebula to be discovered, by Charles Messier in 1764. It was the 27th 'false comet' on his now-famous list. M27 lies in the northerly constellation Vulpecula and rises into prime observing position only during the winter months of June through August.

The Dumbbell got its name from early observers who had only small aperture telescopes. To them the oval nebula we see here more resembled a 2 or 3 kg hand-held dumbbell weight familiar to gym and exercise buffs.

M27's central region is marked by a bright-edged equator with darker diffuse poles. The reddish arcs around the periphery mark incandescent photoionisation fronts where the expanding gas bubble moves at 31 km/sec into the cold dense gas of the Galaxy's spiral arm.

When we observe the Dumbbell visually in a six-inch or larger telescope, it looks only modestly less bright that this image. We can't see the red glow visible in this image because it is too faint for our eyes. We can readily see the central star, which is a notable object in its own right as the largest-diameter white dwarf in the known planetary nebulae.

The ageing red supergiants that end up as planetary nebulae supply the building blocks of future stars, planets, and planet inhabitants. Through their winds, AGB stars contribute about 85% of the gas and 35% of the dust from stellar sources to the galactic interstellar medium. It's been said before: We are full of star stuff.

When the long night of star imaging ends and the sun rises, South Africa turns on it daytime magic to reveal a world no less beautiful.

Sky Candy

Imagine for one moment that everything we know about astronomy
became all the wonders we can't see with our eyes,
a snorkel dive into the cosmic reef,
a whirl on the carousel you dreamed of as a kid,
the most exquisite meal you have ever enjoyed,
dare to dance with a red giant,
a musical score made of galaxies
Imagine if we turned astrophysics into art,
and discovered how big we really aren't in this universe.

Why waste time imagining? Let's Go!

The wonderous muse of astrophysics as art

Video of Herbig-Haro 666 in optical and IR, as seen by the Hubble Telescope

What we see is about one percent of what's really there

For all the glories our eyes reveal to us in this world_—birds, butterflies, seashores, sunsets, the colour of your newborn baby's eyes—it comes as a bit of a shock to learn that we are seeing a mere 1% of the total amount of information that's really there.

The colourful image to the right illustrates a 100 million light-year section of a cosmic filament—a modest warble in the mammoth wall of sound produced by the Symphony of the Cosmic Web. Band #4 on this 9-layer portrait of the secret life of light is what we see when we look up on a dark dark night, or in most of the photographs in books about astronomy illustrated with old black-and-white monochrome pictures taken by the likes of the 200-inch Hale telescope on Mount Palomar or the Yerkes 40-inch refractor telescope in Wisconsin.

The fact that colours have temperatures was discovered by accident by Isaac Newton during his 1665 experiments with a prism. One day he held an old-fashioned mercury thermometer in the sun's spectrum noticed that the warmest temperature was in a a region beyond the red end of the band, where his eyes told him nothing was there. The matter was forgotten for nearly half a century until a number of experimenters starting with William Wollaston and Josef von Fraunhofer revealed bit by bit that light is far more complex and structured than anyone suspected.

Today the combination of instrumentation and computation have devised ways to wheedle out the secrets of light using the structural properties of atoms and the laws of electromagnetic energy. Spectral energy is distributed in a single long continuum of energy starting with barely detectable radio whispers, then rising in energy as the wavelengths shorten, upward past our familiar visual symphony into the blissfully inaudible screaming match in those high-energy ultraviolet, X-ray, and gamma ray bands. For such tiny little short bundles of bite, they pack an enormous set of teeth.

A lucky thing for us that most of the time we can't see or feel those high-energy bands. Ultraviolet is powerful enough to burn skin, X-rays can rip the electrons off atoms, and gamma rays are so powerful they can break atoms into pieces. Humans unshackled a monster when they learned how to use gamma rays to split uranium atoms in two.

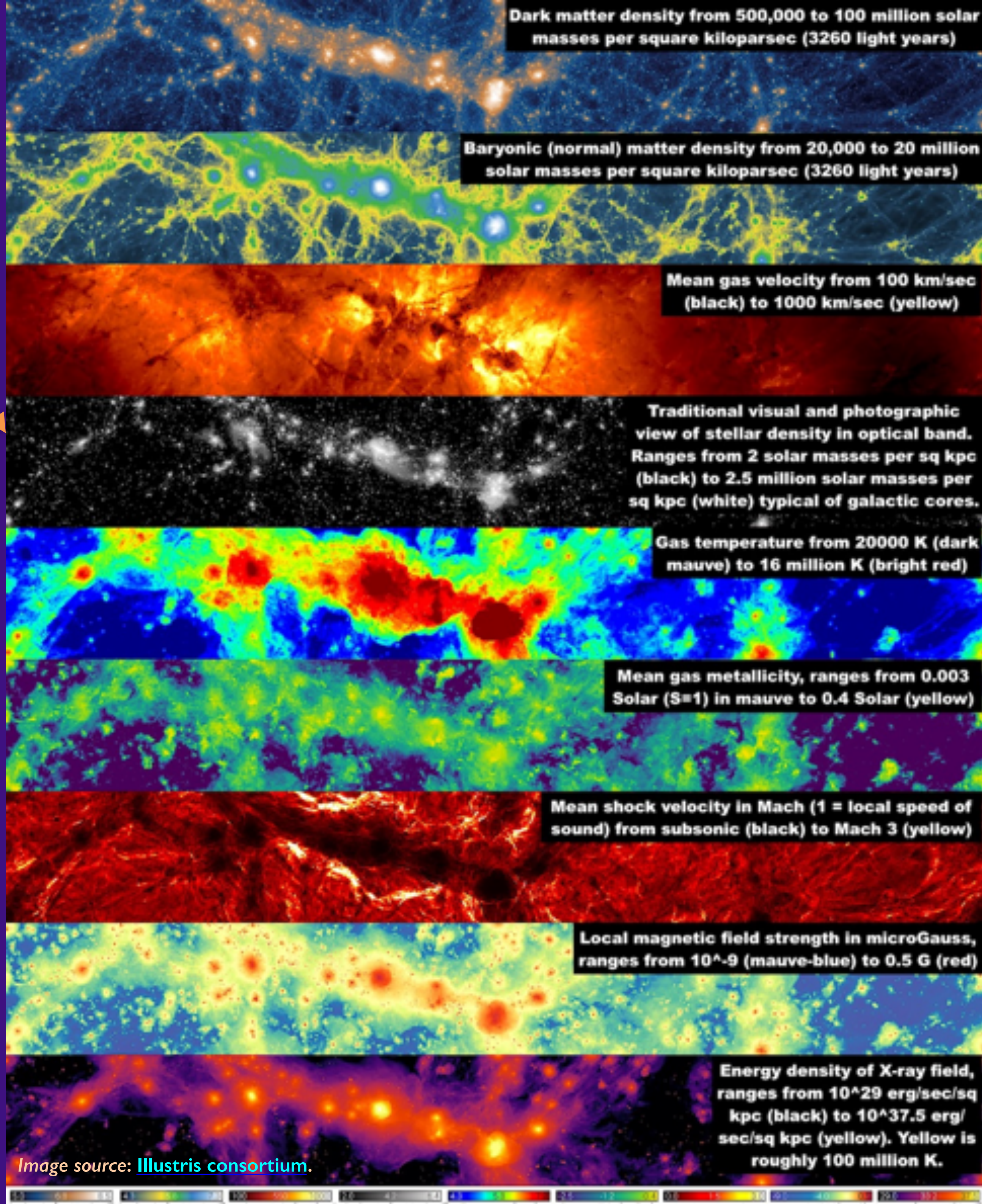


Image source: Illustris consortium.

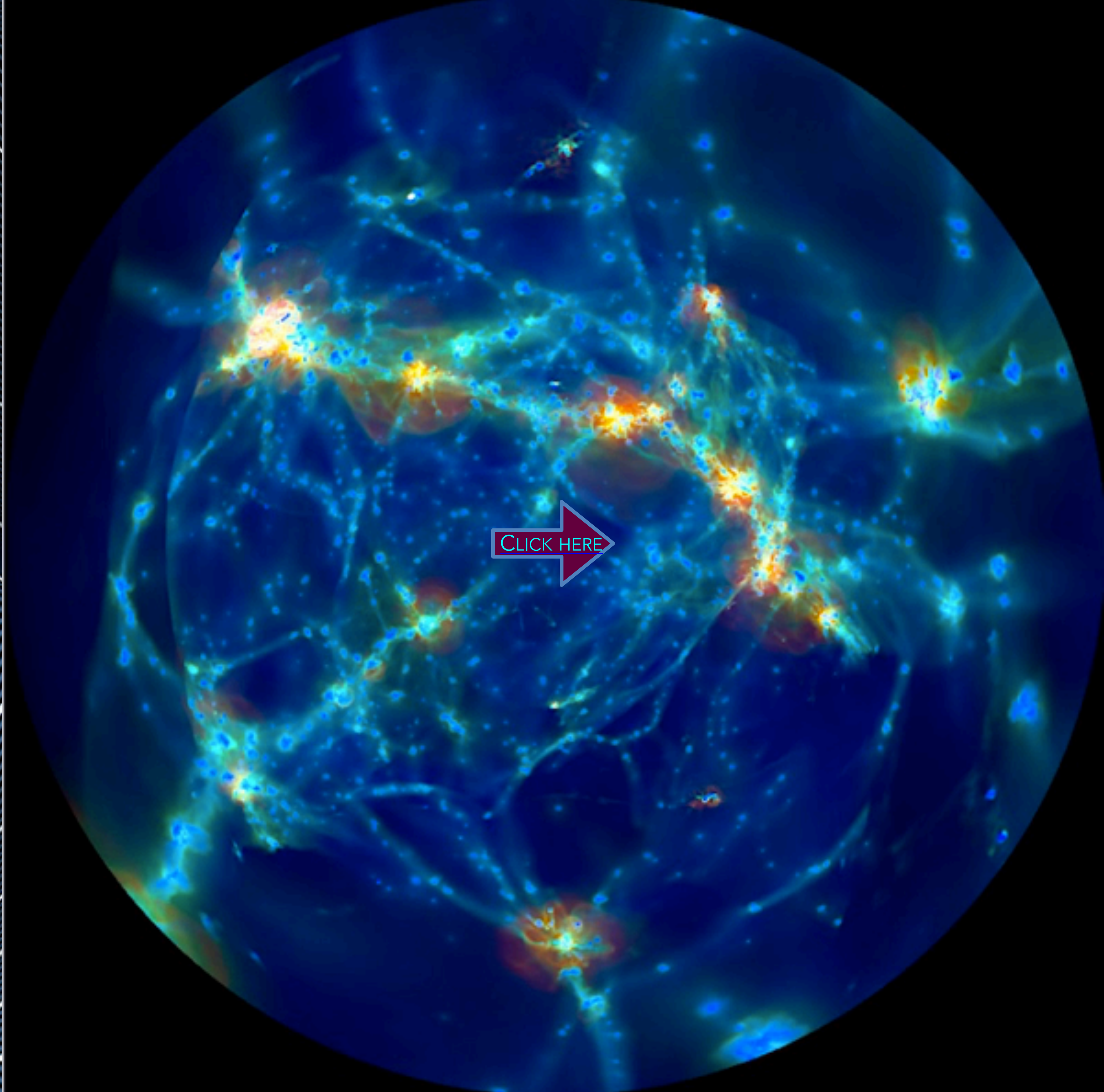
Take a dive into the Cosmic Reef

This spectacular Hubble 3-D virtual-reality video shows two seemingly different objects in the Large Magellanic Cloud, a blue Wolf-Rayed nebula (top right) and the red-yellow star cluster gas-clearing shock front below it. The shapes and colours of these nebulae make them look very different. Indeed, they are. Yet both nebulae result from similar underlying physics: gas ejection via the photon pressure of high-energy UV radiation from adjacent O-type stars. The blue object is NGC 2014, a ring-like annulus of hydrogen and ions surrounding a ~30 solar mass Wolf-Rayet star in a stage of its life cycle in which it hurls away a third of it envelope surface gases as it tries to bring itself into equilibrium between its overburden of formation gas and its high internal pressure. The lower bubble-like emission is NCG 2020, a ring of gas and dust left over after the formation of a massive young star cluster. A cluster that forms O-type stars will experience a heavy load of UV radiation during those stars' lifetimes of four to 10 million years. Only about 1% to 5% of the original formation gas was used during star formation. In small clusters the gas is thinned by the myriad of turbulent shock waves that shiver the timbers of spiral arms, and winds generated by groups of massive stars in the region. Magnetic fields play a key role in bleeding off electrons and ions (mostly hydrogen protons). The end result is a star cluster 'in the clear' glittering beautiful in our eyepieces. The Hubble Telescope animation team turned this into a glorious movie.

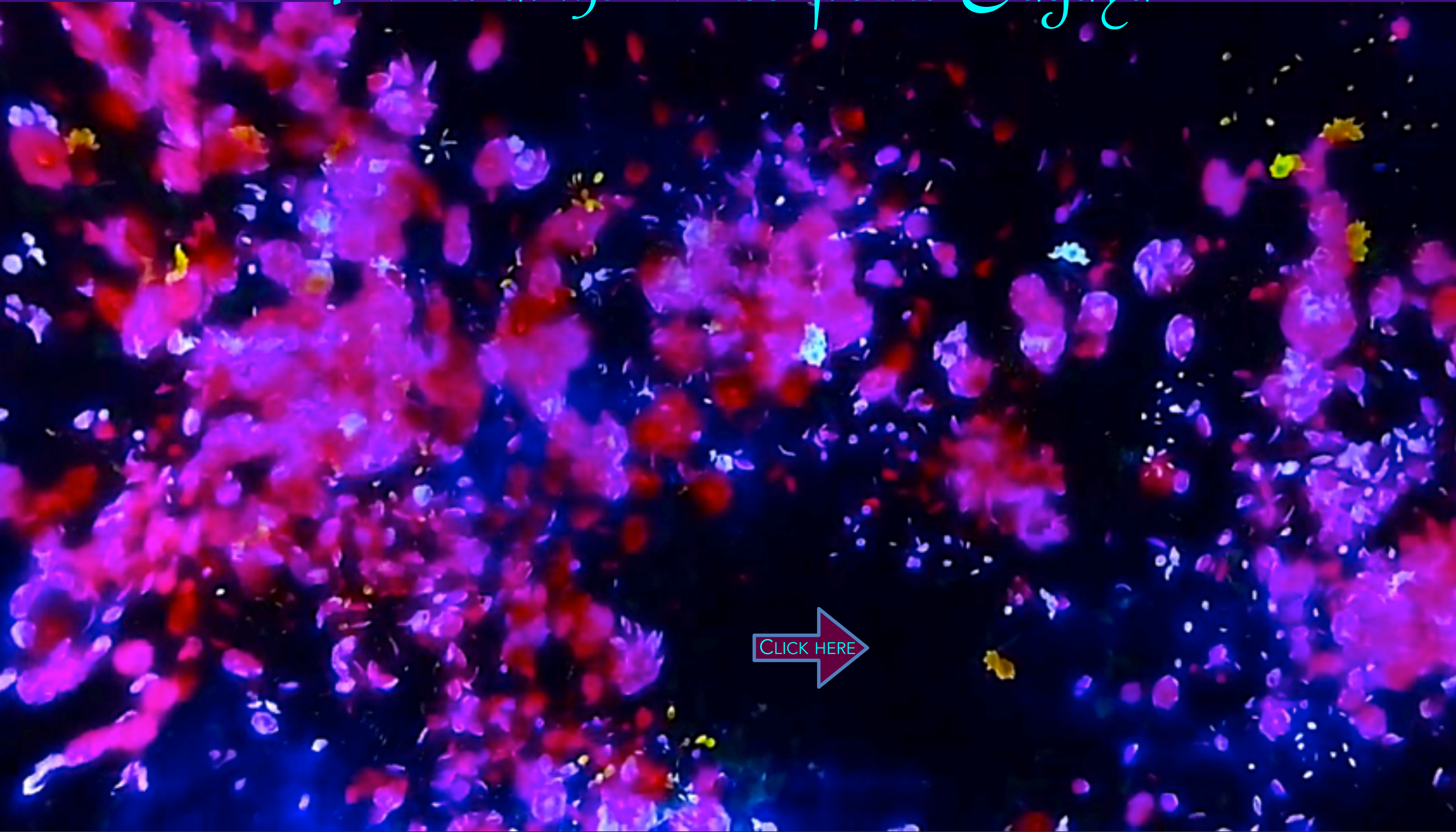
Catch a ride on the cosmic carousel. This computer simulation shows the evolution of the early universe from the lighting-up of the first stars some 13 billion years ago until the hot gases of star and galaxy formation began to cool some 4 billion years ago into the transparent universe we know today. It was made to be shown in a planetarium dome. Hence the unusual rotational effects.

This is one of many such high-resolution simulations of the way the universe works generated on huge supercomputers in Germany by the Illustris Consortium. Illustris started up in 2005 with a theoretical paper about how to write computer algorithms that would accurately portray how the universe would look to us if we had lifetimes as long as the universe itself.

The wave bands adopted in this rotating portrait are ultraviolet, visible light, and infrared, all turned into shades of blue to yellow to indicate relative temperature from brutally cold early space to the hot fulminous explosions that mark the era of galaxy cluster formation. The universe is quiescent for a billion years, but as galaxy groups merge into clusters and then superclusters, explosive episodes of starburst and gas expulsion turn the universe into the writhing, seething streams of galaxy clusters we know today as the Cosmic Web. In reality, these events occurred over such a vast expanse of time that we would spend the entire history of humanity unaware that anything was amiss.



Dinner at the Moonflower Sagaya



art by teamLab Osaka

Dare to dance with a red giant

What does the universe sound like?

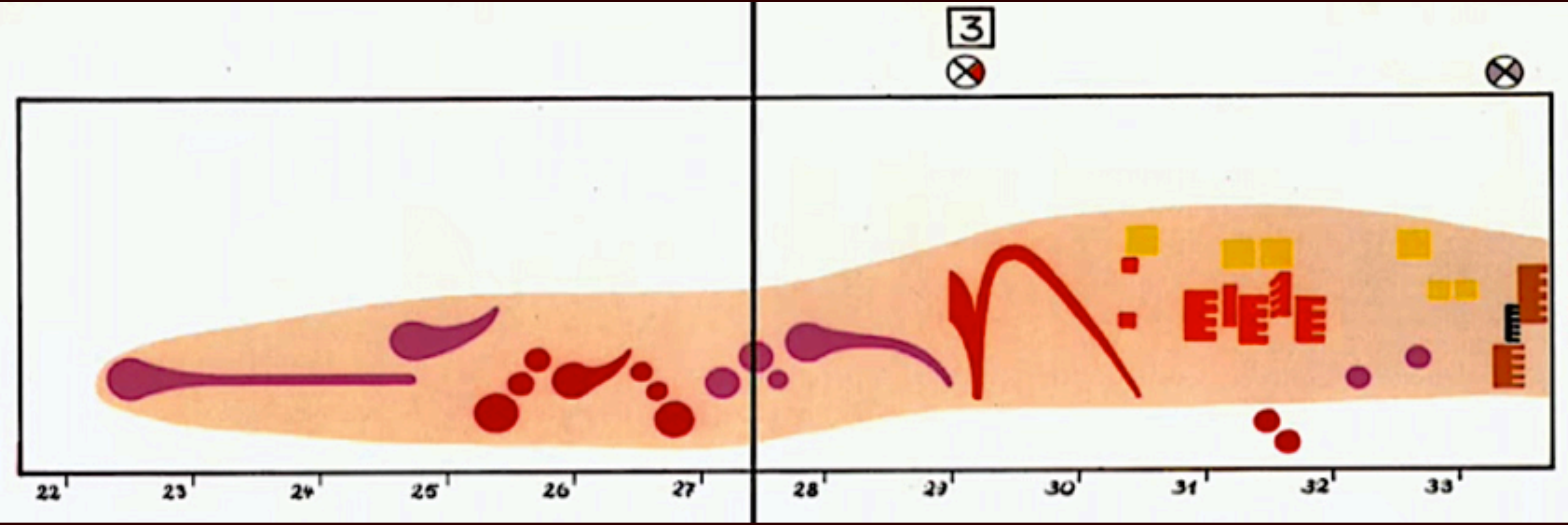
One of the foundation-stone beliefs of the 17th century Enlightenment era was that there is a fundamental law upon which rests all the physical properties of the universe. Find that and you can ride off into the sunset or go fishing forever.

This law was said to be so harmonious that it likened to the harmonies of music. This was the same era that gave us Baroque music and Palladian architecture, neither of which had much tolerance for false notes.

So it's not too surprising that the idea of a Music of the Spheres was as popular among astronomers as it was in aristocratic court circles where today's chamber music settled on its tonal and timbre structures. It's also not surprising that born-&-bred musicians learned keen survival skills by mastering the whims of who was paying them. Bach was of that era (his church had money), as was Johannes Kepler.

Undeterred by this rather prim ancestry, NASA/Hubble sound engineers Matt Russo and Andrew Santaguida found a way to create the sound Kepler never heard (and probably wouldn't have liked). Taking the image of a remote galaxy cluster with the unEnlightenment name RXC J0142.9+443, Russo and Santaguida created this sound portrait based on the brightness and position of the fuzzy galaxies splayed across the spacescape to the right.

Maybe Russo & Santaguida weren't so far-fetched after all

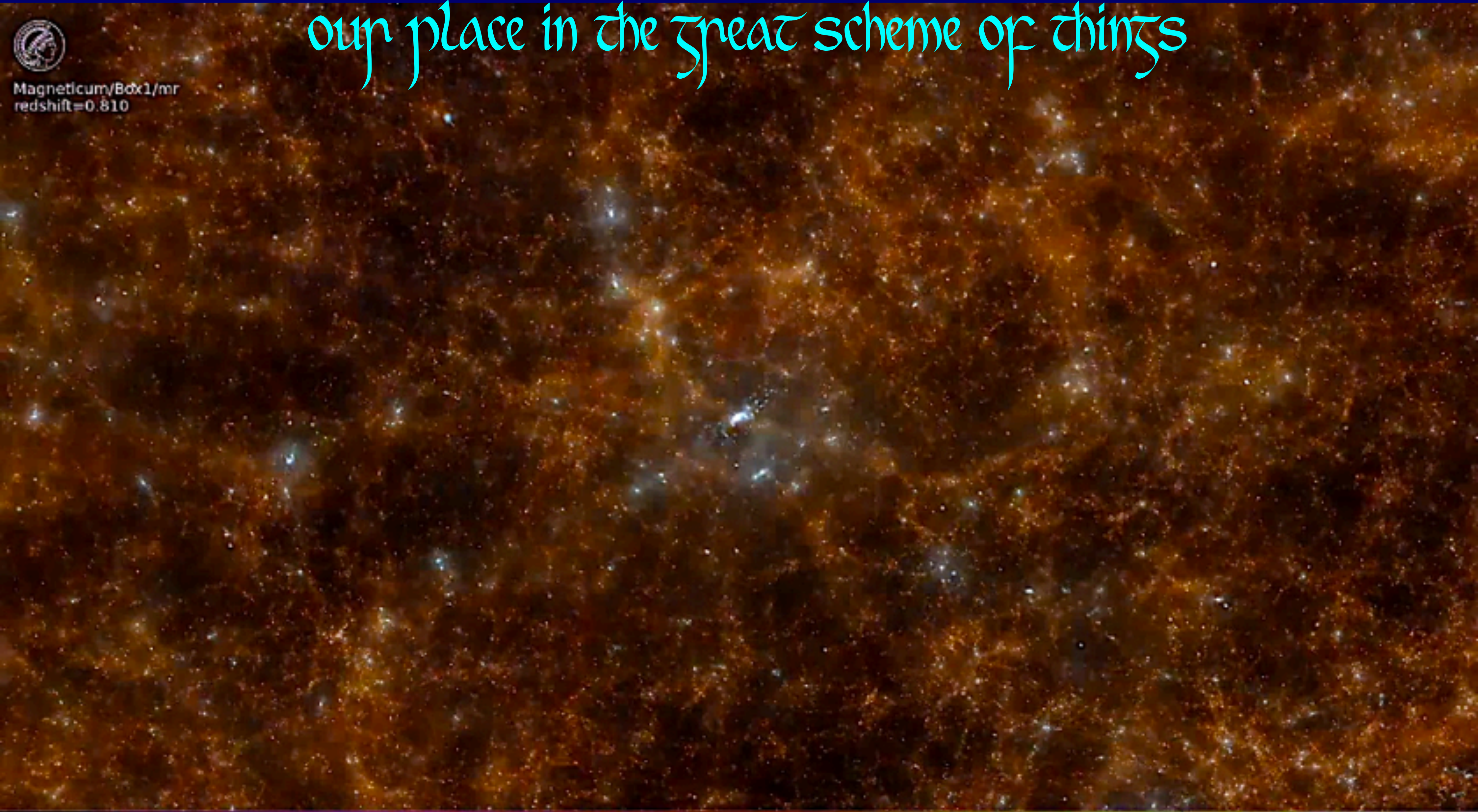


Start here

Imagine if we turned astrophysics into art

START HERE

our place in the great scheme of things



MAGNETICUM PATHFINDER 1.3 GPC ROTATING FRAME FLY-THROUGH.

The rotating image portrays the Cosmic Web at a 1.3 megaparsec size, roughly 2.8% of the 46 Mpc universe. The rotating effect is a visual aid focus to see the structure of the universe at large scale which then zooms in to a galaxy-forming density in the centre. The universe itself does not actually rotate. This simulation displays galaxies as bright dots and the filaments of gas which fills the Cosmic Web as colour-coded to temperature, from cold (brown) to hot (light blue). The ultimate source of the gas in the filament is the emptying-out of colossal voids due to the gravitational attraction of dark and baryonic mass in the galaxies and those ubiquitous filaments. The gas cycle is thus emptying the voids to fill up the galaxies. Those lacy, pretty gas filaments are the cosmic petrol pumps that fuel galaxies. At current star-formation rates the Milky Way would run out of gas in 2.6 billion years. But that gas will substantually, but not be completely, replenished by inflow from the cosmic voids via the petrol hoses of the filaments.

Astronomical Society of Southern Africa

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