

Speaker: Ignacy Sawicki

Venue: The Hall, AIMS research centre

Date: 15 November

Time: 12h00

**Abstract:** The difference between various models of dark energy or modifications of gravity becomes apparent at the level of growth of large-scale structure in the universe. In addition to measuring the background expansion, we are now beginning to probe this aspect. I will discuss a model-ignorant approach to interpreting these observations and show the full set of late-universe observables that we might have in principle in the absence of a theory of dark energy. I will then show how we can construct null tests using these observables which constrain classes of dark-energy models and are uniquely capable of, for example, excluding the general scalar field as a mechanism for acceleration.

### **Astro-coffee**

#### **Title: The Ones in the Middle**

Speaker: Kaustubh Vaghmare (IUCAA)

Date: 26 August

Venue: 1896 Building

Time: 11h00

**Abstract:** The “middle” here refers to the middle of the Hubble tuning fork of galaxy classification, where the S0 galaxies were originally placed. Work done in recent decades has disputed the status of S0 galaxies. I will cite a few examples which will serve the purpose of establishing a motivation to study them in detail. Then, I shall describe my own work based on mid-infrared data from Spitzer.

### **Sky Delights: The Painter’s World**

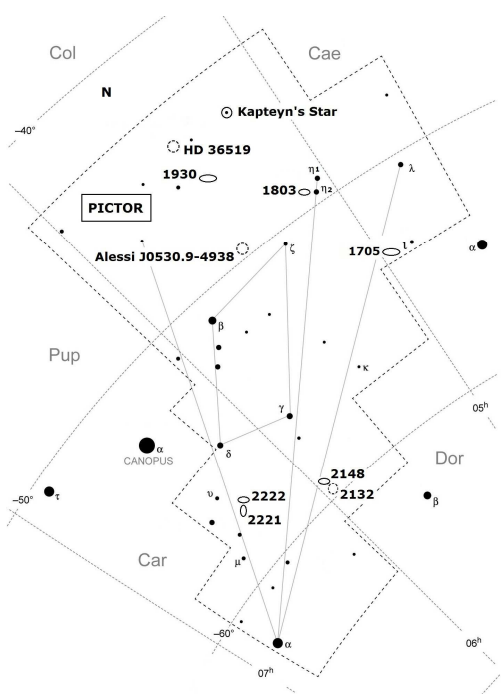
Magda Streicher

The Painter’s Easel is a constellation which Louis de La Caille named Equuleus Pictoris in 1752, simplified to just Pictor by Benjamin Apthorp Gould in 1877. Most of the constellations named by La Caille represent instruments of science or the arts.

Pictor is situated just south of Columba, with Carina to the east and the Large Magellanic Cloud to the south. The French called it The Palette, and in Italian it is known as The Pittore.

But by whichever name one might call it, being able to paint is surely a wonderful gift, and finding a reference to that activity in the name of a constellation is hardly surprising or strange. Just as the painter represents images on a canvas using feeling and colours, so the objects in the night sky leave a lasting impression on the eye and mind.

**Fig 1 Map of the constellation Pictor**



Pictor stretches across 27 degrees, with fairly faint stars making it extremely difficult to draw the constellation's outline with any precision, but this difficulty is abundantly compensated for by the opportunity to study some exceptional objects along the way.

The bright star Canopus in Carina is perhaps the best place to start in an attempt to find this constellation, a few degrees to the west.

Come and explore some of the colourful objects painted on the canvas of the night skies. To group stars into all kinds of shapes stretches and enriches the imagination and mind. One such grouping can be found a mere one degree south of the boundary with Columba. The handful of

stars, clad mostly in a rich-yellow to orange colour, is well outstanding against the background star field. In the middle of the cluster, which is about 18' in extent, we find the most outstanding deep-orange magnitude 7.7 star **HD 3651**, which can also serve as reference. In a way the group can be seen as a half-moon opening up towards the west, with fainter stars nestling inside.

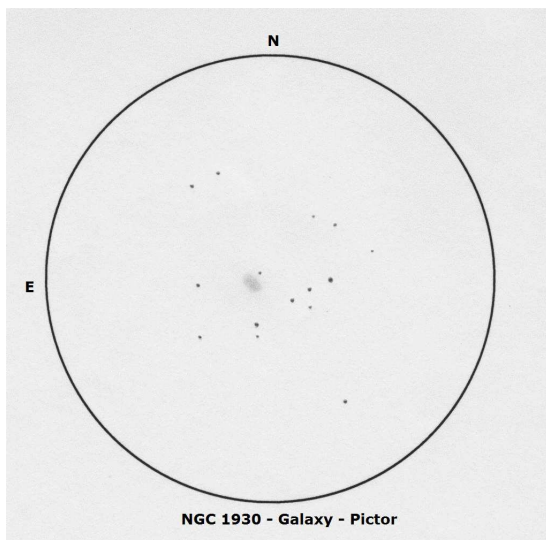
One of the most exceptional stars located within Pictor can be found 3.5 degrees further west. **Hipparcos 24186** is perhaps better known as Kapteyn's Star, a lovely, ruddy-hued type M1 magnitude 8.8 sub-dwarf only 12.8 light years away. The proper motion of 8".7 in a south-eastern direction per year earned it the apt name The Flying Star. A pair of prominent, wide double stars can be seen north of Kapteyn's Star, which should help you spot its position. The Dutch astronomer Jacobus Cornelius Kapteyn was born in Barneveld in the Netherlands on 19 January 1851 and died in 1922. In his late twenties he became professor of astronomy at Groningen, a post he held until retirement at the age of seventy.

**Fig. 2 (right) Jacobus Kapteyn. Painting by Jan Veth (Wikipedia).**



The Isaac Newton Telescope group on the cliffs of the island of La Palma probably sounds like a group of sentinels on the edge of a volcano, but it is, in fact, situated more towards the middle and eastern part of the island. At the southern end lies the volcano Cumbre Vieja, whose western flanks may someday collapse into the Atlantic, triggering a mega-tsunami. However, part of the group of telescopes is the 1-metre-mirror Jacobus Kapteyn Telescope, the naming of which was such a wonderful gesture to this special man.

The galaxy **NGC 1930**, situated another 2.7 degrees further south from Kapteyn's Star, is a somewhat faint object. A few magnitude 11 stars situated towards the west of the galaxy easily point the way. Although this star city is faint, the small bright nucleus is what first catches the eye. Closer investigation reveals the core surrounded by a roundish halo. The author's notes indicate a small round piece of haze towards the south-western side, but she is not quite sure of that and of what it is. Larger scopes will be needed for a proper investigation and some feedback would be much appreciated.



**Fig. 3. The galaxy NGC 1930 in Pictor.**

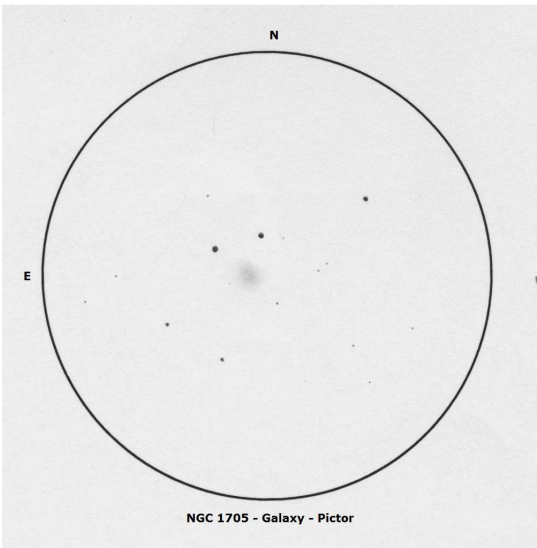
The outstanding double star eta Pictoris is situated in the far western part of the constellation – two beautiful magnitude 5 stars dressed up in rich yellow and orange colours. What makes the orange-coloured eta 2 Pictoris and the field of view special is the galaxy **NGC 1803** situated only 4.5' towards the east of the star. The object is pretty faint and quite a challenge to see, but take up the challenge! Use high magnification and move eta 2 Pictoris to just outside the eyepiece field, use averted

vision and concentrate. Closer investigation shows the galaxy as a soft haze just slightly brighter towards the middle.

About 2 degrees east of NGC 1803 there is a grouping that is not particularly substantial, but nevertheless worth a visit. **ALESSI J0530.9-4938** is known as an asterism consisting of three magnitude 9 stars slightly more outstanding in a line from north to south. Three more stars towards the western field of view complete a sort of half-moon appearance opening towards the south as seen in a wider field of view. It is categorized as a “Milky Way Field”.

Move across to the eastern part of the constellation to pin-point beta Pictoris. An intensive study around the magnitude 3.8 white-coloured type A3 star, 63 light years away, is being undertaken of late. An object with a radius 2–3 times that of Jupiter was found as it occulted beta Pictoris. A team led by Anne-Marie Lagrange (Grenoble Observatory, France) announced a possible planet orbiting the youth star beta Pictoris’s dust disk, at a projected distance of only 8 a.u., putting it comfortably within the realm of the giant planets as in our solar system.

The lovely double star iota Pictoris is situated in the far western part of the constellation, which could be seen as representing the steady stay of the painter’s drawing board, barely 30’ west of the galaxy **NGC 1705**. The two members of this attractive pair are very similar in appearance, with a 5.6 magnitude primary displaying a yellow-white colour and the 6.4 magnitude secondary appearing to be slightly yellow-grey and, therefore, darker in shade. The separation is 12.3”, which is quite easy to split in amateur telescopes. However, the galaxy gives a very soft oval impression in the company of two magnitude 11 field stars. From a hazy edge it rises slowly to a brighter middle part.



**Fig. 4. The galaxy NGC1705 in Pictor**

More towards the central eastern part of Pictor we find a special pair of galaxies forming an imaginary triangle of 1.5 degrees to the west with magnitude 5.8 nu Pictoris and magnitude 5.6 mu Pictoris. This is the nearly identical twin system **NGC 2221** and **NGC 2222** – I cannot think of them in any other terms: two very faint dust flecks, the one just like the other. If you have not been able to spot them, don’t be concerned – this is a very difficult pair of galaxies to glimpse even with bigger amateur telescopes. Although it’s a challenge,

I spotted these two with averted vision from my very dark observation site. Higher

magnification and care are needed to reveal that both grow a little brighter towards the middle area. The direction of NGC 2221 is north to south and seems to be slightly slimmer. A few very faint stars can be glimpsed around the immediate field of view. The northern companion galaxy NGC 2222 is slightly tilted in a north-west to south-east direction barely 1.5' towards the north of NGC 2221. In the west, between the two galaxies, a visible double star forms a triangle with the two galaxies. I have not dared to suggest searching for the very faint galaxy PGC 18839, which has a magnitude of just 15, just 2.5' further north, but if the opportunity arises, go for it.

Two objects, **NGC 2148**, a galaxy, and **NGC 2132**, a star cluster, can be found within a one-degree area about 3 degrees west of the Pictoris twin galaxies. NGC 2148 is no brighter than the above-mentioned two galaxies and displays only an extremely faint, roundish glow. The star cluster NGC 2132, about 52' south-west, comprises only a few stars, of various magnitudes, that are slightly more outstanding against the background star field. What is however, more notable, is the fact that the stars vary from yellow to deep orange in colour. Closer investigation reveals many fainter stars accompanying this group of stars. But this group of stars is a surprise package. Its southern member, HD 40307, which is situated only 42 light years away, has been studied in detail lately and has been found to house a few super-Earths orbiting the orange dwarf star. The exoplanet-hunting HARPS spectrograph in Chile discovered that HD 4037g lies in the system's habitable zone with a mass of that of between 4 and 10 Earths. The exoplanet's orbital period is 198 days, meaning HD 4037g receives about 62% of the heat Earth receives from the Sun (John Bochanski).



**Fig. 5. NGC2221 and NGC2222, a pair of galaxies in Pictor**

In the normal course of events the heavens may sometimes come across as uninteresting when one merely glances at them, just in passing, as it were – but the

next time you decide to wander around outside under the starry skies, take a telescope along and observe the deep-sky objects through different eyes – it will definitely colour your perspective on some of these objects.

OBJECT	TYPE	RA	DEC	MAG	SIZE
NGC 1704	Galaxy	04h54m.2	-53°22'.2	11.8	1.8'x1.4'
NGC 1803	Galaxy	05h05m.5	-49°34'.5	13.4	1.3'x0.8'
Hipparcos 24186 Kapteyn's Star	Star	05h11m.8	-45°02'.4	8.8	*
NGC 1930	Galaxy	05h25m.9	-46°44'.5	12.5	1.9'x1.2'
HD 36519 Star Group	Asterism	05h29m.8	-43°38'.7	8	16'
ALESSI J0530.9-4938	Asterism	05h30m.8	-49°38'.8	9.5	12'
NGC 2132	Open Cluster	05h54m.5	-59°50'.8	8	25'
NGC 2148	Galaxy	05h58m.7	-59°07'.6	14	1.1'x0.8'
NGC 2221	Galaxy	06h20m.3	-57°34'.8	13.6	2.0'x0.5'
NGC 2222	Galaxy	06h20m.4	-57°32'.2	13.9	1.5'x0.3'

## Stop Press – Nova Centaurus 2013!

On Monday, December 02, Australian amateur astronomer John Seach (Chatsworth Island, NSW) discovered a nova in Centaurus, not far from beta Centauri.

A nova is a massive nuclear explosion on a dying star. These stars - white dwarves - are the final evolutionary stage of Sun-like stars. A typical white dwarf has a mass similar to the Sun but its size is similar to the Earth: a teaspoonful weighs a ton. The nearest known white dwarf is Sirius B.

About 40 stars go nova each year in our Milky Way, but only about 10 of these are actually observed. Once a nova is observed, a light curve can be compiled, and based on the curve, it is classified as either a fast, slow, very slow, or recurrent nova. A fast nova drops by 3 magnitudes from maximum within 100 days, while it takes 150 days or more for a slow nova to dim by the same 3 magnitudes. Very slow novae remain at maximum light for a decade or more! Recurrent novae have at least two observed outbursts, separated by decades.