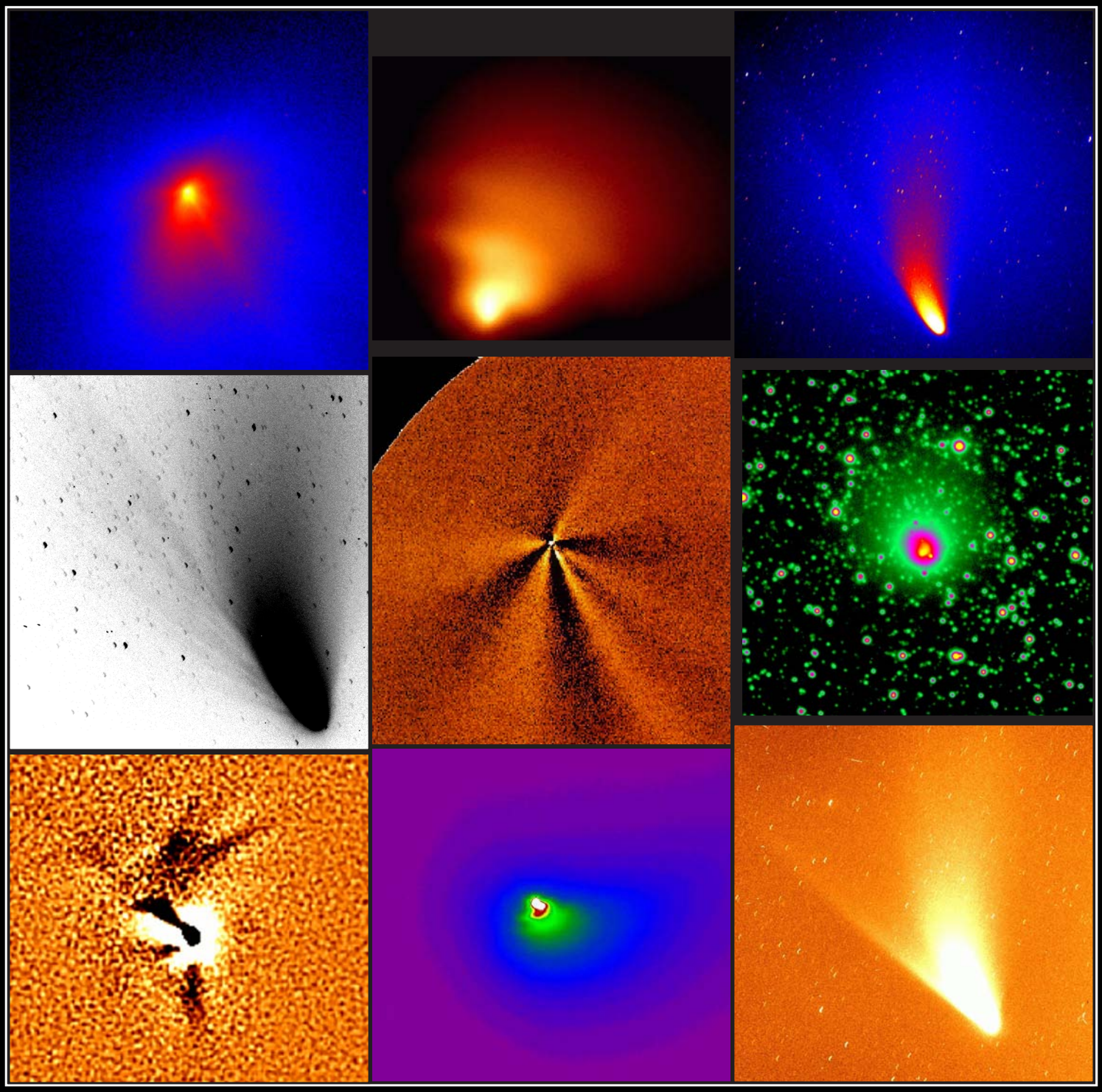
Comet Hale-Bopp

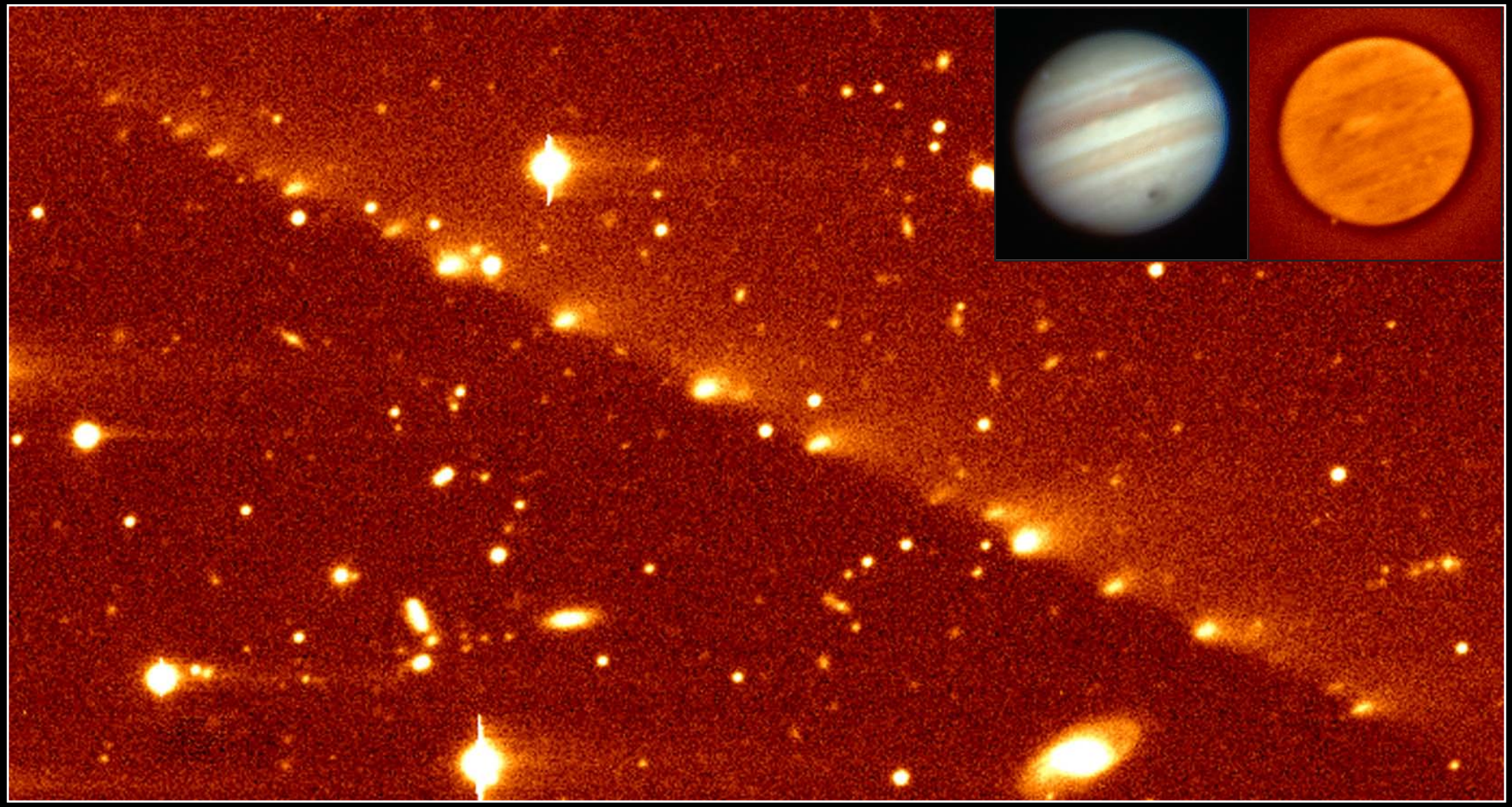


Comets are icy bodies orbiting in the Solar System, which partially vaporize when it nears the Sun, developing a diffuse envelope of dust and gas and, normally, one or more tails. Ground-based observations of the behaviour of many comets support the view first proposed by F. Whipple in about 1949 that the nuclei of comets are essentially *dirty snowballs* a few kilometres across. They appear to be composed of frozen water, carbon dioxide, methane and ammonia, in which dust and rocky material is embedded. As a comet approaches the Sun, solar heating starts to vaporize the ices, releasing gas that forms a diffuse luminous sphere, called the coma, around the nucleus. The coma may be up to a million kilometres across. The nucleus itself is too small to be observed directly. Dust and gas leave the comet's nucleus in the form of jets on the side facing the Sun, then stream away under the Sun's influence. Electrically charged ionized atoms are swept away directly by the magnetic field of the solar wind, forming straight ion tails (alternatively called Type I, plasma or gas tails). Variations in the solar wind cause the ion tail to take on structure, or even break off in a disconnection event. Small neutral dust particles are not carried along by the solar wind but get 'blown' gently away from the Sun by radiation pressure. Dust tails (also called Type II tails) are often broad and flat. The tail grows as a comet approaches the Sun and are always directed away from the Sun: they can be as much as a hundred million kilometres long. Large dust particles become strewn along the comet's orbit and form meteor streams. Shown here are images taken using the ING telescopes. The morphological features explained above are clearly visible.

Credit: The European Comet Hale-Bopp Team.

1995 - 1997

Comet Shoemaker-Levy 9

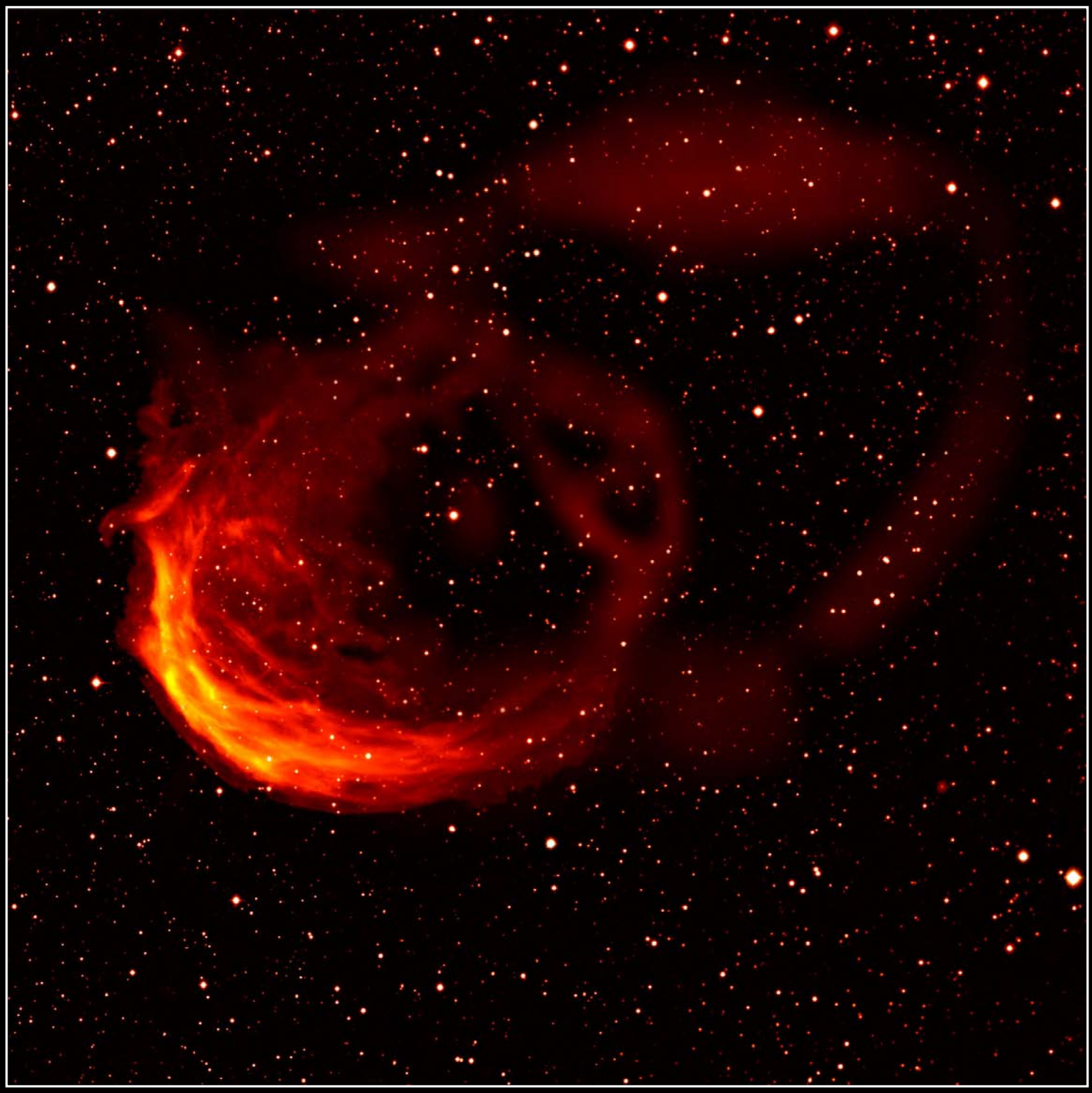


On 1994 July 16-22, over twenty fragments of comet Shoemaker-Levy 9 collided with the planet Jupiter. The comet, discovered the previous year by astronomers Carolyn and Eugene Shoemaker and David Levy, was observed by astronomers at hundreds of observatories around the world as it crashed into Jupiter's southern hemisphere. Images obtained from the 1-m Jacobus Kapteyn Telescope clearly showed the ejecta plume of debris rising over the planet's limb from the impact site of fragments L and G (inset pictures). At the same time the 2.5-m Isaac Newton Telescope was used to observe spectroscopic emission from the vaporised comet, revealing some of its constituent elements. Images shown here were taken using the JKT.

Credit: Alan Fitzsimmons (Queen's University of Belfast).

1994

Sharpless 2-188 Planetary Nebula



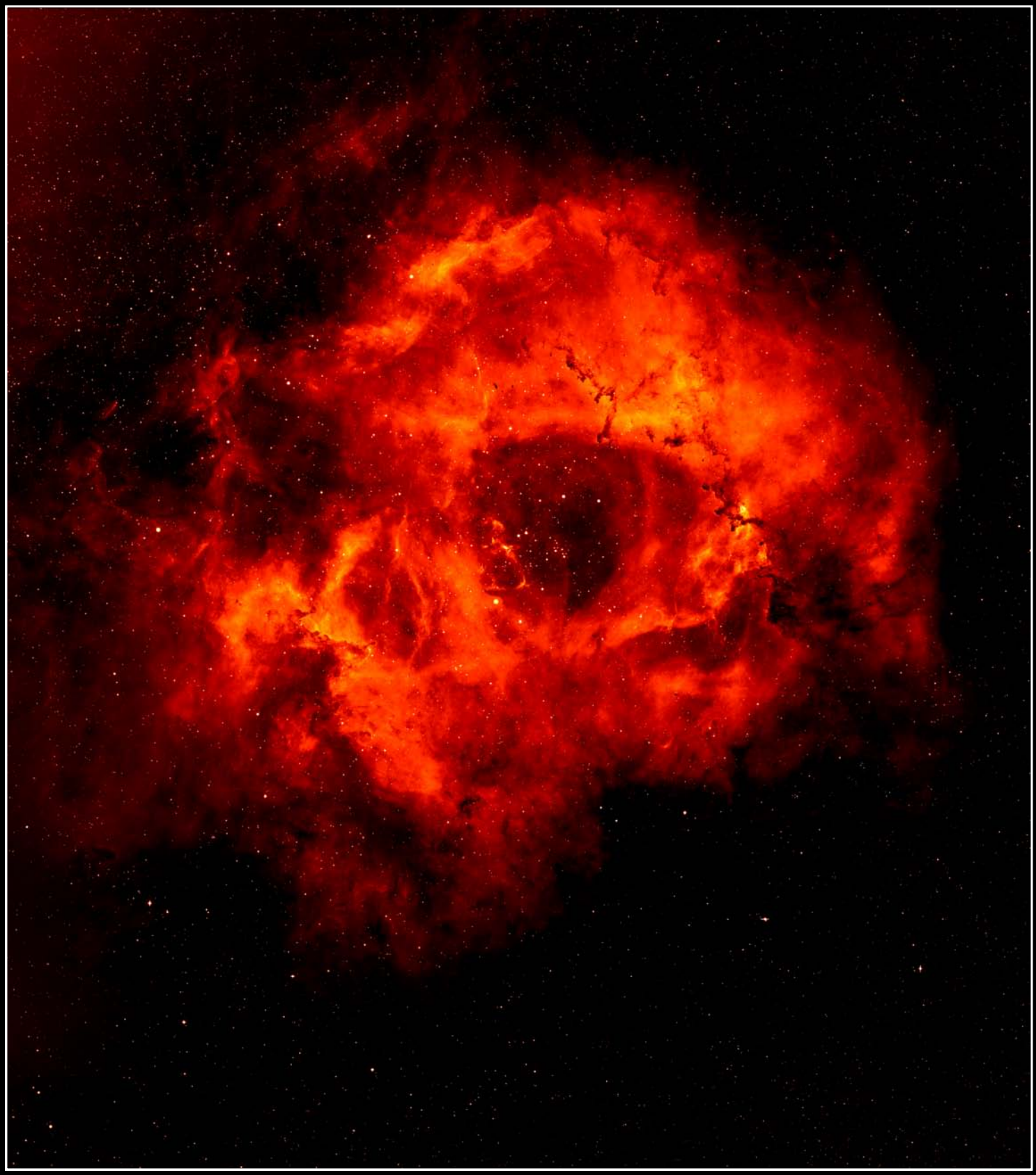
Isaac Newton Telescope + WFC

The central star of Sharpless 2-188 is 850 light years away and it is travelling at 125 kilometres per second across the sky. Observations show a strong brightening in the direction in which the star is moving and faint material stretching away in the opposite direction. The astronomers believe that the bright structures in the arc observed ahead of Sharpless 2-188 are the bowshock instabilities revealed in the simulations, which will form whirlpools as they spiral past the star downstream to the tail. This image was obtained as part of the INT/WFC Photometric Hydrogen-Alpha Survey of the Northern Galactic Plane (IPHAS).

Credit: Nick Wright and the IPHAS collaboration.

2007

Rosette Nebula



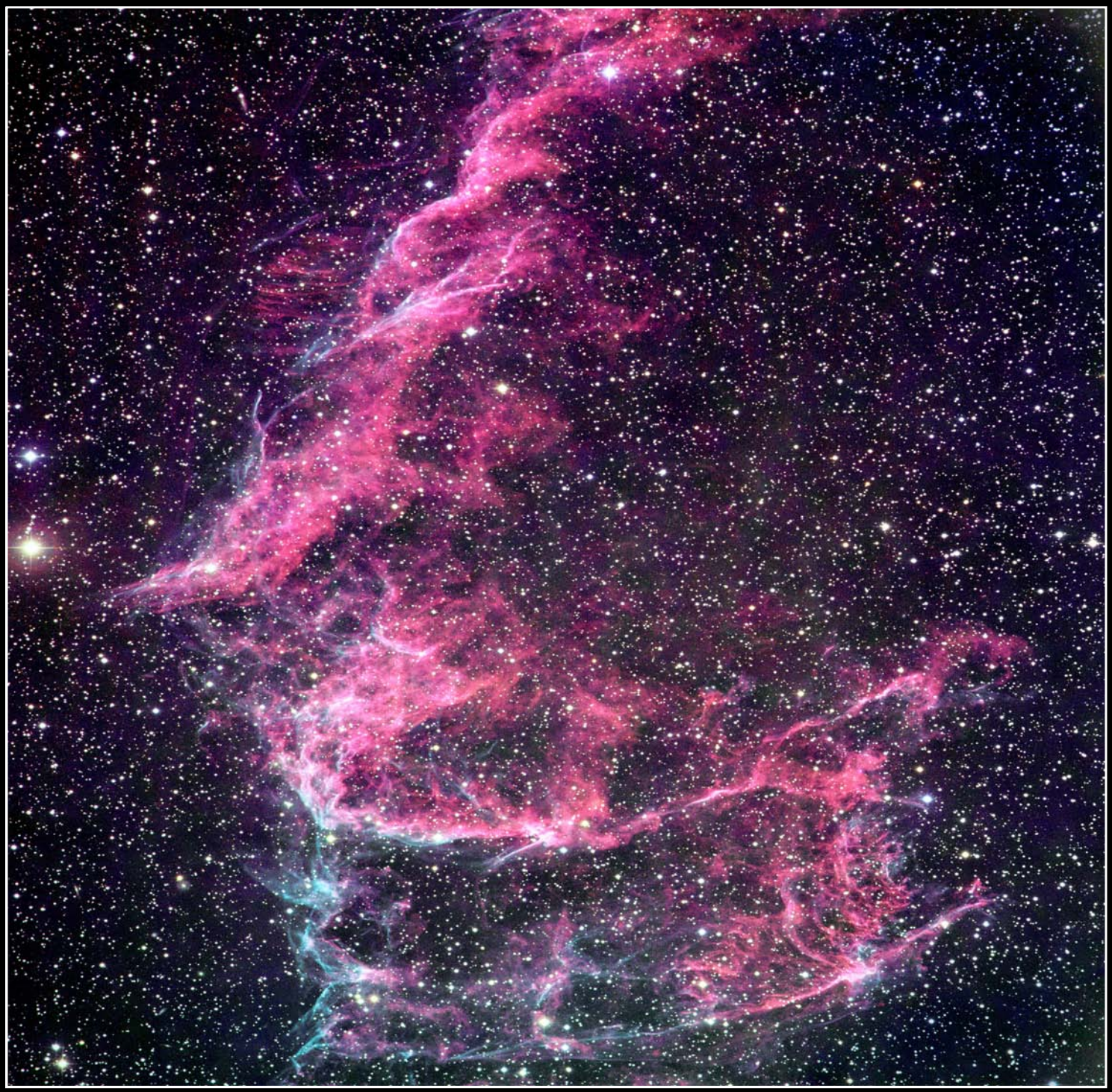
Isaac Newton Telescope + WFC

This image of the Rosette Nebula (NGC 2237) is thought to be the most-detailed ever produced. Compiled from data taken from IPHAS, the Isaac Newton Telescope Photometric Hydrogen-Alpha Survey of the Northern Galactic Plane, the image spans four square degrees, about twenty times the size of the full moon. Resolution is 1 arcsecond per pixel, and North is up, East is left.

Credit: Nick Wright and the IPHAS collaboration.

2007

NGC 6995, a supernova remnant



Isaac Newton Telescope + Photographic Prime Focus Camera

A supernova remnant is the expanding shell of material created by the ejection of the outer layers of a star that explodes as a supernova. A shock wave precedes the ejected shell, colliding with and heating the interstellar gas. The ejected material breaks up into clumps, so the radiation emitted from the shell often does not make up a uniform ring. NGC 6995, part of the Cygnus Loop is the remnant of a type II supernova. For a few days the supernova emitted as much energy as a whole galaxy. When it was all over, a large fraction of the star was blown into space, as shown on this picture. Remnants are typically at most few light-years across.

Photograph by David Malin (AAO).

1992

NGC 6914 and a group of reflection nebulae

Isaac Newton Telescope + Photographic Prime Focus Camera

Reflection nebulae are clouds of dust which are simply reflecting the light of a nearby star or stars. Reflection nebulae are also usually sites of star formation. They are blue because the scattering is more efficient for blue light. Reflection nebulae and emission nebulae are often seen together and are sometimes both referred to as diffuse nebulae. Show here is NGC 6914 and a group of reflection nebulae. This picture was produced by combining images taken separately in red, green and blue light. This complex process was necessary because colour films are not sensitive enough to record very faint objects. This photograph is therefore an accurate reflection of the colours of the universe, much as the eye might see them if it could be made a million times more sensitive.

Photograph by David Malin (AAO).

1992

The Orion Nebula

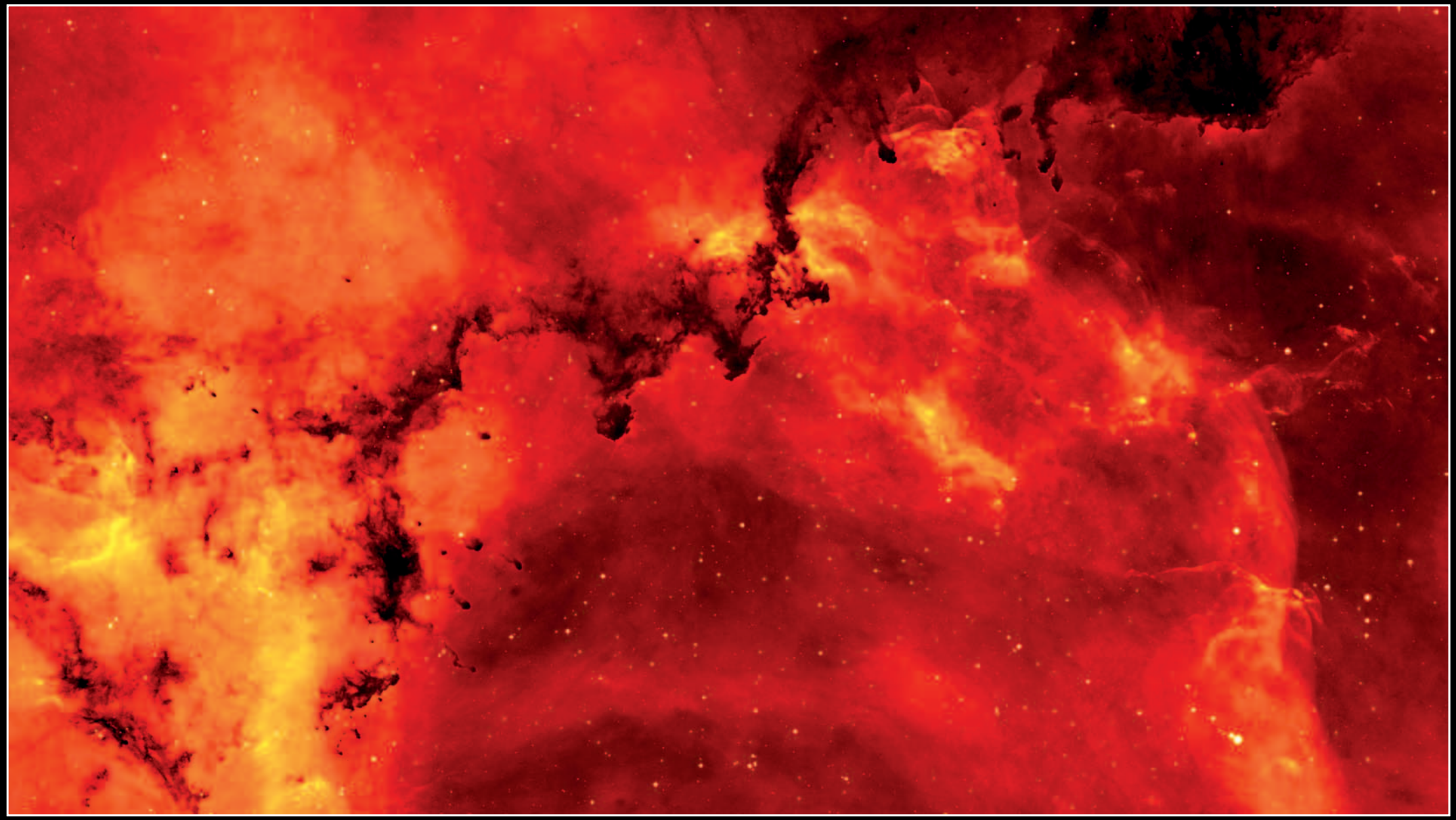
William Herschel Telescope + 2 CCD Mosaic Prime Focus Camera

Emission nebulae are clouds of high temperature gas. The atoms in the cloud are energized by ultraviolet light from a nearby star and emit radiation as they fall back into lower energy states (in much the same way as a neon light). These nebulae are usually red because the predominant emission line of hydrogen happens to be red (other colours are produced by other atoms, but hydrogen is by far the most abundant). Emission nebulae are usually the sites of recent and ongoing star formation. Shown here it is the star-formation region M42, also known as the *Orion nebula*. Located at a distance of about 1,600 light years, the Orion nebula is the brightest diffuse nebula in the sky, visible to the naked eye. It is the main part of a much larger cloud of gas and dust which extends over 10 degrees well over half the constellation Orion. This image is a 10 second “true-colour” composition using filters B, V, and R on the WHT 2 CCD mosaic prime focus camera.

Credit: Simon Tulloch (ING) and Nik Szymanek (SPA).

1999

Dust Lanes in Rosette Nebula



Isaac Newton Telescope + WFC

Dust lanes in the centre of the Rosette Nebula or NGC 2237. Field of view is 30×20 arcmin, North to the left and East is down.

Credit: Nick Wright and the IPHAS collaboration.

2005

M92 Star Cluster

Jacobus Kapteyn Telescope + CCD

Messier 92 globular star cluster is a splendid object, visible to the naked eye under very good conditions and a showpiece for every optics. Its 11.2 arcminute angular extension corresponds to a true diameter of 85 light years, and may have a mass of up to 330,000 suns. This image was achieved by combining 100-s exposures in B, V and R filters obtained with a CCD detector at the Cassegrain focus of the Jacobus Kapteyn Telescope.

Credit: Daniel Bramich and Nik Szymanek.

2001

Mairan's Nebula

Isaac Newton Telescope + WFC

M43 is actually a part of the Great Orion Nebula, M42, which is separated from the main nebula by an impressive, turbulent dark lane. First discovered in 1731 by Jean-Jacques Dortous de Mairan, M43 is occasionally known as de Mairan's Nebula. The image shown here is a 300-second exposure in Hα combined with colour information from an amateur CCD image.

Credit: Nik Szymanek and Simon Tulloch.

2002

M13 Globular Cluster

Jacobus Kapteyn Telescope + CCD Camera

The globular cluster M13, also called the ‘Great Globular Cluster in Hercules’, is one of the most prominent and best known globular star clusters of the Northern celestial hemisphere. It was selected in 1974 as target for one of the first radio messages addressed to possible extra-terrestrial intelligent races, and sent by the big radio telescope of the Arecibo Observatory. This “true-colour” CCD image was taken using the Jacobus Kapteyn telescope and a CCD detector.

Credit: Simon Tulloch (ING).

1999

The Dumbell Nebula

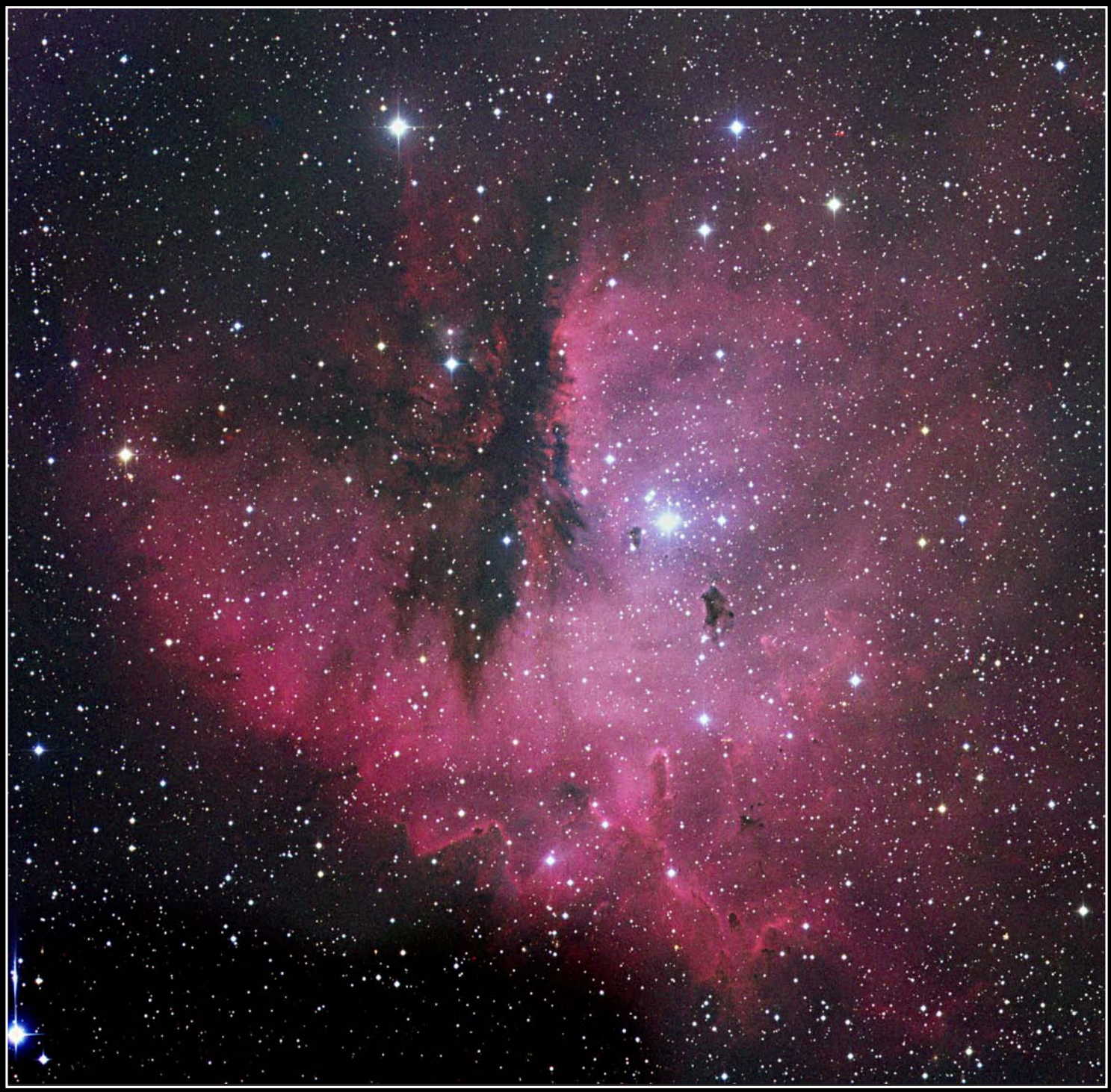
Isaac Newton Telescope + Photographic Prime Focus Camera

Planetary nebulae are shells of gas thrown out by some stars near the end of their lives. Our Sun will probably produce a planetary nebula in about 5 thousand million years. They have nothing at all to do with planets; the terminology was invented because they often look a little like planets in small telescopes. Planetary nebulae are formed in the process of mass loss during which red giant stars ultimately become white dwarfs. The nebula shown here is the Dumbell Nebula (also called M27 or NGC 6853). It was the first planetary nebula ever discovered. We happen to see this one approximately from its equatorial plane; from near one pole, it would probably have the shape of a ring.

Photograph by David Malin (AAO).

1992

NGC 281 and IC 1590



Isaac Newton Telescope + Photographic Prime Focus Camera

Dark nebulae are clouds of dust which are simply blocking the light from whatever is behind. They are physically very similar to reflection nebulae; they look different only because of the geometry of the light source, the cloud and the Earth. Dark nebulae are often seen in conjunction with reflection and emission nebulae. Show here are NGC 281 and IC 1590. NGC 281 is a busy workshop of star formation. Prominent features include a small open cluster of stars, a diffuse red-glowing emission nebula, large lanes of obscuring gas and dust, and dense knots of dust and gas in which stars may still be forming. This image is the result of combining 30 minute photographs taken at the INT prime focus in 3 different filters matching the standard B,V,R system.

Photograph by David Malin (AAO).

1992

The Bubble Nebula

Isaac Newton Telescope + Photographic Prime Focus Camera

NGC 7635, the Bubble nebula. A massive star that is not only bright and blue, but also emitting a fast stellar wind of ionized gas, created this huge space bubble. The Bubble nebula is actually the smallest of three bubbles surrounding massive star BD+602522, and part of gigantic bubble network S162 created with the help of other massive stars. As fast moving gas expands off BD+602522, it pushes surrounding sparse gas into a shell. The energetic starlight then ionizes the shell, causing it to glow. The Bubble nebula is about 10 light-years across and visible with a small telescope towards the constellation of Cassiopeia.

Photograph by David Malin (AAO).

1992

A New Planetary Nebula

Isaac Newton Telescope + WFC

This image is a new planetary nebula discovered by the INT/WFC Photometric Hydrogen-Alpha Survey of the Northern Galactic Plane (IPHAS). It is a two-colour image, red for Hα and green for [OIII]. North is to the right and East is to the top. The nebula was confirmed to be a relatively old planetary nebula using the ISIS spectrograph on the William Herschel Telescope.

Credit: Laurence Sabin, Nick Wright and the IPHAS collaboration.

2006

IC1396B Nebula

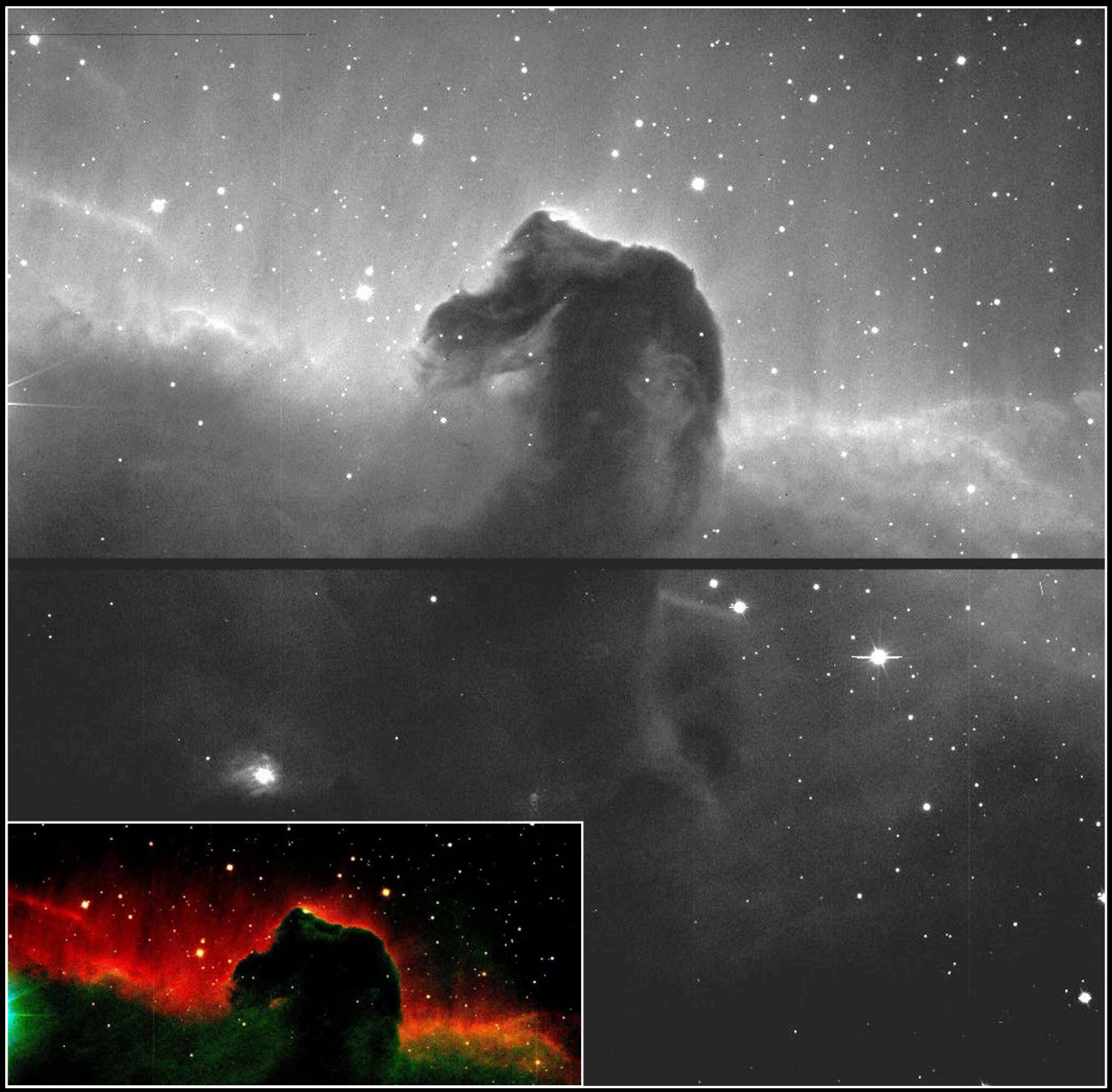
Isaac Newton Telescope + WFC

Part of the nebula IC 1396B in the constellation Cepheus imaged in the red light from hydrogen atoms. The image scale here is roughly 15 × 15 square arcminutes, with North to the left and East down. This image was obtained as part of the INT/WFC Photometric Hydrogen-Alpha Survey of the Northern Galactic Plane (IPHAS).

Credit: Nick Wright and the IPHAS collaboration.

2005

The Horse Head Nebula



William Herschel Telescope + 2 CCD Mosaic Prime Focus Camera

The Horse Head Nebula. This dark dust nebula, in the shape of a horse's head, protrudes into a bright emission nebula, IC 434, in the constellation Orion. A nearby naked-eye star illuminates the surface of an otherwise invisible dusty cloud, exciting the distinctive red emission from hydrogen (inset picture). From this dark cloud projects yet more dust, which has the shape of the head of a horse, seen in silhouette against the glowing background. Shown here is a 10 second integration in grey-scale obtained using the 2 CCD mosaic camera at the WHT prime focus.

Credit: Simon Tulloch (ING) and Nik Szymanek (SPA).

1999

The Blackeye Galaxy

Jacobus Kapteyn Telescope + CCD

NGC 4826 (Messier 64), the Blackeye Galaxy. This galaxy is located some 16 million light years from Earth, and is a spiral galaxy similar to the Milky Way and the Andromeda Galaxy. This type of galaxy comprises a central elliptical core surrounded by a ring of spiral arms. The Sa sub-category of this type of galaxy comprises the tightest spiral, with the Sb and Sc types progressively exhibiting more loosely coiled arms.

Credit: ING Archive and Nik Szymanek.

1995

M101 Galaxy

Isaac Newton Telescope + WFC

This is the nearby Sc spiral NGC 5457 or Messier 101, in Ursa Major. It has several extremely luminous star-forming (HII) regions in the outer spiral arms, some sporting their own NGC numbers. It dominates a small group of galaxies, with some of its neighbours such as NGC 5474 showing wear and tear attributed to the tidal effects of M101. M101 itself is further noteworthy for its extensive and lopsided distribution of neutral hydrogen gas, and for showing evidence of gas falling into its disk at high speeds.

Credit: Peter Bunclark and Nik Szymanek.

1998

M95 Galaxy

William Herschel Telescope + INGRID
Jacobus Kapteyn Telescope + CCD

M95 was one of the galaxies in the key project of the Hubble Space Telescope for the determination of the Hubble constant. The HST was employed to look for Cepheid variables and thereby determine this galaxy's distance. M95 is a barred spiral of type SBb, or SB(r)ab according to de Vaucouleurs' classification, with nearly circular arms. Alan Sandage, in the Hubble Atlas of Galaxies, classifies it as a "typical ringed galaxy". The image shown above was obtained through the filters B, J and Ks, revealing a prominent inner ring.

Credit: Johan Knapen and Nik Szymanek.

2000

M83 Galaxy

William Herschel Telescope + PFIP

In the constellation Hydra can be found a spectacular face-on spiral galaxy. This is M83, the Southern Pinwheel Galaxy. It earned its name from the distinct pinwheel shape of its long spiral arms.

Credit: Chris Benn and Nik Szymanek.

2004

M81 Galaxy

Isaac Newton Telescope + WFC

This image shows the spiral galaxy Messier 81 in its entirety. It is a combination of exposures from the Isaac Newton Telescope and the Digitised Sky Survey.

Credit: Jonathan Irwin, DSS2.

2003

M74 Galaxy

Isaac Newton Telescope + WFC

This conspicuous spiral is a prototype of a grand-design Sc galaxy. Its distance may be about 30 to 40 million light years so its spiral arms are about 1000 light years broad. They are traced with clusters of blue young stars and pinkish colored diffuse gaseous nebulae (HII regions), and reach out to cover a region of more than 10 minutes of arc in diameter, corresponding to roughly 95,000 light years, or about the same size as our Milky Way galaxy. The image shown here is a combination of two 100-second exposures in filter B, two 80-second exposures in filter V and two 60-second exposures in filter R.

Credit: Simon Dye.

2004

The Whirlpool Galaxy

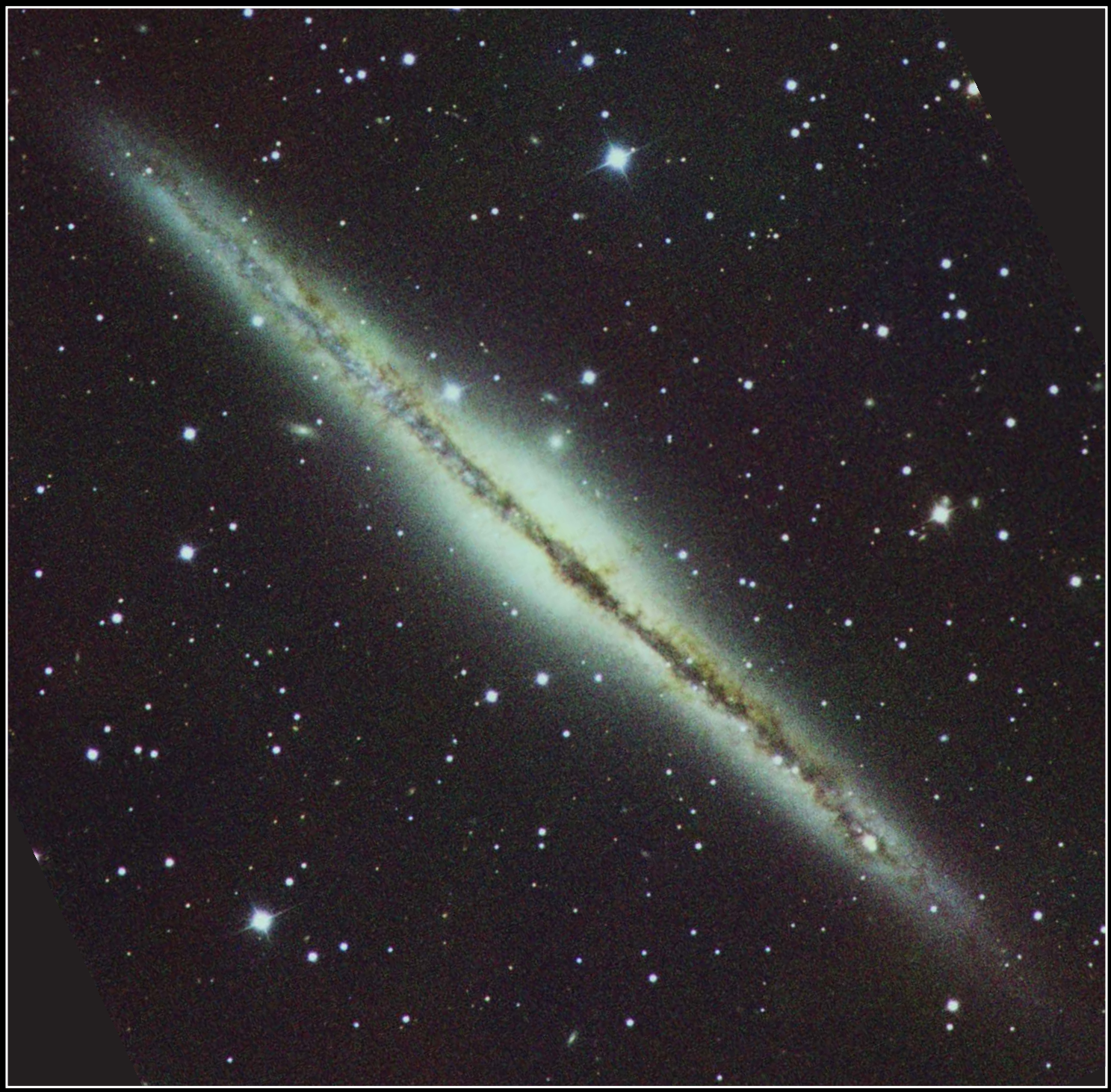
William Herschel Telescope + PFIP

Messier 51 Galaxy, known as the Whirlpool Galaxy, is a bright spiral galaxy fairly close to us (7.5 Megaparsecs = 25 million light years). To the north of M51, at the top of the picture, is a companion galaxy which is being disrupted by the gravitational tidal forces of the main galaxy. The B-band image was obtained by SAR el Príncipe de Asturias (Crown Prince of Spain) on his visit to the William Herschel Telescope the day before of the first stone ceremony of the Spanish 10-m GTC telescope.

Credit: Javier Méndez and Nik Szymanek.

2000

NGC 891, an edge-on spiral galaxy



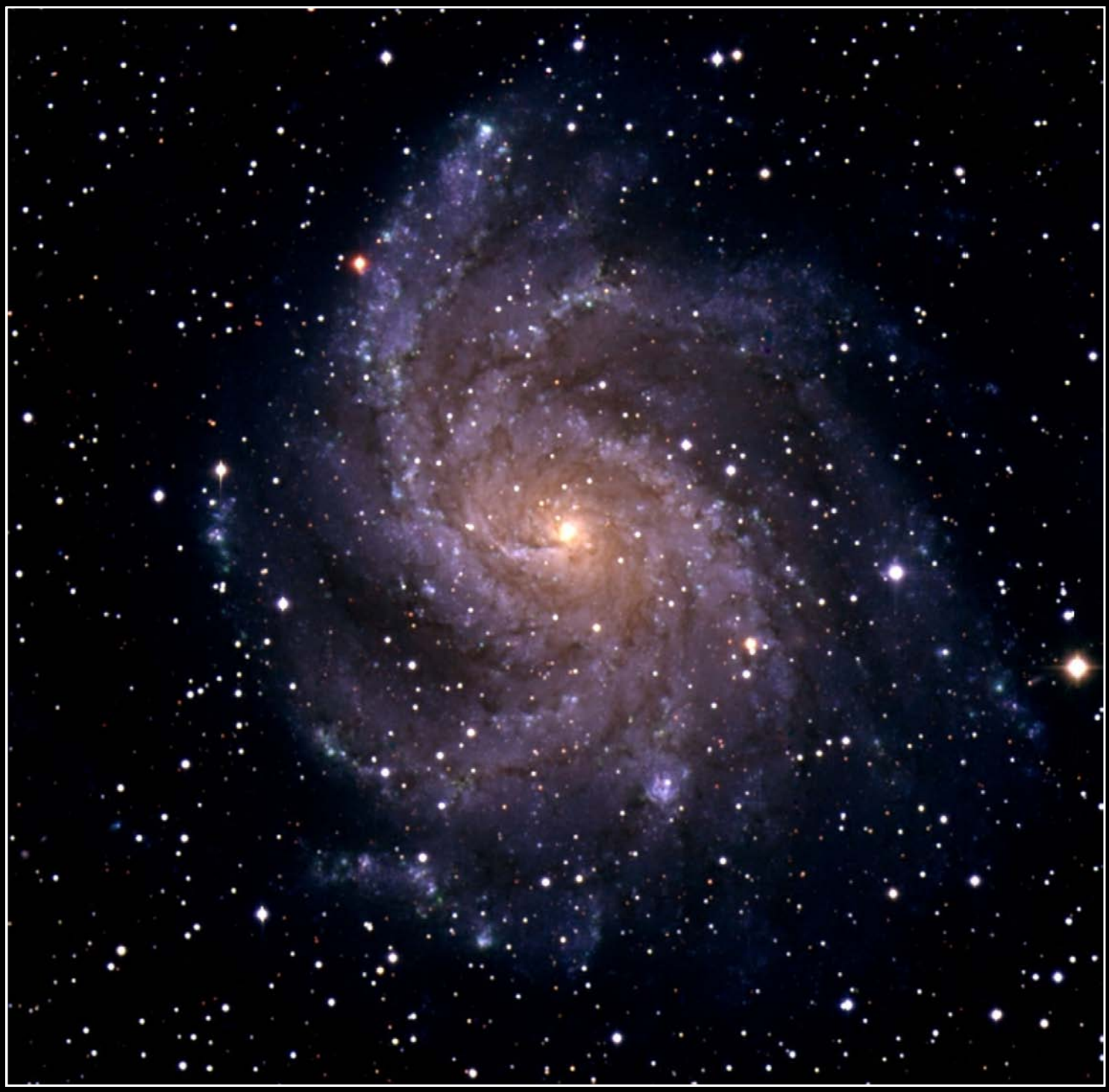
Isaac Newton Telescope + Photographic Prime Focus Camera

NGC 891, an edge-on spiral galaxy. If we could view the Milky Way from a distance of about 30 million light years it would look something like NGC 891. But galaxies that look like this are quite rare because the chance alignment of the thin disk of a spiral galaxy with our line of sight is unusual. A few degrees either side of its orientation and NGC 891 would be just another highly inclined spiral galaxy. From this unusual vantage point we can see in NGC 891 the surprising narrowness of the obscuring dust lane, a dark slightly irregular band across the galaxy. We also see that it is yellowish, confirming that it is dust, which absorbs blue light, as in the Milky Way. Also similar to the Milky Way is the prominent central “bulge” corresponding to the rich star clouds in Sagittarius.

Photograph by David Malin (AAO).

1992

NGC 6946, a face-on spiral galaxy



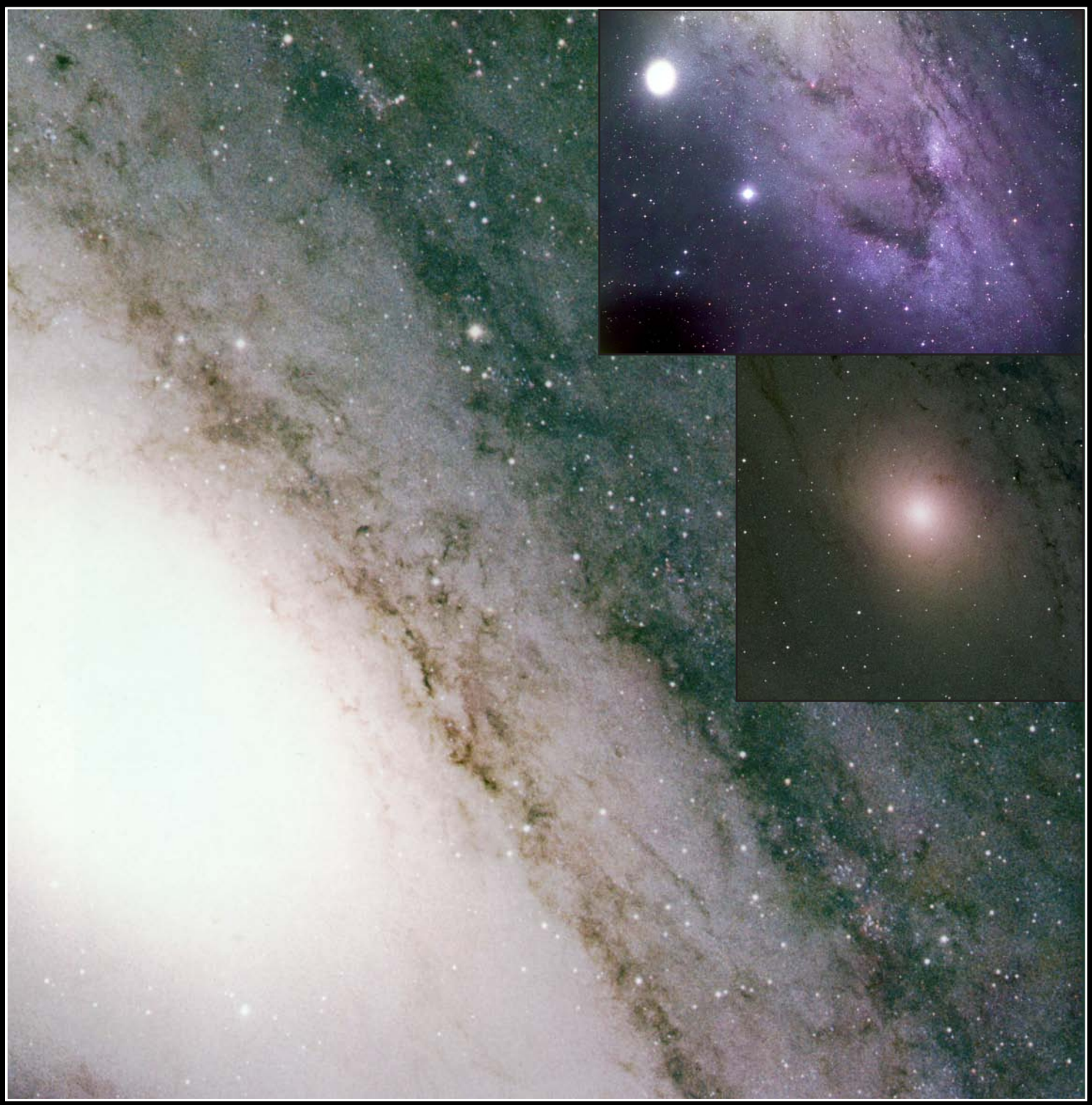
Isaac Newton Telescope + Wide Field CCD Camera

A galaxy is a family of stars, held together by their mutual gravitational attraction, and with a distinct identity separating it from other galaxies. Most galaxies can be categorized into a number of broad morphological types. Spiral galaxies are disc-shaped, with a central bulge, from which spiral arms appear to wind outwards. In barred spirals, a bar of stars extends out from the bulge and the arms appear to be attached to the ends of the bar. Spiral galaxies contain very luminous young stars and significant amounts of interstellar material concentrated in the arms. NGC 6946 (Arp 29) is a face-on SAB(rs)cd galaxy in the constellation Cygnus. This classification refers to the presence of a small core with multiple well-defined arms (cd), with a poorly-developed bar across the middle (AB) and an inner confused ring (rs). Nearly twenty million light years from Earth, it is over seventy thousand light years across.

Credit: Simon Driver (St. Andrews University).

1999

The Andromeda Galaxy



Isaac Newton Telescope + Photographic Prime Focus Camera

The nearest comparable spiral galaxy to the Milky Way is M31 (NGC 224), the great galaxy in Andromeda. It is visible to the unaided eye and has been known as a curious hazy patch since ancient times. Only in the last 75 years has its nature as a distant city of stars like the Milky Way become apparent. Upper right picture shows the central part of M31, the huge mass of stars that are in orbit around its nucleus. Silhouetted against this starry background are tangled sheets and curtains of dust, very reminiscent of dust clouds we see in our own galaxy. At the heart of M31 is a tiny, bright nucleus, seen to be slightly elongated (middle right picture). Hubble Space Telescope pictures show the nucleus to be a double structure, possible the remains of the nucleus of another galaxy which has now been almost completely absorbed in M31. Around the binary nucleus swirls a huge cloud of mostly old, faint stars. These stars are unresolved on the plates that were used to make the middle right picture and have been removed by a photographic process known as ‘unsharp masking’.

1992

Picture by David Malin (AAO).

Abell 2218 Galaxy Cluster

William Herschel Telescope + ING Red Imaging Device (INGRID)

Images from INGRID reveal the central regions of the massive cluster of galaxies, Abell 2218, at a distance of approximately 2 thousand million light years from Earth. Several arc like features are clearly visible around the brightest galaxies at the cluster center. These represent the distorted and gravitationally magnified images of very distant galaxies behind the cluster. The huge concentration of dark matter in the core of the cluster acts as a gravitational lens, bending the paths of light rays from the background galaxies and in the process magnifying their images, in accordance with Einstein's Theory of Relativity. This image is used to study the properties of a rare class galaxies which are bright at near-infrared wavelengths but invisible in the optical, and a possibly related family of very luminous galaxies which emit most of their energy in infrared light. By exploiting the magnification by the cluster lens, astronomers can investigate the properties of these faint galaxies in much greater detail than would otherwise be possible.

Credit: Ian Smail (University of Durham), Chris Packham (ING).

2000

The Triangulum Galaxy

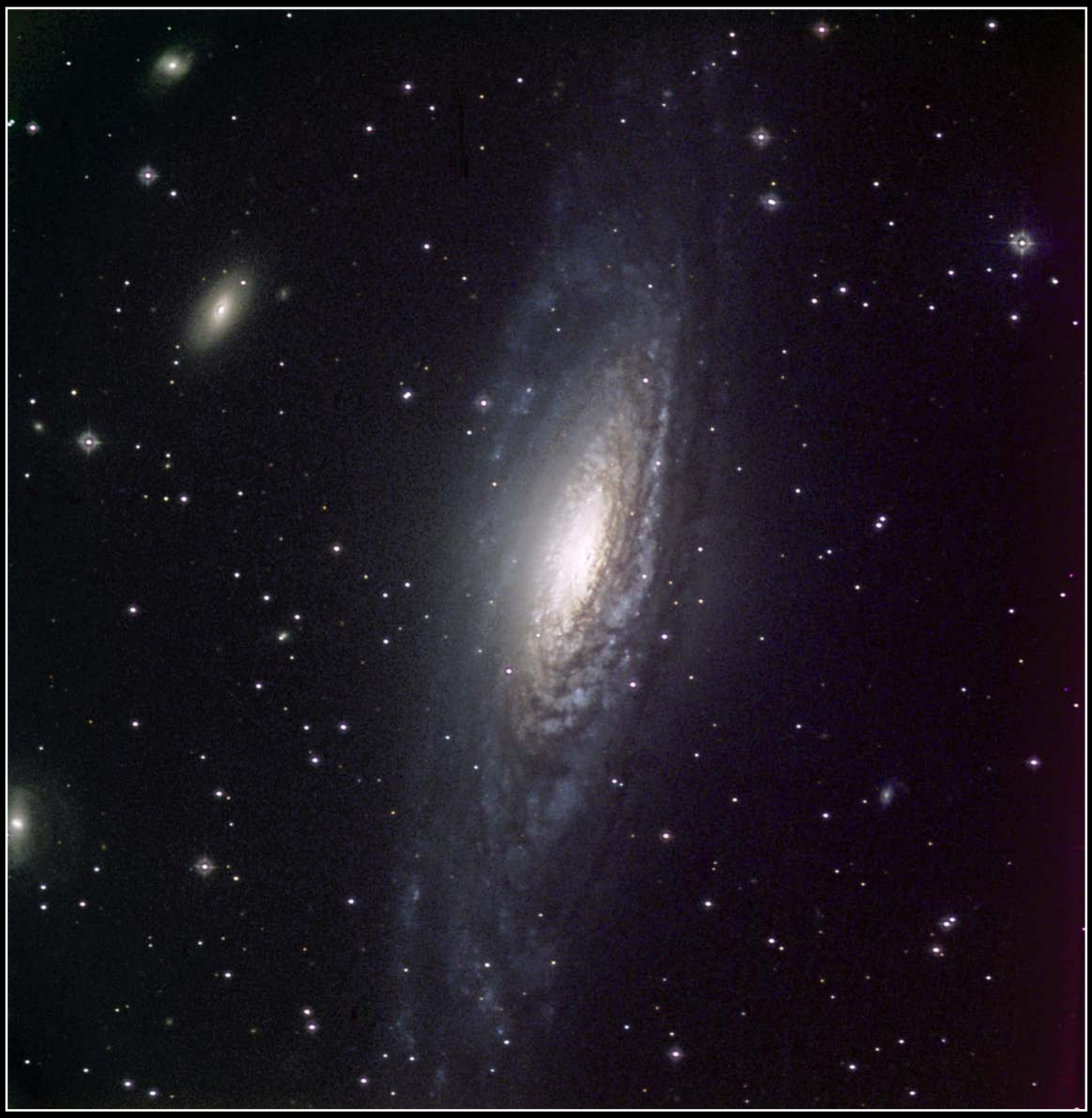
Isaac Newton Telescope + Wide Field CCD Camera

M33 or the Triangulum Galaxy is one of the finest examples of a spiral galaxy in the sky and is about one degree across. The galaxy is a member of the 30 or so galaxies of the Local Group and is close enough - about 2.5 million light years - for us to study the anatomy of a galaxy in great detail. Many individual bright stars pepper the delicate spiral arms which are in turn sprinkled with pink star-forming regions. Several of the clumps of bright stars and their associated nebulae are bright enough to have been catalogued as separate objects. The image shown here was obtained with the mosaic CCDs of the Wide Field Camera at the INT, and it's a composition of frames taken in three narrow bands: the green colour represents the [OIII] nebular line, red is the H-alpha hydrogen emission and blue is mainly stellar light taken through a continuum filter centred at 555.0 nm (Stromgren Y).

Credit: L. Magrini and M. Perinotto (University of Florence), R. Corradi (ING), and A. Mampaso (IAC).

1999

NGC 7331 Galaxy



Jacobus Kapteyn Telescope + CCD

NGC 7331 was discovered by William Herschel in 1784. It is one of the brightest galaxies which is not included in Messier's catalog. It shows a fine spiral structure despite its small inclination from the edge-on position. Several companions and background galaxies are also visible in this image. This image was made from ten 100-second exposures in filters *R*, *V* and *B* respectively.

Credit: Daniel Bramich and Nik Szymanek.

2001

NGC 7217 Galaxy

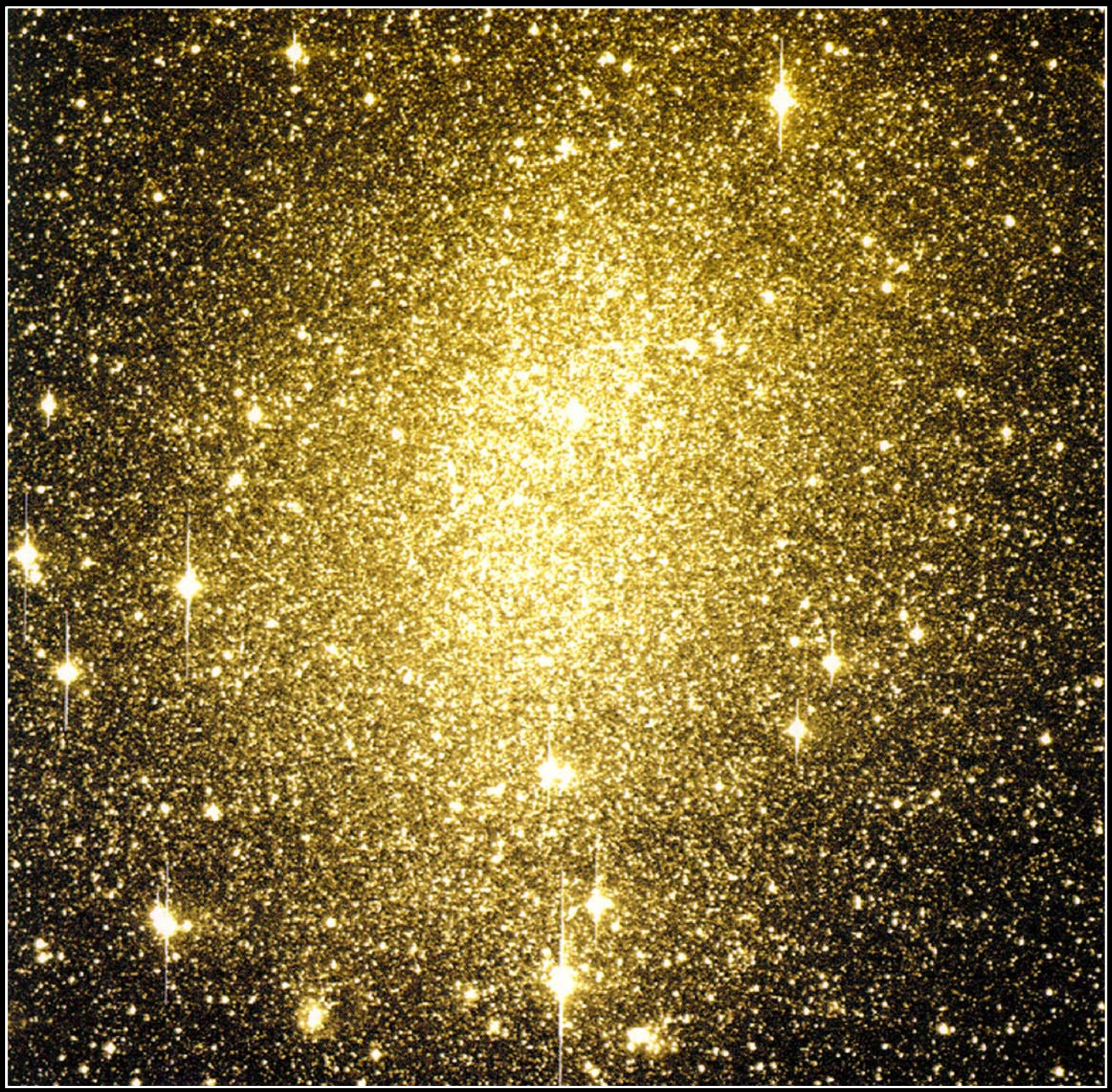
William Herschel Telescope + PFIP

The spiral galaxy NGC 7217 in Pegasus constellation. Image obtained using the Prime Focus Imaging Camera on the William Herschel Telescope and combining the light of filters B, V and R.

Credit: Mischa Schirmer and Gilles Bergond.

2005

Barnard's Galaxy



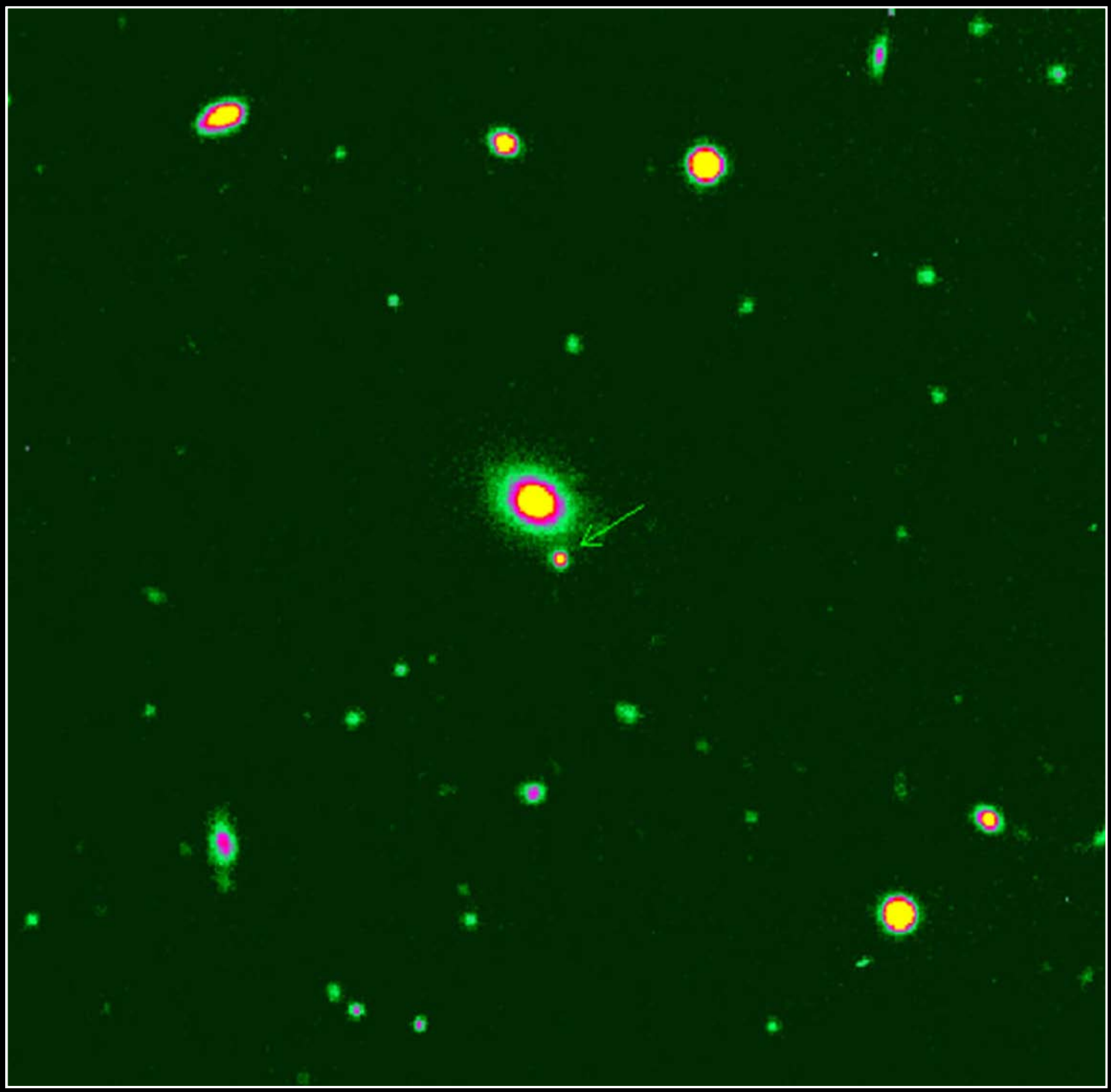
Isaac Newton Telescope + Prime Focus CCD Camera

NGC 6822 or Barnard's galaxy is one of the nearest galaxies and is thus a member of the Local Group. The galaxy seems to be without symmetry and is classified as an irregular. At one end of a prominent bar a few clouds of glowing gas can be seen; at the other, bright bluish stars are scattered out into what appears to be the first signs of a straggling spiral arm. The fact that this galaxy is near enough for us to be able to resolve a large number of its individual stars makes it possible to study the star formation history based on colour-magnitude diagrams. This image was obtained using CCD imaging on the Isaac Newton Telescope. Exposure times were 1000 seconds tipically.

Credit: Carme Gallart and Antonio Aparicio (IAC).

1996

A High-z Supernova



Isaac Newton Telescope + Wide Field CCD Camera

New studies based on observations of supernovae in the farthest reaches of deep space indicate that the universe will expand forever because there isn't enough mass in the universe for its gravity to slow the expansion, which started with the Big Bang. The image shown above was taken using the Isaac Newton Telescope and it corresponds to a high-redshift type Ia supernova thousands of millions of light years away. When a star explodes as a type Ia supernova its brightness is similar to the host galaxy. This latter feature along with the possibility of calibrating their maximum brightness, make type Ia supernovae the best known standard candles to investigate the geometry and the dynamics of our universe.

Credit: Javier Méndez (ING).

1998

The Herschel Deep Field

William Herschel Telescope + Prime Focus CCD Camera

The Herschel Deep Field is a 7x7 arcminute patch of sky in the constellation of Pisces which has been observed with the 4.2-m William Herschel Telescope for a total of about 70 hours. The picture shown here is a “true colour” composite of images taken at ultra-violet, blue and red wavelengths. Most of the objects are distant galaxies, although the very brightest ones are stars. This is one of the deepest images ever taken from the ground and shows images almost as faint as the famous Hubble Deep Field but over a 10 times bigger area of sky. An analysis of the colours of these galaxies has shown that many are at such large distances and “look-back times” that the epoch of galaxy formation must have been at even higher redshifts than was previously thought.

Credit: Nigel Metcalfe and Tom Shanks (University of Durham).

1999