The Southern Spring

22.00 to 04.00 Hours Right Ascension

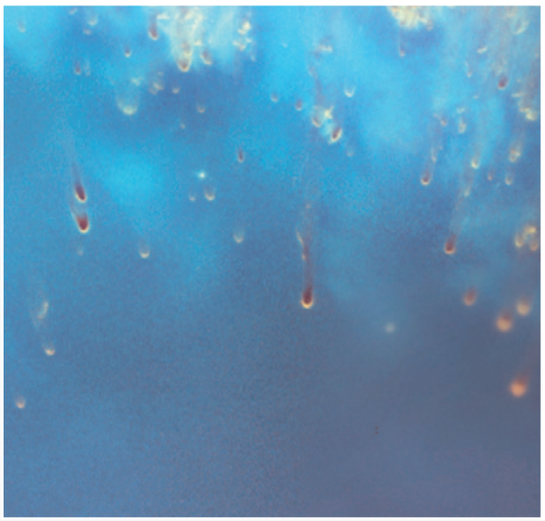
The Southern Spring

The southern spring is the season of the galaxies, as first Sculptor and then Fornax pass over head, each with a rich scattering of extragalactic objects. The South Galactic Pole lies in Sculptor, and so we find few stars and little dust in this direction; stars and dust are out of fashion in spring, as the Milky Way encircles the horizon. As summer approaches, the Small Magellanic Cloud rises ever higher, with its perpetual companion, 47 Tucanae. The Helix Nebula, here captured in narrowband mapped color by the Hubble Space Telescope, is an object of remarkable beauty and provides a glimpse of the ultimate fate of every sun-like star.

The Helix Nebula

The Helix Nebula (NGC 7293) is the nearest planetary nebula to the Sun, at a distance of about 650 light-years. The remnant of a dying, Sun-sized star, the nebula is composed of a series of concentric, expanding, shell-like structures. They are the surface layers of the star, material ejected during different phases of the star's death throes. The inner part of the nebula shows a series of cometary knots arranged like bicycle spokes, pointing away from the central hot star. Cometary knots are seen in other planetary nebulae, and they each are several times the size of our Solar System, much too big to be comets.

The cometary knots are thought to be formed when a hot stellar wind of gas plows into the colder shells of dust and gas previously ejected by the doomed star. The collision causes the gaseous mixture to become unstable (known as a Rayleigh–Taylor instability) so that it fragments into large clumps, which we see as the comet-like knots. These droplets are then blasted by the searing radiation from the newly exposed core of the dying star, which has a temperature of 100,000 degrees C. At this temperature, most of the radiation from the star comes in the form of ultraviolet light, which makes the distended and ejected material of the star fluoresce red and green, like the rarified gas in an advertising sign. However, among the stars, these colors advertise the presence of hydrogen and oxygen.



The Cometary Knots of the Helix

The knots in the Helix Nebula have long been a puzzle, but with the superb resolution of the Hubble Space Telescope some aspects of mystery have vanished. The individual knots are about as large as the Solar System itself but have a mass about that of Earth and are made of dusty gas; their heads are completely opaque and have the brownish hue of molecular clouds. They are shaped by the intense stellar wind from the central star, and their lifetime, like that of the Helix Nebula itself, is likely to be short.

The Helix Nebula

This composite image of the colorful Helix Nebula is about half a degree across (about the size of the full Moon) and was taken with the Advanced Camera for Surveys aboard the NASA/ESA Hubble Space Telescope and the 4-meter telescope at Cerro Tololo Inter-American Observatory in Chile. The object has such a large angular size that both telescopes were needed to capture a complete view.

NGC 7424

NGC 7424 is a magnificent grand-design barred spiral galaxy discovered by John Herschel during his time at the Cape of Good Hope in the 1830s. He noted that it is very large and very faint. However, much of the detail seen in the photograph would not have been noticed, even by the most careful visual observer. The galaxy is seen almost face-on and is about 100,000 light-years across and 40 million light-years away. NGC 7424 has dimensions similar to that of the Milky Way, although with a central bar that is probably more pronounced. As in the Milky Way, many young star clusters are visible, scattered along the delicate spiral arms.

NGC 7424 is home to the fascinating supernova SN 2001ig, discovered by the Australian amateur astronomer Reverend Bob Evans, who has discovered over 40 supernovae in a similar number of years. The suddenly bright star was unusual, and over time seemed to transform itself from a Type II to a Type I supernova. Confused at first, astronomers concluded that a Wolf–Rayet progenitor star with a massive companion was probably responsible for the peculiar changes observed as SN 2001ig evolved. The story of SN 2001ig has enhanced our knowledge of the various processes that characterize supernovae in general.

Magnificent Spiral NGC 7424

The beautiful multi-armed NGC 7424 is seen almost directly face-on. Located at a distance of roughly 40 million light-years in the constellation Grus (The Crane), it is an example of a grand-design galaxy. It has many ionized star-forming regions as well as clusters of young and massive stars.

NGC 7793

NGC 7793 is an intriguing spiral galaxy 13 million light-years away in the direction of the constellation of Sculptor and is a member of the sparse Sculptor Group of galaxies. This cluster includes a number of dwarf galaxies and four other bright galaxies that appear in these pages, NGC 253 (p. 184), NGC 247 (p. 182), NGC 300 (p. 188), and NGC 55 (p. 176). The Sculptor Group is the nearest cluster of galaxies to the Local Group, which includes the Milky Way, Messier 31, the Magellanic Clouds, and a host of smaller entities. Although it is a defined as a group, and the galaxies appear together in the sky, the Sculptor Group is really a loose cloud of galaxies forming a cigar-shaped filament extending 20 million light-years along our line of sight. This collection, along with the Canes Venatici complex and the Local Group, appear to form a loose filament of the Virgo supercluster that extends over a distance of 33 million light-years.

NGC 7793 is another galaxy whose optical appearance causes it to be classified as "flocculent," with rather patchy, ill-defined spiral arms, similar to NGC 3521 (p. 90) and NGC 6744 (p. 160).

Wide-field View of NGC 7793

The chaotic spiral galaxy NGC 7793, as observed with the FORS instrument attached to ESO's Very Large Telescope at Paranal. This wide-field image shows the galaxy's transition from flocculent structure to a loose arrangement of radially symmetric spiral arms towards the nucleus, and is based on data obtained through blue, green, infrared and H-alpha filters.

Spiral Galaxy NGC 7793

This image shows NGC 7793, a member of the Sculptor Group. It has a chaotic spiral structure, unlike the class of grand design spiral galaxies. The image shows how difficult it is to identify any particular spiral arm in these chaotic structures, although it is possible to guess at a general rotating pattern. NGC 7793 is located about 13 million light-years away.

NGC 45

NGC 45 is remarkable for its faintness and is one of lowest surface-brightness spiral galaxies known in the local Universe. It may be an outlying member of the nearby Sculptor Group. The galaxy moves away from us with a recession velocity of about 500 kilometers per second, significantly larger than the average of the group, which is about 250 kilometers per second. The typical distance of the galaxies in the Sculptor Group from us is about eight million light-years, while NGC 45 is at about twice this distance. These discrepancies cast some doubt on its membership in the Sculptor Group.

Despite these doubts and qualifications NGC 45 is unusually small for spiral galaxy, with a diameter of about 30,000 light-years, and it is also quite rare, in that it exists without any obvious companions to stir up star formation. The stars are mostly organized in broad, ill-defined spiral arms inclined about 55 degrees to the line of sight, and there is no obvious dust or central bulge. In such low surface brightness galaxies, the mass is dominated not by the stars but by the invisible dark matter.

Faint NGC 45

NGC 45 is so faint and its dust content so low so that distant galaxies can easily be seen through its transparent disk. The bright foreground star has a magnitude of 6.5 (just visible to the unaided eye) and this makes closer investigations of NGC 45 difficult.

NGC 55

The nearest large galaxy to the Milky Way is the Large Magellanic Cloud, which we see from a distance of 170,000 light-years. It is inclined to our line of sight by about 40 degrees. Magellanic-type galaxies — lopsided spiral galaxies with an offset central bar — are quite rare, so we are lucky to have such a close view of such an unusual specimen.

For purely statistical reasons, edge-on galaxies are also rare, so we are especially fortunate to have in NGC 55 an example of a nearby Magellanic-type galaxy seen edge-on. NGC 55 is a member of the Sculptor group and much more distant than the LMC, at a distance of about six million light-years. As with others in that group (especially NGC 300, see p. 188) it is close enough for us to see it resolved into individual stars. With images made with a large telescope, the central regions look very much like the Milky Way as seen with an ordinary camera and lens.

In the Sculptor Group, the galaxies are few in number and well separated in space. It is probably for this reason that NGC 55 is not rich in star-forming regions, because it is not interacting with any nearby companion galaxies. This is unlike the Large Magellanic Cloud, which is stirred up by encounters with both the Milky Way and the Small Magellanic Cloud. If we could see the Large Magellanic Cloud edge-on it would likely be somewhat deformed by its relatively recent interactions with its near neighbors.

Edge-on galaxy NGC 55

The irregular galaxy NGC 55 is a member of a prominent group of galaxies in the southern constellation of Sculptor. The galaxy is about 70,000 light-years across, distinctly smaller than the Milky Way.

47 Tucanae

47 Tucanae, also known as NGC 104, is the second brightest globular cluster in the sky and is visible to observers south of the Tropic of Capricorn near the (unrelated) Small Magellanic Cloud at some time every clear night of the year. It is at about the same distance as Omega Centauri (16 000 light-years) and a magnitude fainter, but still hazy compared to a normal star. However, it presents a quite different appearance when seen in a telescope. Unlike Omega Centauri, 47 Tucanae is strongly condensed towards the center, so if it is the nucleus of a galaxy stripped of its stars by the Milky Way, it was probably a nucleated dwarf galaxy.

The concentrated light of one million stars packed into a volume of space 120 light-years across makes the heart of 47 Tucanae a very crowded place. If the Solar System were transported to the center of the cluster, the integrated starlight would fill the sky with stars and there would be no night. Also within the expanse of 120 light-years there are 20 or more millisecond pulsars and the X-ray binary stars from which these evolve. Here, too, are a similar number of blue stragglers, first described by Alan Sandage in 1953. These mysterious stars received their name because when their colors are plotted on the color–magnitude diagram that charts the path of stellar evolution, they appear to be “straggling” away from the main sequence of normal stars. They are probably formed from collisions and mergers of lower mass stars. While 47 Tucanae is clearly an ancient cluster, it is far from being the dead heart of a long-vanished galaxy.

47 Tucanae

The concentrated light of one million stars packed into a volume of space 120 light-years across makes 47 Tucanae the second brightest globular cluster in the sky, surpassed only by Omega Centauri.

The Cartwheel Galaxy

The Cartwheel Galaxy (ESO 350-40) was noted by Fritz Zwicky in 1941, but wide-field images of it on early survey plates from the UK Schmidt Telescope were so intriguing that it was soon studied in detail using the Anglo-Australian Telescope.

Lying about 500 million light-years away in the constellation of Sculptor, the cartwheel shape of this galaxy is the result of a violent galactic collision about 300 million years ago. A smaller galaxy has passed right through a large disk galaxy and produced shock waves that swept up gas and dust — much like the rings of waves produced when a stone is dropped into a lake — and the ripples have sparked regions of intense star formation (appearing blue). The bright, outermost ring of the galaxy, which is 1.5 times the size of our Milky Way, marks the shock wave's leading edge. This object is one of the most dramatic examples of the small class of ring galaxies, and it is a great laboratory for studying supersonic collisions between and within galaxies.

Astronomer Bob Fosbury, who led the European Hubble group, the Space Telescope-European Coordinating Facility (ST-ECF) when it closed in 2010, was responsible for much of the early research into the Cartwheel Galaxy along with the late Tim Hawarden — including giving the object its very appropriate name.

The Cartwheel Galaxy Imaged with Hubble

This image of the Cartwheel Galaxy was produced by reprocessing a Hubble dataset from 1994. The reprocessing has brought out more detail in the image than ever before. The remarkable features of this galaxy are the results of a violent galactic collision, either with one of the two small companion galaxies or yet another galaxy that liesoff the edge of the image.

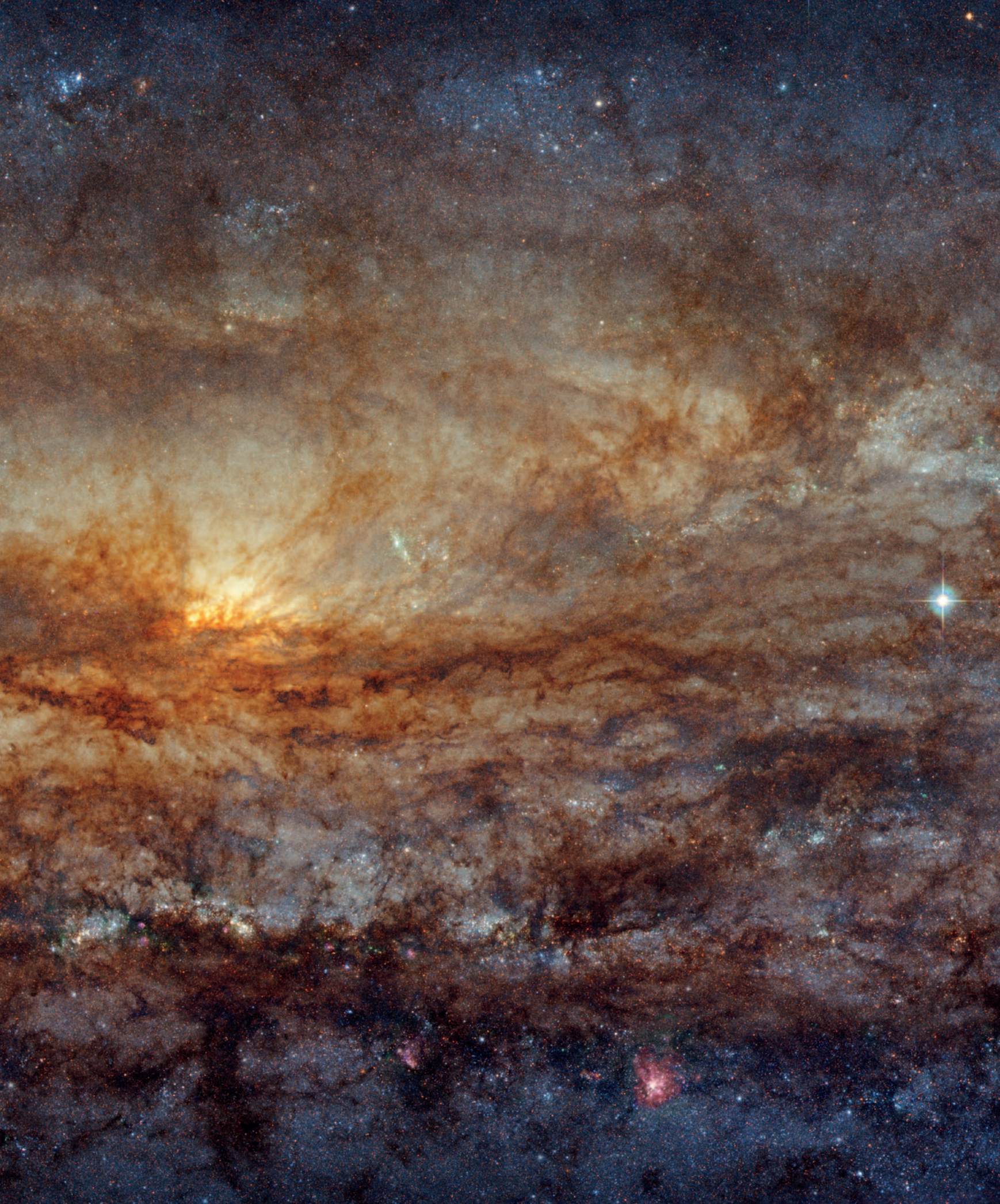
NGC 247

NGC 247 is a dwarf galaxy seen inclined at an angle of about 75 degrees to the line of sight and is a member of the nearby Sculptor Group. The constellation is close to the South Galactic Pole, so the galaxies of the Sculptor Group are seen in a field almost devoid of bright stars. Despite its unfavorable inclination, NGC 247 can be seen to have two main spiral arms where a modest amount of star formation is occurring. The star formation rate can be found from the infrared brightness and the intensity of the radiation from the emission nebula, and in NGC 247 it appears to be equivalent to the creation of a solar-mass star every ten years. For comparison, the Milky Way produces about 70 such stars in ten years.

Dwarf galaxies are defined by their relatively small size and mass and are the most common type of galaxies within groups and clusters, greatly exceeding the number of "normal" spirals and ellipticals. In one standard scenario of cosmic evolution, galaxies are built up by the hierarchical merging of smaller galaxies into larger ones. As the most common type of galaxy in the Universe, dwarf galaxies are thought to be representative of simple, small primordial galaxies unchanged over billions of years. However, the stellar population of NGC 247 shows clear evidence of ongoing, if modest, star formation and it is quite possible that it is itself the result of mergers.

NGC 247

This image of NGC 247 reveals the fine details of this highly inclined spiral galaxy and its rich backdrop. The spiral galaxy NGC 247 is one of the closest spiral galaxies in the southern sky. In this new view from the Wide Field Imager on the MPG/ESO 2.2-metre Telescope, many of the galaxy's component stars are clearly resolved, and glowing pink clouds of hydrogen, marking regions of active star formation, can be made out in the loose and ragged spiral arms. Apart from the main galaxy itself, this view also reveals numerous others far beyond NGC 247. In the upper right of the picture three prominent spirals form a line and still farther out, far behind them, many more galaxies can be seen, some visible through the disk of NGC 247.



NGC 253

NGC 253 is the brightest member of the Sculptor Group of galaxies. Despite being a widely scattered group, this is a true physical association of galaxies whose prominent members include NGC 247 (p. 182), NGC 300 (p. 188), and NGC 55 (p. 176). NGC 253 is a typical starburst galaxy, which implies a high rate of star formation. It is seen almost edge-on and is about 13 million light-years distant. As might be expected in a starburst galaxy, dust dominates the picture, obscuring the prominent central bar that is seen in infrared images. This dust is seen in silhouette against light from the spiral arms. The very bright central part of this galaxy also shows evidence of a violent burst of star formation that began some 30 million years ago. Unlike the light from the central regions of more normal spiral galaxies, which contain older, cool stars, the conspicuous yellow-orange color of the center of NGC 253 seen here is the dust-attenuated light of young, luminous blue stars rather than of the older and fainter yellow population. NGC 253 undoubtedly also hosts an older population of stars around its nucleus, but its presence is dimmed by the dust.

The Sculptor Galaxy

This image shows a small part of the eastern half of NGC 253, and was specially made from five images obtained from the Hubble Legacy Archive. It reveals the extreme dustiness of the galaxy, which is the more obvious because we see it highly inclined to our line of sight. The galaxy glows at 7th magnitude, on the threshold of naked-eye visibility; it is easily seen in binoculars, and in a small telescope NGC 253 looks like a bright elongated silvery streak, about 20 arcminutes long on the sky — almost the width of the Moon. This may account for its alternative name, the Silver Coin Galaxy.