

Spirals and Giants



and Dwarfs

oh my!

Fearlessly tracking down faint galaxies brings rewards of clusters, mergers, and fuzzy wisps.

by Steve Gottlieb and Richard Jakiel

Photographs of galaxies, such as those gracing this magazine, show some of the most beautiful and intriguing objects in the universe. The majestic whorls of spirals, the vast gatherings of distant clusters, and the vivid chaos in the cores of merging pairs invoke a certain awe stirred by the natural wonder of the scene.

They may also invoke feelings of intimidation, especially if you long to observe the galaxies through a telescope. But you needn't fear the dark unknown. Embarking on a tour of galaxies and galaxy clusters can become a meaningful journey. A well-trained eye can pick up structural details and delicate features often taken for granted in photographs. And knowing that the dim, diffuse light at the edge of perception is really a dynamic system of tens of billions of stars will tug at your notion of existence.

To prepare, pick up a good sky atlas such as *Uranometria 2000.0* by Wil Tirion, Barry Rappaport, and George Lovi (Willmann-Bell, Inc.) or *Sky Atlas 2000.0* by Wil Tirion (Cambridge University Press). Then, consider employing a few techniques that will help your eyes gather every precious photon. Practice using averted vision and wear a dark hood over your head at the eyepiece to block extraneous light. Use moderate magnifications of 10x to 15x per inch of aperture to help you discern subtle details. And try your hand at sketching. Not only will it greatly improve your ability in seeing low contrast detail, but you'll have a permanent record of your observations.

Now, let's begin our tour of the spring sky. We'll start at the great spirals and the giant ellipticals, followed by those objects obstructed by the dust and stars of our own galaxy. Finally, we'll briefly tour two enormous aggregations of galaxies — the Coma and Hercules clusters.

Celestial Pinwheels

When observing galaxies, you can divvy them up the way Edwin Hubble did. In 1926, he devised a scheme for categorizing normal spirals into three main groups: Sa, Sb, and Sc. Sa spirals have well-developed central regions surrounded by tightly bound spiral arms. Sb, or intermediate, spirals have broader, fainter cores and arms. Wide open spiral arms punctuated by bright HII knots dominate Sc spirals.

Let's follow the progression starting with the Sa spiral M104 (NGC 4594), known as the **Sombrero Galaxy**. From the bright star Spica in Virgo, move 4.5° east to see this classic edge-on galaxy. It derives its name from the hefty central bulge, the tapering 8' extensions that make up the brim, and a prominent dust lane that bisects the entire galaxy.

For a good look at an Sb galaxy, check out our nearest spiral neighbor, M31 (NGC 224), the **Andromeda Galaxy**. You can detect its soft, elongated glow by following a line northwest from 2nd-magnitude Mirach (Beta [β] Andromedae) through 4th-magnitude Mu (μ) And. In an 8-inch telescope, the most impressive feature may be the prominent jet-black dust lanes that skirt the galaxy's core. But you don't need a scope to enjoy this beauty. At 2.2 million light-years away, M31 is the most distant object visible to the naked eye.

Linger near M31 a bit and check out **NGC 206**, a huge cloud of young, massive stars located along the southwest periphery of the galaxy, about 40' from the core. The combined light from these stars is faintly visible in a 6- to 8-inch scope. Users of 16-inch scopes and larger can challenge themselves by picking out the numerous 15th-magnitude globular clusters orbiting M31. They look like faint stars, so you'll need a detailed finder chart to pinpoint them.

The brightest springtime Sb galaxy is **M81** (NGC 3031) in Ursa Major. A small telescope shows it as a striking ellipse with a bright core. In a 17.5-inch scope, the view reveals a winding spiral arm on the south side of the galaxy and another arm just visible as a short extension hooking around the north end toward a 12th-magnitude star.

Just 38' north of M81 lies **M82** (NGC 3034), an eruptive starburst galaxy. In 6- to 8-inch telescopes at 100x, it draws your attention. Several dark lanes mottle the high surface spindle at an oblique angle to the major axis. Photographs



Bonn Observatory

reveal a tortured disk once thought to be exploding, but now explained by bursts of star formation in M82's nucleus.

Finally, for a springtime view of an Sc spiral, visit **M83** (NGC 5236) in Hydra. Long-exposure photographs and CCD images reveal massive spiral arms peppered with huge star clouds and HII regions. A moderate-sized scope under dark skies shows the bright central region's elongated bar, which has subtle spiral arms that arc around the core forming a cosmic Greek letter Theta (θ). Northern observers should not disregard this southerly galaxy, which ranks among the ten brightest in the sky.

Of all the galaxies in the night sky, spirals appear most abundant, but don't overlook the giant ellipticals.

Hungry Giants

Sparse in numbers, giant elliptical galaxies often span great distances of sky. They can extend more than several hundred thousand light-years, considerably larger than the largest spiral. Older, reddish stars typically dominate their color, and their extreme mass often wreaks havoc on their smaller neighbors.



Left: The center of the spiral galaxy M82 erupts into a fit of newborn stars as it gets tugged gravitationally by nearby M81 (not shown). Above: Hungry elliptical M86 lurks at the center of the Virgo Cluster, where it stalks its smaller neighbors. At the far upper left of the image, NGC 4435 whizzes over NGC 4438, stripping away stars and gas. Right: This infrared image of the Maffei I shows detail not typically seen in visible light because dust from our own Milky Way obscures the light coming from this elliptical giant.

One of the closest giant ellipticals is NGC 5128, also known as **Centaurus A**. This 7th-magnitude system lies just 7° north of the bright globular cluster Omega Centauri. The object's most striking feature is the broad dust lane slashing through its center. This lane is actually the remnants of a spiral galaxy consumed by the massive elliptical about a billion years ago. Observers with large scopes can discern intricate structural details under moderate magnification.

Other hungry giants can be found near the core of the Virgo Cluster. Here, **M84** (NGC 4374) and **M86** (NGC 4406) form a pair of 10th-magnitude "eyes" in a galactic "smiley face." The nearby edge-on spirals, NGC 4402 and NGC 4388,

show evidence that they have lost some of their gas and dust to their massive neighbors. You can view both the big ellipticals and the smaller spirals in the same low-power field.

Much more spectacular is **M87** (NGC 4486), an angry giant that has consumed a number of its brethren. Even the smallest instruments will resolve the galaxy's bright core and slightly oval halo. For a challenge, use a moderate-sized scope with a CCD camera to see the optical jet discovered by H. D. Curtis in 1918. Look for the low-contrast, narrow wisp to the east-northeast of the core.

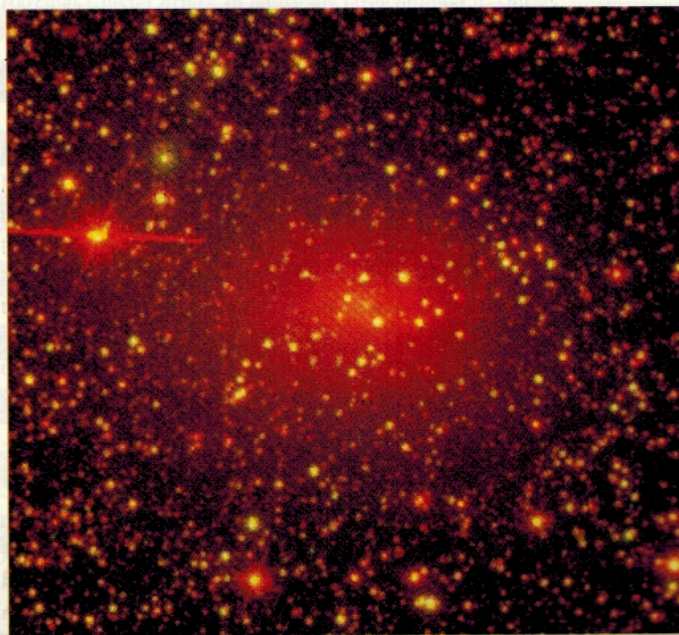
Even M87 pales in comparison with the largest of the ellipticals, the cD galaxy. Named for their immense, extended halos, these reign as the undisputed lords of the realm. Perhaps the most famous is **NGC 6166**, a spectacular giant located in the constellation Hercules. It dominates the galaxy cluster Abell 2199 and has at least four nuclei, three of which are remnants of other galaxies. An 8- or 10-inch scope will reveal an oval, diffuse glow with a mottled central region, even though it lies almost 600 million light-years away. Larger scopes may reveal some of the nearly stellar nuclei plus a faint swarm of attendant galaxies.

Merging Mania

Giant ellipticals are not the only ones producing catastrophe in the universe. Collisions often occur between spiral galaxies. The gravitational tug, called a tidal interaction, between spirals often results in some of the most fantastic phenomena in the cosmos. Well-known colliding galaxies include the Whirlpool Galaxy (M51), the Antennae, and the Mice. Other galaxies, such as the Cartwheel and the Helix, are famous remnants long after the merger has taken place.

Begin at two galaxies on the verge of colliding: NGC 4490, the **Cocoon Galaxy**, and NGC 4485 in Canes Venatici. Their cores lie a mere 4' apart, a distance of only 30,000 light-years. An 8-inch scope shows the unusual shape of the tidally distorted tip of NGC 4490, the larger of the two galaxies. The smaller NGC 4485 has an irregular, oval glow with a brighter core. Large backyard scopes will show an intricate play of dusty motes and bright knots in the more massive spiral.

The spectacular **Antennae**, or NGC 4038 and NGC 4039 in Corvus, make up one of the most unusual sights in the



night sky. Here, a pair of spirals dance in the earliest stages of merger. Tidal interactions have produced two curved tails spanning 20', more than 550,000 light-years long. The resulting mass looks like a warped shrimp with faint condensations occurring in two regions. Recent images with the HST show these areas as hotbeds of star formation.

Observing with an 8- or 10-inch scope will resolve the shrimp, but amateurs equipped with 16 to 20 inchers should see the brightest HII regions and hints of the tidal tails. And better yet, some Dobsonian users have reported seeing the full extent of the galactic creature's "antennae."

The last two objects are examples of merged systems. The first is **NGC 6240** in Ophiuchus, which, in HST images, looks like a lobster complete with claws. It's one of the largest known spiral galaxies. Widespread star formation spans the entire disk of the galaxy, which is visible in a medium-sized instrument as an oval, mottled disk and core. Sixteen-inch scopes or larger should reveal some hints of the claws.

Far to the north lies NGC 2685, the **Helix Galaxy** in Ursa Major, a fine example of a polar ring galaxy. Here, the collision and subsequent merger have taken place between 2 and 5 billion years ago, leaving a belt of gas and dust strewn at right angles to the long axis of the galaxy. Moderate scopes should resolve the the 11th-magnitude spindle shape of the main galaxy. The delicate polar ring is probably not visible in any telescope but would make a nifty challenge for the CCD-equipped amateur.

Behind the Veil

While scanning the springtime sky for galaxies, pause for a moment in the direction of the Milky Way's plane. Here, dust obscures and reddens objects, reducing visibility. Edwin Hubble called this band the zone of avoidance (ZOA). In

recent years, however, infrared, radio, and x-ray studies have penetrated the ZOA. And scientists continue to learn more about the galaxies hidden behind the Milky Way's veil.

Research has revealed, for example, that **IC 10**, an irregular dwarf member of the local group, has recently undergone a period of vigorous star formation, qualifying it as a classic "starburst" galaxy. Located just 3.3° from the galactic plane in Cassiopeia, IC 10 is the closest starburst galaxy to the Milky Way. An 8-inch scope will reveal a hazy spot within a rich star field. In a 13-inch scope, the low surface brightness glow extends to 4' in diameter, elongated northwest-southeast. The appearance is unusual, with no visible core and a superimposed 13th-magnitude star.

In 1967, Italian astronomer Paulo Maffei accidentally discovered a heavily obscured galaxy on a near infrared photograph of IC 1805, a huge star-formation complex in Cassiopeia. At a distance of only 12 million light-years, **Maffei I** had escaped previous detection — its luminosity reduced five magnitudes by intervening dust. If not situated toward the ZOA, this giant elliptical would be one of the showpiece galaxies in the sky. Ferret out Maffei I from the surrounding Milky Way star field using a 13-inch or larger scope. Maffei I's core appears as a low-surface-brightness glow elongated east-west and sometimes mistaken for a small patch of galactic nebulosity.

Groups and Clusters

If you enjoy observing galaxies, why not view them in bunches? Crammed into a mere 4' is **Stephan's Quintet**, a favorite deep-sky target located 30' south-southwest of the bright galaxy NGC 7331. A 6- or 8-inch scope can resolve a couple of dim patches, but a clear view of the entire quintet will probably require a 12-inch scope and dark skies. The

Deep-Sky Objects in the Spring Sky

Object	R. A. (2000.0)	Dec.	Mag.	Size/Sep.	Type	Notes
IC 10	00h20.4m	+59° 18'	10.4	6.3 by 5.1	IBm	
M31	00h42.7m	+41° 16'	3.4	190.5 by 61.7	SA(s)b	
Maffei I	02h36.6m	+59° 39'	11.4	0.6 by 0.5	S0 ⁻ pec:	
NGC 2685	08h55.6m	+58° 44'	11.3	4.5 by 2.3	(R)SB0 ⁺ pec	Helix Galaxy
M81	09h55.6m	+69° 04'	6.9	26.9 by 14.1	SA(s)ab	
M82	09h55.9m	+69° 41'	8.4	11.2 by 4.3	I0	
NGC 4038	12h01.9m	-18° 52'	10.3	5.2 by 3.1	SB(s)m pec	Antennae
NGC 4039	12h01.9m	-18° 53'	10.6	3.1 by 1.6	SA(s)m pec	Antennae
M84	12h25.1m	+12° 53'	9.1	6.5 by 5.6	E1	Virgo Cluster
M86	12h26.2m	+12° 57'	8.9	8.9 by 5.8	E3	Virgo Cluster
NGC 4485	12h30.5m	+41° 42'	11.9	2.3 by 1.6	IB(s)m pec	
NGC 4490	12h30.6m	+41° 38'	9.8	6.3 by 3.1	SB(s)d pec	Cocoon Galaxy
M87	12h30.8m	+12° 24'	8.6	8.3 by 6.6	E ⁺ 0-1 pec	Virgo A
M104	12h40.0m	-11° 37'	8.0	8.7 by 3.5	SA(s)a	Sombrero Galaxy
NGC 4889	13h00.1m	+27° 59'	11.5	2.9 by 1.9	E ⁺ 4	Coma Cluster
NGC 5128	13h25.5m	-43° 01'	6.8	25.7 by 20.0	S0 pec	Centaurus A
M83	13h37.0m	-29° 52'	7.5	12.9 by 11.5	SAB(s)c	
NGC 6045	16h04.6m	+17° 43'	13.3	1.3 by 1.1	SB0 ^b	Hercules Cluster
NGC 6166	16h28.6m	+39° 33'	11.8	1.9 by 1.4	E ⁺ 2 pec	Abell 2199
NGC 6240	16h53.0m	+02° 24'	12.9	2.1 by 1.1	I0: pec	
NGC 7320	22h36.1m	+33° 57'	12.6	2.2 by 1.1	SA(s)d	Stephan's Quintet

Object: Designation in NGC or other catalog. **R. A. (2000.0)** and **Dec.:** Right ascension and declination in epoch 2000.0 coordinates.

Mag.: Visual magnitude. **Size/Sep.:** Size in degrees, arcminutes, or arcseconds, separation in arcseconds.

brightest member, NGC 7320, appears as a small, faint oval. Less than 2' northwest lies NGC 7318, a pair of intertwined spirals containing two stellar nuclei within a common halo.

Backyard telescopes have access to two well-studied clusters: the **Coma Cluster** (Abell 1656) and the **Hercules Cluster** (Abell 2151). The Coma Cluster is a rich, concentrated cloud of hundreds of galaxies about 350 million light-years away. A pair of supergiant cD galaxies, NGC 4874 and NGC 4889, dominate the cluster's core, attended by a retinue of dwarf ellipticals and lenticulars. Over time, a hot intracluster medium glowing with x rays has stripped the spirals of their gas. A few are visible in 6- to 8-inch scopes. But the Coma Cluster really comes into its own with a large scope. In a 16 inch, the field centered on NGC 4874 and NGC 4889 looks like a swarm of bees hovering around two hives with up to two dozen galaxies visible in a 20' circle.

Of the two presiding giants, NGC 4889 is both slightly brighter and larger. In a 13-inch scope, the galaxy appears as a moderately bright oval oriented east-west with several diminutive companions huddled within a few arcminutes. NGC 4874 lies just 6' south of a 7th-magnitude star. The roundish, 1.5' glow is only weakly concentrated, but more impressive is the compact halo of many tiny, dim galaxies. Careful viewing can net at least 100 galaxies spread out over several fields in a 16-inch scope.

In contrast, the Hercules Galaxy Cluster is a remarkably diverse collection of spirals, ellipticals, irregulars, and distorted interacting pairs. This sprawling cluster lacks the high degree of organization and central concentration found in the Coma Cluster but maintains a high percentage of gas-rich spirals. At a distance of roughly 550 million light-years, the Hercules Cluster is a challenging visual target even in 12- to 16-inch scopes, so wait for a night of exceptional transparency and plan your attack carefully.

Our jumping-off point is the 7th-magnitude star SAO 101900. Just 10' east-southeast you'll find the interacting system, NGC 6040. The companion may require a 16-inch



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Above: Five bright galaxies compose the group Stephan's Quintet. The biggest galaxy, NGC 7320, is closer to us than the other four.

Left: Most clusters are comprised mostly of elliptical galaxies, but the Hercules Cluster offers an unusually large number of spirals.



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scope and is found dangling off the south edge. Nearby is a similar double system, NGC 6041 and NGC 6042.

Just 8' away from NGC 6041, lies another dim trio with NGC 6045 as its centerpiece. This distorted edge-on spiral has NGC 6043 and NGC 6047 as its companions. The intertwined pair of spirals, NGC 6050 and IC 1179, swirl nearby, followed by a string of three IC galaxies oriented north-south. A keen observer with a 16-inch scope may glimpse up to three dozen members within 30' of the central region.

Now that wasn't so bad, was it? And this was just the edge of the celestial forest. A thicket of springtime galaxies awaits your discovery. All you have to do is walk in. **A**

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