

Virgo the Virgin

Virgo is one of the constellations of the zodiac, the group of 12 constellations that lies on the ecliptic plane defined by the planets orbital orientation around the Sun. Virgo is one of the original 48 constellations charted by Ptolemy. It is the largest constellation of the Zodiac and the second-largest constellation after Hydra. Virgo is bordered by the constellations of Bootes, Coma Berenices, Leo, Crater, Corvus, Hydra, Libra and Serpens Caput. The constellation of Virgo is highly populated with galaxies and there are several galaxy clusters located within its boundaries, each of which is home to hundreds or even thousands of galaxies. The accepted abbreviation when enumerating objects within the constellation is Vir, the genitive form is Virginis and meteor showers that appear to originate from Virgo are called Virginids.

A very brief and incomplete elucidation on the MYTH and HISTORY of Virgo

In astronomy we deal with rather large timeframes, similarly the history of constellations resides on a relatively vast time scale and comes with broad uncertainties. It seems fair to assert that much of the western lore surrounding the constellations come from the Sumerian and Mesopotamian civilizations, approximately six thousand years ago, with the invention of agriculture, writing, astronomy/astrology, mathematics and the wheel - the zodiac being the wheel of fortune. The first incarnation of the constellation of Virgo is the Mesopotamian grain goddess Nidoba, which is consistent with the view of Virgo being the self-sustaining, life-giving caretaker that most Virgo mythology follows. According to the Babylonian Mul.Apin, a treatise on astrology / astronomy which dates from 1000-686 BC, this constellation was known as "The Furrow", representing the goddess Shala and her ear of grain. Somewhat later, belief systems moved towards the Babylonian Nabu, god of wisdom and justice. Ishtar, the Babylonian goddess of procreation, has also been linked to Virgo mythology. In more modern times, such as the Hellenistic period some 2,500 years ago we have Virgo associated with Persephone the goddess of the harvest as well as Astraea or Dike, the caretaker and justice-giver of humanity. According to myth Astraea was a virgin in life and after leaving Earth, tired of taking care of a humanity that insisted on destroying itself, she is said to have been "placed in the heavens". Perhaps why some mythologists believe her to be the constella-

tion Virgo itself. There is also the connection here with "The Scales of Justice" and the sign Libra which lies next to Virgo in the Zodiac. The study of astronomy had a practical "time keeping" aspect in the cultures of ancient history and as the stars of Virgo appeared before sunrise late in the northern summer, many cultures linked this asterism with crops, harvest and fecundity.

Virgo is usually depicted with angel-like wings, with an ear of wheat in her left hand, marked by the bright star Spica, which is Latin for "ear of grain", and a tall blade of grass, or a palm frond, in her right hand. Spica will be important for us in navigating Virgo in the modern night sky. Spica was most likely the star that helped the Greek astronomer and mathematician Hipparchus "discover" precession of the equinoxes in 127 BC. Precession of the equinoxes, or axial precession, is the gradual change in the orientation of Earth's axis of rotation. Hipparchus measured the longitude of bright stars, Spica and Regulus in Leo among others, and when he compared the data to measurements of his predecessor, the Alexandrian Timochares about 300 B.C, he found that Spica had moved 2° relative to the autumnal equinox (astronomical event around September 22 when the tilt of the earth's axis is inclined neither away from nor towards the Sun, with the centre of the Sun in the same plane as the Earth's equator). Nicolaus Copernicus, who was the first



to propose a comprehensive heliocentric cosmology, displacing the Earth from the centre of the universe, also made numerous observations of Spica while researching precession. Perhaps it should be mentioned that Babylonian records, and the temple orientation of Egypt and Greece, may indicate a far earlier practical knowledge of precession. Spica was also an important star for navigating ships with the sextant before the introduction of GPS.

Locating and Navigating Virgo

Virgo's group of stars doesn't lend itself to a well-defined pattern. It can be difficult for many people to make out the winged maiden holding an ear of wheat in her left hand. As an aid to locating and navigating this constellation first become familiar with the bright star Spica which, as the sixteenth brightest star in the night sky, is clearly visible during the dusk hours in April rising just above the eastern horizon. Then become somewhat familiar with the general figure of the constellation and its named stars, as shown in the chart on the previous page. Spica sets in the west at dawn. Very generally speaking, for astrophotography, the darkest skies are around midnight on a new moon and the clearest region of seeing is above 60 degrees of elevation. Considering these factors April and May are the optimal times for photographing objects in Virgo, although they will never rise above 45 degrees in elevation at Perth region latitudes. A good excuse for an autumn holiday in Weipa or Darwin where Virgo will be almost directly overhead (zenith). The included Stellarium star map shows Virgo as it appears around 10pm in early April

Major stars in Virgo

Spica – α Virginis (Alpha Virginis) - is the brightest star in Virgo and the 16th brightest star in the sky. It has an apparent magnitude of between 0.97 and 1.04. It is a rotating ellipsoidal variable star, which is to say a non-eclipsing close binary star system in which the two components do not eclipse each other but are mutually distorted through their gravitational interaction. The varying amount of distortion changes the effective radiation area of the star and therefore changes the brightness (that is the quick and partial explanation). It is one of the nearest massive double stars to the solar system. The primary star is midway between the subgiant and giant stage of evolution, about 12,000 times brighter than the Sun and one of the nearest stars sufficiently evolved and massive enough to explode as a Type II supernova. (RA 13:25:11.6 DEC -11:09:40.8)

Zavijava – β Virginis (Beta Virginis) - belongs to the spectral class F9V and is only 35.65 light years distant from the Sun. Even though it is designated beta, at magnitude 3.6 it is only the fifth brightest star in the constellation. (RA 11:50:41.7 DEC +1:45:53)

Porrira – γ Virginis (Gamma Virginis) - is considered a binary or multiple star system with visual magnitude of

2.7. The primary stars in the Gamma Virginis system are of the spectral type F0V and have similar visual magnitudes, 3.65 and 3.56. These two stars are virtually identical in size, colour and brightness and reportedly a magnificent star pair for those that like splitting doubles, currently at a bit less than 3 arcseconds separation. (RA 12:41:39.6 DEC -01:26:57.7)

Auva – δ Virginis (Delta Virginis) - is a red giant belonging to the spectral class M3 III with an apparent magnitude of 3.4 visible without binoculars. Delta Virginis is a high-velocity star, moving at the speed of more than 30 km/sec relative to the motion of the neighbouring stars. The star is classified as a semi-regular variable and its brightness varies between 3.32 and 3.40. It is a suspected binary star with an 11th magnitude star – a K-type dwarf – located 80 arc seconds away. (RA 12:55:36.2 DEC +03:23:50.9)

Vindemiatrix – ϵ Virginis (Epsilon Virginis) - is the third brightest star in Virgo. It has a visual magnitude of 2.8. The star is a giant belonging to the spectral class G8 III. It is about 77 times more luminous than the Sun. (RA 13:02:10.6 DEC +10:57:32.9)

Heze – ζ Virginis (Zeta Virginis) - is a main sequence star of the spectral type A3 V. It has an apparent magnitude of 3.4 and is naked eye visible. (RA 13:34:41.6 DEC -00:35:45)

Zaniah – η Virginis (Eta Virginis) - is a triple star system in Virgo. It has a visual magnitude of 3.9 and can also be seen with the naked eye. It belongs to the spectral class A2 V. The three stars form a very close system and can't be resolved in a telescope. (RA 12:19:54.4 DEC -00:40:00.5)

Syrma – ι Virginis (Iota Virginis) - belongs to the spectral class F6 III with an apparent magnitude of 4.1 (RA 14:16:00.9 DEC -06:00:02.0)

Rijl al Awwa, Rijlawwa – μ Virginis (Mu Virginis) - is a yellow star belonging to the spectral class F2III. It has an apparent magnitude of 3.9. (RA 14:43:03.6 DEC -05:39:29.5)

70 Virginis is a yellow dwarf of the spectral type G2.5Va. It has a visual magnitude of 5.0. The star is believed to be evolving into a subgiant because it is brighter than most stars of its spectral type. An extrasolar planet was discovered in the star's orbit in 1996. (RA 13:28:25.8 DEC +13:46:43.6)

χ Virginis (Chi Virginis, 26 Vir) is another multiple star system in Virgo with an apparent magnitude of 4.7, which makes it visible to the naked eye in good seeing conditions. Chi Virginis belongs to the spectral class K2 III, which means that it is an orange giant, one that has a mass double that of the Sun. Its radius is 23 times solar and it is 182 times more luminous than the Sun. The

primary star in the system has three visual companions, a K0-type star with a visual magnitude of 9.1 about 173.1 arc seconds away, a 10th magnitude star 221.2 arc seconds away, and a K2-type star with a magnitude of 9.1, located 321.2 arc seconds away. A massive planet was discovered in the star's orbit in July 2009. It has a mass at least 11 times that of Jupiter and it orbits the star with a period of 835 days. (RA 12:39:14.8 DEC -07:59:44.0)

61 Virginis is a yellow main sequence dwarf belonging to the spectral class G5V with a visual magnitude of 4.7. 61 Virginis is the first well established yellow dwarf almost identical to the Sun with a potential Super Earth, an extrasolar planet more massive than Earth but considerably below the mass of the smaller gas giants, Uranus and Neptune, in its orbit. (RA 13:18:24.3 DEC -18:18:53)

109 Virginis is a white main sequence dwarf of the spectral type A0V. It has a visual magnitude of 3.7, which makes it the seventh brightest star in the constellation. (RA 14:46:14.9 DEC +01:53:34)

ν Virginis (Nu Virginis) is a red giant belonging to the spectral class M1IIIab. It is a semi-regular variable star with a mean apparent magnitude of 4. Its brightness varies by 0.06 magnitudes. (RA 11:45:51.6 DEC +06:31:42)

Exoplanets

As of 2015 there were 35 verified exoplanets orbiting 29 stars in Virgo including the first exoplanet discovered orbiting a pulsar.

Deep Space Objects

Virgo is a galaxy lovers cornucopia, containing a huge galaxy cluster that subtends 8 degrees of arc and contains somewhere between 1,300 – 2,000 galaxies. For perspective 8 degrees of arc is approximately 16 times the diameter of the Moon as we see it. Many of these galaxies are bright enough and large enough to be easily observed in small telescopes and afford an ideal opportunity for some galaxy photography. The cluster is a rather non-uniformly distributed collection of elliptical, spiral and lenticular galaxies. The elliptical galaxies being more centrally located and the spirals extending outward in a roughly prolate extension, approximately four times as long as it is wide, along the line of sight from our Milky Way. This large cluster has been further subdivided into four smaller groupings tentatively specified as; Virgo A being centered around M87, Virgo B around M49, Virgo C around M60 and a Low Velocity Cloud around the large spiral galaxy NGC 4216, as well as other structures at greater distance from these main groups. These subgroups, and even more distant galaxies, are believed to be in the process of merging to form a larger single cluster in the future. The Virgo cluster itself is believed to be a subset of an even more vast grouping termed The Virgo Supercluster. The Virgo Cluster's intracluster medium, the space between the galaxies, is not empty but filled with plasma so hot that it emits X-rays. Within this plasma

cloud are found large numbers of intergalactic stars, planetary nebula, globular clusters and at least one star formation region. For the sake of personal navigation, the main portion of this cluster is next to Virgo's right shoulder at the place where the ear of grain has been harvested from the long blade of grass Virgo is holding in her right hand. Perhaps the ancient ones had better night vision than us moderns – they certainly would have had less light pollution in their skies.

Described next are some of the more notable galaxies suitable for observers and photographers with modest amateur rigs. All the galaxies with an M prefix are of course Messier objects discovered by Charles Messier, Johann Gottfried Koehler, Barnabus Oriani, Pierre Méchain, William Herschel and other astronomers in the latter part of the 18th century.

M49 (NGC4472) is an elliptical galaxy of magnitude 8.4 with a span of 10 arcminutes located about 56 million light years from Earth. It is the brightest member of the Virgo cluster and the first to be discovered. Visible as a distinct smudge in binoculars, it is easily observed and photographed as an elliptical galaxy with smaller galaxies and clusters in the field of view. There are many globular clusters, estimated at around 6,000, orbiting M49. One cluster, UGC 7636, is being stripped of matter and hydrogen gas by its gravitational interaction with M49 according to spectroscopic studies. Other clusters around M49 are suspected of containing black holes. M49 has a general physical form that would suggest it be a strong radio galaxy, but observations show radio emissions typical of average galaxies. The nucleus of this galaxy emits X-rays suggesting the presence of a supermassive black hole at its core. Located on Virgo's shoulder 4 degrees from Vindemiatrix. (RA 12:29:46 DEC +08:00:02)

M87 (NGC 4486) is the largest galaxy in the Virgo cluster and one of the most massive galaxies in the local universe. It is a super bright elliptical galaxy at a distance of 60 Mly from Earth, is clearly visible in binoculars at magnitude 8.6 extending across an angular area of 7.2×6.8 arcminutes with a bright 45 arcsecond core. It is notable for its large population of 12,000 globular clusters and jet of energetic plasma that originates at the supermassive black hole core and extends at least 4,900 light-years, as visible in the image at the top of the next page (courtesy NOAO/AURA/NSF). This jet emits strong emissions in several different wavelengths making M87 one of the brightest sources of radio as well as a significant emitter of X-ray and other wavelengths of light. This highly perturbed jet has some energetic properties that are similar to neutron stars. All of this makes it a prime target of interest to astronomers who wish to observe black holes. Apparently, this jet may be observed by large amateur telescopes under ideal seeing conditions and was first observed visually through the 100-inch Hooker telescope by astronomer Otto Struve. M87 has one or more supermassive



at a dark site. Smaller apertures will of course provide less detail but M84 and M86 will be clearly visible even in modest binoculars. As a suggestion for photographers an 80mm refractor or fast 200mm Newtonian coupled with a crop sensor DSLR should capture the whole spectacle. (Approximately centred on M86 RA 12:26:12 DEC +12:56:46)

M59, M60 and NGC 4647, two elliptical galaxies and one face on spiral, provide another single view for similar sized equipment – the image below left shows M60 and NGC 4647, courtesy NOAO/AURA/NSF. M59 and M60 at magnitude 9.8 and 10.6 respectively should be easy to observe. NGC 4647 at magnitude 12.5 will be more of a challenge to visual observers but easy for photographers. This group is its

own little sub cluster within the greater Virgo cluster. (M60 & NGC 4647 RA 12:43:40 DEC +11:33:09 M59 RA 12:42:03 DEC +11:38:49)

black holes at its centre and gravitationally distorts orbiting and surrounding galaxies NGC 4476, NGC 4478, NGC 4486A, and NGC4486B. M87 is surrounded by a corona of hot gas. (RA 12 : 30:49 Dec +12 : 23:28)

Not far from M87 is a collection of galaxies arrayed in a pair of “chain-like” structures called “Markarian’s Chain”, included here are M84, M86, NGC4438, NGC4435, NGC4425, NGC4402, NGC4388, NGC4413, NGC4473, NGC4461 and NGC4477. This mixed collection of elliptical and spiral galaxies is visible to amateur observers with good-sized telescopes as one view in a long focal length eyepiece. A 200mm Newtonian or a 100mm refractor with a 30 - 40mm wide angle eyepiece should suffice in providing excellent views to dark adapted eyes

M104 (NGC 4594) is a real charmer as shown in the image at the top of the next page (courtesy Todd Boroson/NOAO/AURA/NSF). The Sombrero Galaxy at magnitude 8.0 spanning 8 x 3 arcseconds is an easy catch for visual observers with a shorter focal length eyepiece. A favourite of photographers with longer scopes or a good Barlow on more modest equipment. M104 is not part of the Virgo cluster and is a somewhat unusual spiral galaxy. It is located about 10° due west of Spica. M104, is an edge-on spiral galaxy, it has a bulge at its centre made up of older stars that are larger than normal. It is surrounded by a halo of large, bright globular clusters and has a very prominent dust lane made up of polycyclic aromatic hydrocarbons. Something very energetic is going on in the Sombrero’s centre, as much X-ray light has been detected from it. This X-ray emission coupled with unusually high central stellar velocities causes many astronomers to speculate that there is a black hole at the Sombrero’s centre a billion times the mass of our Sun. (RA 12:40:00 DEC -11:37:23)

Messier 61 (NGC 4303) is a spiral galaxy belonging to the Virgo Cluster and one of its larger member galaxies. It has an apparent magnitude of 9.7. Six supernovae have been discovered in the galaxy in the last hundred years: SN 1926A, SN 1961I, SN 1964F, SN 1999gn, SN 2006ov, and SN 2008in. (RA 12:21:55 DEC +4:28:25)

Messier 58 (NGC 4579) is a barred spiral galaxy in Virgo. It is one of the brightest galaxies in the Virgo Cluster, with an apparent magnitude around 9.7. Two supernovae have been observed in the galaxy: SN 1988A in January 1988 and SN 1989M in June 1989. (RA 12:37:43.5





13:00:31)

NGC 4216 is an intermediate spiral galaxy in the Virgo Cluster with visual magnitude of 10 and a span of 7' x 1'. The galaxy is metal-rich and shows a deficiency of neutral hydrogen in its optical disk, like most galaxies in the cluster. It is believed to be interacting with and absorbing two smaller satellite galaxies. (RA 12:15:54.4 DEC +13:08:58)

Siamese Twins (Butterfly Galaxies, Fish and Chips, NGC 4567 and NGC 4568) are a pair of spiral galaxies in the Virgo Cluster in the process of colliding with each other. Their apparent magnitude is around 11 spanning about 4' in total. A supernova was observed in the galaxies in 2004. (RA 12:36:34 DEC +11:14:17)

DEC +11:49:05)

Messier 89 (NGC 4552) is another elliptical galaxy belonging to the Virgo Cluster. It has a magnitude around 9.7 and span of 5 minutes of arc. There are about 2,000 globular clusters within 25' of the galaxy. For comparison, the Milky Way only has 150-200. M89 is suspected to once have been a radio galaxy or active quasar. It has a surrounding disk of gas and dust that extends about 150,000 light years from the galaxy and jets of hot particles extending about 100,000 light years outward. (RA 12:35:40 DEC+12:33:23)

Messier 90, a spiral galaxy with a visual magnitude of around 9.5 and a span of 9' x 4' is located about a degree and a half from the M87 subgroup. The galaxy's spiral arms are featureless and star forming regions appear truncated because of interaction with the intracluster medium in the Virgo Cluster. For this reason, M90 has been classified as an anaemic galaxy, a spiral characterized by a low contrast between the disk and the galaxy's spiral arms. It serves as the prototype for the class "anaemic galaxy". (RA 12:36:50 DEC +13:09:46)

Eyes Galaxies (NGC 4435 & NGC 4438, Arp 120) are a pair of interacting galaxies, as shown on the right (courtesy ESO), located in the Virgo Cluster with magnitudes around 11 & 10 respectively and spans of 3' x 2' and 3' x 1.5'. NGC 4435 is a barred lenticular galaxy. It contains several young stars in its central regions. The starburst activity is suspected to be a result of the interaction with the neighbouring galaxy NGC 4438. NGC 4438 has a distorted disk and tidal tails because of interactions with other galaxies, and it is difficult to classify it as a spiral or lenticular galaxy. (RA 12:27:46 DEC

NGC 4526 (The Lost Galaxy, The Hairy Eyebrow) is a lenticular galaxy. It belongs to the Virgo cluster. The galaxy has a visual magnitude of about 10.2 and has a span of about 5' x 2'. Two supernovae were discovered in the galaxy: SN 1969E in 1969 and SN 1994D in 1994 - the image at the top of the next page shows the galaxy with SN 1994D clearly visible at lower left (courtesy NASA/ESA). (RA 12:34:03 DEC +07:41:57)

Quasar 3C 273 was the first quasar ever to be identified. With a magnitude of 13 and the optically brightest quasar in the sky, it is the most distant celestial object average amateur astronomers are likely to see through their telescopes. 3C 273 is classified as a blazar, a very compact quasar associated with a suspected supermassive black hole at the centre of an active giant elliptical galaxy. (RA 12:29:06.7 DEC +02:03:09)



Meteor Showers

The Virginids are a group of meteor showers that occur between February and May each year. They appear as though they radiate from different stars in the constellation and the shower name indicates which star is nearest to where the meteors radiate out from.

- The pi Virginids occur between February 13 and April 8 peaking on March 3-9.
- The eta Virginids occur between February 24 and March 27 peaking on March 18/19.
- The theta Virginids occur between March 10 and April 21 peaking on March 20/21.
- The gamma Virginids occur between April 5 and April 21 peaking on April 14/15.
- The alpha Virginids occur between March 10 and May 6 peaking on April 7-18.
- The mu Virginids occur between 1-April and 12-May peaking on April 24.



Most of this meteor activity occurs with the gamma Virginids, an active and predictable shower of around 10 meteors per hour, and the mu Virginids with about 7 meteors per hour.

The next time of some clear skies grab your eyes, optics and cams; Virgo should prove herself to be well worth the effort of taking some time out from earthbound existence.

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