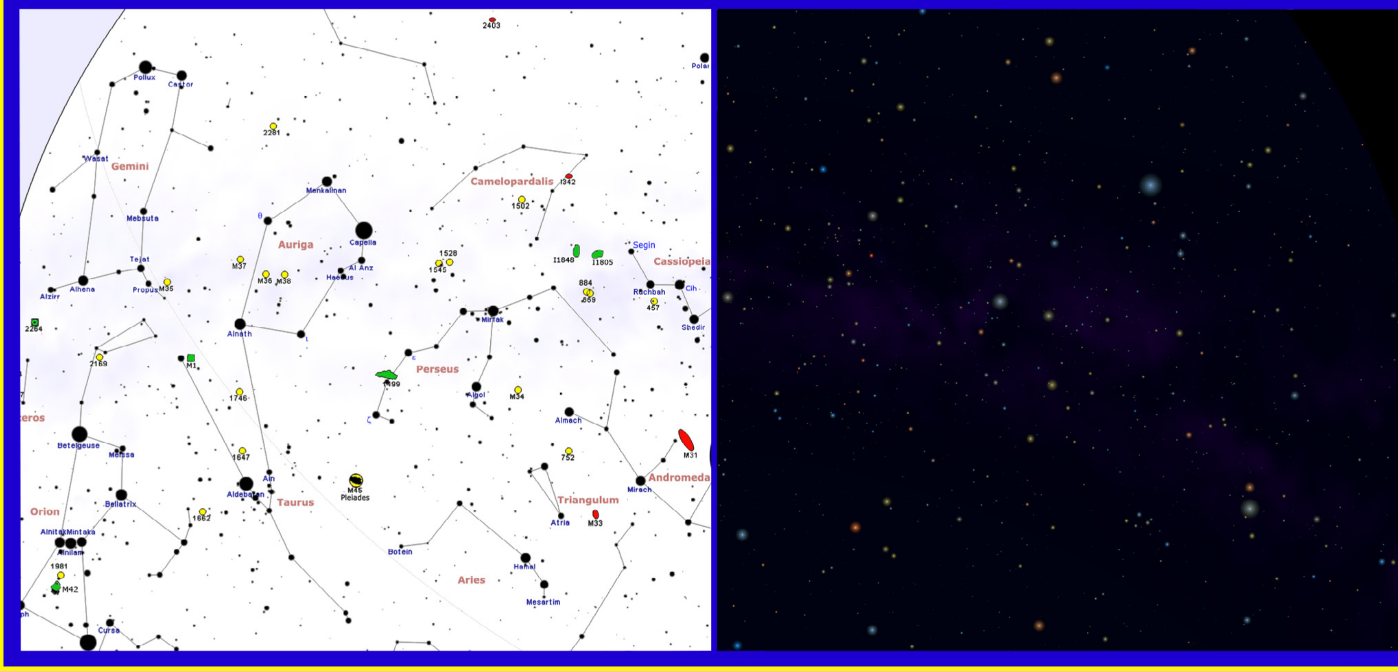
Roberto Mura

Observing the sky

from 40°N

A set of maps for northern observers



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Author of the book: Roberto Mura

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SYMBOLS

The tables make use of the following symbols:

 The best view of the star / the object is with binoculars.

 The star / the object is visible with binoculars, but the best view is with small telescopes.

 The star / the object is visible only with telescopes.

INTRODUCTION

The stars

The Jewel Box, a group of stars in Crux constellation. Each star show his own colour, depending on the surface temperature.

A **star** is a massive, luminous ball of plasma held together by gravity. Stars are formed within extended regions of higher density in the interstellar medium, although the density is still lower than the inside of an earthly vacuum chamber. These regions are called molecular clouds and consist mostly of hydrogen, with about 23–28% helium and a few percent heavier elements.

The formation of a star begins with a gravitational instability inside a molecular cloud, often triggered by shock waves from supernovae (massive stellar explosions) or the collision of two galaxies (as in a starburst galaxy). Once a region reaches a sufficient density of matter to satisfy the criteria for Jeans instability it begins to collapse under its own gravitational force. As the cloud collapses, individual conglomerations of dense dust and gas form what are known as Bok globules. As a globule collapses and the density increases, the gravitational energy is converted into heat and the temperature rises. When the protostellar cloud has approximately reached the stable condition of hydrostatic equilibrium, a protostar forms at the core. These pre-main sequence stars are often surrounded by a protoplanetary disk. The period of gravitational contraction lasts for about 10–15 million years.

Stars spend about 90% of their lifetime fusing hydrogen to produce helium in high-temperature and high-pressure reactions near the core. Such stars are said to be on the **main sequence** (MS) and are called *dwarf stars*. Starting at zero-age main sequence (ZAMS), the proportion of helium in a star's core will steadily increase. As a consequence, in order to maintain the required rate of nuclear fusion at the core, the star will slowly increase in temperature and luminosity. The duration that a star spends on the main sequence depends primarily on the amount of fuel it has to fuse and the rate at which it fuses that fuel, i.e. its initial mass and its luminosity. Large stars consume their fuel very rapidly and are short-lived. Small stars (called red dwarfs) consume their fuel very slowly and last tens to hundreds of billions of years. At the end of their lives, they simply become dimmer and dimmer. However, since the lifespan of such stars is greater than the current age of the universe (13.7 billion years), no red dwarfs are expected to have yet reached this state.

As stars of at least 0.4 solar masses exhaust their supply of hydrogen at their core, their outer layers expand greatly and cool to form a **red giant**. After the star has consumed the helium at the core, fusion continues in a shell around a hot core of carbon and oxygen. The star then follows an evolutionary path that parallels the original red giant phase, but at a higher surface temperature. During their helium-burning phase, very high mass stars with more than nine solar masses expand to form **red supergiants**. Once this fuel is exhausted at the core, they can continue to fuse elements heavier than helium. The final stage is reached when the star begins producing iron. Since iron nuclei are more tightly bound than any heavier nuclei, if they are fused they do not release energy. Likewise, since they are more tightly bound than all lighter nuclei, energy cannot be released by fission. In relatively old, very massive stars, a large core of inert iron will accumulate in the center of the star. The heavier elements in these stars can work their way up to the surface, forming evolved objects known as **Wolf-Rayet stars** that have a dense stellar wind which sheds the outer atmosphere.

An evolved, average-size star will now shed its outer layers as a planetary nebula. If what remains after the outer atmosphere has been shed is less than 1.4 solar masses, it shrinks to a relatively tiny object (about the size of Earth) that is not massive enough for further compression to take place, known as a **white dwarf**.

In larger stars, fusion continues until the iron core has grown so large (more than 1.4 solar masses) that it can no longer support its own mass. This core will suddenly collapse as its electrons are driven into its protons, forming neutrons and neutrinos in a burst of inverse *beta decay*, or electron capture. The shockwave formed by this sudden collapse causes the rest of the star to explode in a **supernova**. Supernovae are so bright that they may briefly outshine the star's entire home galaxy. When they occur within the Milky Way, supernovae have historically been observed by naked-eye observers as "new stars" where none existed before. Most of the matter in the star is blown away by the supernova explosion, forming filaments. What remains will became a **neutron star** (which sometimes manifests itself as a pulsar or X-ray burster) or, in the case of the largest stars (large enough to leave a stellar remnant greater than roughly 4 solar masses), a **black hole**.

The blown-off outer layers of dying stars include heavy elements which may be recycled during new star formation. These heavy elements allow the formation of rocky planets. The outflow from supernovae and the stellar wind of large stars play an important part in shaping the interstellar medium.

Stars are classified by their spectral characteristics. The **spectral class** of a star is a designated class of a star describing the ionization of its chromosphere, what atomic excitations are most prominent in the light, giving an objective measure of the temperature in this chromosphere. Light from the star is analyzed by splitting it up by a diffraction grating, subdividing the incoming photons into a spectrum exhibiting a rainbow of colors interspersed by absorption lines, each line indicating a certain ion of a certain chemical element. The presence of a certain chemical element in such an absorption spectrum primarily indicates that the temperature conditions are suitable for a certain excitation of this element. If the star temperature have been determined by a majority of absorption lines, unusual absences or strengths of lines for a certain element may indicate an unusual chemical composition of the chromosphere.

Most stars are currently classified using the letters **O**, **B**, **A**, **F**, **G**, **K** and **M**, where O stars are the hottest and the letter sequence indicates successively cooler stars up to the coolest M class. According to an informal tradition:
O stars are "blue";
B stars are "blue-white";
A stars are "white";
F stars are "yellow-white";
G stars are "yellow";
K stars are "orange";
M stars are "red".
This even though the actual star colors perceived by an observer may deviate from these colors depending on visual conditions and individual stars observed.

In the current star classification system, the spectrum letter is enhanced by a number from **0** to **9** indicating tenths of the range between two star classes, so that A5 is five tenths between A0 and F0, but A2 is two tenths of the full range from A0 to F0.

Another dimension that is included in this system is the luminosity class expressed by the Roman numbers **I**, **II**, **III**, **IV** and **V**, expressing the width of certain absorption lines in the star's spectrum. It has been shown that this feature is a general measure of the size of the star, and thus of the total luminosity output from the star.
Class I are called supergiants;
class I are called bright giants;
class III are called giants;
class IV are called subgiants;
class V are called either dwarfs or, more properly, main sequence stars.
Under this clasification system, our Sun has the spectral type G2V, which might be interpreted as *"a 'yellow' two tenths towards 'orange' main sequence star"*.

The most used designation for the brightest stars is the **Bayer designation**. Stars designed with this system show a Greek letter, followed by the genitive form of its parent constellation's Latin name. After the letter "omega", lower-case Latin leters are used, and then, upper case Latin letters.

Double stars

A **double star** is a pair of stars that appear close to each other in the sky as seen from Earth when viewed through an optical telescope. This can happen either because the pair forms a binary star, i.e. a binary system of stars in mutual orbit, gravitationally bound to each other, or because it is an optical double, a chance alignment of two stars in the sky that lie at different distances.

A **binary star** is a star system consisting of two stars orbiting around their common centre of mass. The brighter star is called the primary and the other is its companion star, comes, or secondary. Binary stars are classified into four types according to the way in which they are observed: visually, by observation; spectroscopically, by periodic changes in spectral lines; photometrically, by changes in brightness caused by an eclipse; or astrometrically, by measuring a deviation in a star's position caused by an unseen companion.

A **visual binary** star is a binary star for which the angular separation between the two components is great enough to permit them to be observed as a double star in a telescope, or even high-powered binoculars. The brighter star of a visual binary is the *primary* star, and the dimmer is considered the *secondary*. A particular class of binary stars is the **eclipsing binary**; in this system the orbit plane of the two stars lies so nearly in the line of sight of the observer that the components undergo mutual eclipses. In the case where the binary is also a spectroscopic binary and the parallax of the system is known, the binary is quite valuable for stellar analysis. Eclipsing binaries so appear as variable stars, not because the light of the individual components vary but because of the eclipses.

A star system can be composed by three, or more stars gravitally bounded each other. In this case the system il called **multiple star**.

Variable stars

A **variable star** is a star which shows a changement of its apparent brightness over time. Many, possibly most, stars have at least some variation in luminosity: the energy output of our Sun, for example, varies by about 0.1% over an 11 year solar cycle, equivalent to a change of one thousandth of a magnitude.

Variable stars may be either intrinsic or extrinsic. The **intrinsic variable** stars are stars where the variability is being caused by changes in the physical properties of the stars themselves. This category can be divided into three subgroups:
- ***Pulsating variables***, stars whose radius alternately expands and contracts as part of their natural evolutionary aging processes. Classical Cepheides variables, semiregular variables and Mira variables belong to this subgroup.
- ***Eruptive variables***, stars who experience eruptions on their surfaces like flares or mass ejections. Young pre-main sequence stars, Wolf-Rayet stars, luminous blue variables and Gamma Cassiopeiae variables belong to this subgroup.
- ***Cataclysmic or explosive variables***, stars that undergo a cataclysmic change in their properties like novae and supernovae.

The **extrinsic variable stars** are stars where the variability is caused by external properties like rotation or eclipses. There are two main subgroups.
- ***Eclipsing binaries***, double stars where, as seen from Earth's vantage point the stars occasionally eclipse one another as they orbit.
- ***Rotating variables***, stars whose variability is caused by phenomena related to their rotation. Examples are stars with extreme "sunspots" which affect the apparent brightness or stars that have fast rotation speeds causing them to become ellipsoidal in shape.

Open Clusters

An **open cluster** is a group of up to a few thousand stars that share the same origin and a similar age. They are loosely bound to each other by mutual gravitational attraction and become disrupted by close encounters with other clusters and clouds of gas as they orbit the galactic center resulting in being located within the main body of the galaxy, as well as losing cluster members through internal close encounters.

The formation of an open cluster begins with the collapse of part of a *giant molecular cloud*, a cold dense cloud of gas containing up to many thousands of times the mass of the Sun. Many factors may trigger the collapse of a giant molecular cloud (or part of it) and a burst of star formation which will result in an open cluster, including shock waves from a nearby supernova and gravitational interactions. Once a giant molecular cloud begins to collapse, star formation proceeds via successive fragmentations of the cloud into smaller and smaller clumps, resulting eventually in the formation of several hundreds or one thousand stars. In our own Galaxy, the formation rate of open clusters is estimated to be one every few thousand years.

Once star formation has begun, the hottest and most massive stars (stars of O and B spectral class, grouped in a **OB association**) will emit copious amounts of ultra-violet radiation. This radiation rapidly ionizes the surrounding gas of the giant molecular cloud, forming an **H II region**. Stellar winds from the massive stars and radiation pressure begin to drive away the gases; after a few million years the cluster will experience its first supernovae, which will also expel gas from the system. After a few tens of millions of years, the cluster will be stripped of gas and no further star formation will take place. Typically, less than 10% of the gas originally in the cluster will form into stars before it is dissipated.

Normally the OB associations are named after the constellation in which they lie; the typical designation of an OB asssociation is the nominative case of the constellation + OB + a number. The study of the OB associations is important to understand the star forming processes which take place in the regions of our Galaxy and in other galaxies.

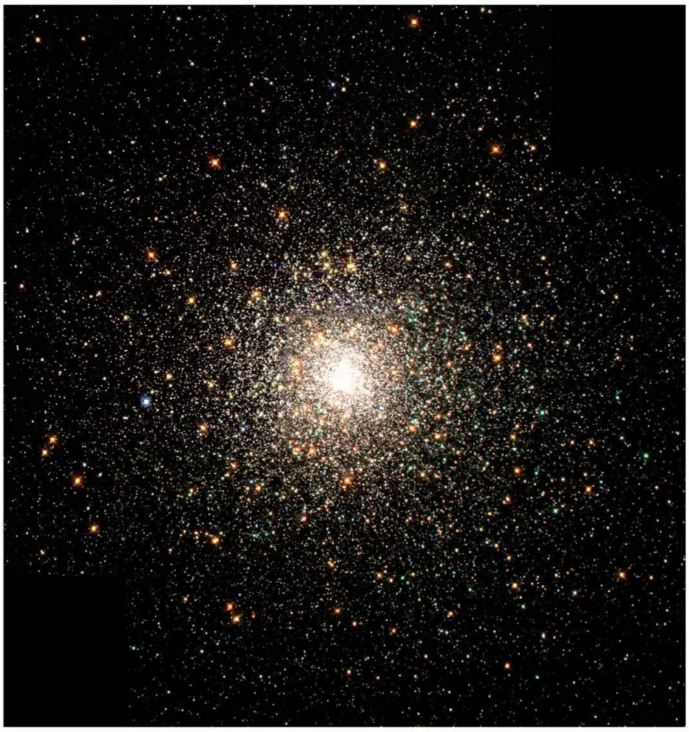
Because open clusters tend to be dispersed before most of their stars reach the end of their lives, the light from them tends to be dominated by the young, hot blue stars. These stars are the most massive, and have the shortest lives of a few tens of millions of years. So the older open clusters tend to contain more yellow stars. Some open clusters contain hot blue stars which seem to be much younger than the rest of the cluster. These blue stragglers are also observed in globular clusters, and in the very dense cores of globulars they are believed to arise when stars collide, forming a much hotter, more massive star. However, the stellar density in open clusters is much lower than that in globular clusters, and stellar collisions cannot explain the numbers of blue stragglers observed. Instead, it is thought that most of them proba-bly originate when dynamical interactions with other stars cause a binary system to coalesce into one star.

Many open clusters are inherently unstable, with a small enough mass that the escape velocity of the system is lower than the average velocity of the constituent stars. These clusters will rapidly disperse within a few million years. In many cases, the stripping away of the gas from which the cluster formed by the radiation pressure of the hot young stars reduces the cluster mass enough to allow rapid dispersal. Clusters which have enough mass to be gravitationally bound once the surrounding nebula has evaporated can remain distinct for many tens of millions of years, but over time internal and external processes tend also to disperse them. Internally, close encounters between members of the cluster will often result in the velocity of one being increased to beyond the escape velocity of the cluster, which results in the gradual 'evaporation' of cluster members.

After a cluster has become gravitationally unbound, many of its constituent stars will still be moving through space on similar trajectories, in what is known as a **stellar association**, moving cluster, or moving group. Several of the brightest stars in the 'Plough' of Ursa Major are former members of an open cluster which now form such an association, in this case, the Ursa Major moving group. Eventually their slightly different relative velocities will see them scattered throughout the galaxy. A larger cluster is then known as a stream, if we discover the similar velocities and ages of otherwise unrelated stars.

In the Milky Way Galaxy there are over 1,000 known open clusters, but the true total may be up to ten times higher than that. In spiral galaxies, open clusters are invariably found in the spiral arms, where gas densities are highest and so most star formation occurs, and clusters usually disperse before they have had time to travel beyond their spiral arms. Open clusters are strongly concentrated close to the galactic plane, with a scale height in our galaxy of about 180 light-years, compared to a galactic radius of approximately 100,000 light-years.

The Pleiades star cluster in constellation Taurus is the brightest open cluster in the sky; it lies in a dusty region of the Orion Spur, near the Taurus molecular cloud, and illuminates part of the surrounding dense interstellar matter, generating many small reflection nebulae.



M80 in Scorpius constellation, is one of the densest globular cluster known in the Milky Way Galaxy. It is composed by hundreds of thousands of stars.

Globular Clusters

A **globular cluster** is a spherical collection of stars that orbits a galactic core as a satellite. Globular clusters are very tightly bound by gravity, which gives them their spherical shapes and relatively high stellar densities toward their centres. Although it appears that globular clusters contain some of the first stars to be produced in the galaxy, their origins and their role in galactic evolution are still unclear. It does appear clear that globular clusters are significantly different from dwarf elliptical galaxies and were formed as part of the star formation of the parent galaxy rather than as a separate galaxy. However, recent conjectures by astronomers suggest that globular clusters and dwarf spheroidals may not be clearly separate and distinct types of objects.

In contrast to open clusters, most globular clusters remain gravitationally bound for time periods comparable to the life spans of the majority of their stars. However, a possible exception is when strong tidal interactions with other large masses result in the dispersal of the stars.

At present the formation of globular clusters remains a poorly understood phenomenon. It remains uncertain whether the stars in a globular cluster form in a single generation, or are spawned across multiple generations over a period of several hundred million years. This star-forming period is relatively brief, however, compared to the age of many globular clusters. Observations of globular clusters show that these stellar formations arise primarily in regions of efficient star formation, and where the interstellar medium is at a higher density than in normal star-forming regions. Globular cluster formation is prevalent in starburst regions and in interacting galaxies. After they are formed, the stars in the globular cluster begin to interact gravitationally with each other.

Most clusters increase steadily in luminosity as this distance decreases, up to a certain distance from the core, then the luminosity levels off. Typically this distance is about 1–2 parsecs from the core. However, about 20% of the globular clusters have undergone a process termed "core collapse". In this type of cluster, the luminosity continues to increase steadily all the way to the core region. Core-collapse is thought to occur when the more massive stars in a globular cluster encounter their less massive companions. As a result of the encounters, the larger stars tend to lose kinetic energy and start to settle toward the core. Over a lengthy period of time this leads to a concentration of massive stars near the core, a phenomenon called *mass segregation*.

Globular clusters have a very high star density, and therefore close interactions and near-collisions of stars occur relatively often. Due to these chance encounters, some exotic classes of stars, such as blue stragglers, millisecond pulsars and low-mass X-ray binaries, are much more common in globular clusters. A blue straggler is formed from the merger of two stars, possibly as a result of an encounter with a binary system. The resulting star has a higher temperature than comparable stars in the cluster with the same luminosity, and thus differs from the main sequence stars formed at the beginning of the cluster.

Of the globular clusters within our Milky Way, the majority are found in the vicinity of the galactic core, and the large majority lie on the side of the celestial sky centered on the core, between Scorpius, Ophiuchus, and Sagittarius constellations. There are about 150 to 158 currently known globular clusters in the Milky Way, with perhaps 10 to 20 more still undiscovered. Large galaxies can have more: Andromeda Galaxy, for instance, may have as many as 500. Some giant elliptical galaxies, particularly those at the centres of galaxy clusters, such as M87, have as many as 13,000 globular clusters. These globular clusters orbit the galaxy out to large radii, 40 kiloparsecs (approximately 131,000 light-years) or more. Every galaxy of sufficient mass in the Local Group has an associated group of globular clusters, and almost every large galaxy surveyed has been found to possess a system of globular clusters.

The Sagittarius Dwarf and Canis Major Dwarf galaxies, two small satellite galaxies of the Milky Way, appear to be in the process of donating their associated globular clusters (such as Palomar 12) to the Milky Way. This demonstrates how many of this galaxy's globular clusters were acquired in the past from other galaxies.

Bright Nebulae

A **bright nebula** (or **diffuse nebula**) is an interstellar cloud of dust, hydrogen gas, helium gas and other ionized gases. Many nebulae or stars form from the gravitational collapse of gas in the interstellar medium (ISM). As the material collapses under its own weight, massive stars may form in the centre, and their ultraviolet radiation ionises the surrounding gas, making it visible at optical wavelengths.

Diffuse nebulae are classified in three major groups: H II regions (emission nebulae), reflection nebulae, and supernova remnants.

H II regions

An **H II region** is a large cloud of gas and ionized gas of glowing low density in which star formation has recently taken place. The precursor to an H II region is a *giant molecular cloud* (GMC). A GMC is a cold and dense cloud consisting mostly of molecular hydrogen. GMCs can exist in a stable state for long periods of time, but shock waves due to supernovae, collisions between clouds, and magnetic interactions can all trigger the collapse of part of the cloud. When this happens, via a process of collapse and fragmentation of the cloud, the star formation takes place.

The most massive stars born within the nebulae will reach temperatures hot enough to ionise the surrounding gas. Soon after the formation of an ionising radiation field, energetic photons create an ionisation front, which sweeps through the surrounding gas at supersonic speeds. At greater and greater distances from the ionising star, the ionisation front slows, while the pressure of the newly ionised gas causes the ionised volume to expand. Eventually, the ionisation front slows to subsonic speeds, and is overtaken by the shock front caused by the expansion of the nebula.

The lifetime of an H II region is of the order of a few million years; radiation pressure from the hot young stars will eventually drive most of the gas away. In fact, the whole process tends to be very inefficient, with less than 10 per cent of the gas in the H II region forming into stars before the rest is blown away. Also contributing to the loss of gas are the supernova explosions of the most massive stars, which will occur after only 1–2 million years.

Spiral and irregular galaxies contain a lot of H II regions, while elliptical galaxies are almost devoid of them. In the spiral galaxies, including the Milky Way, H II regions are concentrated in the spiral arms, while in the irregular galaxies they are distributed chaotically. Some galaxies contain huge H II regions, which may contain tens of thousands of stars. The reason H II regions rarely appear in elliptical galaxies is that ellipticals are believed to form through galaxy mergers. In galaxy clusters, such mergers are frequent. When galaxies collide, individual stars almost never collide, but the GMCs and H II regions in the colliding galaxies are severely agitated. Under these conditions, enormous bursts of star formation are triggered, so rapid that most of the gas is converted into stars rather than the normal 10% or less.

A few of the brightest H II regions belonging to the Milky Way are visible to the naked eye, like the famous Orion Nebula, the Eta Carinae Nebula, and the Lagoon Nebula.

Reflection nebulae

A **reflection nebula** is a cloud of dust or gas which reflects the light of a nearby star. The energy from the nearby star, or stars, is insufficient to ionize the gas of the nebula to create an emission nebula, but is enough to give sufficient scattering to make the dust visible. Thus, the frequency spectrum (and the colour) shown by reflection nebulae is similar to that of the illuminating stars.

Many reflection nebulae shows a deep blue colour; this happens because the hot blue stars have enough energy to illuminate small clumps of gas at high distance, at the edge of the giant cloud in which these stars were formed, and because the scattering is more efficient for blue light than red (this is the same scattering process that gives us blue skies and red sunsets).

NGC 1977 in Orion constellation, is part of a great nebulous complex illuminated by the star 42 Orionis and other nearby stars. In the densest core of this nebula is active the star formation.

Examples of reflection nebulae are Messier 78 in Orion, and the small nebulous patches surrounding the stars of the Pleiades cluster.

Supernova remnants

A **supernova remnant** (SNR) is the structure resulting from the gigantic explosion of a star in a supernova. The supernova remnant is bounded by an expanding shock wave, and consists of ejected material expanding from the explosion, and the interstellar material it sweeps up and shocks along the way.

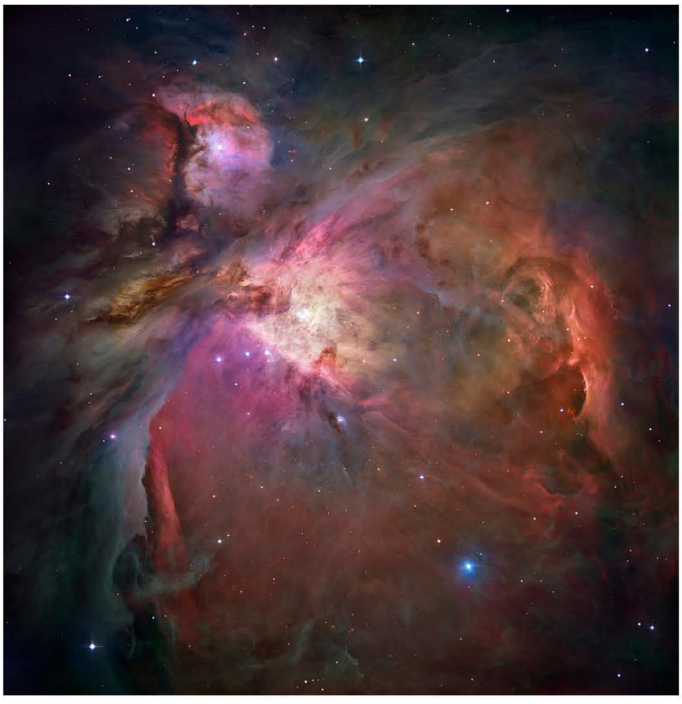
There are two possible routes to a supernova: either a massive star may run out of fuel, ceasing to generate fusion energy in its core, and collapsing inward under the force of its own gravity to form a neutron star or a black hole; or a white dwarf star may accumulate (accrete) material from a companion star until it reaches a critical mass and undergoes a thermonuclear explosion. In either case, the resulting supernova explosion expels much or all of the stellar material with velocities as much as 1% the speed of light, some 3,000 km/s. When this material collides with the surrounding circumstellar or interstellar gas, it forms a shock wave that can heat the gas up to temperatures as high as 10 million K, forming a plasma.

Supernova remnants normally show a shell-like shape and many filaments of gas; the shock wave originated from the explosion of a supernova may clean the surrounding environment, creating a *superbubble* in wich the density of the interstellar medium is very low.

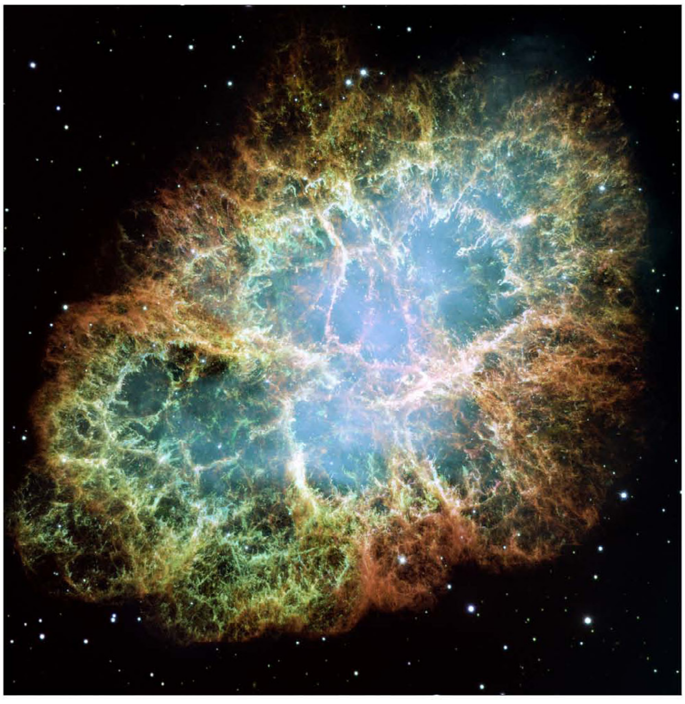
A supernova explosion can provide the shock wave required to comprime a nearby giant molecular cloud, creating the environment in which star formation can take place.

Examples of supernova remnants are Messier 1 (the Crab Nebula) in Taurus constellation, the Veil Nebula in Cygnus and the Vela Nebula, in Vela constellation.

The most famous and best-observed young supernova remnant was formed by SN 1987A, a supernova in the Large Magellanic Cloud that appeared in 1987 (and exploded approximately 168,000 years ago). The most recent remnant in our galaxy is G1.9+0.3, discovered in the galactic center and estimated to have gone supernova 140 years ago.



The Orion Nebula is one of the most famous example of H II region, a place in which star formation processes generated high-mass stars. These stars produce ultraviolet radiation, that ionize the surrounding hydrogen gas, which becames luminous and visible.



The Crab Nebula (Messier 1), in constellation Taurus, is one of the most famous and brightest supernova remnants. The massive star which originated this nebula became visible as supernova on 1054 AD and was recordered by ancient Chinese astronomers.

Planetary Nebulae

A **planetary nebula** is an emission nebula consisting of an expanding glowing shell of ionized gas ejected during the asymptotic giant branch phase of certain types of stars late in their life. This name originated because of their similarity in appearance to giant planets when viewed through small optical telescopes, and is otherwise unrelated to the planets of the solar system.

Stars weighing more than 8 solar masses will likely end their lives in a dramatic supernova explosion. Planetary nebula may result from the death of medium and low mass stars down to 0.8 solar masses. Medium to low mass stars run out of hydrogen in their cores after tens of millions to billions of years in the main sequence. When they run out of hydrogen, the compression of the core will cause the temperature to rise. The outer layers of the star expand enormously and become much cooler in response to the very high temperature of the core. The star becomes a red giant. The core continues to contract and heat up, and when its temperature reaches 100 million K, helium nuclei begin to fuse into carbon and oxygen. The resumption of fusion reactions stops the core's contraction. Helium burning soon forms an inert core of carbon and oxygen, with both a helium-burning shell and a hydrogen-burning shell surrounding it.

Helium fusion reactions cause the star to become very unstable. The helium-burning layer rapidly expands and therefore cools, which reduces the reaction rate again. Huge pulsations build up, which eventually become large enough to throw off the whole stellar atmosphere into space. This ejected gases form a cloud of material around the now-exposed core of the star. As more and more of the atmosphere moves away from the star, deeper and deeper layers at higher and higher temperatures are exposed. When the exposed surface reaches a temperature of about 30,000 K, there are enough ultraviolet photons being emitted to ionize the ejected atmosphere, making it glow. At the end of the process, the cloud has then become a planetary nebula.

Planetary nebulae play a very important role in galactic evolution. The early universe consisted almost entirely of hydrogen and helium, but stars create heavier elements via nuclear fusion. The gases of planetary nebulae thus contain a large proportion of elements such as carbon, nitrogen and oxygen, and as they expand and merge into the interstellar medium, they enrich it with these heavy elements, collectively known as metals by astronomers. Subsequent generations of stars which form will then have a higher initial content of heavier elements. Even though the heavy elements will still be a very small component of the star, they have a marked effect on its evolution. Stars which formed very early in the universe and contain small quantities of heavy elements are known as *Population II stars*, while younger stars with higher heavy element content are known as *Population I stars*.

Out of 200 billion stars, about 3000 planetary nebulae are now known to exist in our galaxy. Their very short lifetime compared to total stellar lifetime accounts for their rarity. They are found mostly near the plane of the Milky Way, with the greatest concentration near the galactic centre. Planetary nebulae have been also detected as members in four globular clusters: Messier 15, Messier 22, NGC 6441 and Palomar 6. However, there has yet to be an established case of a planetary nebula discovered in an open cluster as based on a consistent set of distances, reddenings, and radial velocities.

Only about 20% of planetary nebulae are spherically symmetric. A wide variety of shapes exist with some very complex forms seen. Planetary nebulae are classified by different authors into: stellar, disk, ring, irregular, helical, bipolar, quadrupolar, and other types. Although the majority of them belong to just three types: spherical, elliptical and bipolar. The nebulae of the last type show the strongest concentration to the galactic plane and their progenitors are therefore relatively young massive stars. On the other hand spherical nebulae are likely produced by the old stars similar to the Sun.

An example of planetary nebula is the Helix Nebula in Aquarius, that is also the biggest planetary nebula in the sky, because of its vicinity. Another example is the Ring Nebula (Messier 57) in Lyra constellation.

The Helix Nebula, also known as NGC 7293, lies near the southern edge of the Aquarius constellation. At a distance of 700 light-years, this is one of the closest and brightest planetary nebulae known. The central star is the remnant central core of the star which originates this nebula, and it is destined to became a white dwarf.

Galaxies

A **galaxy** is a massive, gravitationally bound system that consists of stars and stellar remnants, an interstellar medium of gas dust, and an important but poorly understood component tentatively dubbed dark matter. The name is from the Greek root galaxias, literally meaning "milky", a reference to the Milky Way galaxy.

Galaxies come in three main types: *ellipticals*, *spirals*, and *irregulars*. A slightly more extensive description of galaxy types based on their appearance is given by the **Hubble sequence**. Since the Hubble sequence is entirely based upon visual morphological type, it may miss certain important characteristics of galaxies such as star formation rate (in starburst galaxies) and activity in the core (in active galaxies).

The Hubble classification system rates **elliptical galaxies** on the basis of their ellipticity, ranging from **E0**, being nearly spherical, up to **E7**, which is highly elongated. These galaxies have an ellipsoidal profile, giving them an elliptical appearance regardless of the viewing angle. Their appearance shows little structure and they typically have relatively little interstellar matter. Consequently these galaxies also have a low portion of open clusters and a reduced rate of new star formation. Instead they are dominated by generally older, more evolved stars that are orbiting the common center of gravity in random directions. In this sense they have some similarity to the much smaller globular clusters.

The largest galaxies are indeed giant ellipticals. Many elliptical galaxies are believed to form due to the interaction of galaxies, resulting in a collision and merger. They can grow to enormous sizes (compared to spiral galaxies, for example), and giant elliptical galaxies are often found near the core of large galaxy clusters. Starburst galaxies are the result of such a galactic collision that can result in the formation of an elliptical galaxy.

Spiral galaxies consist of a rotating disk of stars and interstellar medium, along with a central bulge of generally older stars. Extending outward from the bulge are relatively bright arms. In the Hubble classification scheme, spiral galaxies are listed as type **S**, followed by a letter (**a**, **b**, or **c**) that indicates the degree of tightness of the spiral arms and the size of the central bulge. An Sa galaxy has tightly wound, poorly defined arms and possesses a relatively large core region. At the other extreme, an Sc galaxy has open, well-defined arms and a small core region.

In spiral galaxies, the spiral arms do have the shape of approximate logarithmic spirals, a pattern that can be theoretically shown to result from a disturbance in a uniformly rotating mass of stars. Like the stars, the spiral arms rotate around the centre, but they do so with constant angular velocity. The spiral arms are thought to be areas of high density matter, or "density waves". As stars move through an arm, the space velocity of each stellar system is modified by the gravitational force of the higher density. (The velocity returns to normal after the stars depart on the other side of the arm.) This effect is akin to a "wave" of slowdowns moving along a highway full of moving cars. The arms are visible because the high density facilitates star formation, and therefore they harbor many bright and young stars.

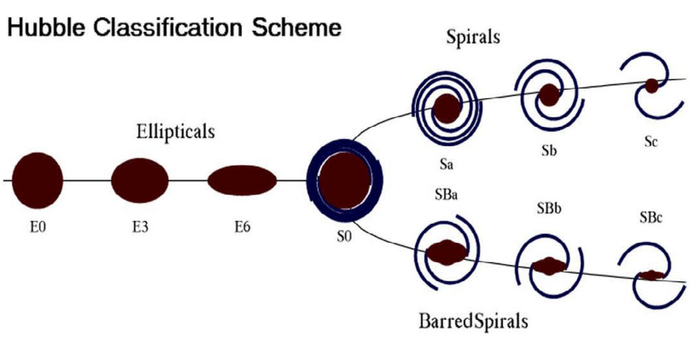
A majority of spiral galaxies have a linear, bar-shaped band of stars that extends outward to either side of the core, then merges into the spiral arm structure. In the Hubble classification scheme, these **barred spiral galaxies** are designated by an **SB**, followed by a lower-case letter (**a**, **b** or **c**) that indicates the form of the spiral arms (in the same manner as the categorization of normal spiral galaxies). Bars are thought to be temporary structures that can occur as a result of a density wave radiating outward from the core, or else due to a tidal interaction with another galaxy. Many barred spiral galaxies are active, possibly as a result of gas being channeled into the core along the arms.

There are many other morphologies of galaxies. **Peculiar galaxies**, for example, are galactic formations that develop unusual properties due to tidal interactions with other galaxies. An example of this is the ring galaxy, which possesses a ring-like structure of stars and interstellar medium surrounding a bare core. A ring galaxy is thought to occur when a smaller galaxy passes through the core of a spiral galaxy. Such an event may have affected the Andromeda Galaxy, as it displays a multi-ring-like structure when viewed in infrared radiation.

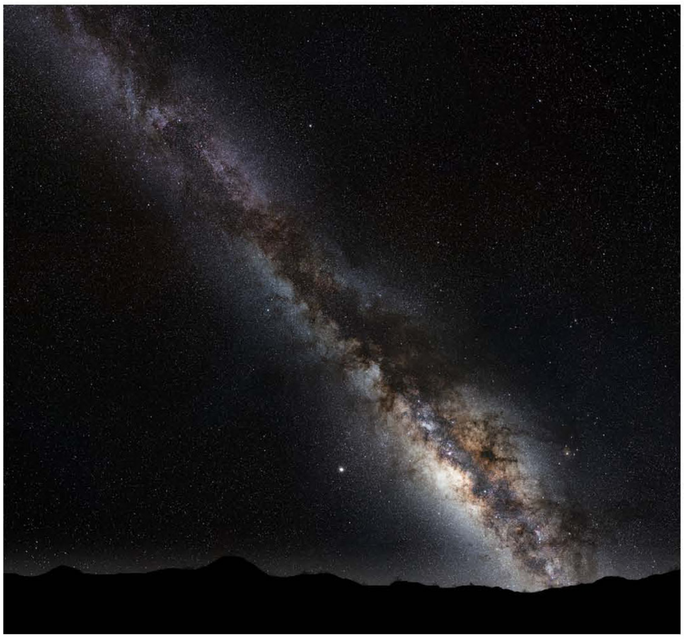
A **lenticular galaxy** is an intermediate form that has properties of both elliptical and spiral galaxies. These are categorized as Hubble type **S0**, and they possess ill-defined spiral arms with an elliptical halo of stars. (Barred lenticular galaxies receive Hubble classification **SB0**.)

In addition to the classifications mentioned above, there are a number of galaxies that can not be readily classified into an elliptical or spiral morphology. These are categorized as **irregular galaxies**. An **Irr-I** galaxy has some structure but does not align cleanly with the Hubble classification scheme. **Irr-II** galaxies do not possess any structure that resembles a Hubble classification, and may have been disrupted. Nearby examples of (dwarf) irregular galaxies include the Magellanic Clouds.

Despite the prominence of large elliptical and spiral galaxies, most galaxies in the universe appear to be **dwarf galaxies**. These galaxies are relatively small when compared with other galactic formations, being about one hundredth the size of the Milky Way, containing only a few billion stars. Ultra-compact dwarf galaxies have recently been discovered that are only 100 parsecs across. Many dwarf galaxies may orbit a single larger galaxy; the Milky Way has at least a dozen such satellites, with an estimated 300–500 yet to be discovered.



The Milky Way



The Milky Way Galaxy as seen from the Earth. The largest and brightest part is coincident with the galactic centre. The dark line along the Milky Way is the Cygnus Rift, an extended dark cloud complex.

The **Milky Way Galaxy** is the galaxy in which the Solar System is located. All the stars that the eye can distinguish in the night sky are part of the Milky Way Galaxy, but aside from these relatively nearby stars, the galaxy appears as a hazy band of white light arching around the entire celestial sphere. The light originates from stars and other material that lie within the galactic plane. Dark regions within the band, such as the Great Rift and the Coalsack, correspond to areas where light from distant stars is blocked by dark nebulae.

The centre of the galaxy lies in the direction of Sagittarius, and it is here that Milky Way looks brightest. From Sagittarius, the Milky Way appears to pass westward through the constellations of Scorpius, Ara, Norma, Triangulum Australe, Circinus, Centaurus, Musca, Crux, Carina, Vela, Puppis, Canis Major, Monoceros, Orion and Gemini, Taurus, Auriga, Perseus, Andromeda, Cassiopeia, Cepheus and Lacerta, Cygnus, Vulpecula, Sagitta, Aquila, Ophiuchus, Scutum, and back to Sagittarius. The fact that the Milky Way divides the night sky into two roughly equal hemispheres indicates that the Solar System lies close to the galactic plane.

The Milky Way consists of a bar-shaped core region surrounded by a disk of gas, dust and stars forming four distinct arm structures spiralling outward in a logarithmic spiral shape. The mass distribution within the galaxy closely resembles the **SBbc** Hubble classification, which is a **barred spiral galaxy** with relatively loosely wound arms.

The galactic disc, which bulges outward at the galactic centre, has a diameter of between 70,000 and 100,000 light-years. The distance from the Sun to the galactic centre is estimated at 26,000 ± 1,400 light-years.

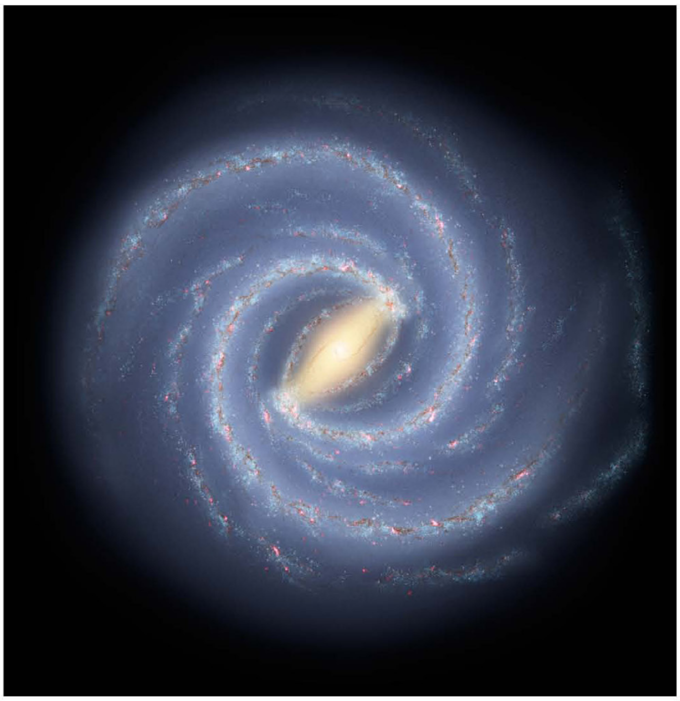


Illustration of the Milky Way Galaxy as seen from an external point of view. The bright bar is clearly evident, as well as the two main spiral arms, the Perseus Arm and the Scutum-Crux Arm. Many small arms and spurs are present, included the Orion Spur.

The **galactic centre** harbors a compact object of very large mass as determined by the motion of material around the centre. The intense radio source named Sagittarius A*, thought to mark the centre of the Milky Way, is newly confirmed to be a supermassive black hole.

The **galaxy's bar** is thought to be about 27,000 light-years long, running through its center at a 44 ± 10 degree angle to the line between the Sun and the center of the galaxy. It is composed primarily of red stars, believed to be ancient. The bar is surrounded by a ring called the "5-kpc ring" that contains a large fraction of the molecular hydrogen present in the galaxy, as well as most of the Milky Way's star formation activity. Viewed from the Andromeda Galaxy, it would be the brightest feature of our own galaxy.

The Milky Way possesses two major stellar **arms**: the **Perseus Arm** and the **Scutum-Crux Arm**. Others two long arms are the **Sagittarius Arm** and the **Cygnus Arm**, sometimes referred as the *Outer Arm*. Between the Sagittarius Arm and the Perseus Arm there is the **Orion Spur**, a small arm in which the Solar System is located. All these features lie on the galactic disk, that is the plane in which the spirals, bars and discs of *disc galaxies* (spirals and barred spirals galaxies) exist. Active star formation takes place in the disk (especially in the spiral arms, which represent areas of high density). Open clusters also occur primarily in the disk, as well as the H II regions.

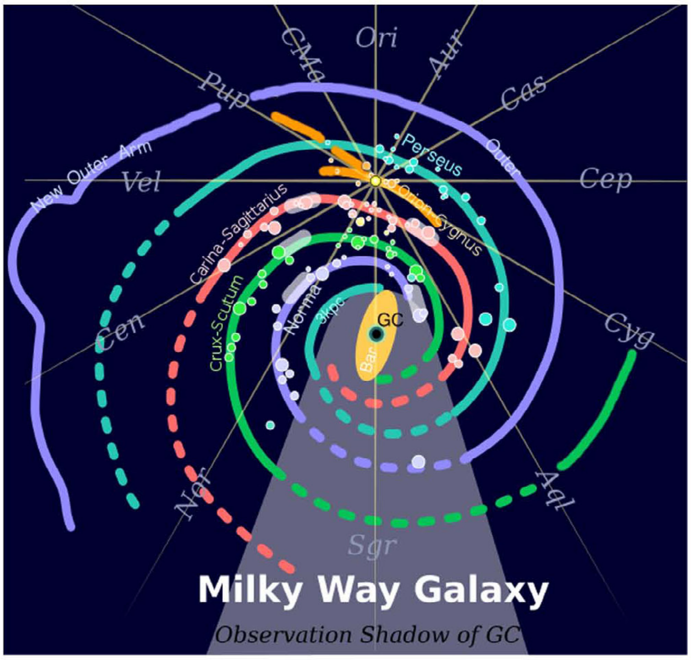
The galactic disk is surrounded by a spheroid **halo** of old stars and globular clusters, of which 90% lie within 100,000 light-years, suggesting a stellar halo diameter of 200,000 light-years. However, a few globular clusters have been found farther, such as PAL 4 and AM1 at more than 200,000 light-years away from the galactic centre. About 40% of these clusters are on retrograde orbits, which means they move in the opposite direction from the Milky Way rotation.

The *Milky Way* and the *Andromeda Galaxy* are a binary system of giant spiral galaxies belonging to a group of 50 closely bound galaxies known as the **Local Group**, itself being part of the **Virgo Supercluster** of galaxies.

Two smaller galaxies and a number of dwarf galaxies in the Local Group orbit the Milky Way. The largest of these is the **Large Magellanic Cloud**, with a diameter of 20,000 light-years. It has a close companion, the **Small Magellanic Cloud**. The Magellanic Stream is a peculiar streamer of neutral hydrogen gas connecting these two small galaxies. The stream is thought to have been dragged from the Magellanic Clouds in tidal interactions with the Milky Way.

Some of the dwarf galaxies orbiting the Milky Way are Canis Major Dwarf (the closest), Sagittarius Dwarf Elliptical Galaxy, Ursa Minor Dwarf, Sculptor Dwarf, Sextans Dwarf, Fornax Dwarf, and Leo I Dwarf. The smallest Milky Way dwarf galaxies are only 500 light-years in diameter. These include Carina Dwarf, Draco Dwarf, and Leo II Dwarf. There may still be undetected dwarf galaxies, which are dynamically bound to the Milky Way, as well as some that have already been absorbed by the Milky Way, such as Omega Centauri. Observations through the zone of avoidance are frequently detecting new distant and nearby galaxies. Some galaxies consisting mostly of gas and dust may also have evaded detection so far.

Current measurements suggest the Andromeda Galaxy is approaching us at 100 to 140 kilometers per second. The Milky Way may collide with it in 3 to 4 billion years, depending on the importance of unknown lateral components to the galaxies' relative motion. If they collide, individual stars within the galaxies would not collide, but instead the two galaxies will merge to form a single elliptical galaxy over the course of about a billion years.



A map of Milky Way as seen from far Galactic North (in Coma Berenices). The star-like lines center in a yellow dot representing the position of Sun. The spokes of that "star" are marked with constellation abbreviations, "Cas" for "Cassiopeia", etc. The spiral arms are colored differently in order to highlight what structure belongs to which arm.

The Perseus Arm is marked in cyan.
The Sagittarius Arm is marked in green.

The Cygnus (Outer) Arm is marked in purple.
The Scutum-Crux Arm is marked in red.

The Orion Spur is marked in orange; it is one of the small-scale structure of the Milky Way. It seems to divide itself into two parts in direction of Puppis constellation, one following the main direction of the other arms and one crossing the Perseus Arm.

The constellations

A **constellation** is a group of celestial bodies, usually stars, which appear to form a pattern in the sky. Astronomers today still utilize the term, though the current system focuses primarily on constellations as grid-like segments of the celestial sphere rather than as patterns. A star-pattern that is not officially classed as a constellation is referred to as an asterism. One famous example is the asterism known as the *Big Dipper*, a term unused by the International Astronomical Union (IAU) as the stars are considered part of the larger constellation of Ursa Major.

In 1922, Henry Norris Russell aided the IAU in dividing the celestial sphere into 88 official constellations. Typically, these modern constellations share the names of their Graeco-Roman predecessors, such as Orion, Leo and Scorpius. While such celestial formations were originally linked to a mythical event, creature or person, the categorization of the night sky into recognizable patterns was important in early land and naval navigation prior to the invention of the compass during the Age of Discovery. With the technical advancement of astronomy, it became important to move from a pattern-based system of constellations to one based on area-mapping, which led to several historic formations becoming obsolete.

In 1930, the boundaries between the 88 official constellations were devised by Eugène Delporte along vertical and horizontal lines of right ascension and declination.from which 37 belong to northen hemisphere and 51 to southern hemisphere. However, the data he used originated back to epoch B1875.0, which was when Benjamin A. Gould first made the proposal to designate boundaries for the celestial sphere, a suggestion upon which Delporte would base his work. The consequence of this early date is that due to the precession of the equinoxes, the borders on a modern star map, such as epoch J2000, are already somewhat skewed and no longer perfectly vertical or horizontal. This effect will increase over the years and centuries to come.

The stars within a constellation rarely have any substantial astrophysical relationship to each other, and their apparent proximity when viewed from Earth disguises the fact that they typically lie light years apart. However, there are some exceptions: in the constellation of Ursa Major, the Big Dipper is almost entirely constituted by stars approximate to one another, belonging to a stellar group known as the *Ursa Major Moving Group*.

In the Western world, the sky of the northern hemisphere is traditionally divided into constellations based on those described by the Ancient Greeks. The first ancient Greek works which dealt with the constellations were books of star myths. The oldest of these was a poem composed by Hesiod in or around the eighth century BC, of which only fragments survive. The most complete existing works dealing with the mythical origins of the constellations are by the Hellenistic writer termed pseudo-Eratosthenes and an early Roman writer styled pseudo-Hyginus. In the 2nd century AD, the Greek astronomer Ptolemy described the constellations in great detail in his influential work the Almagest.

During the Modern Age and the Age of Discovery, when the southern stars were observed and mapped by Europeans scientists, the southern sky was divided into many small new constellations, created on "empty" areas unknown to the previous astronomers. many of these constellations represent technical instruments invented during XVI-XVIII centuries.

Some constellations are crossed by the **ecliptic**. The ecliptic is the apparent path that the Sun traces out in the sky during the year, appearing to move eastwards on an imaginary spherical surface, the celestial sphere, relative to the (almost) fixed stars. In more accurate terms, it is the intersection of the celestial sphere with the ecliptic plane, which is the geometric plane containing the mean orbit of the Earth around the Sun. As the rotational axis of the Earth is not perpendicular to its orbital plane, the equatorial plane is not parallel to the ecliptic plane, but makes an angle of about 23°27', which is known as the *axial tilt* (or obliquity of the ecliptic).

The ecliptic serves as the centre of a region called **zodiac**, which constitutes a band of 9° on either side of the ecliptic; *the Moon and the planets lie always on this region*. Traditionally, this region is divided into 12 signs of 30° longitude each. By tradition, these signs are named after 12 of the 13 constellations straddling the ecliptic. The zodiac constellations, transformed into "signs", are used on astrology.

It is important to distinguish the zodiacal signs from the constellations associated with them, not only because of their drifting apart due to the precession of equinoxes but also because the physical constellations by nature of their varying shapes and forms take up varying widths of the ecliptic. Thus, Virgo takes up fully five times as much ecliptic longitude as Scorpius. The zodiacal signs, on the other hand, are an abstraction from the physical constellations designed to represent exactly one twelfth of the full circle each, or the longitude traversed by the Sun in about 30.4 days.

In the Northern hemisphere the winter sky is dominated by the bright stars of the Orion constellation (to the right), and the stars Sirius (at the bottom), and Procyon (left). Orion is one of the best-known constellation, because of its brightness and its symmetric, hourglass-like shape.

LIST OF CONSTELLATIONS

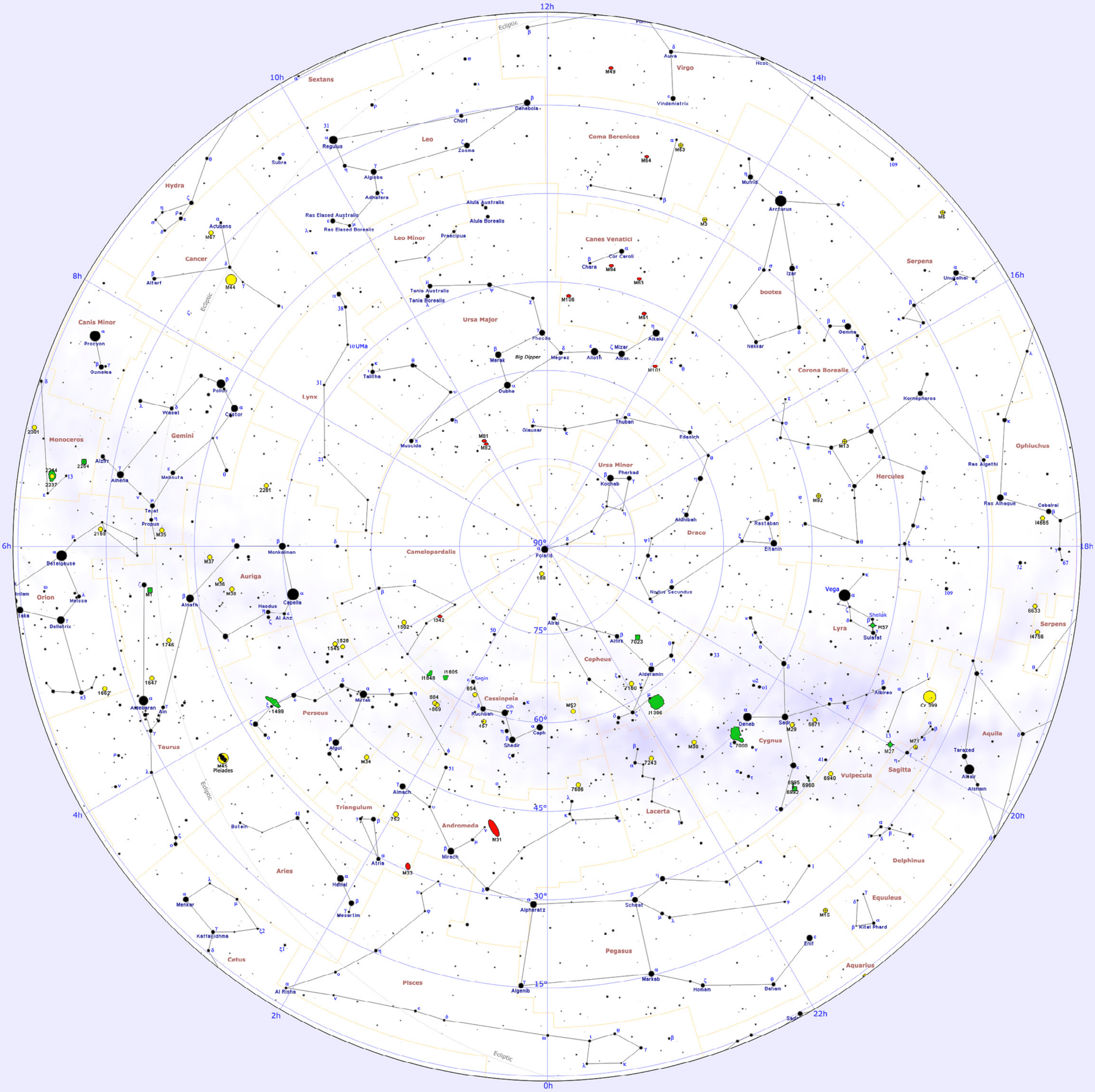
Nominative	Genitive	Abbreviation	Common name
Andromeda	Andromedae	And	*Andromeda*
Antlia	Antliae	Ant	*Air Pump*
Apus	Apodis	Aps	*Bird of Paradise*
Aquarius	Aquarii	Aqr	*Water Carrier*
Aquila	Aquilae	Aql	*Eagle*
Ara	Arae	Ara	*Altar*
Aries	Arietis	Ari	*Ram*
Auriga	Auriga	Aur	*Charioteer*
Bootes	Bootes	Boo	*Herdsman*
Caelum	Caeli	Cae	*Engraving Tool*
Camelopardalis	Camelopardalis	Cam	*Giraffe*
Cancer	Cancer	Cnc	*Crab*
Canes Venatici	Canum Venaticorum	CVn	*Hunting Dogs*
Canis Major	Canis Majoris	CMa	*Greater Dog*
Canis Minor	Canis Minoris	CMi	*Lesser Dog*
Capricornus	Capricorni	Cap	*Sea Goat*
Carina	Carinae	Car	*Keel*
Cassiopeia	Cassiopeiae	Cas	*Cassiopeia*
Centaurus	Centauri	Cen	*Centaur*
Cepheus	Cephei	Cep	*Cepheus*
Cetus	Ceti	Cet	*Whale*
Chamaeleon	Chamaeleontis	Cha	*Chameleon*
Circinus	Circini	Cir	*Pair of Compasses*
Columba	Columbae	Col	*Dove*
Coma Berenices	Comae Berenices	Com	*Berenice's Hair*
Corona Australis	Coronae Australis	CrA	*Southern Crown*
Corona Borealis	Coronae Borealis	CrB	*Northern Crown*
Corvus	Corvi	Crv	*Crow*
Crater	Crateris	Crt	*Cup*
Crux	Crucis	Cru	*Southern Cross*
Cygnus	Cygni	Cyg	*Swan*
Delphinus	Delphini	Del	*Dolphin*
Dorado	Doradus	Dor	*Goldfish*
Draco	Draconis	Dra	*Dragon*
Equuleus	Equulei	Equ	*Little Horse*
Eridanus	Eridani	Eri	*River Eridanus*
Fornax	Fornacis	For	*Furnace*
Gemini	Geminorum	Gem	*Twins*
Grus	Gruis	Gru	*Crane*
Hercules	Herculis	Her	*Hercules*
Horologium	Horologii	Hor	*Pendulum Clock*
Hydra	Hydrae	Hya	*Water Snake*
Hydrus	Hydri	Hyi	*Lesser Water Snake*
Indus	Indi	Ind	*Indian*
Lacerta	Lacertae	Lac	*Lizard*
Leo	Leonis	Leo	*Lion*
Leo Minor	Leonis Minoris	LMi	*Lesser Lion*
Lepus	Leporis	Lep	*Hare*
Libra	Librae	Lib	*Scales*
Lupus	Lupi	Lup	*Wolf*
Lynx	Lyncis	Lyn	*Lynx*
Lyra	Lyrae	Lyr	*Lyre*
Mensa	Mensae	Men	*Table Mountain*
Microscopium	Microscopii	Mic	*Microscope*
Monoceros	Monocerotis	Mon	*Unicorn*
Musca	Muscae	Mus	*Fly*
Norma	Normae	Nor	*Level*
Octans	Octantis	Oct	*Octant*
Ophiuchus	Ophiuchi	Oph	*Serpent Holder*
Orion	Orionis	Ori	*Orion, the Hunter*
Pavo	Pavonis	Pav	*Peacock*
Pegasus	Pegasi	Peg	*Pegasus*
Perseus	Persei	Per	*Perseus*
Phoenix	Phoenicis	Phe	*Phoenix*
Pictor	Pictoris	Pic	*Painter's Easel*
Pisces	Piscis	Psc	*Fishes*
Piscis Austrinus	Piscis Austrini	PsA	*Southern Fish*
Puppis	Puppis	Pup	*Stern*
Pyxis	Pyxidis	Pyx	*Mariner's Compass*
Reticulum	Reticuli	Ret	*Net*
Sagitta	Sagittae	Sge	*Arrow*
Sagittarius	Sagittarii	Sgr	*Archer*
Scorpius	Scorpii	Sco	*Scorpion*
Sculptor	Sculptoris	Scl	*Sculptor*
Scutum	Scuti	Sct	*Shield*
Serpens	Serpentis	Ser	*Serpent*
Sextans	Sextantis	Sex	*Sextant*
Taurus	Tauri	Tau	*Bull*
Telescopium	Telescopii	Tel	*Telescope*
Triangulum	Trianguli	Tri	*Triangle*
Triangulum Australe	Trianguli Australis	TrA	*Southern Triangle*
Tucana	Tucanae	Tuc	*Toucan*
Ursa Major	Urase Majoris	UMa	*Great Bear*
Ursa Minor	Ursae Minoris	UMi	*Lesser Bear*
Vela	Velorum	Vel	*Sail*
Virgo	Virgo	Vir	*Virgin*
Volans	Volantis	Vol	*Flying Fish*
Vulpecula	Vulpeculae	Vul	*Fox*

The Greek alphabet

α	Alpha	ι	Iota	ρ	Rho
β	Beta	κ	Kappa	σ	Sigma
γ	Gamma	λ	Lambda	τ	Tau
δ	Delta	μ	Mu	υ	Upsilon
ε	Epsilon	ν	Nu	ϕ	Phi
ζ	Zeta	ξ	Xi	χ	Chi
η	Eta	ο	Omicron	φ	Psi
θ	Theta	π	Pi	ω	Omega

SKY MAPS

The Northern Hemisphere



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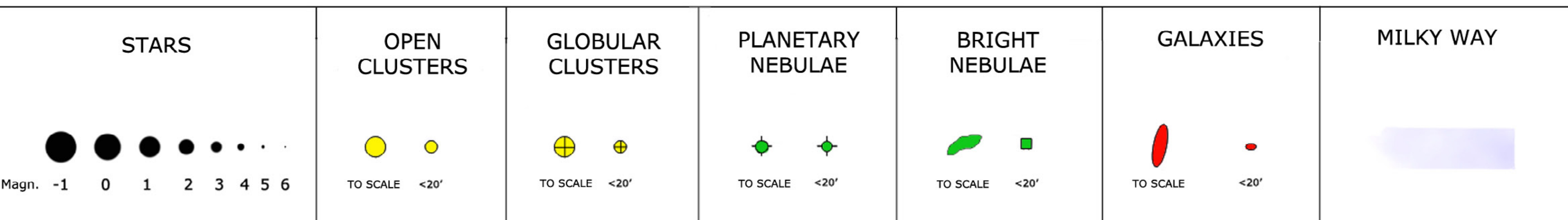
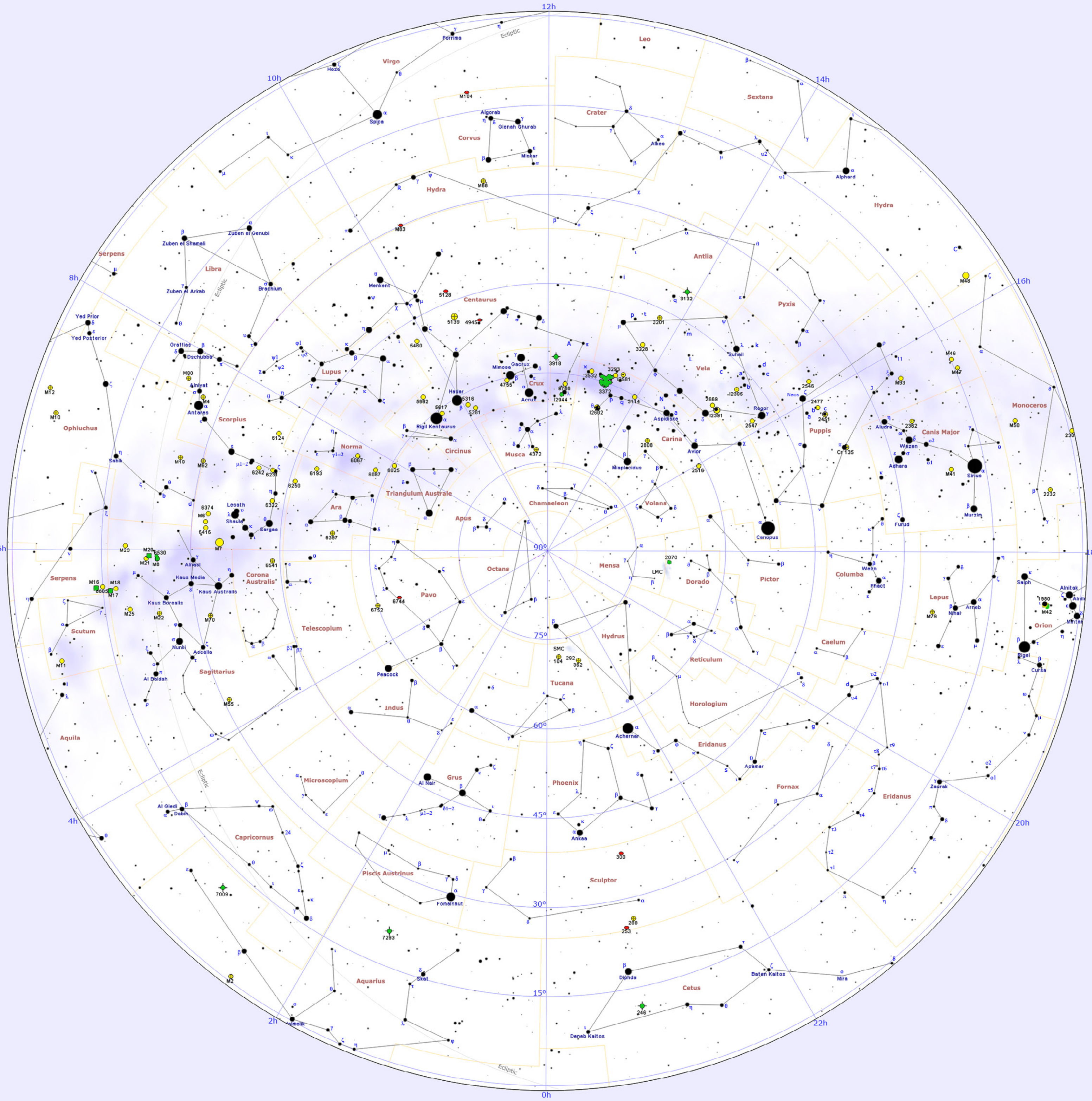


The Southern Hemisphere



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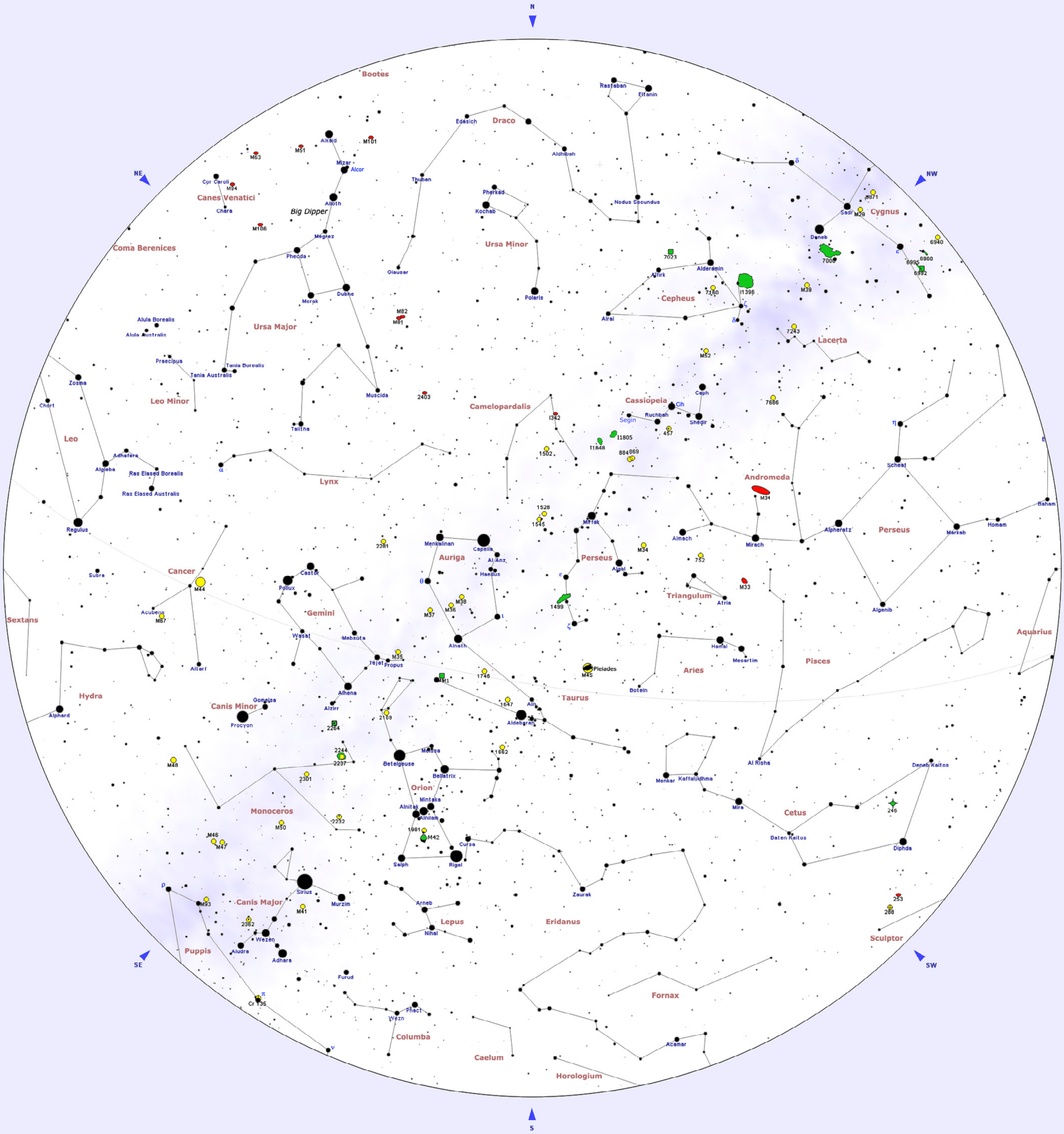

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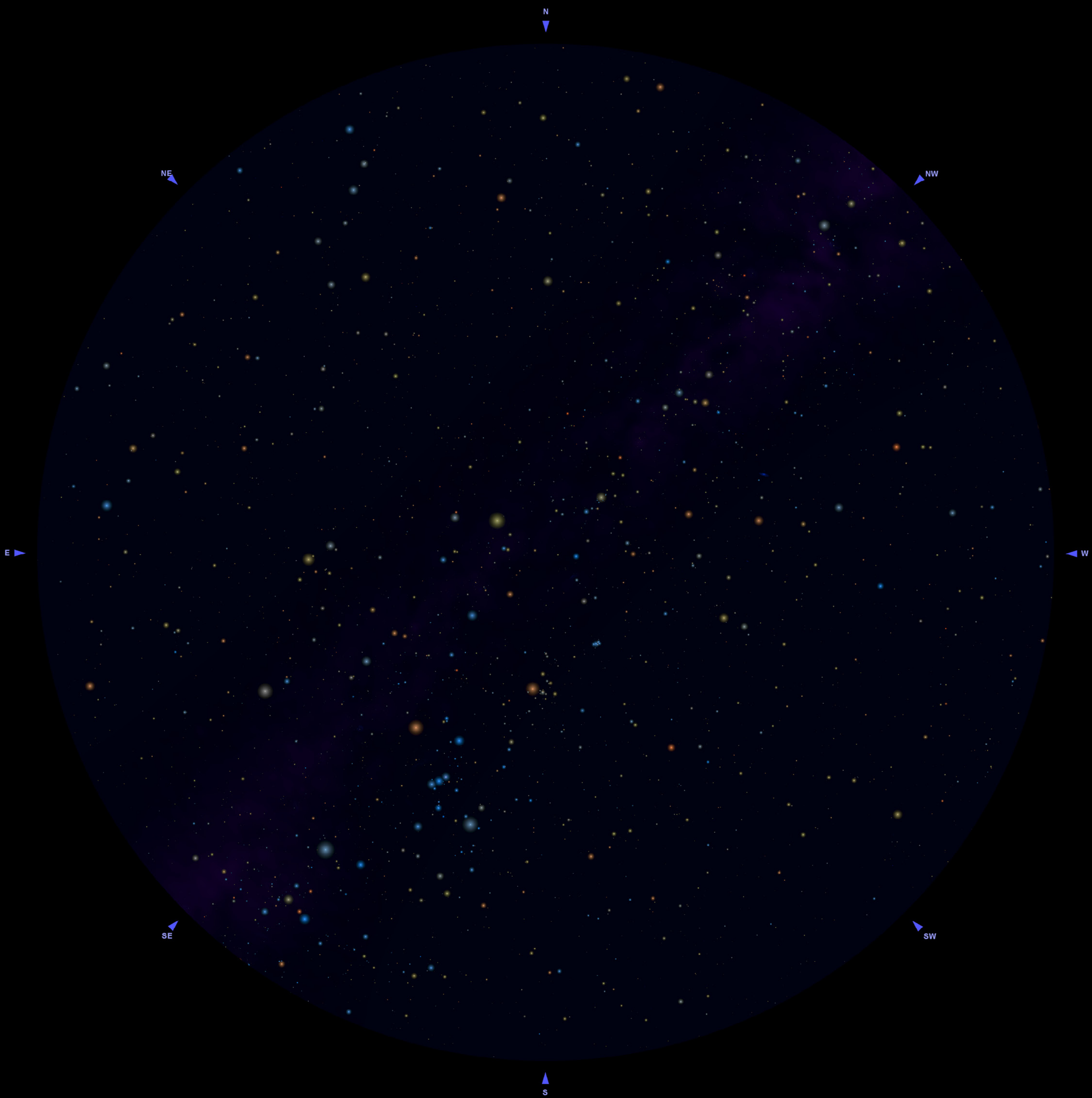

OBSERVATION

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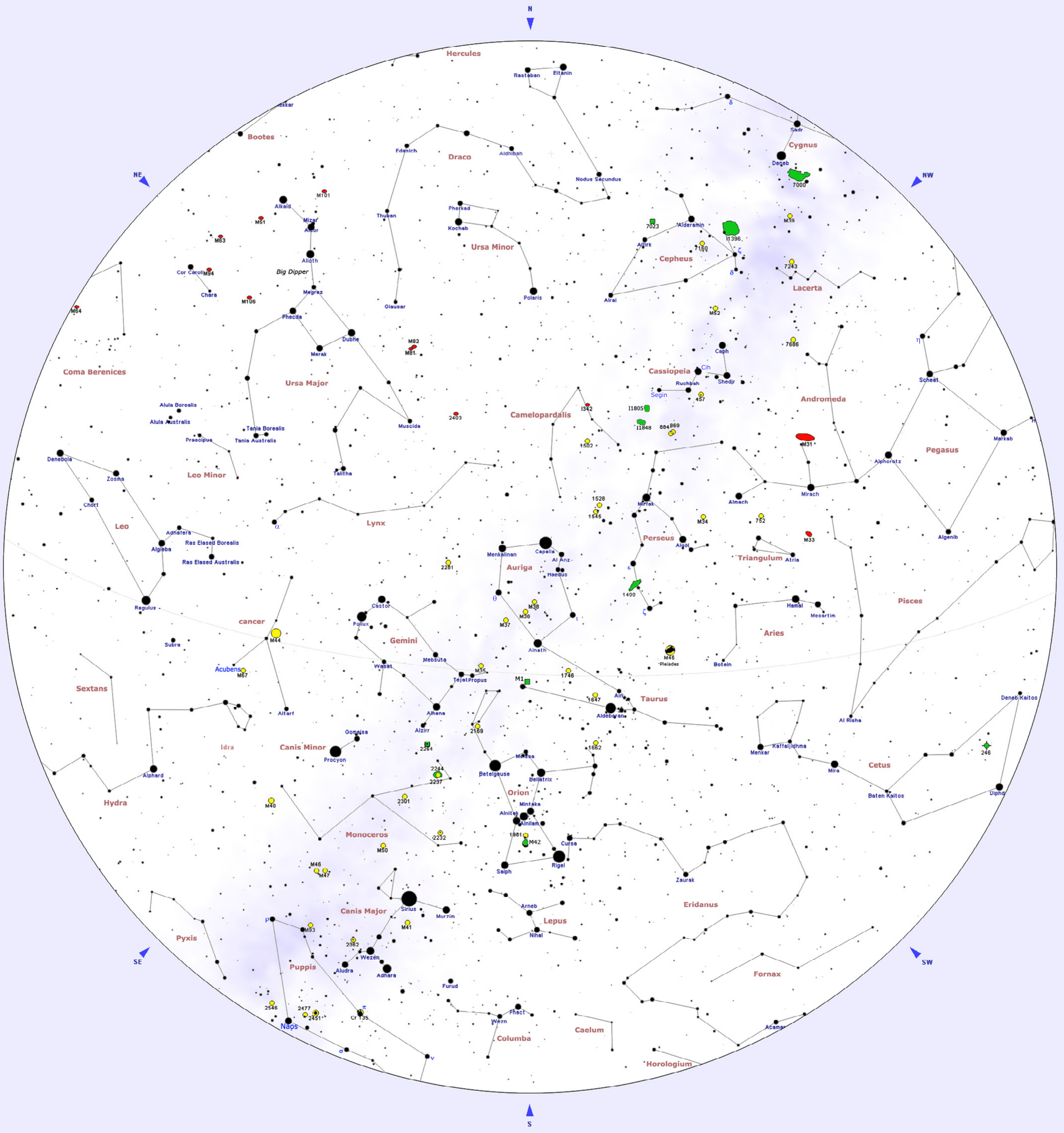
January 15, 9:00 pm
February 1, 8:00 pm
February 15, 7:00 pm

*Add 1 hour if using DST

September 15, 05:00 am *
October 1, 04:00 am *
October 15, 03:00 am *
November 1, 02:00 am
November 15, 01:00 am
December 1, midnight
December 15, 11:00 pm



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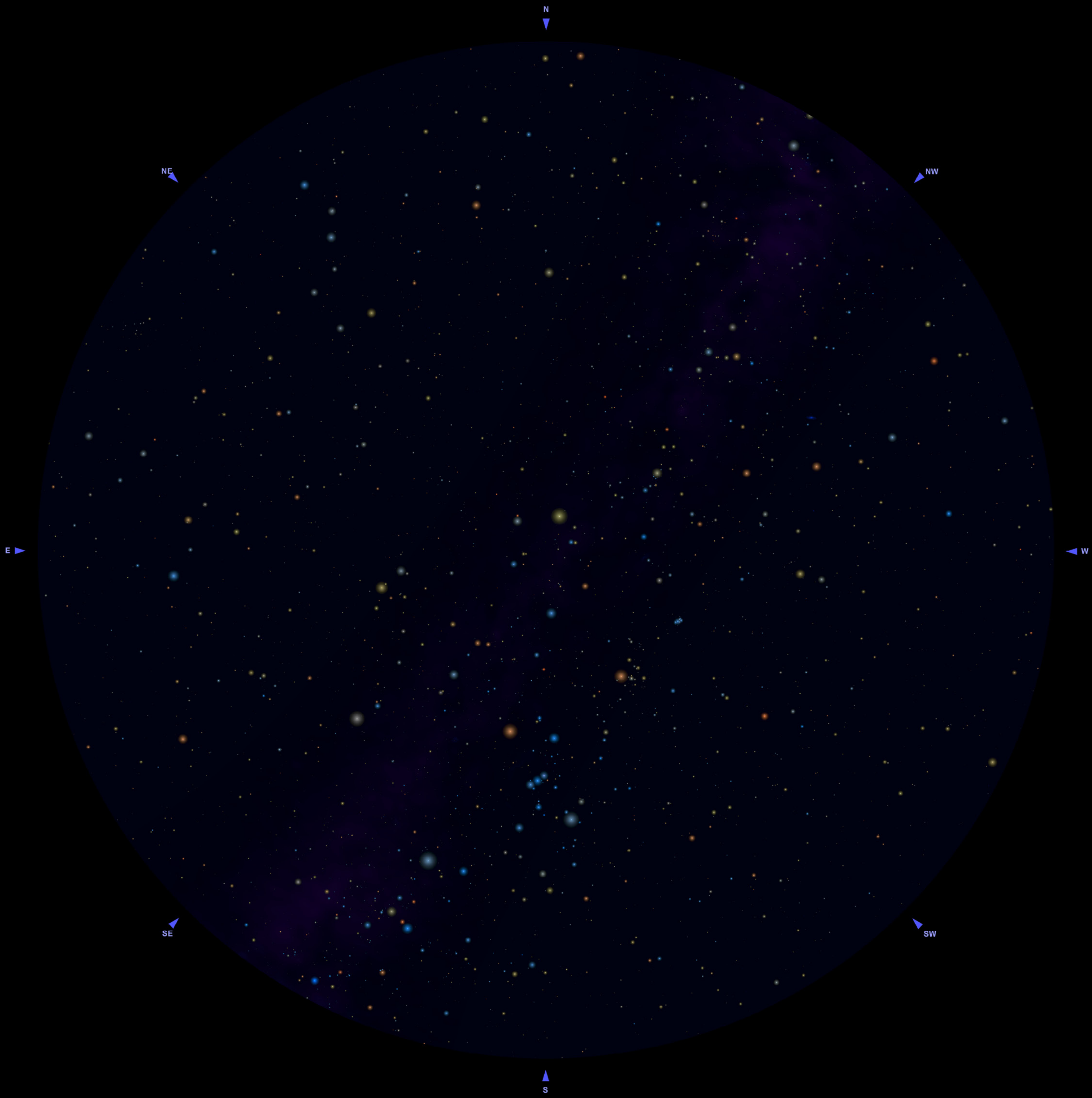

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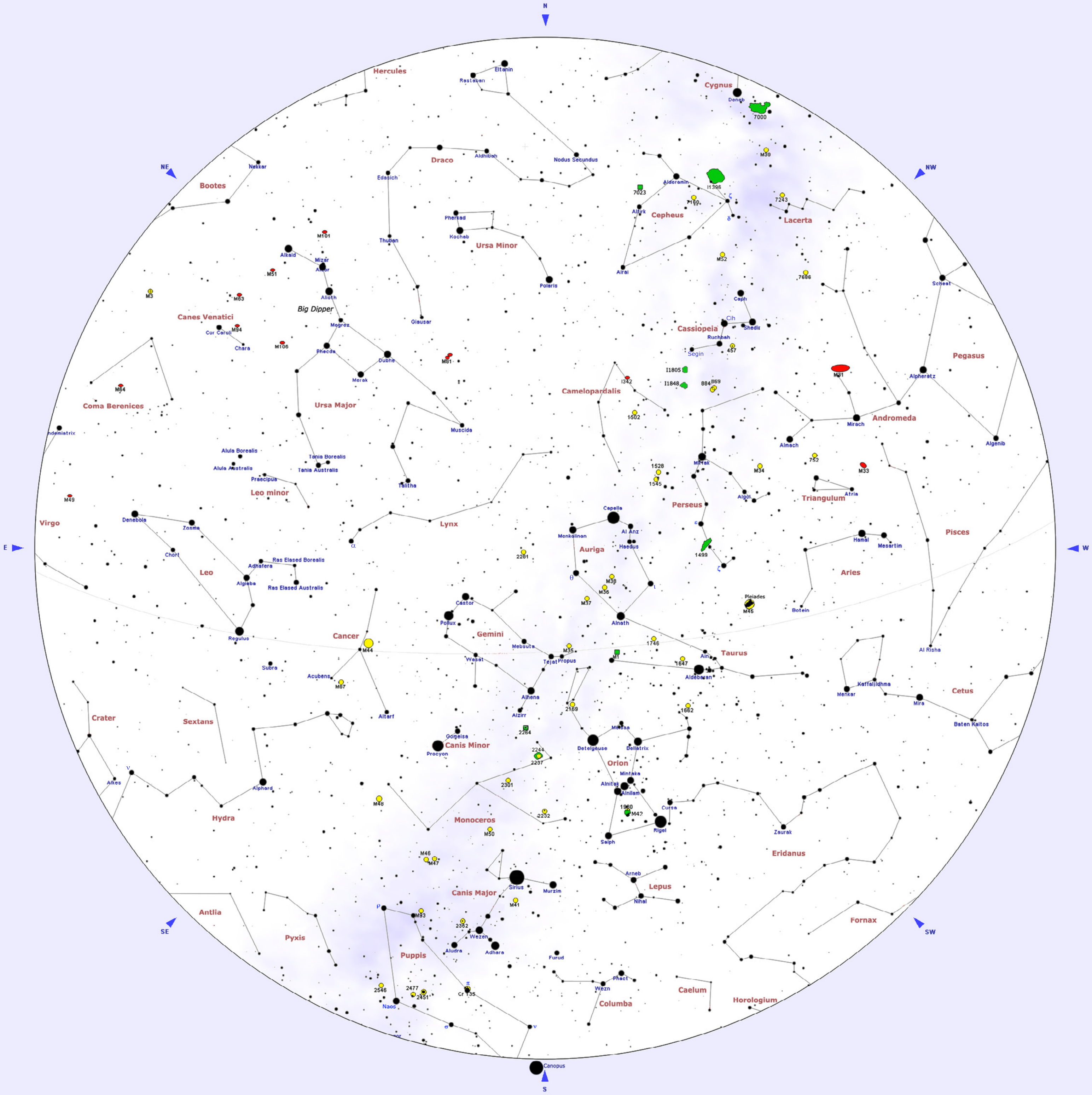
November 15, 2:00 am
December 1, 1:00 am
December 15, midnight
January 1, 11 pm



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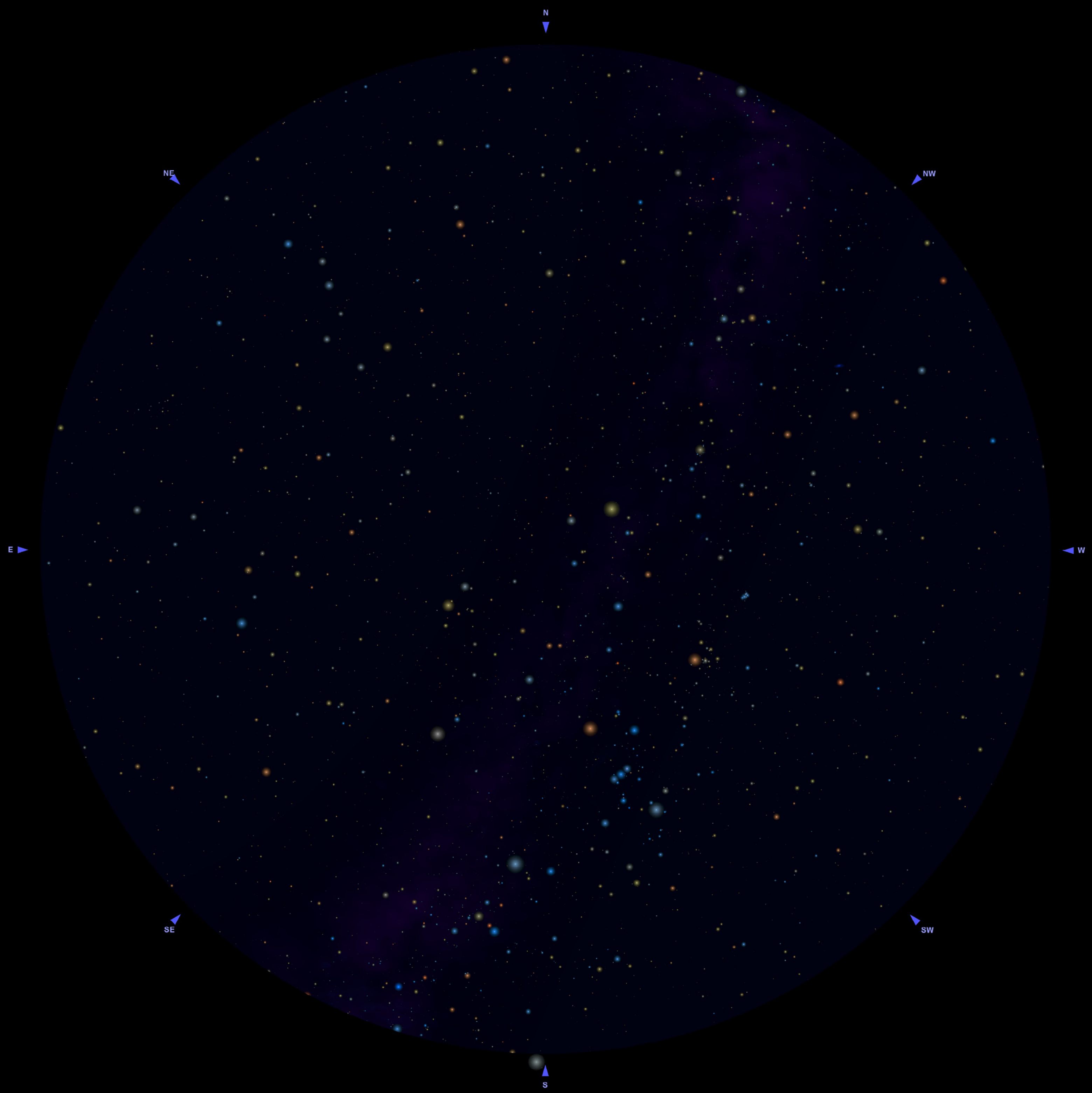

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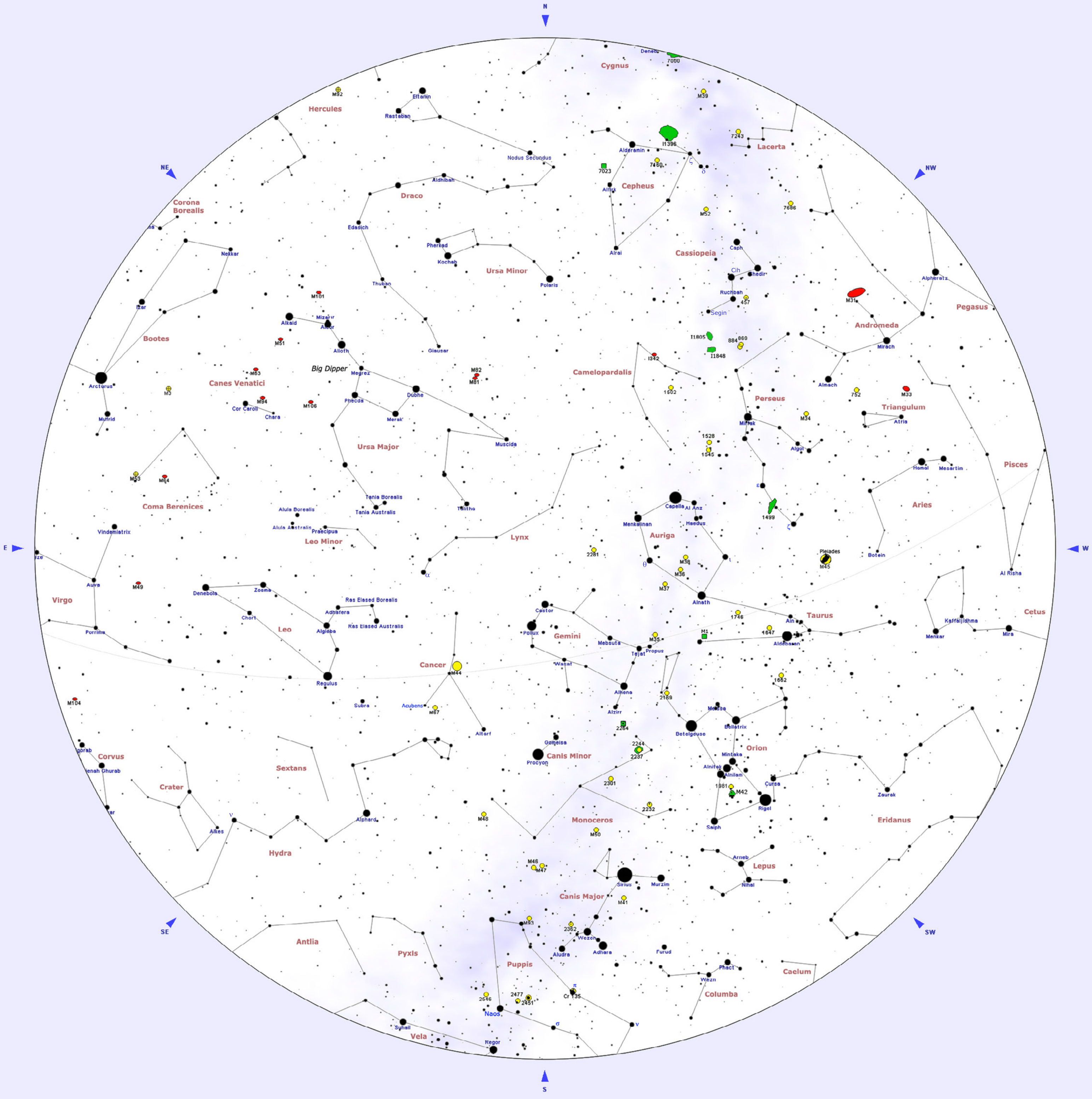
December 15, 1:00 am
January 1, midnight
January 15, 11 pm



LEGEND

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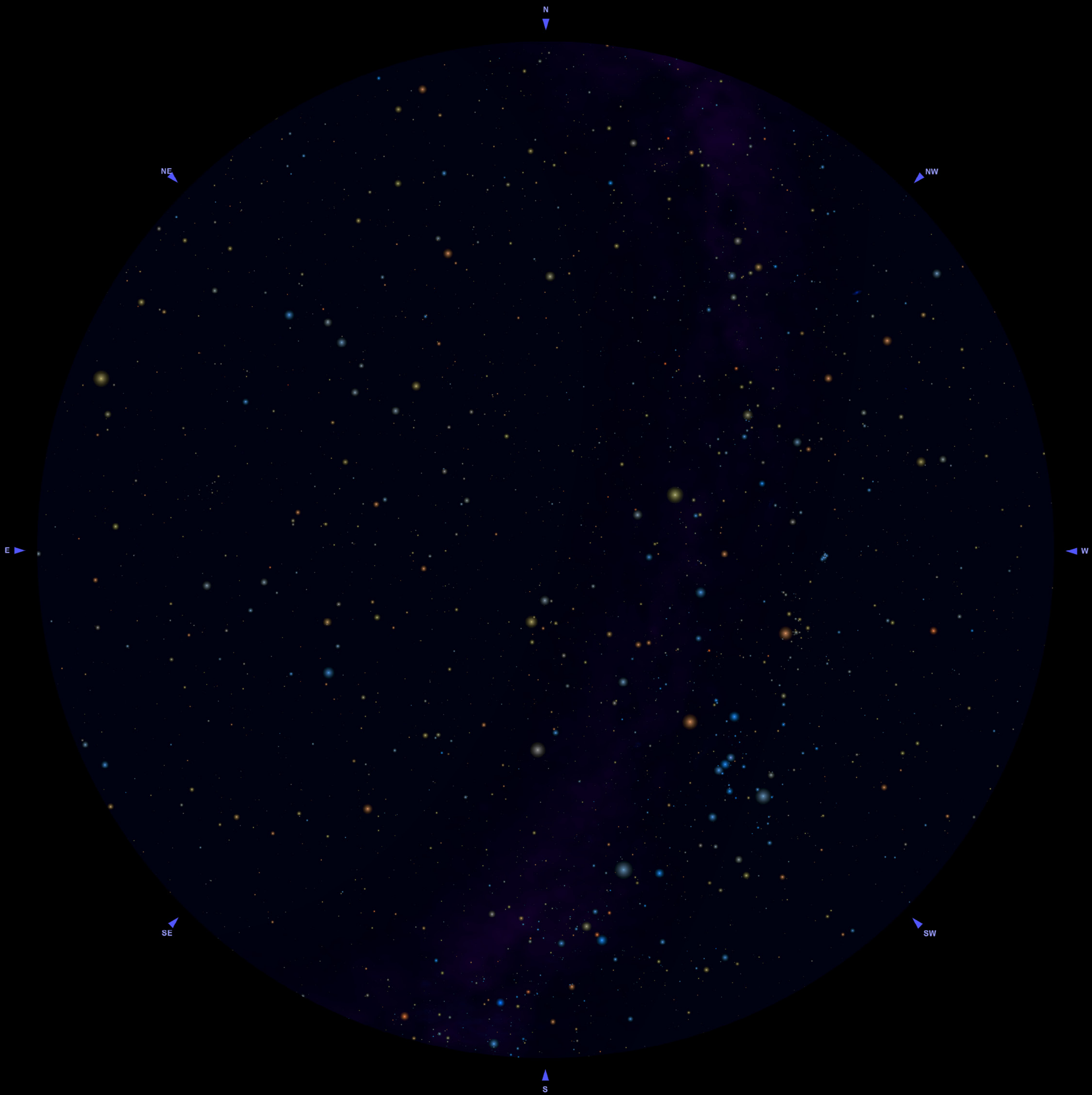

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*Add 1 hour if using DST

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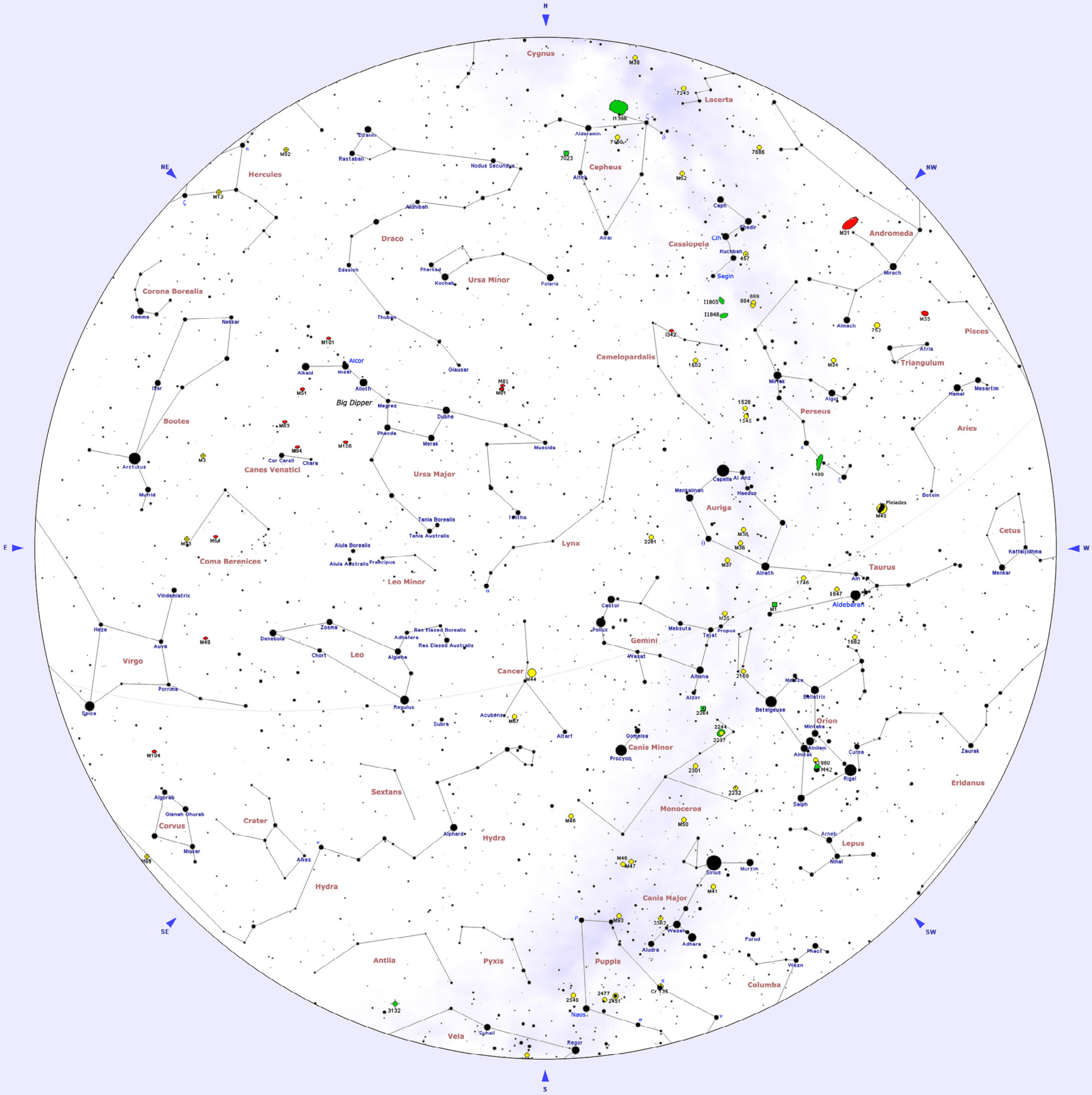
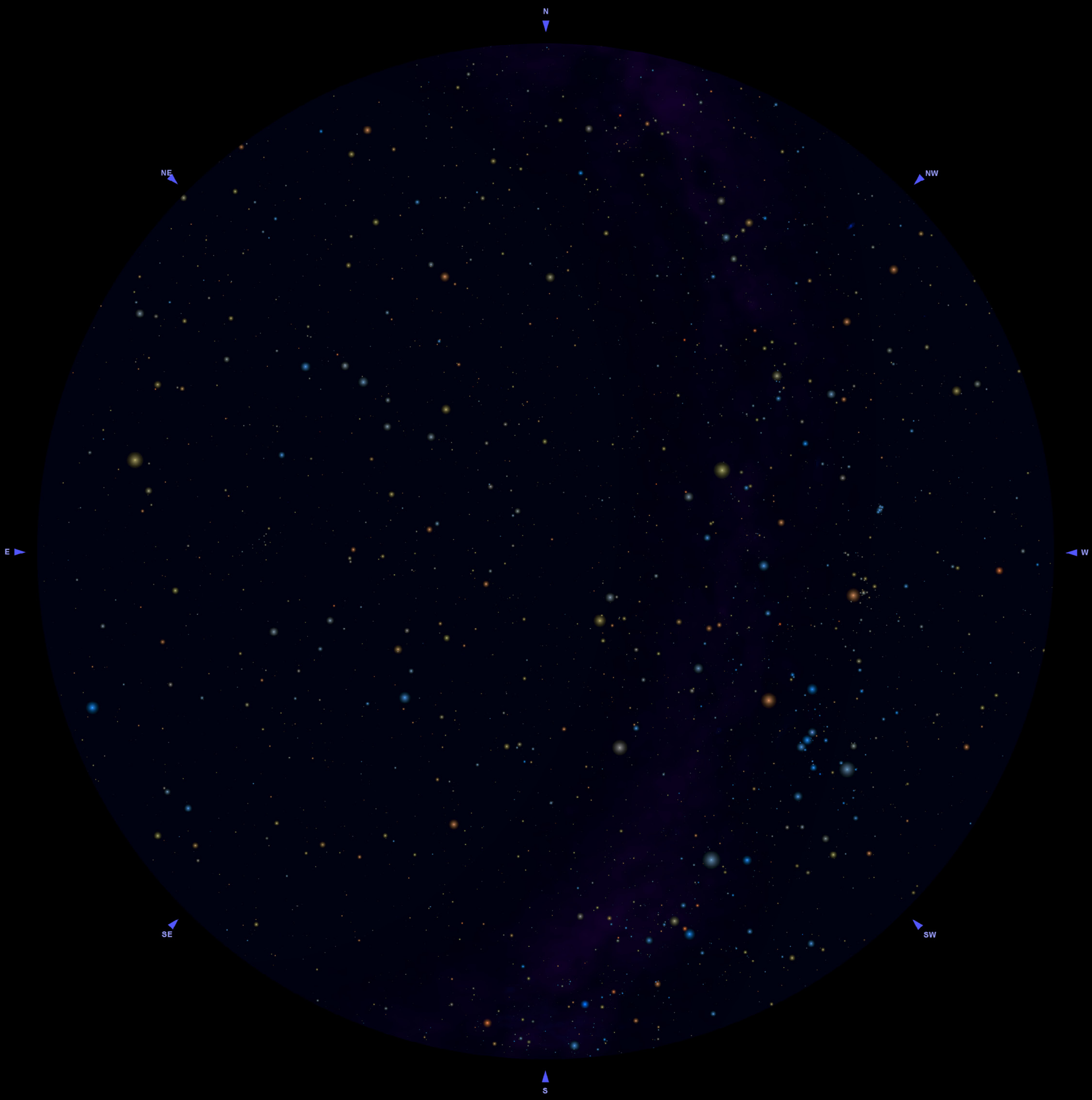
January 1, 1:00 am
January 15, midnight
February 1, 11 pm



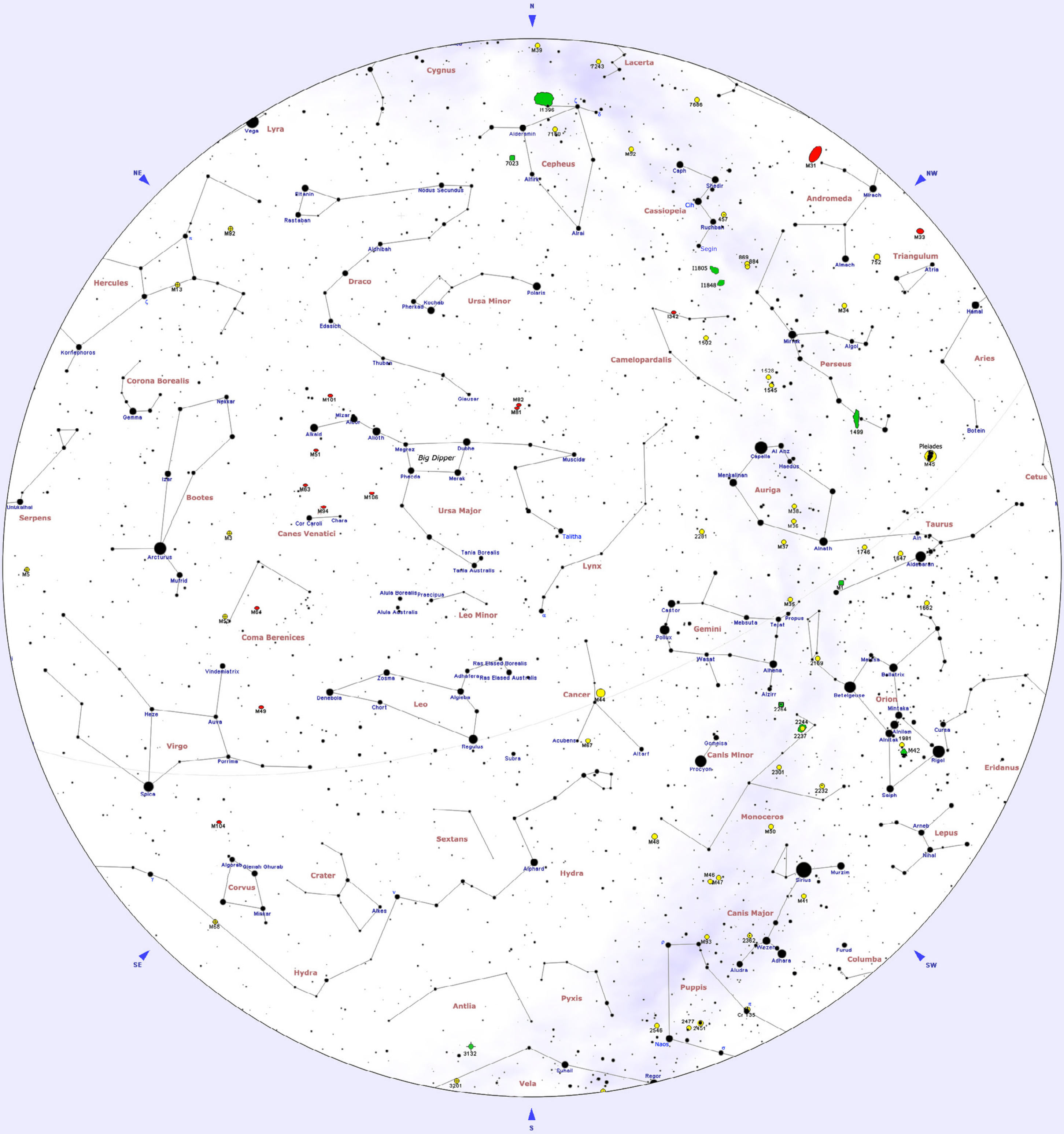
LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	



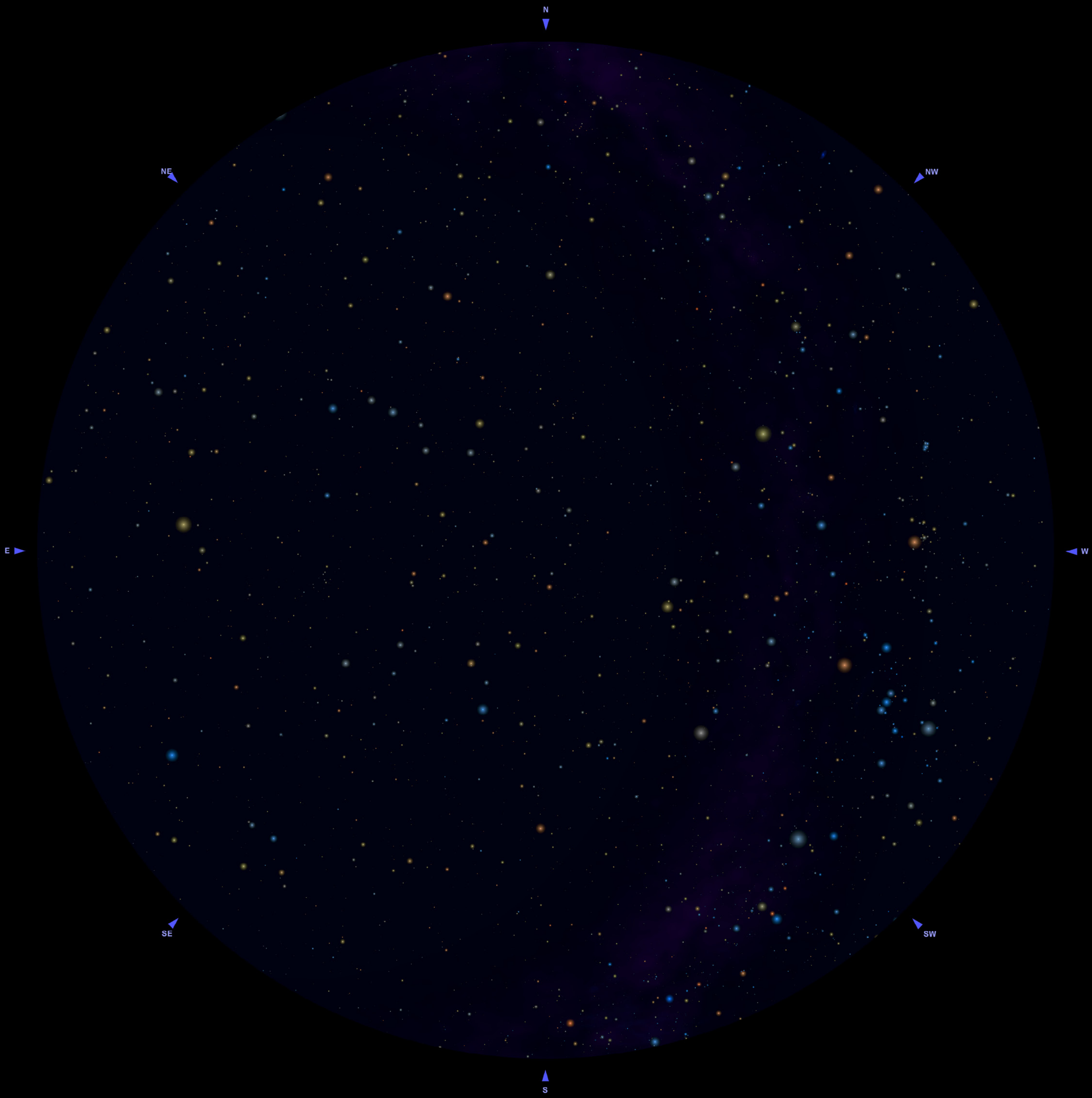
OBSERVATION

March 1, 10:00 pm March 15, 9:00 pm April 1, 8:00 pm * *Add 1 hour if using DST	November 1, 6:00 am November 15, 5:00 am December 1, 4:00 am December 15, 3:00 am January 1, 2:00 am January 15, 1:00 am February 1, midnight February 15, 11 pm



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	

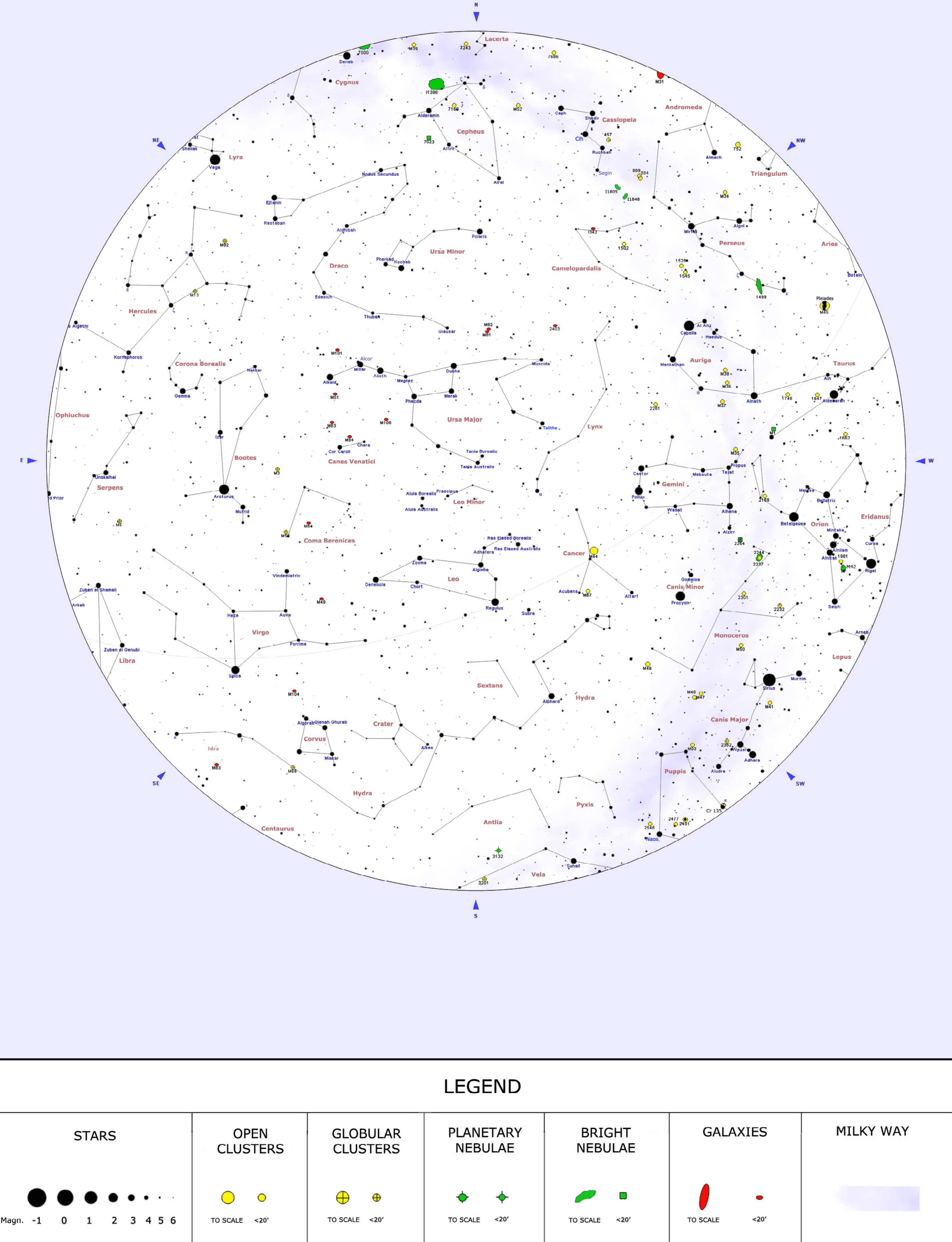


OBSERVATION

March 15, 10:00 pm
April 1, 9:00 pm *
April 15, 8:00 pm *

*Add 1 hour if using DST

November 15, 6:00 am
December 1, 5:00 am
December 15, 4:00 am
January 1, 3:00 am
January 15, 2:00 am
February 1, 1:00 am
February 15, midnight
March 1, 11 pm



N
NE
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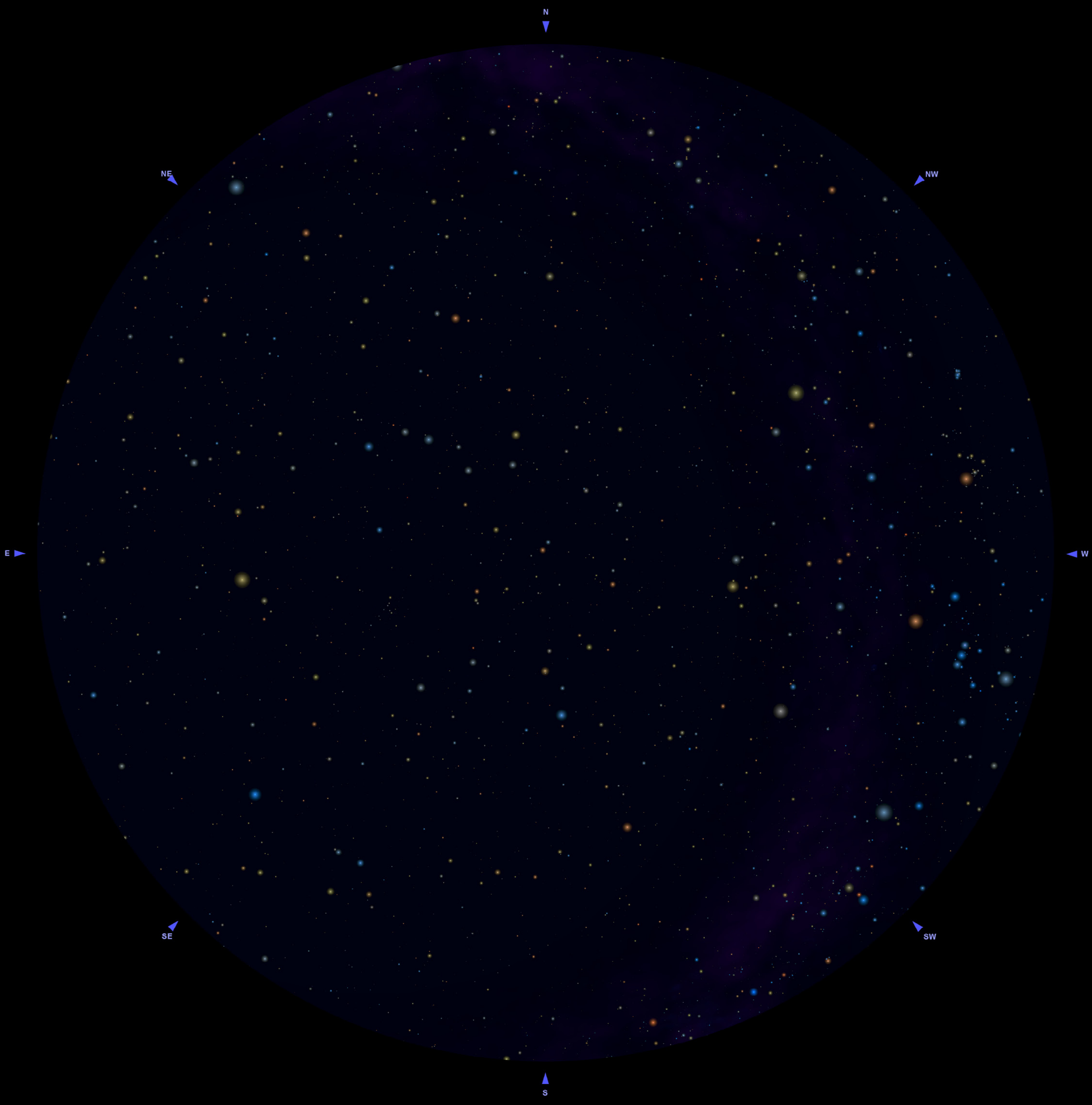
Lacerta
Cygnus
Cepheus
Cassiopeia
Andromeda
Lyra
Triangulum
Perseus
Aries
Hercules
Draco
Ursa Minor
Camelopardalis
Auriga
Taurus
Corona Borealis
Ophiuchus
Ursa Major
Lynx
Bootes
Canes Venatici
Serpens
Gemini
Leo Minor
Orion
Eridanus
Coma Berenices
Cancer
Leo
Canis Minor
Virgo
Libra
Monoceros
Lepus
Sextans
Hydra
Crater
Corvus
Canis Major
Puppis
Pyxis
Antlia
Centaurus
Vela
LEGEND
STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE
<20′
GLOBULAR CLUSTERS
TO SCALE
<20′
PLANETARY NEBULAE
TO SCALE
<20′
BRIGHT NEBULAE
TO SCALE
<20′
GALAXIES
TO SCALE
<20′
MILKY WAY

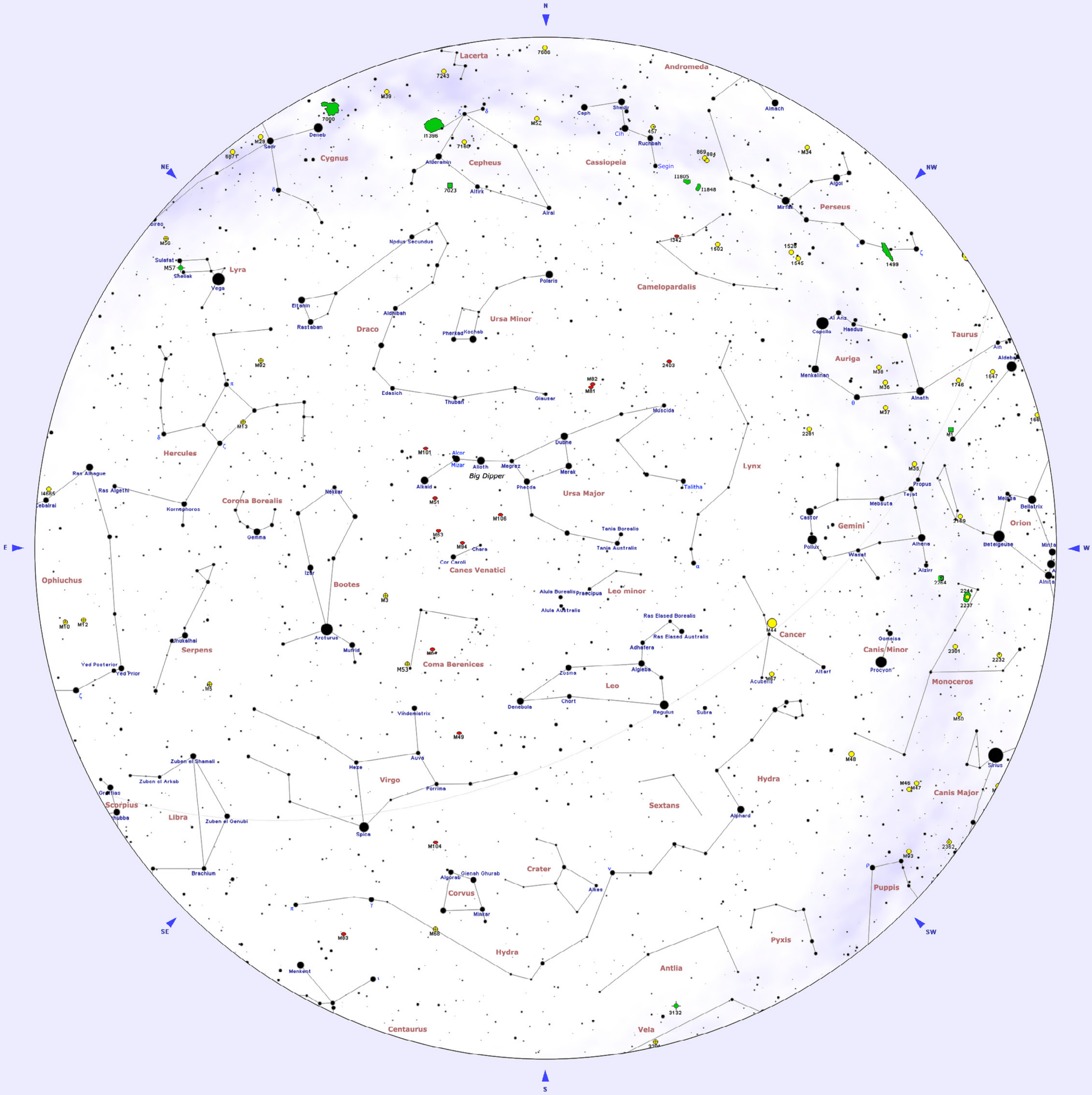


OBSERVATION

April 1, 10:00 pm *
April 15, 9:00 pm *
May 1, 8:00 pm *

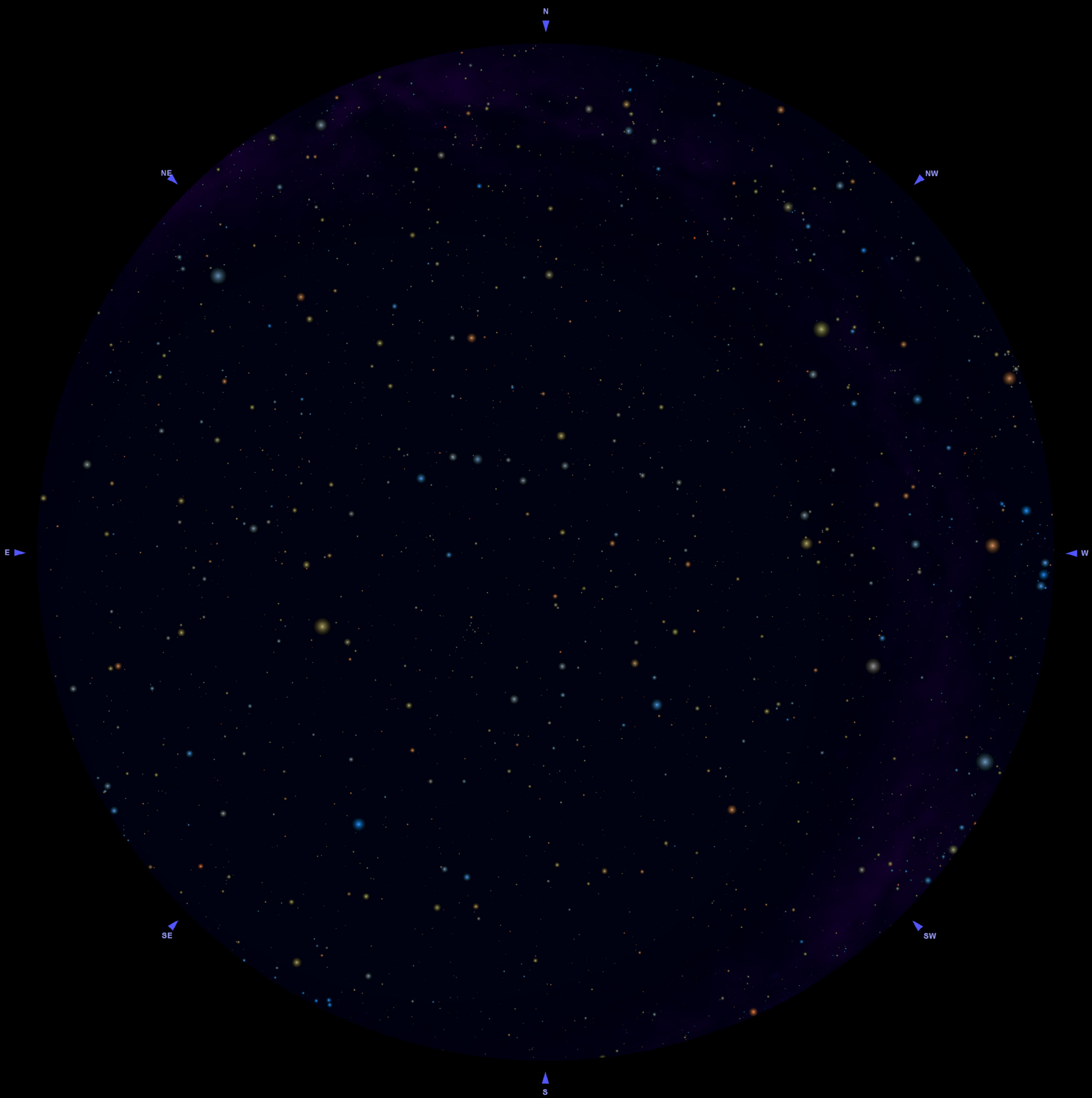
*Add 1 hour if using DST

December 1, 6:00 am
December 15, 5:00 am
January 1, 4:00 am
January 15, 3:00 am
February 1, 2:00 am
February 15, 1:00 am
March 1, midnight
March 15, 11 pm



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	TO SCALE <20'	

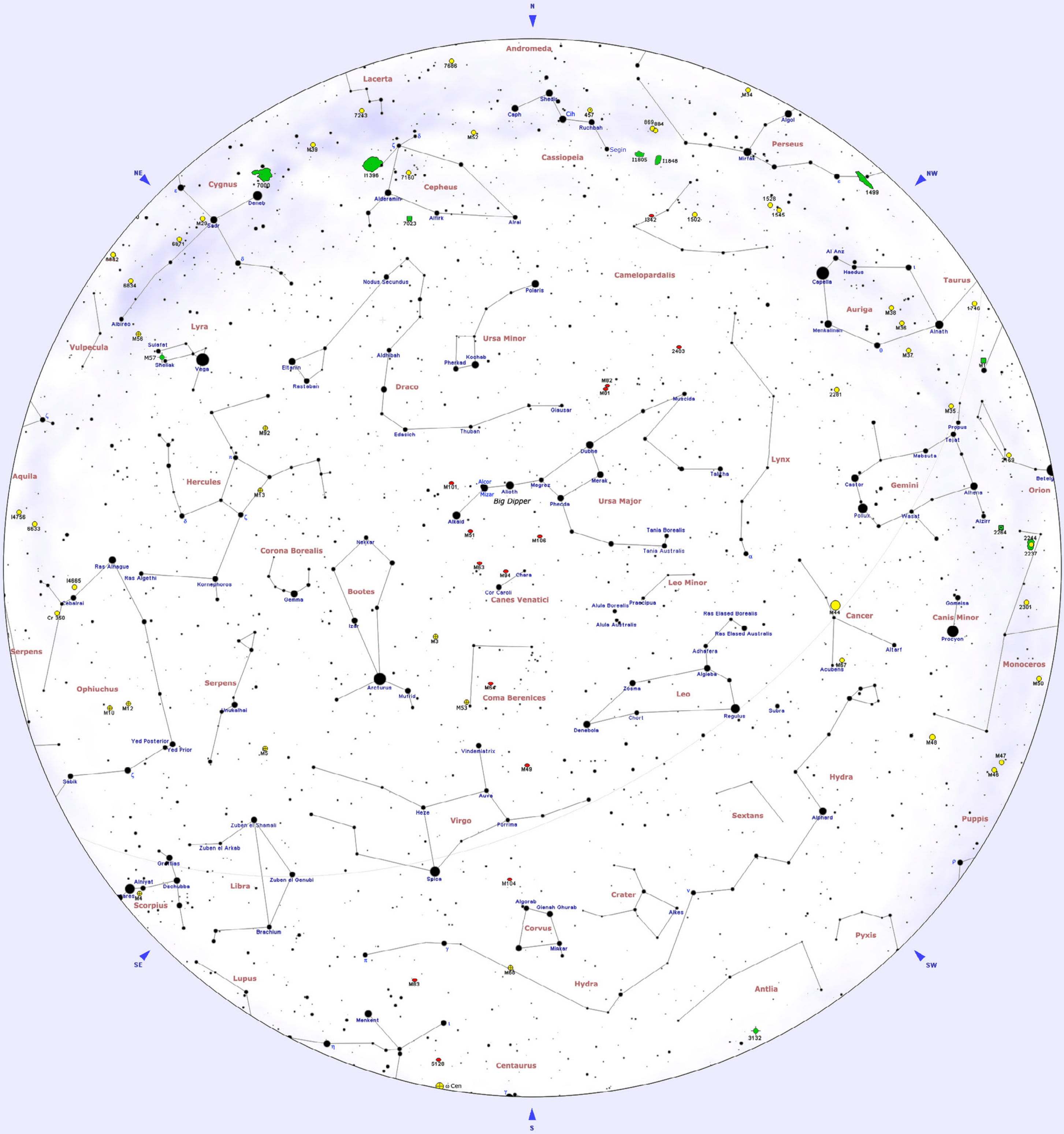


OBSERVATION

April 15, 10:00 pm *
May 1, 9:00 pm *
May 15, 8:00 pm *

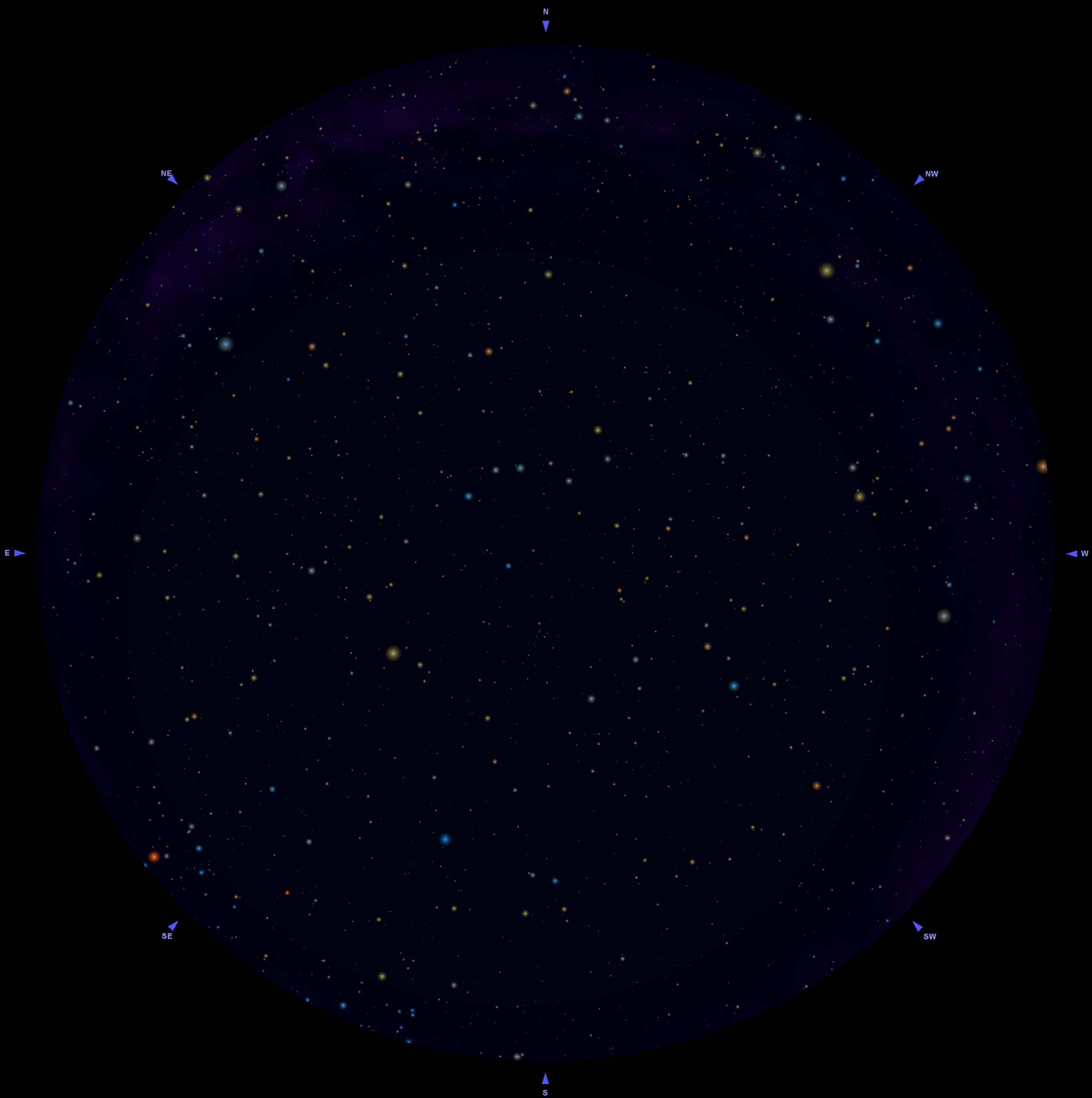
*Add 1 hour if using DST

December 15, 6:00 am
January 1, 5:00 am
January 15, 4:00 am
February 1, 3:00 am
February 15, 2:00 am
March 1, 1:00 am
March 15, midnight
April 1, 11 pm



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	

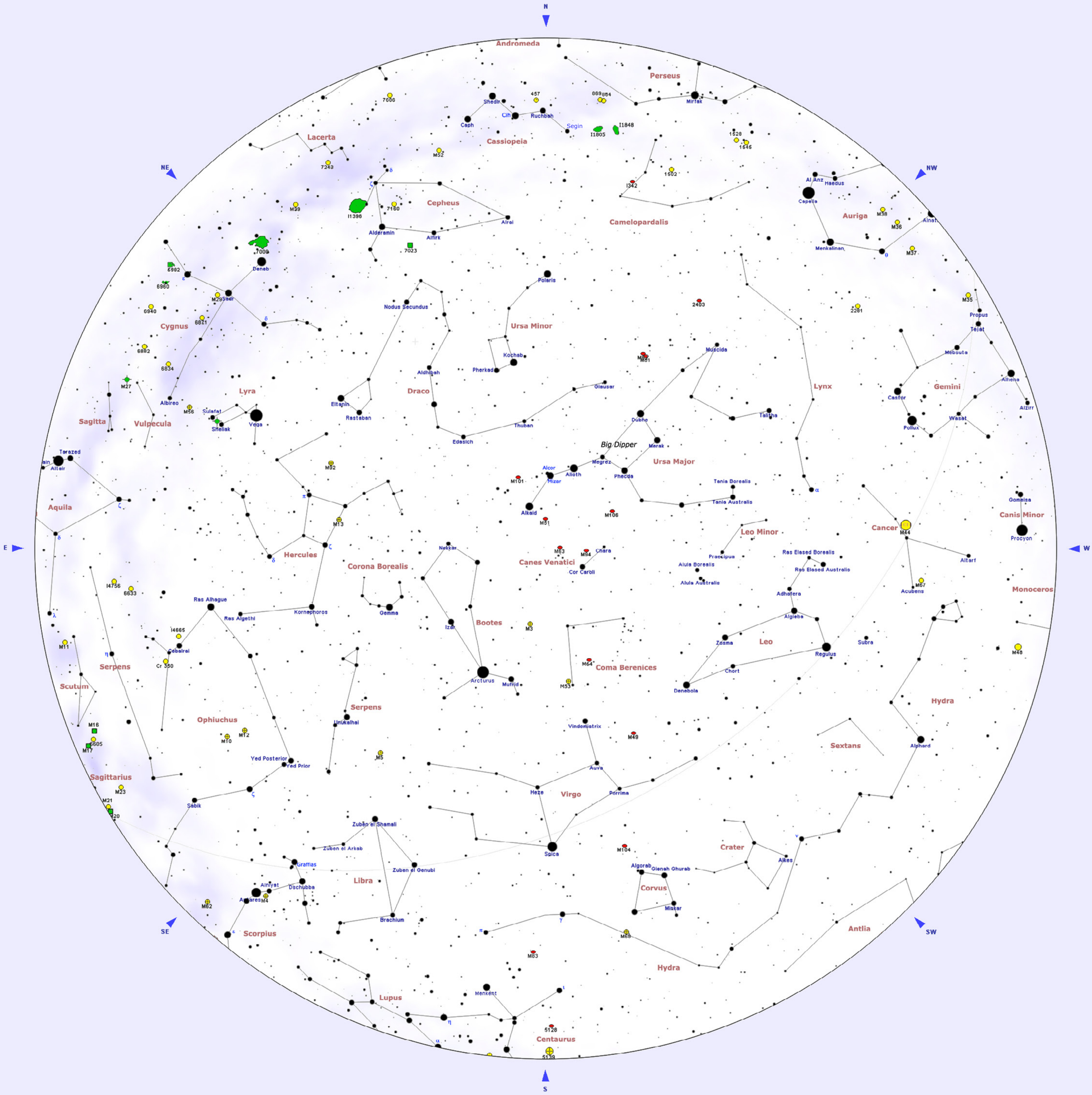


OBSERVATION

May 1, 10:00 pm *
May 15, 9:00 pm *

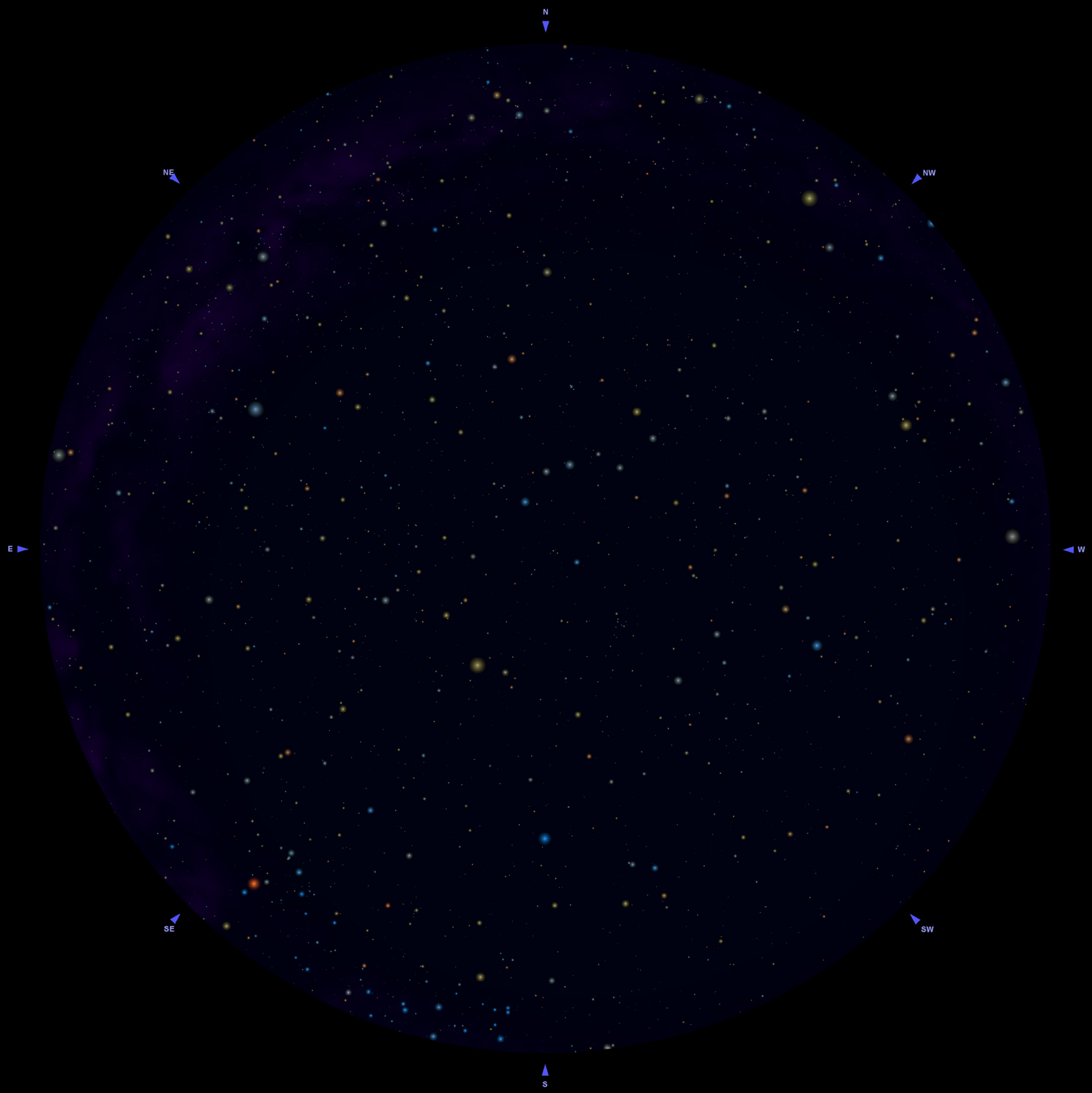
*Add 1 hour if using DST

January 1, 6:00 am
January 15, 5:00 am
February 1, 4:00 am
February 15, 3:00 am
March 1, 2:00 am
March 15, 1:00 am
April 1, midnight *
April 15, 11 pm *



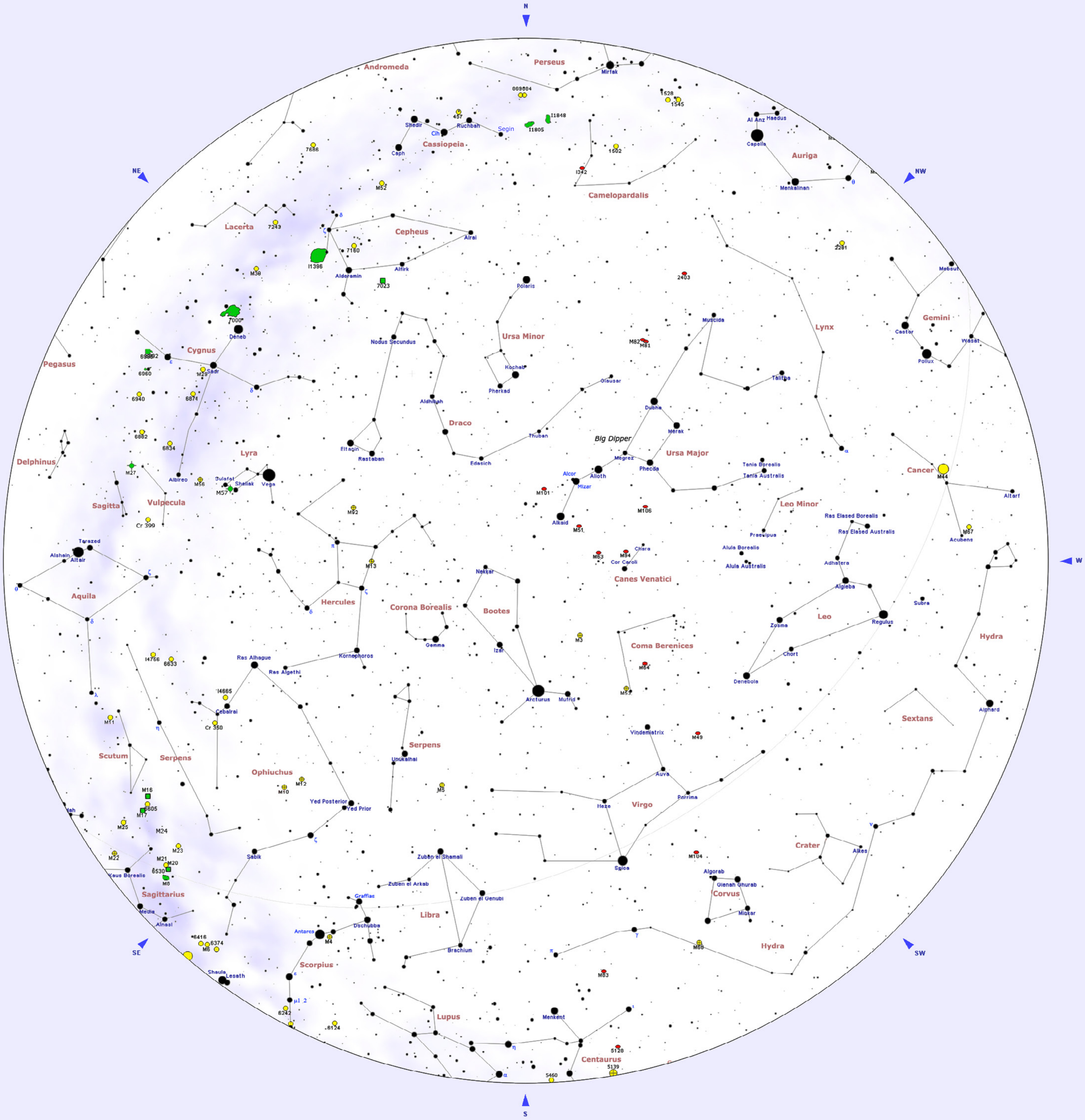
LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	



OBSERVATION

May 15, 10:00 pm * June 1, 9:00 pm * *Add 1 hour if using DST	January 15, 6:00 am February 1, 5:00 am February 15, 4:00 am March 1, 3:00 am March 15, 2:00 am April 1, 1:00 am * April 15, midnight * May 1, 11 pm *


N
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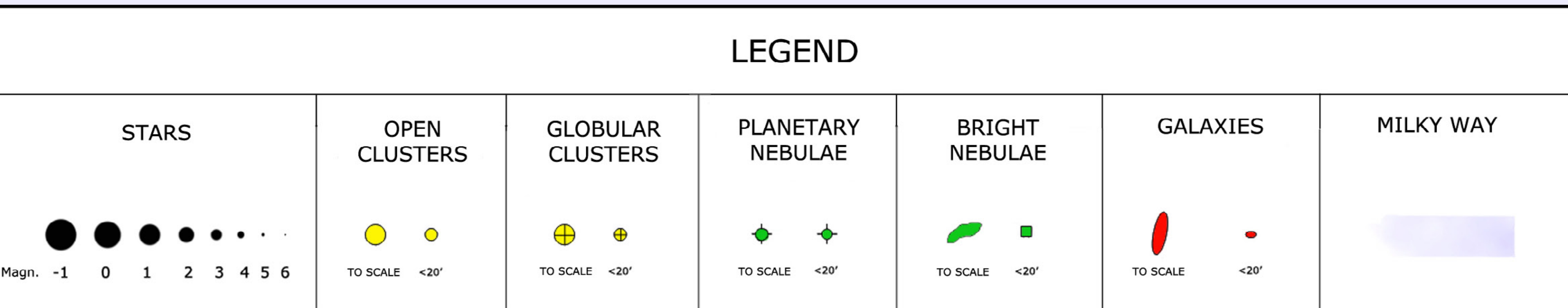
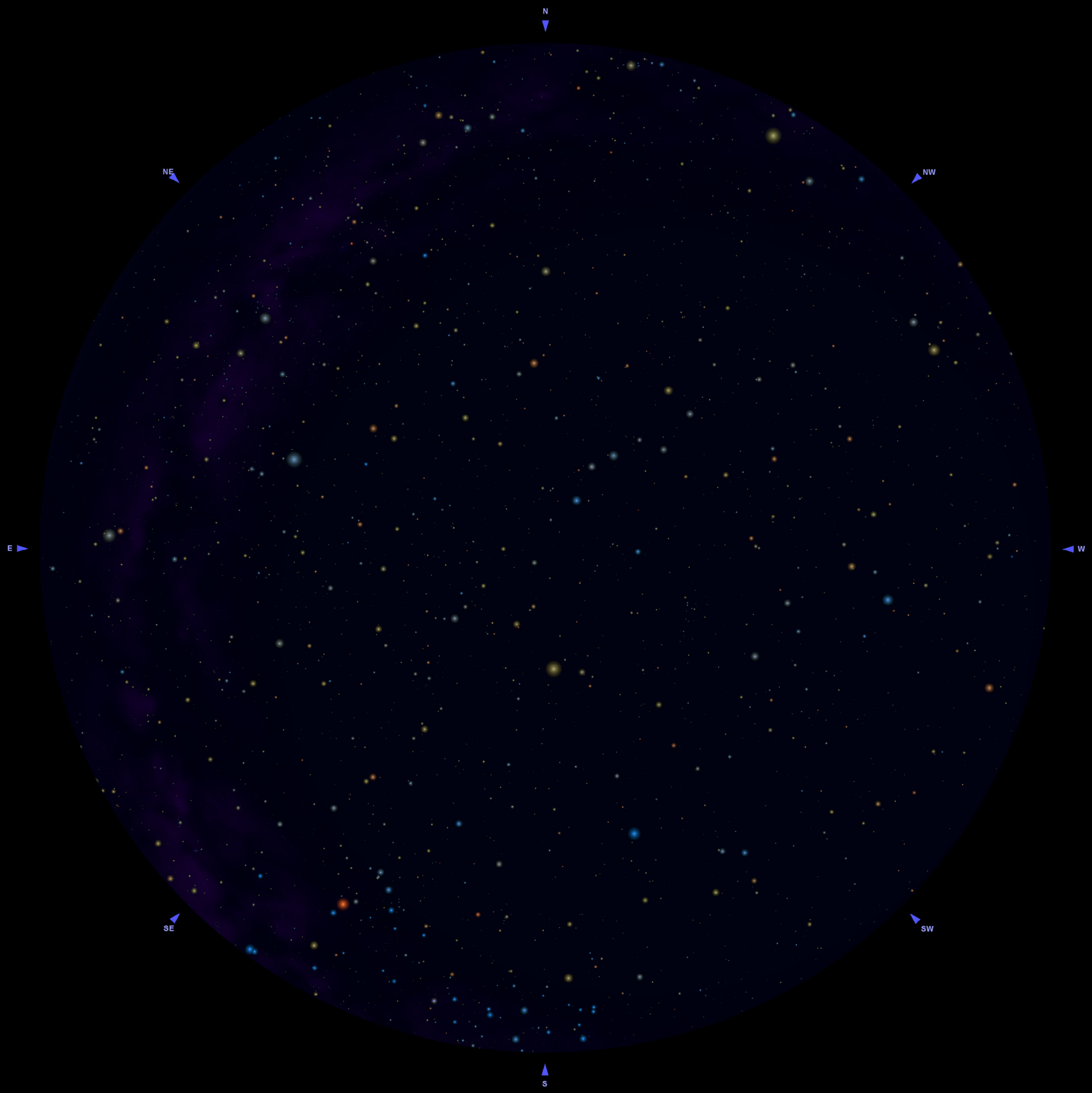
Andromeda
Perseus
Cassiopeia
Camelopardalis
Auriga
Lacerta
Cepheus
Cygnus
Pegasus
Ursa Minor
Lynx
Gemini
Draco
Ursa Major
Big Dipper
Delphinus
Lyra
Sagitta
Vulpecula
Cancer
Leo Minor
Canes Venatici
Aquila
Hercules
Corona Borealis
Bootes
Leo
Hydra
Coma Berenices
Sextans
Scutum
Serpens
Ophiuchus
Virgo
Crater
Corvus
Sagittarius
Libra
Scorpius
Lupus
Centaurus


LEGEND
STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE <20′
GLOBULAR CLUSTERS
TO SCALE <20′
PLANETARY NEBULAE
TO SCALE <20′
BRIGHT NEBULAE
TO SCALE <20′
GALAXIES
TO SCALE <20′
MILKY WAY

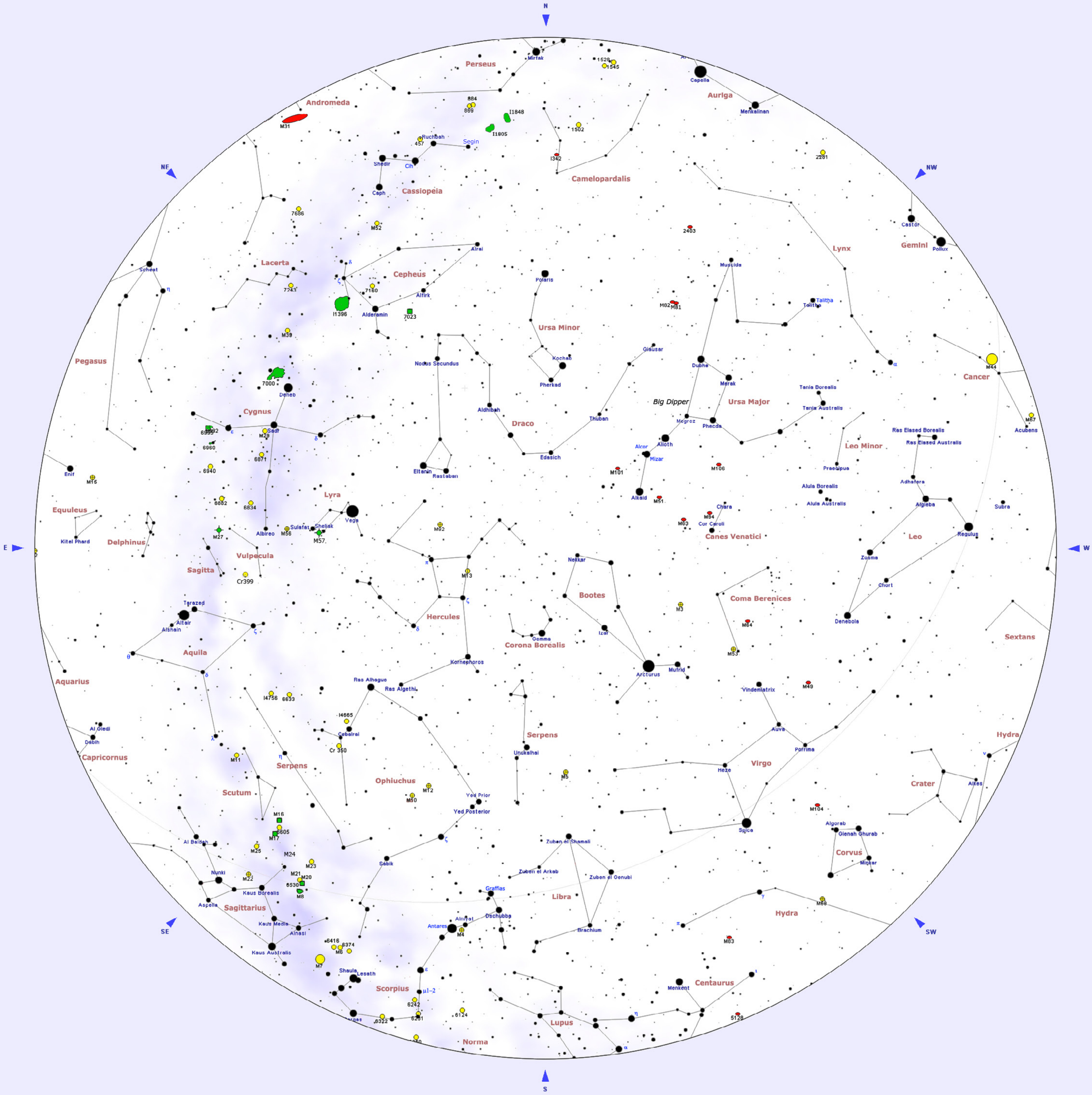


OBSERVATION

June 1, 10:00 pm *
June 15, 9:00 pm *

*Add 1 hour if using DST

February 1, 6:00 am
February 15, 5:00 am
March 1, 4:00 am
March 15, 3:00 am
April 1, 2:00 am *
April 15, 1:00 am *
May 1, midnight *
May 15, 11 pm *


N
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Perseus
Andromeda
Auriga
Cassiopeia
Camelopardalis
Lacerta
Cepheus
Lynx
Gemini
Pegasus
Ursa Minor
Cancer
Cygnus
Draco
Ursa Major
Big Dipper
Leo Minor
Equuleus
Delphinus
Lyra
Vulpecula
Sagitta
Canes Venatici
Leo
Hercules
Bootes
Coma Berenices
Corona Borealis
Aquila
Sextans
Aquarius
Serpens
Capricornus
Ophiuchus
Virgo
Hydra
Scutum
Crater
Corvus
Libra
Sagittarius
Scorpius
Centaurus
Lupus
Norma
Polaris
Vega
Deneb
Altair
Arcturus
Spica
Antares
Regulus
Capella
Castor
Pollux
Mirfak
Menkalinan
Schedir
Caph
Alderamin
Alfirk
Alrai
Dubhe
Merak
Phecda
Megrez
Alioth
Mizar
Alcor
Alkaid
Denebola
Zosma
Algieba
Thuban
Kochab
Pherkad
Eltanin
Rastaban
Albireo
Sadr
Sulafat
Sheliak
Tarazed
Alshain
Izar
Nekkar
Muphrid
Gemma
Kornephoros
Ras Alhague
Ras Algethi
Cebalrai
Unukalhai
Yed Prior
Yed Posterior
Zuben el Chamali
Zuben el Genubi
Zuben el Arkab
Brachium
Graffias
Dschubba
Shaula
Lesath
Kaus Australis
Kaus Media
Kaus Borealis
Nunki
Ascella
Al Baldah
Algorab
Gienah Ghurab
Minkar
Alkes
Menkent
Porrima
Auva
Vindemiatrix
Heze
Scheat
Enif
Kitel Phard
Al Giedi
Dabih
Acubens
Subra
Talitha
Muscida
Tania Borealis
Tania Australis
Alula Borealis
Alula Australis
Ras Elased Borealis
Ras Elased Australis
Adhafera
Praecipua
Chara
Cor Caroli
Chort
Edasich
Aldhibah
Nodus Secundus
Giausar
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I1396
I1805
I1848
7000
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869
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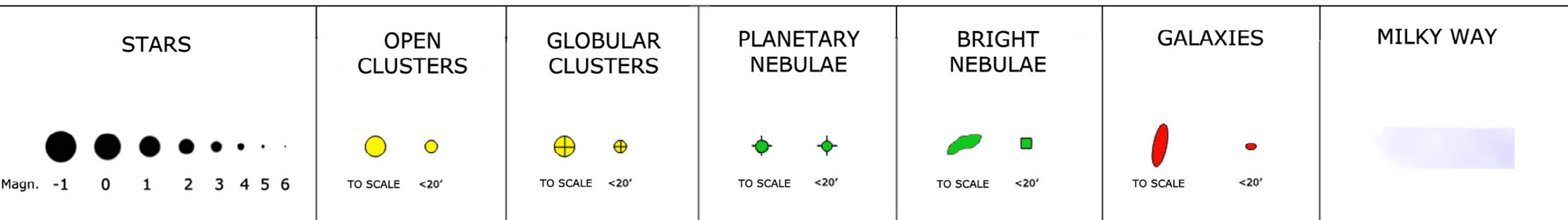
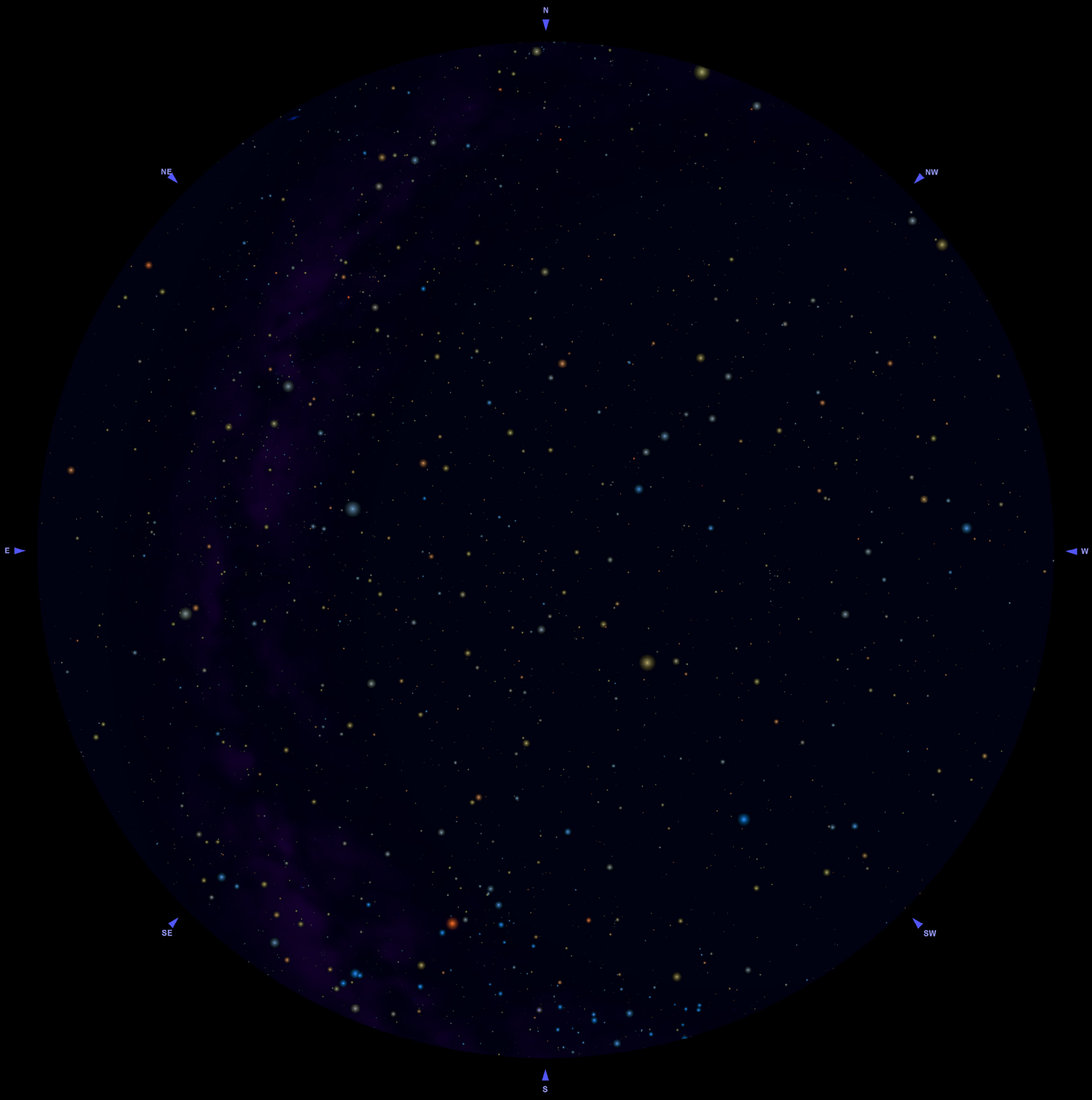
LEGEND


STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE
<20'
GLOBULAR CLUSTERS
TO SCALE
<20'
PLANETARY NEBULAE
TO SCALE
<20'
BRIGHT NEBULAE
TO SCALE
<20'
GALAXIES
TO SCALE
<20'
MILKY WAY

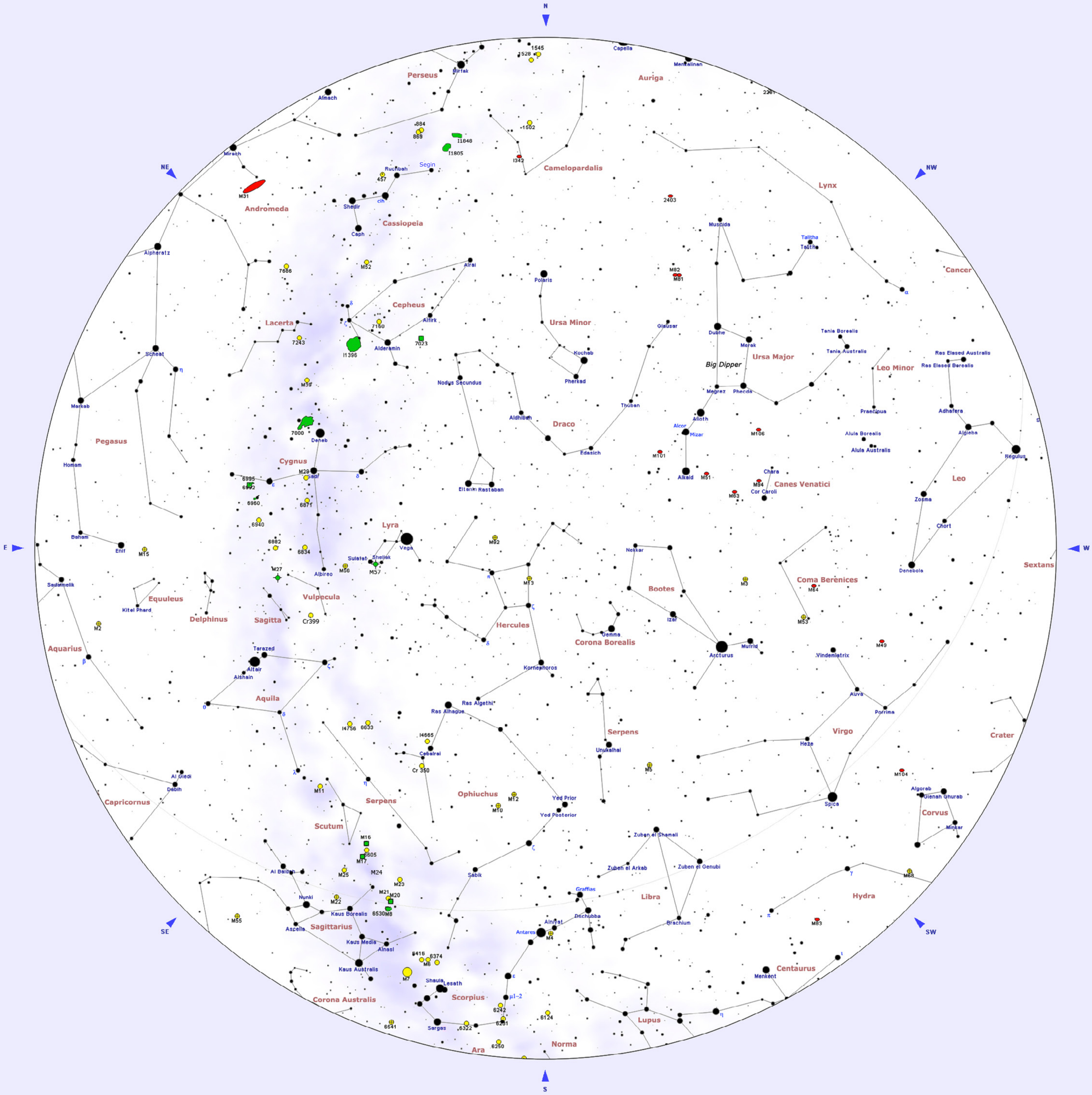


OBSERVATION

June 15, 10:00 pm *
July 1, 9:00 pm *

*Add 1 hour if using DST

February 15, 6:00 am
March 1, 5:00 am
March 15, 4:00 am
April 1, 3:00 am *
April 15, 2:00 am *
May 1, 1:00 am *
May 15, midnight *
June 1, 11 pm *


N
NE
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W
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Perseus
Auriga
Camelopardalis
Lynx
Cancer
Andromeda
Cassiopeia
Cepheus
Lacerta
Ursa Minor
Ursa Major
Big Dipper
Leo Minor
Draco
Pegasus
Cygnus
Canes Venatici
Leo
Lyra
Vulpecula
Equuleus
Delphinus
Sagitta
Bootes
Coma Berenices
Sextans
Hercules
Corona Borealis
Aquarius
Aquila
Serpens
Virgo
Crater
Ophiuchus
Capricornus
Scutum
Corvus
Libra
Hydra
Sagittarius
Centaurus
Scorpius
Corona Australis
Lupus
Norma
Ara
Polaris
Vega
Deneb
Altair
Arcturus
Spica
Antares
Regulus
Capella
Mirfak
Alpheratz
Scheat
Markab
Dubhe
Merak
Mizar
Alcor
Alkaid
Thuban
Kochab
Pherkad
Denebola
Albireo
Sheliak
Sulafat
Rasalhague
Ras Algethi
Kornephoros
Unukalhai
Zuben el Genubi
Zuben el Shamali
Kaus Australis
Nunki
Shaula
Lesath
M31
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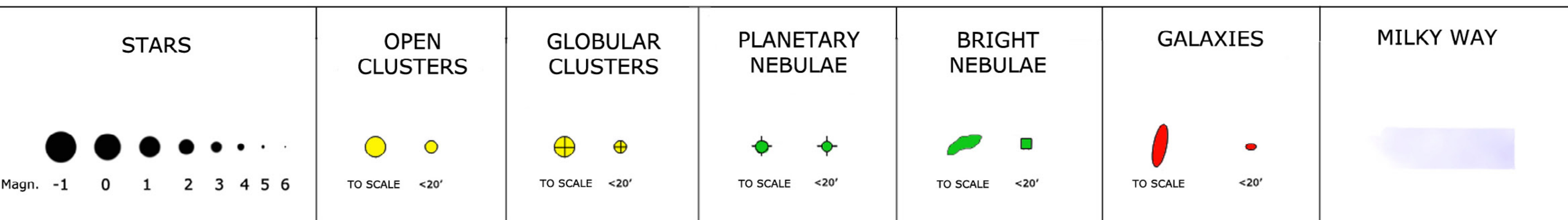
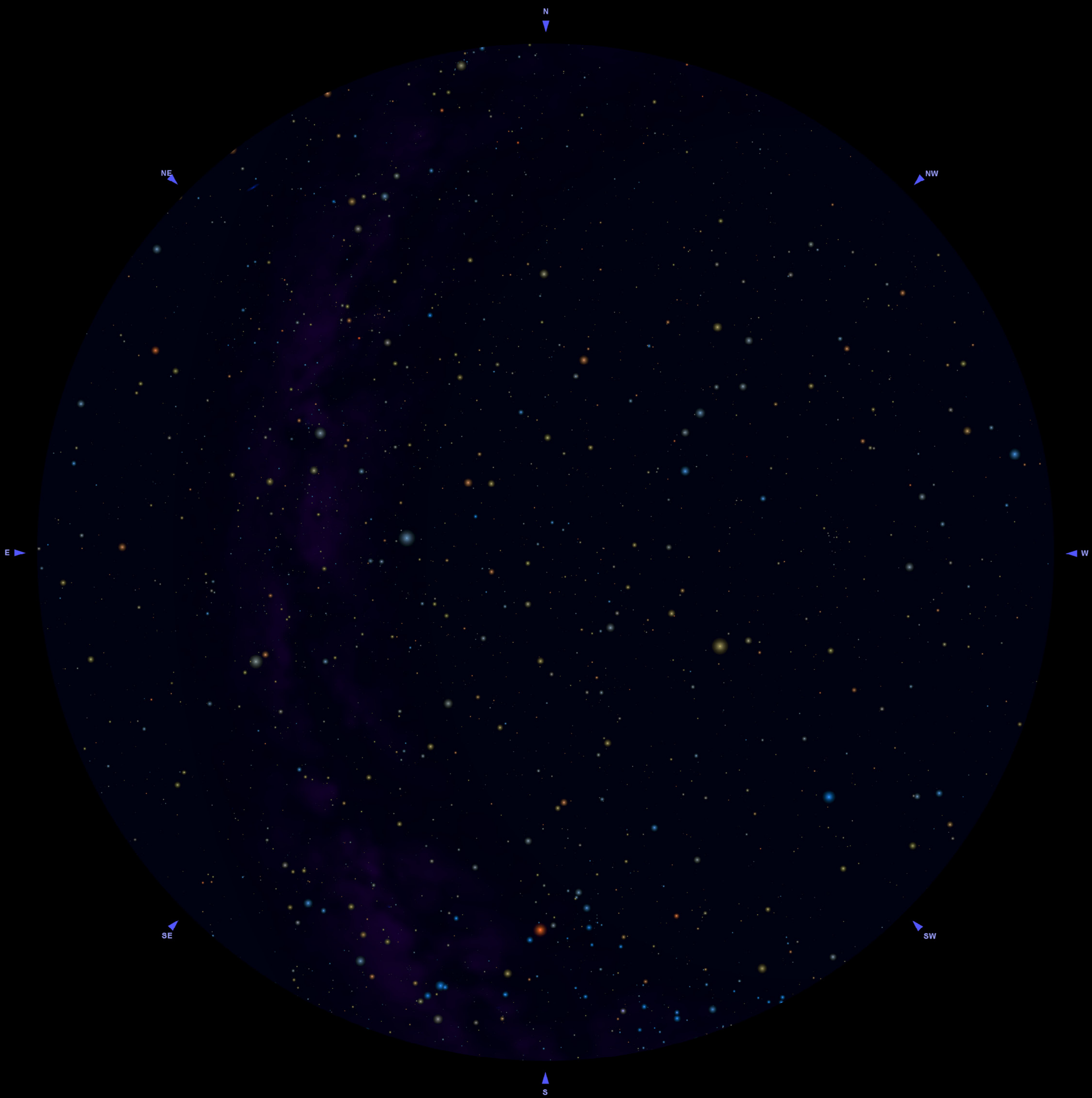
LEGEND


STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE
<20′
GLOBULAR CLUSTERS
TO SCALE
<20′
PLANETARY NEBULAE
TO SCALE
<20′
BRIGHT NEBULAE
TO SCALE
<20′
GALAXIES
TO SCALE
<20′
MILKY WAY

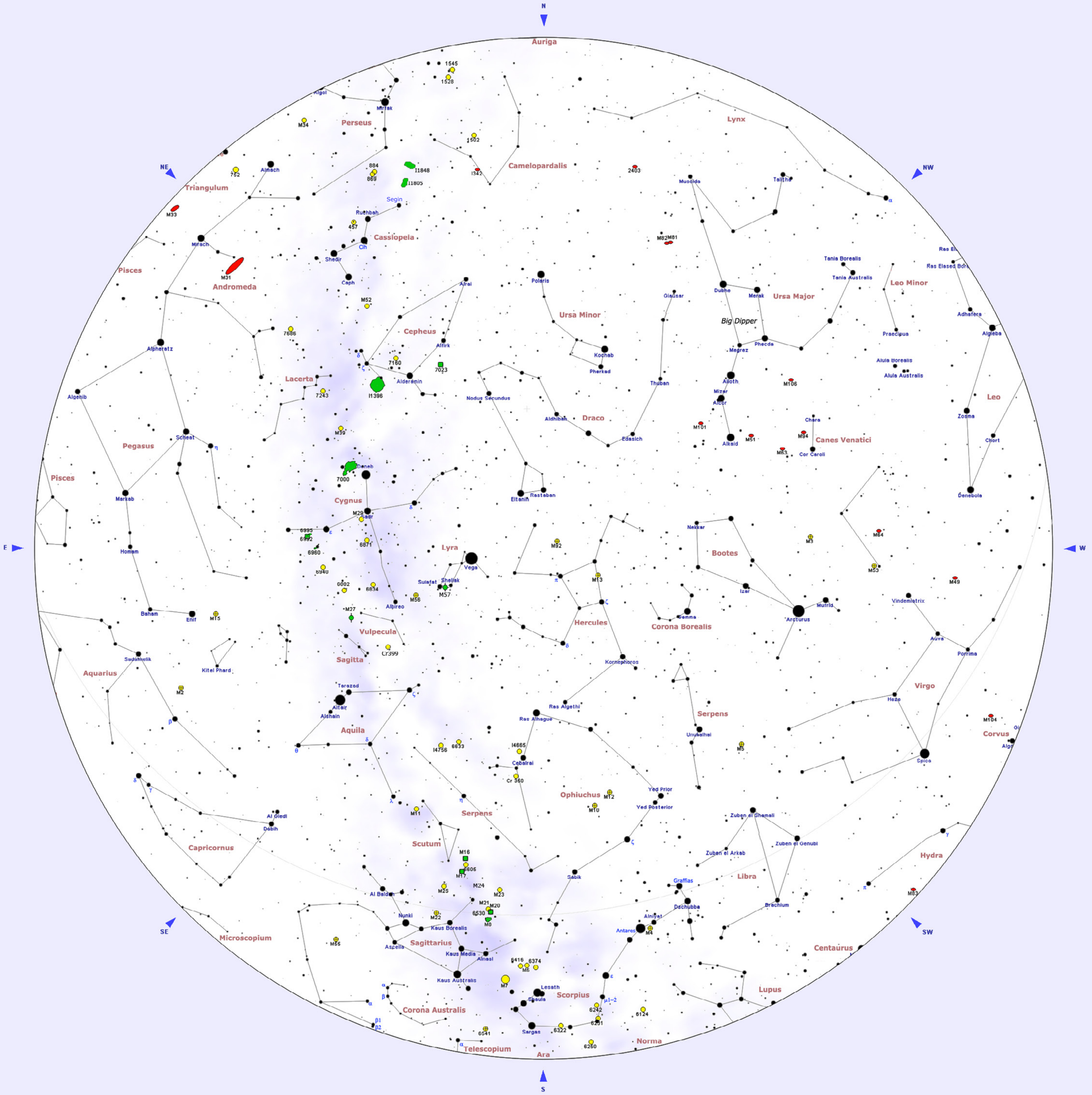


OBSERVATION

July 1, 10:00 pm *
July 15, 9:00 pm *

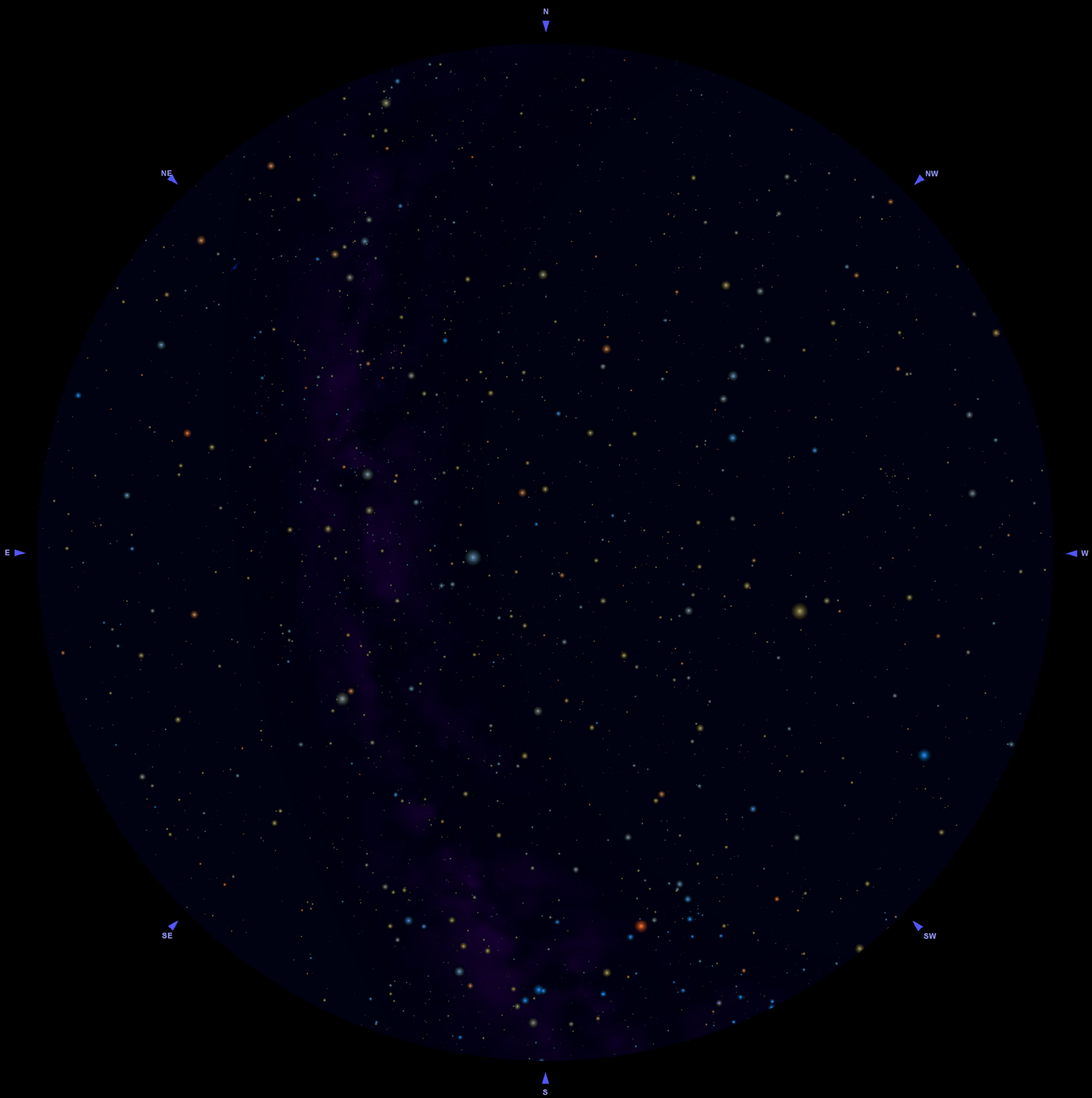
*Add 1 hour if using DST

March 1, 6:00 am
March 15, 5:00 am
April 1, 4:00 am *
April 15, 3:00 am *
May 1, 2:00 am *
May 15, 1:00 am *
June 1, midnight *
June 15, 11 pm *



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	

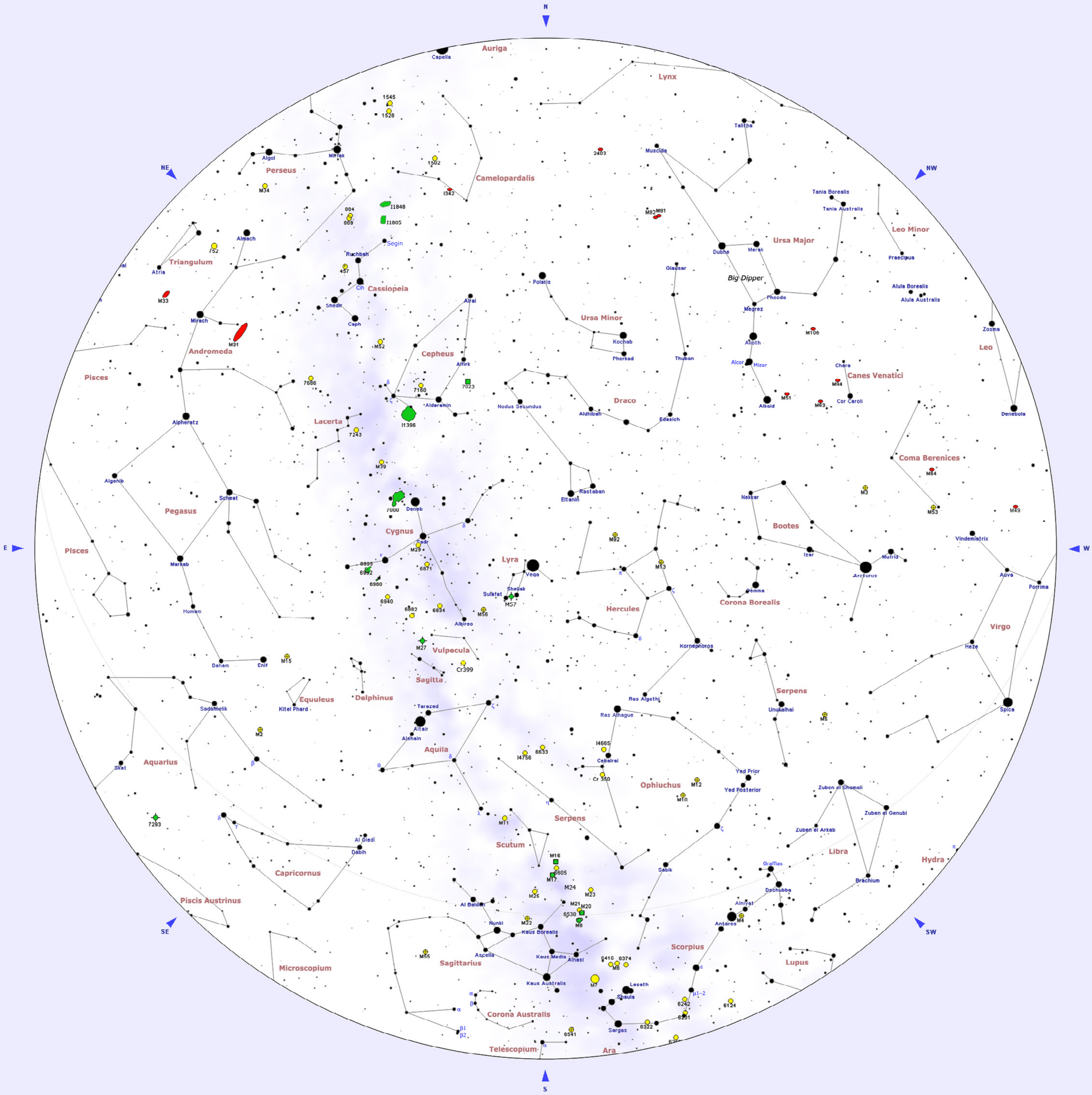


OBSERVATION

July 15, 10:00 pm *
August 1, 9:00 pm *

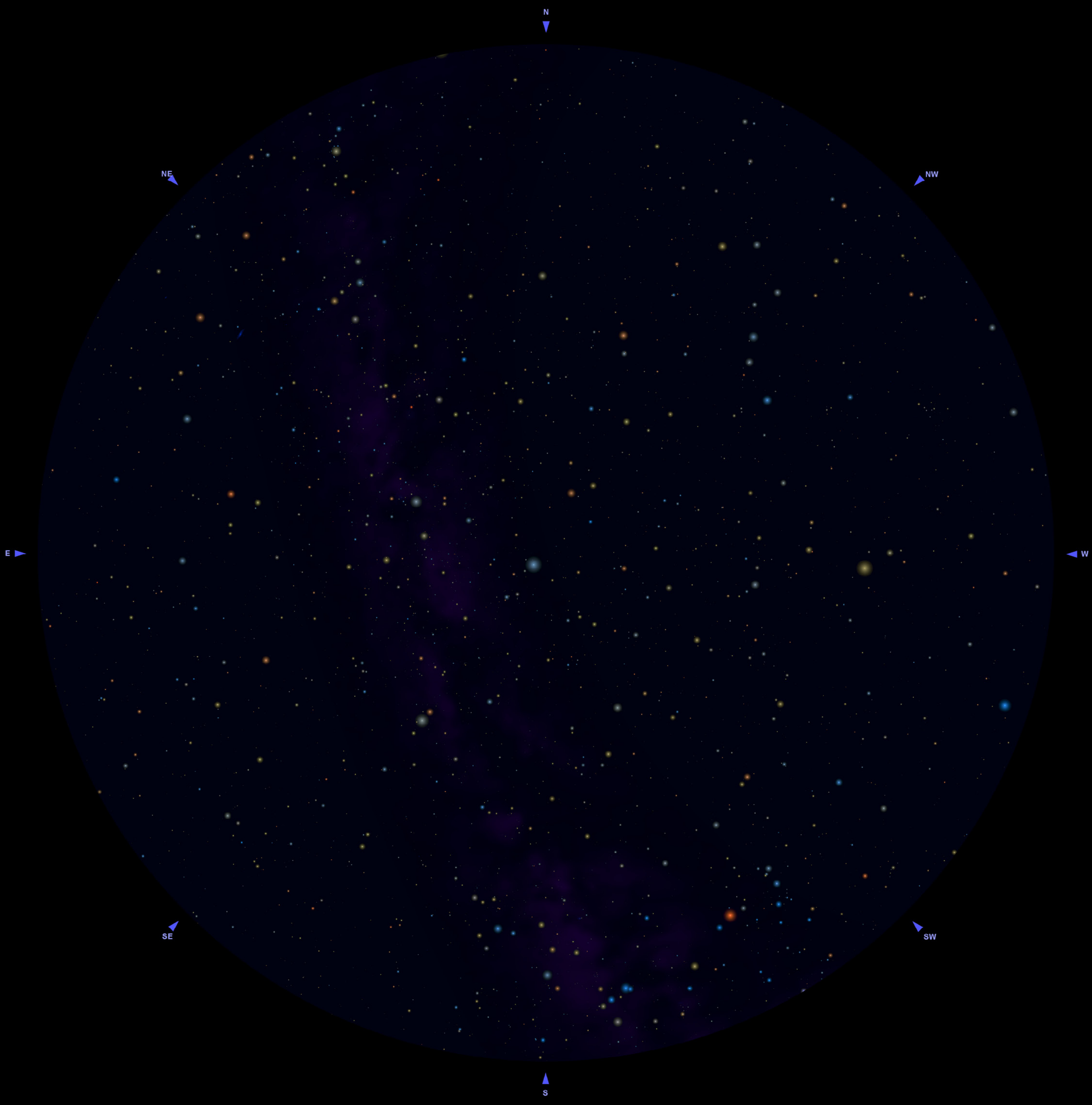
*Add 1 hour if using DST

March 15, 6:00 am
April 1, 5:00 am *
April 15, 4:00 am *
May 1, 3:00 am *
May 15, 2:00 am *
June 1, 1:00 am *
June 15, midnight *
July 1, 11 pm *



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	

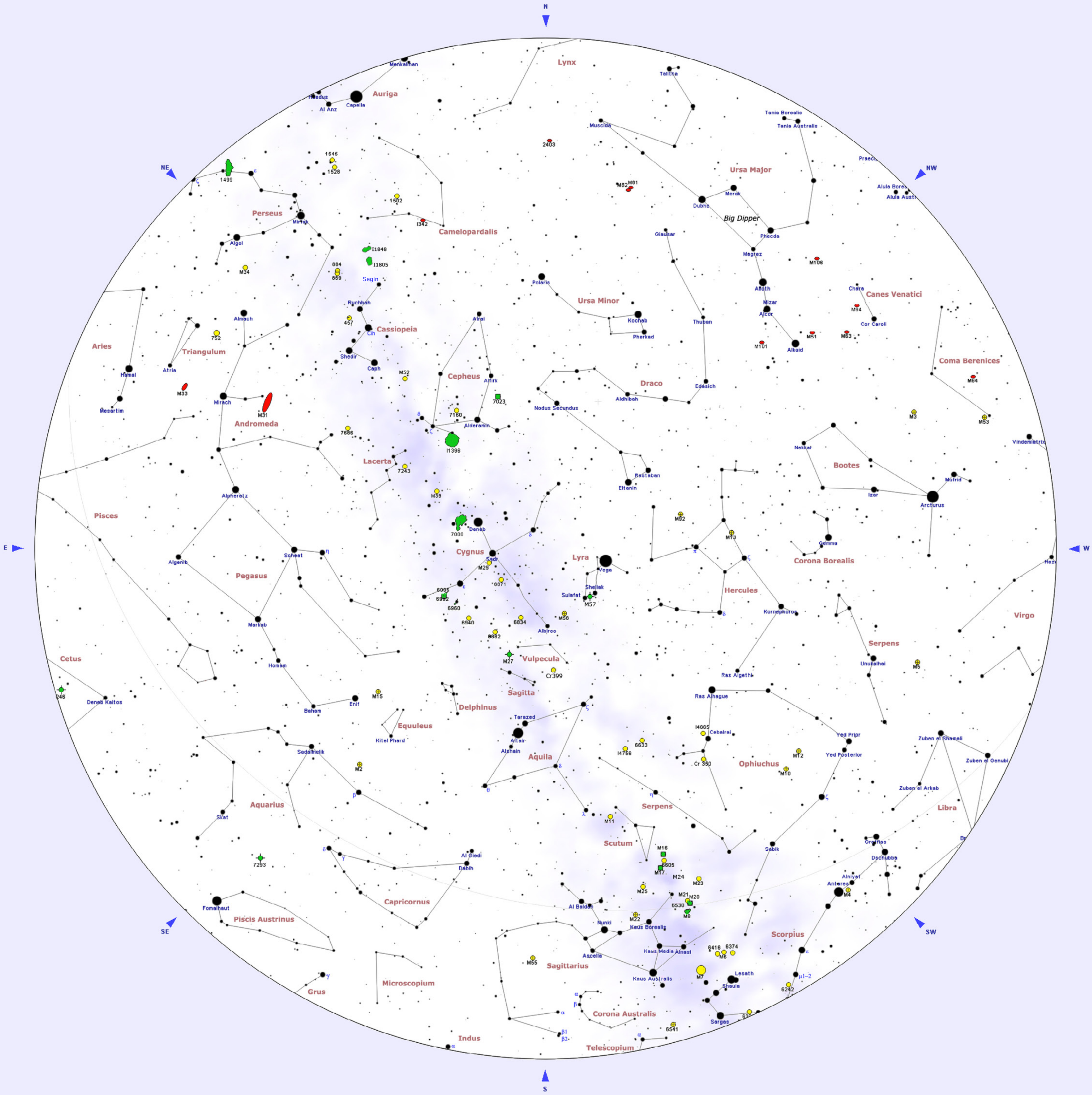


OBSERVATION

August 1, 10:00 pm *
August 15, 9:00 pm *
September 1, 8:00 pm *

*Add 1 hour if using DST

April 15, 5:00 am *
May 1, 4:00 am *
May 15, 3:00 am *
June 1, 2:00 am *
June 15, 1:00 am *
July 1, midnight *
July 15, 11 pm *



N
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Lynx
Auriga
Capella
Perseus
Algol
Mirfak
Camelopardalis
Ursa Major
Big Dipper
Dubhe
Merak
Phecda
Megrez
Alioth
Mizar
Alcor
Alkaid
Canes Venatici
Cor Caroli
Ursa Minor
Polaris
Kochab
Pherkad
Draco
Thuban
Eltanin
Rastaban
Cassiopeia
Schedar
Caph
Ruchbah
Cepheus
Alderamin
Alfirk
Alrai
Triangulum
Aries
Hamal
Andromeda
Mirach
Almach
Alpheratz
Pisces
Pegasus
Scheat
Markab
Algenib
Enif
Lacerta
Cygnus
Deneb
Sadr
Albireo
Lyra
Vega
Sheliak
Sulafat
Vulpecula
Sagitta
Delphinus
Equuleus
Kitel Phard
Aquila
Altair
Tarazed
Alshain
Cetus
Deneb Kaitos
Aquarius
Sadalmelik
Skat
Capricornus
Al Giedi
Dabih
Piscis Austrinus
Fomalhaut
Grus
Microscopium
Indus
Telescopium
Corona Australis
Sagittarius
Nunki
Kaus Borealis
Kaus Media
Kaus Australis
Ascella
Al Baldah
Scorpius
Antares
Shaula
Lesath
Sargas
Dschubba
Graffias
Scutum
Serpens
Ophiuchus
Ras Alhague
Cebalrai
Sabik
Yed Prior
Yed Posterior
Unukalhai
Hercules
Ras Algethi
Kornephoros
Corona Borealis
Gemma
Bootes
Arcturus
Izar
Nekkar
Muphrid
Coma Berenices
Virgo
Vindemiatrix
Libra
Zuben el Genubi
Zuben el Shamali
Zuben el Akrab
Ursa Major
Talitha
Tania Borealis
Tania Australis
Alula Borealis
Alula Australis
Muscida
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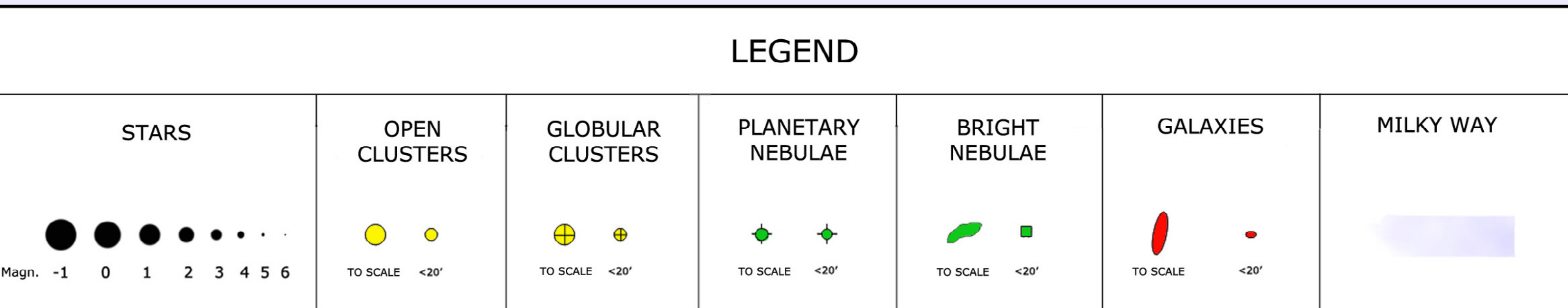
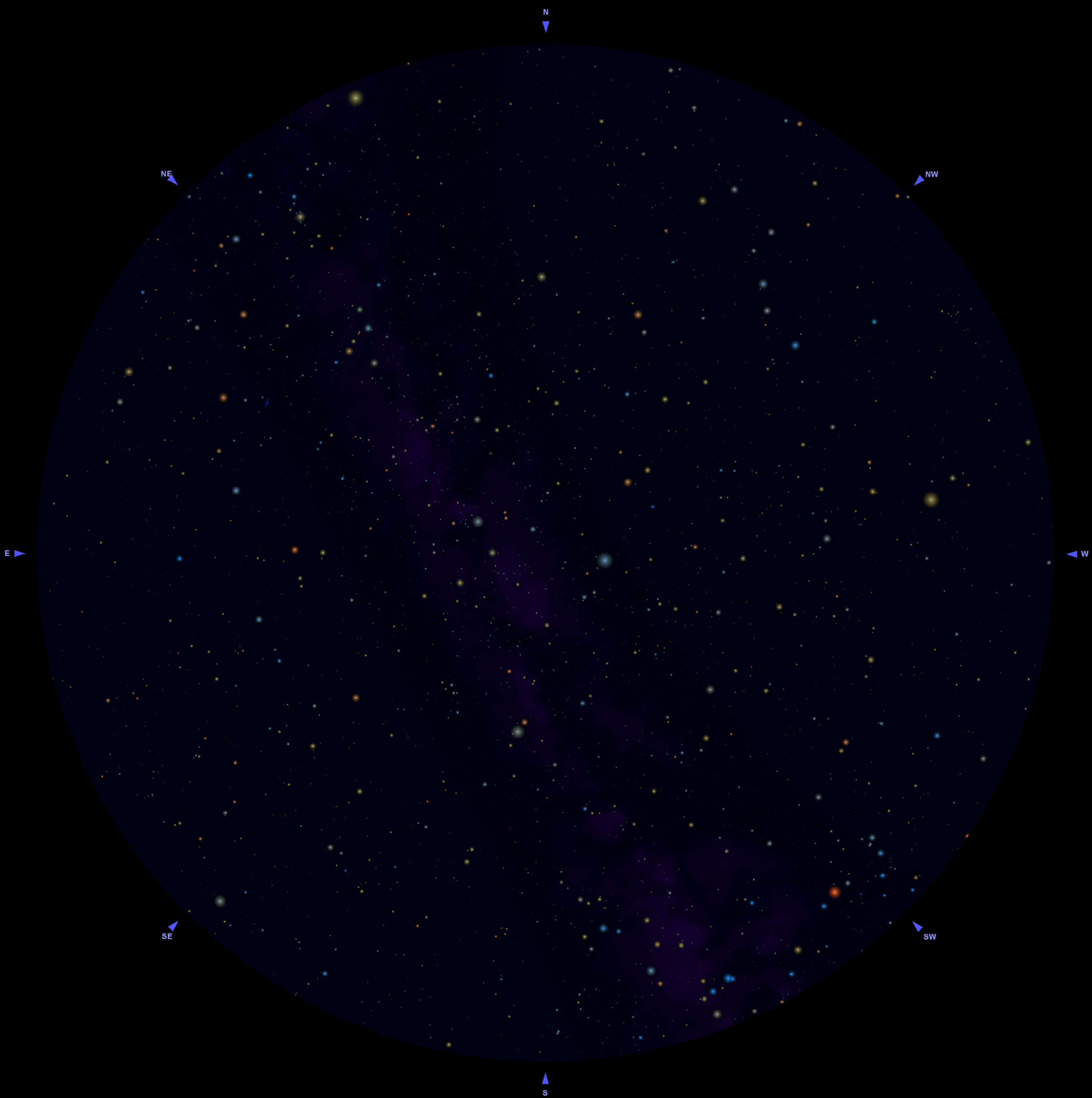


LEGEND
STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE
<20′
GLOBULAR CLUSTERS
TO SCALE
<20′
PLANETARY NEBULAE
TO SCALE
<20′
BRIGHT NEBULAE
TO SCALE
<20′
GALAXIES
TO SCALE
<20′
MILKY WAY

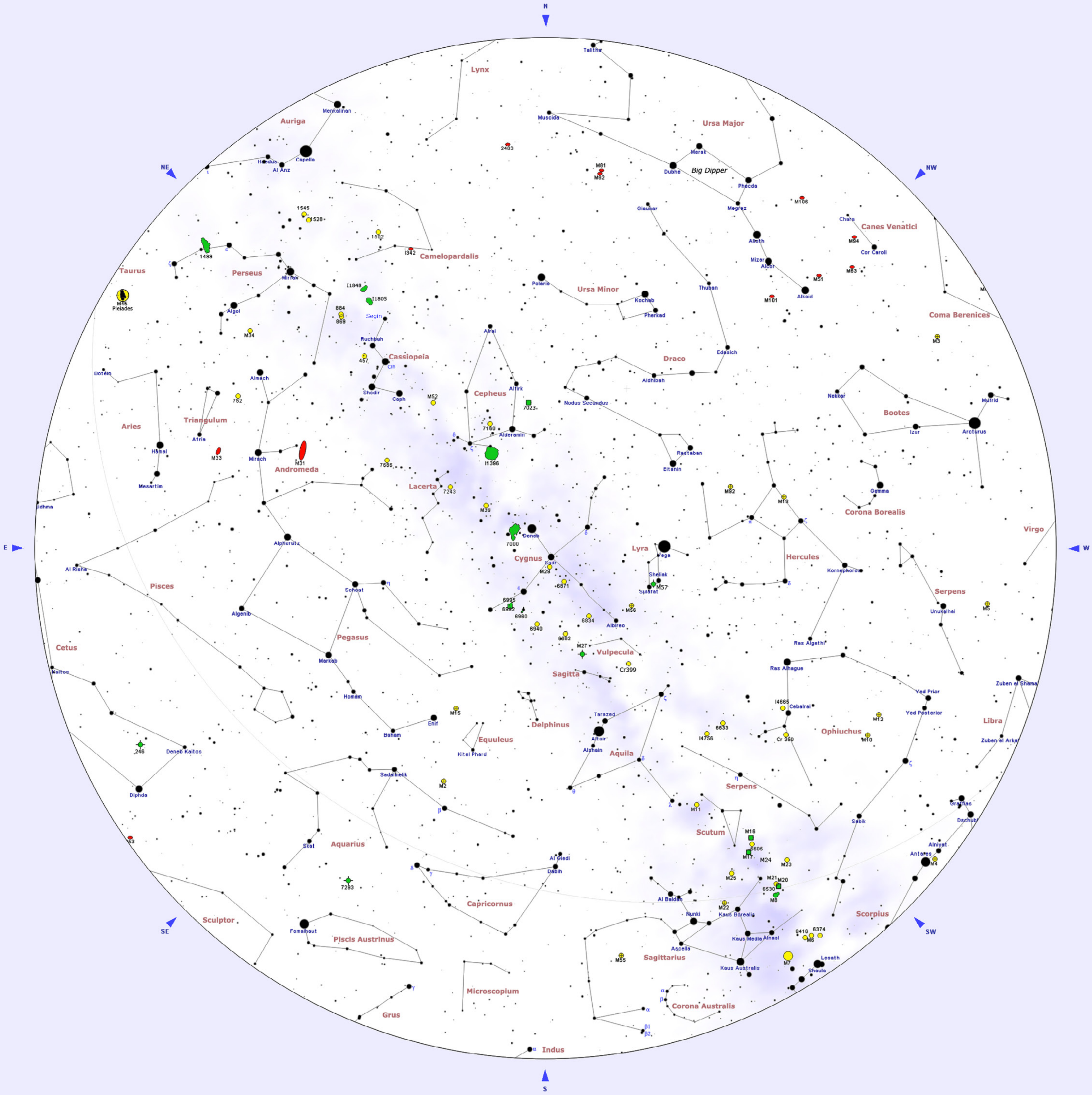


OBSERVATION

August 15, 10:00 pm *
September 1, 9:00 pm *
September 15, 8:00 pm *
October 1, 7:00 pm *

*Add 1 hour if using DST

May 1, 5:00 am *
May 15, 4:00 am *
June 1, 3:00 am *
June 15, 2:00 am *
July 1, 1:00 am *
July 15, midnight *
August 1, 11 pm *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Lynx
Auriga
Ursa Major
Big Dipper
Canes Venatici
Camelopardalis
Perseus
Taurus
Ursa Minor
Coma Berenices
Cassiopeia
Draco
Cepheus
Bootes
Aries
Triangulum
Andromeda
Lacerta
Corona Borealis
Virgo
Lyra
Cygnus
Hercules
Pisces
Serpens
Cetus
Pegasus
Vulpecula
Sagitta
Ophiuchus
Libra
Delphinus
Equuleus
Aquila
Scutum
Aquarius
Capricornus
Scorpius
Sculptor
Piscis Austrinus
Sagittarius
Microscopium
Corona Australis
Grus
Indus
Capella
Menkalinan
Polaris
Dubhe
Merak
Phecda
Megrez
Alioth
Mizar
Alcor
Alkaid
Cor Caroli
Thuban
Kochab
Pherkad
Mirfak
Algol
Pleiades
Schedar
Caph
Alderamin
Arcturus
Gemma
Vega
Deneb
Altair
Alpheratz
Mirach
Markab
Scheat
Algenib
Enif
Hamal
Ras Alhague
Antares
Fomalhaut
Nunki
Kaus Australis
Shaula
Diphda
M31
M33
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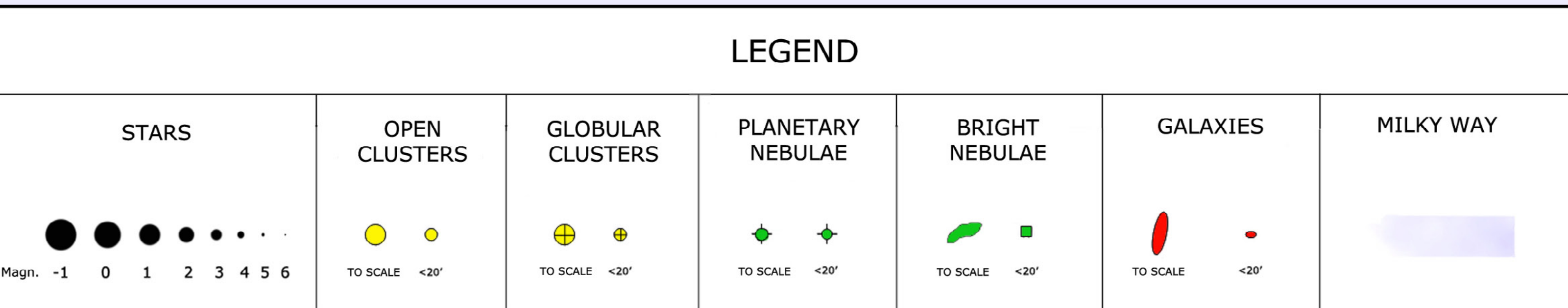
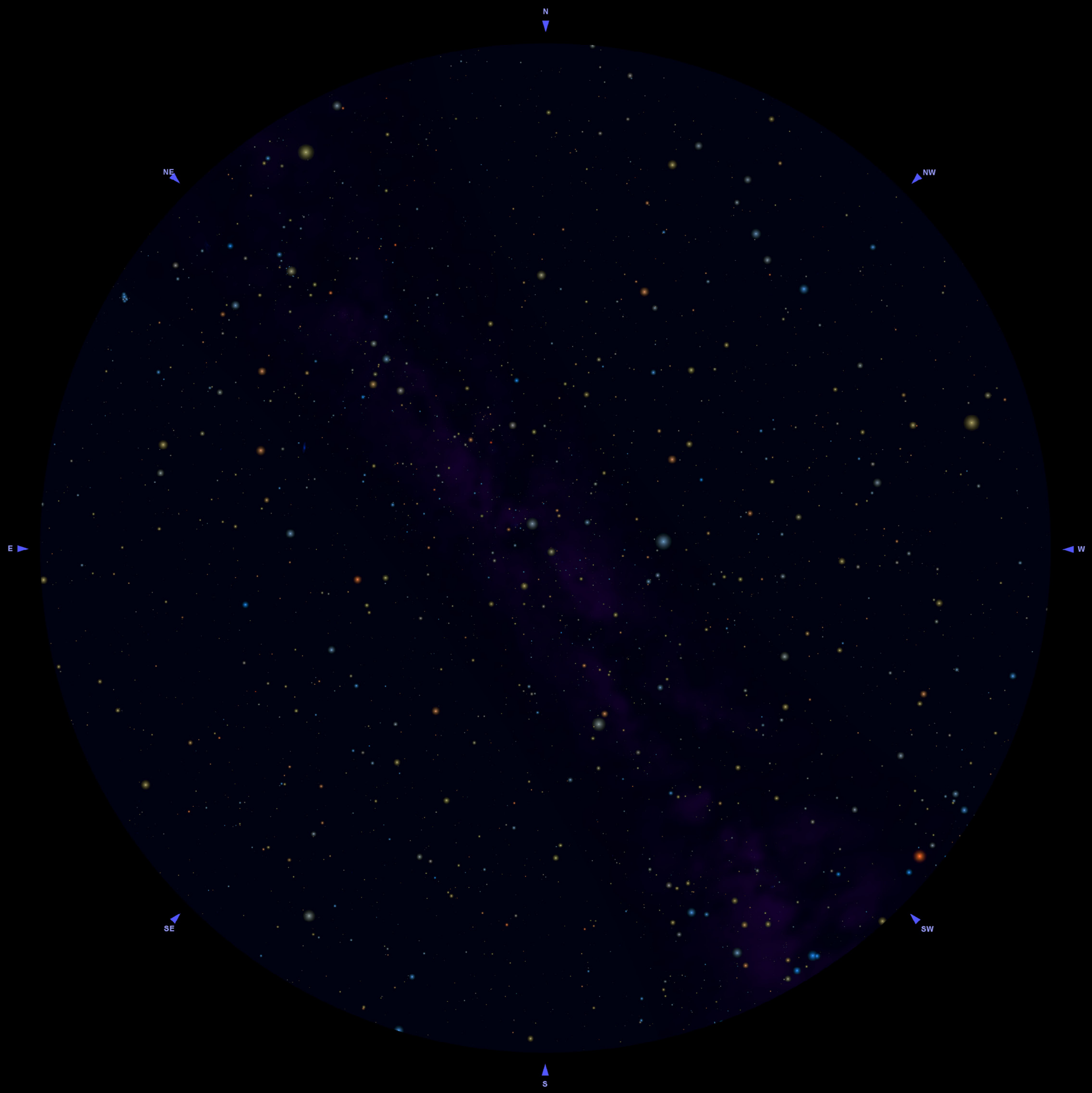
M7


LEGEND
STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE <20'
GLOBULAR CLUSTERS
TO SCALE <20'
PLANETARY NEBULAE
TO SCALE <20'
BRIGHT NEBULAE
TO SCALE <20'
GALAXIES
TO SCALE <20'
MILKY WAY

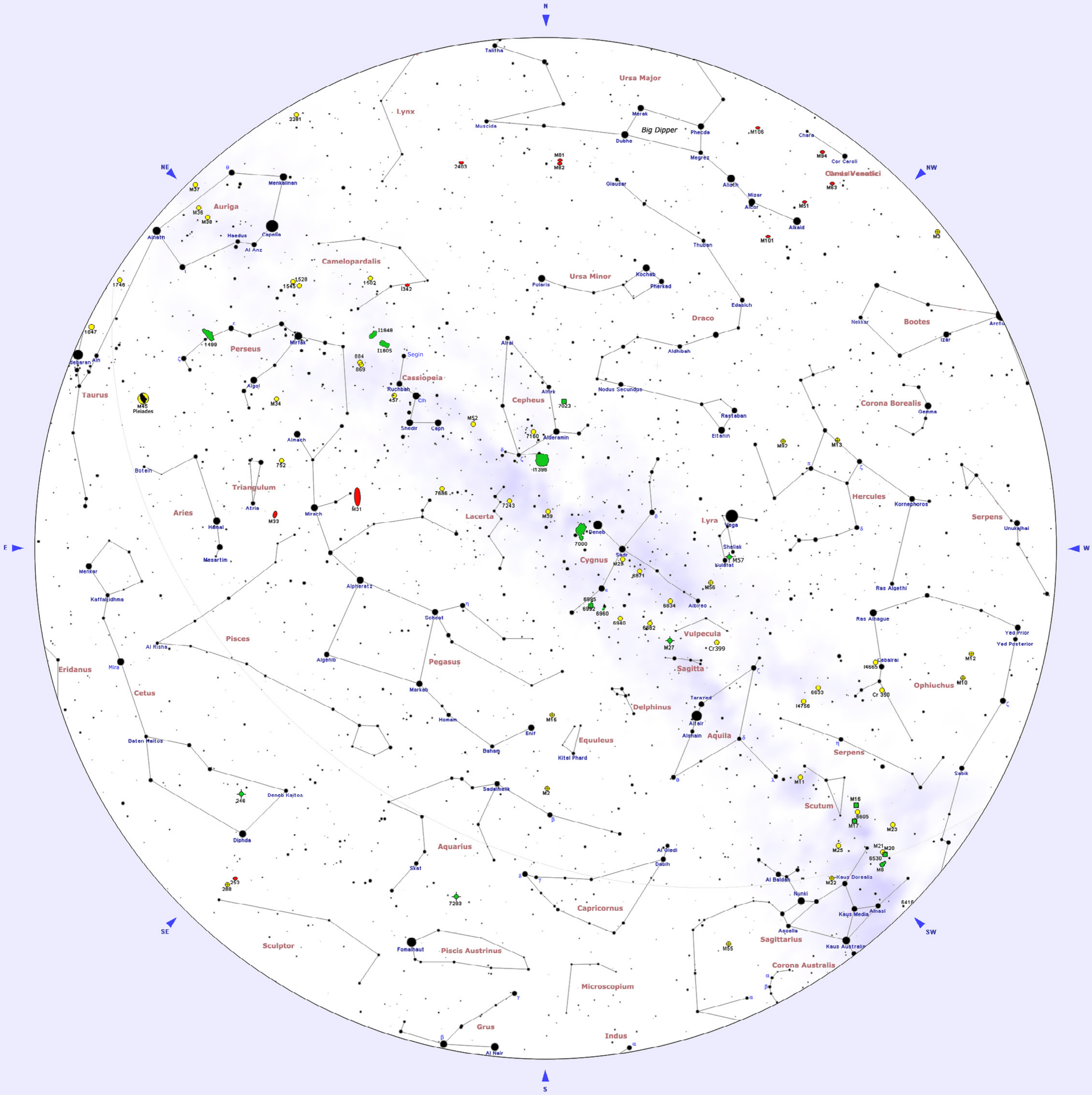


OBSERVATION

September 1, 10:00 pm *
September 15, 9:00 pm *
October 1, 8:00 pm *
October 15, 7:00 pm *
November 1, 6:00 pm

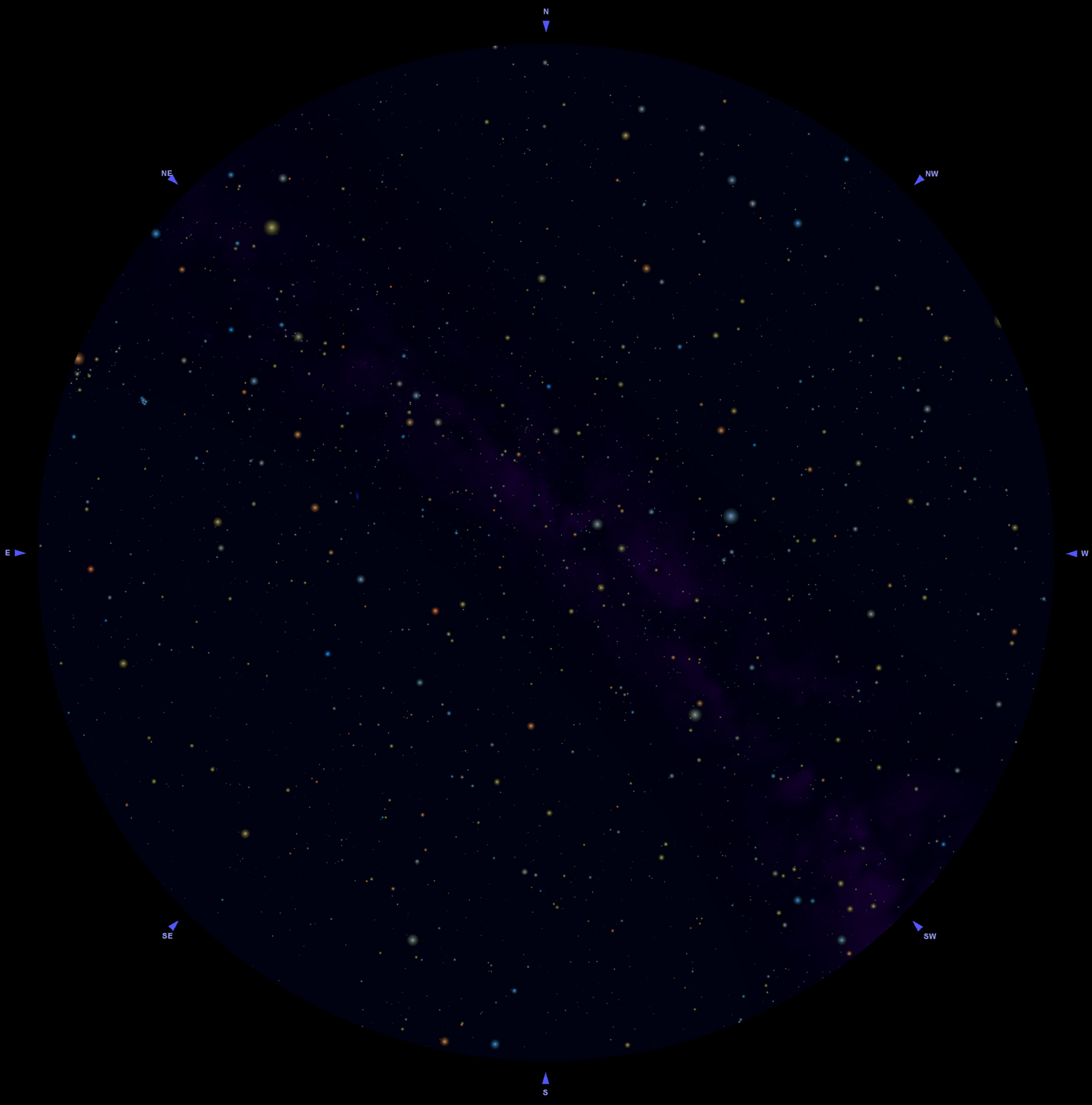
*Add 1 hour if using DST

June 1, 4:00 am *
June 15, 3:00 am *
July 1, 2:00 am *
July 15, 1:00 am *
August 1, midnight *
August 15, 11 pm *



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	



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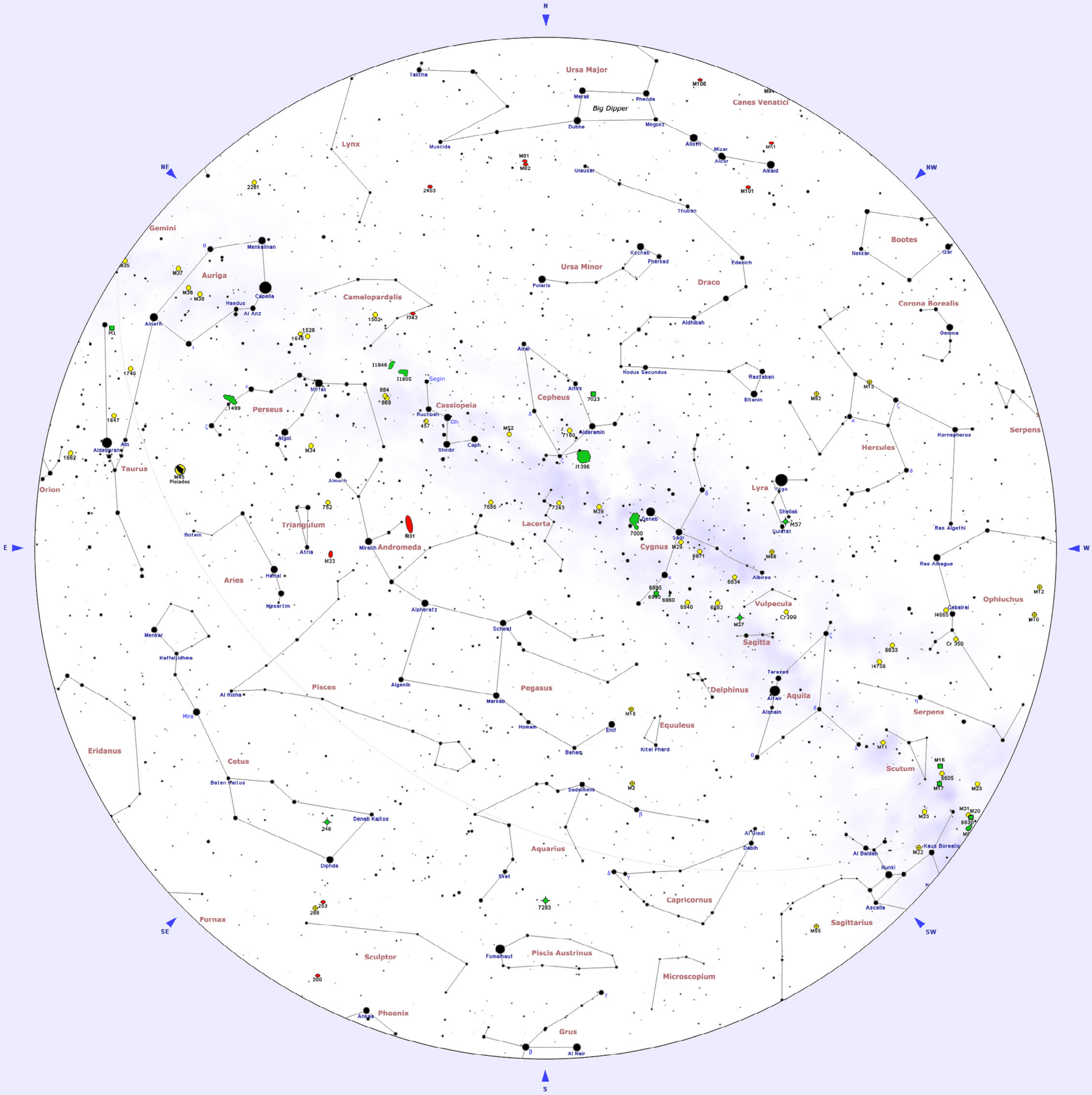
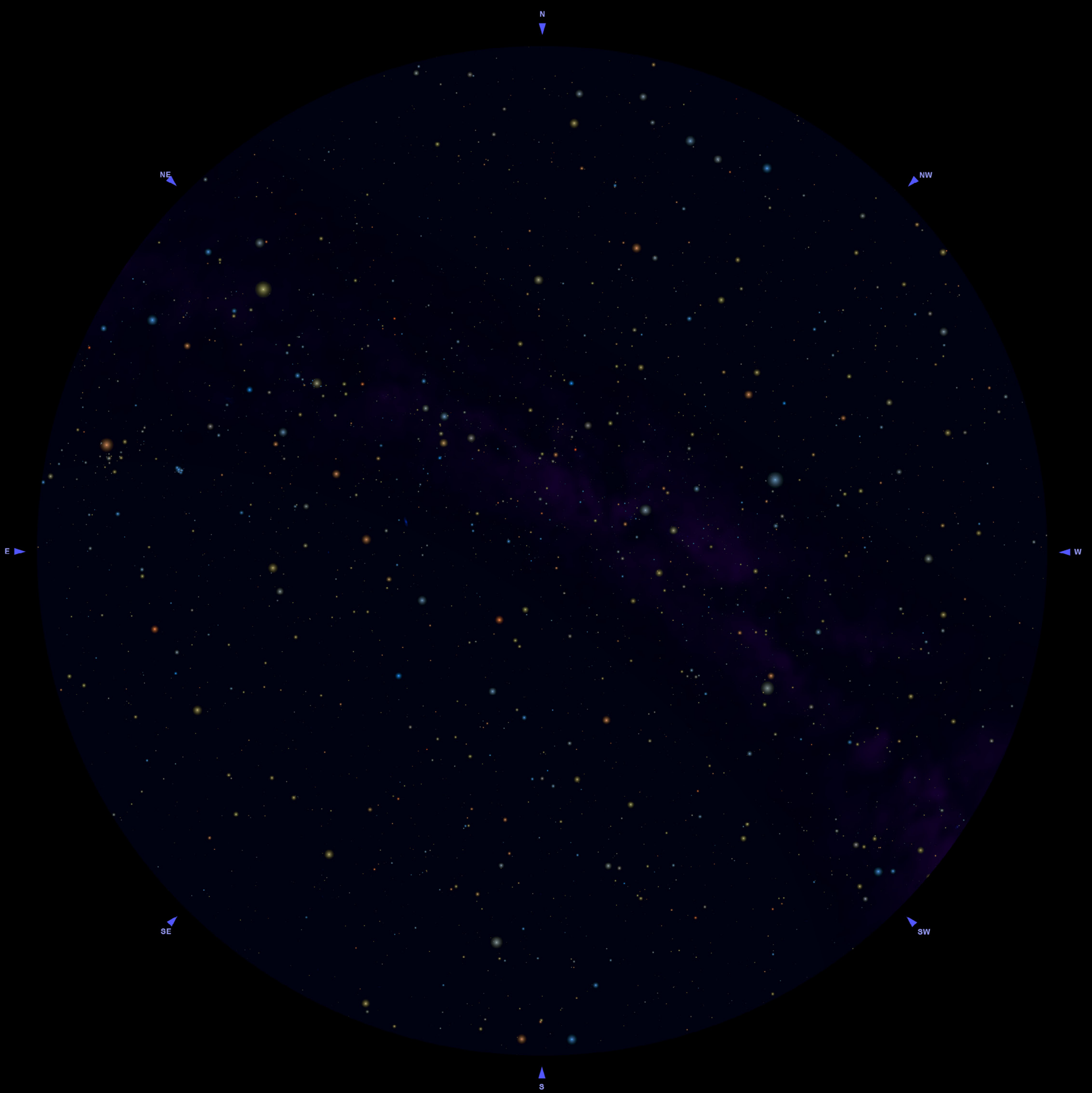


LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	



OBSERVATION

October 1, 10:00 pm *
October 15, 9:00 pm *
November 1, 8:00 pm
November 15, 7:00 pm
December 1, 6:00 pm

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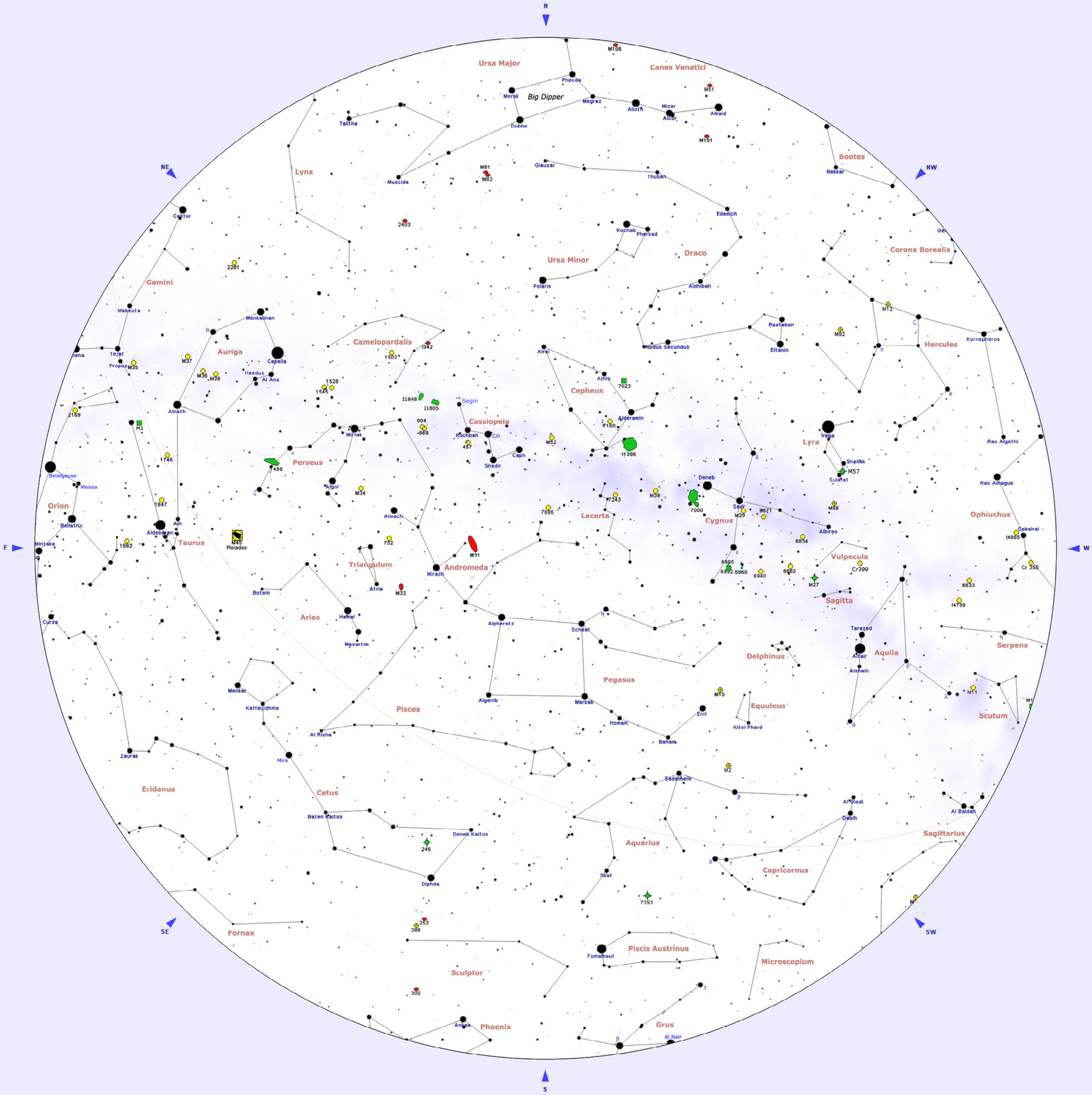
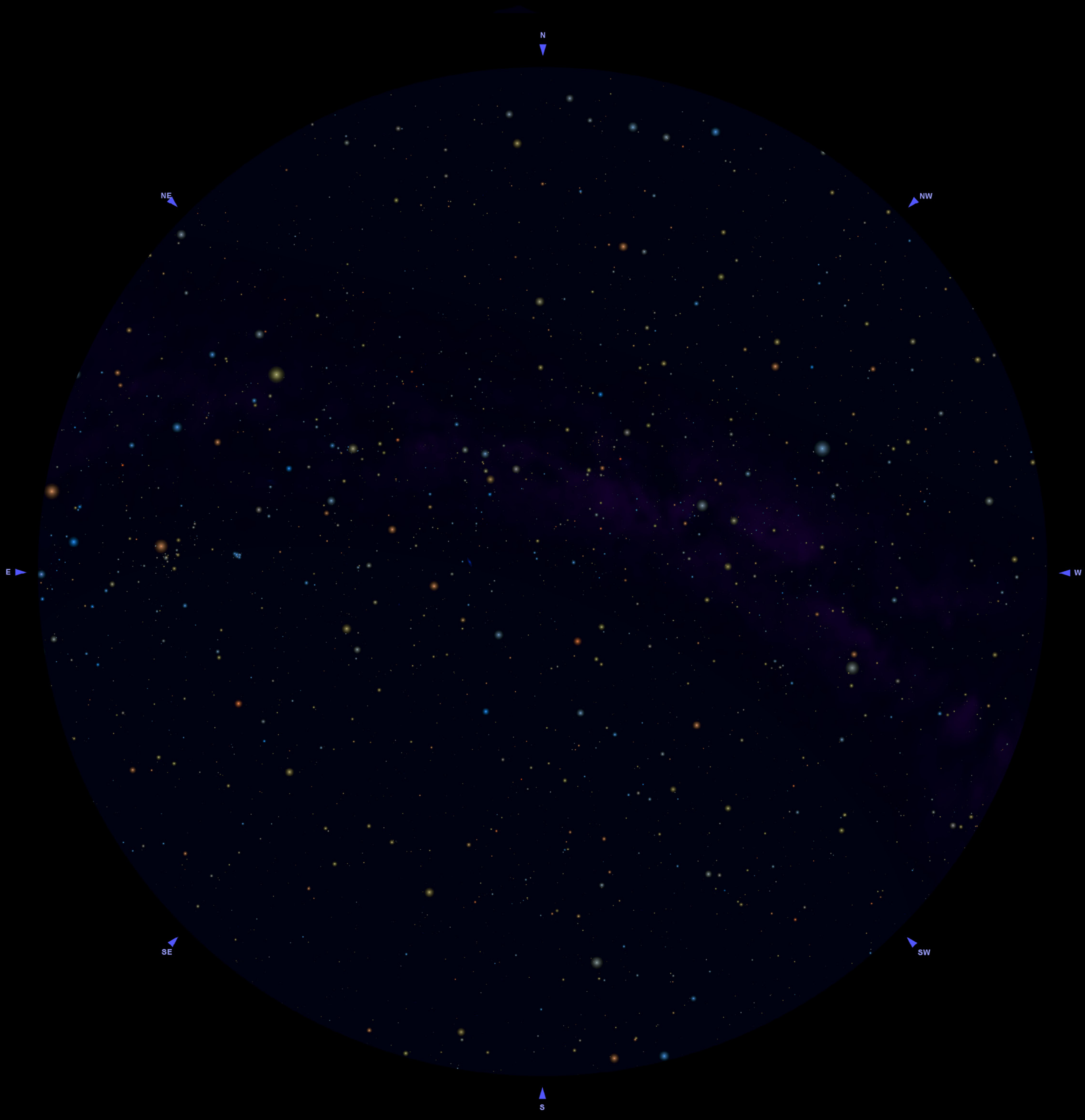
August 15, 1:00 am *
September 1, midnight *
September 15, 11 pm *



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	



OBSERVATION

October 15, 10:00 pm *
November 1, 9:00 pm
November 15, 8:00 pm
December 1, 7:00 pm
December 15, 6:00 pm

*Add 1 hour if using DST

July 15, 4:00 am *
August 1, 3:00 am *
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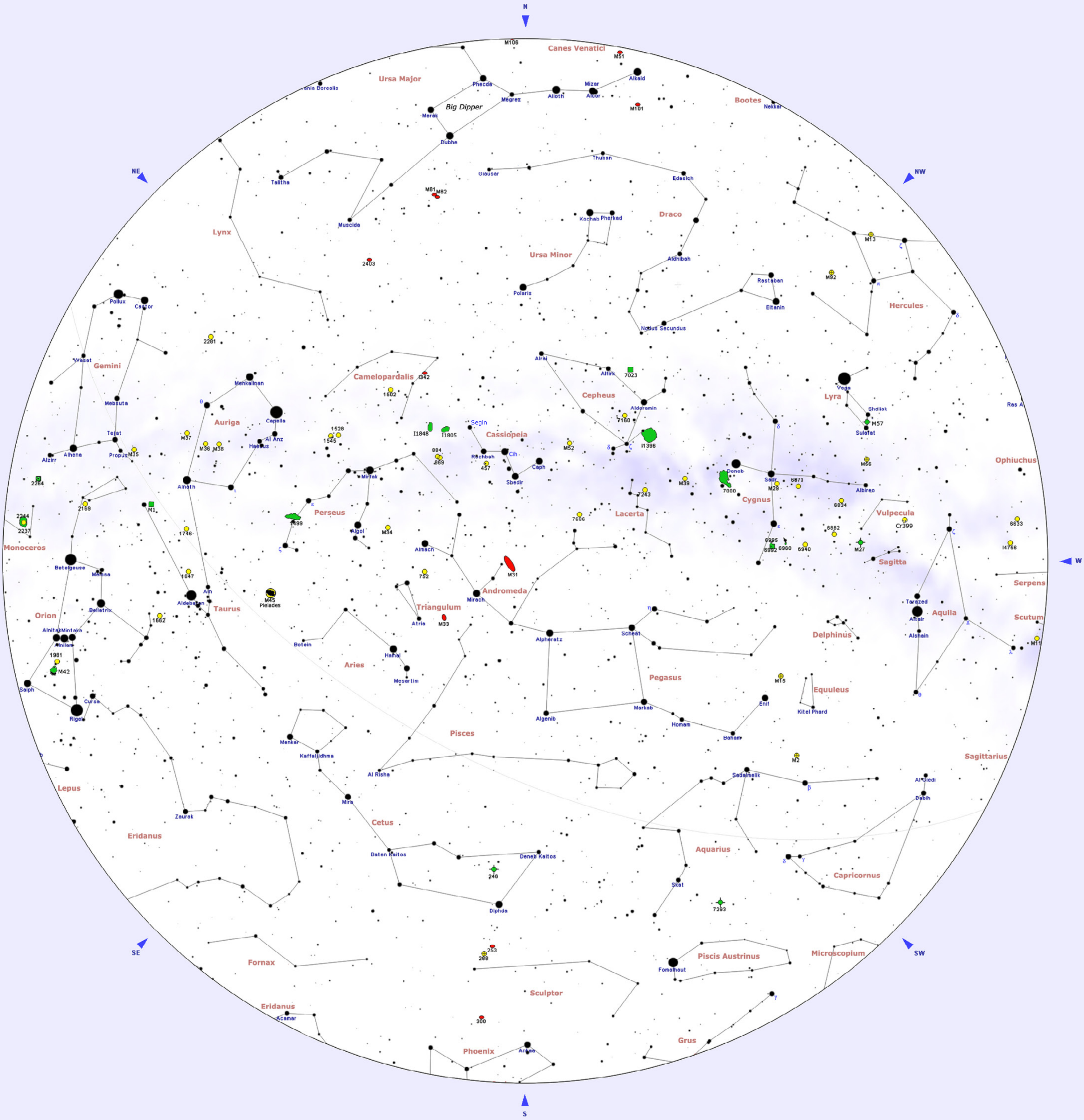
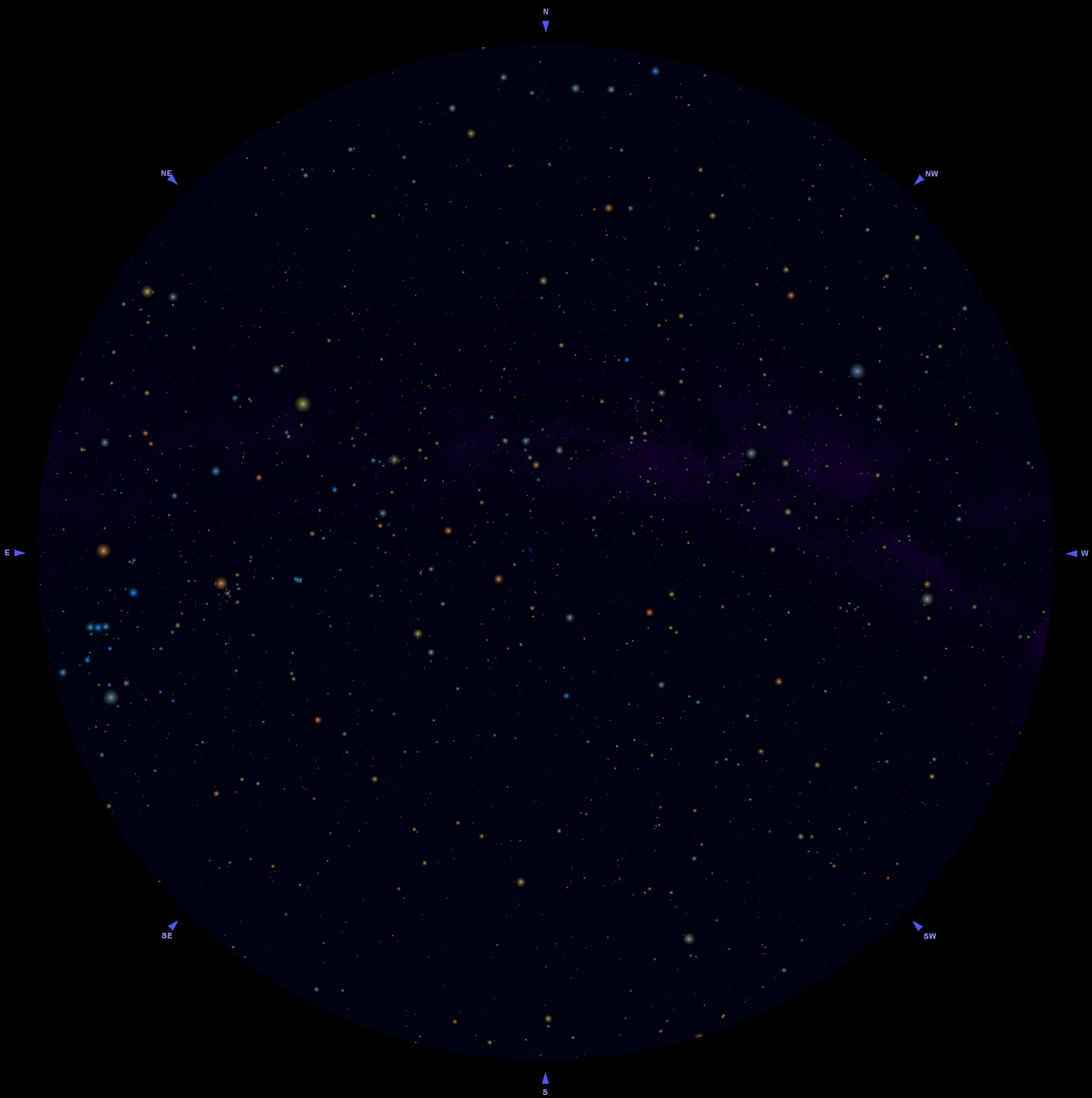
October 1, 11 pm *



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	



OBSERVATION

November 1, 10:00 pm
November 15, 9:00 pm
December 1, 8:00 pm
December 15, 7:00 pm
January 1, 6:00 pm

*Add 1 hour if using DST

August 1, 4:00 am *
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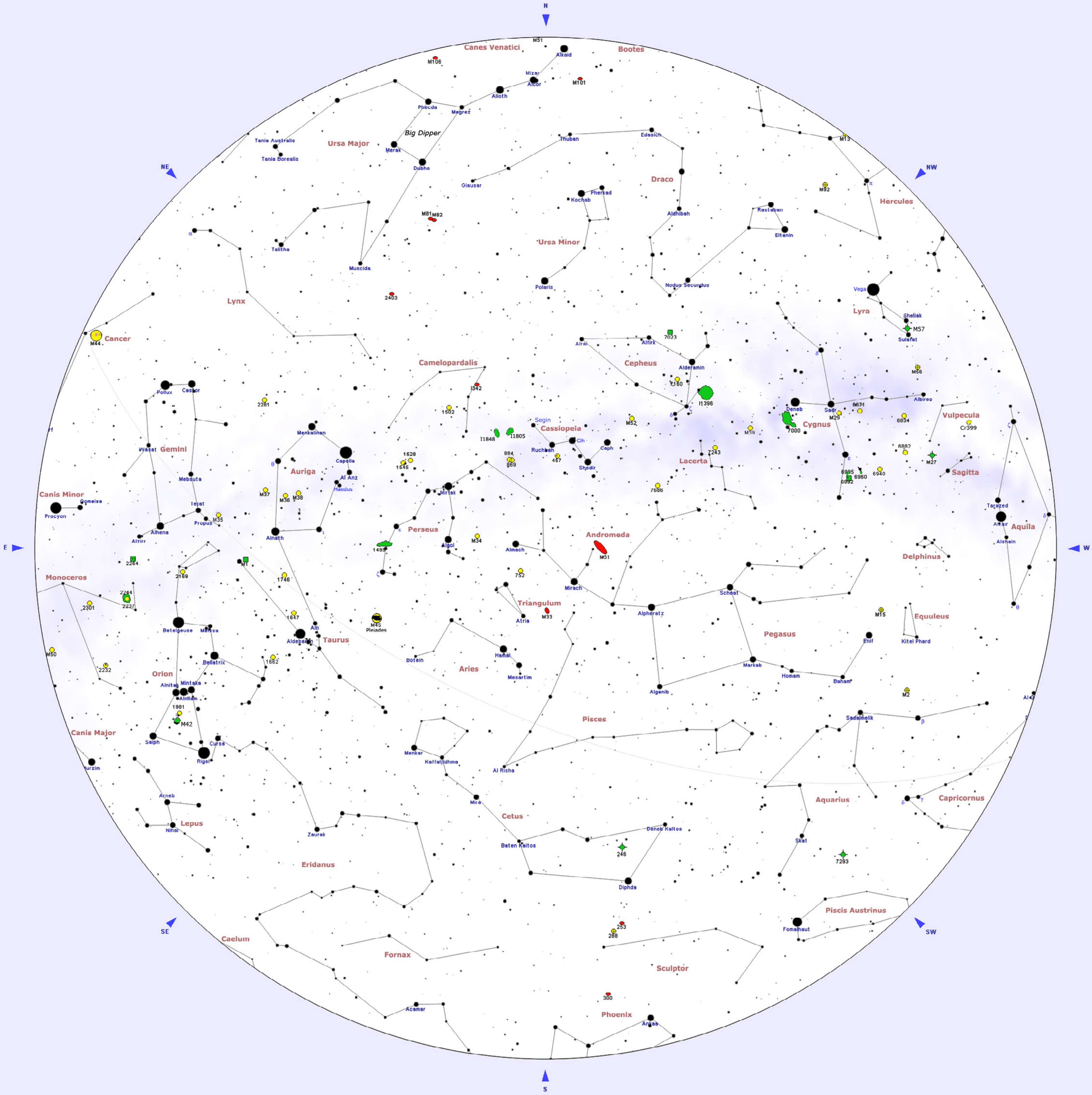
October 1, midnight *
October 15, 11 pm *


N
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Canes Venatici
Bootes
Ursa Major
Big Dipper
Draco
Hercules
Ursa Minor
Lynx
Cancer
Camelopardalis
Cepheus
Lyra
Gemini
Auriga
Cassiopeia
Cygnus
Vulpecula
Lacerta
Canis Minor
Perseus
Sagitta
Andromeda
Aquila
Delphinus
Monoceros
Triangulum
Equuleus
Taurus
Pegasus
Aries
Orion
Pisces
Canis Major
Aquarius
Capricornus
Cetus
Lepus
Eridanus
Piscis Austrinus
Caelum
Fornax
Sculptor
Phoenix
Alkaid
Mizar
Alcor
Alioth
Megrez
Phecda
Merak
Dubhe
Tania Australis
Tania Borealis
Thuban
Edasich
Kochab
Pherkad
Polaris
Giausar
Talitha
Muscida
Vega
Sheliak
Sulafat
Deneb
Sadr
Albireo
Alderamin
Alfirk
Caph
Shedir
Ruchbah
Capella
Menkalinan
Pollux
Castor
Wasat
Mebsuta
Tejat
Propus
Alhena
Alzirr
Procyon
Gomeisa
Elnath
Mirfak
Algol
Almach
Mirach
Alpheratz
Scheat
Markab
Homam
Baham
Enif
Kitel Phard
Altair
Tarazed
Alshain
Algenib
Aldebaran
Pleiades
Betelgeuse
Meissa
Bellatrix
Mintaka
Alnilam
Alnitak
Saiph
Rigel
Cursa
Arneb
Nihal
Hamal
Sheratan
Mesartim
Botein
Menkar
Kaffaljidhma
Al Risha
Mira
Sadalmelik
Skat
Fomalhaut
Zaurak
Baten Kaitos
Deneb Kaitos
Diphda
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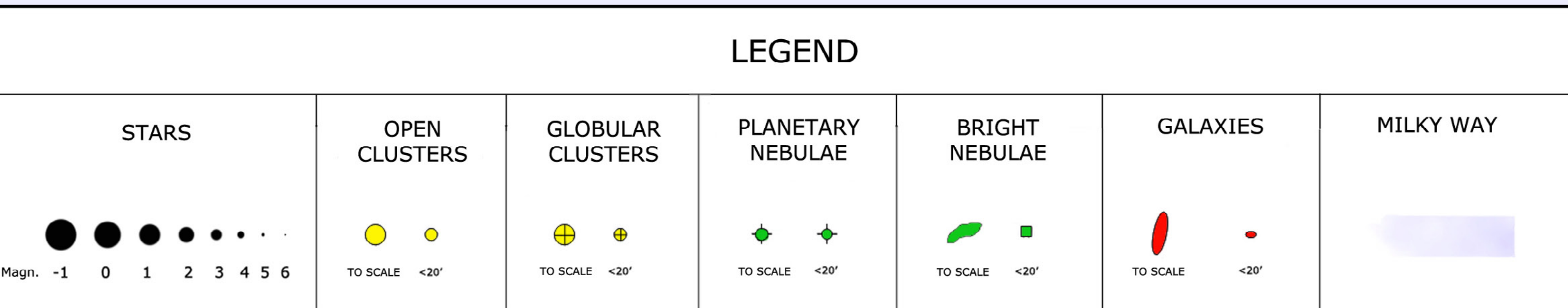
LEGEND
STARS
OPEN CLUSTERS
GLOBULAR CLUSTERS
PLANETARY NEBULAE
BRIGHT NEBULAE
GALAXIES
MILKY WAY
Magn. -1 0 1 2 3 4 5 6
TO SCALE
<20′

OBSERVATION

November 15, 10:00 pm
December 1, 9:00 pm
December 15, 8:00 pm
January 1, 7:00 pm
January 15, 6:00 pm

*Add 1 hour if using DST

August 15, 4:00 am *
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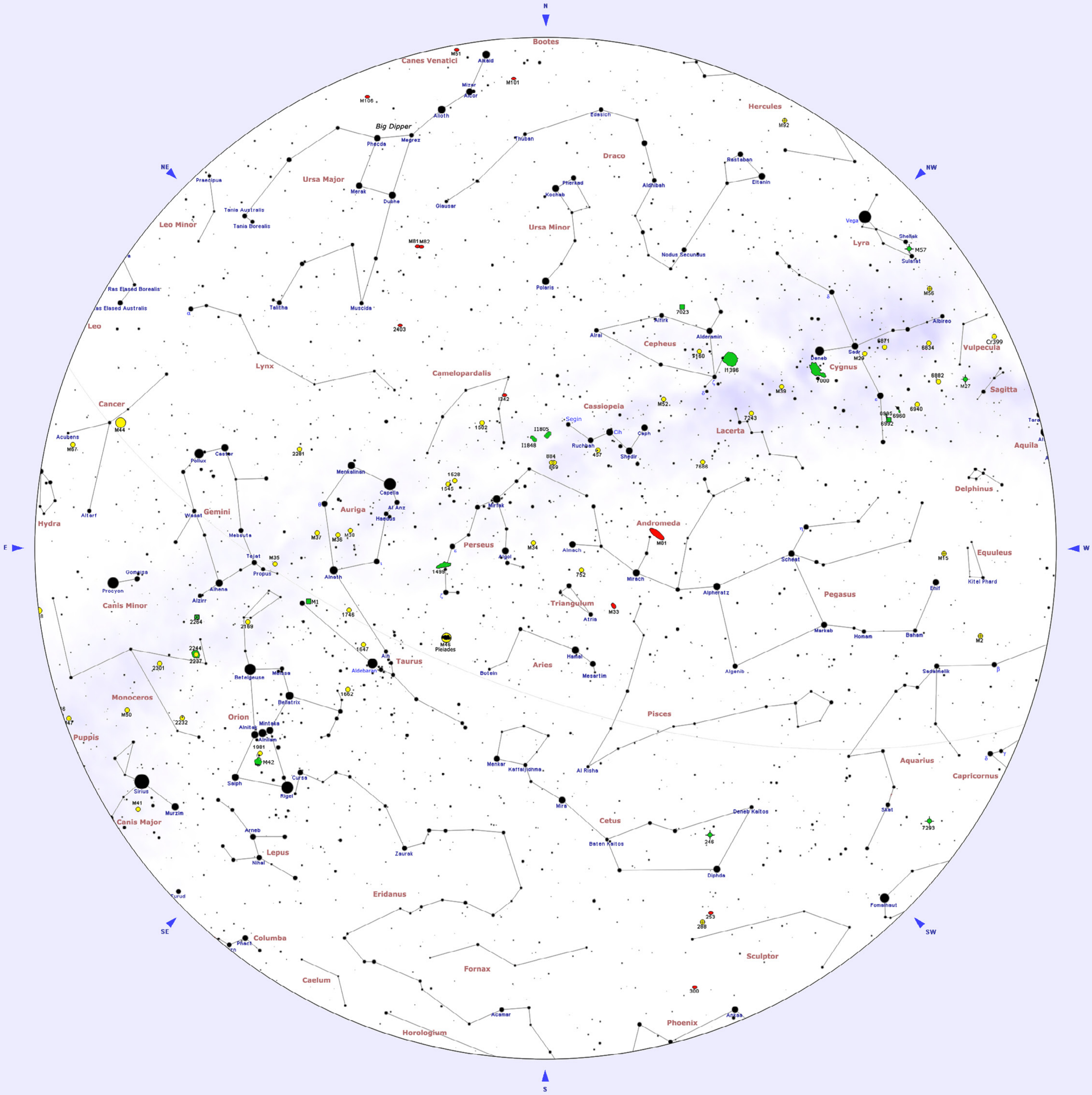
October 15, midnight *
November 1, 11 pm


N
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Bootes
Canes Venatici
Hercules
Big Dipper
Ursa Major
Draco
Leo Minor
Ursa Minor
Lyra
Leo
Lynx
Camelopardalis
Cepheus
Cygnus
Vulpecula
Sagitta
Cancer
Cassiopeia
Lacerta
Aquila
Delphinus
Gemini
Auriga
Perseus
Andromeda
Hydra
Equuleus
Canis Minor
Triangulum
Pegasus
Taurus
Aries
Monoceros
Pisces
Orion
Puppis
Aquarius
Capricornus
Canis Major
Cetus
Lepus
Eridanus
Columba
Sculptor
Fornax
Caelum
Phoenix
Horologium
Alkaid
Mizar
Alcor
Alioth
Phecda
Megrez
Merak
Dubhe
Thuban
Edasich
Rastaban
Eltanin
Aldhibah
Pherkad
Kochab
Polaris
Vega
Sheliak
Sulafat
Albireo
Deneb
Sadr
Alfirk
Alderamin
Alrai
Segin
Ruchbah
Schedar
Caph
Capella
Menkalinan
Hassaleh
Algol
Mirfak
Almach
Mirach
Alpheratz
Scheat
Markab
Homam
Baham
Enif
Kitel Phard
Algenib
Sadalmelik
Pollux
Castor
Wasat
Mebsuta
Tejat
Propus
Alhena
Alzirr
Gomeisa
Procyon
Acubens
Alterf
Elnath
Aldebaran
Ain
Pleiades
Hamal
Mesartim
Atria
Betelgeuse
Bellatrix
Mintaka
Alnitak
Alnilam
Saiph
Rigel
Cursa
Sirius
Murzim
Menkar
Kaffaljidhma
Al Risha
Mira
Baten Kaitos
Deneb Kaitos
Diphda
Skat
Fomalhaut
Arneb
Nihal
Zaurak
Phact
Acamar
Ankaa
Ras Elased Borealis
Tania Australis
Tania Borealis
Talitha
Muscida
Nodus Secundus
Praecipua
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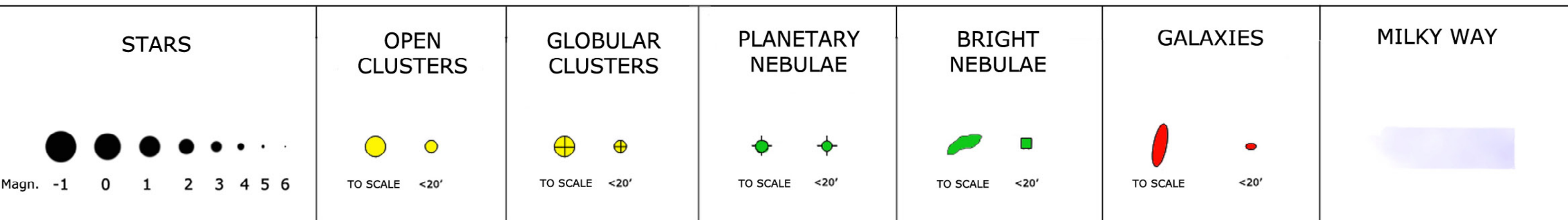
LEGEND

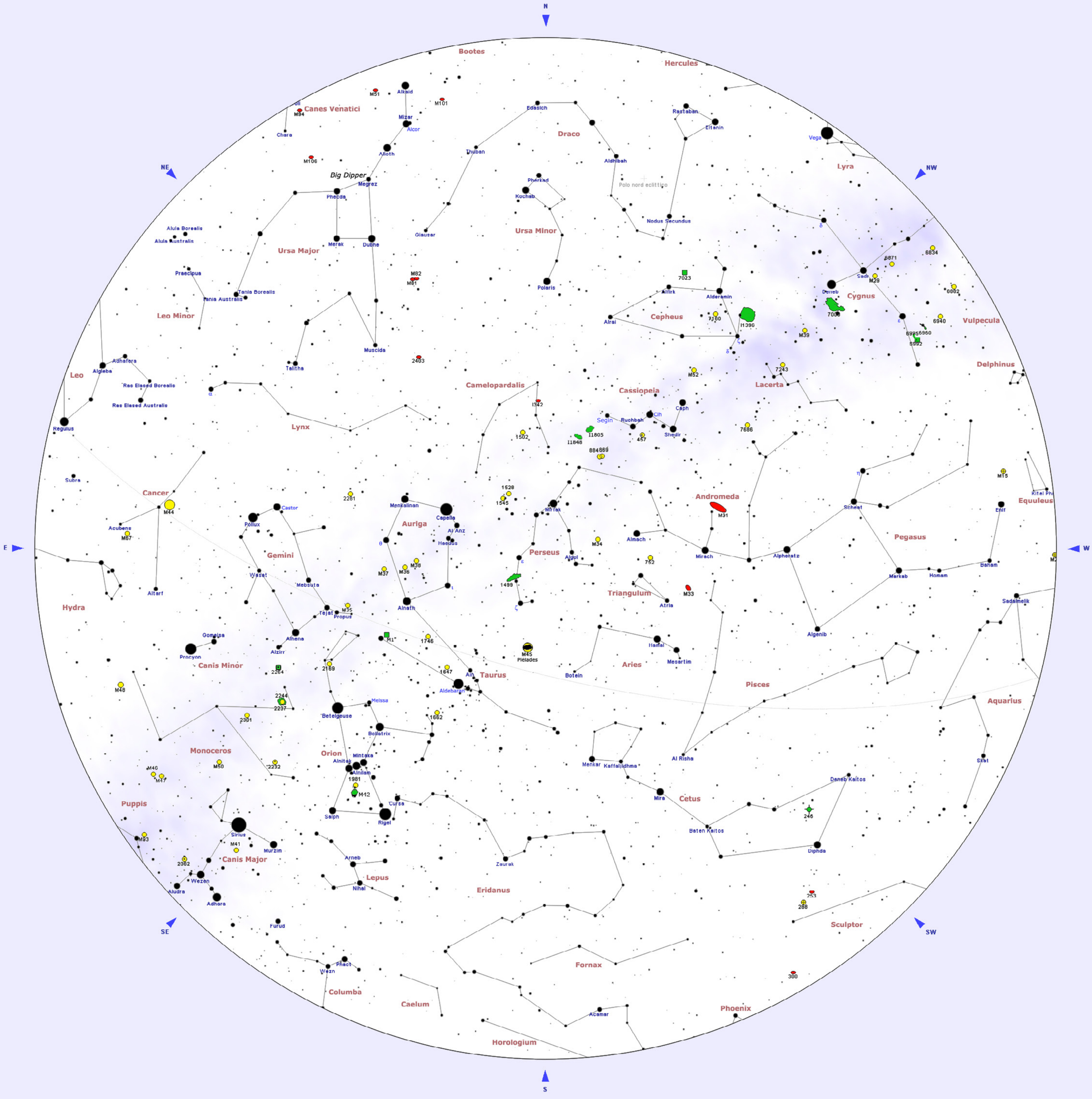

STARS
Magn. -1 0 1 2 3 4 5 6
OPEN CLUSTERS
TO SCALE <20′
GLOBULAR CLUSTERS
TO SCALE <20′
PLANETARY NEBULAE
TO SCALE <20′
BRIGHT NEBULAE
TO SCALE <20′
GALAXIES
TO SCALE <20′
MILKY WAY

OBSERVATION

December 1, 10:00 pm
December 15, 9:00 pm
January 1, 8:00 pm
January 15, 7:00 pm
February 1, 6:00 pm

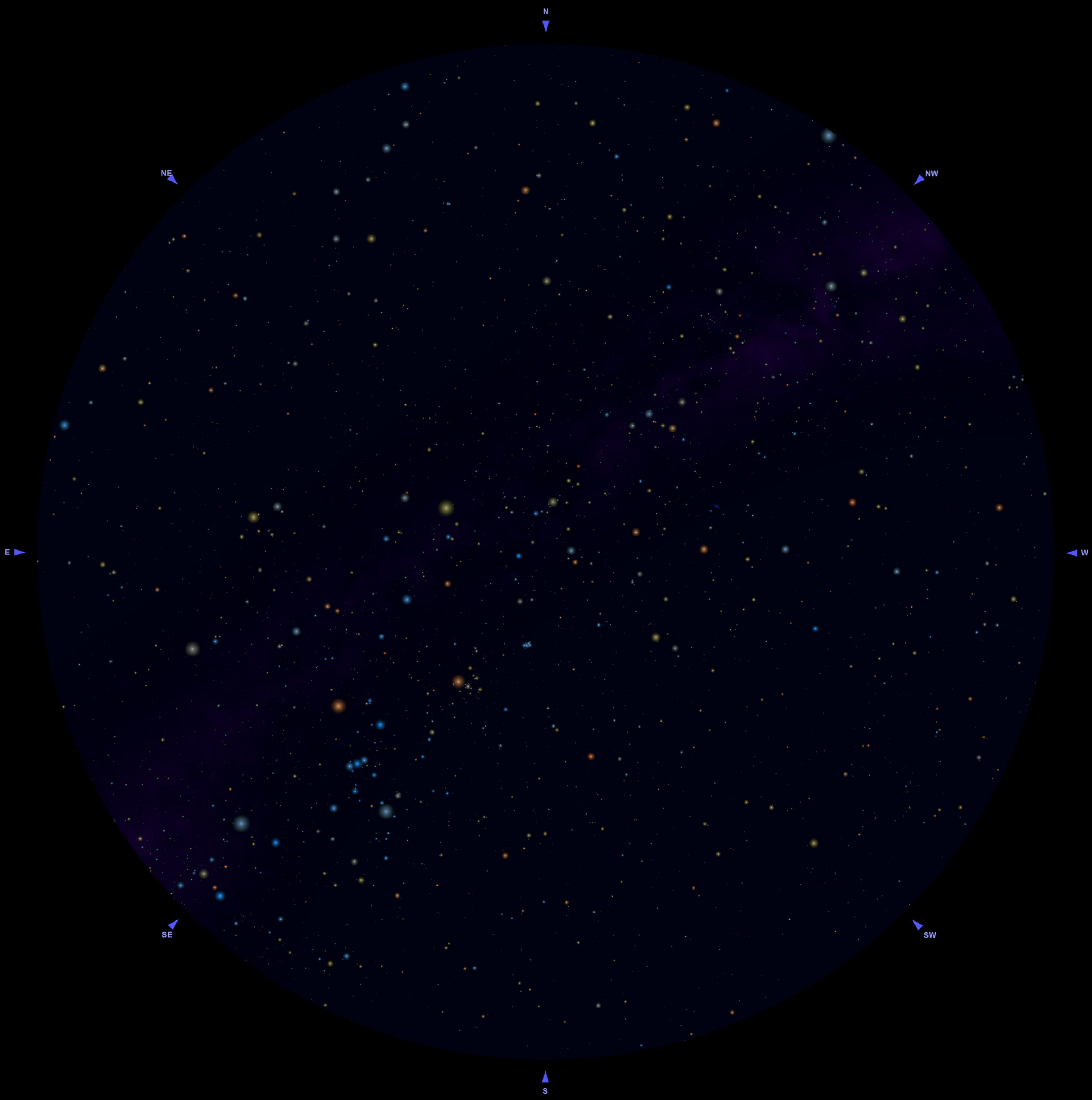
*Add 1 hour if using DST

September 1, 4:00 am *
September 15, 3:00 am *
October 1, 2:00 am *
October 15, 1:00 am *
November 1, midnight
November 15, 11 pm



LEGEND

STARS	OPEN CLUSTERS	GLOBULAR CLUSTERS	PLANETARY NEBULAE	BRIGHT NEBULAE	GALAXIES	MILKY WAY
Magn. -1 0 1 2 3 4 5 6	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	TO SCALE <20′	



OBSERVATION

December 15, 10:00 pm
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November 15, midnight
December 1, 11 pm

TABLES

STARS

The fourty brightest stars

Column Headings

Proper name: the name of the star.
Catalogue number: the Bayer designation of the star, a system developed by Henry Draper in 1603.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the star is located.
Magn.: the apparent magnitude of the star.
Dist.(ly): approximate distance of the star, expressed in light-years.
Spectral type: the spectral class, the luminosity class and peculiarity.
Notes: notable notes about the star.

Double stars

Column Headings

Name: the Bayer or Flamsteed designation of the star.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the star is located.
Mag. A: the apparent magnitude of the primary component.
Mag. B: the apparent magnitude of the secondary component.
Sep.: the separation between the components, expressed in seconds of arc.
Pos. angle: the position angle, counted in degrees from north (0°) through east (90°), south (180°), and west (270°). The position angles are for the component B with respect to the component A.
Colours: the colours of the two components of the system, based on their spectral type.
Notes: notable notes about the star system, membership in star clusters, physic of the system.
Common name: the proper name of the star system.

Variable stars

Column Headings

Name: the Bayer, Flamsteed or variable designation of the star.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the star is located.
Min.: the apparent magnitude at maximum brightness.
Max.: the apparent magnitude at minimum brightness.
Period (days): the average period of variation in days.
Type: the type of variability.
Spectrum: the spectral class of the star. In eclypsing binaries, the spectra of both the components are indicated; in pulsating variables, the variation of the spectrum is showed.
Common name: the proper name of the star.

STARS - TABLES

The fourthy brightest stars

Nr.	Proper name	Catalogue number	RA (2000.0)	Dec.	Const.	Magn.	Dist.(ly)	Spectral type	Notes	Visible from 40°N
1	Sirius	α Canis Majoris	$06^h 45.2^m$	$-16^\circ 43^m$	Canis Major	−1.44	8.6	A0		YES
2	Canopus	α Carinae	06 23.9	−52 41	Carina	−0.62	310	F0		NO
3	Rigil Kentaurus	α Centauri	14 39.6	−60 50	Centaurus	−0.29	4.4	G2 + K1	Closest star to the Sun; triple star	NO
4	Arcturus	α Bootis	14 15.7	+19 11	Bootes	−0.05	37	K2		YES
5	Vega	α Lyrae	18 36.9	+38 47	Lyra	0.03	25	A0	Flat star	YES
6	Capella	α Aurigae	05 16.7	+46 00	Auriga	0.08	42	G6	Multiple star	YES
7	Rigel	β Orionis	05 14.5	−08 12	Orion	0.18	773	B8		YES
8	Procyon	α Canis Minoris	07 39.3	+05 14	Canis Minor	0.34	11	F5		YES
9	Achernar	α Eridani	01 37.6	−57 14	Eridanus	0.45	144	B3	Flat star	NO
10	Betelgeuse	α Orionis	05 55.2	+07 24	Orion	0.58v	427	M2		YES
11	Hadar	β Centauri	14 03.8	−60 22	Centaurus	0.61	525	B1		NO
12	Altair	α Aquilae	19 50.8	+08 52	Aquila	0.76	17	A7		YES
13	Acrux	α Crucis	12 26.6	−63 06	Crux	0.77	321	B0	Two unrelated stars	NO
14	Aldebaran	α Tauri	04 35.9	+16 31	Taurus	0.87v	65	K5		YES
15	Spica	α Virginis	13 25.2	−11 10	Virgo	0.98	262	B1		YES
16	Antares	α Scorpii	16 29.4	−26 26	Scorpius	1.06v	604	M1		YES
17	Pollux	β Geminorum	07 45.3	+28 02	Gemini	1.16	34	K0		YES
18	Fomalhaut	α Piscis Austrini	22 57.7	−29 37	Piscis Austrinus	1.17	25	A3	Has a planet	YES
19	Deneb	α Cygni	20 41.4	+45 17	Cygnus	1.25	3262	A2	One of the brightest known stars	YES
20	Mimosa	β Crucis	12 47.7	−59 41	Crux	1.30	353	B0		NO
21	Regulus	α Leonis	10 08.4	+11 58	Leo	1.36	77	B7		YES
22	Adhara	ε Canis Majoris	06 58.6	−28 58	Canis Major	1.50	431	B2		YES
23	Castor	α Geminorum	07 34.6	+31 53	Gemini	1.58	52	A2	Multiple star	YES
24	Shaula	λ Scorpii	17 33.6	−37 06	Scorpius	1.62v	701	B1		YES
25	Gacrux	γ Crucis	12 31.2	−57 07	Crux	1.63v	88	M4		NO
26	Bellatrix	γ Orionis	05 25.1	+06 21	Orion	1.64	243	B2		YES
27	Alnath	β Tauri	05 26.3	+28 36	Taurus	1.65	131	B7		YES
28	Miaplacidus	β Carinae	09 13.2	−69 43	Carina	1.67	111	A2		NO
29	Alnilam	ε Orionis	05 36.2	−01 12	Orion	1.69	1345	B0	In the Orion Belt	YES
30	Al Na'ir	α Gruis	22 08.2	−46 58	Grus	1.73	101	B7		YES
31	Alnitak	ζ Orionis	05 40.8	−01 57	Orion	1.74	816	O9	In the Orion Belt	YES
32	Alioth	ε Ursae Majoris	12 54.0	+55 58	Ursa Major	1.75	81	A0	In the Big Dipper	YES
33	Regor	γ Velorum	08 09.5	−47 20	Vela	1.76v	842	WC8 + O9	Wolf-Rayet star	YES
34	Mirphak	α Persei	03 24.3	+49 52	Perseus	1.79	593	F5		YES
35	Kaus Australis	ε Sagittarii	18 24.2	– 3423	Sagittarius	1.79	145	B9		YES
36	Dubhe	α Ursae Majoris	11 03.7	+61 45	Ursa Major	1.81	124	F7	In the Big Dipper	YES
37	Wezen	δ Canis Majoris	07 08.4	−26 23	Canis Major	1.83	1787	F8		YES
38	Alkaid	η Ursae Majoris	13 47.5	+49 19	Ursa Major	1.85	101	B3	In the Big Dipper	YES
39	Avior	ε Carinae	08 22.5	−59 31	Carina	1.86	633	K3 + B2		NO
40	Sargas	θ Scorpii	17 37.3	−43 00	Scorpius	1.86	272	F1		YES

Double stars

Name	RA (2000.0)	Dec.	Const.	Magn. A	Magn. B	Sep.	Pos. angle	Colours	Notes	Common Name	View
ψ1 Piscium	$01^h 05.6^m$	$+21^\circ 28^m$	Pisces	5.6	5.8	30.0″	159 °	white - white			
χ Ceti	01 49.6	−10 41	Cetus	4.8	4.8	183.8	250	yellow - yellow			
κ1-κ2 Tauri	04 25.4	+22 18	Taurus	4.2	5.3	339	173	white - white			
θ1-θ2 Tauri	04 28.7	+15 52	Taurus	3.4	3.8	337.4	346	orange - white	In Hyades cluster		
σ1-σ2 Tauri	04 39.3	+15 55	Taurus	4.7	5.1	431.2	193	white - white	In Hyades cluster		
γ Leporis	05 44.5	−22 27	Lepus	3.7	6.3	96.3	350	yellow - orange	In Hyades cluster		
γ Velorum	08 09.5	−47 20	Vela	1.9	4.2	41.2	220	blue - blue		Regor	
ι Cancri	08 46.7	+28 46	Cancer	4.2	6.6	30.5	307	yellow - orange			
53-55 Cancri	08 52.5	+28 17	Cancer	5.9	6.2	240		red - yellow	Not physical		
27 Hydrae	09 20.5	−09 33	Hydra	5.0	6.9	229.4	211	orange - yellow			
γ-40 Leonis	10 20.0	+19 51	Leo	2.2	4.8	1440		orange - yellow	Not physical	Algieba	
κ-6 Draconis	12 33.8	+69 54	Draco	3.8	4.9	960		blue - blue			
ζ-80 Ursae Majoris	13 23.9	+54 56	Ursa Major	2.3	4.0	708.7	71	white - white	Not physical	Mizar - Alcor	
μ1-μ2 Bootis	15 24.5	+37 23	Bootes	4.3	6.5	108.3	171	white - yellow			
ν1-ν2 Bootis	15 31.2	+40 52	Bootes	5.0	5.0	600		orange - white	Not physical		
α1-α2 Librae	14 50.9	−16 02	Libra	2.8	5.2	231.0	314	white - yellow	Not physical	Zubenelgenubi	
γ-11 Ursae Minoris	15 19.0	+71 50	Ursa Minor	3.0	5.0	1080		white - orange	Not physical	Pherkad	
ω1-ω2 Scorpii	16 07.0	−20 46	Scorpius	3.9	4.3	840		blue - orange			
ν Scorpii	16 12.0	−19 28	Scorpius	4.3	6.8	41.1	337	blue - blue			
16-17 Draconis	16 36.2	+52 55	Draco	5.4	5.5	90.3	194	white - white	Not physical		
μ1-μ2 Scorpii	16 52.0	−38 02	Scorpius	3.0	3.5	300		blue - blue	Not physical		
ε1-ε2 Lyrae	18 44.3	+39 40	Lyra	4.7	4.6	173	207.7	white - white	Each component is double	Double double	
ζ Lyrae	18 44.8	+37 36	Lyra	4.3	5.9	43.7	150	white - yellow	Not physical		
α-8 Vulpeculae	19 28.7	+24 40	Vulpecula	4.4	5.8	413.7	28	red - orange	Not physical	Anser	
β Cygni	19 30.9	+27 58	Cygnus	3.1	5.1	34.4	54	orange - blue	Not physical	Albireo	
15 Sagittae	20 04.1	+17 04	Sagitta	5.9	6.8	203.7	320	yellow - white			
α1-α2 Capricorni	20 18.1	−12 33	Capricornus	3.6	4.2	377.7	291	orange - yellow	Not physycal	Al Giedi	
γ Equulei	21 10.3	+10 08	Equuleus	4.7	5.9	352.5	153	yellow - white	Not physical		

Out of sight from 40°N

Name	RA (2000.0)	Dec.	Const.	Magn. A	Magn. B	Sep.	Pos. angle	Colours	Notes	Common Name	View
β Tucanae	$00^h 31.5^m$	$-62^\circ 58^m$	Tucana	4.4	4.8	27.1″	169	white - yellow			
κ Volantis	08 19.8	−71 31	Volans	5.4	5.7	65.0	57	white - blue			
α Crucis	12 26.6	−63 06	Crux	0.8	4.9	90.1	202	blue - blue		Acrux	
γ Crucis	12.31.2	−57 07	Crux	1.6	6.7	110.6	31	red - white	Not physycal; main star is double	Gacrux	
α Centauri	14 39.6	−60 50	Centaurus	0.0	1.2	14.1	222	yellow - orange		Rigil Kentaurus	
δ1-δ2 Apodis	16 20.3	−78 42	Apus	4.7	5.1	102.9	12	red - orange	Not physical		
μ1-μ2 Pavonis	20 00.9	−66 56	Pavo	5.3	5.7	540		orange - orange	Not physical		

Variable stars

Name	RA (2000.0)	Dec.	Const.	Min.	Max.	Period (days)	Type	Spectrum	Common Name
γ Cassiopeiae	$00^h56.7^m$	$+60^\circ43^m$	Cassiopeia	1.6	3.0	-	Irregular	B	Cih
ο Ceti	02 19.3	−02 59	Cetus	2.0	10.1	332.0	Mira type	M	Mira
ρ Persei	03 05.2	+38 50	Perseus	3.3	4.0	50:	Eclypsing binary Algol type	M	
β Persei	03 08.2	+40 57	Perseus	2.1	3.4	2.87	Eclypsing binary Algol type	B + G	Algol
λ Tauri	04 00.7	+12 29	Taurus	3.3	3.8	3.95	Eclypsing binary Algol type	B + A	
ε Aurigae	05 02.0	+43 49	Auriga	2.9	3.8	9892	Eclypsing binary Algol type	A - F	Almaaz
α Orionis	05 55.2	+07 24	Orion	0.4	1.3	2110	Semi-regular	M	Betelgeuse
η Geminorum	06 14.9	+22 30	Gemini	3.2	3.9	232.9	Semi-regular	M	Propus
L2 Puppis	07 13.5	−44 39	Puppis	2.6	6.2	140.4	Semi-regular	M	
ω Canis Majoris	07 14.8	−26 46	Canis Major	3.6	4.2	-	Irregular	B	
R Hydrae	13 29.7	−23 17	Hydra	3.5	10.9	389.6	Mira type	M	
μ Centauri	13 49.6	−42 28	Centaurus	2.9	3.5	-	Irregular	B	
α Scorpii	16 29.4	−26 26	Scorpius	0.9	1.8	1733	Semi-regular	M + B	Antares
α Herculis	17 14.6	+14 23	Hercules	2.7	4.0	-	Semi-regular	M	Ras Algethi
β Lyrae	18 50.1	+33 22	Lyra	3.3	4.3	12.94	Eclypsing binary Beta Lyae type	B + A	Sheliak
R Lyrae	18 55.3	+43 57	Lyra	3.9	5.0	46.0	Semi-regular	M	
χ Cygni	19 50.6	+32 55	Cygnus	3.3	14.2	406.9	Mira type	S	
η Aquilae	19 52.5	+01 00	Aquila	3.5	4.4	7.17	Classical Cepheid	F - G	
P Pygni	20 17.8	+38 02	Cygnus	3.0	6.0	-	Luminous blue variable (S Dor)	B	
β Cephei	21 28.7	+70 34	Cepheus	3.2	5.3	0.19	Beta Cepheid	B	Alfirk
μ Cephei	21 43.5	+58 47	Cepheus	3.4	5.1	730	Semi-regular	M	Erakis / Garnet star
δ Cephei	22 29.2	+58 25	Cepheus	3.9	4.4	5.37	Classical Cepheid	F - G	

Out of sight from 40°N

Name	RA (2000.0)	Dec.	Const.	Min.	Max.	Period (days)	Type	Spectrum	Common Name
β Doradus	$05^h33.6^m$	$-62^\circ29^m$	Dorado	3.5	4.1	9.84	Classical Cepheid	F - G	
ZZ Carinae	09 45.2	−62 30	Carina	3.3	4.2	35.53	Classical Cepheid	F - K	
η Carinae	10 45.1	−59 41	Carina	-0.8	7.9	-	Luminous blue variable (S Dor)	Peculiar	
κ Pavonis	18 16.9	−67 14	Pavo	3.9	4.6	9.09	Classical Cepheid	F	
λ Pavonis	18 52.2	−62 11	Pavo	3.4	4.3	-	Irregular	B	

DEEP SKY OBJECTS

Open Clusters

Column Headings

Name: the cluster's name as plotted on the maps.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the cluster is located.
Diam.: apparent diameter expressed in minutes of arc.
Magn.: the apparent magnitude of the cluster; a symbol ":" after this value means an approximation.
Dist.(pc): approximate distance of the cluster, expressed in parsec. To obtain the distance in light-years, moltiply for 3.26.
Galactic arm: the spiral arm of the Milky Way in wich the cluster is located.
Type: descriptive type based on the system developed by R. J. Trumpler in 1930. It is composed by three parts:
Concentration
I. Detachted; strong concentration toward centre.
II. Detachted; weak concentration toward centre.
III. Detachted; no concentration toward centre.
IV. Not well detachted from surrounding star field.
Range in brightness
1. Small range in brightness.
2. Moderate range in brightness.
3. Large range in brightness.
Richness
p Poor (less than 50 stars).
m Moderately rich (50 to 100 stars).
r Rich (more than 100 stars).
Notes: notable notes about the cluster, membership in OB associations, nebulosity.
Common name: the proper name of the cluster.

Globular Clusters

Column Headings

Name: the cluster's name as plotted on the maps.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the cluster is located.
Diam.: apparent diameter expressed in minutes of arc.
Magn.: the apparent magnitude of the cluster; a symbol ":" after this value means an approximation.
Dist.(pc): approximate distance of the cluster, expressed in parsec. To obtain the distance in light-years, moltiply for 3.26.
Class: concentration class of the globular cluster based on the system developed by H. Shapley in 1927. The values range from 1 to 12; the smaller is the number, the higher is the concentration of stars toward the centre of the cluster.
Notes: notable notes about the cluster, strong X-ray sources.
Common name: the proper name of the cluster.

Bright Nebulae

Column Headings

Name: the nebula's name as plotted on the maps.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the nebula is located.
Diam.: apparent diameter expressed in minutes of arc.
Magn.: the apparent magnitude of the nebula; a symbol ":" after this value means an approximation.
Dist.(pc): approximate distance of the nebula, expressed in parsec. To obtain the distance in light-years, moltiply for 3.26.
Galactic arm: the spiral arm of the Milky Way in wich the nebula is located.
Type: the type of the nebula:
H II regions are nebulae with an high rate of ionized hydrogen emitting light.
Reflection nebulae are clouds of gas and dust illuminated by a nearby star.
SNR is a supernova remnant, a bubble of filamentary gas expelled after the explosion of a supernova.
Notes: notable notes about the nebula, membership in OB associations.
Common name: the proper name of the nebula.

Planetary Nebulae

Column Headings

Name: the nebula's name as plotted on the maps.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the nebula is located.
Diam.: apparent diameter expressed in seconds of arc.
Magn.: the apparent magnitude of the nebula; a symbol ":" after this value means an approximation.
Dist.(pc): approximate distance of the nebula, expressed in parsec. To obtain the distance in light-years, moltiply for 3.26.
Galactic arm: the spiral arm of the Milky Way in wich the nebula is located.
Type: the aspect of the nebula, according to the Vorontsov-Velyaminon system:
1. *Stellar image*.
2. *Smooth disk* (*a*, brighter toward the centre; *b*, uniform brightness; *c*, traces of ring structure).
3. *Irregular disk* (*a*, very irregular brightness distribution; *b*, traces of ring structure).
4. *Ring structure*.
5. *Irregular form* (similar to a diffuse nebula).
6. *Anomalous form*.

Magn. of the central star: the apparent magnitude of the star that originates the nebula.
Common name: the proper name of the nebula.

Galaxies

Column Headings

Name: the galaxy's name as plotted on the maps.
RA(2000.0) and **Dec.**: right ascension and declination, referred to the 2000.0 equinox.
Const.: the constellation in wich the galaxy is located.
Diam.: apparent diameter expressed in minutes of arc.
Magn.: the apparent magnitude of the galaxy; a symbol ":" after this value means an approximation.
Dist.(Mpc): approximate distance of the galaxy, expressed in megaparsec (millions of parsec). To obtain the distance in light-years, moltiply for 3,260,000.
Type: the Hubble type of the galaxy, as described in the introduction.
Nuclear class: the nuclear class according to the system developed by G. de Vancouleurs in 1976; numbers from 1 to 5 indicates the increasing of the luminosity of the nucleus.
Common name: the proper name of the galaxy.

DEEP SKY OBJECTS - TABLES

Open Clusters

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Notes	Common Name	View
NGC 188	$00^{h}44.4^{m}$	$+85^{\circ}20^{m}$	Cepheus	$14'$	8.1	1550	Orion Spur	II 2 r	At high galactic latitude		
NGC 654	01 44.1	+61 53	Cassiopeia	5	6.5	2400	Perseus Arm	II 3 m	Includes ϕ Cas		
NGC 457	01 19.1	+58 20	Cassiopeia	13	6.4	2430	Perseus Arm	I 3 r	In Cassiopeia OB8		
NGC 752	01 57.8	+37 41	Andromeda	50	5.7	400	Orion Spur	III 1 m	In Perseus OB1		
NGC 869	02 19.0	+57 09	Perseus	30	4.3	2200	Perseus Arm	I 3 r	In Perseus OB1	h Persei (Double Cluster)	
NGC 884	02 22.4	+57 07	Perseus	30	4.4	2300	Perseus Arm	I 3 r		χ Persei (Double Cluster)	
M34	02 42.0	+42 47	Perseus	35	5.2	470	Orion Spur	II 3 m	Involved in nebulosity		
M45	03 47.0	+24 07	Taurus	110	1.2	135	Orion Spur	I 3 r		Pleiades	
NGC 1502	04 07.7	+62 20	Camelopardalis	8	5.7	950	Orion Spur	I 3 p	In Camelopardalis OB1		
NGC 1528	04 15.4	+51 14	Perseus	24	6.4	776	Orion Spur	II 2 m			
NGC 1545	04 20.9	+50 15	Perseus	18	6.2	800	Orion Spur	II 2 p			
NGC 1647	04 46.0	+19 04	Taurus	45	6.4	552	Orion Spur	II 2 m			
NGC 1662	04 48.5	+10 56	Orion	20	6.4	400	Orion Spur	I 2 p	in Auriga OB1		
NGC 1746	05 03.6	+23 49	Taurus	42	6.1	460	Orion Spur	III 1 p	Asterism around ι Ori		
M38	05 28.7	+35 50	Auriga	21	6.4	1320	Perseus Arm	III 2 m	In Auriga OB1		
NGC 1980	05 35.4	−05 55	Orion	14	2.5	-	Orion Spur	-			
M36	05 36.1	+34 08	Auriga	12	6.0	1260	Perseus Arm	II 3 m	Involved in nebulosity		
M37	05 52.4	+32 33	Auriga	24	5.6	1230	Perseus Arm	II 1 r			
NGC 2169	06 08.4	+13 57	Orion	7	5.9	1032	Orion Spur	I 3 p			
M35	06 08.9	+24 20	Gemini	28	5.1	860	Orion Spur	III 2 m			
NGC 2232	06 26.6	−04 45	Monoceros	30	3.9	400	Orion Spur	IV 3 p		Little Beehive	
M41	06 47.0	−20 44	Canis Major	38	4.5	720	Orion Spur	II 3 m			
NGC 2281	06 49.3	+41 04	Auriga	15	5.4	500	Orion Spur	I 3 p			
NGC 2301	06 51.8	+00 28	Monoceros	12	6.0	750	Orion Spur	I 3 m	Stellar association		
M50	07 03.2	−08 20	Monoceros	16	5.9	910	Orion Spur	II 3 m	Near Sh2-310 nebula	Pi Puppis Cluster	
Cr 135	07 17.0	−36 50	Puppis	50	2.1	258	Orion Spur	IV 2 p	Contains the planetary nebula NGC 2438		
NGC 2362	07 18.1	−24 57	Canis Major	8	4.1	1530	Orion Spur	I 3 p			
M47	07 36.6	−14 30	Puppis	30	4.4	480	Orion Spur	III 3 m	Two open clusters at 206 and 370 parsecs		
M46	07 41.8	−14 49	Puppis	27	6.1	1660	Orion Spur	III 2 m			
M93	07 44.6	−23 52	Puppis	22	6.2	1100	Orion Spur	IV 1 p			
NGC 2451	07 45.4	−37 58	Puppis	45	2.8	-	Orion Spur	II 2 p			
NGC 2477	07 52.3	−38 33	Puppis	27	5.8	1130	Orion Spur	IV 1 p			
NGC 2547	08 10.7	−49 16	Vela	20	4.7	430	Orion Spur	II 2 p			
NGC 2546	08 12.4	−37 38	Puppis	41	6.3	1000	Orion Spur	III 2 m			
M48	08 13.8	−05 48	Hydra	54	5.8	460	Orion Spur	I 2 m			
M44	08 40.1	+19 59	Cancer	95	3.1	178	Orion Spur	II 2 m		Praesepe / Beehive	
IC 2395	08 41.1	−48 12	Vela	8	4.6	850	Orion Spur	II 3 p			
M67	08 50.4	+11 49	Cancer	30	6.9	830	Orion Spur	II 2 m	At high galactic latitude		
NGC 5460	14 07.6	−48 19	Centaurus	25	5.6	500	Orion Spur	II 3 m			
NGC 6124	16 25.6	−40 40	Scorpius	29	5.8	490	Orion Spur	II 3 m			
NGC 6193	16 41.3	−48 46	Ara	15	5.2	1156	Sagittarius Arm	II 3 p	In Ara OB1; involved in nebulosity		
NGC 6231	16 54.0	−41 48	Scorpius	15	2.6	1800	Sagittarius Arm	I 3 p	In Scorpius OB1		
NGC 6242	16 55.6	−39 30	Scorpius	9	6.4	1200	Sagittarius Arm	I 3 m			
NGC 6250	16 58.0	−45 48	Ara	8	5.9	1020	Sagittarius Arm	IV 3 p			
NGC 6322	17 18.5	−42 57	Scorpius	10	6.0	996	Sagittarius Arm	I 2 p			
NGC 6374	17 32.3	−32 36	Scorpius	20	5.5	-	-	IV 1 p	Is this a true object?		
M6	17 40.1	−32 13	Scorpius	15	4.2	615	Orion Spur	III 2 p		Butterfly Cluster	
NGC 6416	17 44.4	−32 21	Scorpius	18	5.7	800	Sagittarius Arm	IV 1 p			
IC 4665	17 46.3	+05 43	Ophiuchus	41	4.2	430	Orion Spur	III 2 p			

Open Clusters

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Notes	Common Name	View
M7	$17^h53.9^m$	$-34^\circ 49^m$	Scorpius	80′	3.3	245	Orion Spur	II 2 r		Ptolemy's Cluster	
M23	17 56.8	−19 01	Sagittarius	27	5.5	660	Orion Spur	III 1 m			
M21	18 04.6	−22 30	Sagittarius	13	5.9	1300	Sagittarius Arm	I 3 m	In Sagittarius OB1		
M24	18 18.4	−18 25	Sagittarius	90:	4.6	3070	Sagittarius Arm	-	Dense core of stars	Sagittarius Star Cloud	
M18	18 19.9	−17 08	Sagittarius	9	6.9	1500	Sagittarius Arm	II 3 p	Involved in nebulosity		
NGC 6633	18 27.7	+06 34	Ophiuchus	27	4.6	320	Orion Spur	III 2 m			
M25	18 31.6	−19 15	Sagittarius	32	4.6	613	inter-arm?	I 2 p	Contains U Sgr		
IC 4756	18 39.0	+05 27	Serpens	52	5.4	400	Orion Spur	III 2 m			
M11	18 51.1	−06 16	Scutum	14	5.8	1900	Sagittarius Arm	I 3 m			
Cr 399	19 25.4	+20 11	Vulpecula	60	3.6	-	Orion Spur	III 2 p	Asterism; main core at 424 pc	Coathanger / Brocchi's Cluster	
NGC 6871	20 05.9	+35 47	Cygnus	20	5.2	1574	Orion Spur	IV 3 p	In Cygnus OB3? Involved in nebulosity		
M29	20 23.9	+38 32	Cygnus	7	6.6	2200:	Orion Spur	III 3 p	In Cygnus OB1		
NGC 6940	20 34.6	+28 18	Vulpecula	31	6.3	770	Orion Spur	III 2 m			
M39	21 32.2	+48 26	Cygnus	32	4.6	253	Orion Spur	III 2 p			
NGC 7243	22 15.3	+49 53	Lacerta	21	6.4	858	Orion Spur	IV 2 p			
NGC 7686	23 30.2	+49 08	Andromeda	15	5.6	1000	Orion Spur	IV 1 p	May be an asterism		
NGC 7160	21 53.7	+62 36	Cepheus	7	6.1	790	Orion Spur	III 3 p			
M52	23 24.2	+61 35	Cassiopeia	13	6.9	1380	Perseus Arm	I 2 r			

Globular Clusters

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Class	Notes	Common Name	View
M79	$05^h24.5^m$	$-24^\circ 33^m$	Lepus	8.7 ′	8.00	13300	5			
NGC 3201	10 17.6	−46 25	Vela	18.2	6.75	5000	10			
M68	12 39.5	−26 45	Hydra	12.0	8.20	9600	10			
M53	13 12.9	+18 10	Canes Venatici	12.6	7.72	17200	5			
NGC 5139	13 26.8	−47 29	Centaurus	36.3	3.65	5200	8		Omega Centauri	
M3	13 42.2	+28 23	Coma Berenices	16.2	6.35	9900	6			
M5	15 18.6	+02 05	Serpens	17.4	5.75	7600	5			
M80	16 17.0	−22 59	Scorpius	8.9	7.20	8300	2			
M4	16 23.6	−26 32	Scorpius	26.3	5.93	2100	9			
M13	16 41.7	+36 28	Hercules	16.6	5.86	7200	5		Hercules Globular Cluster	
M12	16 47.2	−01 57	Ophiuchus	14.5	6.60	5500	9			
M10	16 57.1	−04 06	Ophiuchus	15.1	6.57	4400	7			
M62	17 01.2	−30 07	Ophiuchus	14.1	6.60	6000	4			
M19	17 02.6	−26 16	Ophiuchus	13.5	7.15	10600	8			
M92	17 17.1	+43 08	Hercules	11.2	6.52	7800	4			
M22	18 36.4	−23 54	Sagittarius	24.0	5.10	3100	7			
M70	18 43.2	−32 18	Sagittarius	7.8	8.08	10800	5			
M55	19 40.0	−30 58	Sagittarius	19.0	6.95	5200	11			
M71	19 53.8	+18 47	Sagitta	7.2	8.30	4000	-			
M75	20 06.1	−21 55	Sagittarius	6.0	8.55	18200	1			
M15	21 30.0	+12 10	Pegasus	12.3	6.35	9400	4		X-ray source	
M2	21 33.5	−00 49	Aquarius	12.9	6.50	11300	2			

Bright Nebulae

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Notes	Common Name	View
IC 1805	$2^{h}33.4^{m}$	$+61^{\circ}26^{m}$	Cassiopeia	60 x 60 ′	6.5	2300	Perseus Arm	H II region	In Cassiopeia OB6	Heart Nebula	
IC 1848	02 51.3	+60 25	Cassiopeia	60 x 30	6.5	2300	Perseus Arm	H II region	In Cassiopeia OB6	Soul Nebula	
NGC 1499	04 00.7	+36 37	Perseus	145 x 40	6.0:	400	Orion Spur	H II region	In Perseus OB2	California Nebula	
M1	05 34.5	+22 01	Taurus	6 x 4	8.4	2000	Perseus Arm	SNR		Crab Nebula	
M42	05 35.4	−05 27	Orion	66 x 60	3.0	400	Orion Spur	H II region	in Orion OB1	Orion Nebula	
NGC 2237-9	06 32.3	+05 03	Monoceros	80 x 60	6.0	1600	Perseus Arm	H II region	In Monoceros OB2	Rosette Nebula	
NGC 2264	06 40.9	+09 54	Monoceros	60 x 30	8.0:	750	Orion Spur	H II region	In Monoceros OB1	Cone Nebula	
M20	18 02.6	−23 02	Sagittarius	29 x 27	6.3	1600	Sagittarius Arm	H II region	In Sagittarius OB1	Trifid Nebula	
M8	18 03.8	−24 23	Sagittarius	90 x 40	6.0	1250	Sagittarius Arm	H II region	In Sagittarius OB1	Lagoon Nebula	
M16	18 18.8	−13 47	Sagittarius	35 x 28	6.0	1750	Sagittarius Arm	H II region	In Serpens OB1	Eagle Nebula	
M17	18 20.8	−16 11	Sagittarius	46 x 37	6.0	1800	Sagittarius Arm	H II region	In Serpens OB1	Omega Nebula	
NGC 6960-92	20 50:	+31:	Cygnus	180 x 180	7.0:	610	Orion Spur	SNR		Veil Nebula	
NGC 7000	20 58.8	+44 20	Cygnus	120 x 100	6:0	600	Orion Spur	H II region		North America Nebula	
NGC 7023	21 01.8	+68 12	Cepheus	18 x 18	7.7	430	Orion Spur	Reflection neb.		Iris Nebula	
IC 1396	21 39.1	+57 30	Cepheus	170 x 140	8.0:	920	Orion Spur	H II region	In Cepheus OB2		

Planetary Nebulae

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Magn. of central star	Common Name	View
NGC 246	$00^{h}47.0^{m}$	$-11^{\circ}53^{m}$	Cetus	225″	8.0	644	Orion Spur	3b	11.94	Pac-Man Nebula	
NGC 3132	10 07.7	−40 26	Vela	47	8.2	613	Orion Spur	4+2	10.07	Southern Ring Nebula	
M57	18 53.6	+33 02	Lyra	70 x 150	9.7	705	Orion Spur	4+3	10.84	Ring Nebula	
M27	19 59.6	+22 43	Vulpecula	350 x 910	7.6	417	Orion Spur	3+2	13.94	Dumbbell Nebula	
NGC 7009	21.04.2	−11 22	Aquarius	25 x 100	8.3	1200	Orion Spur	4+6	11.50	Saturn Nebula	
NGC 7293	22 29.6	-20 48	Aquarius	769	6.3	213	Orion Spur	4+3	13.47	Helix Nebula	

Galaxies

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(Mpc)	Type	Nuclear class	Common Name	View
M31	$00^{h}42.7^{m}$	$+41^{\circ}16^{m}$	Andromeda	178 x 63′	3.4	0.78	Sb I-II		Andromeda Galaxy	
NGC 253	00 47.6	-25 17	Sculptor	25.1 x 7.4	7.3	3.5	Sc p	3, Extremely Small	Sculptor Galaxy	
NGC 300	00 54.9	-37 41	Sculptor	20.0 x 14.8	8.2	2.6	Sd III-IV	3, Extremely Small		
M33	01 33.9	+30 39	Triangulum	62 x 39	5.7	0.94	Sc II-III		Triangulum Galaxy	
M81	09 55.6	+69 04	Ursa Major	25.7 x 14.1	6.9	5.6	Sb I-II		Cigar Galaxy	
M82	09 55.8	+69 41	Ursa Major	11.2 x 4.6	8.3	2.2	P		Bode's Galaxy	
M106	12 19.0	+47 18	Canes Venatici	18.2 x 7.9	8.4	6.9	Sb+p			
M49	12 29.8	+08 00	Virgo	8.9 x 7.4	8.3	12	E4			
M104	12 40.0	-11 37	Virgo	8.9 x 4.1	8.1	19	Sb-	5	Sombrero Galaxy	
M94	12 50.9	+41 07	Canes Venatici	11.0 x 9.1	8.1	7.1	Sb-p II:	5		
M64	12 56.7	+21 41	Coma Berenices	9.3 x 5.4	8.4	7.0	Sb-		Black eye Galaxy	
NGC 4945	13 05.4	-49 28	Centaurus	20.0 x 4.4	8.6	2.8	SBc:	4, Very Small		
M63	13 15.8	+42 02	Canes Venatici	12.3 x 7.6	8.6	9.2	Sb+ II			
NGC 5128	13 25.5	-43 01	Centaurus	18.2 x 14.5	6.7	4.5	S0p		Centaurus A	
M51	13 29.9	+47 12	Canes Venatici	11.0 x 7.8	8.3	6.3	Sc I	5	Whirlpool Galaxy	
M83	13 37.0	-29 52	Hydra	11.2 x 10.2	7.2	3.7	Sc I-II		Southern Pinwheel Galaxy	
M101	14 03.2	+54 21	Ursa Major	26.9 x 26.3	7.8	5.8	Sc I	3, Diffuse	Pinwheel Galaxy	

Out of sight from 40°N

Open Clusters

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Notes	Common Name	View
NGC 2516	$07^h58.3^m$	$-60^\circ52^m$	Carina	$50'$	3.8	400	Orion Spur	I 3 r			
IC 2391	08 40.2	−53 04	Vela	30	2.5	150	Orion Spur	II 3 p	In a moving group	Omicron Velorum Cluster	
NGC 2669	08 44.9	−52 58	Vela	12	6.1	1000	Orion Spur	II 3 p			
NGC 3114	10 02.7	−60 07	Carina	35	4.2	950	inter-arm?	II 3 r			
NGC 3228	10 21.8	−51 43	Vela	18	6.0	490	Orion Spur	I 1 p			
NGC 3293	10 35.8	−58 14	Carina	6	4.7	2600	Sagittarius Arm	I 3 r	In Carina OB1; involved in nebulosity		
IC 2602	10 43.2	−64 24	Carina	50	1.9	147	Orion Spur	II 3 m	Member of the Scorpius-Centaurus association	Southern Pleiades; Theta Carinae Cluster	
NGC 3532	11 06.4	−58 40	Carina	55	3.0	400	Orion Spur	II 1 m		Wishing Well Cluster	
NGC 3766	11 36.1	−61 37	Centaurus	12	5.3	1700	Sagittarius Arm	I 1 p			
NGC 4755	12 53.6	−60 20	Crux	10	4.2	2340	Sagittarius Arm	I 3 r		Jewel Box	
NGC 5281	13 46.6	−62 54	Centaurus	5	5.9	1300	Sagittarius Arm	I 1 p			
NGC 5316	13 53.9	−61 52	Centaurus	14	6.0	1120	inter-arm?	III 1 p			
NGC 5617	14 29.8	−60 43	Centaurus	10	6.3	1200	inter-arm?	I 3 m			
NGC 5662	14 35.2	−56 33	Centaurus	12	5.5	665	Orion Spur	II 3 m			
NGC 6025	16 03.7	−60 30	Triangulum Australe	12	5.1	828	inter-arm?	II 2 p			
NGC 6067	16 13.2	−54 13	Norma	13	5.6	1420	Sagittarius Arm	I 2 r			
NGC 6087	16 18,9	−57 54	Norma	12	5.4	900	Sagittarius Arm	I 2 p			

Globular Clusters

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Class	Notes	Common Name	View
NGC 104	$00^h24.1^m$	$-72^\circ05^m$	Tucana	$30.9'$	4.03	4600	3	X-ray source	47 Tucanae	
NGC 362	01 03.2	−70 51	Tucana	12.9	6.58	9000	3			
NGC 2808	09 12.0	−64 52	Carina	13.8	6.30	9200	1		Contains three distinct generations of stars	
NGC 4372	12 25.8	−72 40	Musca	18.6	7.80	4900	12			

Bright Nebulae

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Notes	Common Name	View
NGC 2070	$05^h38.7^m$	$-69^\circ06^m$	Dorado	$40 \times 25'$	8.0	54900	In LMC	H II region	30 Dor involved	Tarantula Nebula	
NGC 3372	10 43.8	−59 52	Carina	120 x 120	3.0	2300	Sagittarius Arm	H II region	In Carina OB1	Eta Carinae Nebula	
IC 2944-8	11 38.3	−63 22	Centaurus	75 x 50	7.0:	2000	Sagittarius Arm	H II region	In Crux OB1		

Planetary Nebulae

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(pc)	Galactic arm	Type	Magn. of central star	Common Name	View
NGC 3918	$11^h50.3^m$	$-57^\circ11^m$	Centaurus	12″	8.4	797	Orion Spur	2b	14.8	Blue Planetary	

Galaxies

Name	RA (2000.0)	Dec.	Const.	Diam.	Magn.	Dist.(Mpc)	Type	Nuclear class	Common Name	View
NGC 292	$00^h52.7^m$	$-72^\circ50^m$	Tucana	$280 \times 160'$	2.3	0.08	SBmp IV		Small Magellanic Cloud	
(PGC 17223)	05 23.6	−69 45	Dorado	650 x 550	0.9	0.048	SB(s)m III-IV		Large Magellanic Cloud	
NGC 6744	19 09.8	−63 51	Pavo	15.5 x 10.2	8.4	6.7	S(B)b+ II			

SELECTED AREAS OF SKY

SELECTED AREAS OF SKY

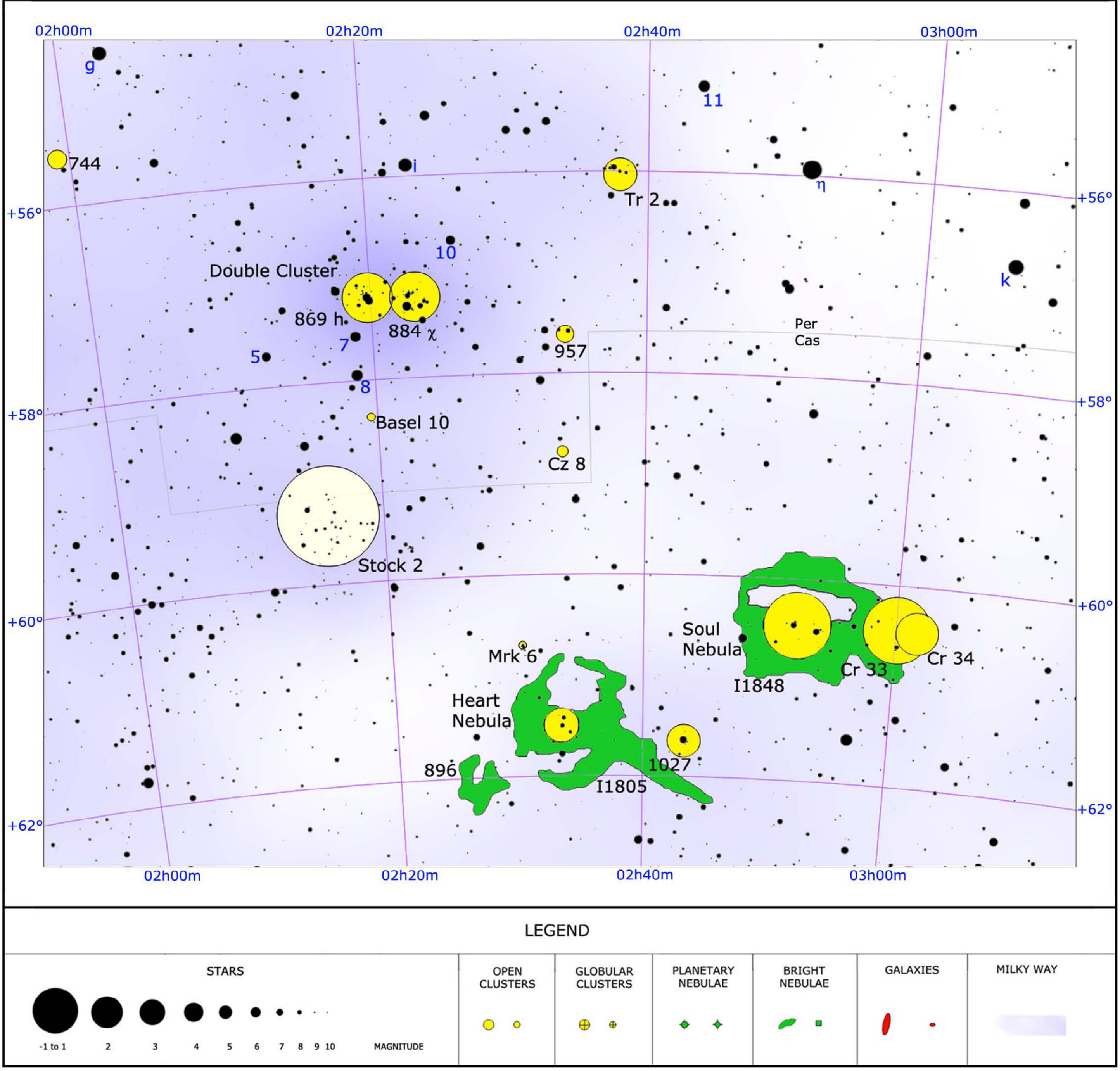
The following maps show 8 selected areas of sky suitable for 8x40 or 10x50 binoculars. Below each map there is a short description of the selected galactic area and of some objects visible there.

On the maps the Celestial North is up and the Celestial South is down, so the stars and the objects are mapped as they appear from 40°N. The only exception is for the Double Cluster map, whose northern declination is highter than the latitude of the point of view.

The six selected areas:

1. h-χ Persei - The Double Cluster
2. Mel 20 - The Perseus Cluster
3. M45 - Pleiades
4. Mel 25 - Hyades
5. Orion Belt and Orion Sword
6. Coma Berenices star cluster
7. Nebulae in Sagittarius
8. Cygnus core

THE DOUBLE CLUSTER

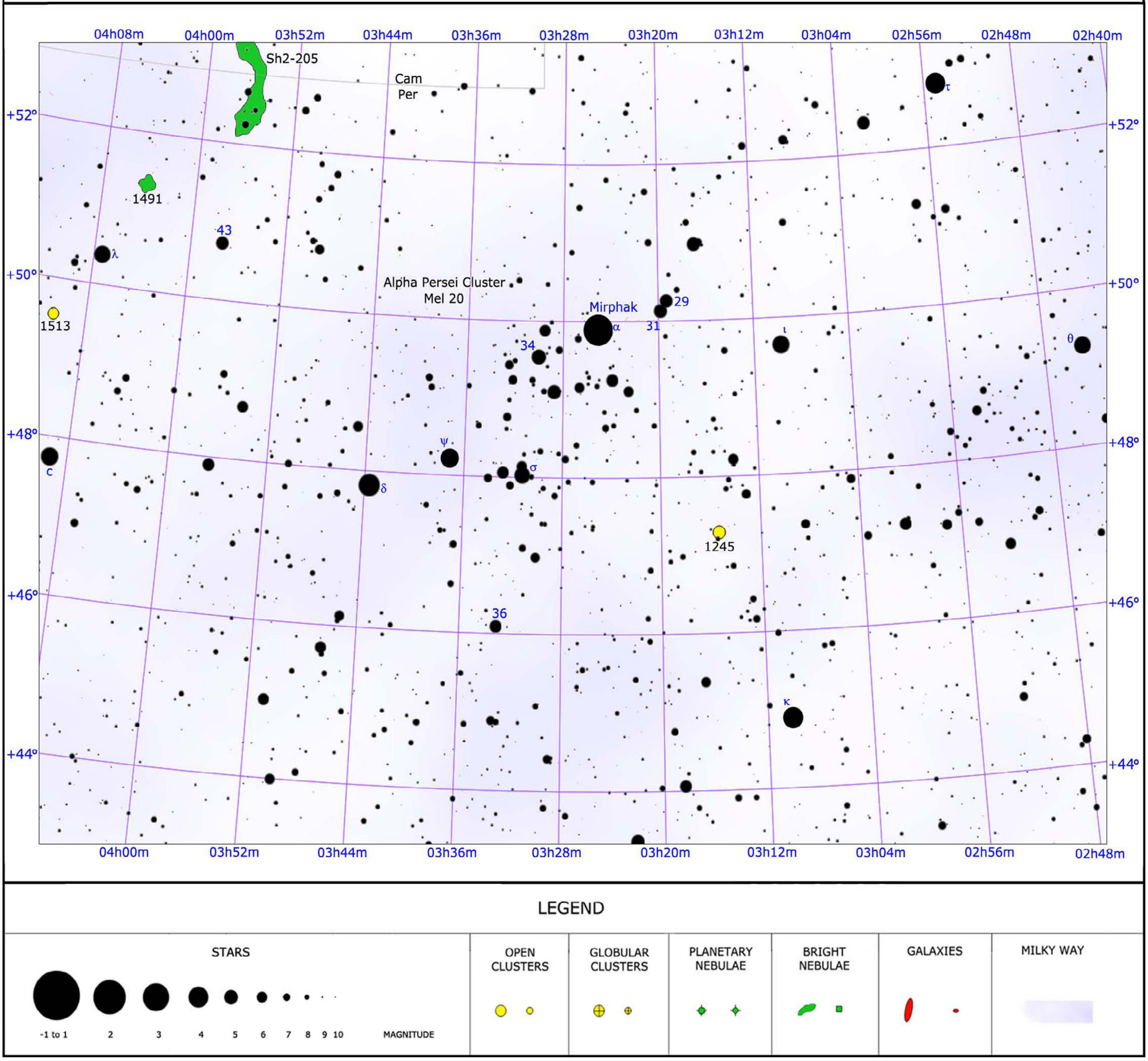


The border between the two northern constellation of **Perseus** and **Cassiopeia** harbours some of the most interesting object of the northern Milky Way; along this direction we can see many unobscured objects belonging to the great Perseus Arm, one of the most prominents spiral arm of the Galaxy. A binocular is enough to see many rich star fields and clusters.

The most prominent object visible here is the well-known **Double Cluster**; this is the common name for the naked-eye open clusters NGC 884 (χ Persei) and NGC 869 (h Persei), which are close together in the constellation Perseus. NGC 884 and NGC 869 are at distances of 7600 and 6800 light-years away, respectively, so they are also close to one another in space. Indeed, both are located in the Perseus OB1 association, a very rich group of young and masive stars. Binoculars are enough to resolve this couple of clusters into dozens of stars.

The same galactic region of the Double Cluster hosts also two extended bright nebulae, named **IC 1805** and **IC 1848**; their shape is responsible of the nicknames **Heart Nebula** and **Soul Nebula**. Along with the nearby **NGC 896**, theese nebulae constitute one of the most prominent star forming regions of the Perseus Arm; they contain large cavities that were carved out by radiation and winds from the region's most massive stars. According to the theory of triggered star formation, the carving out of these cavities pushes gas together, causing it to ignite into successive generations of new stars. All the young, massive stars of this region are grouped into the Cassiopeia OB6 association.

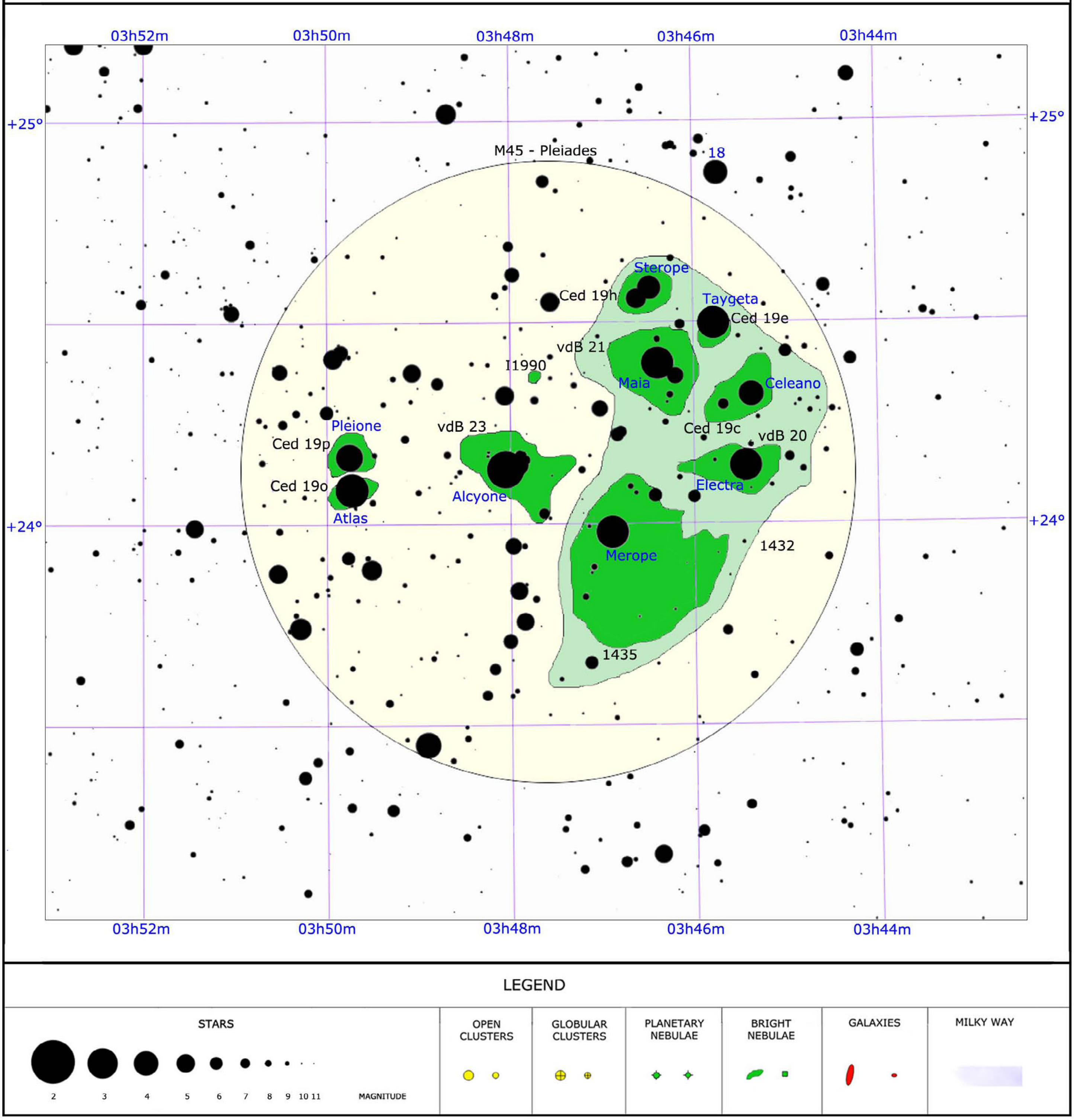
Mel 20 - THE PERSEUS CLUSTER



The **Alpha Persei Cluster**, also know as **Melotte 20**, is a bright stellar association in Perseus constellation. To the naked eye, the cluster consists of several blue stars of spectral type B, along with the most massive member, the yellow supergiant Alpha Persei itself. Brightest members include Alpha, Delta, Epsilon, Psi, 29, 30, 34 and 48 Persei. Through binoculars, dozens of blue-white stars are clearly visible.

The Alpha Persei Cluster is the core of a OB association, known as Perseus OB3; its distance has accurately measured by Hipparcos satellite, as 184 parsecs (601 light-years). The age of the cluster is 50 million years and originated after an intense star formation process; this same process originated also many other OB associations. The most massive stars explosed as supernovae within few millions years, generating powerful shock waves that pushed away any gaseous remnant of the giant molecular cloud in which star formation took place. Part of this gas forms today the so-called *Lindblad Ring*, a giant structure in which other OB associations were formed, such as all the blue stars of Crux, Centaurus and Lupus (the *Scorpius-Centaurus Association*) and Cepheus OB2, in Cepheus constellation.

M45 - PLEIADES

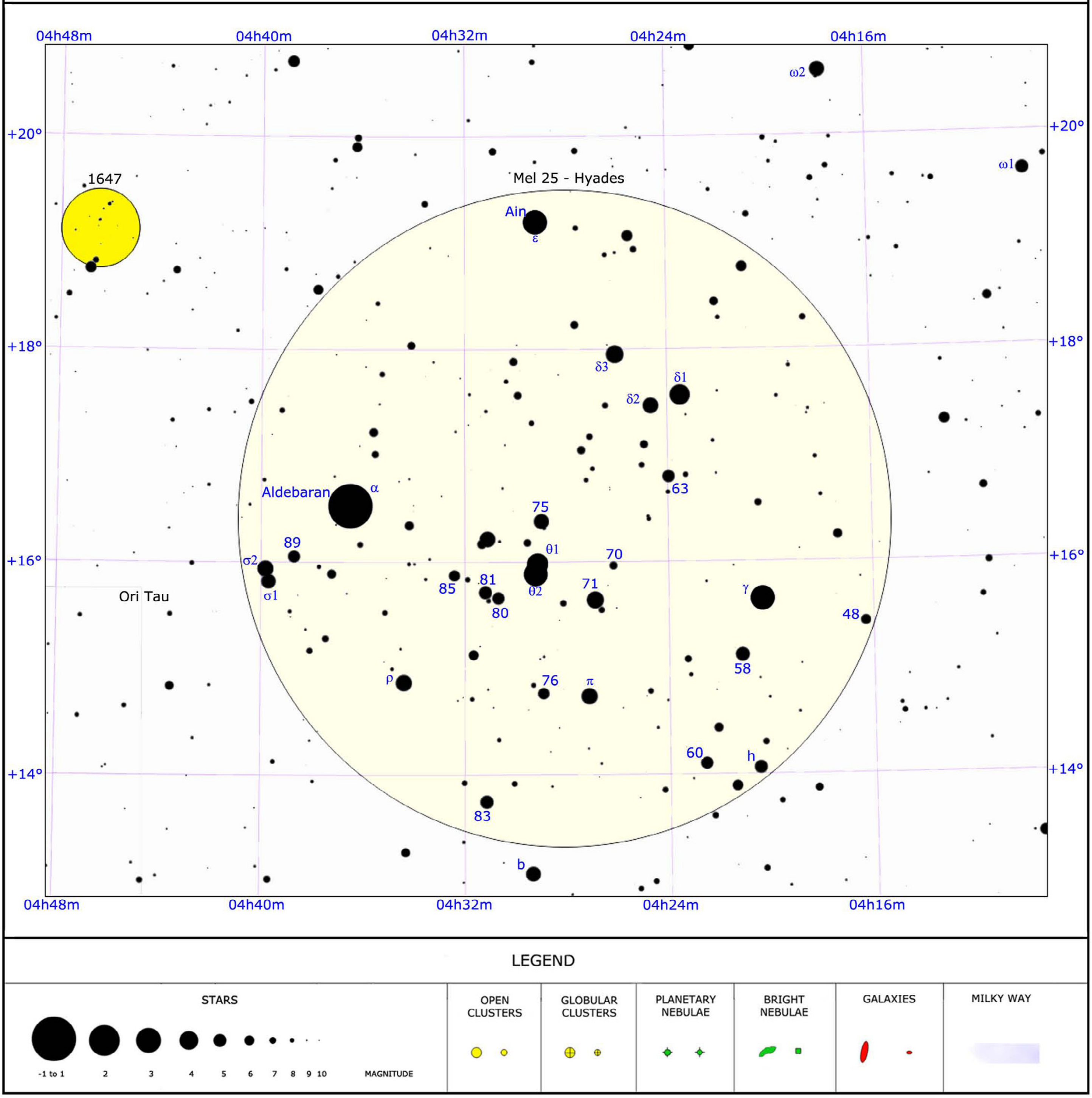


The **Pleiades** cluster, also known as the **Seven Sisters** of **Messier 45**, is the brightest open cluster in the sky. It lies in Taurus constellation and is dominated by hot blue and extremely luminous stars that have formed within the last 100 million years. The nine brightest stars of the Pleiades are named for the Seven Sisters of Greek mythology and are all visible to nacked eye in a dark and clear night. 8x30 and 10x50 binoculars may show dozens of blue-white components, arranged in some concatenations.

The cluster contains over 1,000 statistically confirmed members, although this figure excludes unresolved binary stars. Its distance is currently thought to be the value of about 135 parsecs (roughly 440 light-years); at this distance, the cluster core radius is about 8 light-years and tidal radius is about 43 light-years.

Under ideal observing conditions, some hint of nebulosity may be seen around the cluster, and this shows up in long-exposure photographs. It is a reflection nebula, caused by dust reflecting the blue light of the hot, young stars. It was formerly thought that the dust was left over from the formation of the cluster, but at the age of about 100 million years generally accepted for the cluster, almost all the dust originally present would have been dispersed by radiation pressure. Instead, it seems that the cluster is simply passing through a particularly dusty region of the interstellar medium.

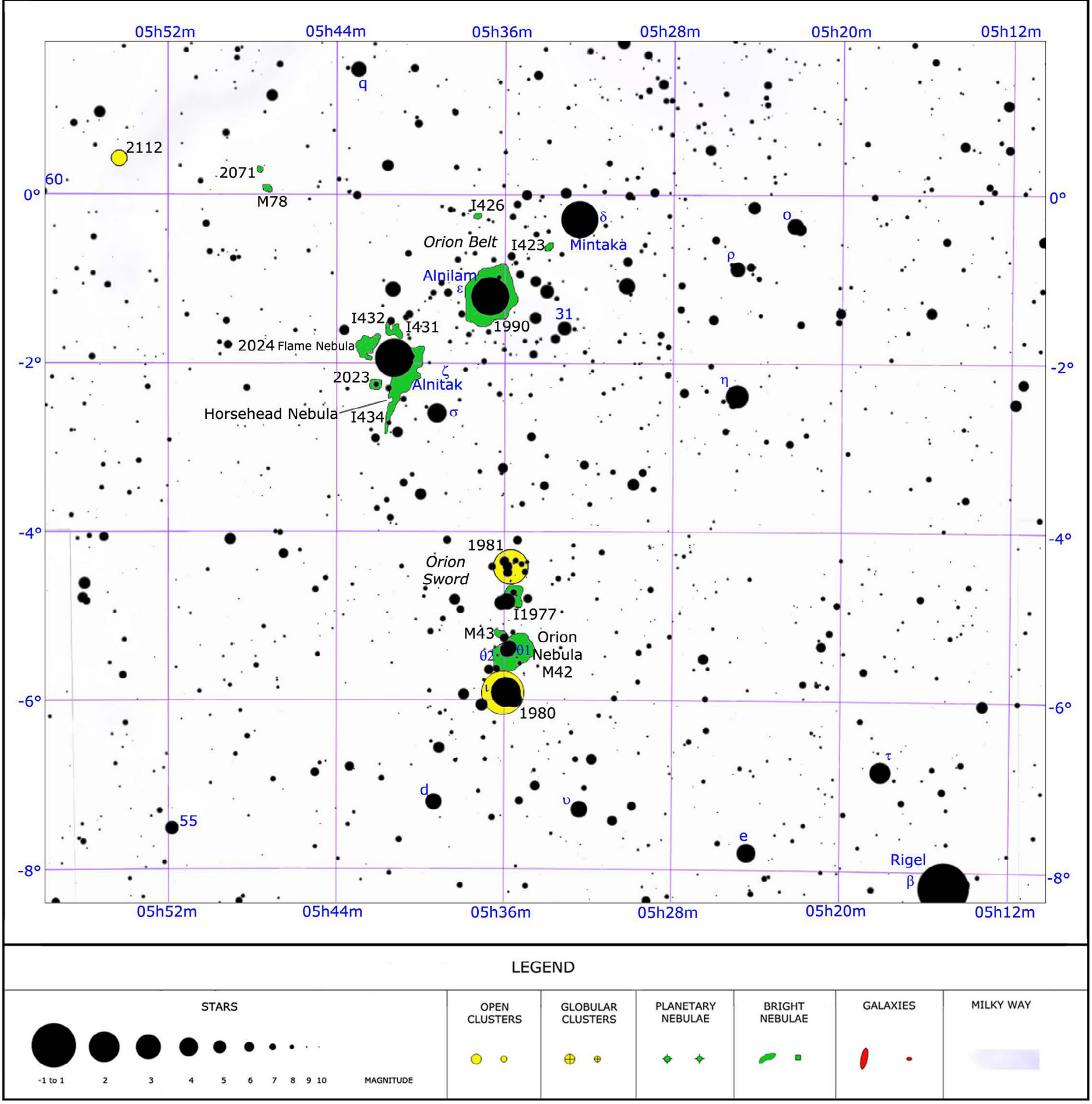
Mel 25 - HYADES



The **Hyades** cluster (Mel 25) in Taurus constellation is the nearest open cluster to the Solar System, at the distance of only 41 parsecs (151 light-years), and one of the best-studied of all star clusters. It consists of a roughly spherical group of 300 to 400 stars that share the same age, place of origin, chemical content, and motion through space. Many of its members are clearly visible also to nacked eye, and form a sort of "V" along with the bright red giant **Aldebaran**, that appears to dominate this cluster; however, Aldebaran is completely unrelated to the Hyades cluster, as it is located much closer to the Solar System, at one third of the distance of the Hyades.

The components of the Hyades have an average age of 625 million years; some of the most massive components are evolved as red giants, such as γ, δ1, ε e θ2 Tauri. The age, the metallicity, and proper motion of the cluster coincide with those of the larger and more distant **Praesepe Cluster** in Cancer constellation, and the trajectories of both clusters can be traced back to the same region of space, indicating a common origin. The most massive stars are concentrated near the core of the cluster, a common phenomenon in old open clusters known as *mass segregation*.

ORION BELT AND SWORD

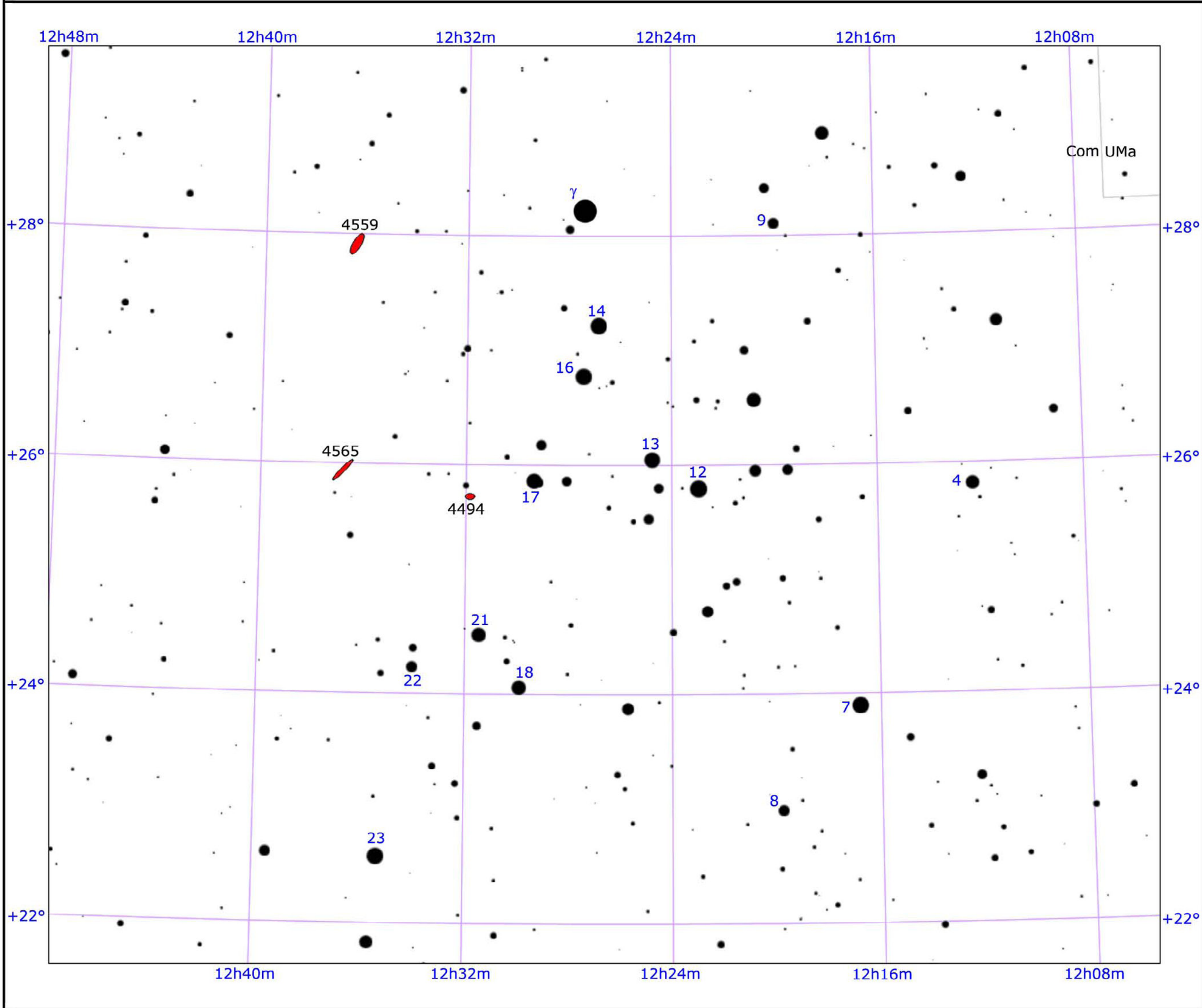


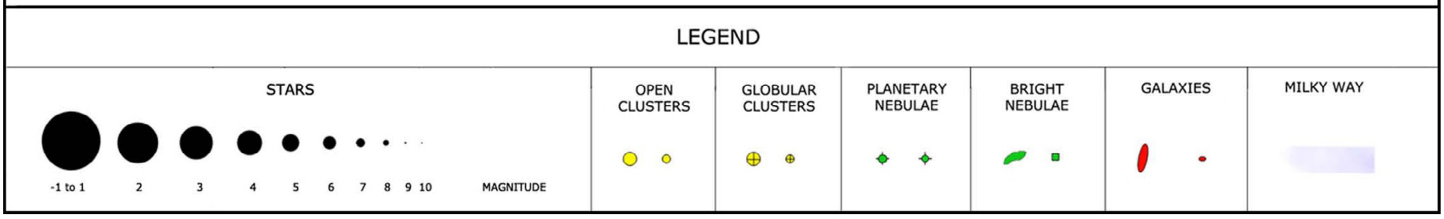
Orion Belt and **Orion Sword** are two of the best known asterisms in the sky. Both are clearly visible to nacked eye also from medium cities; furthermore, their position close to the celestial equator allows them to be seen all around the world.

The **Orion Belt** is composed by three blue, luminous stars: Alnitak, Alnilam and Mintaka; these stars are probably not physically bounded each other, and lie at the distance of respectively 820, 1340 and 915 light-years. Close to Alnitak there is the Flame Nebula (NGC 2024), an H II region ionized by the light of a star embedded in its nebulosity; Alnitak and the nebula are not physically bounded, because the Flame Nebula lies at 1500 light-years from us. Half degree south of Alnitak, a dark cloud hides partially the light of the nebula IC 434, becoming itself visible; its proper name, **Horsehead Nebula**, derives from its shape.

The **Orion Sword** is a group of young stars at 1500-1600 light-years from the Solar System; the centre of this asterism is the great **Orion Nebula** (M42), one of the brightest and best famous nebulae in the sky. The Orion Nebula is an H II region containing a very young open cluster, known as the **Trapezium** due to the asterism of its primary four stars. Two of these can be resolved into their component binary systems on nights with good seeing, giving a total of six stars. The stars of the Trapezium, along with many other stars, are still in their early years. The Trapezium may be a component of the much-larger Orion Nebula Cluster, an association of about 2,000 stars within a diameter of 20 light years. Two bright open clusters are visible to the north and to the south of the nebula, NGC 1981 and NGC 1980 respectively.

COMA BERENICES



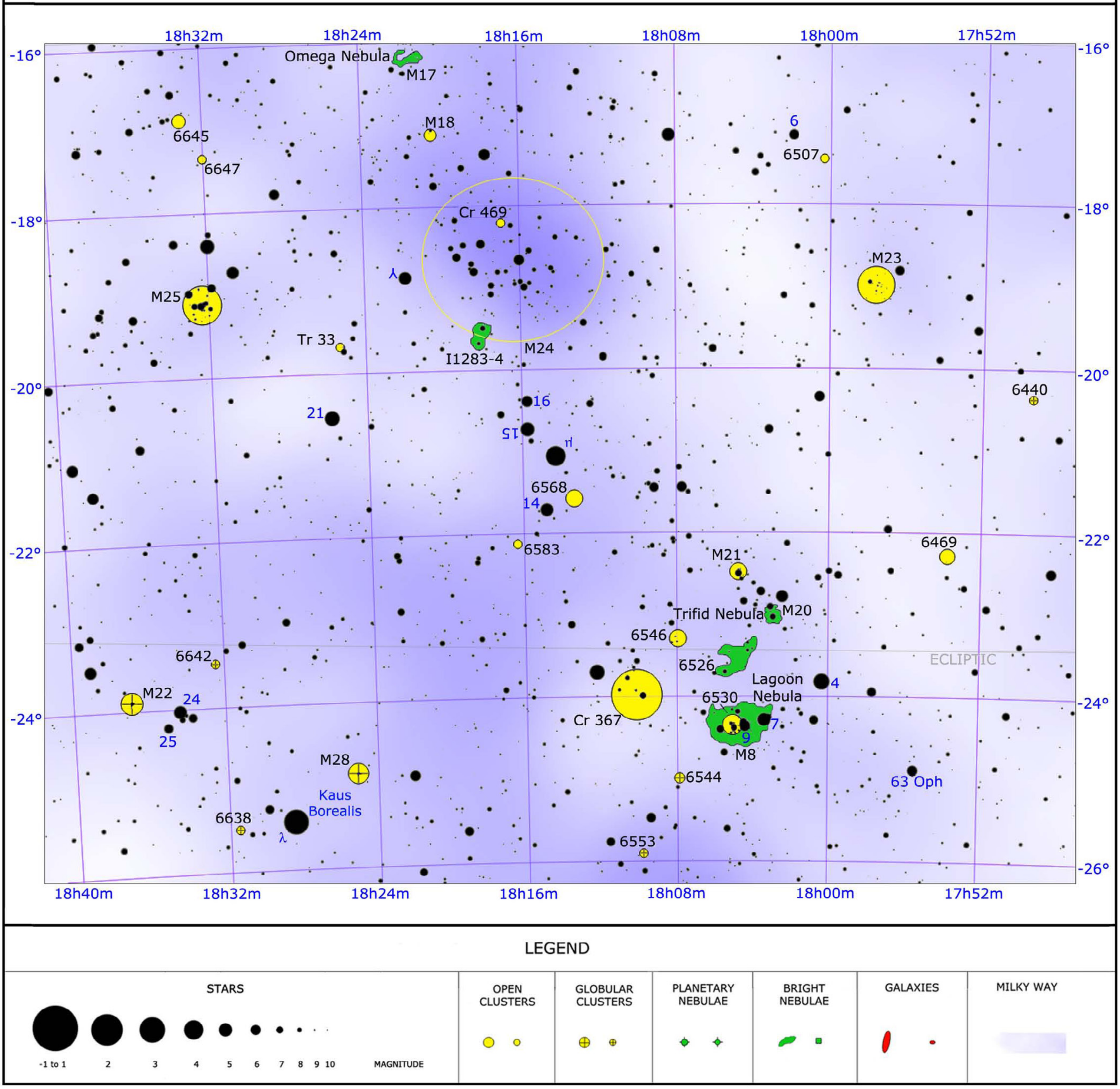


The core of **Coma Berenices** constellation is an extended group of stars widespread on an area of five square degrees; these stars form a small but nearby open cluster, known as **Mel 111**, that lies at 88 parsecs (288 light-years) from the Solar System. Almost all of the 40 components are visible to nacked eye under a dark and clear sky; a small binocular is the best instrument to have the best view of this cluster.

The age of the cluster is 450 million years and some of its components are yellow-orange stars. The shape of Mel 111 gave to the antician astronomers the idea of a tail (the tail of the Leo constellation); Ptolemy III, in around 240 BC, separated this group of stars from Leo and renamed it for the Egyptian queen Berenice's sacrifice of her hair in a legend.

Using a small telescope, some galaxies become visible in the area of this cluster; most of them are spiral galaxies, such as NGC 4559 and NGC 4565, the *Needle Galaxy*.

NEBULAE IN SAGITTARIUS



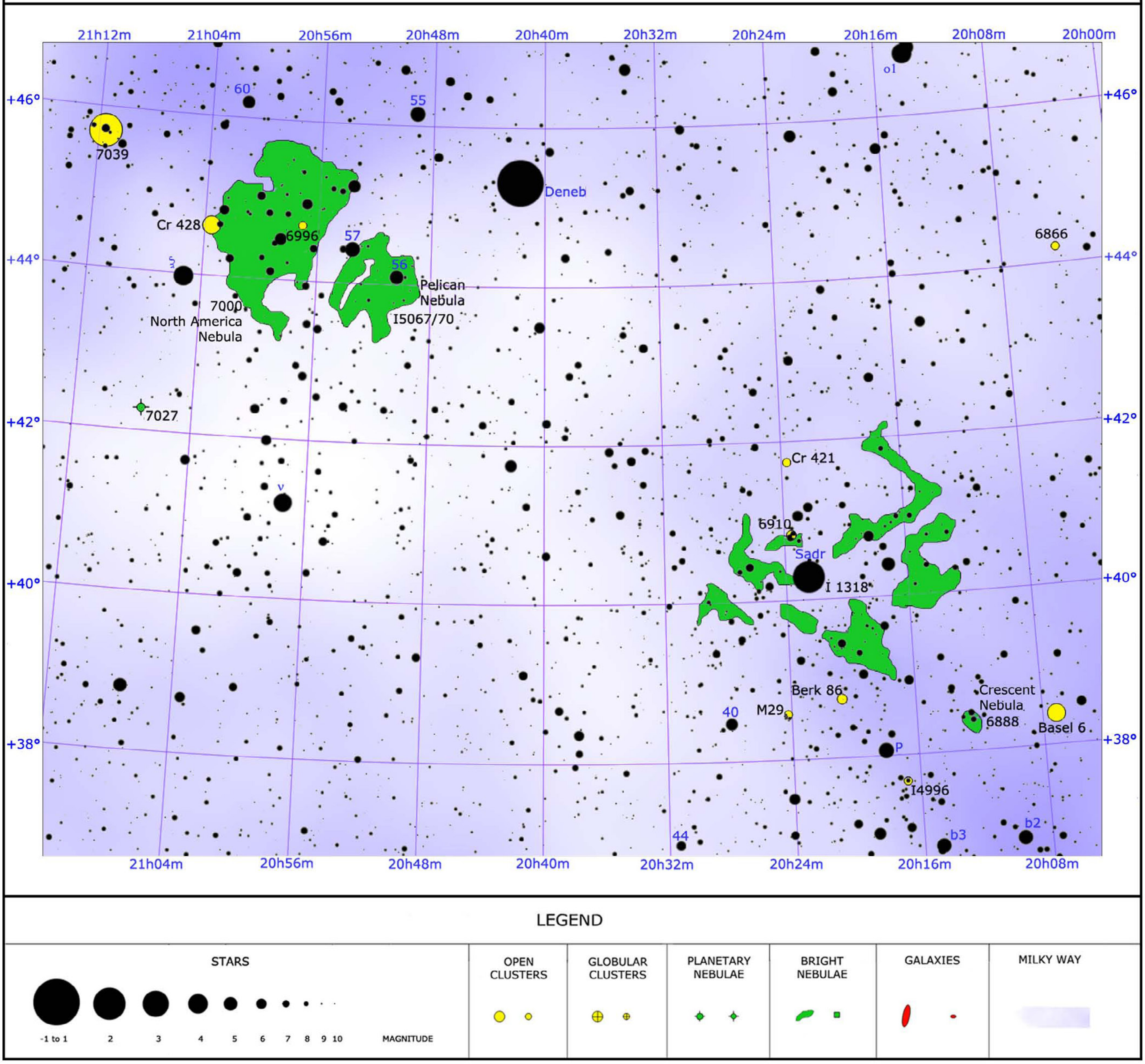
Many bright objects are visible in the northern part of **Sagittarius** constellation, near the galactic centre. Looking with binoculars, rich star fields are revealed, as well as two bright nebulae, **Lagoon Nebula** and **Trifid Nebula**. Both are located in Sagittarius Arm and are site of star formation. The Lagoon Nebula lies at 4100 light-years, in the nearest edge of the arm; the Trifid Nebula is located a bit farther away, at 5200 light-years.

Sagittarius has the hightest number of objects detected by Charles Messier; many of them are globular clusters, such as **M22**, one of the most brilliant globulars in the sky; its position is easy to find, because it lies two degrees north-east of Lambda Sagittarii, and a small binocular is enough to see it as a small bright nebulous patch.

M23 and **M25** are tho open clusters located between Orion Spur and Sagittarius Arm; both are partialy resolved into stars looking with 8x40 or 10x50 binoculars. The bright patch of M24, known also as the **Sagittarius Star Cloud**, is not a true cluster, but a rich and extended star field, belonging to the Sagittarius Arm.

Near the edge with Serpens constellation there is the **Omega Nebula** (M17), which is part of a great star forming region along with the near **Eagle Nebula** (M16) and Sh2-54.

CYGNUS CORE



In the constellation of **Cygnus** we can see the Orion Spur along its median line. Many galactic structures are visible here, such as extended H II regions and clusters of stars. The Milky Way in this direction is partially obscured by a long system of dark clouds, that spans from Deneb to Aquila constellation; these clouds are globally known as **Cygnus Rift** and are clearly visible at nacked eye under a clear sky. Rich star fields are visible with binoculars in this area of sky.

The most famous object in Cygnus is probably the **North America Nebula**, a great H II region at 600 parsecs (1960 light years) from the Solar System; this nebula, along with the smaller **Pelican Nebula**, is part of the giant clouds of the Rift, iluminated here by an embedded and hidden blue star. The two nebulae are separated by a dark cloud in which is active the star formation.

The region around Sadr (Gamma Cygni) is rich of giant molecular clouds as well. Part of this gaseous mass is ionized and illuminated by young luminous stars, such as the components of the Cygnus OB2 association, at 1700 parsecs (5500 light-years). The nebula **IC 1318** belongs to this region, along with many others. The giant molecular cloud named Cygnus X, extended in the direction of Sadr, is one of the most massive clouds known in the Milky Way Galaxy. To this region seems to belong also **M29**, a small young open cluster clearly visible through binoculars.

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Maps and tables

Hemispherical maps and monthly maps
The maps are created using Perseus astronomical simulation software and are adapted and retouched for the specific purpose. Although Perseus is a proprietary software, ELItalia (the company that developed the software) "authorizes any usage of the data supplied or generated with the software. The copyright of images or documents generated with the software belongs to the user who takes them." (from *Copyright.txt* file included on installation).

Tables
The tables include data and informations taken from the following books and publications:

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Selected areas of sky
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Reipurth, B. et al., *Handbook of Star Forming Regions, Volume I: The Northern Sky*, ASP Monograph Publications, 2008. ISBN 1583816704.

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Observing the sky

from 40°N

This atlas contains a set of 24 maps regulated to the latitude of 40°N, similar to those of many important cities in the northern hemisphere, such as New York, Washington D.C., San Francisco, Rome, Madrid, Beijing and Tokyo, as well as information about some double and variable stars and almost 160 deep sky objects.

These maps can be used also from latitudes between 45°N and 35°N without any notable difference.

8 selected areas of the sky suitable for binoculars are displayed in separated and detailed maps, followed by a short description of those galactic regions.