

**Note to Editor: This article follows after “Introduction to sky maps for observing planets and bright stars at evening and morning mid-twilight [August 2021, lat. 40° N]”**

## **Sky Events, September-October 2021 and beyond**

By Robert C. Victor and Robert D. Miller

**September 2021** provides sky watchers the opening act of an evening planetary display, increasingly spectacular for the rest of 2021. As this month begins, Earth has recently overtaken the two giant planets of our solar system, Saturn on August 1, and Jupiter on August 19. These are this year’s dates of their *oppositions*, when we see each planet by facing directly away from the Sun. A planet at opposition is near its closest to Earth, reaching maximum brightness, and visible all night, from dusk until dawn. After its opposition, a planet remains visible in the evening sky for about half a year or more.

### [Evening mid-twilight sky map for September 2021](#)

On Sept. 1 at evening mid-twilight, 40 minutes after sunset, **Jupiter** is prominent at mag  $-2.9$  low in ESE, with **Saturn** at mag.  $+0.3$  in SE,  $17.5^\circ$  to Jupiter’s upper right. The Sun is then  $9^\circ$  below the WNW horizon. On that date, our Spaceship Earth is racing directly away from a point  $5^\circ$  above the star **Antares** in SSW. This red supergiant star marks the heart of Scorpius, the Scorpion. An observer high above the northern side of our solar system would see the planets moving counter-clockwise in their orbits around the Sun. Compared to Earth, Jupiter and Saturn are slower-moving outer planets; since we overtook them in August, we are now leaving them behind.

The two planets interior to Earth’s orbit are now visible in the western sky at dusk: **Venus** is prominent at mag.  $-4$  in WSW. You will need binoculars to spot zero-magnitude **Mercury** very low in bright twilight within  $16^\circ$  to Venus’ lower right. (Mercury is highest in mid-twilight around Sept. 5, but only about  $1^\circ$  above the horizon as seen from lat.  $40^\circ$  N. The situation is even worse for observers farther north.) Both inner planets move faster than Earth, so will catch up and overtake us, Mercury passing inferior conjunction (between Earth and Sun) on Oct. 9, and Venus doing so on Jan. 8.

Look within  $5^\circ$  upper left of Venus on Sept. 1 as the sky darkens, and you will find **Spica**. Each day, Venus shifts position against the background stars by slightly more than one degree. On Sept. 5, Venus will pass  $1.6^\circ$  upper right of Spica. The gap between them will widen to  $4^\circ$  by Sept. 8, with Spica to the lower right of Venus.

**A very thin crescent Moon may be visible on Sept. 7.** Using binoculars, look very early, about 30 minutes after sunset, for the 1-percent crescent very low in west  $29^\circ$  lower right of Venus. Next, find Mercury  $14^\circ$  to Moon’s upper left. Moon’s age seen from mid-U.S. is a tender 24 hours after New.

**The 5-percent Moon is much easier to spot on the next evening, Sept. 8.** Look  $16^\circ$  lower right of Venus, then find Mercury  $5^\circ$  lower left of Moon, and Spica  $4^\circ$  lower right of Venus.

The orientation of the lunar crescent reveals the location of the Sun below the WNW horizon. Imagine the crescent to be an arrowhead. The shaft of the arrow would point directly at the Sun. Note the crescent is tipped over to rest almost on its lower cusp (point), indicating the Sun is to the lower right of the crescent, rather than directly below it.

**Dusk on Thursday, Sept. 9 provides a spectacular view, of an 11-percent crescent Moon just 4° upper right of Venus.** Find Spica 5° below the Moon and 5° lower right of Venus, and Mercury 10° lower right of Spica and 13° lower right of the Moon.

Dusk on Sept. 10 finds Venus within 11° lower right of the 20-percent Moon, and Mercury still 15° lower right of Venus. On Sept. 11, locate Spica about midway between Venus and Mercury.

On Sept. 12, the fat 41-percent lunar crescent appears about 3° upper right of the red star **Antares**. On Sept. 13, the 52-percent Moon is just over 90° (a quarter-circle) east of the Sun and so is just past First Quarter phase, rather low in the southern sky around sunset. That same evening, Mercury reaches greatest elongation, nearly 27° east of Sun.

On Sept. 16, the 83-percent waxing gibbous Moon is within 5° lower right of **Saturn**, while bright **Jupiter** passes 1.4° north of the 3rd-mag. star Delta Capricorni, or Deneb Algedi, tail of the Sea-goat.

On Sept. 17, the Moon, 90-percent full in SE at dusk, is 6° lower right of **Jupiter**. On the next evening, Sept. 18, the 96-percent Moon appears 10° lower left of Jupiter.

On Sept. 20, the fourth Full Moon of summer 2021 appears very low, about 10° S of east at evening mid-twilight. Also try for a difficult pairing, very low in WSW a few minutes earlier in brighter twilight on Sept. 20 and 21: Mercury passing within 1.5° south (lower left) of Spica. Using binoculars, try for the pair 18°-19° lower right of Venus. Observers at mid-northern latitudes will need perfect sky conditions.

Northern hemisphere's autumn begins on Sept. 22 at 3:21 p.m. EDT as the Sun, moving southward, crosses directly over the equator. Three months later, on Dec. 21, the Sun will reach its southernmost point, over the tropic of Capricorn, marking the solstice and the start of our winter season.

At dusk in September, the belt of zodiac constellations makes its lowest angle with the horizon. This year, the visible portion of the belt is marked by four bright planets, in order from west to east, Mercury, Venus, Saturn, and Jupiter. Also within that part of the zodiac are the first-magnitude stars Spica and Antares.

The southernmost part of the zodiacal belt, in the constellation Sagittarius, the Archer, is in the south around sunset in September. This causes the low angle that the zodiac makes with the horizon, the "tipped over" appearance of the waxing crescent Moon in the west, the positions of Venus and Mercury low at dusk this month, despite considerable

elongations (angular distances from Sun) of 40° to 45° for Venus, and up to 27° for Mercury.

Another phenomenon resulting from the low angle of the zodiac to the horizon is the annual “Harvest Moon effect”, early evening moonrises for several days after Full. During Sept. 19-25, as seen from lat. 40° N, the Moon rises less than half an hour later each evening, and noticeably farther north each time. So, if you would enjoy watching a string of daily moonrises without staying up very late, here is your chance!

Besides the Moon and planets, bright stars visible at dusk include golden **Arcturus**, nearly halfway from horizon in west as September opens, and dropping lower as month progresses; **Spica** some 33° lower left of Arcturus; and the *Summer Triangle* of **Vega, Altair, and Deneb** reaching overhead. Blue-white Vega, its brightest member, passes directly overhead at lat. 38.8° N For the rest of 2021, a line from Vega to Altair, 34° long, extended 31° past Altair, locates Saturn. The alignment is most accurate in mid-August and again in late November-early December. In September, watch for **Fomalhaut**, mouth of the Southern Fish, rising 22°-23° lower left of Jupiter.

### **The morning sky -- no planets, but lots of bright stars!**

#### [Morning mid-twilight sky map for September 2021](#)

After Jupiter sets in WSW before dawn, the “**Dog Star**” **Sirius** is the brightest star in the morning sky. In September’s morning mid-twilight, Sirius is found in SE to S. Trace out the

huge *Winter Hexagon* of bright stars. Beginning with Sirius, its southernmost and brightest member, proceed clockwise through **Procyon**; the **Twin stars Pollux and Castor** 4.5° apart; **Capella**, the Mother Goat Star and northernmost member; **Aldebaran**, eye of Taurus the Bull and Follower of the Pleiades star cluster; **Rigel**, Orion’s foot; and back to Sirius. **Betelgeuse**, shoulder of Orion, lies *inside* the Hexagon.

A much more compact asterism is the almost equilateral *Winter Triangle*, consisting of Sirius, Procyon, and Betelgeuse.

On Sept. 1, as Spaceship Earth races away from Antares in the evening sky, it is heading toward a point about 5° above **Aldebaran** in the morning sky. The Sun is in Leo, below the ENE horizon. As we follow our orbit around the Sun during September, the stars will shift their positions westward, as shown on the morning chart. The Moon, just past Last Quarter, will appear near Aldebaran on the morning of Aug. 30. On Sept. 2 and 3, the waning crescent Moon appears near the Twins, Pollux and Castor. On the morning of September 5, let the 3-percent, old crescent Moon low in ENE be your guide to **Regulus**, heart of Leo, just emerging from solar conjunction. Look for the star 7° lower right of the thin, lunar crescent.

The Moon makes its next pass through the morning sky, waning from Full to a thin crescent, Sept. 20-Oct. 5. Watch the waning gibbous Moon pause almost midway from the Pleiades toward Aldebaran on Sept. 26. See a fat crescent Moon pass 3° south of Pollux on Sept. 30, and a thin crescent pause 5° lower left of Regulus on Oct. 3. The last crescent will appear very low in east on Oct. 5.

You will notice that the old crescent, with its cusps pointing upward, is oriented like a bowl on a table, signifying that the Sun is almost directly below it. Also, the Moon, near Last Quarter phase on Sept. 28 and 29, is very high in the sky around sunrise, in Taurus and Gemini, the northernmost constellations of the zodiac.

Attractive gatherings of Moon with stars and planets, and planets with each other and with stars, are illustrated on the ***Sky Calendar***. Subscribe for \$12 per year for three monthly issues mailed quarterly, or view a sample copy at [www.abramsplanetarium.org/skycalendar/](http://www.abramsplanetarium.org/skycalendar/)

In the rest of 2021, **Venus, Saturn, and Jupiter form an attractive lineup** in the southwestern evening sky, anchored by brightening Venus. In late October, telescopes show Venus as a tiny “half-moon”. In November-December, Venus looms large as it approaches Earth, and displays ever-thinner crescent phases, which can be resolved even with binoculars when the planet is observed during bright twilight, soon after sunset.

### **Planetary highlights for October 2021**

**The rest of 2021 will be wonderful for observing showpiece planets. Share the views, safely!**

[Evening mid-twilight sky map for October 2021](#)

**Evenings in October: Venus** is low in SW at dusk, 3° higher at month’s end. Its setting time improves from 1.8 to 2.3 hours after sunset. Enjoy following Venus’ motion, now 1.1° to 1.0° daily against background stars. Watch it go 0.8° S of Delta, middle star in head of Scorpius, on Oct. 9; and about 1.4° N of Antares on Oct. 16.

**Jupiter and Saturn**, in SE to S at dusk, end retrograde, Saturn on Oct. 10, and Jupiter on Oct. 17, before turning east against the stars. Saturn’s turnaround on Oct. 10 is 7.3° WSW of Theta Capricorni. Watch gap close until planet and star set in twilight in Jan. 2022. Jupiter’s pause on Oct. 17 is 1.8° from 2.8-mag. Delta Capricorni, tail of Sea-goat, and 1.4° from 3.7-mag. Gamma. The two stars are 1¾° apart. Jupiter is equidistant from these stars on Sept. 27 and Nov. 6. On Oct. 24, Jupiter-Saturn are 15.4° apart, closer than they will be again until 2039.

**Telescopic views:** As **Venus** closes in on our home planet; its disk grows from 19” (arcseconds) to nearly 26” across this month, while illumination decreases from 62 percent to 48 percent. The best is yet to come! After Venus’ greatest elongation of 47° on Oct. 29, next ten weeks until inferior conjunction on Jan. 8 will be fascinating! The crescent Venus will more than double in apparent size but get very thin, peaking in brilliance at mag. -4.9 midway through the ten weeks, in early December. **Jupiter** features cloud belts and four Galilean satellites, while **Saturn** displays rings tipped 19° from edge-on in October, the best view we will have for many years. Using higher magnification, look for Saturn’s shadow cast upon the rings at the northeast limb of the planet, giving

the scene a 3-D appearance. In mid-October, Jupiter's disk appears 44" across, slightly exceeding the 39" extent of Saturn's rings.

**Mornings in October: Mercury** passes inferior conjunction on Oct. 9 and attains mag. +1.0 in eastern morning sky on Oct. 17. Brightening rapidly, Mercury attains mag. 0 by Oct. 20, and mag. -0.7 by Oct. 25, when it stands at a very favorable greatest elongation, 18° from Sun.

[Morning mid-twilight sky map for October 2021](#)

**Events not to miss include these conjunctions of the Moon with the brightest planets**, in evening sky unless otherwise noted.

**Moon-Venus:** Aug. 10; Sept. 9; Oct. 9; Nov. 7; Dec. 6.

Jan. 3, 12° apart in evening.

Jan. 29 and 30, 13° apart in morning.

**Moon-Jupiter:** Aug. 21, Sept. 17, Oct. 14 and 15, Nov. 11, Dec. 8, Jan. 5, Feb. 2.

**A deep, nearly total eclipse of the Moon in early morning hours of Friday, Nov. 19:**

Moon enters umbra: Fri. Nov. 19 at 2:18 a.m. EST.

Deepest eclipse, 97 percent in Earth's shadow: 4:03 a.m. EST on Fri. Nov. 19,

with Moon just 6° from the beautiful Pleiades star cluster.

Moon leaves umbra: Fri. Nov. 19 at 5:48 a.m. EST.

**Mercury has a favorable morning apparition in late October through mid-November.** Watch for these planet-star and planet-planet conjunctions in morning sky:

Nov. 2: Mercury 4.1° N of Spica. Moon 3° above Mercury and 5° N of Spica on next morning.

Nov. 10: Mercury passes within 1.0° N of Mars. Departing Mercury introduces the emerging faint red planet into the morning sky.

Dec. 27 and 28: Mars appears 4.5° N of its brighter similarly colored rival, Antares, whose name means "not Mars".

**Returning to the evening sky, Mercury** emerges 15° lower right of Venus on Dec. 20, or an easier-to-see 10° lower right of Venus on Dec. 23. On Dec. 28, Mercury passes 4.2° S (lower left) of the soon-to-depart Venus. Mercury reaches a favorable greatest elongation from the Sun on Jan. 6, attains its highest altitude in twilight on Jan. 9, and approaches within 3.4° lower right of Saturn on Jan. 12, before fading quickly through mag. +1.0 on Jan. 15.

Here are monthly evening and morning mid-twilight sky maps for the rest of this year. Use them to follow seasonal changes in positions of bright stars, and wanderings of the planets.

## **THE SKY AT DUSK**

[Evening mid-twilight sky map for November 2021](#)

[Evening mid-twilight sky map for December 2021](#)

## **THE SKY AT DAWN**

[Morning mid-twilight sky map for November 2021](#)

[Morning mid-twilight sky map for December 2021](#)

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