FOUR SUPERMOONS' ~ IN A BLUE MOON

I) Monday, July 3, 2023

II) Wednesday, August 2, 2023

III) Thursday, August 31, 2023 (Blue Moon)

IV) Friday, September 29, 2023

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SUPER-MOONS – BLUE MOON

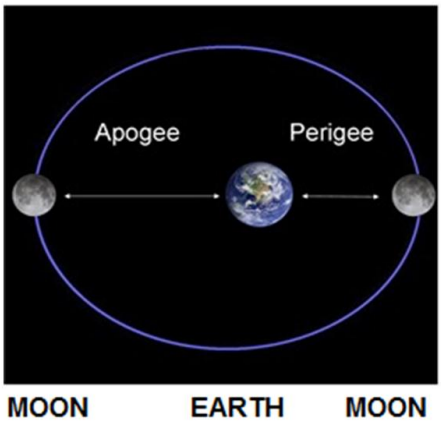
The year 2023 will be experienced with four consecutive Super-Moons of Full-Moon Phases during the month of July / August and September while FULL-MOON on August 31 will be recognized as BLUE-MOON ~ SUPPER-MOON

A phrase commonly known "Once in a Blue moon" is meant for a rare event, but what does it mean in astronomical terms? Can the moon turn blue ? Colour of Moon has anything to do with "BLUE MOON" !

Moon revolves around Earth in an elliptical path as such distance between Moon and Earth – center to center – varies accordingly orbital configuration in space. Reference to Moon-Earth relationship, the Moon is at Perigee the closest approach to Earth in orbit varies from 3,56,355 km to 3,70,399 km while at Apogee the farthest distance from Earth in orbit also varies from 4,04,042 km to 4,06,725 km in orbit respectively.

A Super-Moon is a Full Moon or New Moon phases respectively that occurs at closest distance between Moon and Earth known as the **Perigee** position in orbit around the Earth. A Full Moon phase occurring near approach to perigee produces the maximum large apparent diameter of lunar disc as viewed from Earth. However Supper-Moon New Moon does not show itself during the daytime except during total Solar Eclipse. In astronomy the super-moons during the full-moon or New-moon phases are called **perigean moon** respectively.

Diagram shows the orbit of Moon around the Earth.



A Super-Moon of full moon phase exceeds the disc size and brightness of an average-sized full-moon by some 14%. Lunar-Disc exceeds the disc size and brightness of a **micro-moon** the smallest apparent lunar disc at farthest distance from Earth in orbit called **Apogee** by 30%. Experience observer can notice the size of super-moon at full-moon phase and the brightness.

Diagram below shows the conception of comparative size of lunar-disc, the visuals are **not to scale**

First Super-moon is on Monday the July 3, 2023, the Full Moon Phase will be completed at 17h 09m can be identified against star background in **Sagittarius** Constellation (Dhanus Rasi) and refer to star δ-**Sagittarii** (Purbasadha) and approaching perigee position on July 5, 2023 at 3h 56m .

Next Super-Moon is on Wednesday the August 2, 2023 when the Full Moon Phase will be ended just after mid-night at 00h 02m against star background in **Capricornus** Constellation (Makara Rasi) recognized star α-**Aquilae** (Altair / Sravana) moving towards perigee in the morning on the same day at 11h 22m .

Moon will cross **Perigee** on August 30, 2023 at 21h 25m consequently about 9hr 41m after third Super-Moon will be on Thursday the August 31, 2023, when full moon phase will be completed at 07h 06m against star background in **Aquarius** Constellation refer to star λ-Aquarii (Satabhisaj) being the closest Super-Moon Blue Moon for 2023. This full-moon will turn to maximum apparent diameter of lunar-disc. Normally on an average Lunar Disc will appear about 30% brighter and 14% larger in size than that of normal Full-Moon day. Moreover second full-moon in a calendar month of Gregorian year is termed as **BLUE-MOON**. As such this time it is Super-Moon Blue-Moon

Moon will cross perigee hours on September 28, 2023 in morning at 6h 29m and finally **Last Super-moon** of lunar disc of Full-Moon-Phase is on September 29, 2023, ending at 15h 27m will be viewed against star background in **Pisces** Constellation (Mina) noted star as γ-**Pegasi** (Algenib / Uttara Bhadrapada).

Technical name of a Super Moon used by astronomers is - a perigee-syzygy of the Earth–Moon–Sun system.
It may be mentioned here that term Super-moon is not astronomical, but originates from astrology by an astrologer (not an astronomer) named Richard Nolle who first used the word 'Super-Moon' and defined both a Full Moon and New Moon phases as a Super when the Moon is within 90% of its perigee with that of Earth in orbit. However, it is known that, a New Moon remains in the sky during daytime which rises in the morning sky before sunrise , and sets at around evening after sunset. Similarly **t**he 'New-Moon' Super-moon sometimes coincides with a Solar Eclipse. Of course if there occurs a Solar Eclipse, the black lunar-disc is seen obstructing the solar-disc completely known as Total Solar Eclipse else during Annular Solar Eclipse the lunar Disc seen over solar disc but unable to obscure whole of solar disc forms a ring of fire. Sometimes the lunar-disc covered partially the solar-disc is called Partial Solar Eclipse. If the moon remains near Apogee position in orbit when lunar-disc unable to musk the solar-disc completely, the phenomena is Annular Solar Eclipse. The New Moon does not show itself during the daytime.

NOMENCLATURE OF FOUR SUPER-MOONS

FULL MOON of July, August and September during 2023 are Supper-Moons owing to relative closeness of Moon to Earth in orbit.

August 31, 2023 Supper-Moon is termed as BLUE-MOON - SUPPER-MOON

Date	Time (h:m)	*MOON	Distance (km)	Apparent Size
July 3, 2023	17:09	FULL MOON	361 934	33' 00".3
July 5, 2023	03:56	Perigee	360 149	33' 10".1
August 2, 2023	00:02	FULL MOON	357 528	33' 24".7
August 2, 2023	11:22	Perigee	357 310	33' 25".9
August 30, 2023	21:25	Perigee	357 181	33' 26".6
August 31, 2023	07:06	*FULL MOON	357 341	33' 24".1
* FULL-MOON : SUPPER-MOON : BLUE-MOON				
September 28, 2023	06:29	Perigee	359 911	33' 11".4
September 29, 2023	15:27	FULL MOON	361 552	33' 02".4

*** Ending moment of full-moon phase | Timings are expressed in Indian Standard Time (IST)**

On a full moon day the Moon rises before sunset and sets next day after sunrise and illuminated lunar disc is visible throughout the night.

Full Moon occurs at Opposition –Moon remains opposite to Sun while Earth is in between according to orbital configuration in space as such lunar disc is directly illuminated by the sunrays as viewed by an observer on Earth. While orbiting around Earth, the Moon is positioned between Sun and Earth is the Conjunction as such lunar disc not visible from Earth is New-Moon phase.

As the cycle of phases of moon lasts approximately one month, typically experience 12 full moons in a year. Many cultures have given distinct names to each month's full moon. 12 months, 12 full moons, 12 names are mentioned in western culture.

Phases of Moon take 29.5 days to complete which means it takes just 354 days to complete 12 lunar cycles. So every 2.5 years or so a 13th full moon is observed within a calendar year.

This 13th full moon doesn't conform to the normal naming scheme and is referred to as Blue Moon.

Blue Moons occur once every two to three years. There are roughly 29.5 days between full moon to full moon, as such month of February will never experience a Blue Moon as it only has 28 days in a common year and 29 in a leap year. Sometimes February does not have a Full Moon at all, this is known as a Black Moon, according to Time and Date.

According to NASA in 1883 an Indonesian volcano called Krakatoa erupted and spread ash as high as 50 miles (80 kilometers) into the atmosphere. The tiny ash particles — about one micron in size — acted as a filter, scattering red light and turning the moon a distinct blue-green hue.

Volcanic eruptions have also been known to cause blue moons including the 1983 eruption of El Chichon volcano in Mexico and the eruptions of Mt. St. Helens in 1980 and Mount Pinatubo in 1991.

Only under certain atmospheric conditions, in the aftermath of the massive 1884 volcanic eruption of Krakatoa, a tremendous cloud of ash and dust was injected into the stratosphere (5 to 30 miles above the Earth's surface); this aerosol cloud caused both the moon and sun appear blue from many locations in the Northern Hemisphere for many months after the explosion.

On September 24th, 1950, a 200-mile-wide swath of smoke from a series of smoldering fires in the forests of Northern Alberta in Canada cast an awesome pall over the Great Lakes, parts of New York State and Southern New England. The smoke produced an unusual midday darkness and caused the disk of the sun to shine in eerie hues of pink, blue and even purple!

How often is a Blue Moon?

To see the moon actually turn blue, requires either a massive volcanic eruption or a giant pall of airborne smoke (such as in 1950). But such events are few and far between . . . perhaps occurring only about half a dozen times per century. Cylindrical blue moons are much more frequent, occurring on average about every 2.5 to nearly 3 years

SUPPER-MOON BLUE-MOON ON AUGUST 31, 2023

Approximate hours of Rise-Set of Sun-Moon-Planets

Object	Visibility	Constellation (Rasi)
Sun	Only Day time Celestial Object, Nearest Star	Leo (Simha)
Moon	**Evening to Next Day Moring Visible throughout Night**	**Aquarius (Kumbha)**
Mercury	Evening After sunset low over Western Horizon	Leo (Simha)
Venus	Moring before sunrise till beginning of Morning twilight	Cancer (Karkata)
Mars	Evening after sunset	Virgo (Kanya)
Jupiter	Rises about 2hrs before mid-night till beginning of morning twilight	Aries (Mesha)
Saturn	Evening after sunset visible next day till beginning of morning twilight	Aquarius (Kumbha)
Uranus	Rises about 2hrs before mid-night visible till beginning of morning twilight	Aries (Mesha)
Neptune	Rises about 1hr before sunset visible till beginning of morning twilight	Pisces (Mina)

Around each new-moon and full-moon when the Sun-Earth and Moon are located more or less on a line in space when the range between high and low tides is greatest are known as Spring Tides. A Super-Moon of new-moon or full-moon at its closest to Earth – accentuates these tides. A new-moon or full-moon coincides with the closest position of Moon in orbit around Earth the perigee is **perigean spring tides**. There is usually only a small difference of few centimeters between perigean spring tides and normal tides but too extent depending upon coastline configuration.

The tides are caused by gravitational forces of the Sun and the Moon on the ocean of Earth. When the Moon is closer to the Earth in orbit during super-moon, the gravitational pull is slightly stronger consequently the tides are bigger. However the effect is negligible only couple of centimeter difference with normal full-moon and super-moon tide.

Full-Moon and New-Moon tides can be bigger than tides at other times in the lunar month, as the Sun is adding own gravitational pull producing which is called spring-tides.

The effect that the Sun and the Moon have on the oceans of the Earth are greatest when there is either a Full Moon or New Moon. The tidal force of Earth's oceans by a Super-moon at perigee has a slightly stronger effect than a normal Full Moon or New Moon, but the gravitational force is relatively weak and compared to a normal Full Moon or New Moon, may cause tides to rise by an extra inch or two, (2cm or slightly more).

Actual distance of Moon at perigee or apogee varies due to gravitational perturbation. Very closest Full-Moon within few hours of perigee recurs with 14 synodic month :

Synodic Month is the length of lunar month from new-moon/full-moon to new-moon/full-moon = 29.5305888days.
Anomalistic Month measures the return of moon from perigee to perigee = 27.5545501 days

Amazingly 14 returns to full moon almost exactly equal 15 returns to perigee, a period of about 413 days (approximately 1 year 1 month and 18 days).

14 Synodic Month (new moon to new moon)= 14 x 29.5305888 = 413.4282432 days
15 Anomalistic Month (perigee to perigee) = 15 x 27.5545501 = 413.3182515 days
Closest Full Moon of Century will occur on December 06, 2052 at a distance of 3,56,429 km.

Enjoy the grand and glorious **Full** M**oon Super**-M**oon Blue-Moon on Wednesday, August 31, 2023 as this brilliant celestial floodlight beams from dusk till dawn!**

Moon light is hazardous for night sky observation