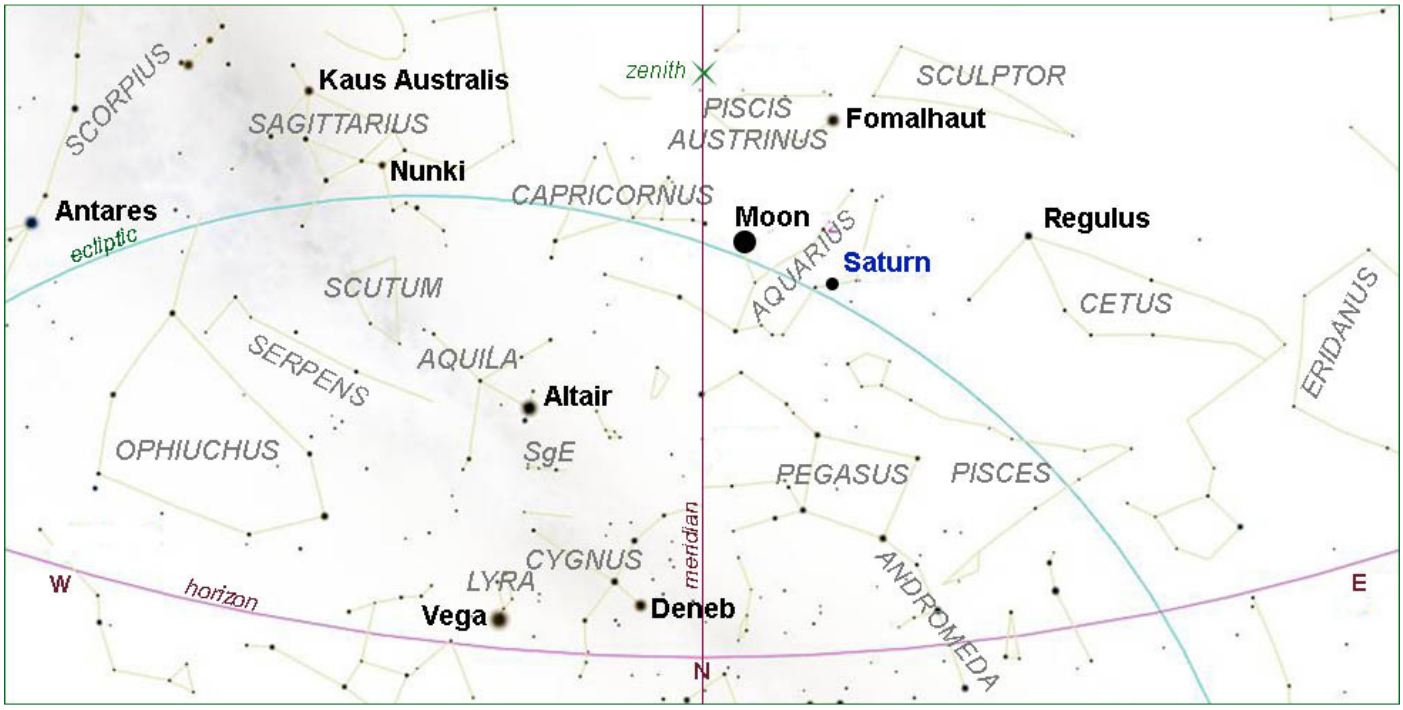
SKYNOTES from Hermanus

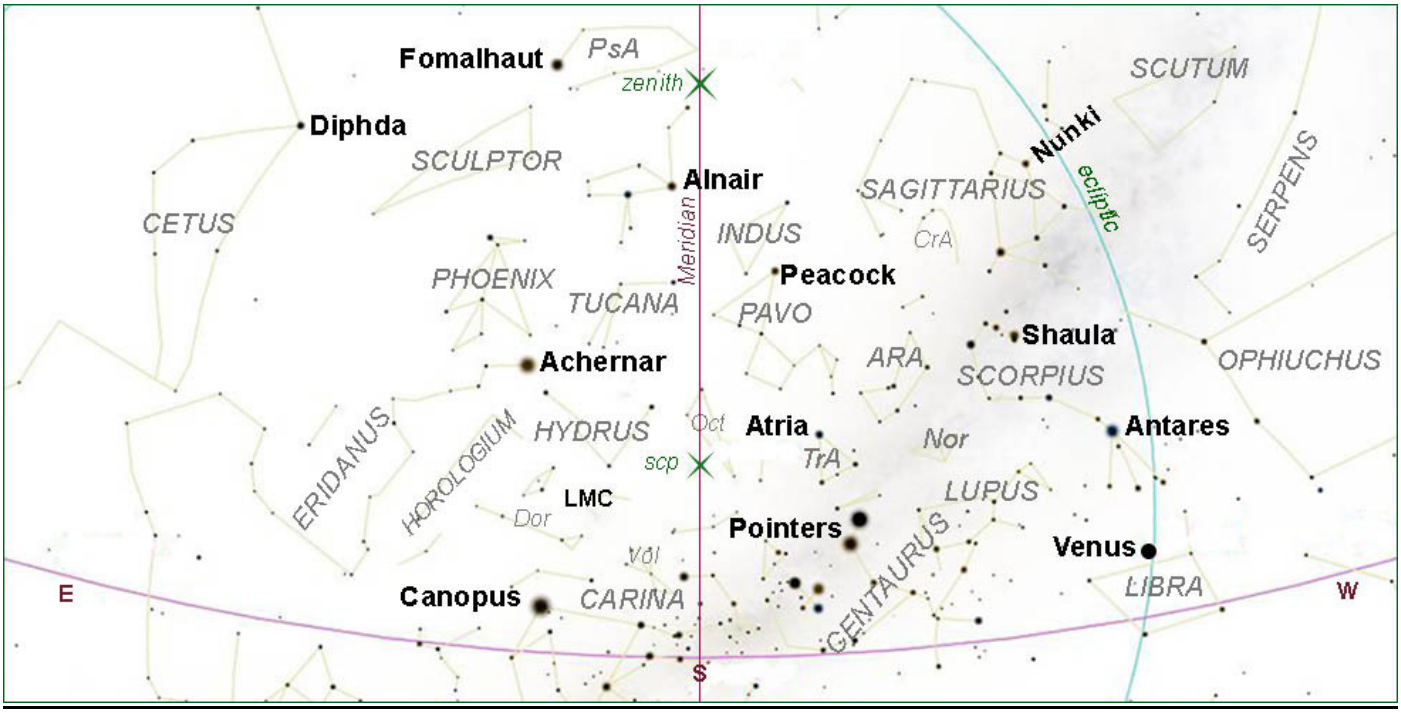
OCTOBER 2024

SKY CHARTS

EVENING SKY OCTOBER 13th at 21h00 (NORTH DOWN)



EVENING SKY OCTOBER 13th 21h00 (SOUTH DOWN)



SUGGESTED EVENING OBSERVATION WINDOWS
(Lunar observations notwithstanding)

Date	*Moon*		*Dusk end*
September 22	*Rises*	**22h56 (71%)**	**20h04**
to **October 4**	*Sets*	**20h30 (4%)**	**20h15**
October 21	*Rises*	**22h59 (80%)**	**20h32**
to **November 3**	*Sets*	**22h14 (5%)**	**20h48**

THE SOLAR SYSTEM

PLEASE NOTE: all events are as predicted for **HERMANUS**, Western Cape, South Africa.

OCTOBER HIGHLIGHTS from THE SKY GUIDE 2024

Date	*Time (SAST)*	*Item*
2	20h49	**New Moon**
	21h40	**Moon** at apogee (406 517 km)
	13h52	**Moon** at descending node
5 - 6		**Moon** near **Venus** at noon
7	22h49	**Moon** (21%) occults **Antares,** dark limb event
9	13h53	**Moon** southernmost (-28.7º)
		Jupiter stationary
10		**First quarter Moon**, near **τ Sgr**
12		**Pluto** stationary
14		**Moon** occults **Saturn** (in daylight)
		Mars at western quadrature
16	09h05	**Moon** at ascending node
17	13h26	**Full Moon** at perigee (357 173 km), Supermoon
18	21h00	**Mars** passes 5.8º south of **Pollux**
22	02h50	**Moon** northernmost +28.7º)
23		**Moon** near **Mars** and **Pollux**
24	10h03	**Last quarter Moon**
26		**Moon** passes 3º north of **Regulus**
	22h09	**Venus** sets followed 5 minutes later by **Antares**
29	19h44	**Moon** at descending node
30	00h50	**Moon** at apogee (406 164 km)

SOLAR SYSTEM VISIBILITY

2024 OCTOBER 13th				*When visible?*
Sun Length of day	Virgo 12 hours 52 minutes	Rise: Transit: Set:	06h03 12h29 18h56	**Never look at the sun without *SUITABLE EYE PROTECTION!***
Mercury Magnitude Phase Diameter	Virgo -4.0 97% 5”	Rise: Transit: Set:	06h28 13h03 19h38	Low in the west after sunset
Venus Magnitude Phase Diameter	Libra -4.0 82% 13”	Rise: Transit: Set:	07h41 14h42 21h43	Evening
Mars Magnitude Phase Diameter	Gemini +0.3 88% 8”	Rise: Transit: Set:	01h49 06h45 11h42	Morning
Jupiter Magnitude Diameter	Taurus -2.6 44”	Rise: Transit: Set:	23h36 04h37 09h33	Morning
Saturn Magnitude Diameter	Aquarius +0.7 19”	Rise: Transit: Set:	15h49 22h14 04h44	Throughout the night
Uranus Magnitude Diameter	Taurus +5.6 4”	Rises: Transit: Set:	21h41 02h52 07h59	Throughout the night
Neptune Magnitude Diameter	Pisces +7.8 2”	Rise: Transit: Set:	16h58 23h06 05h17	Throughout the night
Pluto Magnitude	Capricornus +14.4	Rise: Transit: Set:	12h11 19h22 02h37	Evening

Phase: In a telescope, the inner planets (Mercury, Venus and Mars) appear to us in phases depending on the angle of the Sun’s illumination, as does the Moon. The observed **angular diameter** is given in arc seconds.

Transit: When an object crosses the **local meridian,** it is said to ‘transit’. The local meridian is an imaginary line from the horizon directly north passing overhead through the *zenith* to the horizon directly south.

Magnitude: we are accustomed to hearing stars described in terms of ‘magnitude’. For example, the planet Jupiter at magnitude -1.8 is considerably brighter than the star Antares (in Scorpius) at +1.05. The scale is ‘inverse’; the brighter the object, the lower the value. A ‘good’ human eye on a clear night can see down to a magnitude of about +6.

THE MOON

MARE NECTARIS (Sea of Nectar)

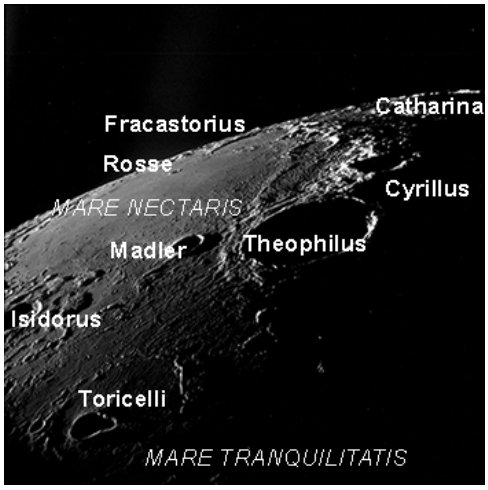
Location: Lunar south-east sector, south of Mare Tranquilitatis and south-east of Mare Fecunditatis

Type: Dark basaltic plain formed by volcanic eruptions.

Size: diameter 360 Km, area 84 000 km.

Age: about 3.8 billion years

Features: Several large craters are situated at the borders of Mare Nectaris. Montes Pyrenaeus borders the mare to the east and Sinus Asperitatis fuses to its north-western edge. The largest crater is lava-filled **Fracastorius** (dia. 124 km) which fuses with the southern "coast". Located near the north-western "coast" is a prominent trio of 100-km craters **Theophilus**, **Cyrillus** and **Catharina**. Another notable feature is a "ghost crater" Daguerre, almost entirely covered with lava, in the northern part of the mare. Nectaris also contains prominent crater **Rosse**, named after William Parsons, 3rd earl of Rosse.



Mare Nectaris from Apollo 11 facing southeast

Named by: Italian astronomer Giovanni Riccioli (1651).

Formation: Mare Nectaris is located in the central part of an 860 km diameter impact basin which was formed 3.8–3.9 billions year ago. This event marks the beginning of the Nectarian period of the lunar geologic timescale. Lava filling of Mare Nectaris is younger than the basin itself. The mare material is approximately 1000m in depth, and mainly of the Nectarian period and the Lower Imbrian epoch, with the mare material of the Upper Imbrian epoch.

Best seen: five days after New Moon (October 7) and four days after Full Moon (October 21).

No eclipses, lunar or solar, will be visible from southern Africa in October 2024

METEOR ACTIVITY

From SGSA 2024	*Maximum Date/Time*	*Moon on max Date/Time*	*Duration*	*Radiant*	*ZHR**	*Velocity Km/sec*
Orionids	October 21 00h00 - 04h00	80% Rises 22h59	Oct 2 – Nov 7	Between **Betelgeuse** and **Alhena** (γ Gem)	20	68

The shower is associated with the periodic comet 1P/Halley and is usually prominent with swift meteors, many appearing in persistent trains. The Orionid shower is considered to be one of the most beautiful showers of the year.

Given its low elevation and close proximity to the Moon, the prospect of observations of this shower seem bleak on October 21st. Better to try about a week later when moonrise is 03h49 and the radiant elevation is about twice as high at 28º above the north-eastern horizon.

* ZHR is an ideal value. It is by definition the number of meteors a single observer could possibly see during a shower's peak with the radiant directly overhead on a clear, dark night. Most observers, however, will not see as many meteors as the ZHR suggests. Also, the presence of a bright moon, atmospheric conditions and the shower's proximity to the horizon can seriously diminish the observation of meteor activity.

COMETS

From Tim Cooper

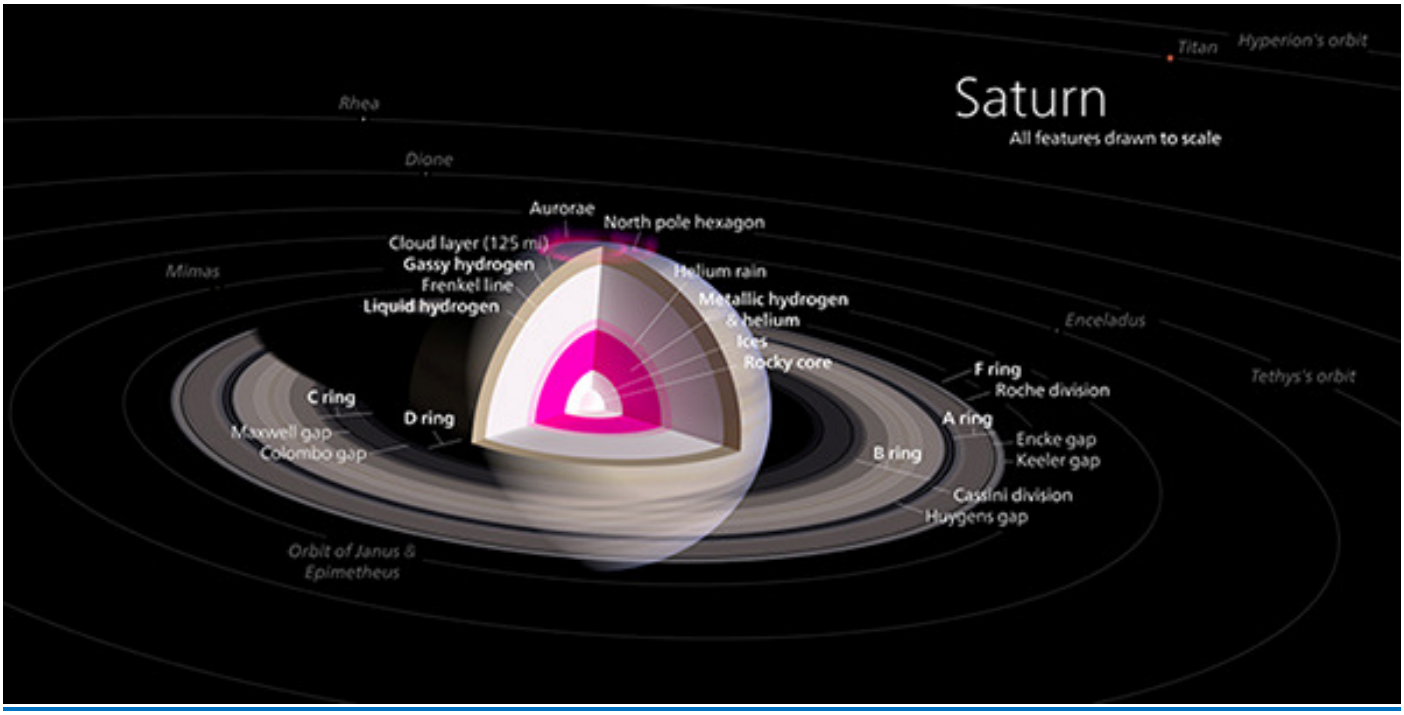
The latest observing circular CAMNotes 2024 No.4 is online, and contains details for observing comet **C/2023 A3** (Tsuchinshan-ATLAS), as well as a request for observations of the Phoenicid meteor shower, first observed in 1956 by S C Venter, and the subject of recent investigations.

Clear skies

Tim

https://assa.saao.ac.za/wp-content/uploads/sites/23/2024/09/ASSA-CAMnotes-2024-Number-4.pdf

LOOKING UP



By Kelvinsong - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=32219154

SATURN

Description	Gas giant planet
Equatorial diameter	119 300 km
Apparent size	0º0'19" *Rings* 0º0'44"
Current Earth distance	8.843 au, 1 322 857 000 km
Light time	1h 13min 32sec
Magnitude	+0.72
Alt/Az	+58º54'02" / +37º47'54"

Visibility on October 13th 2024

Rises	*Transits*	*Sets*
15h50	22h15	04h39

Naked Eye	Yes
Binoculars	Yes, with rings
Telescopes	Yes, with rings and some moons

DESCRIPTION

Saturn is the sixth planet from the Sun and the second largest, after Jupiter. Like Jupiter, Saturn is a "gas giant" planet, composed mainly of liquid and gaseous hydrogen, with no solid surface. But what makes Saturn unique and impressive is its spectacular system of rings.

For ages, Saturn represented the end of the known universe to skywatchers because it was the furthest and slowest-moving planet visible to the naked eye. Thus Saturn was given qualities of the "old man" or the ruler - both leader and measuring device - of any system with order or structure. Perhaps Saturn's extraordinary rings echo the planet's ancient association with social order, age and distant reach.

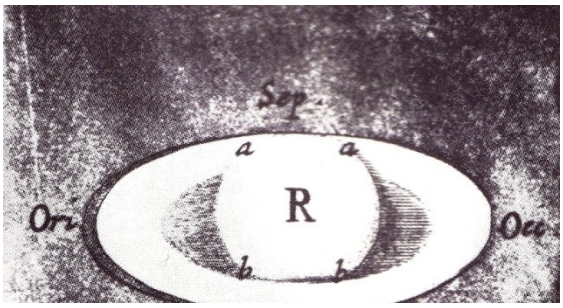
Named after the Roman god Saturn associated with the titan Cronus, father of Zeus and many Olympians, Saturday is the only day of the week to retain its Roman origin in English. In Latin it was *dies Saturn*, "day of Saturn". The Spanish and Portuguese *sabado*, the French *samedi* and the Italian *sabato* come from Latin *dies Sabbati*, "day of the Sabbath".

With an equatorial diameter of 119 300 km, Saturn is almost nine times as large as the Earth and rotates very quickly, its day only 10 hours and 39 minutes long.

DISCOVERY AND HISTORY

Pre-telescopic observation

Saturn has been known since prehistoric times and in early recorded history it was a major character in various mythologies. Babylonian astronomers systematically observed and recorded the movements of Saturn. In ancient Greek, the planet was known as Φαίνων Phainon, and in Roman times it was known as the "star of Saturn". In ancient Roman mythology, the planet Phainon was sacred to this agricultural god, from which the planet takes its modern name.



Robert Hooke noted the shadows (a and b) cast by both the globe and the rings on each other in this drawing of Saturn in 1666- Philosophical Transactions (Royal Society publication), Public Domain.

The Greek scientist Ptolemy based his calculations of Saturn's orbit on observations he made while it was in opposition. In Hindu astrology, there are nine astrological objects, known as Navagrahas. Saturn is known as "Shani" and judges everyone based on the good and bad deeds performed in life. Ancient Chinese and Japanese culture designated the planet Saturn as the "earth star". This was based on Five Elements which were traditionally used to classify natural elements.

The Ring System

The rings of Saturn were first seen by Galileo through his crude telescope, although he was unable to identify what they were. The first person to understand that Saturn was surrounded by a thin, flat ring was Christian Huygens, in 1665. Two centuries later, in 1859, James Clerk Maxwell proposed that the rings could not be solid but must instead be composed of numerous small particles, all independently orbiting Saturn. As telescopes improved, more rings became visible; these were named the "A ring", "B ring", etc. The list today includes rings C, D, E, F and G. Several dark divisions or "gaps" separate the bright rings; the largest of these are the Cassini and Encke divisions.

Since Maxwell's time, scientists have made huge leaps in understanding the rings. In 1980-81, Voyagers 1 and 2 revealed that the planet's stunning system is not a single smooth sheet but rather consists of thousands of individual ribbons. Beginning in mid-2004, NASA's Cassini orbiter found the rings to be even more beautiful - and stranger - than previously imagined.

Although Saturn's rings extend out to 120 000 km from Saturn's surface, they are less than 100 metres thick. So whenever the rings appear edge-on to us, as they do at the two equinoxes during Saturn's 29-1/2 year-long orbits, they seem to disappear. That's what Galileo saw in 1612, and at that time he wrote, "I do not know what to say in a case so surprising, so unlooked for and so novel."

VISIBILITY

Saturn presents one of the most stunning views that can be seen through a small telescope. Even experienced observers never tire of looking at this amazing object. Its rings are spectacular; even a small telescope will show them. Modest-sized telescopes (150 mm and larger) can show much detail in the ring system. There are prominent bright rings, separated by gaps or dark areas called divisions. The most famous and easily-observable is the Cassini Division, separating the system's two main components: the A and B rings. Inside the B ring is a thinly populated band, called the C ring, that is difficult to observe from Earth. Closer to Saturn still is the D ring, which is even more tenuous.

Saturn's average distance from the Sun is 9.5 times that of the Earth, taking 29.5 years to complete one orbit. Saturn's equator and ring system are inclined at about 27 degrees to its orbital plane, so our perspective angle of the rings changes over Saturn's orbital period. Every 14.7 years, as Earth crosses the ring plane, the rings are seen edge-on and all but disappear, becoming almost indiscernible by May 2025. So now is a good time to say goodbye to a unique spectacle.

Its rapid rotation makes Saturn appear visibly flattened at the poles. Like the Sun and the other gas giants, Saturn does not have a uniform rotation rate; it rotates faster at the equator than at the poles.

Peter Kogel's composite of the images he has taken over the years illustrates beautifully the changing angles displayed by the rings in Saturn's journey about the Sun

Observation and Exploration

Saturn's atmosphere has the same banded appearance as Jupiter's, but appears blander, with fewer of the complex ripples, spots and storms that are present on the larger gas giant. Saturn's cloud decks are organized into an alternating pattern of dark belts and bright zones. However, because it is much further from the Sun, the gas is much colder (95 K, at the cloud tops). So the layers are situated deeper down and appear muted due to lots of high-altitude haze above them.

Saturn's cloud features might not be obvious, but they are certainly dynamic! Every now and then, Saturn's atmosphere erupts with a huge, bright storm of convective energy, most recently in 2011. And while the planet lacks a single persistent cloud feature like Jupiter's Great Red Spot, about every 30 years it exhibits a "Great White Spot". First seen in 1876, these infrequent but brilliant ovals stand out distinctly against the planet's otherwise bland atmosphere. One appeared in 1990, so the next one might have been expected around 2020, but the 2011 Great White Spot caught scientists by surprise, showing that there's much to learn about how these storms occur. Spacecraft have also seen an unusual, hexagon-shaped cloud feature near the north pole that is probably a wave-generated phenomenon.

Like Jupiter, Saturn possesses a number of moons that can be seen with a small telescope. The largest and brightest of these is Titan which appears like an 8th-magnitude star moving around Saturn over the course of its 16-day orbital period. Dione, Rhea and Tethys are also visible, though fainter than Titan.

Saturn has been visited by a number of spacecraft: Pioneer 11 in 1979, Voyager 1 and 2 in 1980-81 and most recently the joint NASA-ESA Cassini mission. Cassini entered orbit around Saturn in 2004, successfully completing an eight-year mission to study the planet, its rings and its moons. Cassini's mission has now been extended to 2017.

Atmosphere and Composition

Like Jupiter, Saturn is a "gas giant" planet. The "surface" you see is actually the top of a thick cloud layer floating high in an atmosphere thousands of miles deep. It is composed mainly of hydrogen and helium in gaseous form at the cloud tops and as a compressed liquid or in "liquid metallic" form further down. Like Jupiter, Saturn is also believed to have an Earth-sized rocky core. Interestingly, the bulk density of Saturn is less dense than water: if you could find a bathtub large enough to hold it, Saturn would float.

As is the case on Jupiter, Saturn's outer atmosphere exhibits counter-flowing eastward and westward winds called *zonal jets*. By contrast, Earth has one westward air current at low latitudes (the trade winds) and one meandering eastward current at mid-latitudes (the jet streams) in each hemisphere. Saturn's broad, light-coloured equatorial zone races eastward at roughly 500 m per second - more than 10 times faster than Earth's jet streams.

Because it consists almost entirely of hydrogen and helium, Saturn has an interior structure vastly different from that of Earth or any "terrestrial" planet. Geochemists assume that Saturn has a relatively small core of rock and ice, but they can only surmise what the interior structure is like by noting how hydrogen, especially, behaves under increasing pressure and temperature.

Once the interior pressure exceeds 100 000 times that at Earth's surface (100 000 bars), hydrogen gas compresses into something resembling a hot liquid. Deeper down still, once this liquid hydrogen reaches a pressure of 1 million bars (1 megabar), its molecular and atomic bonds begin to break down. This yields liquid metallic hydrogen - that is, the hydrogen acts not at all like a gas but more like molten metal. Some theorists believe that deep inside Saturn, droplets of liquid helium are "raining out" and falling toward the core.

Liquid metallic hydrogen, like other metals, is an electrical conductor, and the planet's strong magnetic field (about 600 times stronger than Earth's) is apparently generated by electrical currents coursing through this material. Interestingly, Saturn's magnetic field is aligned almost exactly with its spin axis. Its field lines extend far beyond the planet itself and create a magnetic bubble, or magnetosphere, about 100 times the size of Earth's.

As with Jupiter, Saturn possesses both a powerful magnetic field and an internal heat source. The former emanates from the convective motion of electrical charges in the planet's liquid metallic hydrogen interior; the latter powers its turbulent atmospheric weather.

New research suggests that up to 1 000 tonnes of diamond are created in Saturn's atmosphere every year. Diamond rain on Saturn begins in the upper atmosphere. Lightning strikes methane, turning it into carbon soot. As the soot falls, pressure increases, and it turns into graphite, then diamond, which rains onto the planet's core.

The rings appear brilliant white, and with good reason: they are made up of countless billions of particles of almost pure water ice, ranging in size from grains of sand to house-sized boulders. Computer modeling suggests that these icy bits often form loosely bound clumps that quickly break apart due to *Keplerian shear*: the particles closer to Saturn move at slightly faster orbital speeds than those slightly farther out. It's not entirely clear what creates and maintains all the individual ringlets, though they are partly explained by orbital resonances with Saturn's moons and by density waves moving through the ring material - something like ripples that form when you toss a rock in a pond.

The Voyager spacecraft discovered that the rings are not uniform. Thousands of density variations - "ringlets" - exist within the lettered rings. Their intricate structure is the result of complex gravitational interactions and orbital resonances between the ring particles and a number of small moons orbiting within, and just outside, the ring system. Voyager discovered several small moons associated with the prominent gaps in the rings. Those moons act as "shepherds" whose gravity herds the ring particles back into the main body of the rings. The narrow outer F-ring, in particular, shows clumps and braids, generated by gravitational interactions with the nearby small moons Prometheus and Pandora.

One puzzling aspect of this system is the occasional and sudden appearance of ghostly dark streaks extending radially outward through the B ring. First photographed by Voyager 1 in 1980 (though reported by visual observers before that), these "spokes" consist of microscopically fine dust particles. Most proposed explanations either assume that elongated dust grains somehow become charged and aligned with the planet's magnetic or electric fields, or that microscopic grains gain an electrostatic charge strong enough to levitate them rapidly out of the ring plane. But there's still no consensus on how the spokes form.

Farther out is a series of tenuous bands whose origins are tied to specific satellites. The faint E ring, for example, arises because the moon Enceladus is constantly spewing jets of ice particles into space. More distant and even more tenuous is the Phoebe ring, discovered in 2009, that is populated by bits of dust blasted off the small moon Phoebe.

Origin of the Rings

No one knows when or how Saturn's rings formed. They may be very old, dating back to the formation of Saturn itself. Dynamicists now realize that the rings lie within what's termed the *Roche limit*, inside of which tidal stresses from the massive planet will tear apart any large solid object. Past attempts to explain Saturn's rings either assume that when the planet formed it was encircled by a close-in disc of matter that could not assemble into a single object, or that a large body wandered too close to Saturn early in solar-system history and was ripped apart by tidal forces.

But there are two problems with these ideas. First, it's hard to imagine primordial leftovers or a hapless moon with a pure-ice composition - instead, most likely there would have been roughly equal amounts of ice and rock. Second, over time the rings should have become increasingly contaminated with rock, metal, and carbon from meteoroid strikes. Calculations suggest the accumulated debris should account for roughly 10% of the rings' mass, but observations suggest that it's no more than about 1%.

The rings' origin must somehow be tied to that of Saturn's inner, medium-size moons, which (with the exception of Tethys) exhibit a wide range of densities and must contain varying amounts of rock. One recent suggestion is that a moon of roughly Titan's size - one that had segregated into a rocky core and icy exterior - started breaking up as it neared Saturn. As the moon's icy exterior was literally falling apart, the rocky core remained intact and eventually fell into Saturn.

A critical unknown is the total mass of Saturn's beautiful bands and, specifically, in the dense, opaque B ring. Right now there's no way to know for sure - it might be about 10^{20} kilograms (a couple of Mimas's worth), or it might be several times more.

Fortunately, the Cassini spacecraft might provide an answer. NASA wants to keep Cassini going until the planet reaches its northern summer solstice in May 2017. In its final 10 months of operation, Cassini will be directed to repeatedly dive through the clearing between the innermost D ring and Saturn's upper atmosphere only 2,000 miles (3,000 km) wide. Careful tracking of the spacecraft will not only reveal unprecedented details about Saturn's gravity field (and, from that, its internal structure), but also determine the rings' mass.

Moons of Saturn

All told, astronomers have discovered 62 moons around Saturn. Nine were known before the Voyager spacecraft flybys in 1980 and 1981. Another nine were discovered by those spacecraft, and some of those small, inner moons are responsible for the divisions and structure in the rings.

Earth-based observations, and the Cassini orbiter, have revealed numerous asteroid-sized moons. Most of these are quite tiny, no more than 20 miles (30 km) across, having been discovered over the past two decades by astronomers using powerful ground-based telescopes. However, the positions for eight of these small moonlets are known so poorly that they are now considered "lost."

As with Jupiter, many of the outer moons have retrograde and highly inclined orbits. As of 2012, Saturn has 53 named moons and another nine objects awaiting "official status" as moons. There will undoubtedly be more discoveries of these smaller, asteroid-sized objects to come.

Saturn's large moons have proven to be as diverse and interesting as Jupiter's. Titan, in particular, is the second-largest moon in the solar system (after Jupiter's Ganymede), and is the only one known to possess a thick atmosphere. But its surface can be glimpsed at infrared wavelengths or by radar, and a European-built probe called Huygens descended to Titan's surface in late 2004. It's apparently a place where water ice serves as rock and drops of liquid ethane rain down from the hazy sky - certainly one of the most exotic places in the solar system.

Please keep in touch...

Have a look at our excellent website, edited by Derek Duckitt.
https://www.hermanusastronomy.co.za/

Contact ASSA - Get in touch with officers of the Society - we're real people with a passion for astronomy, **so contact us and let's talk!**

With Grateful thanks to the following:

2024 Sky Guide Southern Africa
Peter Kogel
Kelvinsong
Royal Society
Sky Safari
Stellarium
Tim Cooper
Wikipedia

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