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## HOW THE CYCLONE NISARGA WAS NAMED

Relevant for: Geography | Topic: Important Geophysical Phenomenon - Tropical Cyclones

A week after cyclone 'Amphan' wreaked havoc in West Bengal, the country is now bracing to face another cyclone which is headed towards the coastline of Maharashtra and Gujarat. 'Nisarga', which is currently brewing in the Arabian Sea, means nature and was termed by India's neighbouring country -- Bangladesh. The name was accorded in a list formulated by a group of countries.

Bangladesh had also suggested 'Fani', which had made a landfall in Odisha on May 3, 2019. The extremely severe cyclone had caused extensive damage.

The naming of cyclones in the Indian Ocean began in 2000 and a formula was agreed in 2004. The next few cyclones will be named Gati (named by India), Nivar (Iran), Burevi (Maldives), Tauktae (Myanmar) and Yaas (Oman).

Tropical cyclones are named to help the scientific community and disaster managers to identify cyclones, create awareness and effectively disseminate warnings to wider audiences.

The World Meteorological Organisation and the UN Economic and Social Commission for Asia and the Pacific had, at its twenty-seventh Session held in 2000, agreed to assign names to the tropical cyclones in the Bay of Bengal and Arabian Sea.

Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka and Thailand were part of the panel. Later in 2018 Iran, Qatar, Saudi Arabia, the UAE and Yemen were added to the list.

Cyclones around the world are named by Regional Specialised Meteorological Centres and Tropical Cyclone Warning Centres. There are a total of six RSMCs and five TCWCs, including the India Meteorological Department.

The India Meteorological Department (IMD) has been mandated with the duty to name cyclones that develop over the North Indian ocean, including Arabian Sea and Bay of Bengal, by following a standard procedure.

As suggested by the 13 countries, IMD released a list of cyclone names in April, 2020. The names like Arnab, Nisarga, Aag, Vyom, Azar, Prabhanjan, Tej, Gati, Lulu among 160 other names were listed.

The new list included the last name from the previous list 'Amphan' as it remained unused at the time of release. After 'Amphan', ['Nisarga'](#) name was picked up for the ensuing cyclone.

According to the IMD, the names should be gender, politics, religion and culture neutral, not hurt sentiments, not be offensive, be short, easy to pronounce.

Meanwhile, a deep depression has formed over the Arabian Sea and is inching closer to the coastal districts of Maharashtra and Gujarat.

The deep depression is now slated to further turn into a cyclonic storm in 12 hours and then into a severe cyclonic storm in subsequent 12 hours.

It is likely to cross north Maharashtra and south Gujarat coasts between Harihareshwar town in

Maharashtra's Raigad district and Daman as a severe cyclonic storm on the afternoon of June 3.

*This story has been published from a wire agency feed without modifications to the text. Only the headline has been changed.*

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# TASK FORCE SET UP TO EXAMINE MATTERS PERTAINING TO AGE OF MOTHERHOOD, IMPERATIVES OF LOWERING MMR, IMPROVEMENT OF NUTRITIONAL LEVELS AND RELATED ISSUES

Relevant for: Geography | Topic: Indian Demography including Tribes

The Government of India in a gazette notification issued on 04<sup>th</sup> June 2020, has set up a Task Force to examine matters pertaining to age of motherhood, imperatives of lowering MMR, improvement of nutritional levels and related issues.

Union Finance Minister, during her Budget Speech for 2020-21 in the Parliament stated that “Women’s age of marriage was increased from fifteen years to eighteen years in 1978, by amending erstwhile Sharda Act of 1929. As India progresses further, opportunities open up for women to pursue higher education and careers. There are imperatives of lowering MMR as well as improvement of nutrition levels. Entire issue about age of a girl entering motherhood needs to be seen in this light. I propose to appoint a task force that will present its recommendations in six months’ time..” (Ref.: Para 67 of the Budget Speech for FY 2020-21).

The composition of the Task Force is as under:

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## SG /SB

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## MAHARASHTRA'S LONAR LAKE TURNS PINK OVERNIGHT, EXPERTS SURPRISED

Relevant for: Geography | Topic: Lakes, changes therein and in Flora & Fauna and the Effects of such changes

The colour of water in Maharashtra's Lonar lake, formed after a meteorite hit the Earth some 50,000 years ago, has changed to pink with experts attributing it to the salinity and presence of algae in the water body

**AURANGABAD** : The colour of water in Maharashtra's Lonar lake, formed after a meteorite hit the Earth some 50,000 years ago, has changed to pink with experts attributing it to the salinity and presence of algae in the water body.

Located around 500 km from Mumbai, the Lonar lake in Buldhana district is a popular tourist hub and also attracts scientists from all over the world.

Of late, the change in colour of water of the lake, having a mean diameter of 1.2 km, has not only surprised locals, but also nature enthusiasts and scientists.

Experts say this is not the first time that the colour change has happened, but this time it is more glaring.

The lake, which is a notified national geo-heritage monument, has saline water with pH of 10.5, Gajanan Kharat, member of the Lonar lake conservation and development committee, told PTI.

"There are algae in the water body. The salinity and algae can be responsible for this change," he said.

"There is no oxygen below one meter of the lake's water surface. There is an example of a lake in Iran, where water becomes reddish due to increase in salinity," he noted.

Kharat said the level of water in the Lonar lake is currently low as compared to the few past years and there is no rain to pour fresh water in it.

"The low level of water may lead to increased salinity and change in the behaviour of algae because of atmospheric changes...this may be the reason for colour change. This is not the first time that the colour of water has changed," he said.

Dr Madan Suryavanshi, head of the geography department of Aurangabad's Dr Babasaheb Ambedkar Marathwada University, said looking at the scale of this colour change, "this can't be a human intervention".

"In case of a natural phenomenon, there are fungi which generally give a greenish colour to water most of the times. This (the current colour change) seems to be a biological change in the Lonar crater," he said.

During the lockdown phase, there may not have been any disturbance to water which led to this change, he said.

"Season-wise changes occur in water and this might be case with the Lonar lake. We can examine the change if we go there in a week...then we can say more about the change," he

said.

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## PM LAUNCHES AUCTION PROCESS OF COAL BLOCKS FOR COMMERCIAL MINING

Relevant for: Geography | Topic: Distribution of key Natural Resources - Mineral & Oil Resources of India

Prime Minister Shri Narendra Modi launched the auction process of 41 coal blocks for commercial mining through video conference from here today. It was part of the series of announcements made by the Government of India, under the AatmaNirbhar Bharat Abhiyan. The Coal Ministry in association with FICCI launched the process for auction of these coal mines. A two stage electronic auction process is being adopted for allocation of the coal mines.

Speaking on the occasion, Shri Narendra Modi said that India will overcome the COVID -19 Pandemic and the nation will turn this crisis into an opportunity. He said that this crisis has taught India the lesson of becoming AatmaNirbhar, i.e. Self-Reliant. He said an AatmaNirbhar Bharat means reducing dependency on imports, and saving foreign currency on imports. It entails that India develop resources domestically so that the country does not have to rely on imports. It also means becoming the biggest exporters of the commodities that we now import.

To achieve this, the PM said that each sector, each product, each service, should be kept in mind and worked holistically, to make India self-reliant in the particular area. He said a major step taken today will make India self reliant in the Energy sector. He said that this event marks not only the implementation of reforms concerning one Coal Mining Sector but also marks the beginning of lakhs of employment opportunities for the youth. He said that today we are not only launching the auction of commercial coal mining today but also freeing the coal sector from decades of lockdown.

He stressed the irony that India, with the world's fourth largest coal reserve and being the second largest producer, is also the second largest coal importer. He said the situation has lasted for decades now and the coal sector was kept entangled in the mesh of Captive and Non Captive mines. He added that the sector was excluded from competition and transparency was a big problem. Owing to this, he said, the coal sector lacked investment and its efficiency was also questionable.

The Prime Minister said that in 2014, coal linkage was introduced to provide impetus to the coal sector. He said that India has taken a major decision to fully open the coal and mining sector for increased competition, capital, participation and technology. He added that care has been taken to ensure that the new players in the private mining sector do not face the problem of finance. He stressed that self-reliance is not possible without a strong mining and mineral sector as the two are important pillars of our economy.

The Prime Minister said that after these reforms, coal production and the entire coal sector will become self-reliant. Now the market has been opened for coal, so, any sector can buy coal as per their requirements. PM said, these reforms will not only benefit the coal sector but other sectors such as Steel, Aluminium, Fertilizers and Cement as well. It will also help in increasing the power generation.

PM said that reforms in the minerals sector have got strength from coal mining reforms since

minerals like iron, bauxite and other minerals are located very close to the coal reserves. He said that the beginning of auction today for commercial coal mining is a win-win situation for all stakeholders Industries. State governments will get more revenue and a huge population of the country will get employment. There will be a positive impact on every sector.

While implementing coal reforms, PM said that it has been ensured that India's commitment to protect the environment doesn't get weakened. He added, "Latest technology can be introduced to make gas from coal and the environment will be protected with steps like coal gasification. Coal gas will be used in transport and cooking while Urea and steel will promote manufacturing industries." The Prime Minister said that the Government has set a target to gasify around 100-million-ton coal by the year 2030 and four projects have been identified for this purpose and around 20 thousand crore rupees will be invested.

The Prime Minister said that these coal sector reforms will make eastern and central India, our tribal belt in, pillars of development. He added that These areas have a big number of Aspirational Districts and have not been able to reach the desired level of progress and prosperity. He said that 16 aspirational districts in the country have a huge stock of coal but people of these areas have not got adequate benefit of this. People from these places have to migrate to far-flung cities for employment.

The Prime Minister said that the steps taken towards commercial mining will be very helpful to eastern and central India by providing the local population with employment near their homes. He said that the Government has taken a decision to spend 50 thousand crore rupees on creating infrastructure for coal extraction and transportation, which will also create employment opportunities.

The Prime Minister said that reforms and investment in the coal sector will play a big role in easing the lives of tribals. Extra revenue generated through coal production will be used for public welfare schemes in the region. He said that states will also continue to get help from the District Mineral Fund, from which a major chunk would be utilized in development of essential facilities in the surrounding areas.

The Prime Minister said that this auction is taking place at a time when the economic activity is fast returning to normal. Consumption and demand are fast attaining the pre – Covid-19 levels. He listed the sectors where the demand was fast attaining pre-COVID 19 levels such as power consumption, demand for petroleum products, E way bills, Toll collection, Railway freight traffic, digital retail transactions.

He said that the rural economy has also started improving. He added that the crop area under Kharif cultivation and procurement of wheat has also increased this year. This means more money has gone into the pockets of farmers. All these indicators tell us that the Indian economy is ready to bounce back, and march forward.

The Prime Minister wished that India will come out of this crisis as it had come out of a much bigger crisis in the past. PM exuded confidence that India can become AatmaNirbhar and success and growth of India is certain. He also cited how few weeks ago how most of our demand for N-95 masks, Corona testing kits, PPE, and Ventilators were met by imports are now fulfilled through Make In India. He also expressed his confidence that very soon we will become an important exporter of medical products. He requested people to keep up their faith and morale so that we can make Aatmanirbhar Bharat.

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## STUDY SHOWING STARS OF VARIED AGES CAN CO-EXIST IN OPEN CLUSTERS, PROVIDES CLUE TO STELLAR EVOLUTION IN THE MILKY WAY GALAXY

Relevant for: Geography | Topic: The Earth and the Solar System

Stars in our Galaxy are formed from the molecular clouds present in the Galaxy. It is believed that the majority of stars in our Galaxy are formed in the star clusters making them important clues to understand the star formation mechanism. Open star clusters are a system of stars bound by gravity in which stars are born from the same molecular clouds. All the stars in a cluster follow the evolutionary sequence as per their initial masses at the time of formation of these stars. Open clusters are also important in probing formation and evolution of Milky Way Galaxy as they are distributed throughout the Galactic disk.

Astronomers at the Aryabhata Research Institute of Observational Sciences (ARIES), an autonomous science institute under the Department of Science and Technology (DST) Govt. of India, have found that stars of varied ages can co-exist in open clusters. This challenges earlier understanding that stars in an open cluster have the same age.

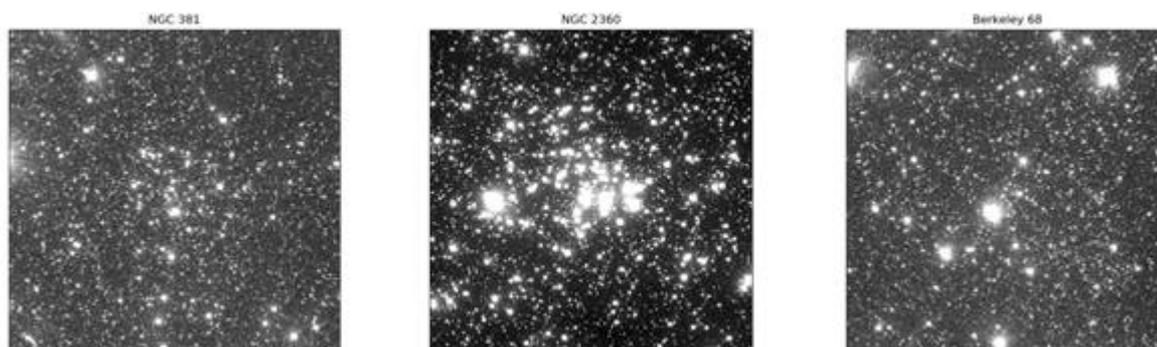
The scientists measured the light from three poorly studied open clusters NGC 381, NGC 2360, and Berkeley 68 observed using the 1.3-m telescope at Devasthal situated in the lap of the Himalaya for studying the evolution of stars in these clusters. They found two different stellar evolutionary sequences in the cluster NGC 2360, which has been observed in very few open clusters in the Milky Way Galaxy until now.

The astronomer Dr. Yogesh Joshi and his research student Jayanand Maurya observed thousands of stars in three open clusters NGC 381, NGC 2360, and Berkeley 68. The clusters are found to be relatively older, having ages between 446 Million years to 1778 million years.

Other than the stellar evolution, the researchers also studied the dynamical evolution of these clusters for the first time. The mass distributions of stars belonging to the clusters have shown the preferential distribution of massive stars in the inner part of the clusters while low mass stars are found towards outer region of the clusters.

It is believed that some of the very low mass stars have in fact, left their parent clusters and may be roaming as a free star like our own Sun. Their study lent important insight about the stellar and dynamical evolution of these clusters. These scientists are further aiming to do an in-depth analysis of many more open star clusters in near future using the observational facilities available at their institute along with the supplementary data provided by the space missions.

Their study has been recently published in 'Monthly Notices of the Royal Astronomical Society,' a leading journal in the field of astronomy and astrophysics published by the OXFORD University Press in UK.



*Figure: Picture of three open star clusters under study*

**(Publication: Monthly Notices of the Royal Astronomical Society, Volume 494, pp. 4713, April 2020.**

**For more details, Dr. Yogesh Chandra Joshi ([yogesh@aries.res.in](mailto:yogesh@aries.res.in)) can be contacted.)**

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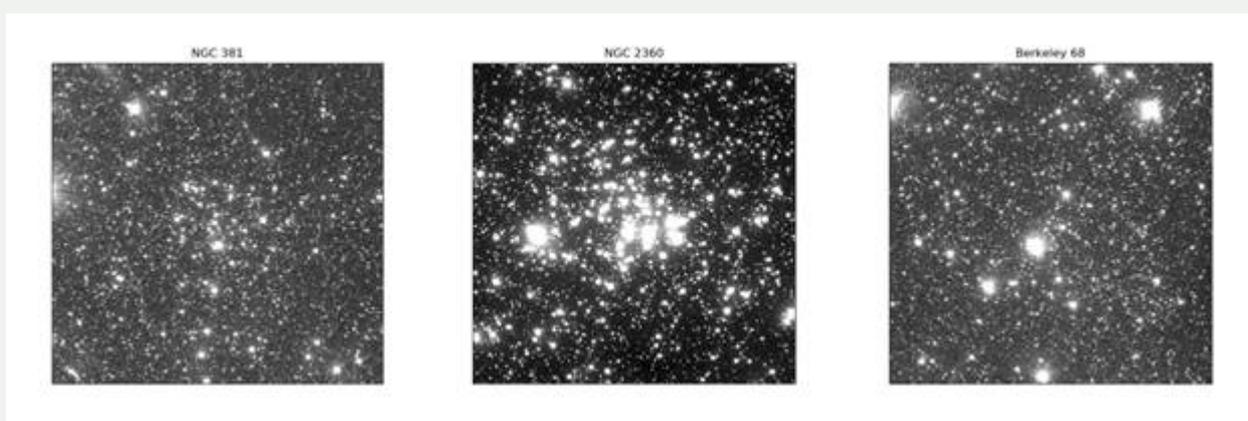
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## DETECTION OF FLUORINE IN HOT EXTREME HELIUM STARS SOLVES THEIR EVOLUTION MYSTERY

Relevant for: Geography | Topic: The Earth and the Solar System

An extreme helium star or EHe is a low-mass supergiant that is almost devoid of hydrogen, the most common chemical element of the universe. There are 21 of them detected so far in our galaxy. The origin and evolution of these Hydrogen deficient objects have been shrouded in mystery. Their severe chemical peculiarities challenge the theory of well-accepted stellar evolution as the observed chemical composition of these stars do not match with that predicted for low mass evolved stars.

A study by the Indian Institute of Astrophysics (IIA) an autonomous institute of Department of Science and Technology which detected the presence of singly ionised fluorine for the first time in the atmospheres of hot Extreme Helium Stars makes a strong case that the main formation of these objects involves a merger of a carbon-oxygen (CO) and a Helium (He) white dwarf.

The research published in the *Astrophysical Journal*, led by Anirban Bhowmick (Ph.D. student, IIA, Bengaluru), Prof. Gajendra Pandey (IIA) and Prof. David Lambert (University of Texas at Texas-Austin), which showed fluorine abundances determined from singly ionized fluorine (F II) lines suggest a very high enrichment of fluorine, about a factor of 100 to 10000 times higher than normal stars.

Clues to evolution of extreme helium stars require accurate determinations of their chemical composition, and the peculiarities, if any, become very important. Fluorine plays a very crucial role in this regard to determine the actual evolutionary sequence of these hydrogen deficient objects. Severe fluorine enrichment w.r.t normal stars (of the order of 800-8000) was observed in the cool EHeS along-with the cooler classical hydrogen deficient stars, the RCB variables (R Coronae Borealis Stars) hinting at close evolutionary connection between them. The scientists explored the relationship of hot EHeS (EHeS having effective temperature  $14000\text{K}$ ), with the cooler EHeS, based on their fluorine abundance and spotted it in the former, thus establishing an evolutionary connection across a wide range of effective temperature.

High-resolution echelle spectra of 10 hot EHeS were obtained from Hanle Echelle Spectrograph (HESP) mounted on the 2-m Himalayan Chandra Telescope at the Indian Astronomical Observatory (IAO) in Hanle, Ladakh, (remotely operated by IIA) including data from McDonald Observatory, USA, and ESO archives.

By comparing the observed fluorine abundances with other abundances of the key elements, the scientists could determine the formation channels responsible for fluorine enrichment. The varied range of observed fluorine abundance across stars having similar atmospheric parameters points out the difference in the individual star's evolution and the ensuing nucleosynthesis. Particularly, the enrichment of fluorine in the atmospheres of carbon-rich EHeS and absence of the same in carbon-

poor EHes suggest that uorine is profusely produced during the merger of a He-CO WD resulting in a carbon-rich EHe, whereas He-He WD merger that results in carbon-poor EHes does not account for uorine overabundance.

The detection of enhanced uorine abundances in the atmospheres of hot EHes solves a decade-old mystery about their formation. It rmlly places hot EHes in an evolutionary sequence with cool EHes and other hydrogen-deficient stars and zeros in on the evolutionary scenario, which involves the merger of two double degenerate white dwarfs (WDs).

(Publication details: *The Astrophysical Journal*, Volume 891, Issue 1, id.40  
<https://iopscience.iop.org/article/10.3847/1538-4357/ab6e6d>)

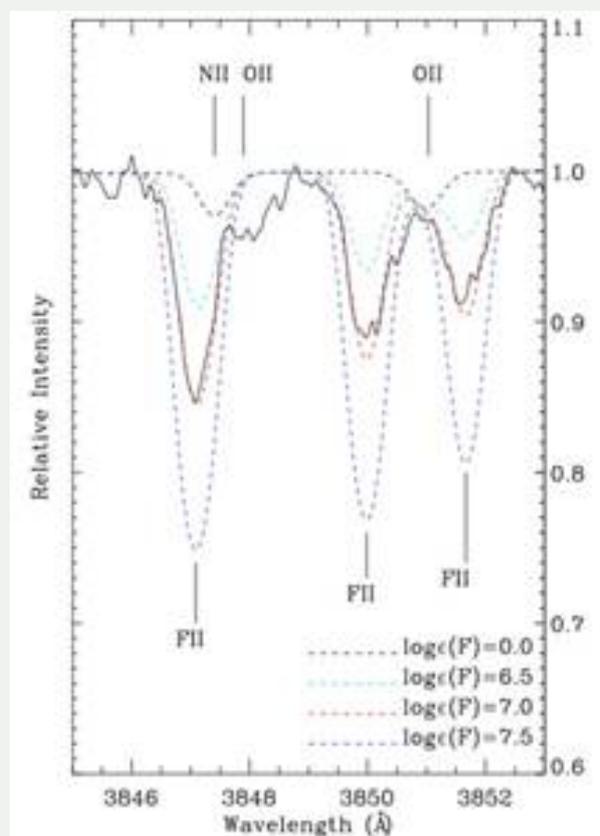


Figure 1: Observed F ii lines in 3850 Å window of the hot EHe V2205 Oph (solid line) with key lines marked. Synthetic spectra are shown for four fluorine abundances.

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NB/KGS/(DST)

An extreme helium star or EHe is a low-mass supergiant that is almost devoid of hydrogen, the most common chemical element of the universe. There are 21 of them

detected so far in our galaxy. The origin and evolution of these Hydrogen deficient objects have been shrouded in mystery. Their severe chemical peculiarities challenge the theory of well-accepted stellar evolution as the observed chemical composition of these stars do not match with that predicted for low mass evolved stars.

A study by the Indian Institute of Astrophysics (IIA) an autonomous institute of Department of Science and Technology which detected the presence of singly ionised fluorine for the first time in the atmospheres of hot Extreme Helium Stars makes a strong case that the main formation of these objects involves a merger of a carbon-oxygen (CO) and a Helium (He) white dwarf.

The research published in the *Astrophysical Journal*, led by Anirban Bhowmick (Ph.D. student, IIA, Bengaluru), Prof. Gajendra Pandey (IIA) and Prof. David Lambert (University of Texas at Texas-Austin), which showed fluorine abundances determined from singly ionized fluorine (F II) lines suggest a very high enrichment of fluorine, about a factor of 100 to 10000 times higher than normal stars.

Clues to evolution of extreme helium stars require accurate determinations of their chemical composition, and the peculiarities, if any, become very important. Fluorine plays a very crucial role in this regard to determine the actual evolutionary sequence of these hydrogen deficient objects. Severe fluorine enrichment w.r.t normal stars (of the order of 800 - 8000) was observed in the cool EHes along-with the cooler classical hydrogen deficient stars, the RCB variables (R Coronae Borealis Stars) hinting at close evolutionary connection between them. The scientists explored the relationship of hot EHes (EHes having effective temperature  $\sim 14000\text{K}$ ), with the cooler EHes, based on their fluorine abundance and spotted it in the former, thus establishing an evolutionary connection across a wide range of effective temperature.

High-resolution echelle spectra of 10 hot EHes were obtained from Hanle Echelle Spectrograph (HESP) mounted on the 2-m Himalayan Chandra Telescope at the Indian Astronomical Observatory (IAO) in Hanle, Ladakh, (remotely operated by IIA) including data from McDonald Observatory, USA, and ESO archives.

By comparing the observed fluorine abundances with other abundances of the key elements, the scientists could determine the formation channels responsible for fluorine enrichment. The varied range of observed fluorine abundance across stars having similar atmospheric parameters points out the difference in the individual star's evolution and the ensuing nucleosynthesis. Particularly, the enrichment of fluorine in the atmospheres of carbon-rich EHes and absence of the same in carbon-poor EHes suggest that fluorine is profusely produced during the merger of a He-CO WD resulting in a carbon-rich EHe, whereas He-He WD merger that results in carbon-poor EHes does not account for fluorine overabundance.

The detection of enhanced fluorine abundances in the atmospheres of hot EHes solves a decade-old mystery about their formation. It firmly places hot EHes in an evolutionary sequence with cool EHes and other hydrogen-deficient stars and zeros in on the evolutionary scenario, which involves the merger of two double degenerate white dwarfs (WDs).

(Publication details: *The Astrophysical Journal*, Volume 891, Issue 1, id.40  
<https://iopscience.iop.org/article/10.3847/1538-4357/ab6e6d>)

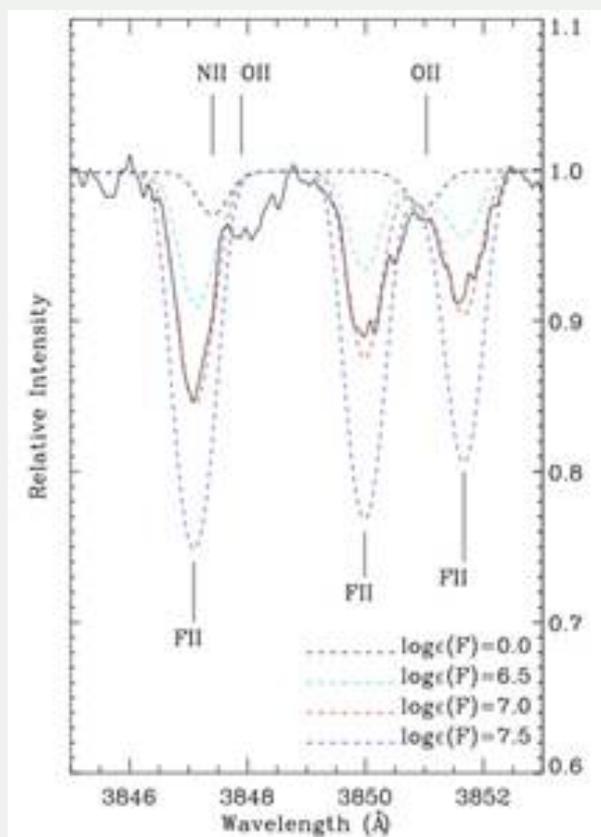


Figure 1: Observed F ii lines in 3850 Å window of the hot EHe V2205 Oph (solid line) with key lines marked. Synthetic spectra are shown for four fluorine abundances.

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## WHAT IS AN ANNULAR SOLAR ECLIPSE?

Relevant for: Geography | Topic: The Earth and the Solar System

An annular [solar eclipse occurred on June 21, 2020](#). This was the first solar eclipse of 2020. It was visible in parts of north India. The rest of the country, however, could observe a partial eclipse.

**Also read | [Online arrangements for viewing solar eclipse](#)**

A solar eclipse occurs when the moon moves between the Sun and the Earth. There are three types of solar eclipses – total, partial and annular. In an annular solar eclipse, the Moon covers the Sun from the centre. This leaves the outer rim of the Sun perceptible.

The phenomenon is popularly known as the 'ring of fire.'

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## STUDY OF OPTICAL PROPERTIES OF SUPER-MASSIVE BLACK-HOLE CAN PROVIDE CLUE TO EMISSION MECHANISM FROM ITS CLOSE VICINITY

Relevant for: Geography | Topic: The Earth and the Solar System

Through 153 nights, 17 scientists from 9 countries in Europe and Asia including researchers from Aryabhata Research Institute of Observational Sciences (ARIES), Nainital, an autonomous institution of the Department of Science and Technology (DST), Government of India took 2263 image frames and observed the changes in a very high energy gamma-ray emitting blazar '1ES 0806+524' using seven optical telescopes in Europe and Asia.

A blazar is a feeding super-massive black-hole (SMBH) in the heart of a distant galaxy that produces a high-energy jet viewed face-on from Earth. Blazars are one of the most luminous and energetic objects in the known universe with a jet composed of [ionized matter](#) traveling at nearly the [speed of light](#) directed very nearly towards an observer.

Dr. Ashwani Pandey, guided by Dr. Alok C. Gupta from ARIES in their study published in the *Astrophysical Journal*, has provided the most extensive observations of this blazar, thereby chalking out the detailed optical properties of the blazar. The team studied in great details 1ES 0806+524' flux, color, and spectral index variations within a day and long timescales of the blazar and explained the mechanism behind the variations.

They explained the large flares as the result of propagation of a shock in the relativistic jet that accelerates electrons to high energies followed by subsequent cooling. According to their study, the small amplitude changes can be understood to arise from small variations in the viewing angle, and hence in the Doppler factor, caused by either wiggling or helical jets or the motion of the most intense emitting region on a roughly helical trajectory within the jet. Variations on intra-day timescales can be explained by the turbulence expected in a relativistic plasma jet according to the study.

In this age of multi-wavelength (MW) time-domain astronomy in which the transient astronomical sources are of great interest due to their rapid change in flux and polarization. Simultaneous MW observation of a particular transient source on an extended period of time is important for understanding the emission mechanism in different electromagnetic (EM) bands. Blazars are among one of the most favourite astronomical transient objects because they emit radiation in the complete EM spectrum, and their flux and polarization are highly variable.



**(Publication details: Optical Variability of the TeV Blazar 1ES 0806+524 on Diverse Timescales Ashwani Pandey, Alok C. Gupta, et al., Astrophysical Journal, Volume 890, Article ID 72(11pp), the Year 2020**

**DOI:**

[10.3847/1538-4357/ab698e](https://doi.org/10.3847/1538-4357/ab698e)

**For more details, Dr. Alok Chandra Gupta (Scientist-F) (+91-7895966668, [alok@aries.res.in](mailto:alok@aries.res.in) ) can be contacted.)**

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# SCIENTISTS DETECT IONOSPHERIC IRREGULARITIES DURING MAJOR SPACE WEATHER EVENTS THAT INFLUENCE COMMUNICATION & NAVIGATION SYSTEMS

Relevant for: Geography | Topic: The Earth and the Solar System

The Earth's magnetic field lines are nearly horizontal over magnetic equator due to which equatorial ionosphere is a bed for a variety of plasma instabilities to cause plasma disturbances and plasma irregularities. These plasma irregularities pose severe problems to the communication and navigation systems and interfere with surveillance operations as well as disruption in detection and tracking of aircraft, missiles, and satellites.

A multi-instrument based ionospheric study of space weather storms over India by the Scientists from the Indian Institute of Geomagnetism (IIG) an autonomous institute under the Department of Science & Technology (DST) have found that the occurrence of equatorial spread  $F$  (ESF) irregularities and GPS scintillations are significantly affected by the geomagnetic storms depending upon the time of the onset of the geomagnetic storm. The Equatorial Spread- $F$  (ESF) caused due to the  $F$  region plasma irregularities is a complex phenomenon encompassing a wide range of scale sizes of irregularities in electron and ion densities as well as in electric fields. They also produce ionospheric scintillations in VHF and GPS receivers when radio wave traverses through the ionosphere.

They have also found that during geomagnetic storms, partial enhancement in pre reversal enhancement (PRE) (an eastward electric field enhancement before turning the westward near the sunset hours in the equatorial ionosphere) in the zonal eastward electric field occurs during post-sunset resulting in around 30% increase in spread  $F$  instead of total inhibition during equinox and winter seasons. The PRE is believed to be produced by  $F$  region dynamo, where it causes  $F$  region of the ionosphere to rise to very high altitude due to sudden increase of the eastward electric field. The study published in the Journal of Geophysical Research showed occurrence of ESF in summer is suppressed by around 75% due to a partial increase in PRE. The researchers observed pre-sunrise height enhancement mostly during winter, which caused ESF to occur at around 50%, followed by equinox and summer.

Understanding the thermosphere-ionosphere-magnetosphere interactions that control the electrodynamic behind dynamical evolution of ionospheric irregularities under disturbed periods like geomagnetic storms is most important in developing and maintaining communication and navigation systems.

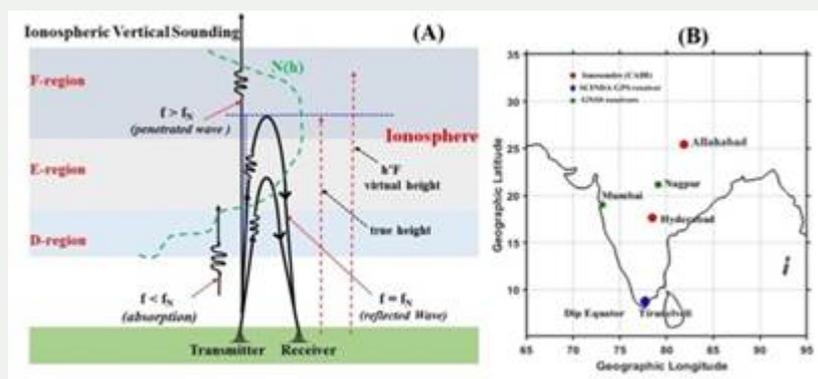
Accordingly, the electrodynamic under these major space weather events was studied using the chain of a ground-based special type of radar Doppler ionosondes along with GPS Receivers over India for the examination of the equatorial and low latitude ionosphere.

In this present study conducted by Dr. Ram Singh under the guidance of Dr. S. Sripathi from IIG, the coupling of high latitude electric fields, winds, and traveling ionospheric disturbances (TIDs) on the equatorial and low latitude ionosphere were investigated during three major space weather events that occurred on 17th March, 23 June, and 20 December 2015. These three magnetic storms were strong geomagnetic storms during the complete solar cycle-24 (cycle that the Sun's magnetic field goes through approximately every 11 years).

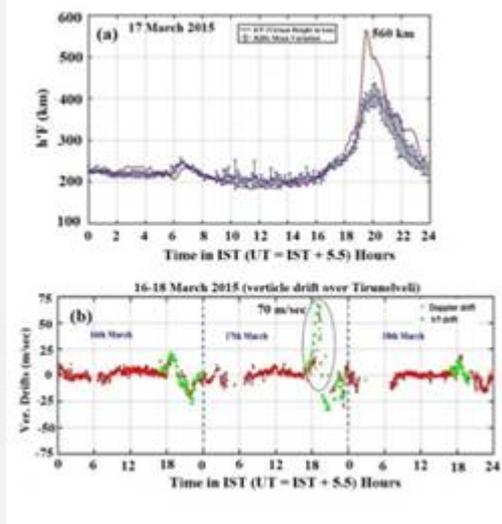
The scientists observed remarkable increase of virtual height of the ionosphere to as high as 560 km over magnetic equator with vertical drift of 70 m/sec due to strong eastward direct penetration electric field which caused intense Equatorial spread F (ESF) irregularities in ionosondes and L-band scintillations in the GPS receivers across Indian region on 17<sup>th</sup> March.

Nocturnal thermospheric meridional winds, as estimated through the study using two ionosondes during this storm night, suggested the equatorward surge of gravity waves in a period of 2 hrs. The suppression of anomaly crest over Indian longitude on the next day of the storm is linked to the westward disturbance dynamo electric fields and disturbance wind effects.

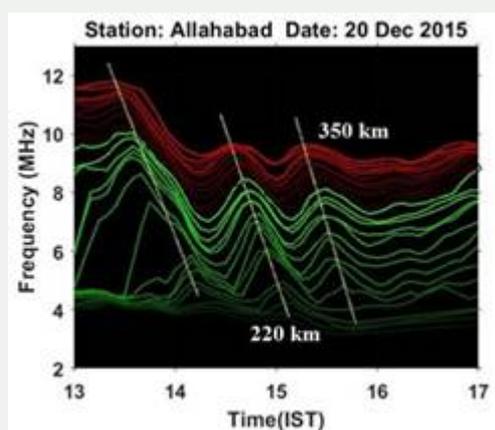
Besides, the scientists also found that enhanced winds during geomagnetic storms can either add or suppress the existing ion densities to produce either positive or negative storm that modify the electrodynamics of the ionosphere, thereby influencing navigation and communication that form a crucial part of our lives.



**Figure-1: (A) a sketch of the geometry of vertical ionospheric sounding,  $N(h)$  represent profile of the electron density variation with altitude,  $f$  is the transmitted frequency of the radio wave, and  $f_N$  is the ionospheric plasma frequency. (B) shows the location of ionosondes and GPS receivers superposed onto the India map.**



**Figure-2: Variations of ionospheric virtual height and vertical plasma drifts on 17<sup>th</sup> March 2015 geomagnetic storm (St. Patrick's day storm) over the Tirunelveli.**



**Figure-3: Temporal variation of ionospheric frequencies at different heights (isoheights) at every 5 km 220-350 km between height interval. Vertical lines show phase propagation of gravity wave fluctuations with ~48 min periodicity, downward phase propagation velocity ~46 m/s, vertical wavelength ~130 km, and horizontal wavelength ~452 km. (high-resolution CADI ionosonde data obtained from Allahabad station).**

**[Publications:**

**For further details, contact Ram Singh ([ramphysics4@gmail.com](mailto:ramphysics4@gmail.com), +91 7506226074), Prof. S. Sripathi ([ssripathi.iig@gmail.com](mailto:ssripathi.iig@gmail.com), +91 9757029898). ]**

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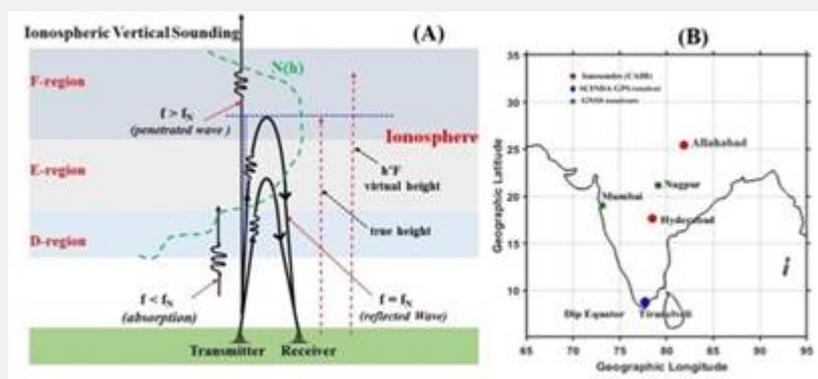
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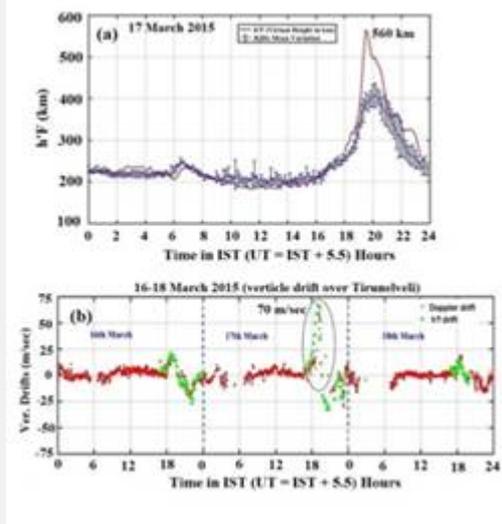
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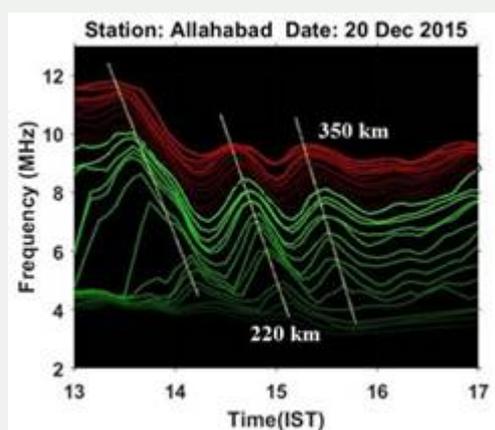
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## GRAVEL GEOMETRY OF THE INDUS RIVER UNRAVELS ITS PALEOCLIMATIC HISTORY

Relevant for: Geography | Topic: Rivers, changes therein and in Flora & Fauna and the Effects of such changes

Researchers from Wadia Institute of Himalayan Geology (WIHG), Dehradun, an autonomous institute under the Department of Science and Technology, Govt. of India, have traced the paleoclimatic history of the Indus River in Ladakh Himalaya with the help of geometric data from overlapping gravels of channel fills.

They studied the discharge during periods in which the river experienced an increase in land elevation, due to the deposition of sediment) and its incision.

River Terraces are ubiquitous in mountains that nourish and help sustain past, present, and future human societies. These terraces are part of valley-wide aggradations, which has been studied extensively in Himalaya to understand the processes driving such a periodic increase in river valley land elevation and incision. Scientists are still debating whether wetter climate intervals with increased rainfall and glacial melting promote river aggradation through increased discharge and enhanced sediment load, or instead, is it during drier conditions when aggradation occurs through increased sediment to water ratio.

The researchers studied the discharge during periods of established river aggradation and incision of the Indus River, Ladakh Himalaya over late Quaternary (the current and most recent of the three periods in the geologic time scale). They used geometric data from overlapping gravels of channel fills to calculate paleodischarges during net river aggradation at 47–23 ka (thousand years), and preserved slack water deposits (SWDs) at 14–10 ka to constrain paleodischarges that occurred during net river incision.

They observed that the aggradation in the Himalayan rivers occurred in glacial-interglacial transient warm climatic conditions (33–21ka and 17–14ka) when the sediment budget in the rivers increased just after the glacial events.

Their study published in the journal *Geomorphology* shows that aggradation took place in the Indus River when sediment to water ratio was higher during MIS-3 (Marine isotope stages (MIS), marine oxygen-isotope stages, are alternating warm and cool periods in the Earth's [paleoclimate](#), deduced from [oxygen isotope data](#) reflecting changes in temperature derived from data from deep-sea [core samples](#)) and incision initiated when sediment to water ratio reduced during post-glacial climatically wet phase (early Holocene).

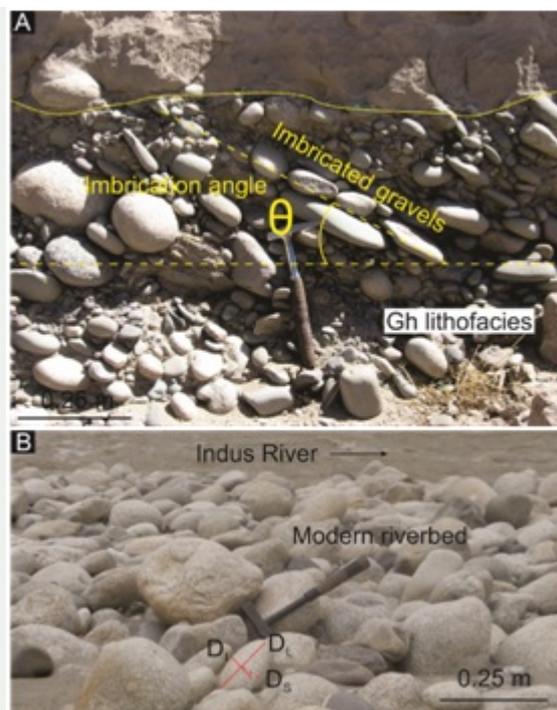


Figure 1 (A) Clast-supported gravels (Gh facies) showing imbrication angle ( $\theta$ ). (B) Photograph showing clast data: longest ( $D_L$ ), intermediate ( $D_I$ ) and shortest ( $D_S$ ) diameters, imbrication angle ( $\theta$ ), and litho-type.

**[Publication details :**

**Kumar, A., Srivastava, P., and Devrani, R. 2020. Using clast geometries to establish paleo river discharges: Testing records for aggradation and incision from the upper Indus River, Ladakh Himalaya. *Geomorphology*, v. 362, p.107202. <https://doi.org/10.1016/j.geomorph.2020.107202>]**

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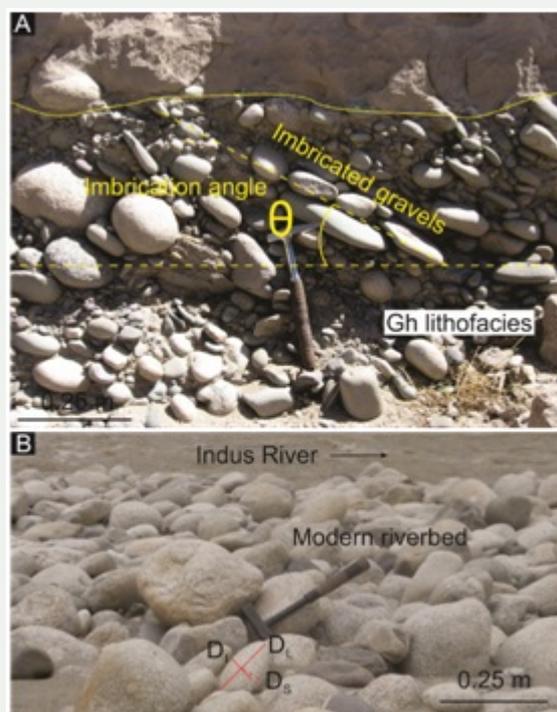


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# ROLE OF ANCIENT ALGAE IN BUILDING A HEALTHY GLOBAL MARINE ECOSYSTEM

Relevant for: Geography | Topic: Distribution of key natural resources - Ocean Resources in world & India

**By-Mohammad Faiyaz Anwar, Scientist at Vigyan Prasar Science Portal**

A study of a microscopic ancient marine algae (**Coccolithophores**) led by the *National Centre for Polar and Ocean Research* (NCPOR) has found that there is a decrease in the concentration of oceanic calcium carbonate ( $\text{CaCO}_3$ ) in the Southern Indian ocean. This decrease in  $\text{CaCO}_3$  is attributed to the increase in the concentration of another single-celled algae known as diatoms. This, in turn, will affect the growth and skeleton structure of coccolithophores, with potential significance for the world ocean ecosystem.

Coccolithophores are single-celled algae living in the upper layers of the world's oceans. They have been playing a key role in marine ecosystems and the global carbon cycle for millions of years. Coccolithophores calcify marine phytoplankton that produces up to 40% of open ocean calcium carbonate and responsible for 20% of the global net marine primary productivity.

Coccolithophores build exoskeletons from individual  $\text{CaCO}_3$  plates consisting of chalk and seashells building the tiny plates on their exterior. Though carbon dioxide is produced during the formation of these plates, coccolithophores help in removing it from the atmosphere and ocean by consuming it during photosynthesis. At equilibrium, coccolithophores absorb more carbon dioxide than they produce, which is beneficial for the ocean ecosystem.

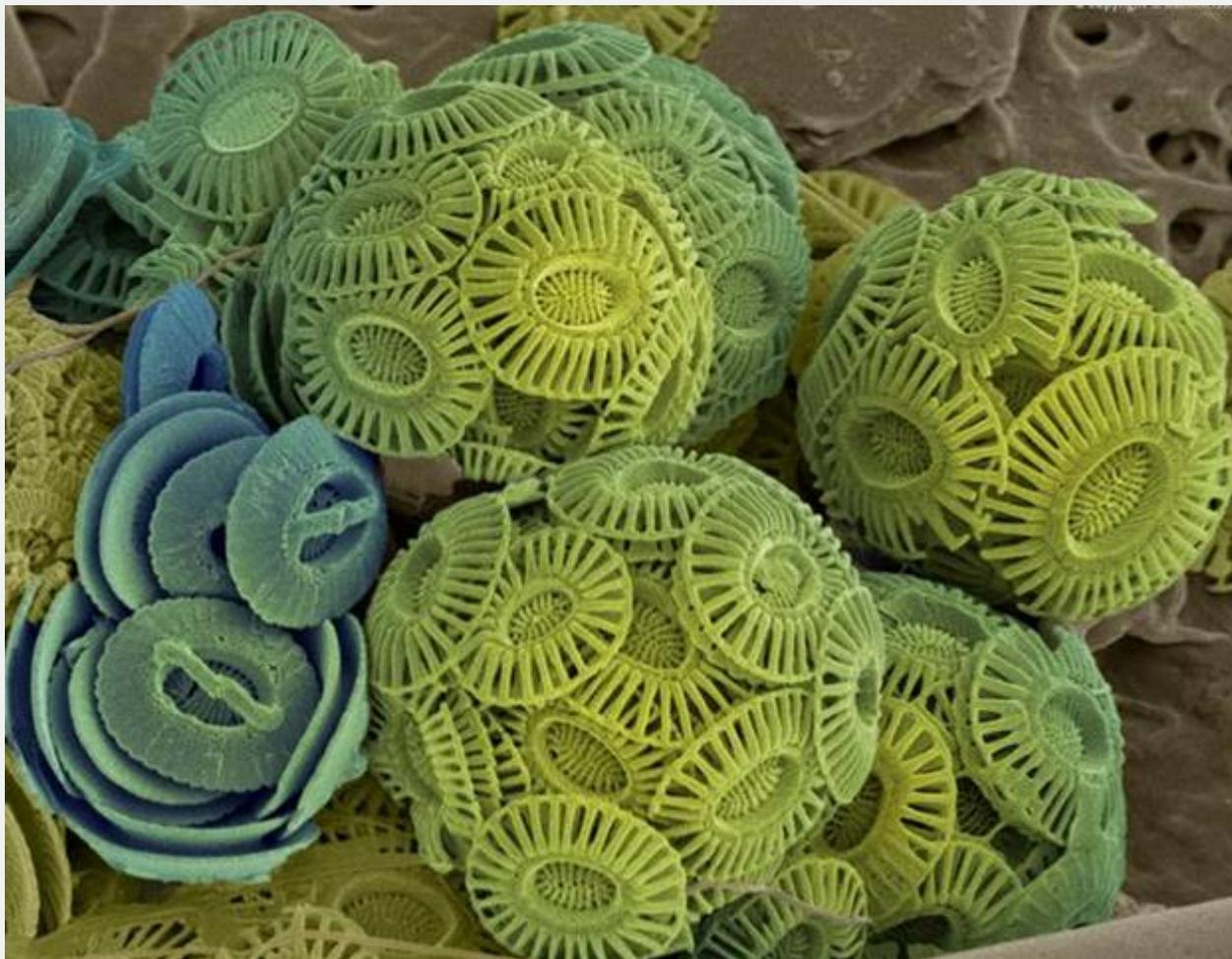
NCPOR, the National Institute of Oceanography (NIO), and the Goa University revealed that abundance and diversity enrichment of coccolithophores in the southern Indian Ocean is highly dependent on time and influenced by various environmental factors such as silicate concentrations, calcium carbonate concentration, diatom abundance, light intensity and availability of macro and possibly micronutrient concentrations.

The research team's analysis revealed that the reduction of coccolithophore diversity in the early summer and late summer periods is due to an increase in the presence of diatom algae, which occurs after sea ice breakdown with climate change and ocean acidification, and increases the silicate concentration in the waters of the Southern Ocean. The scientists also analyzed the maximum coccolithophore diversity during mid-summer in the Subtropical Zone (STZ) and Sub-Antarctic Zone (SAZ), which is controlled by elevated silicate, low temperature, and low salinity conditions.

Scientists found that the biogeographic boundaries of coccolithophores in the southern Indian Ocean are highly variable, controlled by environmental factors in early and mid-austral summer, and grazing pressure in late austral summer. Also, physical forcing may play an important role in the transport of coccoliths and coccospheres at high latitudes, indicating that the southward extension of coccolithophores is important and may occur for short periods during hot summer.

The results of the study point to climate change as a major reason for the altered coccolithophore calcification rate. Different environmental factors and the ability of the species to adapt to those environmental changes would ultimately determine the future coccolithophore calcite production. These investigations are important for future intervention to bring positive changes in the marine ecosystem and global carbon cycle.

Led by Shramik M. Patil, the research team comprised Sathish Rahul Mohan and Sahina Gazi, of NCPOR, Ministry of Earth Sciences, Goa, and Suhas S. Shetye of NIO, and Pallavi Choudhari of the Goa University. The research paper has been published in the *Journal of Deep-Sea Research Part II*.



*Transmission Electron Microscope (TEM) image of Coccolithophores*

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NB/KGS/(India Science Wire)

**By-Mohammad Faiyaz Anwar, Scientist at Vigyan Prasara Science Portal**

A study of a microscopic ancient marine algae (**Coccolithophores**) led by the *National Centre for Polar and Ocean Research* (NCPOR) has found that there is a decrease in the concentration of oceanic calcium carbonate ( $\text{CaCO}_3$ ) in the Southern Indian ocean. This decrease in  $\text{CaCO}_3$  is attributed to the increase in the concentration of another single-celled algae known as diatoms. This, in turn, will affect the growth and skeleton structure of coccolithophores, with potential significance for the world ocean ecosystem.

Coccolithophores are single-celled algae living in the upper layers of the world's oceans. They have been playing a key role in marine ecosystems and the global carbon cycle for millions of years. Coccolithophores calcify marine phytoplankton that produces up to 40% of open ocean calcium carbonate and responsible for 20% of the global net marine primary productivity.

Coccolithophores build exoskeletons from individual  $\text{CaCO}_3$  plates consisting of chalk and seashells building the tiny plates on their exterior. Though carbon dioxide is produced during the formation of these plates, coccolithophores help in removing it from the atmosphere and ocean by consuming it during photosynthesis. At equilibrium, coccolithophores absorb more carbon dioxide than they produce, which is beneficial for the ocean ecosystem.

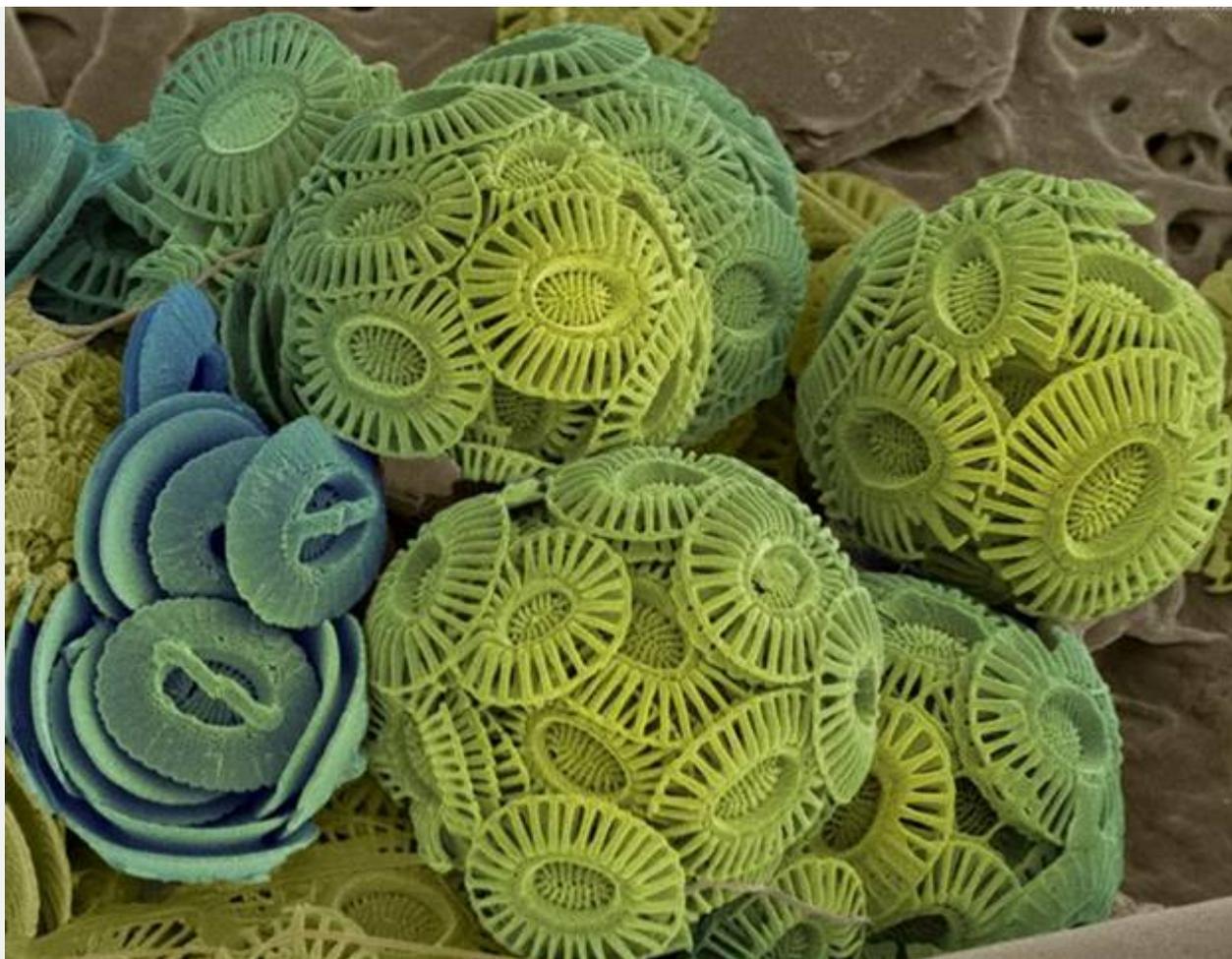
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*Transmission Electron Microscope (TEM) image of Coccolithophores*

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# BLACK HOLE MERGES WITH UNUSUAL COMPACT OBJECT

Relevant for: Geography | Topic: The Earth and the Solar System

Puzzling merger: The mass of the primary was about 23.2 solar mass and the secondary was about 2.6 solar mass. | Photo Credit: [Alex Andrix](#)

The LIGO Scientific and VIRGO Collaborations (LSC) have detected an unusual compact object whose mass falls in between that of a typical black hole and a neutron star. The absence of accompanying electromagnetic signatures such as flashes of light are compatible with both. This puzzling event was registered by the LIGO and VIRGO detectors on August 14, 2019. The work has been published in *The Astrophysical Journal Letters*.

Since the first ever detection of gravitational wave signals emerging from the coalescing of binary black holes in 2015, the LIGO and VIRGO detectors have detected mergers of pairs of black holes, pairs of neutron stars and black hole-neutron star duo. From this experience and from the predictions of theory, the present merger detected on August 14, 2019, only posed a puzzle.

Looking at the signal waveform, it appeared that the primary object in this merger had a mass of about 23.2 times that of the Sun and the smaller, secondary object had a mass of about 2.6 times the solar mass. The pair joined to form a large black hole of mass 25.6 times the Sun's mass, having radiated away 0.2 solar masses.

This is unusual on many counts. For one thing, the mass ratio was approximately 1:9. This is the largest disparity in masses that has been observed till now between members of the coalescing pair. While at 23.2 solar masses, the primary is clearly a black hole, the calculated mass of the secondary object puts it in a dubious spot. It is too light to be a black hole and too heavy to be a neutron star, as far as observations go.

"Theoretically, both the maximum mass of neutron star and minimum mass of a black hole will depend on the complex physics at the core of a neutron star, details of supernova explosion a star undergoes at the end of its stellar evolution and so on," says K. G. Arun from Chennai Mathematical Institute, one of the authors of the paper, in an email to *The Hindu*. "Further, the current observational uncertainties cannot confirm or rule out whether there is a 'mass gap' between the maximum mass of the neutron star and the minimum mass of a black hole."

There is not much information about the lighter object except for the mass. "Due to the mass asymmetry, it becomes very difficult to detect any signatures of neutron star 'tides' which could have given us insights about the star. So one may be able to invoke exotic possibilities," says Prof. Arun. "It is going to be a very active topic of discussion in the astrophysics community in the coming days," he adds.

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## WHEN THE INDIAN OCEAN'S ANCIENT CLIMATE PATTERNS RETURN

Relevant for: Geography | Topic: Indian Climate including Monsoons

Global warming: If current trends continue, the new Indian Ocean El Niño could emerge as early as 2050, the study says. | Photo Credit: [scanned in chennai](#)

About 19,000-21,000 years ago, ice-sheets covered North America and Eurasia, and sea-levels were much lower, with Adam's Bridge exposed so that the Indian subcontinent and Sri Lanka were contiguous. This period, the peak of ice age conditions, is called the Last Glacial Maximum. Researchers analysed simulations of this past climate and predicted that the ongoing climate change could reawaken an ancient climate pattern of the Indian Ocean.

They find that this could be similar to the El Niño phenomenon of the Pacific Ocean bringing more frequent and devastating floods and drought to several densely-populated countries around the Indian Ocean region. If current warming trends continue, this new Indian Ocean El Niño could emerge as early as 2050. The results were published in *Science Advances*.

By studying microscopic zooplankton called foraminifera, the team had published a paper in 2019 which first found evidence from the past of an Indian Ocean El Niño. Foraminifera build a calcium carbonate shell, and studying these can tell us about the properties of the water in which they lived. The team measured multiple individual shells of foraminifera from ocean sediment cores and was able to reconstruct the sea surface temperature conditions of the past.

"In the previous paper, we argued for the existence of an 'Indian Ocean El Niño' during the Last Glacial Maximum. We suggest that the Indian Ocean has the capacity to harbour much larger climate variability than observed during the last few decades or a century," writes co-author Kaustubh Thirumalai, from the Department of Geosciences at the University of Arizona in an email to *The Hindu*. "In this paper, we argue that this climate variability in the Indian Ocean can arise under increased greenhouse gas forcing of global climate change."

He explains that there are many lessons to be learnt from this cooler period about our warmer future, "even though the Last Glacial Maximum consisted of vastly different conditions compared to where the world is headed... For example, global sea-level is rising and glacial ice is melting today whereas the opposite was true for the Last Glacial Maximum"

Prof. Thirumalai adds: "As it is, under present-day conditions, changes in the Indian Ocean Dipole and the El Niño–Southern Oscillation strongly affect Indian Monsoon variability from year to year. If the hypothesised 'equatorial mode' emerges in the near future, it will pose another source of uncertainty in rainfall prediction and will likely amplify swings in monsoon rainfall."

The paper adds that it could bring more frequent droughts to East Africa and southern India and increased rainfall over Indonesia. The team warns that further work is needed to accurately assess this new mode, particularly under lower-emission scenarios and also taking into account past climatic states other than the Last Glacial Maximum.

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# SUPER-EARTHS DISCOVERED ORBITING NEARBY RED DWARF

Relevant for: Geography | Topic: The Earth and the Solar System

Super-Earths are planets which have a mass higher than the Earth's but substantially below those of our local ice giants, Uranus and Neptune

Gottingen: In research led by the University of Gottingen, the RedDots team of astronomers has detected a system of super-Earth planets orbiting the nearby star Gliese 887, the brightest red dwarf star in the sky.

Super-Earths are planets which have a mass higher than the Earth's but substantially below those of our local ice giants, Uranus and Neptune. The newly discovered super-Earths lie close to the red dwarf's habitable zone, where water can exist in liquid form, and could be rocky worlds. The results were published in the journal Science.

The RedDots team of astronomers monitored the red dwarf using the HARPS spectrograph at the European Southern Observatory in Chile. They used a technique known as 'Doppler wobble,' which enables them to measure the tiny back and forth wobbles of the star caused by the gravitational pull of the planets.

The regular signals correspond to orbits of just 9.3 and 21.8 days, indicating two super-Earths -- Gliese 887b and Gliese 887c -- both larger than the Earth yet moving rapidly, much faster even than Mercury. Scientists estimate the temperature of Gliese 887c to be around 70 degrees C.

Gliese 887 is one of the closest stars to the Sun at around 11 light-years away. It is much dimmer and about half the size of our Sun, which means that the habitable zone is closer to Gliese 887 than Earth's distance from the Sun. RedDots discovered two more interesting facts about Gliese 887, which turn out to be good news not only for the newly discovered planets but also for astronomers.

The first is that the red dwarf has very few starspots, unlike our Sun. If Gliese 887 was as active as our Sun, it is likely that a strong stellar wind -- outflowing material which can erode a planet's atmosphere -- would simply sweep away the planets' atmospheres.

This means that the newly discovered planets may retain their atmospheres, or have thicker atmospheres than the Earth, and potentially host life, even though GJ887 receives more light than the Earth.

The other interesting feature the team discovered is that the brightness of Gliese 887 is almost constant. Therefore, it will be relatively easy to detect the atmospheres of the super-Earth system, making it a prime target for the James Webb Space Telescope, a successor to the Hubble Telescope.

"These planets will provide the best possibilities for more detailed studies, including the search for life outside our solar system," said Dr Sandra Jeffers, from the University of Gottingen and lead author of the study.

*This story has been published from a wire agency feed without modifications to the text. Only the headline has been changed.*

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