

# SANT HIRDARAM GIRLS COLLEGE, BHOPAL

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2022

# 3E'S



**Vol. 3**

**BOOST YOUR BRAIN BY GOING  
IN DEPTH WITH SCIENCE.**

**Under the Committee of  
Energy Conservation,  
Department of Physics  
SANT HIRDARAM GIRLS  
COLLEGE, Bhopal**

*“Imagination is more important than knowledge.  
For knowledge is limited, whereas imagination  
embraces the entire world, stimulating progress,  
giving birth to evolution.”*

*– Albert Einstein*

# WHAT'S 3 E'S?

Magazines are something which offers a more long-form writing than a short clips of story in a newspaper and serve specific functions to society.

3 E's stands for EXAMINE, EXPLORE and ENHANCE. This magazine provides you the in depth knowledge related to our environment and the upgradations in science, space and technology. So, examine the environment, explore and enhance your knowledge. Know the interesting facts and this will kindle a genuine interest in our readers mind for science. We aim to empower your minds with a scientific bent of mind.

Let's have fun with science.

# CONTENTS

04

• BLESSINGS & INSPIRATION Paramhans Sant Hirdaram Sahibji

05

• Message From President's Desk

06

• Message From Director's Desk

07

• Message from principal's desk

08

• Message From Teacher's Desk

10

• Editorial board

11

• Articles from editor's team

35

• Factopedia

# BLESSINGS & INSPIRATION

- Paramhans Sant Hirdaram Sahibji



“

The Old, the Infirm and the children are all forms of God. Serve them with heart and soul and win laurels of the Lord.

”

Symbol of simplicity, a legend human being, a noble soul and selfless charismatic person who dedicated whole of his life serving the mankind, especially those who need support the most. A true visionary, he directed his magnanimous social work especially in the field of health & education. Excellent health care units and adorable education institutions established in the remote sub urban area of Bhopal erstwhile known as Bairagarh and now renamed as Sant Hirdaram Nagar are epitomes of his great deeds.

We bow our heads in his lotus feet and our deep tributes to the great soul.

# • Message From President's Desk



**Rev. Siddh Bhauji**

President,

Shaheed Hemu Kalani  
Educational Society

As the President of the society, I would like to congratulate the Department of Physics for taking out this E magazine, 3E's (Vol. 3). I strongly believe that "The mind is not a vessel to be filled, but a fire to be kindled". Magazine kindles the imagination of our learners. I wholeheartedly acknowledge the endeavors of staff and students of this institution, who uses various mediums of expression to empower young girls, spiritually, culturally, and ethically. I am certain, with the amalgamation of committed and devoted efforts of staff members, our students would rise to higher intellectual level to contribute to national building and acquire inner bliss. "With warm wishes and Santji's blessings".

# • Message From Director's Desk



**Hero Gyanchandani**

Director,

Sant Hirdaram Girls

College, Bhopal

As the Director of the College, I would like to congratulate the department of Physics for taking out this E-magazine, 3E's (Vol. 3) covering wide variety of subjects of importance in today's scenario. The mission of the institution appears to be fulfilled as all the articles have been solely contributed by our passionate students. Magazine is the most effective platform of expression and as long it is thought provoking, we would be sure of learning, as everything begins in mind.

Thoughts are powerful to bring out desired change in the society. Think about little more than what is possible that little extra we do, would class you, of your own, 'Do more than belong – participate. Do more than care – help. Do more than believe – practice. Do more than be fair – be kind. Do more than forgive – forget. Do more than dream – work.' Just as our mother earth gives us more and more, this E magazine will enable our learners to give and get a little more of learning. "With warm wishes and Inner Bliss".



# • Message From Principal's Desk



**Dr. Dalima Parwani**

**M.Sc., MCA, M.Ed., Ph.D.**

**Sant Hirdaram Girls College, Bhopal**

It is a moment of great pleasure that Department of Physics, Sant Hirdaram Girls College, Bhopal is coming up with the third issue of their Magazine. I hope that this Magazine will make students and scholars aware of the current updates in the field of Physical Science, which is a pressing need of the hour.

We seek to bring together intellectuals to share their ideas, discoveries and inventions so that practical solutions may be invented which will benefit all sections of society. During the present era of globalization, scientific research has assumed much importance and the theme of this Magazine is very relevant for the current generation. We hope that this Magazine provides a platform for people to share their findings and help them to come up with innovative ideas for the service of humanity through Science.

The women and girls in our country represent a reservoir of talent. We hope that this platform provides them a great opportunity in the emerging Science of this world while helping in keeping alive our precious tradition and culture.

# • Message From Teacher's Desk



**Ms. Jyoti Singh**

**HOD, Asst. Prof. of Dept. of Physics,  
Sant Hirdaram Girls College, Bhopal**

Very few have fully realized the wealth of sympathy, kindness and generosity hidden in the soul of a student. We believe in a joyful experiential learning system wherein each student is encouraged to participate wholeheartedly!

At our college, we leave no stone unturned to offer multitudes of opportunities to our students; it is for them to make the most of it. We at SHGC, Bhopal are aware of our responsibility of shaping our students in such a manner that they will not only excel in all walks of life and be successful change navigators but also will have the courage of conviction to challenge the conventional wisdom.

Our students made us proud and gave us a lot of reasons to celebrate all throughout the year. Every year our student come in the merit list and acquire first position. They are not only active in academic but also in other curricular activities. This magazine is all about science and environment and the articles are written by our students of B.Sc. and M.Sc. Year (2021-22).

Happy Reading!



The information contained in this magazine is compiled with utmost care. The views expressed in the articles contained in this magazine are author's own. All possible efforts have been made to keep the material free from errors. However, Department of Physics, Sant Hirdaram Girls College, Bhopal make no representation or warranty, expressed or implied, as to the originality, accuracy or completeness of any such information. The college shall not be liable for any action arising out of allegations of infringement of copyright of material used by any contributor.

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# 1 Gaganyaan Mission

Pragya Gupta



Gaganyaan mission which is also known as manned mission. Manned space mission includes human sending on spaceflights.

Interestingly India for the very first time will send humans on space independently before this Rakesh Sharma had gone to space but he was sent there by soviet union Now India is sending humans on space using their own technologies self sufficiently

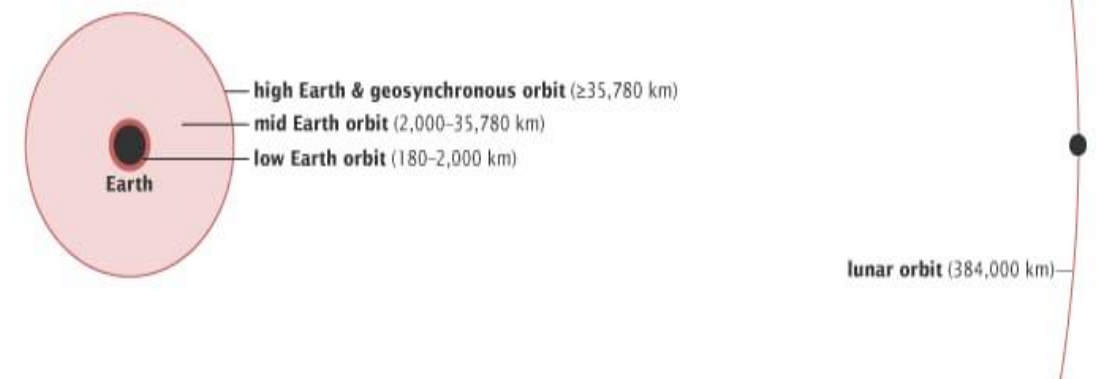
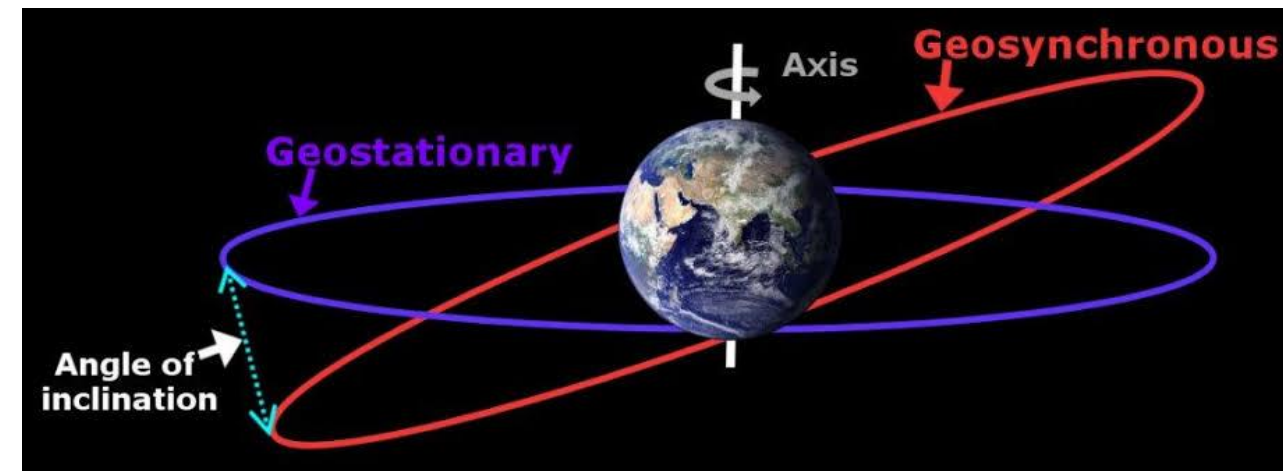
A curiosity arises that who will be that first person who went on space, so In April 1961, a Soviet Cosmonaut Yuri Gagarin became the first person to reach on space. 'Cosmonaut' Is it sounding different? actually U.S uses 'Astronaut', Russia uses 'Cosmonaut' and India is using 'Vyomnaut'. Until now US, Russia and China has managed to send manned mission to outer space And now it will be very proud for India as it will become fourth country to send manned missions on space. India's Indian Space Research organisation is planning to launch its first manned mission to space. Gaganyaan has been designed in such a way to carry three astronauts to low earth orbit for a period of five to seven days by 2022, When India completes 75 years of independence. The launch vehicle which is used to send this spacecraft is GSLV MK III which is capable of launching four ton satellites in the Geosynchronous Transfer Orbit( GTO). Ahead of this manned mission ISRO plans to send two unmanned mission as a part of this Gaganyaan Mission.

However the first unmanned mission is delayed due the coronavirus pandemic. Now these missions are supposed to send by 2022. ISRO is developing the spacecraft for this Gaganyaan mission itself and Russia is helping in the training of astronauts. The manned mission will rotate around the earth every 90 minutes. The astronauts will be able to see sunrise and sunset and they will also perform some experiments on microgravity.

The spacecraft will take 36 hours for the return journey and will land in Arabian Sea of Gujrat Coast as it will not be a soft landing they will land with the help of parachute.

Gaganyaan includes a Space Capsule Recovery Experiment (CRE 2007) which was done to ensure that capsule in space will be able to work in microgravity conditions and can return easily.

ISRO successfully conducted the Crew Module Atmospheric Re-entry Experiment (CARE) spacecraft mission in December 2014 and also completed the first successful flight of crew escape system in July, 2018.



Gaganyaan National Advisory Council has been created with the members of different institutions and industries to deliberate on various aspects of the mission. ISRO has created a Human Space Flight Centre in January 2019 in Bengaluru. The responsibilities of HSFC includes end to end mission planning , crew selection and training and also pursuing activities for sustained human flight missions.

Vyommitra ( Vyom- sky, mitra- friend) is a human spacefaring human robot developed by ISRO. She is a half humanoid who can perform many human actions. ISRO will send Vyommitras to space on unmanned mission to check any casualties.

The spacecraft will consists of Service module and a Crew module which will collectively called Orbital Module. Crew module carrying human beings, Space module powered by two liquid propellant engines in case of any emergency escape and emergency mission abort. The objectives of the mission are the enhancement of science and technology level in the country, Industrial growth, inspiring Youths, improving international collaborations and boosting the employment.

## GSLV MK-III



**Payload to GTO:** 4,000 kg

**Payload to LTO:** 8,000 kg

### **Cryogenic Upper Stage: C25**

The C25 is powered by CE-20, India's largest cryogenic engine, designed and developed by the Liquid Propulsion Systems Centre.

### **Solid Rocket Boosters : S200**

Two S200 solid rocket boosters to provide the thrust required for lift off. The S200 was developed at Vikram Sarabhai Space Centre.

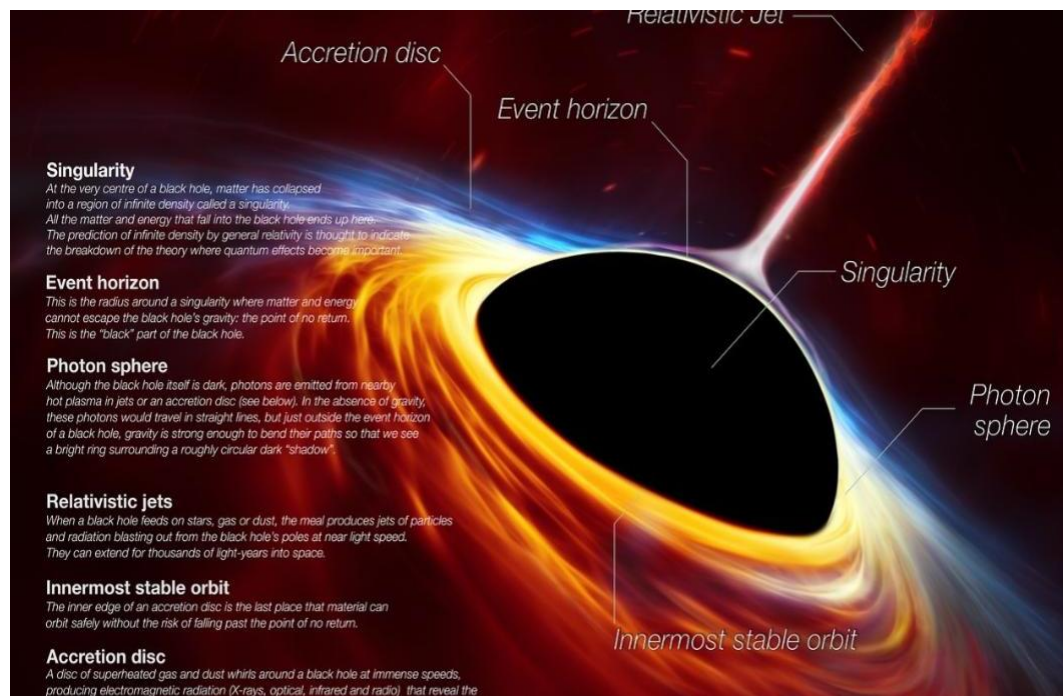
### **Core Stage : L110 Liquid Stage**

The L110 liquid stage is powered by two Vikas engines designed and developed at the Liquid Propulsion Systems Centre.



# 2 A TALK OVER BLACK HOLE IMAGE CAPTURED BY EHT IN 2019

Komal Salwani

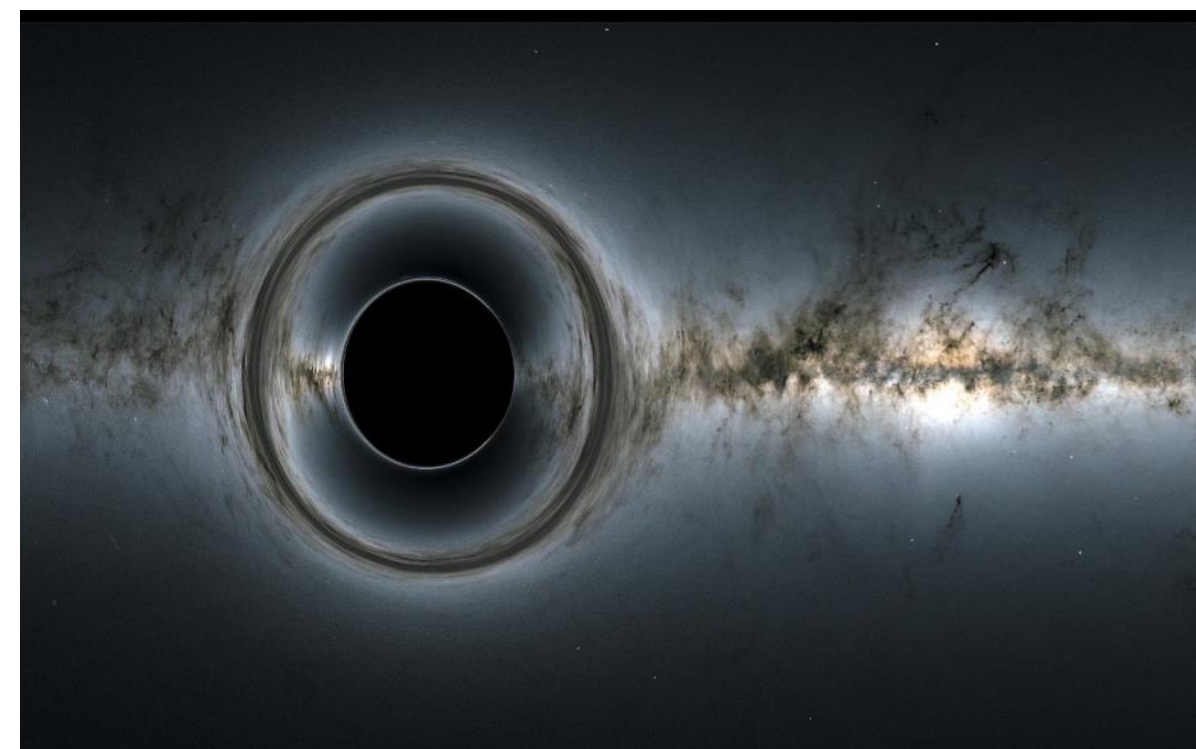


In the heart of a giant elliptical galaxy called Messier 87, a gargantuan beast eats up anything that strays too near which is more than 50 million light years away. Nothing can escape from the monster's grasp and even light can not escape from it, if they crosses a threshold called the event horizon.

Astronomers of the Event Horizon Telescope (EHT) captured the first ever image of a supermassive black hole which was located at the center of a galaxy Messier 87 (M87) in 2019 and appears as a circular void surrounded by a lopsided ring of light. This black hole is 6.5 billion times the Sun's mass. This discovery is the great scientific achievement which had set the world of astronomy on fire and found a mention in the "popular information" section of the Nobel Prize announcement in physics for 2020.

A technique called very-long-baseline interferometry (VLBI), is used by EHT observations, which synchronises telescope facilities around the world and exploits the rotation of our planet to form one huge, Earth-size telescope which can observe at a wavelength of 1.3 mm.

But the dispute arises among physicists related to the alternative possibilities such as naked singularities into the realms of time travel and loops of time. A paper brings the explanation for the compact object that was imaged by EHT, is published in the European Physical Journal C. But it can even be a "naked singularity" with a "gravitomagnetic monopole and is not necessarily a black hole.

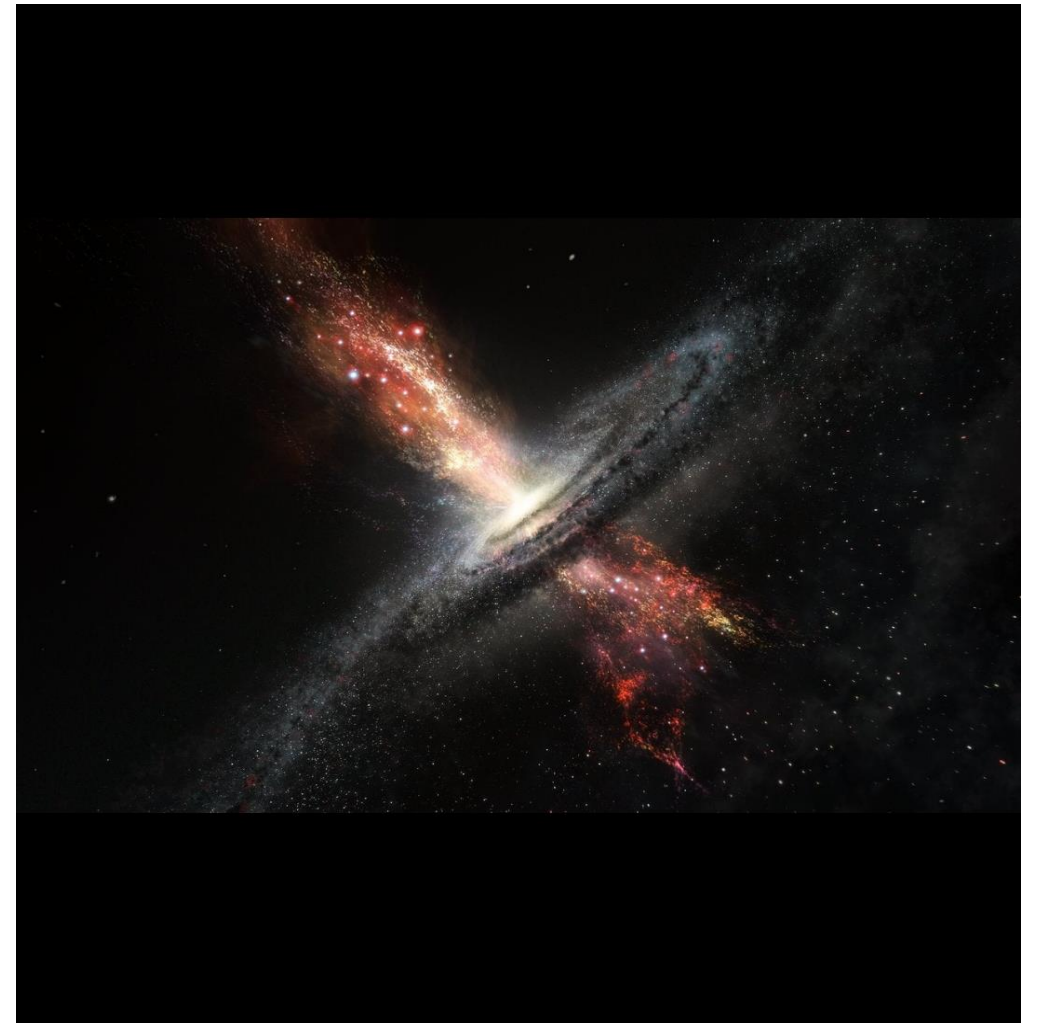


When stars much more massive than the Sun reach the end of their lives, they collapse under their own gravity, and give the product as a black hole. It is divided into two parts: First, **singularity at its core** – a point that is infinitely dense, as all the remnant mass of the star is compressed into this point. And the imaginary surface, **event horizon** – surrounding the singularity, and the gravity of the object is such that once anything enters this surface, is trapped forever.

Without any event horizon shielding singularity, event horizon does not form in many scenarios of stellar collapse and the singularity is exposed to the outside. “Naked singularity” is also called as a “troublesome sibling” of a black hole.

Many researchers show that M87\* could be either a black hole or a naked singularity and each of these possibilities could be plain or coupled with what is called a gravitomagnetic monopole and it in all, leaves four possibilities in principle.

Famous scientists, James Clerk Maxwell, in 19<sup>th</sup> century unified electricity and magnetism as one combined phenomenon, showing that light is an electromagnetic wave. But there is an asymmetry between electricity and magnetism. Dr. Chakraborty, from the Department of Physics, IIT Bengaluru, draws upon an analogy between gravitational force and electromagnetism to explain that in 1963, Newman, Tamburino and Unti (NUT) and called it as a “gravito-magnetic charge” which is also called a gravitomagnetic monopole.



But, now a difficult situation arises, when the NUT-like solutions are allowed and there is a possibility of “closed timelike loops.” These are regions in parameter space of spacetime in which the past merges with the future allowing many peculiar situations. Therefore, this solution comes as a strong criticism from physicists.

The solutions of Einstein's equation i.e., the Kerr and the Schwarzschild solutions, namely black holes with spin and having an event horizon, are considered appropriate for describing astrophysical black holes, like the one that has been recently captured in M87.

Closed timelike curves can be admitted by some important solution of Einstein's equations. Despite this, the solutions have been studied because they have some other useful, important and interesting features. That is why the wormhole solutions that also admit closed time like curves are very much under study today.

Another approach could be only throw away those regions of parameter space that give rise to the closed timelike loops and no need to discard the entire solution. It is also suggested that not all solutions of Einstein equations have closed time like curves, but some have.

Thus, the discussion goes ahead, that whether to use Occam's razor and discard these possibilities or to keep them and handle them with care.



*The first ever photo of a black hole, taken using a global network of telescopes, conducted by the Event Horizon Telescope (EHT) project, to gain insight into celestial objects with gravitational fields so strong no matter or light can escape. File*



# 3 | CLIMATE CHANGE: A BIG CRISIS

Gitanjali

There is no issue more pressing than the future health of our planet and the people who inhabit it. Its health today will dictate the health, happiness and economic prosperity of generations to come. That has to be our focus. We have an overwhelming responsibility to those generations yet unborn. The current situation says that the weather has become more unpredictable, the pandemic has necessitated joining dots between health and environment and the world is roiled by an energy crisis. In August, an IPCC report warned that the planet could be hotter more than 1.5 degree Celsius in the next two decades, even if nations began to cut emissions drastically immediately. Data from the National Institute for Space Research's Prodes monitoring system showed that Amazon lost 13,235 square kilometers of rainforest in the 12-month reference period from August 2020 to July 2021. That's up to 22% from the prior 12-month period and the worst in 15 years. The surging destruction comes despite showing efforts in protecting the Amazon, considered critical to staving off catastrophic climate change. Some scientists warn that if enough of the forest is destroyed, it could cross a tipping point, dry out and turn into savannah.

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That would release huge amounts of carbon, virtually ensuring the world cannot hit the targets laid out to avoid the worst effects of climate change. We all know the drastic effects of climate change results in warmer temperatures and changing weather patterns and disrupting the usual balance of nature. This poses many risks to human beings and all other forms of life on earth. People all over the world are being assertive and speaking out their minds on how climate change poses a fundamental threat to the places, species and people's livelihoods. "Our lungs are not an experiment. Every single minute, every day damage is being done".

Rosamund Aldoo-Kissi-Debrah is a world health organization advocate for health and air quality. She spoke at the October 2021 Ted Countdown Summit in Edinburgh about the necessity for healthy air quality after losing her child Ella Aldoo-Kissi-Debrah because of bad air quality. At age 16, Clover Hogan attended COP21. She went in optimistic that world leaders would come together to act with the urgency required. She was left disillusioned by the empty promises, rampant greenwashing, and the utter lack of youth and frontline voices. After that she took the main stage at COP26 to share her open and honest feeling. She went on like “It is a farce to think that we will solve this problem with the same thinking and the same people who created it. We need in these rooms young people who are not willing to abide by the status quo and we need in these rooms people for whom the climate crisis is already their lived experience and their present-day reality. We continue to talk about the global south as victims of the climate crisis. The global south is being disproportionately impacted by the climate crisis while they have contributed the least to it. And yet they are also the greatest holders of solutions and knowledge and experience of what a grassroots resilience looks like and what that better, brighter future can look like too. So, we need to have the courage to sit not only in the apocalyptic doomsday images that come so easily in front of our minds but we need to have the courage to sit in a radically different future and bring that future into the present. And we will only do that by inviting people who have been historically excluded into these spaces”. Amanda Gorman, the first Youth Poet Laureate of the US, shared her views on climate change through her inspiring poem; “On Christmas Eve 1968, astronaut Bill Anders snapped a photo of the earth as Apollo 8 orbited the moon. Those 3 guys were surprised to see from their eyes our planet looked like an earthrise, A blue orb hovering over the moon’s gray horizon, with deep oceans and silver skies. It was our world’s first glance at itself, our first chance to see a shared reality a declared stance and a commonality.



A glimpse into our planet's mirror and as threats drew nearer, our own urgency became clearer, as we realized that we hold nothing dearer than this floating body we all call home. We have known that we are caught in the throes of climatic changes, as some say will just go away, while some simply pray to survive another day. For it is the obscure, the oppressed, the poor, who when the disaster is declared done, still suffer more than anyone. So, you don't need to be a politician to make it your mission to conserve, to protect, to preserve the one and only home that is ours. Use your unique power to give next generations the planet they deserve. And while this is a training of sustaining the future of our planet, there is no rehearsal. The time is now. So, Earth, pale blue dots, we will fail you not, just as we choose to go to the moon. We know it's never too soon to chose hope. We choose to do more than cope with climate change. We choose to end it. We refuse to lose. Together we do this and more. Not because it's very easy or nice, but because it's necessary and because with every dawn we carry the weight of the fates of this celestial body orbiting a star and as heavy as the weight sounded, it doesn't hold us down, but keeps us grounded.”



There are many more such examples of environmentalists and climate activists persistently trying to make everyone aware of the situation we are currently in. But the thing is, this planet is not a liability of these few persons but It's a collected responsibility of everyone to protect and save it from the damage. These few persons have done enough on their behalf but we must realize the necessity of an individual to act. Just because something which has not affected us personally, it doesn't mean that we can overlook the severity of the circumstances. And what are we goanna do when it will directly affect us,our families? Is it that we don't understand unless we don't suffer? We the Educated ones, we the awared ones, are accountable for bringing change. It is not sufficient enough to only talk about the problems and turning blind eye to all the consequences of our actions. We must act together and act right now to save our planet.

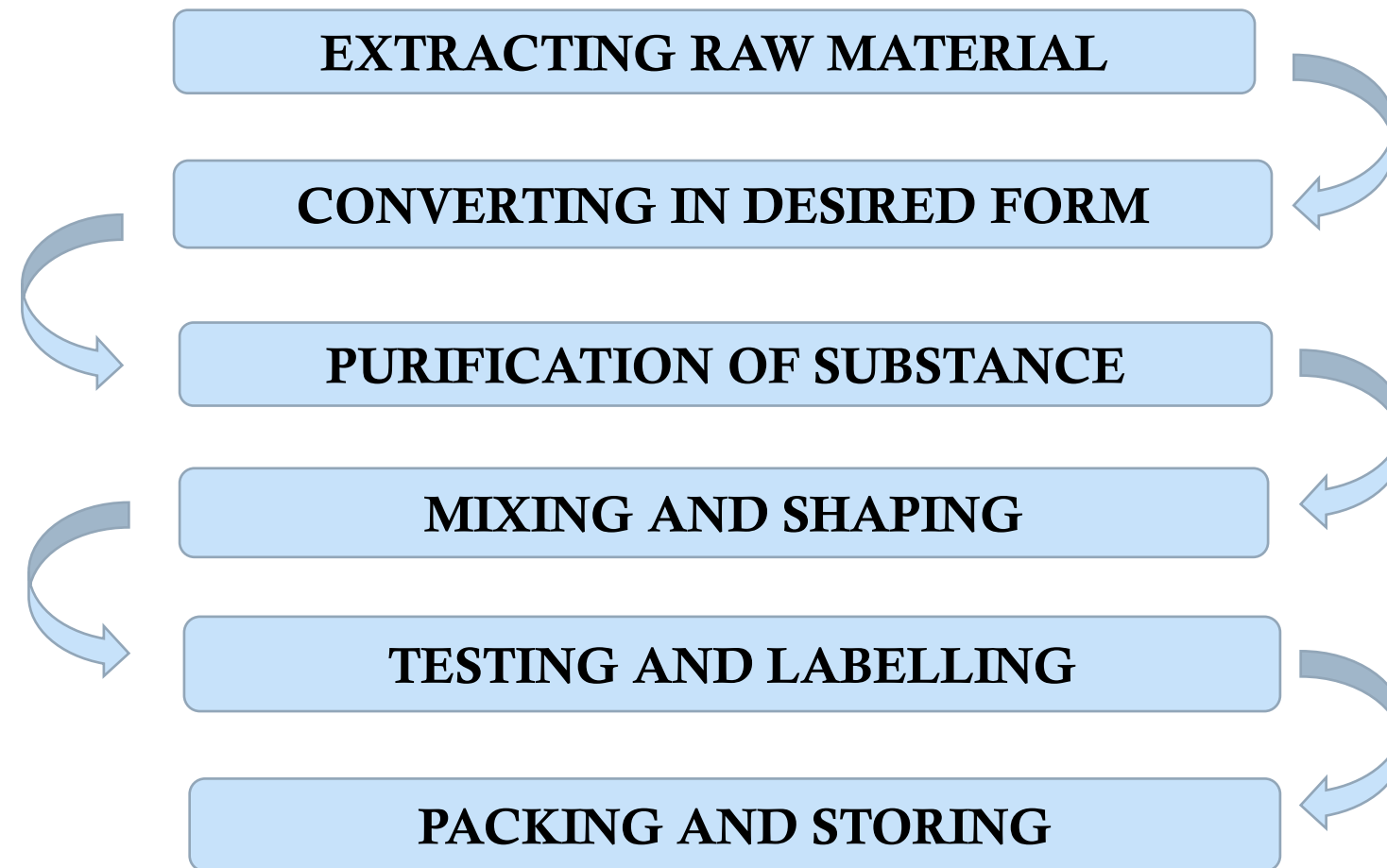
# 4 | CONTRIBUTION OF PHYSICS IN HEALTH SCIENCE

Awani Sharma

In this tough time, middle of this pandemic where we have looked after advantages of almost everything in our surrounding we sometimes neglect the base of most important things. Without getting into the confusing maze of this language let me come direct to the point. When we talk about medicines or ways of curing something we mostly talk about chemicals, processes included and then how to check it whether it's useful or not. But, why do we neglect existence of Medical Physics?

When I look around it's like the world is existing just because of 'PHYSICS' or the world is 100% of physics. The subject itself says physics i.e. dealing, understanding and studying with physical presence of everything and learning its how, why and when. Physics mainly contributes to the technology, all types of infrastructure, helps us to understand laws and rules that are base to govern the physical world and to make human existence possible. We were talking about the point, if physics is that important how does it contribute in medical field? In times of this pandemic we will love to look at everything in the way how does it help us to overcome the present crisis and how helpful it would be in coming days if something more is coming?

Let's talk in short how are medicines manufactured, the very initial step of fighting with any disease,



Here, out of this some very basic and major processes some or the other application of physics is used as the most important process like initially, in extraction we have different processes of extracting (like solute and solvent concept) and collecting different chemicals. Secondly, in converting (like hammering and all) principle of physics is again used. Thirdly, purification is again based on concepts of physics. Similarly, physics is here also a base to proceed further.



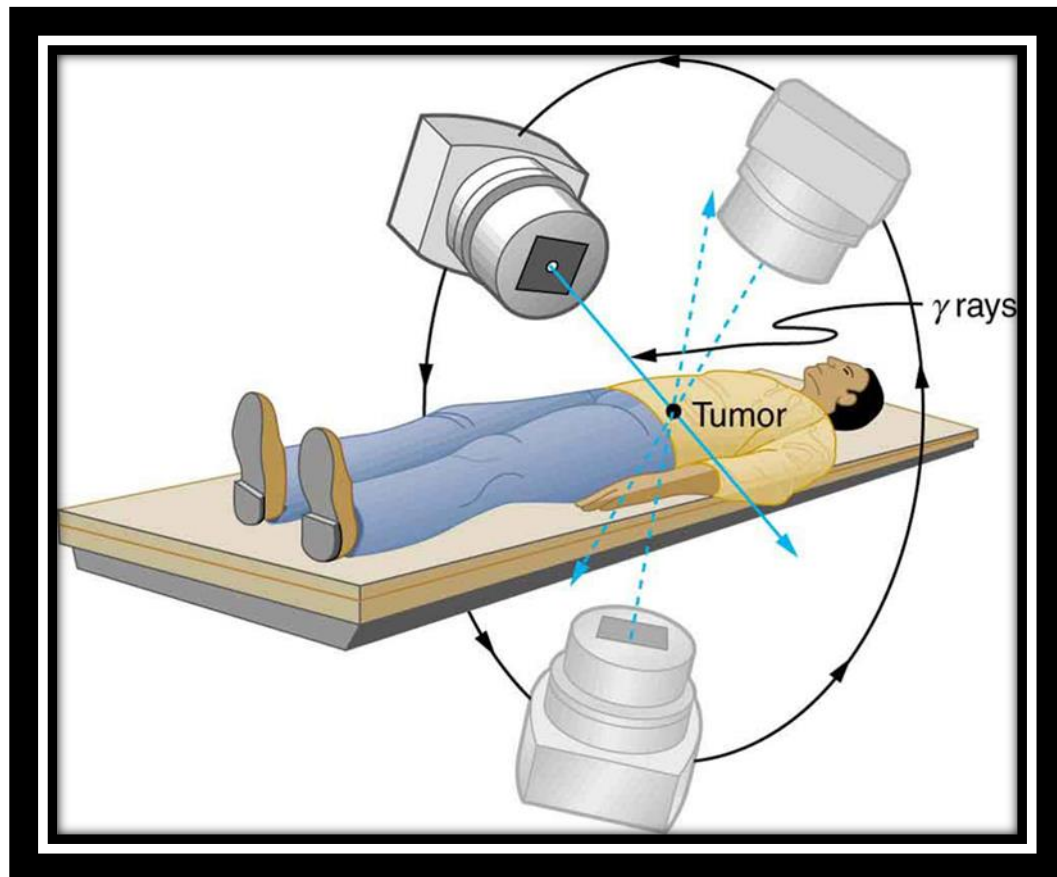
## Now, let's talk about physics in medicines...

In this age of multidisciplinary collaboration, the physics professionals will only be able to make contact and processes advance and easier.

Physics has been always contributing in medical science. Many physical agents such as sound, heat, pressure and light have been used to diagnose and treat diseases. Clinical thermometer, stethoscope, sphygmomanometer (used to measure B.P.) etc. are instruments based on principles of physics. There are numerous physics based contribution to Health Science field. But, we must mention the following major contributions those revolutionised and advanced the health standard and diagnosing and testing easier for human on the earth,

- X-rays imaging and Computerised Tomography (CT) – These are electromagnetic radiation whose wavelength lies b/w  $1\text{\AA}$  to  $10\text{\AA}$ . This are used to see interior of human body.
- Ultrasound or sonography – This are the sound waves with a frequency above human hearing range. Ultrasound is a medical application of SONAR (sonic navigation and ranging). This is also used to see inside of human body.
- Pet imaging – Stands for Position Emission Tomography. It helps in determining cancer like diseases which use glucose to react within body with radioactive equivalent of glucose known as FDG-18.





- Laser therapy – Stand for “ Light Amplification by Stimulated Emission of Radiation”. The technique was invented to use in wars. Clinicians use them to perform surgeries which involves less pain, less blood loss and shorter recovery time.

- Radiotherapy and Radiation Therapy – It has emerged as the most effective therapy for cancer.

At present, health science is only field making many signs of progress on so many fronts. So, there are many challenges leading to more demands and thus will result in multidisciplinary contacts and collaborations, where again the physicists will be the ones who will contribute the most into it. So for this world to improve and function properly the base and the most important thing is principles of physics and their implementation. So like in everything physics has a major contribution in medicinal field too.

# 5 | Chandrayaan – 2

Sneha Agarwal



22 July, 2019 continues to hold immense significance in history of India's cosmic feats , you will see in this article , the lessons learnt from this operation as well as the wealth of new information provided by the orbiter has added to our knowledge about the moon and its environment.

Chandrayaan 2 consists of a Lunar orbiter, Vikram lander and the Pragyan Lunar Rover. The spacecraft was launched at the Satish Dhawan Space Centre, Sri Hari Kota by GSLV Mark III – M1. The craft reached the moon's orbit on 20 Aug,2019 and began orbital positioning manoeuvre for the landing of the Vikram lander. The lander and the rover were scheduled to land on the near side of moon , in the south polar region at a latitude of about 70° south on 6 September , 2019 and conduct scientific experiments for one lunar day, which equals to two earth weeks.

The primary objective of the mission were to demonstrate the ability to soft-land and operate a robotic rover on the lunar surface. The scientific goals of the orbiter were: To study lunar topography, mineralogy, elemental abundance, the lunar exosphere, and signatures of hydroxyl and water ice. Also, to study the water ice in the south polar region and to map the lunar surface and help to prepare 3d map of it.

The lander's velocity was supposed to be reduced from 6000 km/h to 0 km/h in four phases to be carried out within a span of 15 minutes. However, during the second phase, the velocity was not reduced as desired, which the third phase couldn't handle. As a result, Vikram hard-landed within 500 meters of the designated landing site. The Vikram lander, in the final leg of its descent, had a malfunction of some kind that caused it to accelerate instead of slow down, and the only direct communication link with the lander went silent.



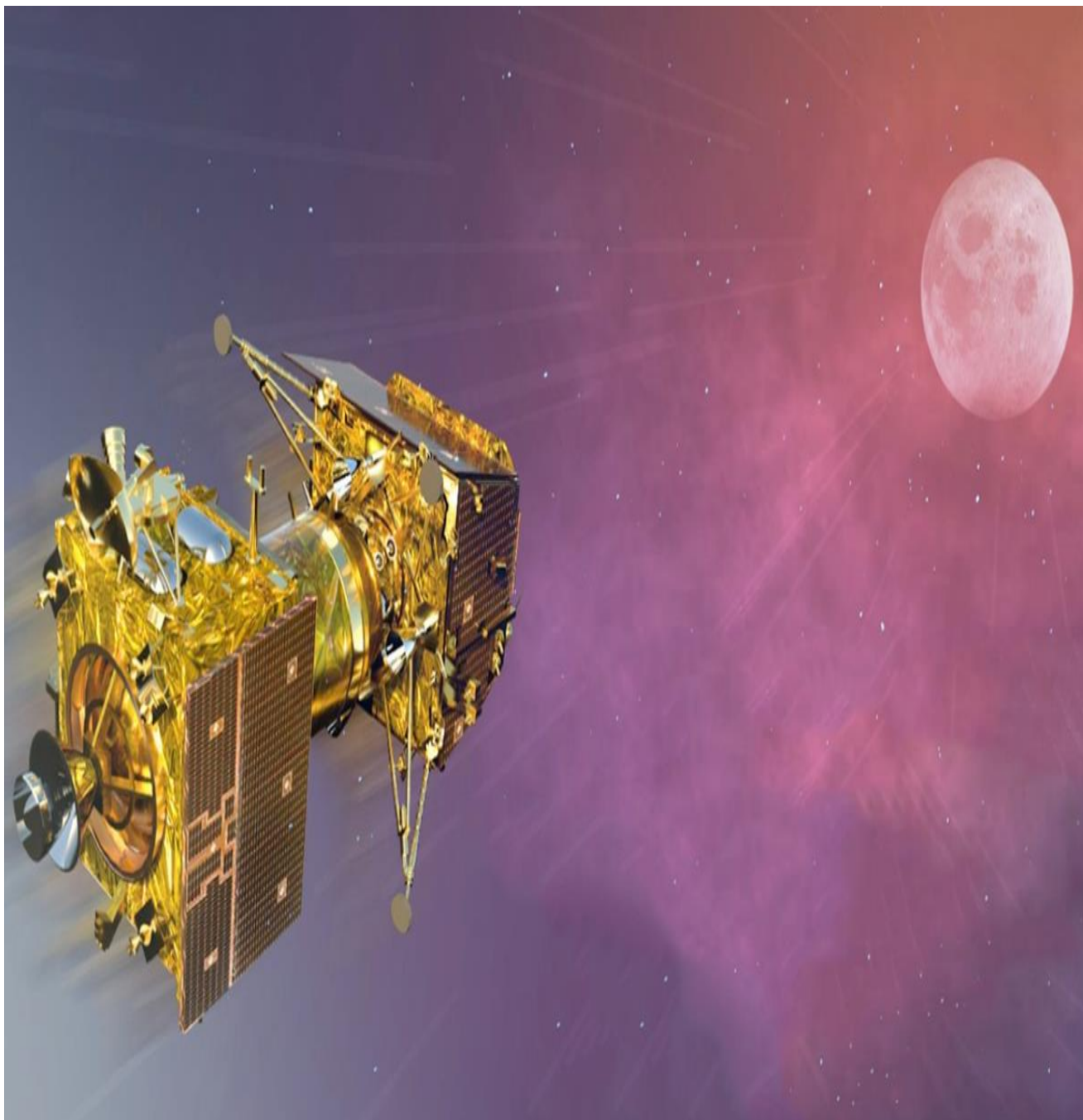
Moreover, as every cloud has a silver lining, the ISRO scientists have taken it in a stride and are learning from the past. (The Vikram Lander had transmitted its performance data until it was 400 meters away from the landing. With the help of this data, ISRO is confident of turning Chandrayaan 3 into a success).

The Chandrayaan 2 orbiter, with its eight scientific instruments, will continue its seven-year mission to study the surface of the moon. Some of the most significant results so far:

The presence of water on the moon had already been confirmed by Chandrayaan 1. Using far more sensitive instrument, the Imaging Infra – Red Spectrometer (IIRS) On board Chandrayaan -2 has been able to distinguish between hydroxyl and water molecules, and found unique signatures of both. This is the most precise information about the presence of H<sub>2</sub>O molecule till date.



Another instrument has detected the minor elements chromium and manganese for the first time through remote sensing . The finding can lay the path for understanding magmatic evolution on the Moon. This instrument has mapped nearly 95% of lunar surfaces in X-rays for 1<sup>st</sup> time .



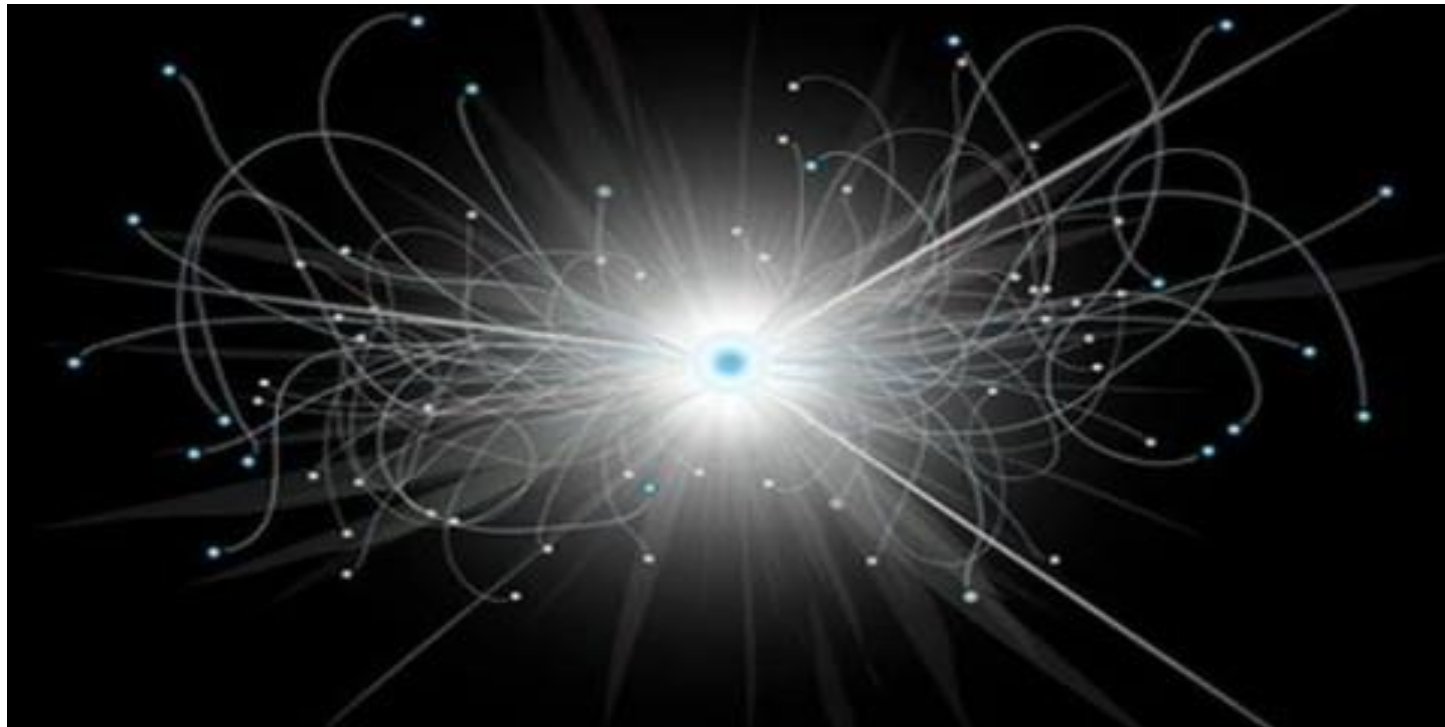
Another instrument called Solar X-Ray Monitor (XSM), has collected information about solar flares. XSM has observed a large no. of microflares outside the active region for the first time and according to ISRO, this “has great implications on the understanding of mechanism behind heating of solar corona “, which has been a open problem for many decades.

In the nutshell, every adversity, every failure every heartache carries with it the seed of an equal or greater benefit and we just need to realize it.

# 6 God Particle Theory

Tuba Tazeen

The Higgs boson is the fundamental particle associated with the Higgs field, a field that gives mass to other fundamental particles such as electrons and quarks. It is an elementary particle in the Standard Model of particle physics produced by the quantum action of the Higgs field. One of the fields in particle physics theory. In the Standard Model, the Higgs particle is a grand scalar boson with zero spin, no electric charge, and no color charge. It is also very erratic, decomposing into other particles almost instantly.



The Higgs Boson is a subatomic particle that is crucial for a stable universe. If it became destabilized, it **could create chaos in the universe**, possibly swallowing up everything in its path, leaving nothing but a cold, dark void.

Candidate Higgs boson events from collisions between protons in the **LHC** (Large Hardon Collider) is the world's largest and most powerful particle accelerator. It consists of a 27- kilometer ring of Superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way). The top event in the **CMS** (Compact Muon Solenoid is a general – purpose detector at the Large Hardon Collider) experiment shows a decay into two photons (dashed yellow lines and green towers). The lower event in the **ATLAS** (Atmospheric laboratory for Applications and science) experiment shows a decay into four muons [**Muons** - an unstable subatomic particle of the same class as an electron (a lepton), but with a mass around 200 times greater. Muons make up much of the cosmic radiation reaching the earth's surface]. It is named after physicist Peter Higgs, who in 1964 along with five other scientists proposed the Higgs mechanism to explain why some particles have mass. This mechanism required that a weak particle known as a scalar boson should exist with properties as described by the Higgs Mechanism theory. This particle was called the **Higgs boson**. The Higgs boson has often been called the "**God particle**" from the 1993 book The God Particle by Nobel Laureate Leon Lederman.

As you walk through the universe as you wave your hand through the space you are moving through the higgs field but there is the difference between the other fields and the higgs there's something that makes the higgs special what makes it special is even in empty space the higgs field is not zero if a field is something that has a number at every pointing space when you turn things off when there are no electrons around that's the way of saying the electron field is at zero in empty space all of the fields we know about are sitting at zero undisturbed except for the higgs field that is what making the higgs a little bit different than all the other forces of nature.

### **Higgs field plays two crucially important roles on modern particle physics :-**

The first feature is it governs the action of the weak nuclear force as we will see there are four fundamental forces – Gravity, Electromagnetism, strong nuclear force, Weak nuclear force these are forces which is different in their own individual ways, the higgs boson is responsible for how the weak nuclear force works

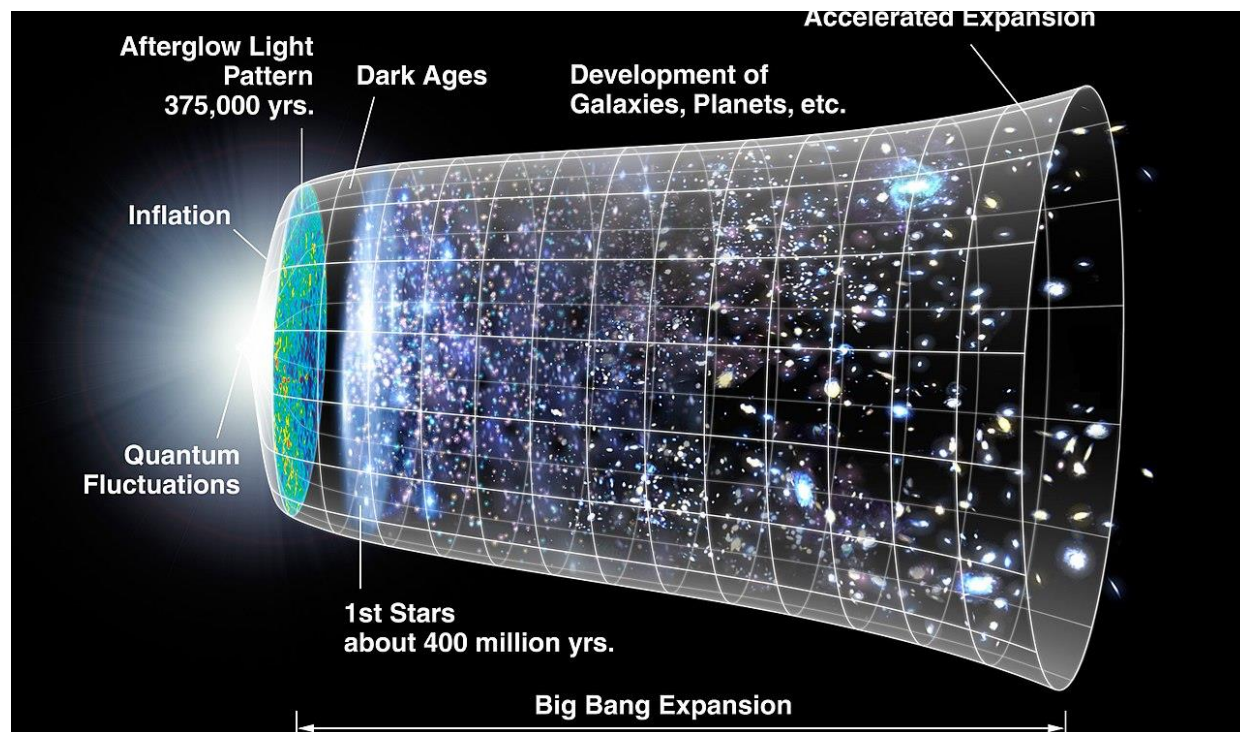
The second main feature of the higgs boson is that it gives mass to elementary particles

**Stephen Hawking says ' God Particle ' could wipe out the universe :-**Once Stephen Hawking bet Gordon Kane \$100 that physicists would not discover the Higgs boson but after losing that bet when physicists detected the particle in 2012, Hawken's then get Disappointed and saying it made physics less interesting. Hawking is not the only scientist who thinks so. The theory of a Higgs boson doomsday, where a quantum fluctuation which means the temporary random change in the amount of energy in a point in space, creates a vacuum "bubble" that expands through space and wipes out the universe, has existed for a while. However, scientists don't think it could happen anytime soon.



# 7 | The Big Bang Theory

Dipika Inda



The universe consists of all the space surrounding the planets and includes all the things from the smallest matter to the space as large as galaxies. The origin of the universe is the origin of everything, basically everything that exists is a part of universe. The universe has no center or edge, and every part of the cosmos is expanding.

There are lot of Myths and stories about the universe and how it came into existence. But the most popular one is Big Bang Theory, it is the most accepted version of the origin of Universe. This theory explains about how the universe began, then expanded and stretched to grow as large as it is right now and it is still expanding.

The Big Bang Theory also explains where all the hydrogen and Helium in the universe came from. In the 1940s, Ralph Alpher and George Gamow calculated that the early universe was hot and dense enough to make virtually all the helium, lithium and deuterium (hydrogen with a neutron attached) present in the cosmos today; later research showed where the primordial hydrogen came from. This is known as “Big Bang nucleosynthesis,” and it stands as one of the most successful predictions of the theory. The heavier elements (such as oxygen, iron and uranium) were formed in stars and supernova explosions.

Initially, the universe was a small point where singularity was there, everything was single, there was no space, no time, no energy, no matter, nothing was there. It was just a single mass which was similar to black hole but had a lot more energy than a black hole and then there was a sudden blast because at certain point everything existed in a single unit was so much that it had to release all the energy and after that there were two era took place- radiation era and matter era.

In the Big Bang theory, the era that started when the gravitational effect of matter began to dominate the effect of radiation pressure. ... Matter is thought to have become predominant at a temperature of around 10<sup>4</sup>K, roughly 30 000 years after the Big Bang. This marked the start of the matter era. The radiation era is the period from about 10<sup>-43</sup> s (the Planck era) to 30000 years after the Big Bang. It is named for the dominance of radiation right after the big bang. The Era is separated in to eight epochs - Planck, Grand unified, Inflationary, Electroweak, Quark, Hadron, Lepton and Nuclear.

We cannot be certain about in which epoch we live in, despite what many have contended, that the Universe began from a singularity. We can, however, break the illustration you see into the different eras based on properties the Universe had at those particular times. We are already in the Universe's 6th and final era.

Early on, the whole universe was dense enough to be completely opaque. But at a time roughly 380,000 years after the Big Bang, expansion spread everything out enough to make the universe transparent. The big Bang theory is important for us to understand because it layouts a framework explaining how the universe was created and breaks down the timeline in which things were created and formed. We are able to see evidence of this theory as technology is constantly advancing and improving.

# 8 QUANTUM BEHAVIOR OF TUNGSTEN DITELLURIDE

Alina Anjum

The discovery challenges a long held distinction between the metals and insulators, because in the quantum theory of materials, insulators were not through to be able to experience quantum oscillations.

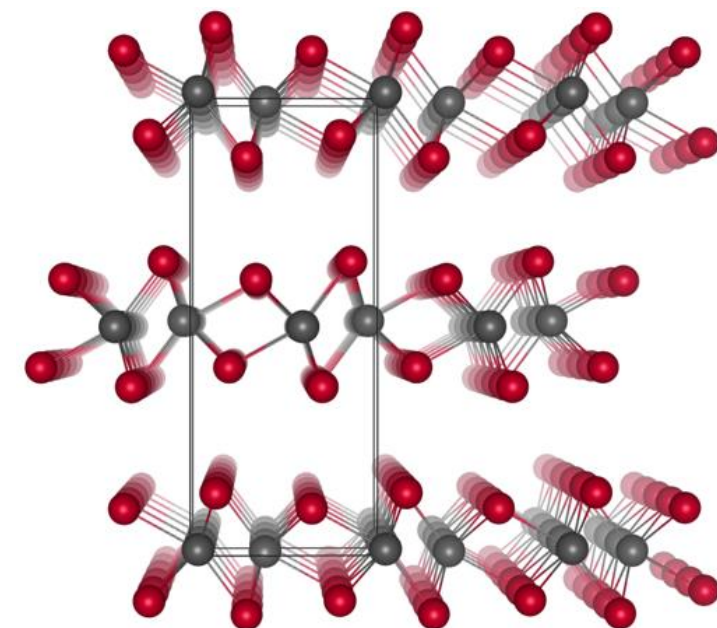
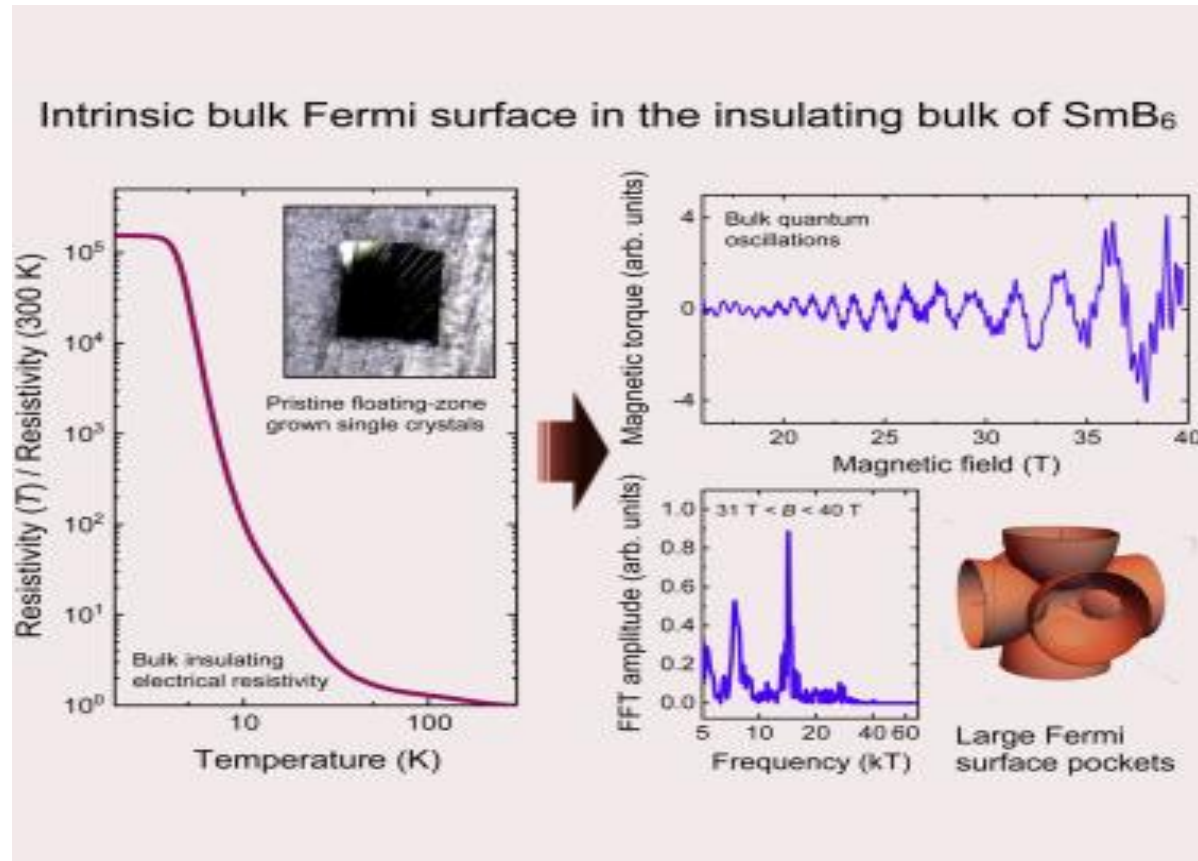
## WHAT IS QUANTUM OSCILLATIONS?

Basically quantum oscillations deals with the series of related experimental techniques used to closely observe the Fermi (length =  $10^{-15}$ ) surface of the metal in the presence of strong magnetic field.

This phenomenon is typically observed in metals rather than insulators. But physicists observed the unexpected quantum behavior in an insulator made from a material called **Tungsten Ditelluride ( $WTe_2$ )**.

## Brief description about Tungsten Ditelluride

Tungsten Ditelluride is an inorganic semi metallic chemical compound. In October 2014, tungsten Ditelluride was discovered to exhibit an extremely large magneto resistance. Tungsten Ditelluride has layered structure, similar to many other transition metal but its layers are so distorted that the honeycomb lattice many of them have in common is in  $WTe_2$  hard to recognize. The tungsten atoms instead form zigzag chains, which are thought to behave as one-dimensional conductors. Unlike electrons in other two dimensional semiconductors, the electrons in  $WTe_2$  can easily move between the layers.



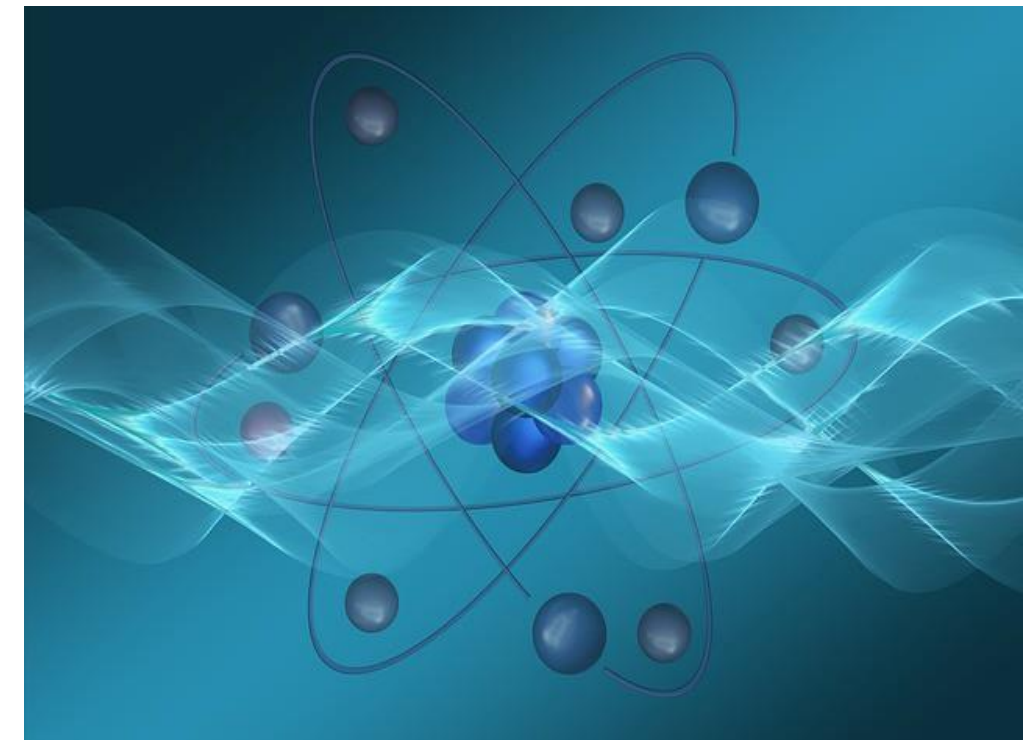
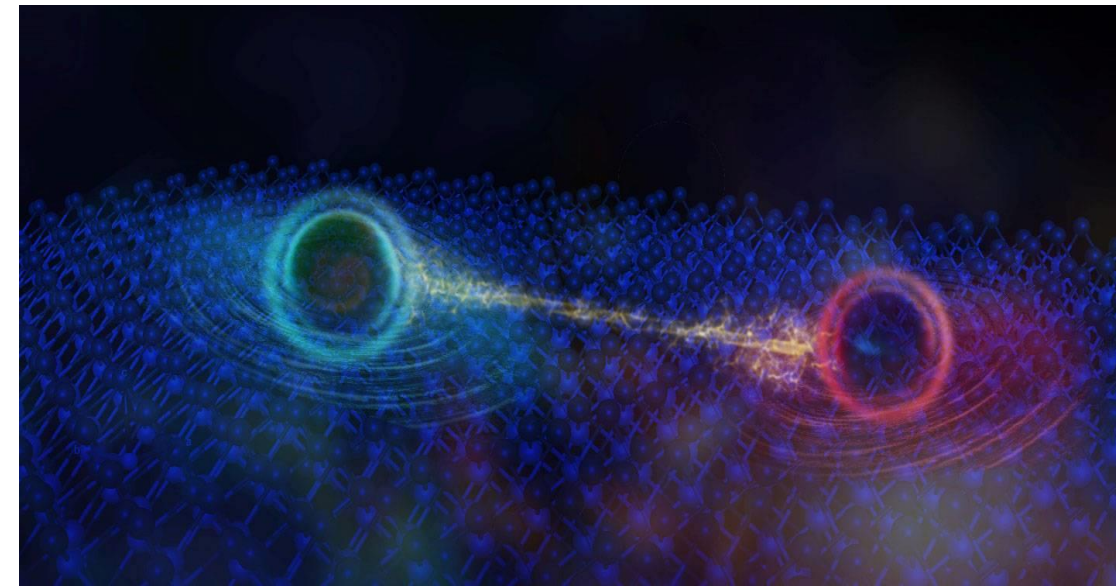
## Tungsten Ditelluride showing property of quantum oscillations

*The observation of quantum oscillations has long been considered a hallmark of the difference between metals and insulators. In metals, electrons are highly mobile, and resistivity- the resistance to electrical conduction- is weak. It was observed that a magnetic field with low temperatures can cause electrons to shift from a “classical” state to a quantum state causing oscillations in the metal’s resistivity. In insulators, by contrast, electrons cannot move and the materials have very high resistivity, so quantum oscillations of this sort are not expected to occur, no matter the strength of magnetic field is applied.*

*When the researchers where studying this material called tungsten Ditelluride, which they made into a two dimensional material. They actually shave the layers of  $WTe_2$  till it became a monolayer- a single atom-thin layer. Thick  $WTe_2$  behaves like a metal. But once it is converted to a monolayer it becomes a very strong insulator.*

*So in this way it has a ‘lot of special quantum properties’ Then it is set about measuring the resistivity of the monolayer Tungsten Ditelluride under magnetic fields. It was strange to see that the resistivity of the insulator, despite being quite large, began to oscillate as the magnetic field was increased, indicating the shift into a quantum state. In effect, the material **which is a very strong insulator was exhibiting the most remarkable quantum property of metal.***

*Basically there are no current theories to explain this phenomenon. But the physicists have put forward a provocative hypothesis-a form of quantum matter that is neutrally charged. With very strong interactions, the electrons are organizing themselves to produce this new kind of quantum matter.*



# FACTOPEDIA

- ❑ Have you ever wondered how touching your phone's screen can make things happen? The electrons in your fingertips repel the like-charged electrons in your phone's screen, causing the electrical circuit at that point to open and a programmed sensor to perform the action coded in the phone's software. That is why you cannot operate your average smartphone with your fingernail or pencil rubber; they do not have the proper electrical charge!
- ❑ There are more stars in the universe than grains of sands on earth
- ❑ **THERE IS A PLANET MADE OF DIAMONDS**  
There's a planet made of diamonds twice the size of earth The "super earth," aka 55 Cancri e, is most likely covered in graphite and diamond. Paying a visit to that planet would probably pay for the \$12 million dollar space suit needed to get there.
- ❑ What's heavier? Feather vs Brick: All objects fall at the same speed. Air resistance causes the feather to look that it's falling slowly.
- ❑ Hydrogen everywhere?: 74% of the atoms in the Milky Way galaxy are hydrogen atoms

# Pride of College



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