# PHYSICS

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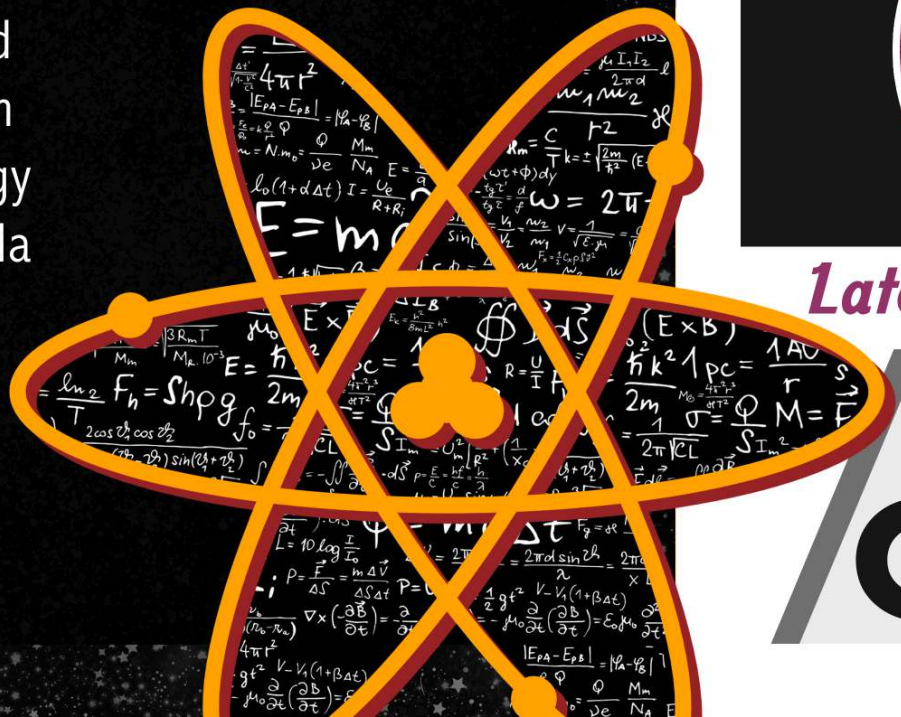

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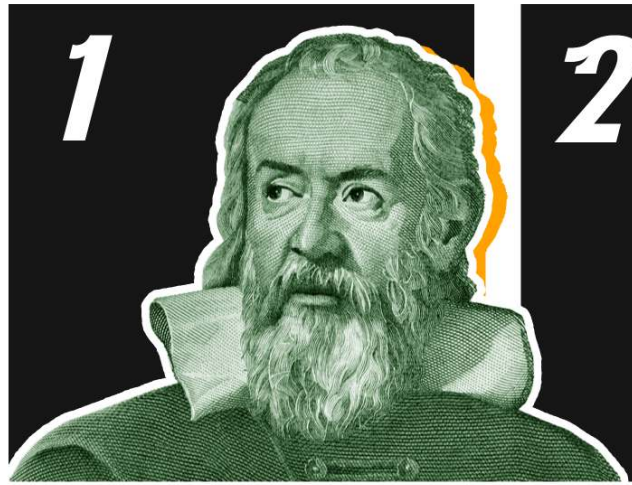
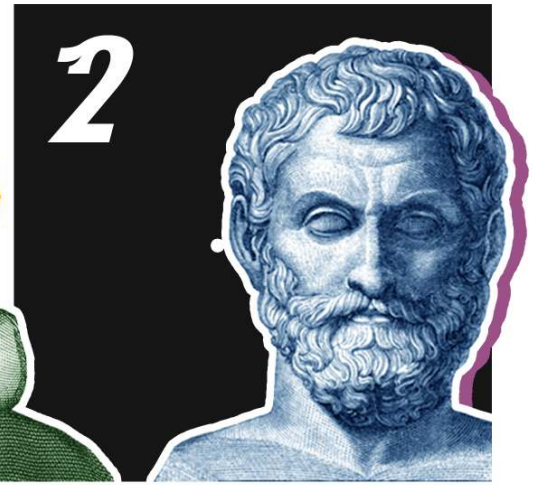



Galileo Galilei

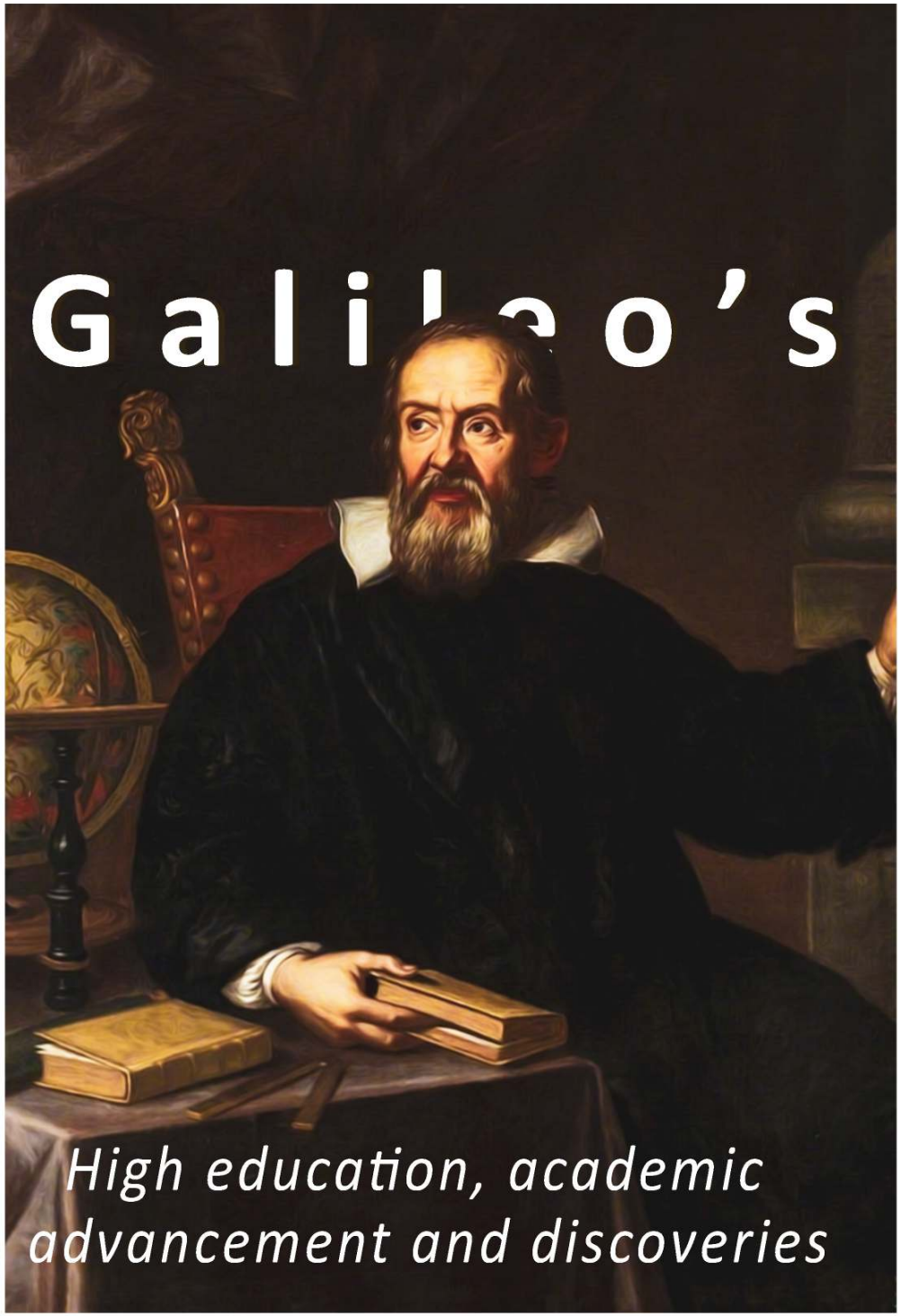



Aristotle


Latest News


Our Work

# MAGAZINE CONTENTS

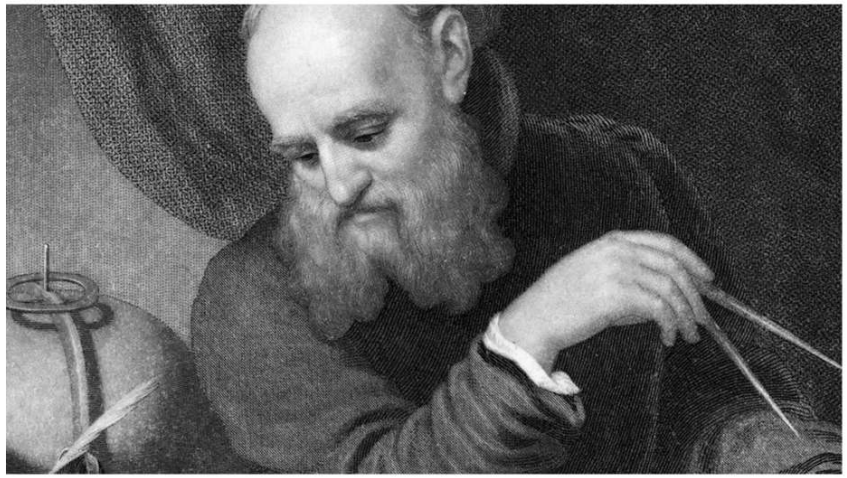



# Galileo's

## *High education, academic advancement and discoveries*

### *His Education*

**In 1851**, Galileo matriculated at the University of Pisa, as he studied medicine. However, he was enamored with mathematics, and decided to elaborate in mathematical subjects and philosophy, although his father' remonstrances. He self-learned the mathematics and Aristotelian philosophy (relative to Aristotle). Unfortunately, He left the university without



### *His Education*

**For many years,** he had given some mathematical lessons in Siena and Florence. In this period, he wrote a short treatise about his first invention, as he invented hydrostatic balance to measure the weight of small quantities. He also began his studies in motion. He applied for the chair of mathematics in the university of Bologna in 1588. Although he was refused, his reputation was still increasing.

He asked to give two lectures in a prestigious literary group called Florentine Academy. He put some ingenious theorems in the center of gravity which gave him recognition from some mathematicians then such as Guidobaldo del Monte (a nobleman and author having several important works in mechanics).

And finally, he could obtain the chair of mathematics in university of Pisa in 1589.

He discovered by experiment that the speed of fall of heavy objects don't depend on its weight as Aristotelian philosophy believed, instead he took the Archimedean approach to solve this problem.

Although his attacks on Aristotle affected his reputation from his colleagues, His patrons could secure his chair of mathematics at university of Padua in 1592, as he taught there from 1592 to 1610.

***In 1609,*** he continued his researches in motion, so he discovered that the distance covered in free-fall motion is proportional to the square of time elapsed and the trajectory equation of projectile (parabola).

Galileo portrayed with a telescope resembling his astronomical discoveries.

# Astronomical Discoveries

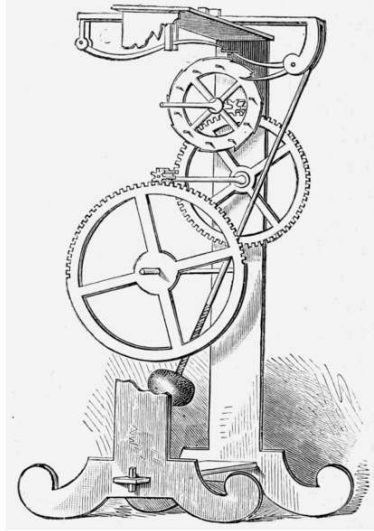

Galileo model of the solar system.


Phases of Venus between October 26 and December 28, 2016 as described by the work of Galileo.

In 1609, Galileo heard about a new invention in Netherlands can be used in magnification of distant things which was called (telescope). So, he figured out this invention and had made his own three powered spyglass from lenses, which enabled him to produce highly powerful telescope. In August for the same year, he introduced his eight-powered instrument to the venetian senate that rewarded him by doubling his salary. So, in this period, he became the highest-paid professor in the university. In the same year, he had magnified his instrument for twenty times and began to notice the heavens. He could draw the moon's motion and realized that its surface isn't smooth, but it is rough and uneven. At early in 1610, he discovered four moons moving around Jupiter, and its telescope could observe a huge number of stars over those which can be seen by naked eye. For his numerous discoveries in astronomical field, he wrote a small book that was called (Sidereus Nuncios). He also discovered the puzzling shape for Saturn which appeared with a ring surrounding it and he noticed that Venus passes by some phases like the moon which proved that Earth has a certain orbit around the sun, but Galileo wasn't central in his studies, as he considered that the sun is the center of universe.

# The First Pendulum Clock

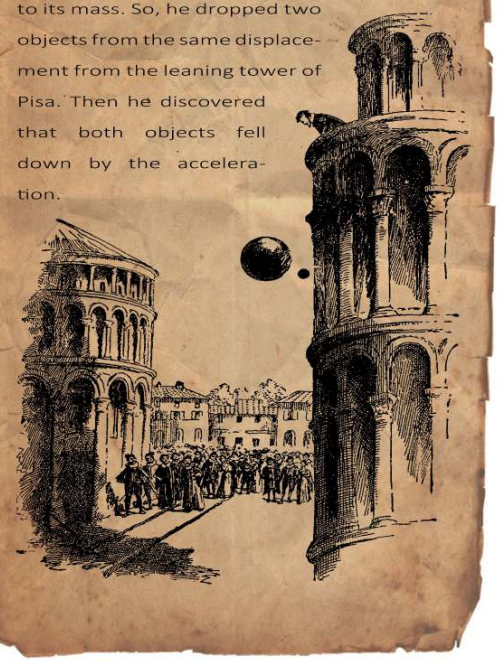
When Galileo was a young man, he noticed that pendulum swings at a constant rate, At the end of his life he created for using pendulum to regulate the mechanical clock, however, the first pendulum clock was manufactured after 15 years from his death. He noticed this strange behavior of the pendulum when he was a student in Pisa Cathedral, and he noticed that the elapsed time for getting pendulum forward and backward is independent of the amplitude. Then, it was though that the first pendulum clock was constructed by Galileo's son (Vincenzo), the evidence is that the model of time management gallery in the science museum in London in 1883 includes some books clock making with practical details for Galileo's scheme.

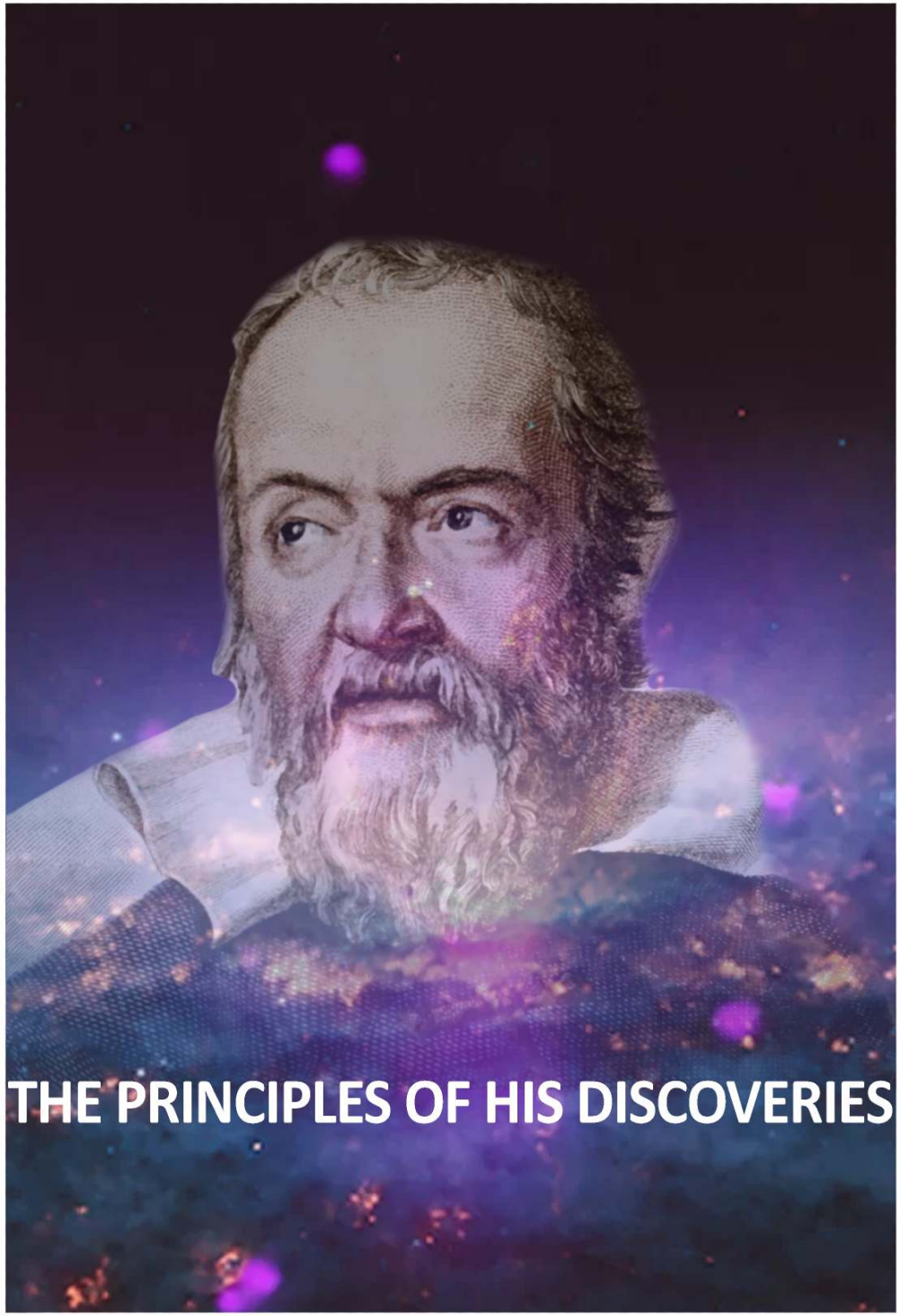


Galileo sketch for the pendulum clock.

## THE PISA TOWER EXPERIMENT

Galileo tried in this experiment to prove that the free-fall object's velocity is independent to its mass. So, he dropped two objects from the same displacement from the leaning tower of Pisa. Then he discovered that both objects fell down by the acceleration.





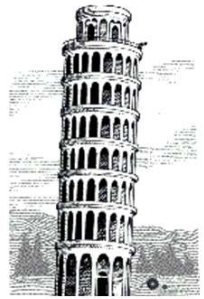

# The principles of his discoveries

***Hydrostatic balance:***

is a set of scales with two pans, each of them equipped with a hook, and a bar which can be lowered or raised by rack and pinion mechanism. This can be an evidence for Archimedes principle: (Any object immersed in a fluid is objected to buoyant force which proportional to the density of the liquid and the volume of the object as: Fbyuoyant =ρvg). Two spheres of the same weight and volume are attached to the bar to balance the scale. then the two balls are lowered in two different liquid for example water and alcohol. Because the alcohol is less dense than water (and so less buoyancy), the balance is no longer balanced.

***Free-fall motion:***

Galileo was the first who proved that the quotient of dividing Δv/Δt (acceleration) is constant which equals to 9.8m/s2, and he put the average velocity concept in the free-fall application, as he supposed v0 is equal to zero, and defined the average velocity as a number between zero and final velocity which can be generalized as the average velocity= ½ v final. Then Δd=vav *Δt. Then Δd= ½ v *t, Δd= ½ a *t2, which proved that the distance covered in free-fall motion is proportional to the square of elapsed time.

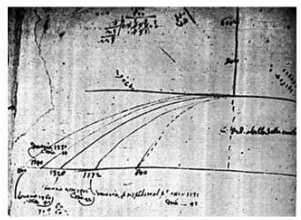


***Pendulum clock:***

the basic principle of pendulum clock that is the potential energy for descending weight is dissipated in regular pulses. When he compared between two pendulums with different angles. They, however, have the same period. He tried to change the mass of the object tied with the string in one case and let the other. He noticed that they have also equal periods. So, he recognized that pendulum moves in a constant rate neglecting the change in amplitude, the angle or mass.

***Trajectory of projectile:***

Galileo described that the projectile motion is classified as a motion in two dimensions which are uniform horizontal motion (x axis), and the naturally accelerated vertical motion (y axis), which makes a curved path shown by Galileo as a parabola. So, he put the equation of trajectory that caused this parabolic shape: y = ax+ bx2, as a= tan θ, and θ is the launch angle or the angle of projectile, and b = (-g)/( 〖2u〗 ^2 〖cos〗 ^2 θ) , as u is the initial velocity and g is the gravitational acceleration.

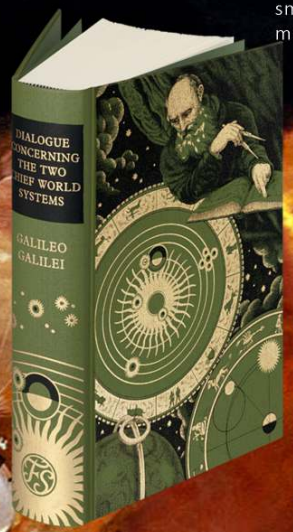


# Galileo's books

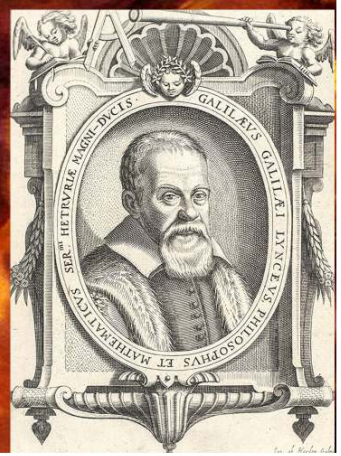
1- In 1604, he published The Operations of the Geometrical and Military Compass, which showed his experimental skills and practical technological applications.

2- In 1610, The Starry Messenger, which contains Galileo's discoveries about moon's surface that isn't smooth or flat but with crates and mountains.

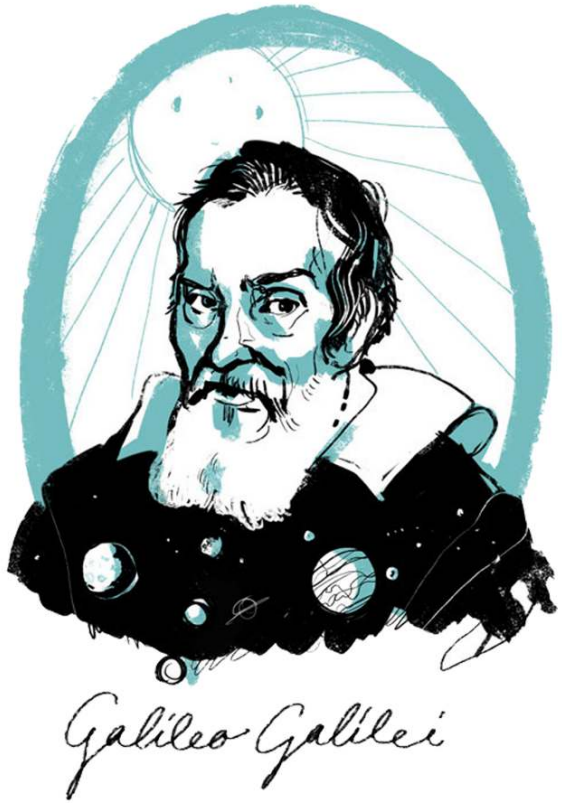
3- In 1612, Discourse on Bodies in Water, which refused the floating principle of Aristotle that he showed that it doesn't depend on the shape of the body instead its weight.




4- In 1638, Two New Science, which includes a brief for his discoveries in motion and strength of materials.




# Galileo's death




By the end of his life, Galileo became blind. In 8th January 1842 He died in Arcetri, as he was suffering from heart palpitations and hard fever, after he had presented his new philosophy in science and its applications and showed his opinion that mathematics is mother language of new science. He actually deserved the nickname of "the father of modern science".-

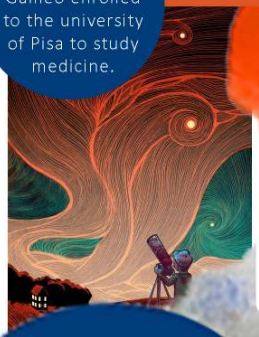
# Timeline of important Events

15/2/1564

Galileo's birth, as he grows up, he became accomplished lutenists with his brother


5/9/1581

Galileo enrolled to the university of Pisa to study medicine.



1586

Galileo invented the hydrostatic balance.

1638

Galileo introduced his book of two new sciences that showed his ingenious discoveries in kinematics and strength of materials.

1612

Galileo published Discourse of bodies in water to show his refusing for Aristotle principle in the issue of immersing bodies in water

1589

Galileo acquired a position of mathematics chair in the university of Pisa

1591

Galileo's father dead, and Galileo's responsibilities increased

1610

Galileo discovered four moons of Jupiter by his telescope, and many of stars that weren't visible by the naked eye.

1609

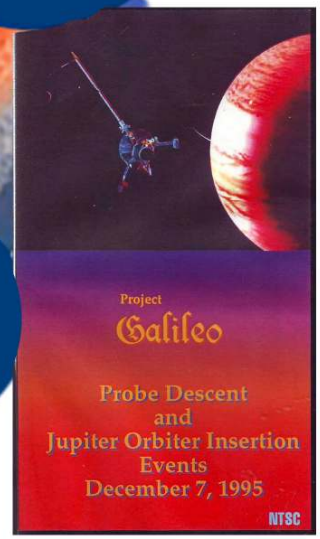
Galileo invented his modified telescope and began his astronomical discoveries.

13/8/1600

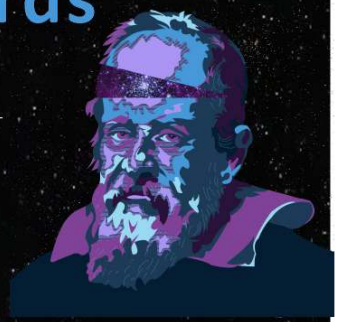
Marina Gamba bore Galileo the second daughter (Virginia) after her eldest sister (Livia).

8/1/1642

Galileo's death

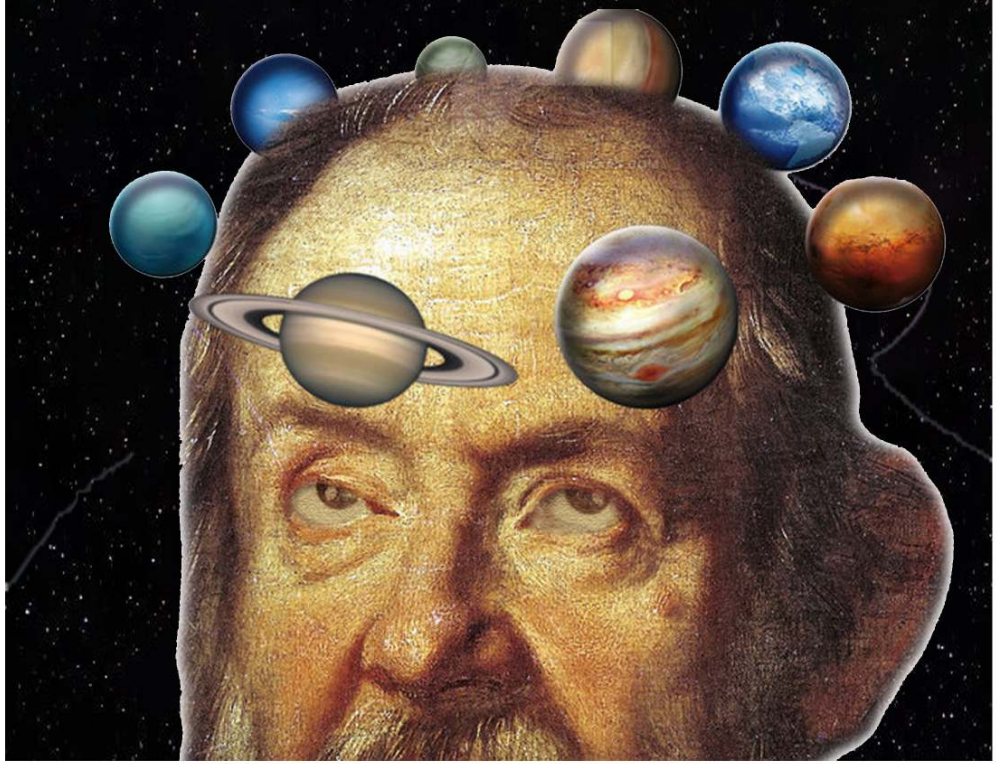


# Galileo's philosophy and some Mathura words



1- "We can't teach people anything; we can help him to discover it within themselves"
2- "It's surely harmful to souls to make it a heresy to believe what is proved"
3- "The truths are easy to understand once they are discovered, the point is to discover them"

4- "In sciences, the authority of thousands of opinions isn't worth as much as one tiny spark of reason in an individual man"
5- "There are those who reason well, but they are greatly outnumbered by those who reason badly."



# Aristotle

**"All men naturally desire knowledge"**

- **Greek philosopher.**
- **Was born in 384 B.C. in Stagira in northern Greece and died in 322 B.C.**
- **Was a student of Plato.**
- **Covered most of the sciences and my arts.**
- **Early modern theories are based on his old theories.**
- **Wrote many books, one of them was On the Heavens.**
- **Tutored a Macedonian boy who later became the empire builder Alexander the Great.**
- **In Arabic philosophy, he was known simply as "The First Teacher"; in the west, he was "The Philosopher."**

## In the Middle of the Heavens

During the many years that humans have been on Earth, Humans have been looking up at the stars trying to understand the concept of what the Universe looks like, how does it work? and where are we in that big Universe surrounding us?

In time, from ancient Babylonian and Egyptian astronomers to contemporary Mediterranean ones many discoveries and theories have been made of how the Universe works but only one of all these theories was led us to the current Heliocentric model. That only one theory was made by the Greek philosopher "Aristotle" who was also scientist and artist. "**It is clear that the earth does not move, and that it does not lie elsewhere than at the center**" Aristotle said. We might feel confused by Aristotle's words, is it possible that the Earth does not move?! Or do we really lie at the actual center of the whole Universe?!

In the 4th century B.C.E, Aristotle described the four elements forming the world which are Earth as the heaviest one, water, air and fire as the lightest one. He also believed of the existence of a fifth element unlike anything on Earth called it "Aether" that refers to the incorruptible substance which the planets and revolving celestials beyond Earth including the sun and moon were composed of. Aristotle also 'lightness' was the nature of moving away from the center and 'heaviness' was the nature of moving toward the center. The same goes for vertices; the lightest rises to the top, and heaviest moves downward so Earth was the heaviest element, hence why it moved towards the center; whereas water, fire and air formed layers around it.

Beyond the layers of the four elements, there are solid spheres of aethers (planets) are moving with constant velocity in circular motion. Aristotle believed that the initial motion of the objects was from a 'prime body' who acted on the outermost sphere which all planets and earth are in it causing a uniform circular motion with different magnitudes for each planet.

There are many observations supported the theory of Aristotle. For one, if the Earth were to move, scholars believed that there would be an observable change in the positions of the fixed stars and constellations. Another observation that supported geocentric theory was the apparent consistency in Venus' luminosity, which was interpreted to mean that it was the same distance from Earth at any given time.

The model created by Aristotle was a part of multiple examples described as the geocentric model. His model had a total of 55 objects in his idea of the universe. At the center of the universe laid Earth. From the center to the farthest exterior, the objects were as follows: Earth, Moon, Mercury, Venus, Sun, Mars, Jupiter, and Saturn. Past Saturn, stars were in a fixed position.

It is surrounded by ten concentric spheres made of a perfectly transparent substance known as "quintessence." These spheres revolve around the earth, carrying the other celestial bodies. As you can see, one is the sphere "of the Moon" ("Lunae"), two is Mercury ("Mercurii"), three is Venus ("Veneris"), four is the Sun ("Solis"), five is Mars ("Martis"), six is Jupiter ("Iovis"), seven is Saturn ("Saturni"), and spheres eight, nine and ten hold the "fixed stars"

It is interesting that it would be pretty similar to our current model if we change the position of the Earth and the Sun, then bring the moon to Earth. Although Aristotle's Universe ended near the fixed stars, his model lasted until the 16th century CE.

Understanding the cosmology, physical universe is one of the oldest and most beautiful sciences at all. "**We are just an advanced breed of monkeys on a minor planet of a very average star. But we can understand the Universe. That makes us something very special**." Said Stephen Hawking.

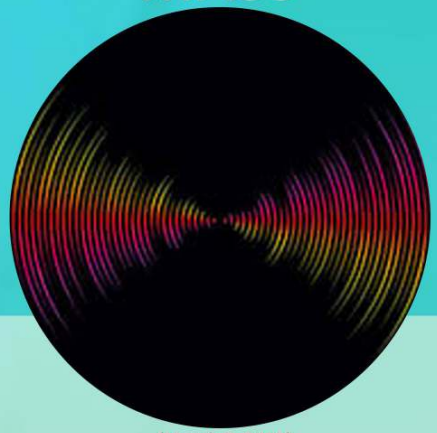

PHYSICS
NEWS

# WORMHOLES

*(April 15, 2019)*

Have you ever wondered whether travelling by wormholes is possible? Do they even exist?
A physicist from Harvard has shown theoretically that wormholes can exist: tunnels in curved space-time, connecting two distant places, through which travel is possible.
After many studies and many theoretically successful attempts to relate many of the theoretical assumptions of the wormhole to the blackholes which are somehow getting more familiar, it was announced by Daniel Jafferis, the author of this research, that travelling through wormholes takes much longer than travelling to the same place using an ordinary spaceship which indicates that it is entirely useless to be used for transportation by humans.
However, his findings were not useless, He says *"The real import of this work is in its relation to the black hole information problem and the connections between gravity and quantum mechanics,"* Jafferis said
This was anchored by the Juan Maldacena from the Institute for Advanced Study and Lenny Susskind from Stanford who also found that the direct connection between the black holes is shorter than the wormhole connection and therefore the wormhole travel is not a shortcut.
Jafferis further says *"From the outside perspective, travel through the wormhole is equivalent to quantum teleportation using entangled black holes"*. He based his theory on a setup first devised by Einstein in 1935 consisting of a connection between two black holes (which is basically a wormhole). Because the wormhole is traversable, Jafferis said, it was a special case in which information could be extracted from a black hole.
The idea of formulating a traversable wormhole isn't new. We have been trying to do so for quite some years now, but a major block that has been stumbling us is the need for negative energy. However, Jafferis has overcome this using quantum field theory tools. Jafferis believes that his theory can reformulate quantum mechanics.

# SOUND CARRIER MASS



*(March 7, 2019)*

It was always believed that sound waves are not but invisible moving weightless through the air. However, physicists have proven that sounds can really do carry tiny amounts of mass, which mainly means that it can make its own gravitational field. This is important to provide us a better understanding of space.
Last year, physicist Alberto Nicolis from Columbia University in New York worked with a colleague from the University of Pennsylvania in Philadelphia to investigate how different waves decay and scatter in a super cold fluid of helium.
This experiment showed that sound creates a non-zero value for mass, and they also kind of "float" along gravitational fields in anti-gravity sense. On small scales as with this on our earth it does not really make much difference. However, when it comes to large stars' quaking roars in the space that pulse through dense objects like neutron stars that is when the interactions between massive sound waves and gravity could be important.
Also, it must be cleared that the mathematical proof hasn't yet been put to test. But theoretically, it is a pretty good step in terms of physics. The researchers suggest it might be easier to weigh an earthquake. The sound generated by a large tremor could amount to billions of kilograms of mass.

# CONTROLLING THE SPEED OF LIGHT

*(April 4, 2019)*

Researches of the university of central Florida have been working on a way to control the speed of light, not just that but also to travel it backward.
Their recent researches have been published in nature and they are expected one day to lead to more efficient optical communication. The technique mentioned in the research could be used to lessen data congestion but in the same time with no information loss. The greatness of such an achievement lies behind the fact that there are more and more devices coming online and data rates are becoming higher.
It is known that many attempts have been made to do so in the past but the new thing about this research is that this new technique involves no passing-through material to speed it up or slow it down which means it is just done in the open. As said study co-author Ayman Abouraddy, who is a professor in UCF's College of Optics and Photonics : *"This is the first clear demonstration of controlling the speed of a pulse light in free space,"*
They managed to speed up a pulse of light up to 30 times the speed of light and managed to slow another one to its half and most importantly, they did make a pulse go backward using a special device called the spatial light modulator. This device was mainly used to mix space and time properties of light to allow them to control the velocity of light.
*"We're able to control the speed of the pulse by going into the pulse itself and reorganizing its energy such that its space and time degrees of freedom are mixed in with each other,"* Abouraddy said.

# ARTIFICALLY MADE ATOMS

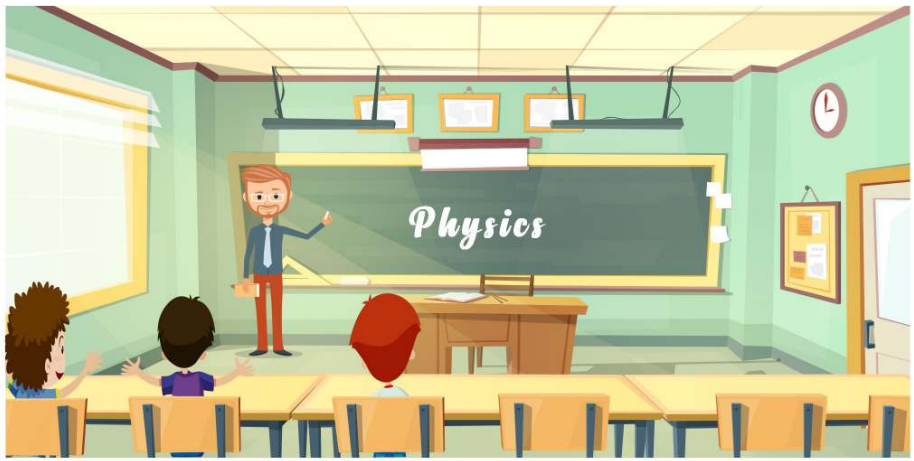
*(April 11, 2019)*

It is true that we all dream of an ultra-secure online communication. This goal has just become a step nearer after this research has been published and it is expected to help develop a secure quantum communication networks and all-optical quantum computing.
*"The big breakthrough is that we've discovered a simple, scalable way to nanofabricate artificial atoms onto a microchip, and that the artificial atoms work in air and at room temperature,"* said Alemán, a member of the UO's Materials Science Institute.
In the future, these artificially made atoms could be used for safer, more secure, totally private communications, and much more powerful computers that could design life-saving drugs and help scientists gain a deeper understanding of the universe through quantum computation.
The first artificial atom made by the team was made from white graphene. till now they seemingly behave the same as a regular atom and possesses the same properties like for example the single photon emission.
Alemán knew that fabricating the artificial atoms is the first step towards harnessing them as sources of single particles of light in quantum photonic circuits which is a huge step for science
*"Our work provides a source of single photons that could act as carriers of quantum information or as qubits. We've patterned these sources, creating as many as we want, where we want,"* Alemán said. *"We'd like to pattern these single photon emitters into circuits or networks on a microchip so they can talk to each other, or to other existing qubits, like solid-state spins or superconducting circuit qubits."*

# GREETINGS FROM PHYSICS CLUB!!

The ultimate dream in life is to be able to do what you love and learn something from it; this is what we had done. We are a group of students that share the same passion, which is physics. So, we decided to make something to document this passion in physics. As a result, The physics club was founded in February,2019. The Physics Club exists to provide events and service opportunities that both explore and promote interests in physics the entire school community. Beyond the task of promoting physics, these events and gatherings are meant to develop a sense of friendship and growth in all avenues.

Throughout the Last few Months, the club made a lot of things to serve the school community. There were night sessions that were held to 10 graders to explain some of their problematic concepts in their curriculum. Moreover, there were experimental sessions that were given in the school's physics Laboratory to explain the experientable concepts to be easier for our students. besides, the club gave calculus sessions as one of the club goals is helping the students to be prepared for national or international competitions. That's why there were sessions that help in improving students' mathematical base. One of the competitions that the club had participated in is Beamline competition demonstrated by CERN.




To sum up, the club's purpose is enhancing its members' understanding of the fundamental laws of nature. Some meetings will center around hands-on activities, analysis of interesting problems, and physics competitions. One thing is guaranteed- members will never leave bored or mentally under-stimulated. I KNOW, we did not make a remarkable achievement to our school, but IT IS JUST A BEGINNING.....