

## Motion in One Dimension

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$\Delta x \equiv x_f - x_i$$

$$\bar{v} \equiv \frac{\Delta x}{\Delta t}$$

$$v_i \equiv \lim_{\Delta t \rightarrow 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

$$\bar{a} \equiv \frac{\Delta v}{\Delta t}$$

$$a_i \equiv \lim_{\Delta t \rightarrow 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

$$x_f - x_i = v_i t + \frac{1}{2} a_i t^2$$

$$x_f - x_i = \bar{v} t = \frac{1}{2} (v_i + v_f) t$$

$$v_f^2 = v_i^2 + 2a_i(x_f - x_i)$$

## Vectors

$$A_x = A \cos \theta$$

$$A_y = A \sin \theta$$

$$\vec{A} = A_x \hat{i} + A_y \hat{j}$$

$$A = \sqrt{A_x^2 + A_y^2}$$

$$\theta = \tan^{-1} \left( \frac{A_y}{A_x} \right)$$

## Motion in Two Dimensions

$$\vec{r} = x\hat{i} + y\hat{j}$$

$$\Delta \vec{r} \equiv \vec{r}_f - \vec{r}_i$$

$$\bar{v} \equiv \frac{\Delta \vec{r}}{\Delta t}$$

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$\vec{r}_f = \vec{r}_i + \vec{v}_i t + \frac{1}{2} \vec{a}t^2$$

$$y = (\tan \theta_i) x - \left( \frac{g}{2v_i^2 \cos^2 \theta} \right) x^2$$

$$h = \frac{v_i^2 \sin^2 \theta_i}{2g} \quad R = \frac{v_i^2 \sin 2\theta}{g}$$

$$a_r = \frac{v^2}{r} \quad a_\theta = \frac{dv}{dt}$$

$$\vec{a} = \frac{d|\vec{v}|}{dt} \hat{\theta} - \frac{v^2}{r} \hat{r}$$

## Chapter I

# Introduction to the Knowledge of the world

## The Laws of Motion

$$\sum \vec{F} = m\vec{a}$$

$$\vec{F}_{12} = -\vec{F}_{21}$$

$$\vec{F}_g = m\vec{g}$$

$$f_s = \mu_s n$$

$$f_k = \mu_k n$$

$$F_{spring} = -kx$$

## Circular Motion

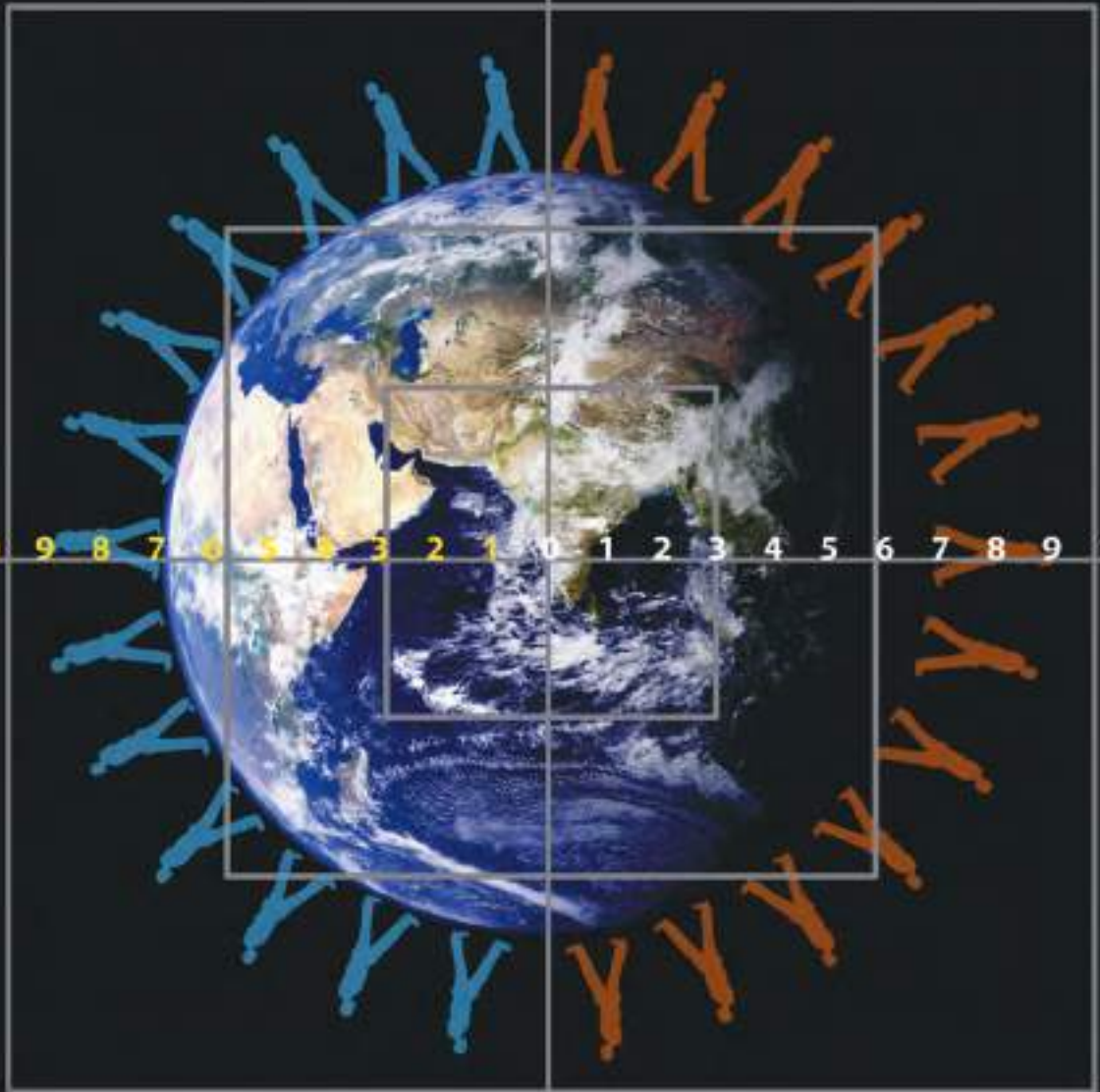
$$\sum \vec{F}_c = ma_c = \frac{mv^2}{r}$$

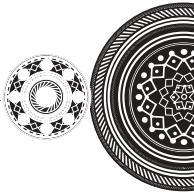
## Work and Kinetic Energy

$$W = Fd \cos \theta = \vec{F} \cdot \vec{d}$$

$$\vec{A} \cdot \vec{B} = AB \cos \theta = A_x B_x + A_y B_y + A_z B_z$$

$$W = \int \vec{F} \cdot d\vec{x}$$





**W**hen I was a little boy, I asked my mother what that marvelous world of stars that flickered above my head was called.  
“**The sky,**” she said.  
“**And who made the sky?**” I asked again.

“**God, my child. He is the creator of the whole world,**” my mother again good-naturedly answered me.

I remained pensive for a while, staring at the ground.

“**And what lies under our feet, mama?**”

“**Hell, my child, where bad people go after their death, and at the Second Coming.**” At nightfall, before I fell asleep, I looked up high, at the flickering stars. I was very sure that somewhere there among them, God existed!

Then I looked down, at the night-covered ground. I was gripped by awe.

I wondered... what terrible things were happening beneath my feet, caused by the powers of darkness?

That night I did not sleep a wink out of fear.

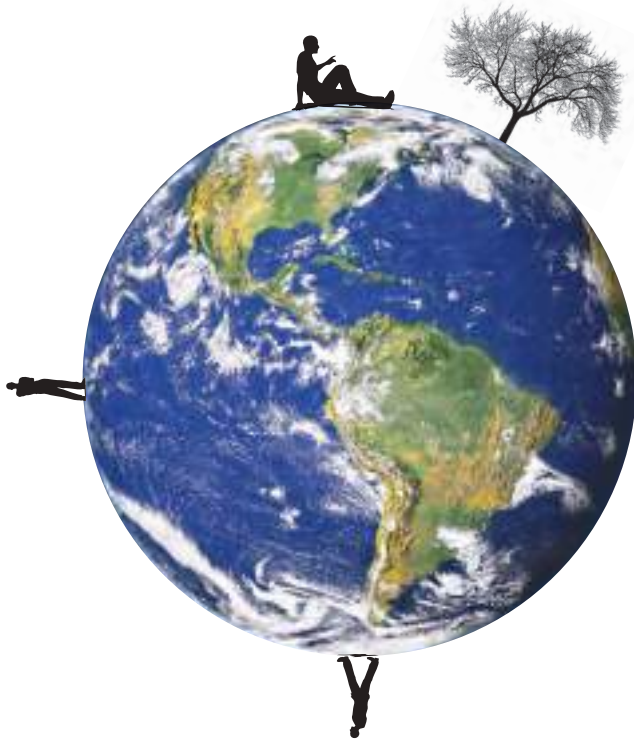
When I grew older, an adolescent now, with an intense thirst for knowledge, I came to realize that, on this round earth, which swims in the Universe, that which for me is up, to another person on the opposite end of the earth is down. That which for me was in front and distant, for another could be behind him and near.

When I grew older, I learned that of the stars I see in the sky, half have been extinguished thousands of years ago, and in their place are other stars, which I do not see, because their light has not yet reached earth... and that other stars are not to be found where I see them, but in another place. Then I realized what a great difference there can be between what “**appears**” and what actually “**is**”. I understood that “**up**” and “**down**”, “**front**” and “**back**”, “**left**” and “**right**” represented conventional notions.

Further, I understood that between a telescope and a microscope was I, the man, the observer, who investigated, in the depths of space and time, the macrocosm and the microcosm.



Supernova blast bonanza



I came to realize that, on this round earth, which swims in the Universe, that which for me is up, to another person on the opposite end of the earth is down.

And then, for the first time, I experienced anguish in trying to prove whether the world, which functions within me and the environment, which I perceive with my five senses to be outside me, are related. Whether I am alive now and, simultaneously, in the future. I was then convinced that my perception is found in the center of a cycle where multiple opposing forces act, with balanced tendencies, giving birth to “becoming”, the cosmic harmony. The past and the future, the “**esoteric**” and the “**exoteric**”, the “**vacuum**” and the “**plenum**”, “**darkness**” and “**light**”, “**being**” and “**non-being**”, the “**true**” and the “**untrue**”...all of them exist, function and produce life, centered around an eternal “now”. Approximately 2,500 years have passed since the time of Aristotle and the other great sages of the ancient Greek world, up to our own time, which is the era of Einstein, Hawking and all leading scientists who strive to interpret the laws of the Universe.

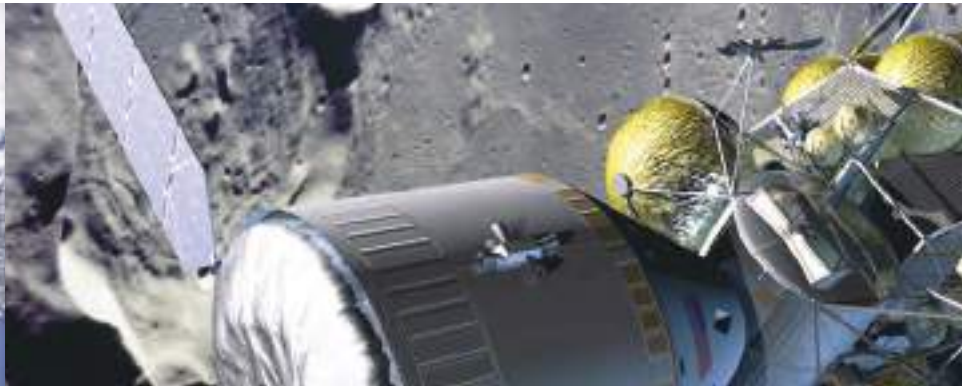
During that period, science has made many leaps. The agony of man to comprehend the Universe has always been great.







Pic.a



Pic.b

a. Image taken by the MERIS instrument on board Envisat on 24 March 2002. The beautiful turquoise colour of the waters around these islands is due to shallow water and the presence of coral reefs.

b. Advanced Camera for Surveys (ACS), the newest camera on NASA's Hubble Space Telescope

Enormous telescopes, from every corner of our planet, explore the starry sky at night, gazing at distant worlds many billions of light years away. Scientific laboratories devoted to the study of cosmic space, circle in orbit, beyond the earth's atmosphere – some manned and some unmanned – struggle to detect among the billion clusters of galaxies a replica of our planet; to hear the voices of intelligent beings, within or beyond our Galaxy; to prove that our plane, is not a an original model of life in the infinite space of the Universe, but a replica of other similar stars that are hospitable to life. However, until today, the Universe, **“has kept silent”**. That distant voice, which will come from within the stars, to declare **“the great presence”** of another society of intelligent beings, has yet to be heard.

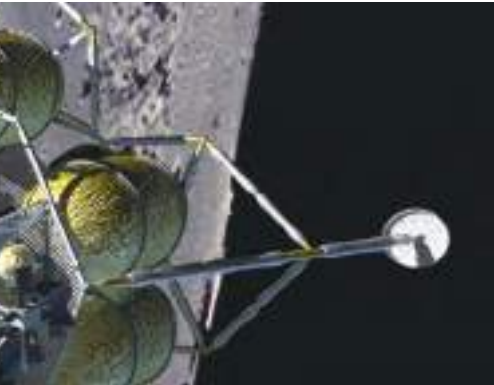
Space rockets launched from earth many years ago, travel at this very moment amidst the stars of our galaxy, striving to discover new worlds in the ocean of space, to receive some message of life, which will break the great silence of cosmic space.

However, man is not searching solely to find another star or planet with intelligent beings.

He is striving to discover the identity of the Universe itself.

He struggles to find an explanation of “why the Universe exists”.

The human mind turns back in time; it passes through the



Pic.c

Pic.d

aeons and the millennia, striving to reach the point where the “**fixed past**” awaits immobile at the “**Nothingness**” station, to embark on the journey of “**motion**”, by boarding the vehicle of the future Space-Time Continuum. Certain scientists of our era have named that station “**Beginning**”. The beginning of motion, the beginning of time, the beginning of space, the beginning of Creation. The great, perennially speculated question has been: “**Is there a beginning?**” **If there is, what was there before the beginning?** “**Nothingness?**” and if there is a beginning, is there an end as well? And if there is an end, do we have the same situation, which existed before there was a beginning?

These questions torment man today, have tormented man in the past and perhaps will still torment him for many years to come. And, I wonder, can the answer be found in our minds?

May it indeed have to do with the interactive relation of wisdom and the celestial world? Or, perhaps, the passionately desired answer lies only within numbers and equations.

Briefly, is cosmogony cosmography?

This study is devoted to addressing this question.

c. NASA’s new crew exploration vehicle in lunar orbit.

d. Located 300 million light-years away in the constellation Coma Berenices, the colliding galaxies have been nicknamed “The Mice” because of the long tails of stars and gas emanating from each galaxy. Otherwise known as NGC 4676, the pair will eventually merge into a single giant galaxy.

Credit: NASA, Holland Ford (JHU), the ACS Science Team and ESA

