



# THE SCIENTIFIC VIEWS OF THE GREAT SCIENTIST ABU RAYHAN BERUNI IN THE FIELD OF MATHEMATICS

B.H. Eshpulatov<sup>1</sup>

G.E. Abdurakhmonov<sup>2</sup>

Teacher, Navoi State Pedagogical Institute<sup>1,2</sup>

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## ABSTRACT

*In this article, there is given the life of the great scientist of the encyclopedia Abu Rayhon Beruni and his view point of mathematics.*

**KEYWORDS:** *theology, Beruni century, genealogy, theorem, trigonometry.*

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## INTRODUCTION

The encyclopedic scholar Abu Rayhan Muhammad ibn Ahmad was born in 973 in the ancient capital of Khorezm, Kot (Kat). Beruni is a great Uzbek thinker, one of the great geniuses of the Middle Ages. He thoroughly mastered all the sciences of his time, first of all astronomy (physics), physics, mathematics (mathematics), theology, mineralogy. With his contribution to the development of these sciences, his name became one of the great figures of world science.

The book of the first President of Uzbekistan IA Karimov "High spirituality is an invincible force" contains the following thoughts about Beruni:

Another brilliant star of our national history, Abu Rayhan Beruni, gave a fair assessment of his work, while the American historian of science Sarton CHI described the century as the "Beruni century". Such a high and justified assessment is explained, first of all, by the invaluable contribution of our great compatriot, the owner of encyclopedic thinking, to the development of science. It should be noted that Beruni thought with great objectivity and truthfulness in scientific matters, as well as in the assessment of historical events and contemporaries. That is why he has suffered so much in life, even at the end of his life, but in spite of all the hardships, he has not renounced his faith, which shows how faithful he is to his spiritual ideals. ”<sup>1</sup>

## METHODS

In his genealogy, the word "berun" means an outer city, and "Beruni" means "one who lives in an outside city." Beruni's interest in science was strong from a young age. The famous scholar Abu Nasr ibn Iraq was educated by Mansur. Ibn Iraq introduced Beruni to Euclidean geometry and Ptolemy's astronomical teachings. Ibn Iraq wrote several works on astronomy and mathematics, 12 of which are dedicated to Beruni. Beruni also always mentions his teacher's name with great respect. At a time when scientific works are kept in the hands of some individuals in very few copies and in manuscript form, the fact that a young scientist has mastered so many different fields of science shows that he is extremely talented. Beruni has created effectively in all fields of science, his scientific heritage is very wide and colorful. Beruni's scientific legacy consists of 152 books and pamphlets. 20 of his works are related to mathematics. His contribution to the science of mathematics is significant. In Beruni's works, the concepts of geometry, arithmetic, algebra, number theory and trigonometry are described in a certain order. The great achievement of the scientist in arithmetic and algebra is that irrational numbers have become equal subjects of arithmetic and algebra. Beruni made great strides, especially in the field of trigonometry.

Beruni worked on finding the general laws of trigonometric functions. Beruni's Mas'ud Qanuni (Al-Qanun al-Mas'udi) was written in 1030. Al-Qanun al-Mas'udi explains in detail the basic rules of mathematical astronomy, the coordinates of the lights, the ways to calculate their order of motion, as well as the plane and spheric trigonometry. He developed the linear and quadratic interpolational rule of trigonometric functions,

proposed a method of averaging, gave the appropriate tables, and accurately calculated the amount of p for several decimal numbers.<sup>3</sup>

Abu Rayhan Beruni's "Monuments of Ancient Peoples" deals with chess. If the chessboard chambers are placed one after the other: first 1, then 2, then its square, cube level, geometric progression is formed.<sup>2</sup>

If these points are expressed by a formula, the following is formed.

$$1+2^1+2^2+2^3+2^4+\dots+2^{63}$$

These joins form a geometric progression. Here:

$$b_1 = 1, q = 2, n = 64.$$

According to the formula for finding the sum of the first n terms of a geometric progression:

$$S_n = \frac{b_1(1 - q^n)}{1 - q} = \frac{1(1 - 2^{64})}{1 - 2} = 2^{64} - 1 = 16^{16} - 1$$

From this we get the following result:

$$S_n = 18\ 446\ 744\ 073\ 709\ 551\ 615$$

Abu Rayhan Beruni's famous work "Qanuni Masudi" is a proof of the sine theorem.

Beruni states the sine theorem: "I say that the ratio of the side AB to the side BC is the same as the ratio of the angle sine of the ACB to the sine of the angle BAC."

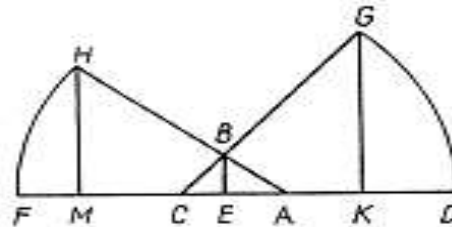
Let an ABC triangle be.

We continue the sides of the triangle ABC in their direction. Assuming that the end A of the triangle is the center and radius AH = 1, we draw the arc HF of the unit circle.

Now we draw the arc GD with the same radius as the center C of the triangle.

We pass the HM perpendicular for the AF section, the GK perpendicular for the CD section, and the BE perpendicular for the AC section. Then Δ from AHM: sinBAC = HM and Δ from CGK: sinACB = GK.

Δ ABE ~ Δ AHM, because HM || BE, hence



$$\frac{AB}{BE} = \frac{AH}{HM} = \frac{1}{\sin BAC} \quad (1)$$

Δ CBE ~ Δ CGK, because BE || GK, from

$$\frac{BC}{BE} = \frac{CG}{GK} = \frac{1}{\sin ACB} \quad (2)$$

(1) As for equation (2),

$$\frac{AB}{BC} = \frac{\sin ACB}{\sin BAC} \text{ equality is formed. The theorem is proved.}$$

Beruni also made a great contribution to the development of mathematical geography. He pioneered the development of ways to determine the geographical distance and latitude of places: by making extensive use of trigonometry and geometry, he achieved much more accurate results than his predecessors, the astronomers. He developed a new method of measuring the length of the earth's circumference. The Beruni method was based on mathematical calculations without the need for difficult and complex measurements for large distances. He found that one level of the arc of the earth's meridian was 110,275 m. This is very close to modern data.<sup>4</sup>

Beruni was the first to make a globe. This invention is still enjoyed by all geographers, every intellectual today. Beruni's indelible contribution to the history of the natural sciences is that he relied on the scientific research method, experiments, and observations he developed in his research work. He raised the method of observation and experimentation to an unprecedented level, which is his great achievement in the field of experimental knowledge. He also has his own ideas about the theory of knowledge. According to him, the basis of knowledge is the knowledge acquired through the members of the senses, which are the source of our knowledge of the world. Speaking of scientific knowledge in general, he says that it is an achievement of



intelligence. Beruni emphasizes the importance of experience in this area. Beruni, an encyclopedic scholar, died in 1048 in the Treasury. Beruni left wise thoughts on the acquisition of science. The following points can be exemplified from them.

Your knowledge is that it stays with you even when you are naked, and you can't lose water when you enter the bathroom.

Knowledge is the fruit of repetition and repetition.

Man has the right to think about this or that branch of science only on the basis of scientific practice and concrete research.

Whoever knows that the advantage of his research is in finding the laws, he will always go the way of proving his views in practice.<sup>3</sup>

## CONCLUSION

In short, it is the sacred duty of every teacher and mentor to study Beruni's scientific heritage in depth and to pass it on to today's youth and to educate them in the future as scientifically, spiritually and economically educated, intelligent and well-rounded people.

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