

Astronomy for students and amateurs

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Abstract. The book "Astronomy", written by Ts. B. Georgiev & P. L. Nedialkov, in Bulgarian, issued in 2017 by the Publishing house of NBU (New Bulgarian University, Sofia), is presented.

Key words: astronomy – general; astronomy – education

The book "Astronomy", issued in 2017 by the Publishing house of NBU (New Bulgarian University, Sofia), is an introduction to the modern astronomy. It is directed to a very wide audience - high school or university students and teachers. The book can be used as a learning aid and also - as a source of information for the preparation of lectures, seminars, etc. The needs of astronomy amateurs, who are significantly competent and demanding readers, have also been taken into account.

The book, with a volume of 336 pages, includes 8 tables and over 300 illustrations. There is also a list of 26 books that the readers could consider for further expansion and deepening of their knowledge.

The astronomy (including astrophysics) is a physical science based on facts, relationships, and laws whose understanding is an essential part of astronomy and science in general.

The subject of the science astronomy is the extraterrestrial cosmic world, including the distances, motions, structure and evolution of cosmic bodies and media, as well as the systems of bodies and media. The subject of astronomy is also the methodology for the study of the cosmic bodies and media. Most of such applications, developed especially for the astronomy, are widely used in our everyday practice. For example, the modern high-sensitivity digital cameras were developed in the 1970s for astronomical research.

The modern astronomy is a rapidly developing fundamental science aimed at continuing the study of the unique processes and phenomena in the universe, including extremely powerful sources of radiation and flows of particles. The developed countries invest huge resources for the construction and operation of very large telescopes at remote from the civilization locations on the Earth's surface or at a space orbit. At the same time, high-tech detectors of radiation and space particles are being developed and operated. By investing, modern astronomy is overtaken only by nuclear physics.

When writing the book, the writers understood that "it can not cover the infinite", but a certain concept must be followed. Such is exposed, for example, by Ephraim Levitan (*Zemlia i Vseennaya*, 2003, 1, 54-61). The authors share this concept and highlight the following main goals of the book: (1) To present basic information on extraterrestrial world as an important part of the modern culture of modern man; (2) Be an incentive for

the reader's further interest in natural and technical sciences; (3) Promote a worldview that rejects mysticism, superstition, and divination.



Fig. 1. Front cover of the book Astronomy

In accordance with these goals, the book contains a core of basic concepts, facts, laws and theories, the presentation of which is illustrated with numerous examples. In addition, sufficient attention has been paid to physical research methods, characteristic of all types of scientific and engineering activities. The absurdity of the foundations of astrology and the naive confidence in the existence of many cosmic civilizations has not been overlooked.

In this book, the numerous and profound results of astronomical studies are illustrated not so much by impressive images of space objects, but by meaningful graphs and diagrams. The latter, unlike the data tables, can communicate with the reader. That is why the authors have selected and adapted to the narrative numerous illustrations from different sources. Results, obtained at the National Astronomical Observatory (NAO) Rozhen and the Astronomical Observatory of Belogradchik are included for better visualization.

The authors consider the Astronomical Calendar of the Institute of Astronomy with NAO at the Bulgarian Academy of Sciences published during the recent years as a natural supplementary material to this book. Contemporary research results are published in the Bulgarian Astronomical Journal (BlgAJ, since 2006), available at <http://www.astro.bas.bg/>, as well as the Publications of the Astronomical Society of Bulgaria (PASB, since 2012), at <http://astro.shu-bg.net/pasb/>.

The book covers in a compact shape the foundations of the two parts of astronomy. The first one is classical astronomy, which studies distances, motions and observable morphology of cosmic objects and their systems. The second is modern astronomy, including astrophysics. It studies the astrophysical processes as well as the structure and evolution of cosmic objects and systems. The extraterrestrial world, generally referred to as the Cosmos, stands out with its vastness in space and time. Along with that, it is extremely diverse and characterized by a multitude of "non-earthly" facts, dependencies and laws.

The book presents the main facts, relationships and interpretations, such as the visible and the real motions of the cosmic objects, the celestial coordinates, the structure and evolution of the Earth, the Moon, the planets and the Sun, the structure and evolution of stars, stellar systems, Milky Way, galaxies and the universe. The physical conditions and processes related to the cosmic objects and the methods for their study are discussed.

The text of the book is divided into 13 chapters. The Astronomical coordinates and the time measurement are covered in chapters 1 and 2. The Earth, the Moon and the Solar System are discussed in Chapters 3–5. The concepts of radiation and spectra, and the modern knowledge of the Sun are given in Chapters 6 and 7. The Stars, stellar systems, galaxies and galactic systems are discussed in Chapters 8–11. The basics of Cosmology, i.e. the concepts of structure and evolution of the Universe as a whole, are given in Chapter 12. The Astronomy as a Science and a Practice, including the Bulgarian astronomy, are presented in Chapter 13.

The unusual in the field of the science astronomy is too much. As it is said, "For a few thousand years the human thought has reached galaxies that have been reached by light for billions of years" (Alexander Mihaylov, the author of a widespread Soviet astronomical school atlas) Therefore, the authors, admiring the diversity of the extraterrestrial world, have mainly referred those aspects of the astronomy basics that should be emphasized according to their views. Astronomical information on the Internet is enormous and impressive, but fragmented. Therefore, the astronomy introductory book should focus on the system of basic astronomical concepts. The descriptive part of astronomy necessarily involves many numerical data. When different astronomical objects are considered, the ranges of variance of the physical parameters and the correlations between them, which should also be emphasized, are important and illustrative.

Here is the contents of the book.

Introduction. The extraterrestrial world in this book

Chapter 1 Basic elements and visible motions of the celestial sphere

1.1 Astronomical observations. Basic elements of the celestial sphere

1.2 Daily rotation of the celestial sphere. Twilight and refraction

- 1.3 Annual rotation of the celestial sphere. Sidereal time and ecliptic
- 1.4 Axial precession of the celestial sphere. Observational manifestations of the precession
- 1.5 Astrology and Astronomy. Checkability of the astrological predictions

Chapter 2 Celestial coordinates, timing, and stellar magnitudes

- 2.1 Astronomical coordinates – horizontal, equatorial and others
- 2.2 Solar time – true, local mean, standard, daylight saving
- 2.3 Julian and Gregorian calendar. Synodic, sidereal and other periods
- 2.4 Hipparchian stellar magnitudes. Constellations, stellar maps and catalogs
- 2.5 Stellar Time – definition, basic formula and applications

Chapter 3 The Earth and the Moon

- 3.1 The Earth as a planet – shape, radius and mass
- 3.2 The Earth's atmosphere – composition and temperature stratification
- 3.3 The Earth's interiors – composition and density stratification
- 3.4 The geomagnetic field and the Earth's magnetosphere
- 3.5 The Moon as a moon – distance, phases, periods, eclipses and tides
- 3.6 The Moon as a small planet – surface, structure and origin

Chapter 4 The Solar system – structure and orbital features

- 4.1 Developing of the concepts of the world and the Solar System up to the 17th century
- 4.2 Laws of Kepler and Newton. Study of the Solar System after the 17th century
- 4.3 Titius-Bode Law in the Solar System and exoplanets
- 4.4 Orbital consistent patterns and the nebular hypothesis
- 4.5 Deviations from the orbital patterns

Chapter 5 Solar system – composition and physical characteristics

- 5.1 Physical characteristics of the planets
- 5.2 Planets from the Earth group
- 5.3 Giant planets and their companions
- 5.4 Dwarf planets, asteroids and meteoroids
- 5.5 Comets, meteor streams, meteors, bolides and meteorites
- 5.6 Exoplanets. Fermi Paradox

Chapter 6 Electromagnetic radiation and spectra

- 6.1 Electromagnetic radiation - waves, quanta, spectra
- 6.2 Elementary processes of interaction between radiation and matter
- 6.3 Spectra of hydrogen and star atmospheres
- 6.4 Black body and its spectrum
- 6.5 Pogson apparent magnitude of a star, photometric Systems and color indexes

Chapter 7 The Sun and the solar activity

- 7.1 Basic data, energetics and evolution
- 7.2 Interior structure, photosphere and atmosphere
- 7.3 Elements of the solar activity

- 7.4 Cycles of the solar activity
- 7.5 The Sun and the climate of the Earth

Chapter 8 Physical parameters and classifications of the stars

- 8.1 Parallax, parallactic and geometric distance
- 8.2 Absolute stellar magnitude and photometric distance
- 8.3 Basic data for normal stars
- 8.4 Temperatures, spectra and spectral classification
- 8.5 Spectrumluminosity and colormagnitude diagrams
- 8.6 Luminosity classes and colorcolor diagrams

Chapter 9 Double and nonstationary stars. Stellar evolution

- 9.1 Double stars – visual, spectral and eclipsing
- 9.2 Stellar masses. Relationships Mass-Luminosity and Mass-Radius
- 9.3 Pulsating variable stars – Cepheids, Lyrae and Mira types
- 9.4 Eruptive variable stars – low mass, novae and supernovae
- 9.5 Stellar evolution and final phases of stellar evolution

Chapter 10 Composition and structure of the Galaxy

- 10.1 The Milky Way – our galaxy (the Galaxy)
- 10.2 Star clusters and associations
- 10.3 Color-magnitude diagrams of star clusters
- 10.4 Interstellar medium and nebulae
- 10.5 Structure and populations of the Galaxy
- 10.6 The rotation of the Galaxy and the motions of the stars

Chapter 11 Morphology, distances and structure of Galaxies

- 11.1 The elite galaxies
- 11.2 Morphological classifications of galaxies
- 11.3 Distances to galaxies and Hubble Law
- 11.4 Galactic structures and relationships
- 11.5 Groups and clusters of galaxies

Chapter 12 Cosmology

- 12.1 Cosmological observations
- 12.2 The cosmological principle
- 12.3 Homogeneous and isotropic universes
- 12.4 Models of Friedmann
- 12.5 Cosmology tests
- 12.6 History of the Universe
- 12.7 Formation of structures
- 12.8 The future of the Universe

Chapter 13 Astronomy as a science and practice

- 13.1 Worldview and Astronomy
- 13.2 Subject, partitions and results of astronomy
- 13.3 Astronomy and other sciences
- 13.4 Astronomical studies and breakthroughs in the 20th century
- 13.5 Astronomy in Bulgaria

List of introductory astronomy books, published in Bulgarian, is given in the References.

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