

ASTROPHYSICS

1. Advanced astronomical instrumentation
2. Radiative transfer and emission mechanisms
3. Stellar structure
4. Star formation
5. Nucleosynthesis and stellar evolution
6. Variable stars
7. Binary and multiple stellar systems and exoplanetary systems
8. Compact objects
9. Accretion processes in astrophysics
10. The Milky Way Galaxy
11. Diffuse matter in the Universe
12. Structure and history of the Universe
13. Astrophysical methods of cosmic distance determination
14. Multimessenger astrophysics; gravitational waves

Recommended reading:

Bradt H:
Astronomy methods
Cambridge UP 2004
ISBN 978-0-521-53551-9

Bradt H:
Astrophysics processes
Cambridge UP 2008
ISBN 978-0-521-84656-1

Choudhuri AR:
Astrophysics for physicists
Cambridge UP 2010
ISBN 978-0-521-81553-6

Karttunen H:
Fundamental astronomy
Springer 2007
ISBN 978-3-540-34143-7

SPACE PHYSICS AND PLANETARY SYSTEMS

1. Fundamentals of magnetohydrodynamics
2. Fundamentals of space plasma physics
3. Solar activity phenomena
4. The solar cycle and its origin. Space climate reconstructions
5. The solar wind. Structure of the heliosphere
6. The terrestrial magnetosphere, plasmasphere, ionosphere
7. Space weather: causes, effects, monitoring, forecasting
8. Cosmic rays and energetic particles in the heliosphere
9. Structure and origin of the Solar System
10. The periphery of the Solar System 1: heliopause, the local ISM
11. The periphery of the Solar System 2: TNOs, comets
12. Planetary dynamics and orbital evolution in the Solar System
13. Stellar activity and the solar-stellar connection
14. Exoplanetary systems
15. The interstellar medium in our galactic neighbourhood

Recommended reading:

Baumjohann W., Treumann RA:
Basic space plasma physics

Imperial College Press 1997
ISBN 1-86094-079-X

Stix M.:
The Sun. 2nd ed.
Springer 2002
ISBN 978-3-642-56042-2

Lissauer J. J. & de Pater I.:
Fundamental Planetary Sciences
Cambridge UP 2019
ISBN 978-1-108-41198-1

===== Melléktárgyak: =====

SOLAR PHYSICS

1. Solar structure, helioseismology
2. Convection and differential rotation
3. Solar magnetohydrodynamics: basics and MHD waves
4. Dynamo theory
5. Force-free magnetic field configurations
6. Solar activity in the photosphere and flux emergence
7. Solar activity in the chromosphere and corona. Coronal heating
8. Observational methods in solar physics
9. Long-term variations in solar activity. The solar cycle

Recommended reading:

Stix M.:
The Sun. An Introduction.
Springer 2002
ISBN 9783642560422

Priest E.:
Solar magnetohydrodynamics
Reidel 2000
ISBN-13: 978-90-277-1833-4

PHYSICS OF THE SOLAR SYSTEM

1. Fundamental plasma physics
2. Solar wind and interplanetary magnetic field
3. Structure of the heliosphere
4. Energetic particles in the heliosphere
5. Space weather and its terrestrial effects
6. Planetary magnetospheres
7. Comparative planetology
8. Small solar system bodies
9. The origin of the Solar System

Recommended reading:

Baumjohann W., Treumann RA:
Basic space plasma physics
Imperial College Press 1997
ISBN 1-86094-079-X

Lissauer JJ, de Pater I.:
Fundamental Planetary Sciences
Cambridge UP 2019
ISBN 978-1-108-41198-1

Milone EF, Wilson WJF:
Solar System astrophysics 1-2
Springer 2014

CELESTIAL MECHANICS

1. Two-body problem: classical treatment. Orbit determination
2. Two-body problem: canonical treatment
3. Three-body problem
4. Perturbed two-body problem, variation of constants
5. Lagrange planetary equations, secular and resonant perturbations
6. Canonical perturbation theories
7. Resonances in celestial mechanics
8. Chaos in celestial mechanics
9. Chaotic dynamics and stability of the Solar System

Recommended reading:

Érdi Bálint:

A Naprendszer dinamikája
ELTE Eötvös Kiadó 2005

Murray, C. D, and Dermott, S. F.:
Solar System Dynamics
Cambridge UP 2000

PHYSICS OF EXOPLANETS AND EXOPLANETARY SYSTEMS

1. Detection methods of exoplanets
2. Characterisation of exoplanets, Earth-like planets, gas and ice giants
3. Physical description and formation of protoplanetary discs
4. Formation of planets, gravitational instability, core accretion hypothesis
5. Planet-disc interactions, planetary migration
6. Formation of the Solar System, the Nice and the Grand tack model
7. Dynamics of exoplanetary systems, formation of resonant and nearly resonant exoplanetary systems
8. Exoplanets and exomoons in the habitable zone
9. Exoplanet atmospheres

Recommended reading:

Perryman, M.
The Exoplanet Handbook,
Cambridge UP 2018 (2nd edition)

Armitage, P.
Astrophysics of planet formation
Cambridge UP 2012

Deeg, H. J., Belmonte, J. A. (eds.)
Handbook of exoplanets
Springer, 2018

PHYSICS OF THE INTERSTELLAR MEDIUM

1. Basic physical description of the ISM
2. Physics of neutral hydrogen (HI) regions
3. Physics of ionized hydrogen (HII) regions
4. Interstellar dust
5. Physics and chemistry of molecular clouds

6. Star formation and pre-main sequence stellar evolution
7. Our interstellar environment
8. Supernova remnants, shocks and turbulence in the ISM
9. Detection of interstellar matter: instruments, wavebands, spectral features

Recommended reading:

Draine B. T.:
Physics of the Interstellar and Intergalactic Medium
Princeton UP 2011
ISBN 978-0-691-12214-4

Derek Ward-Thompson, Anthony P. Whitworth
An Introduction to Star Formation
Cambridge UP 2011
ISBN 10: 0521630304

STELLAR ASTROPHYSICS

1. Stellar parameters and their relationships
2. Polytropic spheres
3. Stellar convection
4. The rotation of stars
5. Stellar pulsation
6. Protostars and pre-main sequence stars
7. Stellar activity and the solar-stellar connection
8. Brown dwarfs and ultracool stars
9. Close binaries
10. Interpretation of stellar spectra
11. Cataclysmic variables
12. Supernovae

Recommended reading:

Böhm-Vitene E.:
Introduction to stellar astrophysics 1,2,3
Cambridge UP 1989-1992
ISBN 0 521 34402 6
ISBN 0 521 34870 6
ISBN 0 521 34871 4

Kippenhahn R., Weigert A., Weiss A.:
Stellar Structure and Evolution. 2nd ed.
Springer 2012
ISBN 978-3-642-30304-3

GALACTIC ASTRONOMY

1. Stellar statistics
2. Stellar kinematics
3. Stellar dynamics: mean field theory
4. Stellar dynamics: encounters and relaxation
5. The structure of the Milky Way Galaxy
6. The galactic spiral structure and its origin
7. Star clusters and associations
8. The galactic center
9. The solar neighbourhood

Recommended reading:

Sparke & Gallagher: Galaxies in the Universe.
Cambridge UP 2007
ISBN-13 978-0-511-29472-3

Binney J.: Galactic Dynamics

EXTRAGALACTIC ASTRONOMY

1. General properties and classification of galaxies
2. Galaxy clusters, galaxy groups, spatial distribution of galaxies
3. Galactic dynamics
4. Interacting galaxies, active galactic nuclei (AGN), and quasars
5. Diffuse matter in galaxies and the intergalactic medium
6. The nearby universe
7. The Universe at high redshifts
8. Mergers and the evolution of galaxies
9. Gravitational lensing

Recommended reading:

Sparke & Gallagher: Galaxies in the Universe.
Cambridge UP 2007
ISBN-13 978-0-511-29472-3

Schneider P.: Extragalactic Astronomy and Cosmology - An Introduction.
Springer 2006
ISBN 978-3-540-33175-9

COSMOLOGY

1. Fundamentals of Relativistic Cosmology
2. The Evolution of the Universe
3. Precision Cosmological Measurements: SNe Ia and Large-scale structure
4. Precision Cosmological Measurements: the Cosmic Microwave Background
5. Particle cosmology
6. Thermal history of the Universe
7. Cosmological inflation

Recommended reading:

Frei Zsolt, Patkós András:
Infláció kozmológia
Typotex 2004

Bernard J. T. Jones:
Precision cosmology
Cambridge University Press 2017

Scott Dodelson:
Modern cosmology
Academic Press 2003

Kolb E., Turner M.:
The Early Universe
Frontiers in Physics 1994

HIGH ENERGY ASTROPHYSICS

1. Cosmic rays
2. Instruments of gamma and X-ray astronomy
3. Neutron stars, pulsars, magnetars, FRBs
4. Binary X-ray sources
5. Black holes

6. Supernovae
7. Gamma bursts
8. Neutrino astronomy
9. Gravitational wave astronomy

Recommended reading:

Kolb U.:
Extreme environment astrophysics
Cambridge UP 2010
ISBN 978-0-521-18785-5