ENTRANCE EXAM FOR PhD. STUDY
field of study: Astrophysics
specialization: Solar Physics

Topics from the field: ASTRONOMICAL DEVICES

1. Astronomical telescope

Refractor, reflector, ocular; aberrations of telescope, resolution of telescope. Earth's atmosphere and telescope.

2. Dispersion of light

Dispersion of light, dispersive prism, examples of usage – spectroscopy.

3. Interference of light

Interference of light. Fabry-Perot and Michaelson interferometer, interference filters.

4. Diffraction

Diffraction of light, diffraction grating – description, physics, properties, modes of exploitation in astronomy – spectroscopy.

5. Polarization

Polarized light, its origin and modes of exploitation in astrophysics. Measuring of polarized light.

Topics from the field: ASTROPHYSICS

1. Internal structure of stars

Fundamental equations of internal structure of stars. Sources of the star energy. Energy transfer from the star's core to its surface. Star structure depending on its evolutional stage.

2. Theory of stellar atmospheres

Description of radiation in stellar atmospheres, excitation and ionization of atoms, absorption and emission coefficient, optical thickness, radiative transfer equation and its solution, local thermodynamic equilibrium, Saha (ionization) equation, Boltzmann equation, statistical equilibrium, models of stellar atmospheres. Analysis of chemical composition of atmospheres.

3. Radiation of the cosmic objects

Thermal and non-thermal radiation, nebular radiation, radiation in lines. Atomic spectra and molecular spectra. Stellar spectrum – continuum and line spectrum. Absorption and emission lines, profiles of spectral lines. Broadening of spectral lines: collisional, Doppler and rotational. Physical processes involved in formation of continuous and line spectra, curve of growth.

4. Basic characteristics of stars

Apparent and absolute magnitude, bolometric magnitude. Luminosity, radius, temperature, spectral type. Ranges of star characteristics depending on their evolutional stage. Mutual relationships between basic characteristics, Stefan-Boltzman law. HR diagram, mass-luminosity diagram, evolutionary passes of stars.

5. Observational methods in astrophysics.

Spectroscopy, spectrophotometry, photometry (visual, photographic, photoelectric, CCD). Color index, excess, polarimetry.

Topics from the field: SOLAR PHYSICS

1. Sun as a star

Position and motion of the Sun in the Galaxy. Mass, radius and chemical composition. Solar rotation (differential), luminosity, effective temperature and spectrum. Evolution of the Sun. Sun in the H-R diagram

2. Solar convection and magnetic fields on the Sun

Conditions for the convection development. Dynamics. Granulation, supergranulation and their observation. Magnetic fields on the Sun. Magnetic structures of quiet and active photosphere.

3. Solar photosphere and chromosphere

Layers of the solar atmosphere, their description and parameters. Physical phenomena occurring in individual layers. Faculae and sunspots. Chromosphere dynamics and its structures.

4. Solar corona

Spectrum – stratification into components K, F, E - description of their properties. Phenomena in corona - coronal rays, prominences, condensations, coronal holes, bright points, transient phenomena.

5. Solar activity and its cycles.

11- and 22-year cycles, secular cycles. Solar K-corona – changes of its shape, flattening and brightness along the solar cycle. Solar eruptions.

RECOMMENDED LITERATURE

● Stix, M.: The Sun - An Introduction. Springer Verlag; 2nd edition, 2002.

● Gray, D.F.: The observation and analysis of stellar photospheres. A Whilley Interscience Publication, New York, 1976.

● Kourganoff, V.: Introduction to Advanced Astrophysics. Reidel Publ., Dordrecht, 1980.