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Teaching the courses of astronomy and concepts of modern natural science in Kazan Federal University

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There are varieties of advanced techniques of training in the courses in astronomy and concepts of the modern natural science in Kazan Federal University (KFU). It should be emphasized that the course of the modern natural science (COMNS) has a great part of astronomy. It was considered that astronomy is cosmic and distant. Chemistry, biology, physics are terrestrial and close. Nevertheless, astronomy is the most universal and connecting science. When we speak about the course in COMNS, we should remember that this course must be taught by astronomers or other science professors, because COMNS philosophy has nothing to do with science.

Keywords: Teaching; Astronomy; Conceptions of natural science

1 Introduction

Our system of teaching astronomy and COMNS in KFU can be divided for convenience into four parts: the theoretical part, the practical part, the interactive and video-informative parts. We will investigate the course in COMNS in the astronomy part only.

Many university leavers agree to teach astronomy in school, and sometimes they make the priority choice for astronomy. The more enthusiasts that there are, the more that astronomy and astronomical information will become accessible in our lives.

2 Observation complex

By the end of the XIX century it was difficult to carry out the high accuracy astronomical observations in the city so in 1901 the Engelhardt Astronomical Observatory (EAO) was opened. It was equipped with instruments, which were donated by Engelhardt V.P. to KFU.

Part of the equipment was moved from the urban observatory but eventually astroclimatic conditions did not satisfy the requirements of astronomers even in the

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suburban observatory. That is why in the second part of last century Kazan State University and EAO organized a number of southern highland astronomical stations, such as Alma-Ata, Nakhichevan and Zelenchuk stations, where, the largest telescopes of department and EAO were installed. These stations favoured the development of the level of the scientific research and improved the quality of the training of young specialists.

Some training of specialists in astronomy was started in Teacher's Training Institute in Kazan along with university astronomical scientific-educational departments.

In the middle of the last century, D.Y. Martynov (the director of the EAO) made an effort to equip the EAO with a large telescope. A 125-cm reflector of ERT was designed specially for EAO in LOMO. Unfortunately, D.Y. Martynov took this telescope away, when he got a job in SAI MSU in 1954.

Many years later A.A. Nefedjev (the director of EAO from 1958 to 1976) succeeded in getting financing to produce 1.5 m reflector of Richey-Chretien system. However, for some reasons this telescope could only be put to use in the Turkish Highlands Astronomical Observatory near Antalya in the recent years of the last century.

Nowadays, the students familiarize themselves with the skills of astronomical observations in EAO, using several telescopes; such as the 35 cm meniscal telescope of the Maksutov system (AZT-452), the 50 cm reflector AZT-14 and the Gade astrograph. The meniscal telescope and the Gade astrograph are used for the photographic observations, and the reflector is used mainly for photoelectric observations of stars occultation by the Moon. Also, the students take amateur pictures of the sky areas and phenomena, such as the comets.

The students of KFU complete more serious and more skilled astronomical observations in Zelenchukskaya station where they study the methods of photographic observations with 40 cm wide-angle Zeiss Jena astrograph and become familiar with 6 m azimuth reflector of the Special Astrophysical Observatory(SAO). The degree work of many students is based on observations, which were made using this telescope. It should be noted that great attention is paid to the study of radio astronomy and observation methods on RATAN-600 SAO RAS, the largest radio telescope.

A few decades ago, the students' specialization was divided into celestial mechanics, astrometry and astrophysics, nowadays astrophysics is the major area. There are both objective and subjective factors and it corresponds to the trends of astronomical disciplines on a worldwide scale. Among the observation of the students, great attention is paid to the spectroscopic methods of study of astral atmospheres and their chemical composition.

Hopefully, 1.5 m telescope will be available to students in Turkey in the near future. The lack of proper financing is the main obstacle. Nowadays we can only speak about the indirect use of this telescope in training courses. The research workers and professors get the observational materials during their rare visits to Turkey, as for students, they process it in Kazan.

Great attention is paid to the group observations of both students and pupils. For this purpose, extra classes are conducted for young enthusiasts of astronomy in KFU and facilities were provided for students and pupils who can stay overnight to work with the professional telescope in the Engelhardt Observatory. Often, the group consists of pupils, students and postgraduates.

3 AZT-14 modernization

CCD photometer was produced in AFR-14, for the educational-practical tasks solution in the CCD photometry field. CCD photometer is equipped with a set of universal adapters, and it has been possible to study the technical characteristics of CCD detectors (chips) of different manufacturers and the photometric features of the system with different CCD matrix, such as S1C of the domestic manufacturer CUP NPP "Electron-optronic", Alta U9000 was produced by "Apogee instruments inc", ST-10 by "SBIG inc". Besides, the work is carried out in the stellar CCD photometry field and there is development in the receiving of light curves processes, for reduction to the standard Johnson photometric system and the optical data processing by means of specialized Midas professional software. The instrument is equipped with quick transfer system by axes and accurate adjustment when scanning the parts of the sky for astrophysical observation tasks, for developing the methods of operational search and observations of satellites, asteroids and comets. The satellite channel was set up for efficient remote control by the instruments. With the help of the satellite channel the data communication remote data handling (in case of need), control and technical recourse systems of climate-control management, navigation and review management, and detached electro-distribution network is carried out.

The principle of frequency-phase control underlies in the automatic actuator dome AZT-14, which was assembled and tested in 2007–2008. The designed machine consists of three main parts: a stationary control unit with an induction transmitting loop; a dome-autonomous unit with a loop connection and with two transmitting antennas along the visor; a telescope amplifying unit with receiving antenna, which is located on the focusing block AZT-14. The operation principle can be described briefly in the following way. The Reference generator (7 KHz) the low-frequency amplifier for the loop connection with the dome unit, phase detectors, the comparison scheme and relay unit of motor drive are located in the stationary unit. The dome unit is powered by a battery, which is recharged from the main VERS. The dome unit takes the frequency of the reference generator by way of receiving induction loop of connection, it forms a phase shift for the second antenna amplifies both the signal and it radiates the signals by way of step-up transformer and transmitting antennas along the visor, each on their own side. The receiving antenna which is located on the telescope takes these signals and turns them to the stationary control unit.

The received-signal phase is compared with the reference generator phase in the stationary unit, and the discrete signal control of the motor drive of the dome is formed depending on the phase shift of the received signal. Thus, this control system has allowed the automation of the dome moving and the elimination of the problem of pointing of the telescope by the observer.

The control of the listed information technology systems complex is carried out from the dedicated center, which is located in a private premises equipped with climate control systems and stabilized power actuator telescopes, separate dedicated electrical distribution networks and loops of grounding for measuring, processing and computer systems. Besides this center has communication mediums, data transmission by way of GPS and GLONASS navigation (time station). In particular, the climate control system underwent trials at ambient temperatures from 35 degrees below zero to 35 degrees over zero in the building with the AZT-14 telescope in 2006–2008. The

automatic temperature control facilities, the aerations, the dew point temperature control in the under dome space, the excess pressure formation, the cleaning, the air drying, which is fed to the telescope mirrors and detectors are displayed on the work station monitor in an appropriate graphical form and archived with the system launch as necessary.

Conclusion

In the near future, the EAO telescopes will be upgraded. It will be possible to conduct the training observations at a high technical level and to familiarize young researchers with modern observational equipment.