LATVIJAS UNIVERSITĀTE
ANNO 1919

FOTONIKA-LV
LATVIJAS UNIVERISTĀTES NACIONĀLĀ ZINĀTNES PLATFORMA

The 3rd International Conference FOTONIKA-LV

"Achievements and Future Prospects"

Four years after the end of the project:

FP7-REGPOT-2011-1, No 285912, FOTONIKA-LV
"Unlocking and Boosting Research Potential for Photonics
in Latvia – Towards Effective Integration in the European Research Area"

Riga, 24–25 April 2019

Riga, 2019

The 3rd International Conference FOTONIKA-LV "Achievements and Future Prospects". "Unlocking and Boosting Research Potential for Photonics in Latvia – Towards Effective Integration in the European Research Area". University of Latvia, Riga, 24–25 April 2019.

Editors

Dina Bērziņa, Arnolds Ūbelis, Vidvuds Beldavs

ISBN 978-9934-18-457-4

Overview of achievements of Astrophysics and Planetary Sciences in Baldone

Ilgmārs Eglītis

Institute of Astronomy, University of Latvia

E-mail: Ilgmars.Eglitis@lu.lv

The Astrophysical Observatory (*code 069*) of the Institute of Astronomy, University of Latvia in Baldone, Riekstukalns began its activities in 1958, by separating the Astronomy sector from the Institute of Physics of the Latvian Academy of Sciences (LAS) as an independent structure. A year later, the first building of the Laboratory of Astrophysics was built in the territory of the next observatory, 5 km from Baldone town near Riekstu Hill, the so-called "White House". The founder and first director of the Observatory, Jānis Ikaunieks (1912–1969), planned to develop two directions of research: to create a large base interferometer in radio astronomy and in red optics, and investigations of stars in the last evolutionary stage. In 1959, an agreement was signed with Carl Zeiss of East Germany on the construction of a Schmidt telescope to ensure the performance of optical observations.

In 1967 the name of the Laboratory of Astrophysics was changed by decision of LAS to Latvian SSR AS Radioastrophysical Observatory with an objective – creation of a 2 km ridge for a multi-antenna variable base radio interferometer. This project was not realised due to premature death of Jānis Ikaunieks; the development of the area of radio interferometry, the placement of 30 m rotating radio antennas on Roņu Island, Engure and Salacgrīva was stopped also. These plans were developed twelve years earlier than in England, where a radio-like interferometer of similar size recorded radio signals from distant galaxies for the first time resulting in a Nobel Prize (1974). Thanks to the efforts of Arturs Balklavs (1933–2005), the next long-term director of the Observatory, the direction of radio astronomy studies remained, and 10 m radio antenna was bought in 1972 to study solar activity at ranges 755, 610 and 326 MHz.

The development of optical astronomy is in line with Jānis Ikauniek's idea. At the beginning of January 1965, the 1.2 m large field of view (19 m^2 field of view) Schmidt system telescope with an input aperture of 0.8 m was added to the Observatory's infrastructure. It is the twelfth largest Schmidt telescope in the world still to date.

Investigations of carbon stars: B, V, R, I photometry, low resolution spectroscopy

More than 5% carbon stars in Milky Way Galaxy were discovered in Baldone Observatory. Main photometric characteristics of these stars were obtained. New type of variability of late stars – DY Per with irregular dimming by 2–5 magnitudes was selected. "General Catalogue of Galactic Carbon Stars" was prepared in 2001 and the catalogue data now are continuously updated. On the basis of the Schmidt telescope low resolution objective prism spectrum analysis, a method for estimating the absolute size, surface temperature, distance and evolution stage of carbon stars has been developed (Fig. 1). This method uses the latest achievements of carbon star research in the Great Magellan Cloud and estimates of the magnitude of interstellar absorption. The results of the method are currently being tested using Gaia's space telescope measurements. The distribution of the carbon star is believed to be related to the structure of the Milky Way galaxy arms. The hypothesis that the Galaxy has another, more distant arm than the "outer arm" is being checked. The loss of matter from the C stars forms carbon-rich shells – space areas with a high concentration of a vital chemical element.

Monitoring of small bodies of Solar system

CCD observations of the asteroids with Baldone Schmidt telescope began in 2008. In the Minor Planet Circulars and the Minor Planet Electronic Circulars were published 5434 astrometric positions of 1488 asteroids to now. Among them, 77 asteroids were newly discovered at Baldone Observatory. Eleven asteroids were named. The accurate orbits of asteroids were calculated with OpenOrb 4.2 and for two interesting asteroids (428694) 2008 OS9 from the Apollo group and the Centaur (330836) Orius (2009 HW77), the evolution of orbital elements was calculated. The results of the project will provide an opportunity to predict the probability of collision of dangerous asteroids and small bodies of the Solar System with the Earth, as well as to analyse the chemical composition of the observed small bodies of the solar system, thus obtaining information about useful minerals on the cosmic bodies.

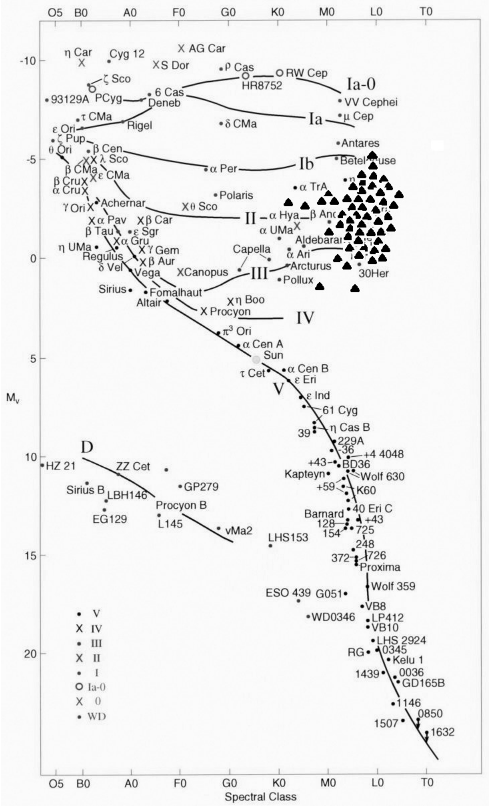

Figure 1. By blue dots labelled displacement of C stars on H-R diagram

Digitisation of Baldone Schmidt telescope wide field 22000 direct astroplate archive

Digital processing of photographic plates of star fields allows determining the coordinates and stellar magnitudes with high accuracy, 0.5” and 0.1 mag respectively, for all registered objects on these plates. The images were processed using advanced complex of LINUX / MIDAS / ROMAPHOT programmes. Modern approach to processing of early photographic observations with new technologies is an effective instrument for rediscovery of asteroids, correction of their orbits, investigation of variable stars of different type and obtaining proper motion of stars. Approbations of this software complex are the catalogues of stars coordinates and their U-magnitudes. In addition, the project ensures the preservation of a unique national database with international access.

Upgrading the Baldone Schmidt telescope

Upgrade of Baldone Schmidt telescope mechanics and optical system using “fly eye” technologies allows looking forwards to participate in projects of investigation of carbon stars, blazars, and studies of Solar system small bodies. Two 1 square-degree of view CCD cameras were installed in the main focus of the Baldone Schmidt telescope.