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VARIABLE STAR ASTRONOMY AT KONKOLY OBSERVATORY OF THE HUNGARIAN ACADEMY OF SCIENCES

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ABSTRACT We present the brief history as well as the present status of the variable star astronomy at Konkoly Observatory, Hungary. Special emphasis is given to the subjects being carried out in international cooperations.

INTRODUCTION - HISTORICAL BACKGROUND

The Konkoly Observatory was reorganized near Budapest at the end of the 1920's, under the directorship of A. Tass. At that time the observatory had a 7-in. astrograph and a 24-in. Newton-Cassegrain telescope, which were used for photographic photometry. This relatively accurate techique was suitable for variable star research.

An important question of that time was whether the non-repetitive nature and long period modulation found in some of the RR Lyr stars were real. This was the first subject of the systematic variable star research in Hungary, led by L. Detre, the former director of the observatory.

VARIABLE STAR RESEARCH

Stellar Pulsation

The systematic study of variable stars has been carried out using photographic technique and, from the end of the 1950's photoelectric photometry. Long-period modulation was discovered and the period determined in a couple of RR Lyr stars, or already known periods were corrected. An interesting model to explain the Blashko-effect, the magnetic oblique rotator, was suggested by J. Balázs: the Blashko-period was supposed to be equal to the rotation period of the star. A four-year cycle was discovered in the Blashko-effect of RR Lyrae by L. Detre and B. Szeidl, the consecutive cycles started always with a + or - 90 deg phase shift. A spot scenario gives natural explanation to this finding and offers a large scope for speculations about solar analogies in RR Lyrae stars (Fig.1).

The investigation of RR Lyr stars has other traditions

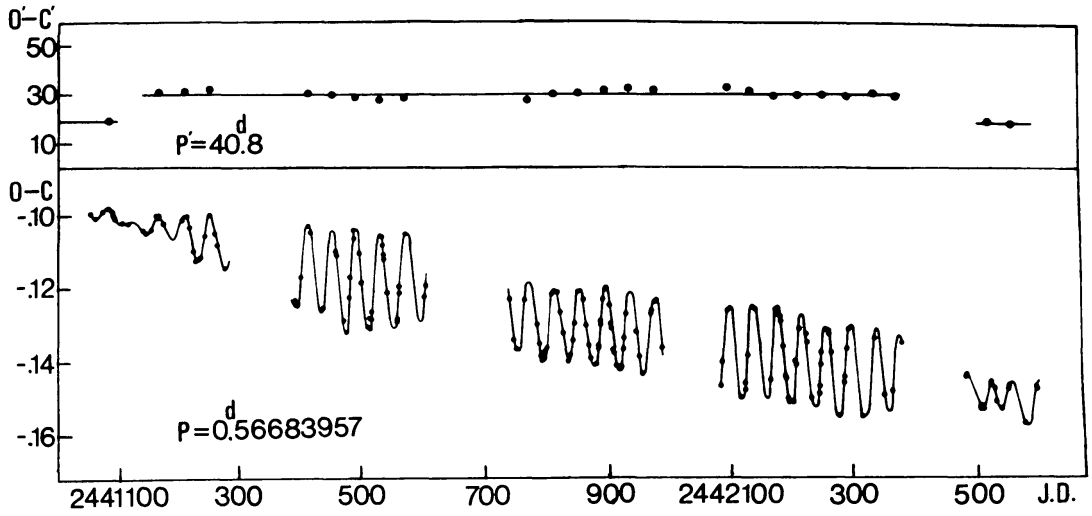

Fig. 1. Four year activity cycle of RR Lyrae, demonstrated by the O-C diagram of the fundamental mode (lower panel), and by the O'-C'diagram of the Blashko-period (upper panel).

at Konkoly Observatory: systematic, statistical studies of the period variations of field and cluster (M3: Szeidl, M15: Barlai) RR Lyr stars. We also search for double mode RR Lyr's in M15 (Barlai, Jurcsik). The old hopes that the directions of the period changes in the cluster variables gave a clue to the direction of the stellar evolution of these stars have failed until now but we continue to collect the observational data in order to investigate this problem.

From the beginning of the 70's the investigation of pulsating stars has widened at Konkoly Observatory. We started to examine the period variations of the Cepheid variables of the northern sky (about 100 stars) and later these studies were extended to the southern sky. Evolutional changes were detected in some cases. An interesting result was the discovery of the phase jumps in the O-C diagrams of some Cepheids, during very short time intervals, and we cannot explain this feature yet. Recently, the long period cyclic variability of many O-C diagrams of Cepheids could be interpreted by the binary nature of the stars in question. Periods of the binary orbits could be found for some of the binary Cepheids (Szabados).

Earlier there was no distinction between the RR Lyr and dwarf Cepheid stars (= high amplitude Delta Scuti stars). The observations and study of these variables have continued at our observatory for a long time (Szeidl). Nearly 10 years ago we also started to investigate low amplitude Delta Scuti stars, which pulsate in radial as well as non-radial modes with many frequencies. The study of these stars need continuous observations, which is possible only in international campaigns. We take part and also organize such campaigns (Paparó).

A good program for the very moderate astroclimate of central Europe is the observations of long period stars: RV Tau stars and SRd variables. They pulsate sometimes in few modes, and the mode identifications allow us to study the physics of these stars (Zsoldos).

The theoretical works on stellar pulsation have became an outstanding research nowadays. Studies are being made about the roles of resonances in pulsation and about chaotic stellar pulsation. E.g. it was possible to demonstrate that R Sct has a deterministic chaotic pulsation. To test the theoretical results long observational datasets are essential, and that needs international cooperation (Kovács, Kolláth).

Stellar Activity

In the late 1960's the investigation of stellar activity was strengthened worldwide and started at Konkoly Observatory too, through the observations of flare stars. The emphasis, however, was soon shifted to the starspot activity studies, which became more intensive after the presentation of the already classic review paper about the properties of the RS CVn binaries by D.S. Hall in the IAU Coll. No. 26 held in Budapest, Hungary.

The short period eclipsing RS CVn binaries are one of our targets. Especially long dataset was gathered on SV Cam. Flare events were also observed in this star (very few flare observations exist on these type of variables), and it was possible to connect the flares with the position of the starspot responsible for the migration wave. Other short period RS CVn systems are also being observed (Patkós).

Some of the non-eclipsing RS CVn binaries were observed and studied very intensively. Starspot modelling based on Budding's equations were used to describe the light variations caused by (usually two) starspots in these systems. Using 15 years of photometry, we could demonstrate the existence of active longitudes and the typical lifetime of an active region ($\sim$7 years) in the long-period RS CVn binary HK Lac. The starspot modelling is impossible in the (late K) dwarf binary BY Dra, where both stars of the system are active, but the long-term variability of the starspots is extremely interesting. An other active dwarf star, V833 Tau, shows variability in three time-scales: it has a rotational modulation (1.8 days), medium-term changes (200-300 days), and a long-term variation ($\sim$ 60 years). All the research mentioned in this paragraph were and are being done in close international cooperations, especially with Drs. D.S. Hall (USA) and B.R. Pettersen (Norway) (Oláh).

Recently the investigations of the planetary and proto-planetary nebulae has been started (Jurcsik).

One of the successful program of our institute, the search for supernovae, dates back to almost 30 years (Lovas).

FACILITIES - COOPERATIONS

By the beginning of the 1960's the scattered light of Budapest became too bright, so Konkoly Observatory decided to establish an observing station far from the city lights. About 120 km from the capital three telescopes were installed between 1962 and 1975. One telescope is a 60/90 cm Schmidt, which has also a 5 deg and a 2 deg objective prism. A 50-cm (20-in) telescope is used for photoelectric observations in the Johnson UBV system. Our largest instrument is a 1-m (40-in) RCC telescope. At present it can be used: a) for photographic observations of cluster variables, and b) photoelectric photometry using a thermoelectrically cooled photon counting photometer in the Cousins UBVRI system. This photometer has a limiting magnitude of about 15 mag and is suitable also for high-speed photometry (e.g. lunar occultations). Soon a low dispersion spectrograph with CCD detector will be in operation. The 60-cm (24-in) telescope in Budapest is still useful for observing large amplitude, relatively bright (10-11 mag.) stars in the Johnson UBV system.

The library of Konkoly Observatory is very well supplied. All the important astronomical periodicals are on the shelves from the very first issues of their editions. On the basis of exchanging materials we are in connection with most of the astronomical libraries of the world. The materials of IAU Colloquia and Symposia and other astronomical books can also be found in the library.

The Information Bulletin on Variable Stars is edited by our observatory from its beginning, and till now more than 3500 issues were published.

We have traditionally good and well established cooperations with the Eastern European countries, and well developing contacts with other countries in the world. Many of our scientific programs are carried out on the basis of international collaborations, as it is seen from the description of our programs above, and we are willing to widen these contacts. The strong personal scientific interest is essential in these cooperations.

ACKNOWLEDGEMENTS

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