

# THE LICK OBSERVATORY PROGRAM ON PROPER MOTIONS OF RR LYRAE STARS

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It is the purpose of this note to reveal the nature and progress of a long term astrometric program at the Lick Observatory (see references by S. Vasilevskis in *Trans. Int. Astron. Union*, **XI B**, 404, 1962). One of its many goals is the measurement of absolute proper motions of RR Lyrae stars with respect to faint galaxies. The first-epoch photographs, obtained in 1947–54 by Shane and Wirtanen for the sky north of declination  $-23^\circ$ , were supplemented later by plates of poorer quality down to  $-33^\circ$  with the 20-in. astrograph. This means that first-epoch plates are now on hand which cover three-fourths of the sky and on which stars of 9–17 mag. may be measured for proper motions. Since these photographs represent the largest and most homogeneous set that will be available in the foreseeable future, we shall try to estimate the number of RR Lyrae stars which may be measured on them.

As a guide we take the 1968 edition of the *Russian Variable Star Catalogue*, which contains a little over 4400 RR Lyrae stars. For the sky north of  $-33^\circ$  nearly 2000 of these stars are brighter than average magnitude 17.0, 1000 brighter than 15.0, and about 350 brighter than 12.0. Experience with the Lick program shows that 80% of these stars should be measurable, after account is made for losses due to plate defects, blended images, and other factors.

An important limitation to the usefulness of the measured motions is imposed by the size of the mean errors, which amount to  $0''.7/\text{century}$  for an epoch difference of 20 yr. This mean error is the same size as the proper motion of a typical RR Lyrae star of 13.0 mag. But for an epoch difference of 50 yr the mean error drops to  $0''.3/\text{century}$ , which is comparable to the motion of an RR Lyrae star of 15.0 mag. Useful results for the fainter RR Lyrae stars will not be possible until after a third epoch about the year 2000.

The Lick program will be of assistance in indirect ways to other observers in their reduction of photographs for proper motions, where suitable reference stars with motions on an inertial system are not available. One statistical approach for reducing from relative to absolute proper motions involves both a correction for solar motion and galactic rotation. The program will provide positions of the solar apex, the mean secular parallax, and the constants of galactic rotation which are required by the observers for reference stars of 9–17 mag.

A second indirect way in which the Lick program will be of help to other observers comes from the analysis of the differences between the Lick motions and those given in the AGK3. If the Lick motions are regarded as free of systematic errors, then these differences may be treated as correction to be applied to the AGK3 motions in order to bring them into an inertial system. Thus, the AGK3 stars, with motions corrected

this way, may serve as suitable reference stars in astrometric plate reductions by other observers.

In practical applications the treatment of the faint reference stars on a more sound basis will enhance still more the value of the great amount of plate material which exists in many observatories for about 300 of the brightest RR Lyrae stars. Reference is made to the recent work of van Herk and of Clube.

Progress to date is represented by the nearly completed pilot proper motion program. In 1967 an 8% sample of the 1246 fields north of  $-23^\circ$  was selected for measurement and reduction. Solutions for solar motion and galactic rotation have been made, using nearly 9000 stars in 83 fields that lie outside the zone of avoidance. Preliminary values of the galactic rotation constants have been obtained for stars of 10–17 mag. Preliminary values for the correction to the precession constant have been obtained and are discussed at another session of this meeting by Dr S. Vasilevskis. It is anticipated that the various results from the pilot program will be applicable to the problem of reductions from relative to absolute motions discussed earlier. Following the completion of the analysis for the pilot program, work will begin soon thereafter on the full proper motion-program, which will include many more RR Lyrae stars. The results should be available after 1975.