ON THE ASTRONOMICAL RESEARCH WITH THE TORUN 60/90 CM SCHMIDT TELESCOPE

A. Woszczyk
Institute of Astronomy
Nicolaus Copernicus University, Torun, Poland

ABSTRACT: The Torun Schmidt telescope and its scientific applications are described. A special attention is given to the Torun Objective Prism Sky Survey.

I. INTRODUCTION

The origin of the Torun Schmidt telescope goes back to the idea of a Polish National Observatory born about 60 years ago. In the fifties this idea took the form of the Central Astronomical Observatory of the Polish Academy of Sciences with a two meters reflector as principal telescope and a medium size Schmidt telescope as its companion instrument. The realization of this project started by placing an order for a smaller (cheaper) instrument in the Zeiss optical factory in Jena in 1958, and in 1962 the telescope was delivered.

Awaiting the construction of a Central Astronomical Observatory it was decided to install this Schmidt telescope in the Astronomical Observatory of the Nicolaus Copernicus University of Torun. Later, the idea of the big Polish National Observatory was abandoned and the smaller "companion instrument" of the original project became the largest optical telescope in Poland. This telescope is one of the four Zeiss medium size "universal" telescopes built more than 20 years ago for the Budapest, Jena, Peking and Torun Observatories.

II. TECHNICAL PARAMETERS OF THE TORUN SCHMIDT TELESCOPE

The Torun Schmidt telescope is in fact a Schmidt-Cassegrain telescope. Its basic technical parameters are the following:

1. in the Schmidt arrangement:
   - the main F/3 spherical mirror: glass BK7, diameter 900 mm,
   - the correcting plate: glass BK7, diameter 600 mm,
   - the focal distance: 1808 mm; the scale: 8.8 μm = 1",
   - field of view;circular, diameter $4\overset{\circ}{.}5$.

   In this arrangement two objectives prisms can be used: one in glass BK7 and another in glass F2. Both have a refractive angle of 5° and

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give respectively a dispersion of 250 and 550 Å/mm near H-gamma.

2. in the Cassegrain arrangement the main mirror is used with full aperture; with a quasi hyperbolic secondary mirror an effective focal length of 13500 mm is provided. The focus can be obtained either directly through a hole in the main mirror or laterally by means of an additional plane mirror through the hollow axis of declination.
The telescope is mounted in fork and provided with an electric drive of Zeiss Gaber type.

The site of the telescope is the village of Piwnice near Torun, about 90 m above sea level, with an average number of 100-120 clear nights per year and a seeing ranging from 3 to 10 arcsec.

III. THE TORUN OBJECTIVE PRISM SKY SURVEY

The Schmidt telescope certainly has great advantage of high efficiency, specially for the galactic structure studies, through its high aperture ratio and through its large field. With its freedom from off-axis aberrations and its near perfect achromatism it is an ideal instrument for stellar spectroscopic exploration. The enormous amount of spectroscopic informations obtainable with Schmidt telescopes in a relatively small amount of observing time convinced Miss W. Iwanowska, former director of Torun Observatory, to initiate an Objective Prism Sky Survey (Iwanowska, W. 1963). In this project the accessible sky ought to be covered with photometrically calibrated objective prism plates. The collection of plates so produced could serve as a plate library on one hand, for further spectrophotometric investigations of selected regions or stars and, on the other hand, to secure a reference source for variable astronomical objects.

The survey is being carried basically on Kodak IIa-F and IIa-O plates with objective prism F2 (250 Å/mm). The spectra are generally widened to 0.2 mm. To avoid the overlapping of the spectra in the crowded regions, the Milky Way belt is also exposed with the prism BK7 (shorter spectra), or less widened, or taken in a shorter exposure time. The percentage of the overlapping spectra in the Milky Way region with the longest exposure time in good atmospheric conditions and with a widening to 0.2 mm goes from 45% for the emulsion O to 75% for the emulsion F. In the polar cap region the respective coverage goes from 5% to 20%, in both cases with the objective prism F2.

The plates are calibrated photometrically by means of a 12-spots tube sensitometer. The calibration plates are taken on a separate piece of plate for the respective emulsion and observing night.

Up to now, our collection of about 2000 plates covers 850 fields ($4\overset{\circ}{.}5$ of diameter) on the sky (Fig. 1). The most complete coverage is for the region ±6° from the galactic equator, the galactic meridian ($\ell = 0°$ and $\ell = 180°$) and the galactic polar cap. The limiting magnitude of the different plates is from 8 to 12 mag.

Almost all the staff-members of the Torun Observatory participated in this project. The quality of this material for spectrophotometric studies was tested by several peoples (Smolinski J., Strobel A., Zaleski L., results published in the Torun Observatory Bulletin in the years 1969-

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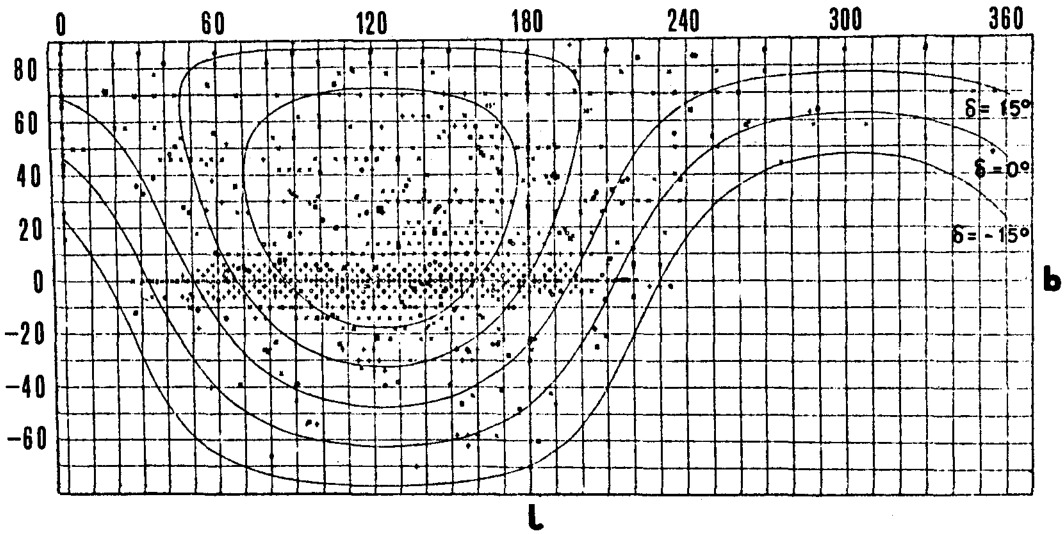

Fig. 1. Actual coverage of the sky (galactic coordinates ℓ'' and b'') with the plates of the Torun Objective Prism Sky Survey. + ÷ emulsion O, x ÷ emulsion F. Those symbols encircled mean that the given field was pictured at least two times with a given emulsion.

1976).

A system of quantitative three-dimensional classification of these spectra for F, G and K stars was elaborated by Strobel A. (1973, 1976). In this system the following stellar parameters: spectral type (with a precision of 0.1 of the type), luminosity class (with a precision of one class) and iron abundance [Fe/H] (with a precision of about 0.25 in [Me/H]) can be determined. Each determination of these parameters is based on several criteria of line intensities, spectral "jumps" and pseudo continuum levels. Another system of quantitative classification of our material, related to the narrow band photometric classification was proposed by Jeneralczuk J. (1981) for O-M stars.

IV. SPECTROPHOTOMETRICAL STUDIES OF INDIVIDUAL OBJECTS

Besides the sky survey the Torun Schmidt telescope was basically used with objective prism for photographic spectrophotometry of individual objects.

Iwanowska W., strongly interested in the problem of stellar populations (see e.g. Iwanowska W., 1966), directed a series of paper in which spectroscopic characteristics of several stellar families (e.g. F, G, K stars, carbon stars, helium stars, RV Tauri variables, etc.) where investigated in conjunction with the position and movement of these stars in the galactic system.

Several emission lines variable objects were studied spectrophotometrically. Many Novae were observed and the evolution of their continuum as well as of their emission lines were followed over several months (among others, the papers of Glebocki, Krawczyk, Smolinski, Woszczyk for N Her 63, N Del 67, N Cyg 75, etc.). Symbiotic objects are also currently investigated (e.g. CI Cyg by Mikolajewski M.).

A special attention is given to the study of comets. The photographic photometry of the comets 1967n and 1968c in the CN and C2 bands were carried out by Typek J. and for several other comets the evolution of cometary emissions was investigated for a large range of heliocentric distances with the objective prism spectra.

Most of this objective prism researches were considerally extended with the aid of slit spectra of larger dispersion and resolution. In fact, the objective prism spectroscopy guided by the slit spectroscopy seems to us a quite efficient way of investigation.

V. OTHER APPLICATIONS OF THE TORUN SCHMIDT-CASSEGRAIN TELESCOPE

In its Schmidt optical arrangement the Torun telescope was tested by Swierkowska S. for the astrometric application. She concluded the good quality of this instrument for the determination of the astronomical objects position (precision better than 0."2 in both coordinates).

In the Cassegrain (or Nasmyth) optical arrangement the Torun telescope is used mainly with a small Cassegrain spectrograph (installed on one side of the fork) or with a photoelectric photometer (on the other side of the fork). Occasionally a photoelectric polarimeter was also used. The Torun Cassegrain spectrograph designed by Richardson H., from the D.A.O. in Victoria, gives several dispersions from 15 to 160 Å/mm and is used for the studies of the Ap stars, stars with a chromospheric activity and other peculiar objects.

The photoelectric photometer actually works in the fast photon-counting mode and is controlled by Polish made minicomputer Mera 305. Its maximal time resolution is less than 10 nanosec, the sampling time is 16 μsec and the dark current level 10-20 pulses per sec. This instrument is mainly used by its builder Wikierski B. and Dr. Turlo Z. to observe optical pulsars looking for the glitches.

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