

ARCHIVE OF PHOTOMETRIC PLATES OBTAINED AT CLUJ ASTRONOMICAL OBSERVATORY

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Abstract. Description of the archive of photometric plates obtained at the Astronomical Observatory of Cluj in the period 1952 – 1974 is presented. The plate inventory is made within the framework of the Wide-Field Plate Database project. The plates were taken in the regions around 110 variable stars (eclipsing variables and RR Lyr type stars), as well as in some comparison stars regions.

Key words: variable stars –photographic plates archive.

1. INTRODUCTION

The inventory of all wide-field photographic plates obtained at Cluj Observatory in the period 1952 – 1974 is made within the framework of the Wide-Field Plates Database project (WFPDB, <http://www.skyarchive.org>). The aim of this project is to inventory all photographic plates obtained all over the world, in professional observatories, and to organize an online access to the data. A detailed description of the WFPDB can be found in Tsvetkov et al. (1994).

In a previous paper (Chiș et al. 2000) we have presented an information about the photographic plates obtained at Cluj Observatory for investigations of small planets and comets. But the main activity of the observatory in the period 1952 – 1974 was the study of variable stars. Both visual and photographic observations were made. 110 eclipsing binaries and RR Lyr stars, as well as four different regions containing the images of comparison stars were recorded on the plates. Their description is a subject of the present paper. The plates are stored in the library of the Cluj Observatory under very good conditions without humidity and big temperature changes.

The study of variable stars was initiated in our observatory by Ioan Armeanca (1900–1954), who tried to implement here the astronomical techniques learnt in Germany between 1930 and 1933, when he prepared his doctoral thesis in the Astronomical Observatory of Göttingen University. His astronomical activity was

interrupted by his premature death in 1954, but continued by his younger colleagues Gheorghe Chiș and Ștefan Radu. Later on the observing group was extended: Elvira Botez, Ioan Todoran, I. Popa, V. Pop, V. Ureche, I. Mihoc, D. Chis and N. Lungu joined it. Some young astronomers and students were sporadically involved in the observations. The observers and their contribution, according to the number of the plates obtained by them, are presented in Table 1. The other observers, mentioned in the Table 1, are quoted with their full names in the archive in the relevant observer column.

Table 1

Contribution to the photometric plate archive

Observer	Contribution (%)	Observer	Contribution (%)
I. Todoran	32	Șt. Radu	7
I. Popa	13	I. Mihoc	6
G. Chiș	11	I. Armeanca	1
E. Botez	10	D. Chiș	1
V. Pop	9	N. Lungu	1
V. Ureche	7	Others	2

The photographic plates were used to obtain light curves for several eclipsing variables and RR Lyr type stars. The light curves and ephemerides for the observed variable stars are mainly published in *Publications of the Astronomical Observatory of Cluj*, as well as in *Studii și Cercetări de Astronomie și Seismologie* (later *Studii și Cercetări de Astronomie*), *Information Bulletin of Variable Stars*, *Astronomische Nachrichten* and other astronomical journals.

2. INSTRUMENTS AND TECHNIQUES USED

The observations were done at the old astronomical observatory of the Cluj University, located near to the southern border of the city (in the 30s of the last century). The instrument used to obtain the photographic plates was Prin equatorial, which has two components: a Newton telescope (with a parabolic mirror with $D= 50$ cm and $F= 250$ cm) and a refractor ($D= 20$ cm and $F= 300$ cm). Detailed description of the location of the observatory and about the instrument can be found in Chiș et al. (2000).

The limiting photographic magnitude with a 10 minutes exposure is approximately 14.5 for the Newton telescope and 12.5 for the refractor. The plate scale is respectively 68.8 arcsec/mm and 82.5 arcsec/mm.

In the beginning of the photographic observations in Cluj Observatory the emulsion type used was Guilleminot. But later on most of the plates used were AGFA

or ORWO. For some of the plates a hypersensibilization was applied according to a technique described by I. Armeanca in his doctoral thesis (Armeanca 1933). The observations were made in the photographic band (pg) and in photovisual band (pv) with using of Schott yellow filter (GG 11, 2 mm thick). All information about the emulsion type and hypersensibilisation of the plates is given in a relevant column of the archive. In a separate column the presence of the yellow filter is given.

3. DESCRIPTION OF THE ARCHIVE

The archive, made in Excel, has 11 666 entries. For illustration of the archive we present some extracted rows (from the first archive rows) in Table 2. In order to save space in this sample we have omitted columns 3 and 4 (Equatorial Coordinates of the Star), column 10 (Observer's Name) and column 12 (Remarks).

The first column of the archive contains the serial plate number, written on the envelope, in which the plate is kept: the letter E before the plate number stands for the plates obtained with the equatorial, the letter O (coming from the Romanian word Oglinda, translated as Mirror in English) stands for the plates, obtained with the Newton telescope. The letter V (coming from Visual) stands for plates obtained with the Schott GG 11 filter. The Roman figures in brackets emphasize that the plate was exposed more than one time. This was the common multiexposure technique used to determine the variations of the light flux coming from the investigated variable star. We have recorded only the first and the last exposure in order to save the length of the archive.

In the second column the observation date (DD.MM.YYYY) is given. The image on the first photographic plate from the archive was recorded on July 2nd, 1952 and the last on March 4th, 1974.

The third and fourth columns contain the equatorial coordinates of the variable star - Right Ascension (in hours, minutes, seconds and fractions of second) and Declination (degrees, arcminutes, arcseconds), taken from the General Catalogue of Variable Stars (Kukarkin et al. 1969). The catalogues epoch is 1900.0.

In the next two columns (fifth and sixth) the moment of the beginning of the observation, in Universal Time (hh mm ss), and the duration of the exposure, in seconds, are given. In the seventh column we put the name of the stars according to the General Catalogue of Variable Stars. The different types of emulsions are listed in the eighth column. In the next (ninth) column the presence of the Schott GG 11 filter is mentioned. The last two columns (tenth and eleventh) are devoted to the observer's name and the plate size, which was usually 6×9 cm for the Newton telescope plates and 9×12 cm for the refractor plates, providing an field of $2^{\circ}.30$ and $2^{\circ}.06$, respectively.

The last (twelfth) column contains notes about the plate state. There are few

plates, which were broken, but not in their central part, so we are still able to get a useful information from them.

Table 2

Sample of the plate archive

Plate No.	Date	Start	Exposure	Star	Emulsion	Filter	Size
E 2	02-Jul-52	18 42 00	480	RT Lac	Guilleminot		9 x 12
E 4 (I)	04-Jul-52	17 29 30	300	RT Lac	S Guilleminot		9 x 12
E 4 (XI)	04-Jul-52	19 54 00	300	RT Lac	S Guilleminot		9 x 12
E 3	08-Jul-52	17 31 00	1500	RT Lac	Guilleminot		9 x 12
E 5 (I)	10-Jul-52	20 46 05	300	RT Lac	S Guilleminot		9 x 12
E 5 (VI)	10-Jul-52	22 14 05	300	RT Lac	S Guilleminot		9 x 12
EV 1	06-Aug-52	20 59 00	3600	QY Aql	Agfa ISO	GG 11	9 x 12
EV 2	07-Aug-52	23 36 00	3600	QY Aql	Agfa ISO	GG 11	9 x 12
O 3 (I)	11-Aug-52	22 55 05	180	QY Aql	S Guilleminot		6 x 9
O 3 (III)	11-Aug-52	23 34 35	180	QY Aql	S Guilleminot		6 x 9
OV 1	05-Sep-52	19 13 17	3600	QY Aql	Agfa ISO	GG 11	6 x 9
OV 2	06-Sep-52	21 51 17	1020	QY Aql	Agfa ISO	GG 11	6 x 9
EV 4	19-Nov-52	20 39 33	2940	SX Psc	S Guilleminot		9 x 12
OV 3	20-Nov-52	00 12 33	1800	M 45	Agfa sens		6 x 9

Only few stars among the observed 110 variable stars were observed in a systematic way. Among them we mention the stars for which there are available more than 100 photographic plates: SX Cnc (245 plates), DP Aqr (238), DO Aqr (205), WY Dra (201), RW Cnc (198), RT Com (171), SZ Her (169), CC Her (163), ZZ Cyg (150), AB Cas (141), WZ Boo (139), UZ Lyr (132), UW Ori (130), XZ And (124), SV Boo (121), BE Eri (116), WW Cyg (115), XX Boo (102), etc. The complete list of the stars and star regions, the number of the plates taken in the region of each variable star, as well as the period, in which they were observed, is presented in Table 3.

Table 3

Variable stars and stellar regions observed in Cluj Observatory

Object name	Number of plates	First observations	Last observations
AB Cas	141	11-Dec-52	17-Feb-72
AC Eri	20	29-Nov-65	18-Jan-71
AF Gem	4	28-Jan-54	25-Mar-58
AM Tau	6	11-Feb-55	01-Mar-56
AN Tau	8	30-Sep-53	26-Jan-59
AV Vul	1	18-Nov-58	18-Nov-58
AZ Gem	5	04-Feb-53	10-Feb-53
BE Eri	116	19-Jan-61	19-Feb-72
BG Eri	34	05-Jan-61	29-Dec-72

BK Eri	69	09-Dec-60	03-Feb-73
BO Cyg	23	22-Jul-58	06-Oct-60
CC Her	163	12-Jul-54	21-Apr-71
CL Aur	8	03-Nov-53	22-Jan-61
CO Cep	12	25-Mar-68	06-Mar-69
CX Aqr	5	19-Jul-58	03-Dec-58
DH Her	6	26-May-56	10-Jul-56
DI Peg	5	31-Oct-54	28-Sep-61
DK Peg	24	02-Nov-53	05-Dec-55
DO Aqr	205	02-Sep-61	02-Sep-65
DP Aqr	238	02-Dec-60	04-Aug-70
EG Ori	3	15-Feb-63	15-Feb-63
ET Ori	37	15-Jan-53	15-Mar-65
FN Her	90	26-May-54	11-Sep-59
KP Aql	1	17-Jun-56	17-Jun-56
LV Her	1	17-Jun-56	17-Jun-56
M 44	67	12-Jan-64	05-Jan-67
M 45	46	02-Aug-52	17-Jan-67
North Pole	373	15-Jul-54	30-Jan-70
QY Aql	18	21-Jul-52	10-Aug-56
Region	3	19-Nov-52	01-Aug-53
RT And	43	23-Oct-53	31-Jul-66
RT Com	171	18-Mar-59	06-Feb-73
RT Lac	10	02-Jul-52	23-Sep-60
RT Leo	4	20-Mar-55	20-Mar-55
RT Per	52	26-Nov-59	14-Jan-71
RU Boo	80	05-Apr-59	31-Jul-66
RU Mon	25	12-Feb-59	26-Jan-73
RV Com	94	18-Mar-59	07-Apr-65
RV Lyr	95	21-Jul-54	15-May-66
RV Per	48	16-Dec-53	23-Jan-60
RW Cnc	198	08-Apr-59	19-Apr-69
RW Com	54	02-Mar-53	13-Jul-66
RW Gem	1	28-Nov-53	29-Nov-53
RW Leo	1	10-May-55	10-May-55
RW Mon	7	15-Mar-55	19-Mar-55
RW Tau	7	18-Aug-60	08-Feb-72
RY CMi	3	20-Mar-56	20-Mar-56
RY Gem	1	23-Mar-54	23-Mar-54
RZ Com	2	05-Feb-53	05-Feb-53
RZ Dra	52	21-Mar-56	16-Jun-70
ST Cet	3	07-Oct-62	07-Oct-62
ST Per	41	11-Aug-60	29-Nov-65
ST-SU Cet	30	02-Oct-62	02-Oct-65
SU Cet	20	08-Oct-61	11-Jan-64
SV Boo	121	20-Mar-59	01-Aug-66
SV Cam	26	19-Mar-62	04-Mar-74

SV Cnc	83	09-May-59	06-Apr-65
SW Cyg	18	29-Jul-61	02-Aug-68
SW Lac	9	16-Oct-53	03-Aug-62
SW Psc	53	04-Sep-64	11-Oct-66
SX Cnc	245	03-Apr-59	29-Apr-67
SX Dra	2	14-Aug-56	15-Aug-56
SX Psc	41	26-Sep-52	13-Jan-59
SY Psc	49	07-Oct-63	11-Jan-64
SZ Her	169	30-May-54	14-May-71
T LMi	10	10-Mar-56	13-Feb-59
TT Del	51	02-Jul-53	05-Aug-67
TU Cnc	1	02-Apr-56	02-Apr-56
TU Com	92	19-Mar-59	17-Jun-63
TU Her	95	27-May-54	18-May-71
TX Com	87	18-Mar-59	22-Jun-65
TZ Lyr	1	21-Mar-56	21-Mar-56
UU And	6	16-Dec-53	23-Oct-56
UU Cet	46	20-Nov-61	29-Nov-66
UW Boo	10	11-Mar-54	18-May-55
UW Ori	130	14-Jan-53	03-Jan-61
UX Cet	86	26-Nov-64	25-Oct-67
UX Peg	16	27-Aug-58	05-Sep-62
UX UMa	31	27-Jul-61	11-Mar-70
UZ Eri	76	23-Sep-61	20-Jan-69
UZ Lyr	132	30-May-54	08-Jul-70
V Tri	80	31-Aug-53	03-Sep-59
V387 Cyg	32	09-Jun-58	04-Nov-60
VV UMa	11	19-Mar-55	09-May-55
VX Dra	2	19-Mar-59	19-Mar-59
VX Lac	45	11-Jul-52	28-Sep-64
VY Lac	50	17-Jul-52	26-Nov-54
W Del	16	08-Jul-66	31-Oct-68
W Equ	5	22-Jul-58	18-Sep-60
WW Boo	77	20-Mar-59	05-Aug-66
WW Cyg	115	30-May-54	01-Aug-67
WW Dra	2	06-Jun-56	25-Nov-64
WX Dra	73	22-Mar-59	02-Oct-59
WY Dra	201	15-Oct-59	10-Oct-70
WY Hya	91	15-Jan-53	15-Mar-58
WZ And	23	10-Sep-62	13-Sep-66
WZ Boo	139	20-Mar-59	28-Jun-68
WZ Oph	2	26-May-56	10-Jul-56
X LMi	71	11-Jan-61	15-Jun-62
X Tri	51	12-Feb-59	22-Oct-67
XX Boo	102	25-Apr-59	18-Aug-66
XY Eri	48	20-Dec-60	08-Feb-69
XZ And	124	09-Feb-59	21-Aug-69

XZ Per	11	26-Oct-53	21-Sep-66
Y Cam	2	20-Mar-59	20-Mar-59
Y Cyg	1	22-Jul-58	22-Jul-58
Y Leo	83	11-Feb-54	22-Feb-74
Y LMi	53	08-Apr-59	17-Apr-63
Y Psc	4	02-Nov-61	26-Oct-62
YY Del	15	19-Jun-61	04-Oct-66
Z Dra	20	20-Jul-62	23-Apr-71
Z Per	8	24-Sep-64	01-Oct-64
ZZ Cyg	150	13-Jun-54	13-May-71
TX Gem	2	25-Mar-55	05-May-58

The light curves and ephemerides were published even for stars for which only few photographic plates were available. In such cases the photographic observations were supplemented with visual observations (see, for example, Chiş and Todoran 1956, 1957).

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