I. CHRONICLE

In 1999 two Conferences of the 6 m telescope users attended by leading observers from Russia and CIS were held at the Observatory on April 20 and November 2. Below are presented the programmes and the abstracts of some reports read at the Conferences.

Conference of the 6 m telescope users, April 20, 1999

The Conference was held in Nizhnij Arkhyz in the Small Conference Hall of SAO. Among the telescope users there were the members of the Programme Committee: Yu.N. Gnedin, V.L. Afanasiev, Yu.Yu. Balega, A.V. Zasov, V.A. Gagen-Torn.

CONFERENCE PROGRAMME

1. Director's report

Yu.Yu. Balega (SAO RAS)
BTA operation in the second half of 1998

2. Scientific reports

Yu.N. Gnedin (MAO RAS)
BTA and present-day astronomy

V.I. Zhdanov (Kiev, SU)
Study of gravitation lenses by panoramic spectroscopy

V.D. Bychkov (SAO RAS)
Polarimeter MINIPOL

V.E. Panchuk (SAO RAS), *D.E. Mkrtichian* (Odessa)
Astroseismology problems and prospects

SUMMARIES OF SOME REPORTS

Yu.Yu. Balega

On the BTA operation in the second half of 1998

1. BTA observing time

The distribution of observing time in 1998 is presented in Table 1. As before the observing time is registered in two independent manners: the BTA Maintenance Service (MS) keeps a record of the total time the telescope is in operation with the dome slit opened during the night time, while the astronomers register only the time actually used for a scientific programme. For a number of years the latter has remained approximately constant and accounted for about 72 % of the time noted by the MS.

Table 1: *Observing time at BTA in 1998 (in hours)*

Month	MS	Observers	%
January	194.5	155.0	80
February	101.0	62.0	61
March	76.0	57.0	75
April	96.0	74.5	78
May	105.5	63.0	60
June	94.0	74.0	79
July	179.0	118.5	66
August	213.0	163.0	77
September	194.5	142.5	73
October	182.0	155.0	85
November	73.5	52.0	71
December	124.0	80.0	65
total	1633.0	1196.5	73

It is seen that the fall of 1998 was a spell of fine weather in contrast to 1997. The total average amount of observations taken over the data of many years is 1633 hours, 966 hours falling within the second half year.

2. Telescope and equipment

In 1998 the telescope was operated without grave failures. Losses of time caused by the faults in its systems were not higher than 1 %. Due to inadequate funding in the second half of 1998, the Observatory had to rely on its own powers in updating the BTA ACS. The replacement of the drives was suspended. A new camera for a sky surveying was reduced to service in the BTA control room. Images from the viewers of the devices are displayed on the computer monitor, which allows the guiding precision to be improved.

An echelle spectrometer NES was put into trial operation, including polarimetric accessories and an iodine cell. Observations with this device have already been scheduled, about 400 spectra have been obtained. Test observations with a matrix Photometrix have been carried out.

3. Accomplishment of observational programmes

62 time requests (357 nights) for observing in the second half of 1998 were submitted to the 6 m Telescope Programme Committee; 48 requests were granted. In 1998 the BTA observational time was distributed as follows:

- SAO RAS — 38 %,
- other institutions of Russia — 24 %,
- CIS (Ukraine, Armenia) — 11 %,
- other countries of the world — 27 %.

The distribution of time as to the methods of observations throughout the whole year: (the number of nights is presented, the sum of which exceeds the number of nights in the year, because in many cases 2 and more methods were used during a night)

MPFS	69
PF, CCD	65
SP-124	45
MSS	35
Lynx	28
Speckle	28
UAGS	26
Fabry-Perot	15
PFES	12
NES	9
MANIA	7
MINIPOL	6
H-Magnetometer	3

The following programmes were carried out to the best advantage in the second half of 1998:

- T.A. Kipper (Tartu) — "Stars with helium flares",
- T.A. Lozinskaya (SSI) — "Supernova explosion in IC 1613",
- J. Madej (Poland) — "Gamma source SGR 1900+14",
- O.K. Silchenko (SSI) — "Decoupled nuclei of galaxies",
- A.M. Fridman (INASAN) – "Spiral-vortex structures",
- A.A. Tokovinina (SSI) – "Orbits and masses of red dwarfs",
- O.M. Sholukhova (SAO) – "Unique objects in other galaxies",
- M. Roth (Germany) — "Planetary nebulae in M81",
- K.L. Maslennikov (MAO RAS) – "Objects of the Kuiper Belt".

The engineering nights were used for preventive treatment of the optics and mechanical units of BTA, updating of BTA ACS, instrumentation testing (including foreign). Continuous control over the stability of tracking and pointing precision was executed.

V.I. Zhdanov

Investigation of gravitation lenses

It is anticipated to perform a panoramic spectroscopy of the gravitation lenses H 1413+117, B 1422+231, Q 2237+030, and 0957+561 with high angular and spectral resolution to separate the individual spectra of macroimages of the quasars in the gravitation lenses. The ultimate aim is to investigate the fine structure of the quasars, separate the effects of microlensing and proper light variations of the quasars for the purpose of refining the data on lense gravitators. Within the frames of the programme panoramic spectrograms of the lenses H 1413+117 and Q 2297+030 have been obtained with the multipupil spectrograph.

Software has been developed for separation of the individual spectra of the images of the quasars in the Clover Leaf-type lens, on the basis of which it has been managed to process the data of observation of H 1413+117 with a not very good image quality. In one of the image of this object a relative distortion of the spectrum has been found, which can be interpreted as a microlensing effect.

Systems of lines with z=0.31 and 0.75 have been detected, which are of particular interest for the gravitator of this lens has not been identified yet.

V.D. Bychkov

Polarimeter MINIPOL

The polarimeter MINIPOL (Dolan & Tapia, 1986) has been made available to SAO RAS by the University of Arizona to be used until 2010. It is a classical-type polarimeter measuring linear and circular polarizations in the range from 3000 Å to 9000 Å. Since 1991 the instrument has been employed at SAO for stars of 18^m and makes it possible to attain an accuracy of polarization measurement on the 6 m telescope of 0.8 % per minute. Accuracies like this are achievable with the 1 m telescope for stars of 14^m. Over 9 years of operation eleven and eight research programmes have been accomplished with this polarimeter on the 6 m and 1 m telescopes, respectively. The most interesting results obtained with the 6 m telescope are the followings.

- Polarization of radiation from SS 433 in the ultraviolet region has been investigated (Dolan et al., 1997).
- Periodicity has been found in the radiation of

SQO 0716+714 (Impei et al., 2000).

• Behaviour of polarization in the polars BY Cam and AM Her has been studied (Tapia et al., 2000a,b).

• Polarization has been found in some unique objects from FBS and SBS (Tapia and Bychkov, 1997).

Polarization of the Hale-Bopp comet has been investigated with the 1 m telescope (Gnedin et al., 1999).

To enhance the capabilities of the polarimeter, it has been updated over the past time, and is being extensively used at present to carry out a number of scientific programmes.

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V.E. Panchuk, D.E. Mkrtichian

Astroseismology – problems and prospect

Astroseismology is a science concerned with studying of the star as an oscillating system. The idea of investigation of a mechanical system by way of examination of the spectrum of proper oscillations is one of the oldest in mechanics, but it has not so far applied to stars. Astroseismology originated from helioseismology — the lead that was born by the problem of deficiency of solar neutrinos. Fundamental properties of the expected and detected oscillations have been picked out:

1. Giantic set of frequencies accessible to observation (in the case of the Sun — about 10 mln).

2. Acoustic oscillations live for several thousand cycles, which makes it possible to isolate them and measure with a high accuracy.

3. Because of the small amplitude, they do not affect the evolution of a star.

Thus we have rather a fine tool for investigation, which enables acoustic wave velocity variations with depth to be measured, angular velocity variations with depth and latitude to be studied, the depth of the convective zone and the helium abundance in it to be estimated. Many types of stars may have pulsations with the enumerated properties. First of all, there are the stars of the type of the Sun, Delta Scuti, rapidly oscillating Ap stars, and pulsating white dwarfs. The observed pulsations of the Sun are predominantly of p-mode character, i.e. give sound waves. In white dwarfs g-modes dominate, i.e. motions are mostly non-radial. In stars of Delta Scuti type, p-modes develop in the envelopes, and g-modes develop in the cores. The rapidly oscillating Ap stars with surface magnetic fields have a still more complex pattern. Pulsations of a sphere are described by iegenfunctions: the product of the function of the radius by the spherical harmonic function. The function is defined by three degrees: n — radial degree which determines the number of nodes between the centre and the surface of a star; l — angular power characterizing the product of the radius and of the total horizontal wave number of the mode; and m — azimuthal quantum number, i.e. the projection of l on the stellar equator. p-modes may be purely radial (l=0), however in the g-mode l is always larger than or equal to 1. Analytically, two characteristics of frequency behaviour have been isolated: a great interval between the frequencies, which is determined by the propagation of the acoustic wave from the star's centre, and a small frequency interval associated with acoustic velocity gradient, mostly in the core. Computation of these characteristics will allow an astroseismic analog of the Hertzsprung-Russell diagram to be constructed — a grid in the coordinates of large and small frequency intervals for constant masses and ages (parameterized hydrogen abundance in the core). The technique of application of such diagrams opens up a new level of accuracy: if the frequencies can be measured with an accuracy permitting their separation (1 millihertz for the Sun), the mass is then determined to an accuracy of 2–4 per cent, and the age with that of 5 per cent. The estimates for field stars are more pessimistic: the errors in the determination of the mass and of the path of mixing — 3 per cent, the helium abundance and the age — 12 per cent. Until recently, photometric measurements formed the basis of observations. Several campaigns of WET (Whole Earth Telescope) were launched. To make this approach applicable in

spectroscopy, one has to create spectroscopic equipment with a sufficient time resolution (1 minute) and an accuracy of radial velocity measurement better than 10 m/s, to conduct synchronous observations at several telescopes and unify the reduction. One of the authors (D.E.M.) started the first systematic survey by the fast spectroscopy methods of a group of rapidly oscillating Ap stars. In particular a synchronous spectroscopic monitoring of Ap stars with the telescopes substantially separated in longitude (SAO and McDonald Observatory of the University of Texas, A.Hartzes) has been carried out for the first time in the world. Several hundred spectra with a time resolution of 1–2 minutes have been obtained. It has been found for the first time that the amplitude of non-radial pulsations depends on the line intensity and on the kind of chemical element. It has been inferred that:

a) non-radial pulsations in rapidly pulsating Ap stars are of zonal character;

b) there exist vertical and horizontal inhomogeneities in the atmospheres, and these inhomogeneities are possible to reconstruct.

II. Conference of the 6 m telescope users, November 2, 1999

The Conference was held in St. Petersburg in the Big Conference Hall of the Pulkovo Observatory. It was attended by the following members of the Programme Committee: Yu.N. Gnedin, I.M. Kopylov, V.L. Afanasiev, Yu.Yu. Balega, D.A. Varshalovich, A.V. Zasov, T.A. Kipper, B.M. Shustov.

CONFERENCE PROGRAMME

1. Director's report

1. Yu.Yu. Balega (SAO RAS)
Peport of the director of SAO RAS on the operation of the 6 m telescope in the first half of 1999

2. Scientific reports

2. Yu.N. Gnedin (MAO RAS)
History of the Programme Committee and new tasks

3. T.A. Lozinskaya (SSI)
Observations of two unique objects in the dwarf Irr galaxy: a peculiar SNR and the nebula related to a WO star

4. Yu.V. Glagolevskij (SAO RAS)
Magnetic fields of Ae/Be Herbig stars

6. M.A. Pogodin (MAO RAS)
Ae/Be Herbig stars

7. I.O. Drozdovskij (AI St.Petersburg)
Stellar population of the galaxies of the groups IC 342/Maffey and M81

SUMMARIES OF SOME REPORTS

Yu.Yu. Balega

BTA in the first half of 1999

Table 2: *Observing time in the 1st half of 1999 (in hours)*

Month	BTA MS	Observers	%
January	241.5	198.0	82
February	84.5	66.5	79
March	170.0	146.5	86
April	128.0	100.5	79
May	97.0	67.5	70
June	125.0	96.0	77
sum	846.0	675.0	80

1. Observations

The distribution of the number of observing hours in the first half of 1999 is given in Table 2.

2. Telescope and equipment

In the first half of 1999 the oil supply system fitted with a new drive resumed its operation under the condition of cooled oil, which reduced heat evolution inside the dome. The pointing precision of the 6 m telescope is presently 2–3″; digital viewing is provided in all the foci.

A possibility of remote access to the telescope foci is ensured through the net. 9 sets of CCD matrices are now in operation at the telescope. The echelle spectrometers NES and PFES are regularly used in observations.

A new multipupil fiber spectrograph provided a two-fold gain in the efficiency of observations. A fast spectroscopy regime with the matrix Photometrix is implemented. For reasons of obsolescence the television scanner was retired from service on January 1, 1999.

The distribution of observations according to the techniques in the first half year is presented in Table 3.

Table 3: *Distribution of observations according to the techniques*

Device	Number of nights
MPFS	25
PF, CCD	18
SP-124	23
MSS	17
Lynx	20
Speckle	6
UAGS	34
Fabry-Perot	6
PFES	9
NES	9
MOFS	10

Table 4: *Duration of one programme (in nights)*

Programme duration (nights)	Number of programmes 1997	1998	1999
1	7	5	2
2	5	9	12
3	25	7	29
4	14	5	25
5	7	7	12
6	11	7	7
7	6	5	0
8	0	6	1
9	0	1	0
10	0	2	0
11	0	3	0
13	0	1	0
17	0	1	0

Number of nights allocated by the Programme Committee in 1997–1999 for one programme is shown in Table 4.

Thus, as in the previous years the Programme Committee allocates for most of the programmes 3–4 nights. More successful were the observations for the following programmes:
V.G. Klochkova (SAO RAS) — "Proto-planetary nebulae",
H. Greiner (Germany) — "Identification of X-ray sources",
E.A. Barsukova (SAO RAS) — "Variability of CI Cam",
V.I. Zhdanov (Kiev, KSU) — "Study of gravitational lenses",
G. Richter (Germany) — "Circumnuclear regions of nearby Seyfert galaxies",
I.O. Drozdovskij (AI St.Petersburg) — "Stellar populations of galaxies",
N.A. Tikhonov (SAO RAS) — "Periphery of irregular galaxies",
I.D. Karachentsev (SAO RAS) — "Periphery of the Local Group of galaxies",
J.A. Stepanyan (SAO RAS) — "Spectroscopy of SBS objects",
N.A. Sakhibullin (Kazan', SU) — Spectroscopy of TDS at late evolutionary stages".

T.A. Lozinskaya

Observations of two unique objects in the dwarf Irr galaxy: a peculiar SNR and the nebula related to a WO star

Abstract. The observations were carried out during 1996–1999 with the MPFS and the IFP of the 6 m telescope. Standard reduction procedures were performed using software developed at the Special Astrophysical Observatory (Vlasyuk, 1993) for MPFS observations and that designed by Boulesteix (Observatoire de Marseille) in 1993 for IFP observations.

We also undertook additional observations of the galaxy at centimeter wavelengths using the VLA, in the narrow-band H_α and [OIII] filters with the KPNO 4 m telescope, and proposed ROSAT HRI observations in the soft X-ray range.

1. The peculiar SNR S8

From the MPFS observations we produced surface brightness distributions for each emission line and for the continuum, maps of line intensity ratios, an integrated spectrum of the remnant accumulated from all pixels, and a two-dimensional gas velocity field over the SNR and surrounding field. We detected a systematic velocity gradient of the main component of the H_α line and additional weak high-velocity red and blue features.

From ROSAT HRI observations we have detected for the first time a luminous X-ray source associated with the SNR. Our X-ray data show that the SNR appears to be peculiar: this is one of the brightest nebulae in the galaxy, at the same time, this is one of the most luminous X-ray SNR, like Crab Nebula and Cas A. We explain the co-existence of the bright X-ray emission and very bright optical emission in terms of scenario of a SNR expanding inside a low-density cavity surrounded by a dense shell.

2. The unique nebula related to a star of a rare class WO

The deep monochromatic H_α image of the area, we obtained with IFP, for the first time clearly shows two extended, weak, shell-like formations 100 and 300 pc in size on both sides of the bright elongated core, known previously as nebula S3.

Our measurements of radial velocities and line widths throughout the bipolar structure indicate the expansion of both shells.

A possible explanation of the structure is that

these two shells are formed by a powerful wind on both sides of a dense layer of swept-up gas at the edge of a "supercavity" formed by previous stellar activity in the area.

Yu. V. Glagolevskij

Magnetic fields of Ae/Be Herbig stars

To establish the time the characteristic features of chemically peculiar (CP) stars form, magnetic fields of a sample of Ae/Be Herbig stars have been measured. It turns out that strong global fields are absent in these stars with a probability of 96 %. The field appears in stars after the Ae/Be Herbig stage near the ZAMS which is suggested by the relationships between magnetic field value and abundance of some chemical elements and age: as long as the field is zero the chemical abundance is normal. The field and chemical anomalies appear after the accretion ceases and the atmosphere is stabilized; under these conditions it rises to the surface. The surface fields of Ae/Be Herbig stars may occasionally emerge in individual parts of the surface and affect many non-stationary phenomena. Loss of angular momentum of stars as they evolved to the main sequence occurred with no effect of strong global magnetic fields. Data are available to suggest that the field in CP stars is relic rather than dynamo generated.

The structure of magnetic fields has been investigated in a sample of CP stars. These stars have either dipole-quadrupole (or displaced-dipole) or purely dipole field structures. A preliminary inference has been made that the former are relatively young, whereas old stars have simple dipolar field configurations. The field distribution over the surface in a number of stars was compared with the distribution of chemical anomalies. Concentration of some elements turned out to be maximum at the places where the field strength is utmost (near the poles), while others concentrated in the regions with horizontal lines of force (at the magnetic equator). Evidence has been derived that strong magnetic fields are inherent in evolved stars.

M.A. Pogodin

Ae/Be Herbig stars

The nature of magnetism in young Ae/Be Herbig objects remains so far uncertain. Direct field measurements will not give results because of insufficient brightness of the objects. However, oblique methods are possible which are based on the fact that the magnetic field affects largely the structured features of the gaseous envelope. Concurrent investigations of rapid variability of emission line profiles and parameters of linear polarization in different bands make it possible to obtain indirect estimates of the fields in Ae/Be Herbig stars.

The author has obtained a bulk of observational data on the stars AB Aur and HD 36112. The quantitative interpretation of observations is performed by way of computation of theoretical line profiles for an arbitrary distribution of density, temperature and velocity in the envelope. As a result, inhomogeneous structures have been detected in the stellar wind of AB Aur and HD 36112. Evidence of a dense circumstellar disk and a number of chemical anomalies have been found in HD 36112.

I.O. Drozdovskij

Stellar population of the galaxies of the groups IC 342/Maffey and M81

When carrying out our programme on the 6 m telescope, it was expected to obtain deep CCD frames of galaxies belonging to two nearby groups IC 342/Maffei and M81. The main objective of the programme is to study stellar complexes in galaxies of these groups: structure of the complexes, sites of star formation, origin, old stellar population at the periphery of galaxies and evolution of galaxies. Observations of the stellar population will permit the distances of the galaxies studied to be refined, and thus the spatial structure of these two groups to be specified. The galaxies IC 342 and IC 2574 were given priority in the observations.

Two tasks were formulated for each of the galaxies in accordance with the observing conditions:

- to obtain deep images of several preselected fields in different parts of the galaxy for a large-scale photometric survey of the galaxy stellar population;
- in case the images are very good, to take as deep photographs as possible of one or two regions at the outskirts of the galaxies with a view to isolate the old halo population.

As a whole, the programme can be considered accomplished by 70 %. The programme of creation of the survey has been fulfilled to a greater extent as compared with the acquisition of deep photographs.