行政院國家科學委員會補助專題研究計畫執行報告

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※　**Taiwan-Baltic Open Cluster Study（1/2）**　※
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■赴國外出差或研習心得報告一份
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□國際合作研究計畫國外研究報告書一份

執行單位：國立中央大學天文研究所

民　國　92　年　05　月　14　日

PROGRESS REPORT

on the research project

"Taiwan-Baltic Open Cluster Study"

jointly led through by

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2003 April 18

I. SCIENTIFIC WORK

PHOTOMETRY IN THE VILNIUS SYSTEM

Lithuanian group

During the first year of the project investigations of 14 open clusters were started in the Vilnius seven-color photometric system: M67, NGC 1750/58, NGC 1342, NGC 1647, NGC 2395, NGC 6996, NGC 7789, Tombough 5, King 6, IC 348, IC 361, Collinder 428 and Barkhatova 1. The clusters under study span a wide range of ages − from less than 1 Myr to about 2 Gyr. For these clusters, multicolor photometry was obtained in the Vilnius system photoelectrically or/and using CCD techniques. Observations were performed using the 1.65-meter telescope of the Moletai observatory in Lithuania, the 1.5-meter telescope of Steward Observatory (USA), the 1-meter telescope of Maidanak Observatory in Uzbekistan and the 1-meter telescope of the US Naval Observatory Flagstaff Station. Currently we are doing reductions of observations and analyses of the first results.

M67

This cluster is one of the main CCD standards in the Vilnius system. The cluster is good both for the flat-fielding correction and for the determination of color equations between the instrumental and standard systems. It contains stars of various colors (blue stragglers and red giants). The cluster is one of the best-studied old open clusters of solar chemical composition. It was investigated in a number of photometric systems, including UBVRJ, JHK uvbyβ, DDO, the Beijing system and others. Consequently, this cluster is a good object for testing possibilities of any photometric system. In the case of the Vilnius system, the cluster is one of the cornerstones for the system's calibration in ages and metallicities.

The M67 stars were observed in the standard Vilnius system photoelectrically several times, with increasing accuracy of photometry. For this we have used the 1-meter telescope at the Maidanak Observatory in Uzbekistan and the 1.5 meter telescope of the Arizona University at Mount Lemmon. CCD observations in the Vilnius filters were obtained on the 1-meter telescope of the Flagstaff Station of the US Naval Observatory in Arizona. The diameter of the field is 20′. The first results of CCD photometry obtained in 1994 were published by Boyle, Kazlauskas, Vansevičius, Straižys, Urba, Sūdžius and Smiriglio (Baltic Astronomy, 1998, vol.7, 369). The investigation was based on

photometry of 279 stars down to V=15 mag. In 2000 we have repeated observations with a better account of flat-fielding and non-linearity effects. The results of CCD photometry of 420 stars down to 16.4 mag will be published in 2003. The obtained accuracies of photometry at V=16 for different passbands are: ±0.01 mag for Y, Z, V, S passbands, ±0.02 for X passband and ±0.03 for P and U passbands.

Comparing our M67 photometry with previous studies, we found that large scale errors in our case are only ± 1 %, while, for example, in the widely used work of Montgomery et al. (1993) the large scale errors reach ± 3 %. So, Vilnius photometry makes it possible to determine parameters of M67 with much greater accuracy. The well known gap in M67 (located at V = 13 mag) is completely free of any stars, while in Montgomery work it is not so clean. And the second gap (located at V = 14.2 mag) is also better revealed in our HR diagram. Only at approximately V = 15 mag the errors in our measurements increase to 0.01 mag and photometry becomes less accurate than provided by Montgomery. This happens because of random errors, since our goal is to obtaining very accurate photometry for bright stars in M67 rather than to go deeper towards the faintest ones. A paper on the results is in preparation.

NGC 1750 and NGC 1758

There is a number of open clusters in the direction of the Taurus, Aurige and Perseus dark clouds, which embraces the Galactic anti-center direction. Among them there is an interesting object considered for a long time as the overlapping clusters: NGC 1746, NGC 1750 and NGC 1758. In our earlier investigation (Straižys, Černis and Meištas, Baltic Astronomy, 1, 125, 1992) we have shown that NGC 1746 is not a cluster, but the two other groupings of stars, NGC 1750 and NGC 1758, are real open clusters located at distances of 510 pc and 680 pc. With the aim to identify members and sequences of both clusters and to determine their more exact distances and ages we undertook a new investigation of the area, which is based on CCD exposures in the filters of the Vilnius system done with the 1-m telescope of the USNO Flagstaff Station. Two sets of frames of 20′ diameter, centered on NGC 1750 and 1758, were made. We have obtained magnitudes and color indices of 350 stars down to V=17. However, for the investigation of the clusters we used about 250 stars down to only V=16 since for the fainter stars the accuracy of photometry appeared to be too low. At V=16 the r.m.s. errors of the magnitudes X, Y, Z, V and S do not exceed ±0.02 mag, and only for the ultraviolet magnitudes U and P the accuracy is lower: ±0.04 and 0.03 mag, respectively. The stars belonging to both clusters and to the Galactic background were identified, using the photometric data and proper motions. The main characteristics of the clusters determined in the

present investigation are given in Table. A paper on the results is in preparation.

Cluster	Number of members	E_{Y-V} (mag)	A_v (mag)	Distance (pc)	Age (10^6 yr)
NGC 1750	83	0.26±0.04	1.08±0.17	660	550±50
NGC 1758	88	0.25±0.04	1.04±0.17	760	550±50

IC 348

Photometric classifications of stars in the areas around the reflection nebula NGC 1333 and the open cluster IC 348 in Perseus, based on the Vilnius seven-color system, have been compared with the classification obtained from stellar spectra. In general, good agreement was found. In some cases, the differences between the results of classification may be due to the unresolved binarity of stars. Three stars have been confirmed to be emission-line pre-main-sequence objects. In the direction of IC 348 the interstellar reddening law has been estimated. The results are presented in the paper:

Straižys V., Corbally C.J., Kazlauskas A., Černis K., "A Comparison of Photometric and Spectral Classification of Some Stars in Perseus", Baltic Astronomy, v.11, p.261-268, 2002.

NGC 7789

Photoelectric observations in the Vilnius system of 25 red giants and clump stars in the open cluster NGC 7789 were used to determine the photometric spectral type, absolute magnitude, interstellar reddening, effective temperature, metallicity, surface gravity and distance. From averages over the stars in the sample, the mean overall metallicity of the cluster is found to be [Fe/H] = −0.09 ±0.05, the color excess E(Y−V) = 0.21 ± 0.01 (E(B−V) = 0.25) and a true distance modulus was found to be 11.32±0.04 mag. A slight difference in [Fe/H] was detected between the He-core-burning clump stars and H-shell-burning first ascent giants.

A draft of the paper:

Bartašiūtė S., Tautvaišienė G. "Vilnius Photometry of Red Giants in the Open Cluster NGC 7789", Astrophysics and Space Science (in preparation).

NGC 1342 and NGC 1647

These two open clusters in Perseus and Taurus were included in our program as well investigated clusters suitable for calibration of the system in terms of physical parameters. Both clusters were observed in the UBV system by some groups of authors and MK classification of their brightest members is available. NGC 1342 was also investigated in the uvbyβ system. Proper motions are available in both clusters, and this makes possible to compare photometric and astrometric criteria of membership.

In 2003, photoelectric standards for both clusters have been measured in the Vilnius System with the 1.5-m telescope of Arizona University at Mount Lemmon. 12 stars were observed in the cluster down to 12.5 mag.

CCD exposures of both clusters in the Vilnius filters were obtained with the 35/51 cm Maksutov telescope of the Moletai Observatory in Lithuania.

The observing material is now in the reduction process, and we expect the results later in 2003.

NGC 2395

This cluster in Gemini is included in our program as an insufficiently investigated object. It was studied only in the UBV system. A considerable interstellar reddening (E_{B-V}=0.72) was obtained. The V, B-V diagram of the cluster is very scattered and the cluster members are not separated form the foreground and background stars. In March 2003 we obtained both photoelectric standards and CCD exposures with the same telescopes used for NGC 1342 and NGC 1647.

The observing material is now in the reduction process, and we expect the results later in 2003. This cluster was observed also by our colleagues in Taiwan.

Tombaugh 5

RA(2000) = $3^h\ 47^m\ 48^s$, DEC(2000) = $+59^o\ 03'\ 00''$. This small faint cluster was discovered by Tombaugh in 1941. The cluster was studied

photographically by Reddish in 1954. The distance estimate is 1800 pc, the color excess is about 0.35 mag. We have made photometric observations of this cluster in the Vilnius system, since currently there is no data available about this cluster in the WEBDA online database of open clusters.

The observing material is now in the reduction process, and we expect the results in 2004.

King 6

RA(2000) = $3^h\ 28^m06^s$, DEC(2000) = $+56^o\ 27'\ 00''$. This cluster was discovered by King in 1949. Recent studies by UBVI CCD photometry give the E(B−V) = 0.50 ± 0.10, and it is found that the stars fainter than V~16 seem to have a smaller reddening (E(B−V) ~0.4), while the stars brighter than V~13 appear to have a larger reddening (E(B−V)~0.6). In our study we seek to prove or deny this inhomogeneity in reddening. The distance to this cluster is about 870 pc, angular diameter 10′, metallicity is about 0.46 dex.

The observing material is now in the reduction process, and we expect the results in 2004.

IC361

RA(2000) = $4^h\ 19^m$, DEC(2000) = 58^o 18′. In the WEBDA open clusters online database we found the distance 1070 pc, reddening 1.117 and the age of 52 Myr. The recent CCD photometric survey in the BVRI system yields [Fe/H] = −0.23, E(B−V) = 0.66, $(m-M)_o$ = 11.98 and age 1.25−1.5Gyr, which are different from previous determinations. We decided to employ the Vilnius system since it works well in areas of large interstellar reddening.

Our observing material is now in the reduction process, and we expect the results in 2004.

NGC 6996

RA(2000) = $20^h\ 56^m.5$, DEC(2000) = $+44^o$ 38′. The North America Nebula contains two open clusters: NGC 6996 and Collinder 428. The first of them was studied photographically by Muller (1936) and Barkhatova (1958). According to Muller the cluster contains 22 stars and has an angular diameter 7'. Barkhatova counts about 60 stars down to photographic magnitude 15 within

the angular diameter 15'. She finds the cluster to be at a distance of 500 pc and to have the color excess 0.64 mag. The positions of the brightest stars of the cluster form a curve similar to the spiral.

The most recent studies by Zdanavicius and Straizys (Astrophys. & Space Sci. 173, 309, 1990) gave a distance to this cluster of about 620 pc and the mean extinction Av = 1.74. They have found that the extinction within the cluster is variable.

The earliest stars were found to be of spectral type B9 by Schwassmann and van Rhijn in 1938 and B5.5 by Zdanavicius and Straizys (Astrophys. & Space Sci. 173, 309, 1990). Most of other suspected cluster members are of spectral types A2-A5V. Four G8-K0 giants are also present. All this means that the age of NGC 6996 is very similar to age of the Hyades and this excludes the possibility that the cluster is evolutionary related with the North America and Pelican nebulae star-forming region which is by two orders younger.

In many previous works Vilnius photometric system has been proven to be very efficient in studying interstellar extinction and galaxy structure. The ability of this system to classify stars in the presence of highly variable extinction is absolutely necessary in studying distant open clusters towards the North America and Pelican nebulae.

Our present study of NGC 6996 using Vilnius CCD photometry aims to reach the turn-off stars in this open cluster. This should allow us to obtain the reliable age, distance and membership for this cluster. Together with other open cluster in this region (Collinder 428 and Barkhatova 1) we intend to determine is the relationship present between the open clusters and the surrounding star-forming regions. This is very important in understanding evolution of star-forming regions and their interaction with open clusters in this region of our Galaxy.

Our observing material is now in the reduction process, and we expect the results in 2004.

Collinder 428

RA(1950) = 21^h $01^m.4$, DEC(1950) = $+44^o$ 23′. Currently there are no data available about this cluster in the WEBDA open clusters online database. The cluster was discovered by Collinder in 1931 from star concentration studies in photographic plates. The same method was used by Barkhatova in 1958 who revealed this open cluster to have asymmetric shape by 15' x 20' and to contain 37 probable members. It was impossible to determine a distance and interstellar extinction to this cluster. So, having no distance and no HR diagram for this open cluster it is difficult to prove that this group of stars is a real open cluster and not just a window in the surrounding nebulosity.

In our study we seek to prove or deny that Collinder 428 is a real open cluster. We also expect to understand the relationship between this bona fide open cluster and the surrounding North America and Pelican nebulae.

Our observing material is now in the reduction process, and we expect the results in 2004.

Barkhatova 1

RA(1900) = 20^h 50^m, DEC(1900) = $+45^o$ 40′. This open cluster was first recognized by Barkhatova in 1958 by studying star concentrations on photographic plates and using various stellar count methods available at that time. Since then nobody has attempted to prove or deny existence of this open cluster.

According to Barkhatova (1958) there should be about 60 stars down to 15 magnitude in this cluster, but visually it doesn not emerge from surrounding stars. So, most researchers are skeptical about its existence.

For this cluster (as well as for Collinder 428and NGC 6996) we obtained two CCD fields − one centered on probable open cluster itself and another located nearby. This should help us to reveal probable open cluster members by comparing two HR diagrams − one containing only background stars and another with probable open cluster stars. We hope our study will reveal the true nature of these probable open clusters.

Our observing material is now in the reduction process, and we expect the results in 2004.

FUNDAMENTAL PARAMETERS AND CHEMICAL ABUNDANCES

Latvian group

1. List of the targets (a first year priorities) was prepared and discussed (I.Platais, J.C.Mermilliod, J.Sperauskas).
2. High-dispersion (R = 45,000; λλ 3500 -10,000 Å) spectroscopic observations were carried out at Terskol Observatory (Elbrus, 3100 m) using the 2-m telescope and the spectrometer MAESTRO (head of group Dr. F. Musaev). First members (possible members) of two open clusters NGC2420 and Tr2 were observed. CCD images were processed, one-dimensional vectors extracted, and wavelengths calibrations carried out.
3. Scheduled updates of software and the methodology of abundance analysis were started. First, a new version of CCD data reduction package DECH20T was installed at IAPS of the University of Latvia in co-operation with the Special Astrophysical Observatory (Russia). Second, identification of absorption lines over large spectral region using new observations and synthetic spectra were carried out and a new list of lines (more than 150 lines beyond Fe were selected) was prepared for abundance analysis. Third, collaboration with atomic physicists (J.Alnis) started to analyse (update) accuracy of oscillator strengths for the selected lines. Finally, an update of the spectrum synthesis code for calculation of isotopic abundances using molecular lines was discussed with M. Schmidt (N. Copernicus Astronomical Center, Torun) and future collaboration was coordinated in this field.
4. A high-resolution spectrum (42,000) of the peculiar star W CMa (member of Serpens OB2 ossociation) observed at Haute-Provence (France) observatory was gathered. Future collaboration in the field of neutron-capture nucleosynthesis was co-ordinated with the Free University of Brussels (Drs. A.Jorissen, S.Goriely).

VARIABILITY OF STAR CLUSTERS

Taiwanese group

Several star clusters have been monitored in winter of 2002/2003 with the Lulin One-meter Telescope (LOT) with high time resolution (a few minutes) and long time coverage (a few days to weeks), NGC 654, NGC 1513, NGC 1605, NGC 2269, and NGC 2324. More are scheduled in 2003. The data would allow us to discover variable stars of different timescales, including the rare possibility of planet transit events. We are developing data processing pipelines to deal with the large amount of imaging data.

HIGH-DISPERSION SPECTROSCOPY OF EVOLVED STARS

Lithuanian group

Open clusters are important tools in the study of the Galactic disk as well as in understanding of stellar evolution. The number of identified open clusters in the Galaxy is now in excess of 1200, however the detailed abundances of carbon, nitrogen, oxygen and other important chemical elements are investigated from high-resolution spectra of giant stars in only about ten open clusters. The advantage that cluster members have to be coeval and identical except for mass and evolutionary stage, which can be identified unambiguously, may efficiently serve for the analysis of changes in stellar atmospheres related to internal processes of stellar evolution. During the first year of the project, high-resolution spectral investigations of stars in six open clusters were started.

NGC 7789

High-dispersion spectra have been obtained for six red giants and three clump stars in the old open cluster NGC 7789 using the 2.56-meter Nordic Optical Telescope (NOT) in La Palma (Spain). The overall metallicity of the cluster stars was found to be close to Solar ([Fe/H] = −0.04 ± 0.05). Compared with the Sun and other dwarfs of the Galactic disk, abundances in the investigated stars suggest that carbon is depleted by about 0.2 dex. The oxygen abundances are normal in most of the red giants, however are slightly depleted in the giants at the tip of the red-giant branch and in the clump stars. Among other mixing-sensitive chemical elements, an overabundance of sodium and aluminium is suspected in the majority of the stars.

A draft of the paper is enclosed:

Tautvišienė G., Edvardsson B., Puzeras E., Ilyin I. "Chemical composition of evolved stars in the open cluster NGC 7789", (Astronomy and Astrophysics, in preparation).

NGC 2506, NGC 6134, NGC 6819, Collinder 261 and IC 4651

High-resolution (R ≈ 40 000) spectra of selected giants and clump stars in five open clusters were obtained with the new spectrograph (SARG) at the 3.5 meter Telescopio Nazionale Galileo (belongs to Italy) in La Palma (Canary Islands, Spain). The spectra are of almost full coverage from 4650 to 7900 Å, with only a small gap of about 40 Å near 6200 Å. The spectra are already reduced with the standard IRAF routines for eshelle spectra. The final analysis of abundances for up to 25 chemical elements in observed stars are expected to be finished in 2003 and 2004.

RADIAL VELOCITIES

Lithuanian group

NGC 2099 (M 37)

Memilliod et al. (Astron.&Astrophys., 1996, 307, 80) have presented 474 radial velocities for 55 red giants brighter than V=12 and redder than B−V = 0.50, measured with the CORAVEL. The membership of 35 red giants has been confirmed and 16 spectroscopic binaries have been discovered. The mean radial velocity for this cluster, based on 30 stars, is 7.68 ± 0.17 km/s.

Kalirai et al. (Astron. J., 2001, 122, 3239) have made deep CCD photometry (V~24.5) and derived the main cluster parameters using the V,B−V diagram: E(B−V) = 0.21±0.03, (m−M) = 11.55±0.13, d = 1513 (+146/−133) pc, Z = 0.02. However, this cluster is very large. Nilakshi and Sagar (Astron. & Astrophys., 2002, 381, 65) have made CCD observations of NGC 2099 in the area of about 24'x 34' in the cluster region and in the 12' x 12' area located 45' away from the cluster center up to V~22 mag in B, V and I passbands. The cluster parameters were determined by fitting isochrones in the V,(B−V) and V,(V−I) diagrams: E(B−V) = 0.30, d = 1360±100 pc, age = 400 Myr, Z = 0.008, which are slightly different from the parameters obtained earlier.

Our plan is to check membership and binarity of the red giants located in the outer field 45' away from the cluster center.

NGC 6996

This cluster is under investigation in this project by means of photometry in the Vilnius system (see description in Sect. I). Accurate radial velocity measurements are not present in the literature. We plan to check membership and binarity of the red giants in this cluster.

NGC 1750/1758

This cluster is under investigation in this project by means of photometry in the Vilnius system (see description in Sect. I). Accurate radial velocity measurements are not present in the literature. We plan to check membership and binarity of the red giants in this cluster.

NGC 2281, NGC 2632, NGC 6709, IC 4756

During the period of observations in May-July, 2003 with the 1.65-meter telescope at the Moletai observatory (Lithuania) we will start long-term observations with the CORAVEL instrument of the red giants in five open clusters. The aim of this program is to carry out a search of binarity and variability of the red giants and to select new peculiar stars for further spectral observations to be carrier out by the Latvian group.

CLUSTER DYNAMICS

Taiwanese group

Galactic open clusters were selected from the 2MASS database on the basis of the latest open cluster catalogue (Dias et al 2002, AA, 389, 871). Parameters such as radial stellar density profile, morphological ellipticity and concentration were derived. We found that

1. Open clusters, though with seemingly irregular appearance, have member stars distributed in a structured manner, concentrating progressively toward the center.
2. Even the youngest star clusters in our sample (a few Myr old) show evidence of mass segregation. These cluster has not had time for dynamical relax process to become effective, thus the structure must inherit from that in the parental molecular cloud and the star-forming process.
3. Most star clusters are elongated. Young clusters seem to show considerable amounts of ellipticity, again perhaps because of the complex morphology of star-forming clouds. By the time of ~100 Myr, i.e., on the relaxation timescales of these clusters, internal gravitational interaction starts to govern the structure of the cluster. By the time of ~1-2 Gyr, external perturbation (e.g., Galactic tidal force, differential rotation, encounters with giant molecular clouds, etc.) becomes the dominant factor in shaping a star cluster.
4. The higher a star cluster lies above the Galactic plane, the less elongated its morphology is. This is a clear consequence of the tidal force from the Galactic disk.

Some of these results have been reported as a conference paper (Chen & Chen, "*Evolution of Spatial Structure of Star Clusters*", in IAU/APRM Proceedings, 2002, held in Japan). Results based on 31 clusters were represented as a poster paper in the Chinese (Taiwan) Physics Society Meeting in February of 2003. A full paper is being drafted. Since the full release of

the 2MASS data in March 2003, more clusters are being analyzed at the moment.

II. TECHNICAL WORK

1-meter telescope at Maidanak Observatory (Uzbekistan)

Lithuanian and Taiwanese groups

Lithuanian and Taiwanese partners have worked out a plan of the upgrade of the 1-meter telescope of Maidanak Observatory in Uzbekistan. Before the observing season of 2004, the facility is planned to be upgraded with a modern electronic control system and relevant software for the full telescope control including positioning, dome and its window moving, focusing, lightning, automatic star searching, star chart monitoring, and dome synchronization. It has been agreed that the upgrade could be successfully done by involving engineers of the Yunnan Observatory (China) as subcontractors. In November of 2002 a group of Yunnan engineers has visited the Maidanak observatory and investigated the present state of the 1-meter telescope. It has appeared that the costs of the renovation should be larger than it was thought initially (done by Uzbek staff and to a less computerized level), and we need to combine budget reserved for instrumentation of the first two years in our project. The concrete plan of technical work and obligations of all the four involved sides is finalized and a four-partial agreement should be signed at once if the project will be supported for the second year.

1.65-meter telescope at Moletai observatory (Lithuania)

Lithuanian group

During the first year of the project, the renovation of the 1.65 m telescope control system has been continuing. The new computer running LINUX telescope control system was implemented with the corresponding computer-hardware as well as with two new encoders for operating of Right Ascension and Declination axes of the telescope. The work is in progress. Two photomultiplier tubes for the photometers to be used for photometry in the Vilnius system were bought.

CORAVEL Instrument

Lithuanian and Latvian groups

Plans for an upgrade of the CORAVEL-type spectrometer and for observations according to the joint research project were discussed and accepted by Laimons Zacs, the principal investigator from Latvia, and Julius Sperauskas,

a project participant from Lithuania, during the meeting on 26 -28 Feb 2002 in Riga.

The consensus of opinion was that the Coravel-type photoelectric spectrometer, built in 1998 at the Vilnius university observatory, is an efficient instrument for measurements of radial velocities of stars. During the period of 1998 − 2002 this instrument was successfully used for several joint research program (Platais et al., 2003, Astron.& Astrophys., 397, 997; Fekel et al., 2002, Astron. J., 124, 1064; Upgren, Sperauskas, Boyle, 2002, Baltic Astronomy, 11, 91; Sperauskas and Bartkevicius, 2002, Astron. Nachr., 323, 139).

It was agreed that further modernization of this instrument is needed and that it will capacitate to use the Coravel-type spectrometer more efficiently for carrying out observations in the frame of the Taiwan-Baltic project and also for the future joint researches between the participating countries of this project in the future.

The main aims of the modernization of the CORAVEL are:

a) to reduce the errors of measurements of radial velocities, introduced by the variable illuminations of the entrance slit of the spectrograph (guiding, seeing effects, etc.) This could be achieved by increasing about two times the scanning rate of the spectrum and by adjusting the mercury spectral lamp instead of the neon lamp to ensure more precise check of short term spectrum drift due to change of the ambient temperature and flexure of the instrument;

b) to increase a confidence limit of an electronics interface of the CORAVEL by designing and producing new electronic circuitries, using of additional software for analysis procedure of observations in real time and purchasing the spare parts such as photomultipliers and supply units;

c) to adopt the Coravel for it use with the modern telescopes having as high focal ratio as F/7. Now the usage of this instrument is limited by the focal ratio < F/11.

The Latvian group has promised to transfer $2000 to the Vilnius University by the end of April 2003 for the work in renovating the CORAVEL. Financing for the realization of the next stages of this project will be discussed in detail after approval of the budget of the Joint research project for the period 2003 − 2004.

III. SCHOLAR EXCHANGES

From Taiwan, Prof. Wen-Ping Chen visited Vilnius (Lithuania) from 3 to 10 in February of 2003. During his visit he gave two talks at the Joint Seminars of Vilnius Astronomers. A meeting was organized with members of the Lithuanian group as well as a number of discussions concerning the joint scientific work and the plan of renovation of the 1-meter telescope in Uzbekistan.

Also from Taiwan, Mr. Chin-Wei Chen (PhD student) visited Vilnius (Lithuania). Mr. Chin-Wei Chen had stayed from 3 to 17 in February 2003. He gave a talk at the Joint Seminar of Vilnius Astronomers, and participated in preparing a program for observations of peculiar open clusters to be accomplished by the Taiwanese and Lithuanian groups.

From Lithuania, Dr. Julius Sperauskas visited Riga (Latvia). Dr. Julius Sperauskas stayed in Riga from 26 to 28 in February 2003. Plans for the upgrade of the CORAVEL-type spectrometer and for observations according to the joint research program were discussed and accepted together with Laimons Zacs.

From Lithuania, a visit of Dr. habil. Gražina Tautvaišienė to Taipei (Taiwan) is scheduled from 7 to 15 in July of 2003. The trip will be combined with the participation in the General Assembly of the International Astronomical Union (IAU) in Sydney (Australia) and results of this project will be presented at the IAU Symposium No. 219.

A workshop conference devoted to the current Taiwan-Baltic Open Cluster project, entitled "*Dynamical and Chemical Evolution of Galactic Open Clusters*" will be held November 20-25, 2003 in Taiwan, on campus of the National Central University. Colleagues in the Taiwan-Baltic collaboration from Latvia and Lithuania, as well as associated astronomers from Uzbekistan and China will meet to discuss the progress made and future planning. There will be invited and contributed oral presentations, with the possibility of some poster papers. Some 40 participants are expected, and a special issue of Baltic Astronomy is negotiated to serve as the proceedings of this meeting.

赴國外出差心得報告 (2003.05.14)

中拉立疏散星團研究
Taiwan-Baltic Open Cluster Study

There are two overseas trips that were relevant to, and paid by, the project, a visit to Maidanak Observatory by the Yunnan group in December 2002 and a visit to Vilnius by the NCU group in February 2003.

Mainak Trip (Dec 2002)

The grant pays for the trip made by the Yunnan group (of 1 astronomer Prof Pei-Sheng Chen and 2 engineers) under the agreement that an assessment would be done as to how to proceed with the renovation. The trip turned out to be physically demanding due to heavy snow, but technically rewarding.

Dec 18 ……. 22:00 departured from BJ
Dec 19 ……. 2:00 arrived in Tashkent
10:00-17:00 discussed with the director and Hojaev in more detail about the trip to Maidalak and relevant issues about the telescope.
20:00 taken the train to Kutab
Dec 20 ……. 11:00 arrived in Kutab
13:00 departed to Maidalak by car
18:00 arrived in Maidalak including 1.5 hours of trekking for 2 km in deep snow
Dec 21 ……. 8:00-20:00 work with the 1 m telescope and the dome
Dec 22 ……. 8:00-20:00 work with the 1 m telescope and the dome
Dec 23 ……. 9:00 left for Kutab, including walking for 8 km in snow and then by car
Dec 23 ……. 18:00 arrived in Kutab
Dec 24 ……. 9:00 left for Tashkent by car with very bad road condition in snow and fog
17:00 arrived in Tashkent
20:00-22:00 phone meeting with W. P. Chen and discussed with the director of the UBAI
Dec 25 ……. Morning departed back to Beijing
Dec 26 ……. 16:00 back at home in Kunming

Both the telescope (optical and mechanical systems) and the dome were carefully examined. A renovation plan resulted from this very useful trip.

Vilnius Trip (Feb 2003)

The PI visited Vilnius (Lithuania) from 3 to 10 in February of 2003. During his visit he gave two talks at the Joint Seminars of Vilnius Astronomers, "*Census of Small-Icy Bodies in the Solar System---The Taiwan-America Occultation Project*", and "*Current Status of Astronomy Research Activities in Taiwan*". A meeting was organized with members of the Lithuanian group as well as a number of discussions concerning the joint scientific work and the plan of renovation of the 1-meter telescope in Uzbekistan. There were numerous communications between WP Chen and G. Gržina Tautvaišienė about the planning and duty-sharing both for the telescope renovation project and other scientific activities.

PhD student, Mr. Chin-Wei Chen, was visited Vilnius and stayed longer (from 3 to 17 in February 2003) than W. P. Chen did. He gave a talk at the Joint Seminar of Vilnius Astronomers about his research work on "*Spatial Structure in Galactic Open Clusters*", described earlier in this report. He also participated in preparing a program for observations of peculiar open clusters to be accomplished by the Taiwanese and Lithuanian groups.