

行政院國家科學委員會補助專題研究計畫執行報告

中拉立疏散星團研究 (2/2) Taiwan-Baltic Open Cluster Study (2/2)

計畫類別：■個別型計畫 □整合型計畫
(國際合作計畫)

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計畫主持人：陳文屏 (台灣)

本成果報告包括以下應繳交之附件：

- 赴國外出差或研習心得報告一份
- 赴大陸地區出差或研習心得報告一份
- 出席國際學術會議心得報告及發表之論文各一份
- 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 93 年 04 月 20 日

PROGRESS REPORT
(the second year)

on the research project

“Taiwan-Baltic Open Cluster Study”

jointly led through by

Prof. Wen-Ping Chen

**Graduate Institute of Astronomy
National Central University
Taiwan**

Dr. Laimons Začs

**Department of Physics
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and

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**Institute of Theoretical Physics and Astronomy
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2004 April 20

I. SCIENTIFIC ACTIVITIES

During the second year Lithuanian and Taiwanese researchers finished, among other work, an extensive study of the open cluster NGC 2395. This cluster in Gemini was 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 from the foreground and background stars.

In 2003 the Lithuanian group obtained CCD exposures of the cluster in the Vilnius system with the 35/51 cm Maksutov telescope of the Moletai Observatory in Lithuania, photoelectric standards for this clusters have been measured in the Vilnius System with the 1.5-m telescope of Arizona University at Mount Lemmon. Taiwanese astronomers have investigated the morphology of the cluster. The results have been summarized in a draft of the paper, enclosed as *Appendix 1*.

During the second year the Lithuanian researchers have performed a new series of astronomical observations on the telescopes located both at the Moletai Observatory of VU ITPA and at a few observatories outside Lithuania. The surveys of target star clusters have resulted in a number of papers published or submitted to ISI journals and four contributions to the International Meeting "Stellar Photometry: Past, Present and Future" (Vilnius, September 17-20, 2003) and the 203rd Meeting of the American Astronomical Society (Atlanta, January 2004).

The Lithuanian group has completed their study of the overlapping clusters NGC 1750/1758 by means of CCD photometry in the Vilnius seven-color system. The CCD results are published for 420 stars down to $V=16$ mag in and around the overlapping clusters. For 287 of these stars, the results of photometric spectral classification are given, along with accurate estimates of interstellar extinction and distances. The distance to the interstellar clouds lying in the direction of these clusters has also been determined. It was found that for both clusters the amount of interstellar extinction is the same, $A_V=1.06$ mag, as are their distances from the Sun ($r \approx 760$ pc). These results suggest that the two clusters are penetrating into each other.

On the basis of our earlier investigation within this project (the first year) of the open cluster 7789 an analysis has been performed on possible changes in abundances of carbon, nitrogen and oxygen, which affect stellar spectra and, consequently, the accuracy of photometric determinations of stellar atmospheric parameters. The results of this analysis are thought to have practical applications to choosing optimal photometric filters for the Gaia satellite.

Vilnius group has also published the results of their extensive study in the seven-color Vilnius system of the open cluster M 67. The paper summarizes CCD observations on the 1-meter telescope of the US Naval Observatory Flagstaff Station made during six observing runs (from 1994 to

2001) and photoelectric observations on the 1.5-meter telescope of Steward Observatory (USA) performed in three successive runs (2000–2003).

New photoelectric observations in the Vilnius system, made at Maidanak Observatory (Uzbekistan), were published for 63 members of the intermediate age cluster NGC 752. Based on the stars with accurate photometric classifications, the main cluster parameters such as distance modulus, reddening, and metallicity have been redetermined. The major conclusion drawn from this investigation is that the metallicity for the evolved stars (red clump giants), $\langle[\text{Fe}/\text{H}]\rangle = -0.07 \pm 0.06(\text{s.d.})$, appears to be systematically higher than that found for the unevolved F-type cluster members, $\langle[\text{Fe}/\text{H}]\rangle = -0.17 \pm 0.05(\text{s.d.})$. This confirms our earlier result obtained within the same project (the first year) for another intermediate age cluster, NGC 7789. Both findings may be a strong indication that mixing processes could have taken place in the evolved stars, which might alter photometric determinations of their surface abundances. In the paper on NGC 752, the distribution for the binary pairs among the cluster members and their predominant effects on the derived cluster parameters are analyzed by means of computations of a synthetic cluster with inclusion of the spread due to binarity.

Catalogs of photoelectric observations of standard stars in the Vilnius system have been prepared which include the open clusters NGC 1342 (12 stars), NGC 1647 (15 stars), NGC 2395 (12 stars) and NGC 2099 (50 stars) as well as two suspected but yet not confirmed open clusters Dol-Dzim 5 (13 stars) and Upgren 1 (10 stars).

In the second year, seven-color observations were performed at the Moletai Observatory with the new CCD camera: 54 exposures were taken for the open cluster NGC 2395, 49 exposures for NGC 1342, and 74 exposures for NGC 1647.

At present, CCD photometry in the Vilnius system of the central part ($20' \times 20'$) of open cluster NGC 2099, obtained in 2001 with the 1-meter telescope of the US Naval Observatory Flagstaff Station, is being processed.

Also, the new program code for determining the physical parameters of stars (effective temperature, gravity, metallicity, distance) from the photometric observations of stars both in the Vilnius and Strömvil photometric systems is under development. For this purpose a set of observations of about 1000 stars with known physical parameters is used. This program will be finished later in 2004.

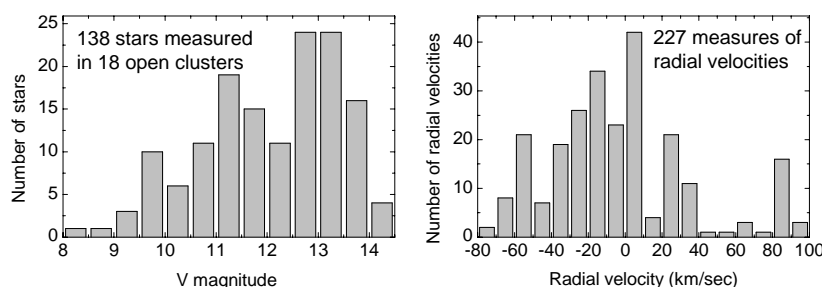
For the second year program of radial-velocity measurements, giant stars mainly in poorly populated and distant open clusters were proposed. Such clusters usually lack any radial-velocity observations even for their brightest members. The goal of this program was to establish the cluster membership of red giants and to identify among them possible spectroscopic binaries using their radial velocities to be measured with the Coravel-type photoelectric spectrometer.

According to this program the radial velocities of the target stars were measured using the 1.5 m, 1.55 m and 2.3 m telescopes of the Steward Observatory, University of Arizona (USA). These observations were performed during October–December 2003.

The list of the clusters and the number of measured stars in each of them, together with the number of individual radial velocity measurements, in are given below.

CLUSTER	Number of stars measured	Number of radial velocity measurements
NGC 188	1	1
NGC 1883	12	24
NGC 1907	12	24
NGC 2194	13	16
NGC 2355	1	1
NGC 2420	1	4
NGC 2506	9	12
NGC 2548	9	19
NGC 2627	12	21
NGC 6882	6	20
NGC 6996	8	16
BA 12	11	11
IC 1369	3	4
BA 15	5	6
NGC 7142	5	5
NGC 7209	7	14
NGC 7830	14	18
NGC 7772	8	10

The histograms of visual V magnitudes and radial velocities for the measured stars are shown in the figure.



The results of radial velocity measurements for the open cluster NGC 6882 were presented at the 203rd Meeting of the American Astronomical Society in Atlanta.

Now an analysis of the radial velocities obtained for stars in the target open clusters is being performed. For the majority of clusters photometric observations are also needed.

It is obvious that to achieve the goals of this program, and, especially, for the identification of spectroscopic binaries among the measured stars, another observing run using a 1.5– 2 m class telescope should be organized.

In May 2003 a long term monitoring of radial velocities for a sample of red giants in open clusters, proposed by J.-C. Mermilliod, was started at the Moletai Observatory. These stars were detected as small amplitude radial velocity variable stars during the course of comprehensive radial velocities study of open clusters at the Geneva Observatory. The aim of this program is the identification of new binaries among the red giant of nearby open cluster by combining radial velocities obtained at both the Moletai and Geneva observatories.

By now, 230 radial velocities measurements for 39 red giants in 8 open clusters have been obtained using the Coravel-type spectrometer and the 1.65 m telescope of the Moletai Observatory.

At the same observatory, radial velocities of 13 stars with V magnitudes down to ~ 12.5 mag and supposed to be the members of the open cluster DoDz 5 were measured in May 2003. According to the values of radial velocities obtained, these stars cannot be treated as members of the open cluster.

The Latvian group has carried out high-dispersion ($R = 45,000$; $\lambda\lambda$ 3500 - 10,000 Å) spectroscopic observations at Terskol Observatory (Elbrus, 3100 m) using the 2-m telescope and the spectrometer MAESTRO (*head of the group Dr. Faig Musaev*) and CCD camera in February and November 2003. The members and possible members of four open clusters (aggregates) NGC2420, Tr2, NGC1545, and Wolf 630 were observed. CCD images were processed, one dimensional vectors extracted, and wavelengths calibrations carried out.

Atmospheric parameters and abundances for HD148897 (Wolf 630), NGC 2420 X, and HD27277 (NGC 1545) were calculated using standard methods of stellar atmospheric models and spectral synthesis. The preliminary results of analysis have been presented (see Publications and presentations) at International Astronomical Union 25th General Assembly (Sydney 13-26 July 2003), Joint European and National Astronomical Meeting – JENAM (Budapest, 25-30 August, 2003), and the Taiwan-Baltic Workshop „Dynamical and Chemical Evolution of Star Clusters” (Chung-Li, 24–29 November, 2003). Reduction of the rest spectra observed in NGC1545 and Tr2 are in progress (*Mg. Oskars Alksnis*).

The peculiar star W CMa (member of Serpens OB2 association) has been observed (*Dr.Imants Platais*) using High Accuracy Radial velocity Planet Searcher (HARPS) at the ESO La Silla 3.6-m telescope in March 2004. The spectrum of very high resolution ($R = 115,000$) was gathered in the spectral region from 4400 to 6900 Å with the goal to determine the atmospheric parameters and abundances. Analysis of this cool carbon-rich star ($T_{\text{eff}} = 3000$ K) with very crowded spectrum is in progress. One short spectral region with the identifications of selected spectral details has been attached.

An analysis of the high-resolution spectrum of DY Per (possible member of Tr2) has been carried out. Atomic and molecular lines were identified. Radial velocity (-42.0 km/s) was measured for the first time for this peculiar cool star. High velocity (150 km/s) outflow was identified in DY Per. The preliminary results were presented at JENAM-2003 (see Publications and presentations).

Radial velocities for selected stars in open clusters (NGC188, NGC2420, NGC1545) and for a few unique stars (BD+57 2161, W CMa) were measured with CORAVEL in collaboration with J.Sperauskas (Vilnius University).

Analytic expressions for Green's function describing the process of transfer of polarized radiation in homogeneous isotropic infinite medium in case of spherical symmetry and nonconservative scattering are obtained (*Dr.Freimanis Juris*). Spherical eigenfunctions of the homogeneous transfer equation are not used, due to their strong divergence; instead, direct transformation from plane-parallel to spherical symmetry is carried out, leading to convergent solutions. The possible existence of generalized eigenfunctions of homogeneous transfer equation is accounted for.

The updates of software for abundance analysis continued (*Bc. Raivis Spelmanis*) in collaboration with *Dr. Mirosław Schmidt (N.Copernicus Astronomical Center, Poland)*. The update of list of carbon bearing molecules was continued (one fragment from this list is attached) and the molecular spectrum of C₂ and CN for cool stars was synthesized. The carbon abundance for BD+57 2161 was calculated using the molecular lines.

Preparation of a new list of atomic lines for abundance analysis is in progress in collaboration with atomic physicists (*Mg. student Aigars Atvars, Dr. Janis Alnis*).

The Taiwanese group, together with Dr Chenggang Shu (Shanghai Observatory), completed a paper on morphology study of open clusters (*Appendix 2*). The important conclusion is that almost all the open clusters they investigated are elongated in shape, even among the youngest ones with only a few million years old. Because these young stellar systems have not had time to relax, their shapes must reflect the conditions in the parental molecular clouds from which the star clusters formed, rather than the results of internal dynamical evolution. Also the ellipticity of a cluster is found to be correlated with the height of the cluster above the Galactic plane, vividly showing the prominent effects of Galactic tides. Some open clusters in fact display tail-like structure. The analysis of NGC 2395 (*Appendix 1*) is an application of the technique. The combination of expertise, i.e., morphological study by the Taiwanese group and photometrical study by the Lithuanian group, provides the best example of collaboration as a product of this joint project.

II. TECHNICAL COOPERATION

The project partners from Taiwan (NCU) and Lithuania (VU AO and TFAI) have worked out a plan of the renovation of the Maidanak Observatory 1-meter telescope, which until 1993 was the property of Lithuania and now belongs to the Ulugh Beg Astronomical Institute of Uzbekistan (UBAI). By August 2004, this facility will be upgraded with computerized control system and relevant software for the full telescope control including pointing, tracking, focusing and illumination and for observing procedure (star-chart finding, target acquisition, etc.). In the second year the engineering contract has been awarded to the Yunnan Observatory (China), which has an identical telescope and successfully upgraded its system a few years ago. At the beginning of April the UBAI astronomers, together with experts from Moscow and Kharkov universities, started the repairs of the telescope's current electronics and other relevant mechanical components (installation of the mirror, alignment of the optics) necessary before the installation of the new control system. For this, some financial support will be provided by the Lithuanian and Taiwanese groups to cover part of travel expenses of an electronics engineer from Moscow University (a copy of the quadrilateral agreement between ITPA VU, NCU, UBAI and Yunnan AO is attached as *Appendix 3*).

At the Moletai Observatory (Lithuania), a series of technical works have been done during this year in order to get its telescopes ready for operation with the CCD camera.

On the Latvian side, much of the technical work foreseen in the project has been allotted to the modernization of the CORAVEL spectrometer. According to the agreement between the University of Latvia and Vilnius

University "Upgrade of the CORAVEL-type spectrometer of the Vilnius University" the following equipments were designed and made:

1. Equipment for measuring photographic spectra of stars and producing of the CORAVEL-type masks. This equipment consists of the optical-mechanical module of the microphotometer MF-2 equipped with the precise motorized translator stage for scanning spectra, the photon-counting system used for measuring profiles of spectral lines, the CCD for visual identification of the spectrum and the projector for printing apertures on the photographic mask. The scanning of the spectrum and the microphotometer tracing are performed with a computer.
2. Motorized translation stage, driven by stepping motor. To drive the motor from a computer the electronics interface designed for Coravel-type spectrometer is used. Travel range of this translator is 75 mm and resolution - 0.0025 mm (400 steps/mm).
3. Electronics module for the Coravel-type spectrometer. This module is a new version of the module made in 1997 and includes a new design of circuits necessary for the power supply of the spectrometer. It provides the following voltages: +24 V for the stepping motor control unit, +12 V for the amplifier-discriminator F316A of the photon-counting system, +5 V for the computer interface card, high voltage (+500 V to +1000 V) for the high voltage divider of the Hamamatsu photomultiplier R 647. The module includes the computer interface card (the old version designed in 1997) which ensures the data acquisition from photon counter and the control of stepping motor of Spectrum scanning unit. Since Sep 2003 the new electronics module is being used for radial velocity measurements (Photo cora0 - the CORAVEL-type spectrometer and the new electronics module mounted on the Steward Observatory 1.5 m telescope).
4. Translation Stages of 3 axis configuration for mounting photoelectric detector to the spectrograph of the radial-velocity meter and measuring its curvature of the focal plane.
5. The new computer program running under Win OS for the data acquisition and for control of the radial velocity meter is being written. The old version of such a program was written in DOS environment.

III. MUTUAL VISITS AND EXCHANGES OF RESEARCHERS

From Taiwan, the project coordinator Prof. Wen-Ping Chen visited Vilnius on September 16–21, where he had a few meetings with all the project participants from Lithuania to discuss present and future prospects of collaboration within and beyond the Taiwan-Baltic project. Also, Prof. Chen gave a talk at the International Astronomy Meeting “Stellar Photometry: Past, Present and Future” held at Vilnius University on the occasion of the 250th anniversary of its Astronomical Observatory.

From Lithuania, on October 15–16 Dr. Stanislava Bartašiūtė (AO VU) visited the Institute of Atomic Physics and Spectroscopy (University of Latvia), where she had meetings with Dr. Laimons Začs, a project leader on the Latvian side. Among the subjects discussed were possibilities of collaboration of Vilnius photometrists and Latvian spectroscopists. So far, close scientific ties between the two parties in this project were only in the fields of high-dispersion spectroscopy and radial velocity observations.

On November 21 through December 1, a group of project participants from Lithuania, Prof. Gražina Tautvaišienė, Dr. Stanislava Bartašiūtė, Vygandas Laugalys and Eduardas Puzeras and project participants from Latvia, Dr. Laimons Začs and Dr. Juris Freimanis, visited Taiwan. They took part in the Taiwan-Baltic Workshop “Dynamical and Chemical Evolution of Star Clusters” held on November 24–28 at NCU. Apart from the participants from the Taiwan-Baltic partnership countries, astronomers from Uzbekistan, USA and P. R. of China also took part in the workshop. Astronomers presented a large number of contributions on their recent research in the field. The conference poster and the program are attached as *Appendix 4*. During the workshop, Lithuanian and Latvian groups visited the Lulin Observatory, where the Taiwan 1-m telescope was put into operation not long ago. Along with a plenty of personal contacts and discussions during the workshop and beyond, the project participants from the Baltic countries, Uzbekistan and Taiwan had a meeting with Dr. Hu, a representative of the National Science Council of Taiwan.

In addition to host the Open Cluster Workshop in November 2003, Taiwan also hosted the visit (September 2003 to February 2004) of Dr Alishar Hojaev from Uzbekistan. His visit is not directly paid by, but the scientific activities were related to our program. From Lithuania, Dr. Erika Pakštienė (ITPA VU) visited NCU for her post doctoral research (February-May 2004). This visit was granted by the NSC in Taiwan.

IV. FUTURE WORK

As it was foreseen in the project, during the third year of the project coordinated observations on the newly refurbished telescope in Maidanak have to be started. For this reason modern star-light detectors have to be tested and calibrated for the Maidanak 1-m telescope, the corresponding light-transparency filters manufactured. The telescope renovation taken place in the last two years would only be followed with intensive scientific collaboration.

A need of complementary observational material was revealed for a large number of open clusters, for which the analysis was started (NGC 1342, NGC 1647, NGC 2395, Tombaugh 5, King 6, IC 361, NGC 6996, Collinder 428, Barkhatova 1 and many others). We hope to finish the observations and analysis during observing runs to the Maidanak observatory and mutual visits of researchers in the collaborating countries.

A significant task for the third year is to train young researchers of the project as well as our Uzbek colleagues to work with the refurbished 1-m Maidanak telescope. Concrete plans of continuing scientific collaboration have been made to concentrate, in the third year, on photometric monitoring of young star clusters for variability, e.g., variables, binaries, or even exoplanet transits. The already successful, ongoing program of photometric, radial-velocity, proper-motion studies at Moletai and Lulin will continue. With the addition of the to-be-ready 2.4 m telescope of Yunnan Observatory and the Shanghai theoretical group on Galactic structure and evolution, to which our open cluster data shall contribute, an even more fruitful year can no doubt be expected.

In summary, it is fair to conclude that our program in the last two years has been highly productive. Research teams who did not recognize each other work together, from mutual technical help, to complementary scientific activities, to scholar exchanges. In every aspect this is what an international collaboration could have expected for, academically and culturally. We look forward to further collaboration in the years to come.

Publications:

All together we have the following refereed papers (marked by SCI) and presentations in the second year:

1. Chang, R. X., Shu, C. G., Chen, W. P., Hou, J. L., Fu., C. Q., 2003, Two-Phase Model for the Evolution of the Milky Way Disk, *Mon. Not. Royal Astron. Soc.*, submitted [SCI]
2. Chen, W. P., C. W. Chen, & Shu, C. G., 2004, Morphology of Galactic Open Clusters, submitted to *Astron. J.* [SCI]
3. Chen, W. P., Chiang, P. S., Chu, Y. H., & Li, J. Z., 2004, Stellar X-Ray Sources in the Rosette Nebula, *Chinese J. Astron. & Astrophy.*, 2, 153 [SCI]
4. Chen, W. P., Chen, C. W., Chen, H. C., Lee, H. Z., & Ko, C. M., 2003, NGC 7380 --- A Case for Comprehensive Collaboration, in Taiwan-Baltic Workshop “*Dynamical and Chemical Evolution of Star Clusters*”, National Central University, Chung-Li, 35-61
5. Chen, C. W., Chen, W. P., & Shu, C. G., 2003, Morphological Evolution of Open Clusters, in Taiwan-Baltic Workshop “*Dynamical and Chemical Evolution of Star Clusters*”, National Central University, Chung-Li, 84-96
6. Chen, W. P., Chen, C. W., and Shu, C. G., 2003, Morphology of Galactic Open Clusters, *Bulletin AAS*, 202, 2702
7. Chen, C. W. & Chen, W. P., 2003, Dynamics of Galactic Dissolving Star Clusters, Chinese Physics Society Meeting, Hualien, Taiwan

8. Freimanis J., 2003. Polarimetric investigations of Open Clusters: from observations towards symbiosis with the theory. In Proceedings of Taiwan-Baltic Workshop “Dynamical and Chemical Evolution of Star Clusters”, National Central University, Chung-Li, 170-183
9. Freimanis J., 2003. On the Green’s function for spherically symmetric problems of transfer of polarized radiation. *Astronomy & Astrophysics*, EDP Sciences, in press [SCI]
10. Freimanis J., On the Green’s function for spherically symmetric problems of transfer of polarized radiation. Joint European and National Astronomical Meeting (JENAM), Budapest, 25-30 August 2003
11. Hojaev, A., Chen, W. P., & Lee, H. T., *Astron. and Astroph. Trans*, 2003, CCD Observations of the Open Cluster NGC 6823 and Associated Bright Nebula NGC 6820 --- First Results and Prospects of the Uzbek-Taiwan Collaboration at Maidanak, 22, 799
12. Hojaev, A., et al. 2003, Study of Open Clusters and Star Formation at Mt. Maidanak within Uzbek-Baltic-Taiwan Collaboration, in Taiwan-Baltic Workshop “*Dynamical and Chemical Evolution of Star Clusters*”, National Central University, Chung-Li, 97-118
13. Laugalys, R. P. Boyle, A. Kazlauskas, F. J. Vrba, A. G. D. Philip and V. Straižys, Large-scale errors in CCD photometry of M 67, 2003, *Baltic Astronomy*, vol. 12, 497–502. [SCI]
14. Laugalys, A. Kazlauskas, R. P. Boyle, F. J. Vrba, A. G. D. Philip and V. Straižys, CCD photometry of the M67 cluster in the Vilnius system. II. New photometry of high accuracy, 2004, *Baltic Astronomy*, vol. 13, 1-33. [SCI]
15. Lee, H. T. & Chen, W. P., 2003, Chandra X-Ray Study of the Carina Nebula, Chinese Physics Society Meeting, Hualien, Taiwan
16. Li, Y. S. & Chen, W. P., 2003, Deep Intermediate-Band CCD Photometry of Globular Cluter M13 and Its Stellar Population, Chinese Physics Society Meeting, Hualien, Taiwan
17. Li, Y. S., & Chen, W. P., 2003, Deep Intermediate-band Imaging Photometry of Globular Cluster M13 and its Stellar Population, in Taiwan-Baltic Workshop “*Dynamical and Chemical Evolution of Star Clusters*”, National Central University, Chung-Li, 119-132
18. Lin, H. C., et al. Chen, W. P., 2003, Current Status of the Lulin Observatory, Chinese Physics Society Meeting, Hualien, Taiwan
19. Platais I., Pourbaix D., Jorissen A., Makarov V.V., Berdnikov L.N., Samus N.N., Lloyd Evans T., Lebzelter T., Sperauskas J. 2003. *Astronomy & Astrophysics*, vol.397, p.997-1010 [SCI]

20. Platais I., 2003. New horizons with open clusters – the WOCS. In Proceedings of Taiwan-Baltic Workshop “Dynamical and Chemical Evolution of Star Clusters”, National Central University, Chung-Li, 1-20
21. Platais I., Kozhurina-Platais V., Barnes S.A., Reid I.N., Belfort M., Sperauskas J., Dzervitis U., Bronnikova N.M., 2003. WIYN Open Cluster Study: how NGC 6882 got rejuvenated. American Astronomical Society Meeting, 203, Bulletin AAS, 35, 1229
22. Sanchawala, K., Chen, W. P., Lee, H. L., Chu, Y. H., Sato, S., Tamura, M., & Nakajima, Y., 2003, Young Stellar Population in Carina Nebula, in Taiwan-Baltic Workshop “*Dynamical and Chemical Evolution of Star Clusters*”, National Central University, Chung-Li, 241-255
23. V. Straizys, A. Kazlauskas, A. Černiauskas, R. P. Boyle, F. J. Vrba, A. G. D. Philip, V. Laugalys, K. Černis and F. Smriglio, Overlapping open clusters NGC 1750 and NGC 1758 behind the Taurus dark clouds: II. CCD photometry in the Vilnius system, 2003, *Baltic Astronomy*, vol. 12, 323–352. [SCI]
24. V. Straizys, S. Bartašiūtė and V. Deveikis, Seven-color Vilnius photometry of the open cluster NGC 752, 2004, *Baltic Astronomy* (submitted). [SCI]
25. G. Tautvaišienė, B. Edvardsson and S. Bartašiūtė, Selecting a photometric system for Gaia: C, N, O and alpha-process elements, 2003, *Baltic Astronomy*, vol. 12, 532–535. [SCI]
26. Wang, J. J., Chen, W. P., Miller, M., Qin, S. L., & Wu, Y. F., 2003, Massive Star Formation Triggered by Collision between Galactic and Accreted Intergalactic Clouds, submitted to *ApJL* [SCI]
27. Wang, J. J., Duschl, W. J., and Chen, W. P., 2003, Multiple Jets Driven by a Triple Massive Protostellar System with Wobbling Disks, in Proceedings of the IAU Symposium 221, Sydney [SCI]
28. Wu, Z. Y., Shu, C. G., & Chen, W. P., *Chin. Phy. Lett.* 2003, Dynamical Evolution of Globular Clusters in the Galaxy, 20, 1648 [SCI]
29. Yeh, W. H., Chen, W. P., Zhou, X., & Hojaev, A., 2003, Star Formation Activity in the NGC 6820/6823 Complex, Chinese Physics Society Meeting, Hualien, Taiwan
30. Začs L., 2003. A detailed spectroscopy of selected peculiar stars in open clusters. In Proceedings of Taiwan-Baltic Workshop “Dynamical and Chemical Evolution of Star Clusters”, National Central University, Chung-Li, 147-159

31. Začs L., Schmidt M., Spēlmanis R., Sperauskas J., 2003. A detailed spectroscopy of BD+57 2161. *Astronomy & Astrophysics*, EDP Sciences, in preparation [SCI]
32. Začs L., Spēlmanis R., Musaev F., 2003. The heavy element abundance pattern in lead stars. International Astronomical Union 25th General Assembly, Sydney 13-26 July 2003
33. Začs L., Spēlmanis R., Musaev F., Galazutdinov G., 2003. Detailed abundance analysis of neutron-capture rich giants. International Astronomical Union 25th General Assembly, Sydney 13-26 July 2003
34. Začs L., 2003, An abundance analysis of the halo barium star HD148897. Joint European and National Astronomical Meeting (JENAM), Budapest, 25-30 August
35. Začs L., Musaev F., Spēlmanis R., 2003. A high resolution spectroscopy of the unusual RCrB variable DY Per. Joint European and National Astronomical Meeting (JENAM), Budapest, 25-30 August 2003
36. Zdanavičius J., Zdanavičius K., Kazlauskas A., Chen C.W., Černis K., Straizys V., Tautvaišienė G., Chen W.P., Boyle R., Seven-color Vilnius photometry of the open cluster NGC 2395, 2004, *Baltic Astronomy* (in preparation). [SCI]
37. Zhang, Z. W. et al. Chen, W. P., 2003, The Lulin One-meter Telescope — Commissioning and Current Status, Chinese Physics Society Meeting, Hualien, Taiwan

Appendix 3: Signature sheet of the four-party agreement for the renovation project of the Maidanak 1 m telescope in Uzbekistan.

OTHER CONDITIONS Neither party shall be entitled to transfer their rights or obligations under the present Agreement without a written consent from the other parties. Any alterations and addenda to the present Agreement shall be valid only if they are made in written form and duly signed by all parties. After signing the present Agreement all preceding negotiations or correspondences pertaining to the same contract become null and void. The present Agreement is made up in English.

Astronomy Institute, NCU

ITPA, Vilnius University

By: WEN-PING CHEN

By: Zemunas Rudziskas

Signature: [Handwritten Signature]

Signature: [Handwritten Signature]

Title: Director

Title: Director

Date: 24 July

Date: 2003



Ulugh Beg Astronomical Institute

Yunnan Observatory

By: Sh. Elgamberdiev

By: Li Yan

Signature: [Handwritten Signature]

Signature: [Handwritten Signature]

Title: Director

Title: Director

Date: 2003.07.20

Date: 2003.08.19



Appendix 4: Conference poster and the program of the Taiwan-Baltic Workshop held in late 2003

**Dynamical and Chemical Evolution
of Star Clusters**

November 24-28, 2003

National Central University, Taiwan
Science IV Building Room 1013

Star Clusters — Overview and Formation

Dynamics and Structure

**Observations of Star Clusters I — Spectroscopy
and Chemistry**

**Observations of Star Clusters II — Photometry,
Astrometry and Other Techniques**

Scientific Organization Committee
Imants Plagais (Chair) Johns Hopkins U., USA
Wen-Ping Chen National Central U., Taiwan
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*A Taiwan-Baltic Workshop sponsored by National
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and National Central University*

HCC TH2 by H. E. Chiang with LOT

Dynamical and Chemical Evolution of Star Clusters

24 – 29 November 2003

Programme

Monday, November 24

20:00 Reception (Room S4-1002 Faculty Lounge, Astronomy Institute)

Tuesday, November 25

Session 1: Star Clusters --- Overview and Formation

Chair: G. Tautvaisiene

08:20 - 09:20 Registration
09:00 - 09:20 **Prof Wing Ip** (Dean of College of Science)
"Opening Remarks"
09:20 - 10:00 **Imants Platais**
"New Horizons with Open Clusters --- the WOCS"
10:00 - 10:40 **Li Chen**
"Open Clusters and the Galactic Disk Abundance Distribution"

10:40 - 11:10 *** Coffee Break ***

Chair: I. Platais

11:10 - 11:50 **Wen-Ping Chen, Chin-Wei Chen, Hui-Chen Chen, Huang-Zi Lee, Chung-Ming Ko**
"NGC 7380 - A Case for Comprehensive Collaboration"
11:50 - 12:30 **Hsu-Tai Lee**
"Induced Star Formation in the Orion and Monoceros Molecular Clouds"

12:30 - 14:00 *** Lunch Break ***

Session 2: Dynamics, Structure and Stellar Population

Chair: L. Zaes

- 14:00 - 14:40 **Chenggang Shu**
"Dynamic Evolution of Globular Clusters in the Galaxy"
- 14:40 - 15:20 **Chin-Wei Chen**
"Morphological Evolution of Open Clusters"
- 15:20 - 15:50 *** Coffee Break ***

Chair: H. H. Fu

- 15:50 - 16:30 **Alisher Hojaev**
"Study of Open Clusters and Star Formation at Mt. Maidanak within Uzbek-Baltic-Taiwan Collaboration"
- 16:30 - 17:10 **Yang-Shyang Li**
"Deep Intermediate-band Imaging Photometry of Globular Cluster M13 and its Stellar Population"

Wednesday, November 26

Session 3: Observations of Star Cluster I - Spectroscopy and Chemistry

Chair: C. G. Shu

- 09:00 - 09:40 **Grazina Tautvaisien**
"Abundances in Open Cluster: Results and Concerns"
- 09:40 - 10:20 **Laimons Zaes**
"A Detailed Spectroscopy of Selected Peculiar Stars in Open Clusters"
- 10:20 - 10:50 *** Coffee Break ***

Chair: C. M. Ko

- 10:50 - 11:30 **Eduardas Puzeras**
"Chemical Composition of Evolved Stars in the Open Cluster NGC - 7789"

- 11:30 - 12:10 **Juris Freimanis**
*"Polarimetric Investigations of Open Clusters:
from Observations Towards Symbiosis with the Theory"*
- 12:10 - 12:40 **Open Discussion**
*"Taiwan-Baltic Open Cluster Study I – Progress Report from
PIs"*
- 12:40 - 14:00 *** Lunch Break ***

: Session 4: Observations of Star Cluster II – Photometry

Chair: W. P. Chen

- 14:00 - 14:40 **Stanislava Bartasiute**
*"Kinematics and Metallicity of the Galactic Disk :
Signs of the Connection Between Field Stars and Open
Clusters"*
- 14:40 - 15:20 **Vygandas Laugalys**
"Accuracy of CCD Photometry: Open Cluster M67"
- 15:20 - 15:50 *** Coffee Break ***

Chair: S. Bartasiute

- 15:50 - 16:30 **Hsieh-Hai Fu**
*"Photometry, Kinematics and Membership of Selected Open
Clusters"*
- 16:30 - 17:10 **Kaushar Sanchawala**
"Young Stellar Population in Carina Nebula"
- 17:10 - 17:50 **Juei-Hua Clair Hu**
"Search for Exoplanets and Variable Stars in Star Clusters"
- 17:50 - 18:40 **Open Discussion**
*"Taiwan-Baltic Open Cluster Study II – Future Planning on
Science, Humanware and Hardware"*
- 19:00 **Banquet**

Thursday, November 27

Excursion to Taipei City (Palace Museum, Taipei Astronomical Museum, CKS memorial hall, Dr. Sun-Yat Sen's memorial hall, Long-Shan Temple and Wang-Hwa night market.)

Friday, Saturday, November 28, 29

Trip to Lulin Observatory (San-Yi Wood Carving Museum, Ali-Shan Youth Corps, Ali-Shan Forest Recreation Area, Lulin Observatory, Sun Moon Lake)

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