NIKOLAY SERGEYEVICH KOMAROV AND THE DEVELOPMENT OF THE SPECTROSCOPIC RESEARCHES IN ODESSA ASTRONOMICAL OBSERVATORY

T.V.Mishenina, A.V.Dragunova

Astronomical Observatory of Odessa National University,
Marazlievskaya, 1v, 65014 Odessa, Ukraine, *astro@paco.odessa.ua*

Figure 1: N.S.Komarov (1938-2003)

Komarov Nikolay Sergeyevich was born on June, 16th, 1938 in Sestroretsk Leningrad region in the family of navy officer. Two years after the family moved to Odessa where in 1955 Nikolay graduated from the school and entered the University, the mathematical branch of the Faculty of Physics and Mathematics. After the launch of the first artificial satellite of the Earth he has been moved to astronomical specialisation of the physics branch of the Faculty. In 1955-1960 he made a number of marks of the artificial satellite passing and became a champion in the number of marks. Nevertheless he has a great interest in spectroscopy. His master thesis was devoted to the spectra of meteors. This was made despite that fact that the main activity of the Observatory was in an area of the visual observation of variable stars and a photometrical research of the meteors and comets using the photo-plates. Having graduated University in 1960, Nikolay Sergeyevich began his work at the Odessa Astronomical Observatory (OAO). During a year he was engaged in the visual observations of variable stars on a 19-inch clock-workless telescope installed at the open platform in Mayaki observational station without any pavilion.

In 1961 N.S.Komarov was a post-graduate student. Prominent Odessa astronomer Sergey Vladimirovich Rublyov considerably influenced the further choice of the scientific interests of Nikolay Sergeyevich. Rublyov sent him to the Crimean Astrophysical Observatory (CrAO) where N.S.Komarov was engaged in the spectral observations on a 50-inch reflector with the purpose to obtain and collect the observational material for his PhD thesis. In CrAO another prominent astronomer Ivan Miheyevich Kopylov proposed to Komarov to start dealing with phenomenon of "metal" stars. The thesis "Kinematic and morphological characteristics of the "metal" stars" was successfully defended by Komarov in 1968, and he obtained the scientific degree of the Candidate of Physical and Mathematical sciences (PhD equivalent). Shortly after, he was appointed at the position of the head of department of astrophysics (the largest in Observatory at that time). Then, in 1970, N.S.Komarov headed the research sector, and later the department of astrospectroscopy (later this department of the physics of stars and galaxies became again the largest department in Observatory).

Nikolay Sergeyevich was the leader by his nature, he had good mathematical education, and he always has an intuition where the interesting and perspective line of investigation can be found. In 1967 V.A.Pozigun and N.S.Komarov constructed an infra-red (IR) – electrospectrophotometer (ESPM) and they started in the Soviet Union pioneer observations of the stars in the near IR region. With an advent of ESPM, the new epoch of spectroscopic investigations in OAO started. ESPM was attached to 17" telescope. As a detector the photomultiplier tube RCA7102 was used (it was brought by prof. V.P.Tsessevich from USA). The cooling was made by frozen carbon dioxide; the spectra were registered on a data tape. In September 1966 the observations of Vega and χ Cyg were obtained. At that time the military-industrial establishment of the USSR was very interested in spectral observation in the near IR region. To get the military

contracts on the determination of the energy distributions in the IR spectra of some stars it was necessary to establish the new observational stations in the sites with a good astronomical climate. The first observational station has been founded in Vannovsky (near Ashgabat, Turkmenistan). The 17" telescope with IR spectrometer was installed at that station, and it was in operation from 1970 to 1975. In 1970 two new spectrometers of the Seya-Namioka type were constructed with the aim of a signal registration in a visible spectral region, and one spectrometer with the discrete scanning for IR region. First the thermostabilization was made using the frozen carbon dioxide, and then by thermoelectric cooler created on the basis of the Komarov's technical project. The new equipment was used for observations at the peak Terskol in the North Caucasus (telescope AZT-7 and 80-cm telescope built in OAO). Then the spectrometer of the Seya-Namioka type was attached to the telescopes in the Abastumani Observatory (Georgia) in 1973–1974, and at Mondy (Sayan Mountains, at the Solar Observatory of Siberian branch Academy of Sciences of USSR). The telescopes were constructed by the Odessa Observatory engineers and astronomers L.S.Paulin, N.N.Fashchevskij, V.N.Ivanov, and equipped with the spectrometers and photometers that were constructed also in OAO. The telescopes were installed at the stations of MAO AS USSR (Pulkovo) at the pass Bezymyannyy (Caucasus), Armenia, and at Murghab (Pamir Mountains). In 1970, Nikolay Sergeyevich developed the project "Extinction Service" to investigate the atmospheric extinction by photometric methods. He involved Odessa astronomer N.I.Dorohov to this program in 1972. In 1976 N.I.Dorohov together with engineer V.Egorov elaborated the new EPM for photometric system WBVR. This photometer was used for observations at Mayaki station and Terskol station. In 1986 Odessa astronomer A.F.Pereverzentsev under the supervisory of N.S.Komarov made an electrophotometer for the photometric system UBVRI. Later it was installed on the pass Bezymyannyy (Armenia). In 1991 N.S.Komarov initiated creation of the two-channel EPM for 80-cm Odessa telescope on the Mnt. Dushak – Erekdag (Turkmenistan), and similar photometer for the 1m Odessa telescope installed in the Vyhorlat Observatory (Slovakia). Photometers were made by N.I.Dorokhov. All the works on automation of the observational process was initiated and supervised directly by N.S.Komarov. Nikolay Sergeyevich personally took part in the observations at all the Odessa Observatory stations. In addition he participated in the observations of solar eclipses and zodiacal light at the following places: Chukotka, Kamchatka, Sakhalin, mountains of Hindu Kush. In 1968 N.S.Komarov together with V.A.Pozigun decided to start the Observatory's computerization. The first computer "Promin'" was bought using the money from the military contracts gained by the Komarov's department. The spectroscopic investigations by N.S.Komarov were not limited only by simply obtaining the energy distributions in spectra. The study of the stellar fundamental parameters, spectroscopic analysis of the stellar atmospheres, the determination of the chemical composition and synthetic spectra calculations were carried out by his group, and then these works were continued in the department of spectroscopy ("Komarov's department" as it is now called in Observatory).

Creation by N.S.Komarov together with N.A.Sahibullin, A.Sapar and Y.Straume the workshop "Stellar atmospheres" favoured to the coordination of all the works carried out in USSR on the observation and interpretation of the high resolution spectra, and the modelling of the stellar atmospheres. In 1976, the first big meeting of this group was held in the Tartu Observatory (Tyravere, Estonia). In fact, the group continues its work up to now. In 2002 Komarov decided to enlarge the format of the existing workshop "Stellar atmospheres" to the International Conference "Chemical and dynamic evolution of the stars and galaxies".

In 1989, in the Special Astrophysical Observatory of the Russian Academy of Sciences N.S.Komarov defended his ScD thesis "Structure of the atmospheres of the cool giant stars", and then he gained the professor title. He published about 160 scientific papers and 3 monographs. He also prepared 56 scientific reports about the Observatory's works on contracts. Atmospheres of stars, especially cool stars, were interesting to N.S.Komarov. The presence of a large number of atomic and molecular absorption lines is the characteristic feature of spectra of these objects. And this is puzzling, intriguing, and at the same time attracting essence of this problem. In his monograph "Cool giant stars" N.S.Komarov generalised the main results obtained by him personally and under his supervisory. It should be noted that this book he devoted to the memory of his teacher S.V.Rublyov. In this work he summarized the results on absolute energy distributions in stellar spectra; spectral classification of giant stars; the analysis of the radiation blocking factor in stellar spectra by the atomic and molecular absorption lines; fundamental characteristics of stars (the scale of effective temperatures, absolute star sizes, bolometric magnitudes, surface gravities); structure of atmospheres of the cool stars (thermochemical equilibrium, synthetic spectrum calculations with an account of the molecular absorption; abundances of chemical elements). It should be also noted that N.S.Komarov supported such works at the Odessa Observatory as NLTE analysis of the stellar spectra; an investigation of the metallicity gradient in galactic disk using the calibrations "[Fe/H] – CN" for open clusters, the determination of the isotopic abundances; formation of the dust in the upper layers of atmospheres of giants etc.

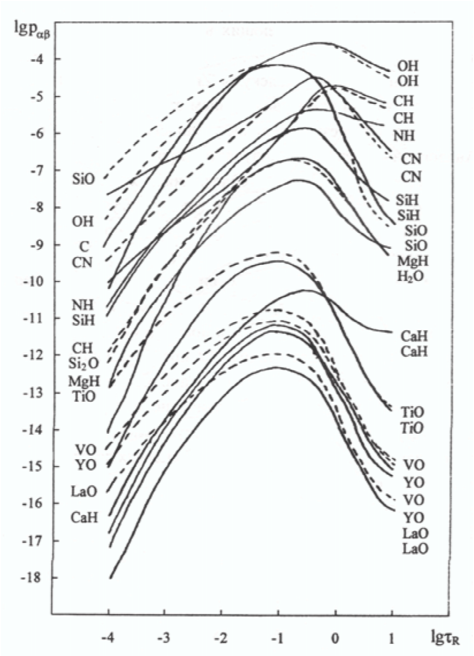

Figure 2: log $p_{\alpha\beta}$/log τ_R

Now let us turn to some concrete results obtained by N.S.Komarov. Taking into account the effective depths of the absorption line formation for a differential methods based on a curve of growth N.S.Komarov succeeded in determination the relative abundances of elements with a good accuracy of the order of 0.1dex (in 70-s!). Having based on the study of 12 open clusters he also showed that the matter in galactic spiral arms is distributed non-uniformly, and this non-uniformity is reflected in its chemical composition. As a result, it was possible to estimate the value of the radial metallicity gradient in a galactic disk: d[Fe/H]/dR = – (0.07 ± 0.03).

The most favourite plot of Nikolay Sergeyevich (that he always demonstrated, see Fig. 1) shows the partial pressure of the molecules in atmospheres of the cool stars as a result of thermochemical equilibrium (these calculations were made in the beginning of 80-s). In fact, this result is actual up to now. Idea about the temeperature inversion in the upper layers of the cool stars for many years was actively supported by N.S.Komarov was confirmed recently by the existence of chromospheres in K – M – giants.

More than ten PhD theses were prepared under his supervisory, and also due to his initiative. He was a member of a specialized councils on (both ScD and PhD) theses defence on astrophysics and radioastronomy, a member of professional astronomical societies, including International and European societies, a member of editorial boards of many scientific and popular scientific Journals and magazines. Nikolay Sergeyevich delivered a course of astrospectroscopy to the students of Odessa University, as well he delivered lectures to the participants of International Gamow's Summer Astronomical School, to auditorium of the former society "Znanie" and in "Planetarium". Nikolay Sergeyevich was also one of the organizers of workshops on spectrophotometric and photometric standards. He was the active participant of many international scientific conferences on the problems of spectroscopy, stellar atmospheres, cool stars, chemical evolutions of the Galaxy. Now the spectroscopic researches in OAO are continued, but the accent of these investigations is somewhat displaced – from energy distributions to the analysis of the high resolution spectra using the sophisticated astrophysical methods. Cool and hot stars, supergiants, giants and dwarfs, variable stars of the various types, pulsing and eclipsing binary stars, the stars belonging to the open and globular clusters are the subject of spectroscopic investigations. The calculations of synthetic spectra are now carried out using the NLTE approximation, the study of the chemical and dynamic evolution of the Galaxy and other galaxies is performed. Obtained results are published in the high-level international astronomical journals. There are many articles published by the followers of N.S.Komarov.

Besides of astronomy, N.S.Komarov had a great interest in yachting, he participated in the large yachting contests of the Black and Azov Sea. He has the daughter Natalia and the grandson – Nikolay Komarov Jr. He was the well-known astronomer, and the astronomical world respects him.

With this Conference, devoted to his memory, we with gratitude pay a tribute to him for his energy, work and merits.

References

Komarov N.S., Dragunova A.V., Karamysh V.F., Orlova L.F., Pozigun V.A.: 1979, *Photometric and spectral catalogue of the bright stars*, Naukova Dumka, Kiev, 536p.

Komarov N.S., Pozigun V.A., Belik S.A, Dragunova A.V., Gopka V.F., Zakozhurnikova N.N., Kantsen L.E., Karamysh V.F., Mishenina T.V., Orlova L.F., Pereverzentsev A.F., Russo T.A., Cherkass A.G.: 1983, *Spectrophotometrie of stars in the region of λ 550 900 nm.*, Naukova Dumka, Kiev, 312 p.

Komarov N.S.: 1999, *Cool giant stars*, Astroprint, Odessa, 216 p.

Komarov N.S.: 1967, Kinematic and Morphological Properties of Stars with Enhanced Metal Lines, *AZh*, **44**, 110.

Komarov N.S., Pozigun, V.A.: 1968, Stellar Energy Distribution at Infrared Wavelengths, *AZh*, **45**, 133.

Komarov N.S., Medvedev Yu.A., Mishenina T.V.: 1973, Spectrophotometry of M-type giant stars,

AZh, **50**, 1193.

Komarov N.S., Panchuk V.E.: 1974, Spectral classification of late-type stars, *AZh*, **51**, 593.

Komarov N.S., Dragunova A.V.: 1975, On selective absorption in stars of spectral class M. I. The influence of the blanketing effect on stellar magnitudes; the integrated blocking coefficient, *AZh*, **52**, 1251.

Komarov N.S., Tsymbal V.V.: 1980, Thermochemical equilibrium in the atmospheres of cool stars – Atoms and ions, *AZh*, **57**, 1010.

Komarov N.S., Shcherbak A.N.: 1980, The abundance of chemical elements in the solar neighborhood, *PAZh*, **6**, 637.

Komarov N.S., Mishenina T.V., Motrich V.D.: 1985, Determination of the NA content in the atmospheres of K giants, *AZh*, **62**, 740.

Korotin S.A., Komarov N.S.: 1989, The influence of non-LTE effects on the sodium abundance in the atmospheres of K giants, *AZh*, **66**, 866.

Gopka V.F., Komarov N.S., Mishenina T.V., Yuschenko A.V.: 1990, Analysis of the abundance of heavy elements in the atmospheres of K-giants – Barium and lanthanoids, *AZh*, **67**, 1204.

Korotina L.V., Komarov N.S.: 1992, Fundamental characteristics of cool giant stars, *AZh*, **69**, 1168.

Komarov N.S., Basak N.Yu.: 1993, The chemical composition of two Praesepe giant stars, *AZh*, **70**, 111.

Kovtyukh V.V., Komarov N.S., Depenchuk E.A.: 1994, Abundance of Helium and Other Chemical Elements in the Atmospheres of Classical Cepheides, *PAZh*, **20**, 215.

Dorokhov N.I., Dorokhova T.N., Komarov N.S., Mukhamednazarov S.: 1997, News from Mt. Dushak-Erekdag station of Odessa astronomical observatory, *OAP*, **10**, 123.

Komarov N.S., Dragunova A.V., Belik S.I.: 1998, Averaged energy distributions in the stellar spectra, *KFNT*, **14**, 274.

Komarov N.S., Zgonyajko N.S., Vasil'eva S.V.: 2001, Abundances of chemical elements in the atmospheres of k supergiants in the Small Magellanic Cloud, *KFNT*, **17**, 471.

Komarov N.S. : 2002, Evolution from the nuclides to the chemical elements, *OAP*, **15**, 23.

Belik S.I., Dragunova A.V., Komarov N.S.: 2004, Determination of fundamental characteristics for stars of the F, G, and K spectral types. The surface gravities and metallicity parameters, *KFNT*, **20**, 430.