Serb. Astron. J. № 196 (2018), 29 - 36
DOI: https://doi.org/10.2298/SAJ1896029P

UDC 929:52
Professional paper

ALEKSANDAR KUBIČELA (1930 – 2017) – AN ASTROPHYSICAL RESEARCH PIONEER AT THE ASTRONOMICAL OBSERVATORY OF BELGRADE

L. Č. Popović and I. Vince

Astronomical Observatory, Volgina 7, Belgrade, Serbia
E–mail: *lpopovic@aob.rs, ivince@aob.rs*

(Received: February 25, 2018; Accepted: March 15, 2018)

SUMMARY: Here, we give a short biography and summary of scientific contributions of Aleksandar Kubičela, a doyen of astronomy in Serbia, and an astrophysical research pioneer at the Astronomical Observatory of Belgrade. Additionally, we evoke some of our memories concerning scientific collaboration with Aleksandar Kubičela.

Key words. History and philosophy of astronomy – Obituaries, biographies

1. SHORT BIOGRAPHY

On January 20, 2017 Dr Aleksandar Kubičela, a doyen of astronomy in Serbia and one of the founders of astrophysical investigations at the Astronomical Observatory of Belgrade, passed away.

Dr Aleksandar Kubičela (nickname Aks) was born on March 22, 1930 in Bela Crkva as the second child of father Djuro and mother Maria. He spent his childhood and finished his primary education in Bela Crkva (in 1941). After a break in education due to World War II, he finished high school (Gimnazija in Bela Crkva) on June 21, 1949, as an excellent student.

He showed a great interest in astronomy and in the same year (1949), he moved to Belgrade, where he started to study astronomy (at the Faculty of Science of Belgrade University). However, his financial situation was very bad, and he had sought for a job (to finance his studies). Naturally, first he tried to find a job at the Astronomical Observatory of Belgrade and asked the authorities of Belgrade Observatory for such an opportunity.

From documents at the Astronomical Observatory of Belgrade (Radovanac 2012) one can see that in the same year (1949) he was accepted upon his written request, to be employed at the Astronomical Observatory (as a student who is enrolled in the first year of the study of astronomy)[1]. He received a position of "Junior hydro-metheorogical technician" and started to work at the Observatory as well to study astronomy at the Faculty of Science of Belgrade University.

In 1952, he received a position as "Hydrogeological technician". From the archive of the Astronomical Observatory, it can be seen that he enlisted military service from September 1957 until November 1958, he again started to work at the Astronomical Observatory from November 15, 1958 as the "Technical staff" of the Observatory (Document 919/1 of the Astronomical Observatory issued on November 15, 1958), but now as a member of the Division for Solar activity.

From the document (issued in 1960) about the work validation of the Astronomical Observatory staff (filled by A. Kubičela), it can be seen that he was involved in observations of variable stars, Sun

[1]Document No 6708 of the Council for scientific institutions of People Republic of Serbia issued on November 21, 1949.

activity and work in preparation for the solar eclipse observations (February 15, 1961). He also wrote that he was out of work around 30 days in order to prepare exams.

One of the central Aleksander Kubičela's tasks in 1960s was observing the solar eclipse (in February, 1961). He was very active in planning the observations, and he proposed a new method for observations of solar chromosphere during the solar eclipse. To perform the observations, he asked for a project (to make a special instrument) and he was invited to defend the project by giving a presentation to the Committee for organization of Solar eclipse in 1961. The presentation was successful and he got the project. He constructed the instrument (shown in Fig. 1, left in the painting as the larger one) and successfully observed the chromosphere during the eclipse (see e.g. Kubičela 1968, 1970). This work, as well as other activities in observational and instrumentation work, led to his promotion to a new position. In 1962 (Document 246, February 23, 1962) he was promoted to the position of "Independent observer".

He finished studies at the Faculty of Science (major astronomy) on September 20, 1962 and got a new position as the "Independent observer and the person for scientific analysis of observed data" in the group for variable stars. On November 19, 1962, he was elected in the position of "Junior Research Assistant". For this position, he was elected by the Scientific committee of the Astronomical Observatory after a positive report about his scientific activity written by Dr. Ivan Atanasijević and Dr. Vasilije Oskanjan.

After four years, in 1966, he was elected to the position of "Senior Research Assistant" (the report was written by Pero Djurkovic, Milorad Protić and Dr. Vasilije Oskanjan dated March 10, 1966; the report was accepted by the Scientific Council of the Astronomical Observatory in April 1966), and soon after that (in June 1966) he became the Head of the Astrophysical Group (which was formed in 1960). From the report for his new position, it is clear that Aleksandar was involved in observations, and showed special interest in the solar physics and instrumentation.

In 1967, there was an opening for scientific collaboration between Yugoslavia and India, which gave him an opportunity to obtain specialization in the solar physics. He got support from Yugoslav and Indian governments to spend 18 months (1968-1969) at the Kodaikanal Astrophysical Observatory, at that time led by the very famous astronomer Dr. Manali Kallat Vainu Bappu. K. V. Bappu advised his work at the Observatory, and he specializated in solar physics (mostly in solar granulations). The results of this work and additional investigations were published in his PhD thesis (1973) entitled: "One spectrographic approach to kinematical picture of super-granular motion" (*Jedan spektrografski prilaz kinematičkoj slici supergranularnog kretanja*) supervised by Dr. Mirjana Vukićević-Karabin (Kubičela 1973). In the preface of the thesis, he wrote that most of the work presented in the thesis was done at Kodaikanal Observatory with great help (and supervision) of K. V. Bappu.

After his specialization in India, he came back to the Belgrade observatory and was nominated as the head of the Astrophysical Group (again elected by the Scientific Council of the Astronomical Observatory, report was written by Prof. Dr. Mirjana Vukićević-Karabin, Pero Djurković and Milorad Protić).

Finishing the PhD thesis, he asked the Scientific Council of the Astronomical Observatory (No 1250, from November 26, 1973) to be elected to a scientific position. However, due to some administrative issues and some unusual circumstances (in the archive, there are a number documents showing that it was a problem with administration, and some personal relationships), the Committee for the writing of the report for his scientific position was formed in January 1976. The committee members were Prof. Dr. Branislav Ševarlić, Dr. Mirjana Vukićević-Karabin and Dr. Ilija Lukačević. They wrote a positive report which was accepted by the Scientific Council of the Astronomical Observatory in 1979. Finally, in May 1979, he got the Senior Researcher (*Viši naučni saradnik*) position at the Astronomical Observatory. He remained in this scientific position until his retirement (in 1990). It is interesting that, even though he had all needed results qualifying him for the Research Professor position, he did not apply for it.

On personal request, he resigned from the position of the head of the Astrophysical Group in 1980, but he still actively participated in the work of the group. His interest was in astrophysical research, first of all solar physics, and also the physics of stars. He also worked in development of instrumentations for the telescopes at Astronomical Observatory. He improved telescope instrumentation at the Observatory, for example he designed the telescope (Small Refractor) for solar spectroscopy. Additionally, he paid interest in all fields of astronomy, for example since 1978, he led project of Astronomical Observatory titled: "Physics of the motion of celestial bodies and satellites".

One of the important activities of Aleksandar Kubičela was popularization of astronomy. He was a very active member of the amateur Astronomical Society "Rudjer Bošković", where he participated in publishing the popular journal "Vasiona" and wrote several popular texts for the journal. He also gave a number of popular lectures in Planetarium of the Society.

In 1990. he retired and officially finished his work at the Astronomical Observatory, but he continued to work in astronomy and actively was involved in the life of the Observatory and in popularization of astronomy. He was a member of the Scientific Council of the Astronomical Observatory, and continued to work with younger colleagues. It is interesting to note that looking at ADS author query, one can find 92 references of Aleksandar Kubičela (which is incomplete, first reference is since 1968), and out of these 92, 44 references are dated after 1990. This indicates Aleksandar continued to work actively and that he was very productive after his retirement.

Fig. 1. *Aleksandar Kubičela (right) in the front of the painting "Solar eclipse in 1961" (painted by his brother, academy-trained painter Petar Kubičela). In the bottom left corner of the painting, he stands by the telescope he constructed specially for this event (see text). Photo collage by Dr. Vladimir Čadež.*

2. MEMORIES OF IŠTVAN VINCE

Aleksandar Kubičela, or as we nicknamed him, Aks, was my supervisor at the beginning of my research career, and later we became close coworkers on various scientific and research tasks until his retirement. He single-mindedly pursued an ambition to create the best content, and he inspired me and those around him to do so as well. Those of us who were fortunate enough to have worked with him were, and will always be, encouraged by his intellectual curiosity and wisdom, his generous support, his ability to find links between theoretical results and observed data, and his drive to construct new instruments or modernize old ones for astronomical observations, which have been able to collect data that were suitable to check theoretical results, hypotheses or answer questions under study. Through his persistent and tireless approach to resolve dilemmas and problems which inevitably emerged in the analysis of the observational results and passion with which he approached the construction or reconstruction of observation equipment, he taught us how to do the scientific-research in practice.

In the course of our decades-long cooperation I have had the opportunity to follow and participate in his research. By reading his scientific papers one can learn about his research achievements. Therefore, here I would rather write about my impressions of his qualities that cannot be discovered by reading his scientific articles, which are deprived of his working spirit and give only as objective as possible results. I would like to depict his personality recalling: what I have learned from him, his influence on my cogitation, his research abilities, his achievements in practical work, and all impressions that I kindly bear in mind.

Aks and I first met in 1971, the year when I was offered to develop (as the topic of my final thesis at the Department of Astronomy) a computer program for reduction and analysis of polarimetric observation of flare stars observed at Astronomical Observatory of Belgrade (Vince 1975). While I was working on that task, essentially the inverse problem of determining the parameters of stellar light polarization, Aks introduced me to the secrets of observation techniques. That was the first time I saw how the inside of a photometer for observation of polarization of stars really looks like. Of course, everything was different from that I imagined, based on the schemes in the textbooks. Since then, I have become seriously interested in the astronomical observational technique.

From him, I learned how all the problems that occur during the processing of raw observation data which are weighed by random, systematic and personal errors. That's when I first encountered a problem of influence of observer's personal impact on the observed data and on the reduction of recorded signals of stellar light. Then I realized that this personal influence can never be completely eliminated. I've learned that very short observer remarks written in the observer's notebook can be of crucial importance in the reduction, analysis and interpretation of observed data. I have learned that every observed value carries either directly or indirectly the observer's "imprint", and the duty of the person who carries out the reduction of observations to convert that data into a set of "soulless" numbers or graphs, i.e. to demonstrate the obtained results as real as possible. I realized that the proper interpretation of the reduced data is significantly more difficult for the researchers who did not directly participate in the observation or reduction. Also it became clear to me why the researcher's practical experiences is very important for a proper theoretical interpretation of the observed data, and vice versa, how a properly interpreted theoretical result can inspire observers to improve the observation procedure. Slowly but surely, I began to understand the profound meaning of the inscription on the facade of the main building of the Astronomical Observatory "Omnia in numero et mensura", which later became the motto of my undergraduate lessons in the subjects of reduction and analysis of astronomical observation.

In 1972, upon the successful completion of studies, I got a job at the Astronomical Observatory in the Astrophysics Group. Aks was at that time the head of the Group. He just finished the renovation of double-astrograph into a solar spectrograph. He adapted the guiding telescope of double astrograph into a Littrow-type spectrograph (Kubičela 1975). Thus, it became a one of a kind, worldwide unique equatorial solar spectrograph not described before in any textbook on practical spectroscopy. So I had the opportunity to learn in practice how a spectrograph works, but, what was even more important for me, I could see every part of it with my own eyes and touch them with my hands. An incredible experience for a beginner researcher!

By adjusting the parameters of the telescope and the optical grating, Aks, from an old telescope, constructed a high quality spectrograph for a specific purpose (Kubičela 1975). This spectrograph could have been successfully used only for measuring the speed of large scale plasma features in the solar photosphere by the Doppler method in a relatively narrow spectral region; it was not a universal spectrograph but dedicated to a very specific purpose. In addition, Aks introduced another interesting observation method. Specifically, by projecting the solar disc image 30 cm in front of the entrance slit of the spectrograph, the grating (in fifth spectral order at the wavelength of blaze angel) cut out a square shaped area from the solar disk image. This then enabled an original optical averaging of velocities of small (granular and 5-minute oscillations) and medium scale (supergranular) features; consequently, the velocities of large scale structures could be detected. By this method, a space filtering of the desired scale of velocities was achieved. Through the implementation of this original idea, the velocity measurements in several thousand points on the solar disk were avoided. The number of observations was reduced to only about 40 selected areas on the solar disk. Spectrograms in the vicinity of the 630.2 nm spectral region were recorded on photographic film. Moreover, for the purpose of measuring the Doppler shift of spectral lines, Aks reconstructed an old long-screw position measuring machine. The positions of the spectral lines on photographic film were determined by balancing the fluxes of artificial light trough two windows positioned at the right and left wing of the spectral line profile image. By doing this, being again Aks's particular solution, the repeatability of the line position measurements was about 6 m/s, quite enough for the detection of the theoretically predicted velocity of photospheric large-scale plasma motion of about 20 m/s. Systematic errors of the measured velocity values generated in the observed square area by other large-scale motions like solar differential rotation, apparent oscillation of solar rotation axis, limb-effect, and daily changes of wavelengths of telluric calibration lines were determined and corrected. The work on determining and removing these systematic errors provided me with tremendous experience in dealing with this kind of error.

Aks accepted the ideas for observations of other researchers too, and with great enthusiasm aided the construction of appropriate observation devices or adaptation of pre-existing instruments for the purpose of the suggested observation. I remember the passion with which he worked on converting the solar spectrograph into a solar scanning monochromator in order to create a new observation program for monitoring the variation of the absorbed radiation energy in selected spectral line profiles during the solar activity cycles proposed by one of our co-workers. Aks did not object to his (already well-established), observation technique in order to achieve a new, at the time, very actual research goal. Again, as was his custom, he constructed an original photo-electric scanner based on a metal wire circular rheostat and rotating tipping glass cube in front of the focal plane of a Littrow lens (Arsenijević 1988). By rotating the glass cube the spectrum image was shifted with respect to the exit slit of monochromator. The solar irradiance (integrated solar light) was created by using the pinhole camera (camera obscure) method, where the spectrograph entrance slit was used as the aperture of the pinhole camera. By projecting the solar image on the optical grating via the pinhole (without any optics), the integral spectrum of the entire solar disk was obtained.

Likewise, when we obtained a CCD camera, without hesitating he turned, again, the solar monochromator into a spectrograph. Thanks to his intuition, we solved the problem of minimization of the optical fringe system appearing on CCD images caused by interference of quasi monochromatic light (Kubičela et al. 1994). Simply, by approximately aligning the incident angle of light falling on the CCD chip surface, the fringes almost completely disappeared. This method turned out to be much more efficient in the case of quasi monochromatic images than the usual method of flat-fielding. Of course, this method has serious drawbacks: the tilting angle depends on the wavelength and the CCD chip surface largely was positioned out of camera focus. Consequently, every time the wavelength range was changed, it was necessary to adjust the slope of the CCD chip. Fortunately, in our case the out-of-focus problem was negligible since the focal ratio of pinhole lens was about 50. After publishing this method, it was introduced by several solar observers over the world.

Aks enthusiastically accepted the proposals of other researchers for the reconstruction of instruments. He allowed making changes to the instruments which he constructed and selflessly helped in the realization of those changes and their successful implementation. I remember when I suggested the construction of an iodine vapor chamber as a secondary standard for measurement of wavelength variation of telluric lines in the solar spectrum; he encouraged me, accomplished the necessary modification of the spectrograph and helped me during several years of fulfilling and testing this wavelength standard.

Aks, besides the construction of the solar spectrograph and related measuring instruments, participated in the construction of a stellar polarimeter; equipment for measuring the light polarization of stars. The first, so called rapid polarimeter was constructed for observing the flare stars by using fast modulating stellar light flux with a rapid rotating polaroid filter (Oskanjan et al. 1965). Later, Aks converted this A.C. polarimeter into a D.C. one, with polaroid filter which was rotated with a frequency of 32 Hz. The modulated light flux was converted into a photomultiplier electric signal, giving 64 sinusoidal signals in seconds. Each sinusoid specifies the amplitude and angle of the plane of polarization (parameters of polarization). The electrical signal then was converted into a magnetic signal by a magnetic tape recorder. The magnetic signal from the magnetic tape was then converted again into electric signal in the laboratory, which of course was modulated in accordance with the frequency of rotation of the polaroid filter. This observation method, in principle, allowed the monitoring of the changes of the polarization parameters with extremely high temporal resolution, which was desirable especially during a flare phases (that usually lasted only a few minutes). The study of the variation of polarization during the flare phase was the basic goal of the research. Of course, in practice this high time-resolution was never achieved due to the low value of the signal-to-noise ratio. The increase of the signal-to-noise ratio was accomplished by overlapping (averaging) a number of sinusoids in a very unique way. Each sinusoidal signal with an electronic switch (flip-flop) was subdivided into ten slices, and with electricity from each slice a capacitor was filled. This procedure was repeated with each successive sinusoid, summing the charge in each capacitor. After finishing this procedure, by measuring the voltage on these ten capacitors, values corresponding to the same phase of the rotating polaroid were obtained. These ten measured voltage values define again a sin function, whose amplitude and phase determined the parameters of stellar light polarization. The number of sinusoids for summing was chosen by balancing between the required time resolution and the required signal-to-noise ratio. Since the observed signal was recorded on the magnetic tape the measurements could be repeated as many times as necessary. All of the components of this measuring device were placed in a large wooden commode. One of our foreign coworkers, when he saw this unusual measuring device, suddenly said: “This is a wooden computer, isn't it?”. Ever since then we've nicknamed it: wooden computer.

Unfortunately, observation of flare star polarization was terminated after about 10 years, because of very low scientific productivity; the number of observed flares was only a dozen over 10 years. Instead an observation program of the polarization of Be stars and red super-giants was proposed. Aks converted the quick A.C. polarimeter into a much slower D.C. one (0.017 Hz), immediately (Kubičela et al. 1976). About five years later, this slow polarimeter was modernized by recording the observed signal on magnetic type in digital instead of analog form. This innovation greatly accelerated the reduction of polarimetric observations. At the beginning of the 90s of the last century, the polarimeter was once again modernized by converting the observed amplified photomultiplier analog electrical signal into a digital one by an AD converter, which was then collected directly in a computer's memory, allowing for almost on-line determination of the observed parameters of stellar polarization (Skuljan et al. 1994). At the end of the 90s, Aks constructed a new polarimeter on the basis of CCD camera as a detector (Vince et al. 1997).

Inevitably, Aks had role in the construction of measurement instruments for quantitative determination of the sky quality for the purpose of the selection of a new astronomical observation site outside of Belgrade. As a measure of sky quality, the relative transparency of the atmosphere and the brightness of the night sky were determined for several potential observatory sites. For the purpose of measurements, Aks assembled a portable electro-photometer, which was attached to an alt- azimuth mounted Maksutov telescope. The description of this observing device and some of the obtained results can be found in an article by Arsenijević et al. (1981). Additionally Aks constructed a specific, two-channel scintillation-meter for measuring the amplitude of stellar light scintillation in two frequency ranges. From measured data, the determination of the distribution of air turbulence eddy sizes was possible, which was crucial for determination of seeing. Moreover, the measured scintillation defines the important component of the random variation of detected stellar signal. Therefore, it is very important to determinate the signal-to-noise ratio. He accepted everyone's ideas of introducing new methods of measuring the sky quality and enthusiastically helped constructing appropriate measuring devices. I remember when I proposed a method for measuring atmospheric turbidity based on polarimetric measurements of scattered solar (or moon) light in the Earth atmosphere (Vince and Kubičela 1981). He constructed a measurement instrument maximally adapted for outdoor working conditions and measurements. He determined where to place position measuring points in the sky by overlapping shadows of the edges of a triangular prism projected on a flat platform, which was attached to the collimator tube of polarimeter. Thus, circumspect calculations of the coordinates of each measurement point and the Sun in spherical coordinate system, which could not be performed in the required short time of the measurement interval without using a computer, were avoided. In addition, the method of selecting the point of observation in the sky did not require a complicated re-adjustment of the instrument before each measurement. We made two such instruments, which served to measure the relative turbidity of the atmosphere at potential locations for establishing an astronomical observation station. Instruments were constructed in such a way that non-experts could also perform measurements. On the basis of this instrument, a project to measure and monitor global pollution of the atmosphere above a geographic position, such as a city, an industrial area, or a tourist resort, was proposed. Although the project was not accepted, near the center of Belgrade on the roof of the Faculty of Electrical Engineering building, testing and sporadic measurements of air pollution were conducted in the course of a few years.

Aks was an outstanding member of the expedition we organized in the frame of the project aimed at selecting the location for a new high-altitude astronomical observatory. With us, he tirelessly visited potential mountain sites in the former Yugoslavia and performed measurements over several years in the late 70s to select the best mountain peak for a high-altitude astronomical observing station. He was not only professionally, but also emotionally, very attached to this project. For example, from the peak of Rgajska Mountain, named "Jovan's Head" (Jovanova Glava), one of the selected potential places for a high-altitude station which he particularly preferred, he brought a stone weighting several kilograms and hung it on the wall of our office with the inscription "anti-foundation-stone of high-altitude station". This stone hung there for years as an inspiration to work if someone's motivation diminished.

He has invested a lot of time and effort in this project, and with great enthusiasm he fought to make the dreams of Belgrade astronomers come true. He proposed purchasing and specified the characteristics of a mobile observatory from the company RAND, which could be positioned in various potentially good observing sites for a year or two, performing both astronomical and astroclimate observations. His skill largely contributed also to selecting a telescope of appropriate performances for the new observatory from the French company REOSC. In addition, he contributed to the determination of telescope pavilion characteristics and helped the engineering company Kirilo Savić to design the building according to astronomical microclimate requirements. Unfortunately, because of the economic crisis in the former Yugoslavia at that time, the purchase of mobile observatory and the planned delivery of the telescope by REOSC failed. Still, his enthusiasm did not wave. He was convinced that one day a modern astronomical observation station will be built out of Belgrade at a place with reasonable astroclimate conditions. And, indeed, after almost thirty years, his dream comes true. At the air distance of only about 3 km from the "anti-foundation-stone", at the Jabučevo Peak of Vidojevica Mountain, a new high-altitude astronomical station was established with two telescopes. Unfortunately, due to illness he was not able to visit this station to see the new telescopes, but happily listened to my "reports" about the phases of the building of the central house with offices and living rooms, construction of the pavilions for the telescopes, and purchasing and mounting new telescopes and observation equipment. A few months before his death, I promised that I would show him pictures of the new observatory and telescopes. Unfortunately, due to his passing away, this meeting with him didn't happen!

I would like to mention Aks's unavoidable role in planning research programs and the construction of observation instruments for total eclipses of the Sun. As a participant in a large international expedition that was organized for the observation of the total solar eclipse on the island of Hvar in the Adriatic Sea (at that time in the former Yugoslavia) in 1961, he had prepared an unusual experiment to track changes the intensity of chromospheric spectral lines with height in the solar atmosphere (Kubičela 1968). For that purpose he linked a stellar spectrograph to one of the cameras of the double-astrograph (Kubičela 1968). The edge of the lunar disk served as a scanning screen in front of the chromosphere of the Sun during the flash-phase of the eclipse. The position of the Moon's disk in front of solar disk defined the observed height of the chromospheric layer in the direction of the telescope's line of sight. A photographic plate was used as the detector of the spectrum, which moved in the spectrograph's focal plane, synchronized with the movement of the lunar disk in front of the chromospheric layer during the flash spectrum phase of the eclipse. Through this method, an interesting three-dimensional observed data set (intensity, wavelength, chromospheric height) was recorded on a single (in fact two-dimensional) photographic plate (Kubičela 1970).

For the purpose of observing the total solar eclipse of February 1980, Aks organized an expedition to the zone of totality in the central India. The expedition aside from Aks and me counted four more members. We performed three observational experiments: flash spectra observation in the Mg II spectral lines with a modern (at the time) multichannel digital device (OMA), photographic observation of partial phases, and photographic observations of polarization of the solar corona during the phase of totality. For me, that expedition was one of the most useful experiences in practical astronomy.

In the course of preparing an expedition to observe the total eclipse in July 1991 in Mexico, Aks was engaged in preparing the observation programs and in the construction of observational instruments. In addition to the already established observation instruments, he constructed a very unusual one. It was a light, portable spectrograph for observing the flash spectra. We called it "squinty-eyed" because the instrument's line-of-sight was realigned by several tens of degrees away from the Sun. Unfortunately, the expedition was not carried out because of the threat of war conflicts in the former Yugoslavia.

Aks helped me in preparing the observation programs and in conceptual solutions of observation equipment for the total solar eclipse expeditions that I organized in August 1999 in Serbia and Romania. Three expeditions were organized with more than fifteen observation programs and participation of about 50 scientists (astronomers, physicists, meteorologist and mathematicians), and about 40 amateurs. Aks and I proposed four spectral observations during the flash phase of the eclipse (Vince 1999a, Vince 1999b): tracking the Balmer jump, the continuum emission coefficient, electron density and temperature variation with height in the solar atmosphere with high time resolution (30-50 Hz) could be determined. For that purpose, a slitless spectrograph fast CCD camera was prepared. Simultaneous observation of the flash spectrum of hydrogen and helium lines in vicinity of the 389 nm wavelength region was planned, which could give the relative abundance of helium in spicules. From these spectra (using a suitable pair of spectral lines) the height of the beginning of the FIP (First Ionization Potential) effect could be determined as well. From the flash spectrum observation of the Mn I 539.47 nm spectral line by a Czerney-Turner spectrograph or by a Fabry-Perot interferometer, the emission component intensity distribution of this line with height could be determined. With a Fabry-Perot device and with physicists the observation of the sodium resonance D-lines was planned. The goal of this observation was the monitoring of the behavior of the absorption spectral lines at the second and third contact of eclipse. In fact, it would be a repetition of Aks's experiment from 1961, but with a much more modern equipment. By using this equipment to take solar spectra consecutively very near and far from lunar limb during the partial phase of eclipse, the sodium abundance in the lunar atmosphere could be determined. Unfortunately, due to the bad meteorological conditions these experiments were not successful.

After his retirement, Aks helped me in the regular optical adjustment of the solar spectrograph of the Astronomical Observatory of Belgrade for many years. We remained close until his death. With his passing, I have suffered the loss of a great friend, mentor, and source of inspiration.

3. MEMORIES OF LUKA Č. POPOVIĆ

Personally, I met Aleksander in March 1992, when I started working at the Astronomical Observatory. At that time he was retired, but he actively worked, primarily in solar physics, and also in the interpretation of observations of stellar polarization (monitoring was performed with the Big Refractor - the 65cm refractor of the Astronomical Observatory).

It was interesting to discuss with him different problems in astrophysics. He possed an immense knowledge of astrophysics and much experience in observation; he always paid interest to all fields of astronomy. I remember the impact of the comet Shumaker-Levy with Jupiter (see Popović, Kubičela, Arsenijević et al. 1995). Specially for this event, he made an adapter for the Big Refractor to attach the CCD camera (which was the first time it was used at the Astronomical Observatory). I remember how he and all of the observers were happy to get the first CCD images of Jupiter with spots, caused by the impact with fragments of the comet.

He was always ready to move to another field, but solar physics was his preference in astronomy. I also remember when we started to investigate active galactic nuclei (in the middle of the 90s), he was more than excited to learn about them but also tried to combine his knowledge from solar physics, since the background physics should be similar. He made an original illustration of the AGN structure, and compared the AGN and solar corona ("Co-Existence of Two Plasma Phases in Solar and AGN Coronas", Kubicela et al. 1998). He was very helpful in understanding the AGN physics, and in the organization of the scientific work in this field (the first papers published from AGN group of Astronomical Observatory were co-authored with Aks, see Popović et al. 1995, 2001, and a number of papers after that). We were the co-authors of 27 papers during our very intense collaboration in the period 1993-2003, and for me, it was a very great pleasure to work with Aks, and learn from him. Our last project was to investigate the broad spectral lines of III Zw 2 in order to provide some conclusions about kinematics of the broad line region in this galaxy (see Popović et al. 2003). We finished this project, and it was one of the (if not the) last scientific papers he published, before he really retired.

4. IN CONCLUSION

From 1949 to 2010 Aleksandar Kubičela was very active in astronomy and set the foundations for astrophysical research in Serbia. He had very significant scientific results, but he also was involved in popularization of astronomy and in instrumentation. He gave a very important contribution to Serbian astronomy, particularly as one of Serbian pioneers in astrophysics in 1960s, when the scientific work in this field started in Former Yugoslavia. We (who were working and collaborating with him) will always remember Aleksandar as a very kind person, ready to help younger colleagues and give some new ideas. For the authors of this text, it was a great pleasure to collaborate with Aleksandar-Aks, he was a very good teacher and colleague, and also a friend. At the end let us say that his passing is a great loss for the entire astronomical community and especially for astronomers from Serbia.

REFERENCES

Arsenijević, J., Kubičela, A., Vince, I., Djurašević, G. and Ivanović, Z.: 1981, *Publ. Astron. Obs. Belgrade*, **31**, 89.

Arsenijević, J., Kubičela, A., Vince, I. and Jankov, S.: 1988, *Bull. Astron. Belgrade*, **138**, 1.

Kubičela, A.: 1968, *Publ. Astron. Obs. Belgrade*, **15**, 1.

Kubičela, A.: 1970, *Kodaikanal Obs. Bull.*, **188**, 9.

Kubičela, A.: 1973, PhD Thesis, Faculty of Science, University of Belgrade, http://elibrary.matf.bg.ac.rs/handle/123456789/120.

Kubičela, A.: 1975, *Publ. Astron. Obs. Belgrade*, **20**, 47.

Kubičela, A., Arsenijević, J., Popović, L. Č., Trajković, N. and Bon, E.: 1998, *Serb. Astron. J.*, **158**, 43.

Kubičela, A., Arsenijević, J. and Vince, I.: 1976, *Publ. Dept. Astron. Belgrade*, **6**, 25.

Kubičela, A., Jevremović, D., Popović, L. Č., Skuljan, J., Arsenijević, J. and Vince, I.: 1994, *Bull. Astron. Belgrade*, **150**, 37.

Oskanjan, V., Kubičela, A. and Arsenijević, J.: 1969, *Bull. Astron. Belgrade*, **27**, 1.

Popović, L. Č., Kubičela, A., Arsenijević, J., Jevremović, D. and Vince, I.: 1995, *Bull. Astron. Belgrade*, **151**, 85.

Radovanac, M.: 2014, *Publ. Astron. Soc. "Rudjer Bošković"*, **13**, 731.

Skuljan, J., Arsenijević, J. and Kubičela, A.: 1994, *Bull. Astron. Belgrade*, **149**, 85.

Vince, I.: 1975, *Bull. Astron. Belgrade*, **126**, 59.

Vince, I.: 1999a, *Publ. Astron. Obs. Belgrade*, **65**, 201.

Vince, I.: 1999b, *Contrib. Astron. Obs. Scalnaté Pleso*, **28**, 260.

Vince, I. and Kubičela, A.: 1981, *Publ. Astron. Obs. Belgrade*, **31**, 49.

Vince, I., Popović, L. Č., Kubičela, A. and Arsenijević, J.: 1997, *I.A.P.P.P. Communications*, **67**, 56.

АЛЕКДАНДАР КУБИЧЕЛА (1930 – 2017) – ЈЕДАН ОД ЗАЧЕТНИКА АСТРОФИЗИЧКИХ ИСТРАЖИВАЊА НА АСТРОНОМСКОЈ ОПСЕРВАТОРИЈИ У БЕОГРАДУ

L. Č. Popović and I. Vince

Astronomical Observatory, Volgina 7, Belgrade, Serbia

E–mail: *lpopovic@aob.rs, ivince@aob.rs*

УДК 929:52

Стручни чланак

У раду се даје кратка биографија и осврт на научни рад Александра Кубичеле, једног од пионира у астрофичким истраживањима на Астрономској опсерваторији. Додатно аутори износе своја сећања везана за научни рад са Александром Кубичелом.