1. SOME OF THE MAIN RESULTS OF THE OBSERVATORY'S RESEARCH ACTIVITY

On the 13^{th} of May 1999. about $13^h\ 30^m$, during an air attack of NATO aggressors, the Large Meridian Circle of the Belgrade Astronomical Observatory has been destroyed. Seven stellar catalogues have been produced on this instrument, which, for this very reason, was put to the central and foremost place in our plans for modernization of our astronomical instruments.

In spite of NATO aggression, fellows of Belgrade Observatory have continued during 1999 contributing to collective research efforts of international astronomical community. Since the contributions published in international journals and results of observational programs are of particular interest to the astronomical community, I propose here to present a review of just these achievements.

Blagojević, Popović, Konjević and Dimitrijević (1999) reported on the results of theoretical and experimental study of Stark broadening and shifting of analogous spectral lines along the lithium ($3s^2S$ - $3p^2P^o$) and beryllium ($3s^3S$ - $3p^3P^o$) isoelectronic sequences. For the evaluation of Stark broadening parameters the impact semiclassical method is used. The Stark widths and shifts along both sequences are measured in the plasma of a low-pressure pulsed arc. Plasma electron densities were determined from the width of the He II P_α line while electron temperatures were measured from the relative line intensities. Both experiments agree within estimated uncertainties with our semiclassical results. Although the overall agreement between theory and experiments is found, gradual change of the discrepancy for the widths along the sequence is detected. The comparison of experimental Stark shifts with the theoretical ones shows that the magnitude and direction of line shifts along the Li-sequence may not always be predicted by theory. The comparison of experimental Stark widths along the Be-sequence for B II, C III, N IV and O V with semiclassical theory shows a similar tendency. The discrepancy with theory is large for the B II and it is improved for higher members of the sequence. The only measured Stark shifts for N IV and O V are of different signs (red for N IV and blue for O V), and this change of sign along the sequence cannot be explained by the theory.

Ćirković (1998/99) and Ćirković and Yurchenko (1998/99) have investigated the structure and dynamics of the gaseous galactic haloes, recently discovered observationally around a large part of low- and intermediate-redshift normal galaxies through redshift-coincidence studies of the QSO absorption spectra. If such gaseous haloes are generic phenomena (which is in accordance with currently intensely investigated theories of hierarchical structure formation), it is to be expected that they manifest themselves in several ways. In particular, the hypothesis that the same class of objects is responsible for both Ly_α (and metal-line absorption systems) puts some constraints on the theoretical density profiles of gas in such haloes, as pointed out by Ćirković

(1998/99) at the instance of models for metal-absorbing haloes recently put forward by Srianand and Khare. Two observational facts are important to keep in mind in any such analysis: the column density vs. impact parameter relation inferred from coincidence studies, and the maximal total mass of gas which could be located in galactic haloes (which is actually a set of constraints following from the studies of galactic dynamics, diffuse X-ray emission data, as well as the primordial nucleosynthesis). The preliminary conclusion seems to be that no single power-law density profile can satisfactorily account for both metal and Ly_α absorption line populations; however, our very poor knowledge of the chemical evolution of halo matter somewhat weakens this conclusion and makes further work in this direction a necessity. On the other hand, Ćirković and Yurchenko (1998/99) have analyzed the question: what limits can be imposed on the sizes of gaseous haloes of normal galaxies when interaction with environment is taken into account? Thermal pressure of intergalactic medium does not seem to be an important factor; however, the ram pressure confinement is somewhat more promising. However, critical radii for ram-pressure stripping of gas in outer halo are still larger than the maximal empirically established absorption radius for galaxies which are located in the field, i.e. in not particularly dense environment. The conclusion reached is that field galaxies could very well be approximated as isolated structures, and the environment does not play any significant role in stratification and dynamics of gaseous galactic haloes. This conclusion, however, is valid only for recent epochs. If, as indicated by many more recent observations, the formation of well-defined galaxies occured much earlier than traditionally thought, this same question might well have had the opposite answer in epochs around z∼3.

In collaboration with Dr. Jonathan Bland-Hawthorn of the Anglo-Australian Observatory, probably the world's foremost expert on low surface brightness optical recombination emission, Ćirković and Samurović have continued their previous work on the recombination emission lines originating in huge extended gaseous haloes of normal galaxies (Cirkovic, Bland-Hawthorn and Samurovic 1999). In their communication, they showed that the observation of H_α emission of such a halo of L∼L* galaxy at low (z∼0.1) redshift is feasible with the current level of sensitivity, but it still presents observers with a formidable task (for instance, exposure times required even at the 8m class telescopes are about 10 hours per galaxy), and the choice of targets for such a survey has to be made very discriminatively. These results follow from a generalized expression for intensity of fluorescent radiation caused by ionizations due to the metagalactic ionizing background as a function of redshift. It has been shown that this is not simple classical $(1+z)^{-4}$ relation, but somewhat complicated expression, which is still easily tractable in any particular case. Natural extension of these calculations are those dealing with the effects of strong clumping of matter within the halo. In addition, the necessary observational support for gaseous haloes is expected to come from Chandra orbital X-ray observatory, which will bring new momentum and topicality to this research. Another form of baryonic dark matter presumably hiding in the haloes of spiral galaxies is Massive Compact Halo Objects, commonly known as MACHOs. The properties of MACHO halo of our Galaxy, and, by extension, generic spiral galaxies at $z = 0$, have been the subject of the detailed study by Samurović, Ćirković and Milošević-Zdjelar (1999). This work has been carried out in

the framework of the Belgrade-MACHO project, which enters its third consecutive year of successful work. The focus of this year's work has been the connection between the cosmological density of baryonic dark matter and the MACHO abundance in the Milky Way halo. It has been shown that observationally measured optical depths toward LMC, SMC and Galactic bulge put strong constraints on the total amount of MACHOs within the galactocentric distance of 50 kpc. Coupled with other constraints, like the flatness of the Milky Way rotation curve, baryonic abundance from primordial nucleosynthesis, and the assumptions on the baryonic nature of MACHOs, this limits the range of possible values of the global halo flattening parameter q. High values of q ($\geq$ 0.8) are improbable due to overabundance of baryons in the low redshift census. On the other hand, low values (q $\leq$ 0.2) representing extremely flattened haloes are also implausible, because they conflict with the measured optical depths for microlensing. Our best fit, therefore, are moderately flattened haloes with q$\sim$0.6. In addition, several interesting consequences of this mode of linking local with global cosmological results arose; one of them is the conjecture that only the values in the lower range for Hubble constant (H0 $\leq$ 60 km s^{-1} Mpc^{-1}) are entirely consistent with the baryonic census. However, it is still not clear how the high- and low-redshift regimes could be smoothly connected, nor what precise profile (including uncertain core radius) of the dark halo is to be employed. Of course, more sophisticated models, including contribution of non-baryonic matter will probably be capable of answering these dilemmas.

Dimitrijević (1999) reviewed results of the efforts of the Belgrade group to provide to astrophysicists and physicists an as much as possible complete set of Stark broadening parameters needed for stellar opacity calculations, stellar atmosphere modeling, abundance determinations and diagnostics of different plasmas in astrophysics, physics and plasma technology. Stark broadening has been considered within the semiclassical perturbation approach and the modified semiempirical method.

Potassium lines are present in Solar and stellar spectra; for example potassium has been found in SN 1987 A eject. This element is a product of alpha processes - neutron capture on slow time scale, and the data on its spectral line broadening parameters in various ionization stages are of interest in considering and modelling of subphotospheric layers. Such data are likewise of interest for the fusion plasmas and laser-produced plasmas research and for the investigation of soft X-ray lasers.

Dimitrijević and Sahal-Bréchot (1999a) have calculated within the semiclassical-perturbation formalism, electron-, proton-, and He III-impact line widths and shifts for 4 K VIII (for temperatures from 200,000 K up to 3,000,000 K and perturber densities 10^{18}cm^{-3} - 10^{22}cm^{-3}) and 30 K IX multiplets (for temperatures from 200,000 K up to 5,000,000 K and perturber densities 10^{18}cm^{-3} - 10^{22}cm^{-3}).

There are no experimental data concerning the Stark broadening of K VIII and K IX spectral lines. There exists, however, a prediction for K IX $4s^2S$ - $4p^2P^o$ Stark width (Djeniže and Labat, 1996), obtained with the help of established regularities of the Stark widths along Na isoelectronic sequence. For T = 500 000 K and an electron density of 10^{17} cm^{-3}, Djeniže and Labat (1996) obtained for the Stark full width (FWHM) the value 0.0057$\pm$25% Å, while the present result is 0.0099 Å. The presented data might be of interest for some problems in stellar and laboratory plasma

research, especially for subphotospheric layers consideration, investigation and modeling of fusion and laser-produced plasmas, and of soft x-ray lasers, as well as for the checking and development of the Stark broadening theory for multicharged ion line shapes, as e.g. for investigations of systematic trends along isoelectronic sequences. Using a semiclassical approach, Dimitrijević and Sahal-Bréchot (1999b) have considered electron-, proton-, and ionized helium-impact line widths and shifts for 20 In III and 2 Tl III multiplets, for perturber density of 10^{17} cm^{-3} and temperatures T = 20,000 – 500,000 K, and electron-, proton-, and He III-impact line widths and shifts for 2 Pb IV multiplets, for perturber density of 10^{17} cm^{-3} and temperatures T = 50,000 – 1,000,000 K.

There are no experimental results concerning In III, Tl III and Pb IV. There are however theoretical results for In III $5s^2S$-$5p^2P^o$ and Tl III $6s^2S$-$6p^2P^o$ multiplets, obtained within the semiempirical approach. The obtained widths at the temperature of 15000 K are about two times smaller than our lowest value at 20000 K. The corresponding experimental data will be very useful for further development and refinement of the theory of multicharged ion lines, and for Tl III and Pb IV particularly for the investigation of regularities along the isoelectronic sequences.

Calcium lines are present in solar and stellar spectra Adelman and Davis Philip (1992) have found, for example, neutral calcium lines in the Gamma Geminorum spectrum and Trimble (1991) reports the presence of this product of alpha processes in SN 1987 A ejecta. Accordingly, Stark broadening data on neutral calcium spectral lines are of interest for stellar plasma as well as for laboratory plasma research and modeling. Dimitrijević and Sahal-Bréchot (1999c) have calculated within the semiclassical-perturbation formalism electron-, proton-, ionized helium-, ionized magnesium-, ionized silicon-, and ionized iron-impact line widths and shifts for 189 neutral calcium multiplets. Accordingly, the relevant data for all principal perturbers in the solar plasma are provided.

There are two experimental studies reporting on the results of measurements of neutral calcium line Stark broadening parameters. Kusch and Pritschow (1970) have investigated experimentally Stark widths and shifts of four neutral calcium lines from plasma produced in a pulsed capillary discharge, and reported results for an electron density of 10^{18}cm^{-3}. Only for one line (the 5188.8 Å line from the $4p^1P^o$-$5d^1D$ multiplet) there exists a sufficiently complete set of atomic data needed for an adequate application of our approach. For this line, however, the impact approximation condition is not satisfied for the reported electron density. Hühn and Kusch (1973) published experimental Stark widths for the 4318.6 Å and 4425.4 Å lines from the $4s4p^3P^o$ - $4p^2\ ^3P$ and $4s4p^3P^o$ - $4s4d^3D$ multiplets, from plasma produced in a high pressure arc. Only the 4425.4 Å line may be compared with our results. For an electron density of 10^{17}cm^{-3} and the temperature 10,000 K, Hühn and Kusch (1973) obtained for the full width at half maximum the value 0.29 Å, while our result is 1.26 Å. The semiclassical result of Griem (1974) is 1.51 Å. As one can see, the agreement between the experimental result and both theories is very poor. The reasons for such large difference between the experiment and the theory have been discussed in detail in Konjević and Roberts (1976), and the principal point of their remarks on the experiment is the lack of an independent measurement of electron density.

Using the semiclassical perturbation approach, we have calculated electron–, proton– and He II–impact line widths and shifts for 32 Zn I multiplets as a function of temperature and perturber density. The obtained results have been compared with the existing theoretical and experimental data

Neutral zinc spectral lines are present in stellar (*e.g.* Sneden *et al.* 1991) and solar (*e.g.* Biémont and Godefroid 1980, Grevesse 1984) spectra. Therefore, Stark broadening parameters of Zn I lines are of interest for a number of astrophysical problems, *e.g.* for abundance determinations, as well as for stellar plasma analysis, modeling and diagnostics. Such data are also of interest for laboratory plasma diagnostics, modeling and investigation.

Within the semiclassical-perturbation formalism Dimitrijević and Sahal - Bréchot (1999d) have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 32 neutral zinc multiplets, as the continuation of the project to create a large Stark broadening data set for astrophysical and laboratory plasma research purposes. The agreement of all experiments with the present calculations as well as with other found in the literature is very poor. The ratio of experimental widths of Kusch and Oberschelp (1967) and the theoretical ones vary from 0.25 up to 3.56. The experimental widths of Fishman *et al.* (1979) are two times larger than theoretical values from both approaches. The temperature trend of the experimental widths of Rathore *et al.* (1985) is in such disagreement with both theoretical approaches that the ratios of the measured and calculated Stark widths vary *e.g.* for the 4722.16 Å line from 2.24 for $T = 13{,}700$ K up to 0.77 for $T = 18100$ K for the present results, and from 2.02 up to 0.69 for the theoretical values of Dimitrijević and Konjević (1983). For the shift, ratios of experimental values of Rathore *et al.* (1985) and the results of the present calculations vary from 1.24 to 0.46 for the same spectral line.

In the analysis of the Kusch and Oberschelp (1967) experiment, Konjević and Roberts (1976) have found large variations of Stark widths within multiplets, and supposed that this may be caused by the improper treatment of the self-absorption. Moreover, Dimitrijević and Konjević (1983) have shown on the basis of the analysis of Stark width systematic trends within spectral series, that the experimental results of Kusch and Oberschelp (1967) are in disagreement with such trends. Reliable experimental determinations of neutral zinc Stark broadening parameters will be of interest for checking and development of Stark broadening theory.

The study of Djurašević, Zakirov and Erkapić (1999) deals with the problem of the orbital and physical parameters' estimation of the W UMa type eclipsing binary RZ Tauri, based on the interpretation of new photometric U B V R observations. The light curves obtained at the Maidanak Observatory during 1989-91 show a slight asymmetry around secondary minima and a small difference in the height of the successive maxima.

These curves are analysed in the framework of the Roche computer model by applying the inverse-problem method. The analysis shows that RZ Tau system is in an overcontact configuration with $q = m_2/m_1 \sim 0.362$ and $i = 82^o.8$, generating total-annular eclipses. The best fitting is achieved with a bright active region on the secondary star, placed near the neck region between the components, with the temperature contrast between the spotted area and the surrounding photosphere being

$A_S = T_S/T_2 \sim 1.070$.

The spectral type of this system (F0 V) defines its behaviour as being between convective and radiative. Therefore Djurašević, Zakirov and Erkapić (1999) treated the gravity-darkening coefficients as free parameters in the inverse problem. The obtained value ($\beta_{1,2} \sim 0.215$) is likely to be appropriate for this case, showing that the common envelope of RZ Tauri is partly convective.

The basic parameters of the system and of the active region are estimated for all individual U, B, V and R light curves.

The paper of Djurašević and Erkapić (1999) concerns the light curve analysis of the active binary system of *OO Aql*. Basic orbital and physical parameters of this system were estimated by analysing photometric observations by Lafta and Grainger and Essam et al. Both groups of observations gave quite different light curves with a conspicuous asymmetry arising from unequal height of successive maxima. A slightly changed programme by Djurašević was applied. The programme was based on the Roche model and it included an option of overcontact configuration and active (bright or dark) spotted regions on the system's components. An inverse-problem method by Djurašević was used to estimate the parameters of the system and the active regions. The light-curve analysis suggested a significant change in the system. For Lafta and Grainger's light curves the analysis of Djurašević and Erkapić (1999) showed the presence of a dark spotted area near the polar region of the primary component. This dark area covered about 22% of the primary's hemisphere. Essam et al.'s light curves had very complex shape. In this case the mechanism of the mass transfer and the exchange of the thermal energy between the components could produce a bright-spot (**bs**) area on the secondary, near the Lagrange equilibrium point L_1 around the neck region between the stars. To explain a sharp increase of the system's brightness in the B filter immediately after the secondary minimum, Djurašević and Erkapić (1999) had to introduce also a hot-spot (**hs**) area of high temperature contrast on the secondary. With the increase of the brightness in the V-filter being of much lower intensity, this hot spot region could be taken as a local eruption. The behaviour of the B-V colour index with the orbital phase is in favor of this hypothesis as well.

The obtained results show that the light-curve changes are due to the development and moving of active spot regions on the components.

The paper of Djurašević (1999) is devoted to the problem of the determination of the orbital and physical parameters of the active eclipsing binary *SV Cam* on the basis of the interpretation of photometric observations made by Patkós during the period 1973 – 1981. The problem is solved in two stages: by obtaining a synthetic light curve in the case the parameters of the corresponding Roche model are given *a priori* (direct problem), and by determining the parameters of the model for which the best fit between the synthetic light curve and the observations is achieved (inverse problem). A total of 18 light curves are analysed in the framework of the Roche model, involving two spotted regions on the primary component of the system (Sp G3 V), with the temperature contrast between the spotted area and the surrounding photosphere $A_s = T_s/T_1 = 0.65$. The basic parameters of the system and of the spotted areas are estimated.

According to the obtained results the spotted areas are formed at high latitudes

and cover a significant part of the stellar surface. No clear cyclicity of the system's activity is noted from the analysed observations. There are some indications that the spotted area at high latitudes (above 70°) corresponds to an enhanced activity. Since the system's period is short ($P \sim 0^d.59$), the presence of spotted regions at high latitudes can be explained by the dynamo mechanism for rapid rotators. During the analysed period the spotted areas tend to fall into the specially active longitude sectors at high latitudes, near the stellar polar regions.

The light curve analysis allowed an estimation of the system's parameters and those of the active spotted regions.

In Djurašević, Antonopoulou, Rovithis-Livaniou and Deliyannis (1999), visual (BV) light curves of the RS CVn type binary system *SZ Psc* are presented. The light curves show a period change towards decreasing phases.

New parameters for the system are found based on an analysis of the observed light curves using the Djurašević's inverse-problem method.

The observed light curves of *SZ Psc*, in both observational bands, can be successfully interpreted within the Roche model with three spotted areas on the surface of the more massive component. Characteristics of the spots and a general discussion of the observed light curves and the results are given.

Janot-Pacheco, Jankov, Leister, Hubert, and Floquet (1999), present photometric data and 209 high-resolution, high signal-to-noise ratio optical spectra of the Be star eta Centauri obtained in 1993 and 1995, respectively. Time series analysis of these and other data, performed using the CLEAN, CLEANEST and Fourier Doppler Imaging techniques, show the presence of multiperiodic variations. They are interpreted in terms of low and high order non-radial pulsation modes. A strong frequency of 1.29 c/d is detected in line profile and photometric variations. It is attributed to a mode with l = 2. Other high amplitude signals present in spectroscopic data are 1.78 c/d, 3.82 c/d and 4.51 c/d. A frequency of 1.48 c/d appearing in spectroscopic data is compatible with the 1.56 c/d periodicity largely dominant in observations taken prior to 1993. The corresponding "superperiods" for four of the frequencies are commensurate at the 8% level. The star showed period and non-radial pulsation degree variations on timescales as short as 1.5 hour. The dominant mode apparently alternates between l = 2 and l = 4 every other day during the eight day time span. This could be a modulation linked to the superperiod or to the stellar rotation. The main periodicities detected in our analysis are compatible with the theoretical unstable g modes in SPB variables. Short time scale variability (1-3 hr), typical of high-order p modes is also systematically present.

It was found by Labat, Bukvić and Tankosić (1999) that the metastable atoms diffusing in a parent gas and bombarding a metal electrode, will cause the electric charge to build up on the electrode. The laser resonant pumping of a transition with the metastable lower level will cause depletion of the metastable atoms density, that consequently, alters the electrode potential.

It has been shown that in the case of neon, 1s5 metastable atoms are predominantly responsible for the appearance of the optovoltaic (OV) signal that is defined as a potential difference between two electrodes equidistant from the discharge. By the laser induced fluorescence method a stationary distribution of metastables, produced

by a discharge and diffusing into a neutral gas, has been measured. The results are supported by a model.

The dependence of the OV signal on the position of the laser beam between the discharge and one of the electrodes has also been measured and a physical model developed.

Large catalogues of asteroid mean elements need to be computed as a first step in the computation of proper elements, used to study asteroid families. The algorithms for this purpose available so far are only accurate to the first order in the masses of the perturbing planets; the mean elements have satisfactory accuracy for most of the asteroid belt, but degraded accuracy in the neighborhoods of the main mean motion resonances, especially the 2 : 1. Milani and Knežević (1999) investigated a number of algorithms capable of improving this approximation; they belong to the two classes of Breiter-type methods and iterative methods. The former are obtained by applying some higher order numerical integration scheme, such as Runge-Kutta, to the differential equation whose solution is a transformation removing the fast angular variables from the equations; they can be used to compute a full second order theory, however, only if the full second order determining function is explicitly computed, and this is computationally too cumbersome for a complicated problem such as the N-body. The latter are fixed point iterative schemes, with the first order theory as an iteration step, used to compute the inverse map from the mean to osculating elements; formally the method is first order, but because they implement a fixed frequency perturbation theory, they are more accurate than conventional single iteration methods; a similar method is already in use in our computation of proper from the mean elements. Many of these methods are tested on a sample of asteroid orbits taken from the Themis family, up to the edge of the 2 : 1 resonance, and the dispersion of the values of the computed mean semimajor axis over 100,000 years is used as quality control. The results of these tests indicate that the iterative methods are superior, in this specific application, to the Breiter methods, in accuracy and reliability. This is understood as the result of the cancellations occurring between second order perturbation terms: the incomplete second order theory, resulting from the use of a Breiter method with the first order determining function only, can be less accurate than complete, fixed frequency theories of the first order. Milani and Knežević (1999) have therefore computed new catalogues of asteroid mean and proper elements, incorporating an iterative algorithm in both steps (osculating to mean and mean to proper elements). This new data set, significantly more reliable even in the previously degraded regions of Themis and Cybele, is in the public domain.

Within the semi-classical approximation chemi-ionization processes during symmetrical atom-Rydberg atom collisions were considered by Mihajlov, Dimitrijević, Ignjatović and Vasiljević (1999), as well as the inverse chemi-recombination processes during the scattering of free electrons by corresponding collisional ion-atom complexes and molecular ions. It was shown that these processes must be taken into account when modeling the low-temperature layers of solar atmosphere and atmospheres of some helium-rich stars.

Ozeren, Doyle and Jevremović (1999) investigate the extent to which the Wilson-Bappu relationship holds for chromospherically active binaries using the Mg II h and

k lines of 41 RS CVn stars observed with IUE. The resulting fits are different from the relationships obtained for single, less active stars. The paralaxes used were those from the Hipparcos catalogue, these give a much better correlation than the magnitudes taken from CABS. Within a particular luminosity class the relationship is good, however it tends to break down when we incorporate objects ranging in luminosity from class I to V. From model calculations it appears that there is very little dependence of the Mg II line width on effective temperature. The line width does however depend on the column mass at the transition region boundary showing increased line width at lower column mass. There is also a dependence on the column mass adopted for the temperature minimum; however, the major and dominant parameter is the surface gravity scaling as $g^{-1/4}$. Within a luminosity class more active objects will show larger lines widths reflecting a higher column mass deeper in the atmosphere, e.g. at the temperature minimum level.

The lines of the ionized rare earth elements (REE) are present in the spectra of CP stars in a wide temperature domain. Usually, REE abundance analysis is based on the lines of the first ions, which have experimentally determined the oscillator strengths, but due to low ionization potentials the second ions of the REE are dominant in stellar atmospheres. The lack of atomic data for the lines of second ions of the REE did not allow to use them for abundance determinations, although line identifications were successful. For example, Cowley (1984) identified Dy III lines in spectra of a few magnetic stars, Cowley and Greenberg (1988) surveyed lines of doubly ionized REE in UV spectra of five magnetic stars, Mathys and Cowley (1992) presented Pr III identification in optical spectra of a number of CP stars, Sadakane (1993) suggested overabundance of La in α CMa and o Peg, two hot Am-type stars and Ryabchikova et al (1999) provided an identification and quantitative analysis of Eu III lines in the optical spectra of 10 CP stars. The lines of Eu II in the optical spectra of CP stars are usually very strong and lie in the damping part of the curve-of-growth. Since in A-type stars mentioned here Stark broadening is the main pressure broadening mechanism corresponding data on Stark broadening of stellar spectral lines are needed for a number of astrophysical problems including the line formation and the abundance determinations.

Popović, Dimitrijević and Ryabchikova (1999) present the Stark widths for three La II and six La III multiplets, and Stark widths and shifts for six Eu II lines by using the modified semiempirical approach. Also, for Eu II $\lambda = 664.505$ nm and for Eu III λ 666.635 nm lines estimates of the electron impact widths have been performed. Data in this article are the very first Stark broadening calculations for spectral lines of ionized lanthanum and europium and first reliable data on the rare - earth elements Stark broadening, which is important in particular for the abundance analysis of CP stars. The importance of the Stark broadening effect in stellar atmospheres under different conditions has equally been considered. Stark broadening becomes significant in hot stars, and it should be taken into account in the analysis of stellar spectral lines for $T_{eff} > 7000$ K in particular if europium is overabundand.

The Au II lines are observed in Hg-Mn and other CP stars. The investigation of gold in Hg-Mn stars shows that the abundances, obtained from the Au II $\lambda = 174.0476$ nm line, are between 4000 (for χ Lup) and 20000 (for κ Cnc) times larger than solar

ones. Considering that the resonant lines of ionized heavy elements ($z \geq 30$) are located in the ultraviolet spectral region, the abundance analysis of these elements has become possible thanks to satellite observations with high resolution spectrographs as e. g. International Ultraviolet Explorer (IUE) satellite (R = 12000) or Goddard High Resolution Spectrograph (GHSR) installed at Hubble Space Telescope. The number of heavy ion lines observations of the higher photometric quality and spectral resolution is increasing. Consequently, experimental and theoretical spectroscopic data for modeling of these lines are required.

Popović, Dimitrijević and Tankosić (1999) presented the electron - impact broadening parameters for six Au I lines and eight Au II transitions as a function of temperature, calculated by using the semiclassical perturbation (Au I) and modified semiempirical (Au II) approach, respectively. In addition to electron - impact full halfwidths and shifts, Stark broadening parameters due to proton-, and He II-impacts have been calculated for Au I lines, for perturber densities 10^{15} - 10^{19} cm^{-3} and temperatures $T = 2500 - 50000$ K. For Au II spectral lines, the electron - impact broadening calculation has been performed within the modified semiempirical approach. Considering the very complex spectrum of Au II, the jj coupling approximation for matrix - element calculation has been used. Calculations have been performed assuming the quantities concerned to be a function of temperature for an electron density of $N_e = 10^{17}$ cm^{-3}.

In order to bring out the influence of Stark broadening mechanism for gold spectral lines in stellar plasma, Popović, Dimitrijević and Tankosić (1999) have calculated the Stark widths for Au II $\lambda = 174.0476$ nm through the different models of stellar atmospheres. For the case of a hot A type star, in photospheric layers the line width due to Stark broadening is one order of magnitude larger than the one due to the thermal Doppler mechanism. In higher layers of the stellar atmosphere (τ about -4) however, the thermal Doppler mechanism is more important. In the case of white dwarf atmospheres the Stark broadening mechanism is important in all layers of atmospheres and in deeper atmosphere layers the Stark width is two or three order of magnitude larger than the thermal Doppler width. For the three atmosphere models considered in this article, Stark broadening effects should be taken into account in abundance determination and other investigations of stellar plasmas.

Spectroscopic and photometric observations of two R Coronae Borealis (RCB) stars, S Apodis and RZ Normae, have been carried out by Skuljan and Cottrell (1999) during the decline phase of each of these stars. Although the declines have very different global characteristics - the depth of the decline in brightness is respectively 6 and 2 magnitudes in S Aps and RZ Nor - there are some strong similarities in the spectroscopic and photometric characteristics. The photometry shows strong reddening during the initial phase of these declines. The spectroscopy indicates that similar characteristics are observed in the NaI D region with very few other spectroscopic changes. In both declines NaI D lines show strong emission components and high velocity (blue-shifted by up to 300 km s^{-1}) absorption lines. The centre of the absorption features appears to be shifted gradually during the declines indicating the acceleration of the dust cloud.

The spectral lines observations show a variability on all time scales: from minutes to years and decades. The variations in the range from minutes to days (short - term

variations) relate to the convective motions (granulation and supergranulation) and to the solar oscillations. The variations lasting for years and decades (long - term variations) are connected with the dynamical and thermal modulation of the internal layers and are also linked to the evolution of magnetic fields over a 11 - year cycle of the Sun.

The paper of Vince (1999) presents results of spectral line variations on these two very different time scales.

The central observational program in 1999 was the one pertaining to investigations of the 11th August 1999 total Solar eclipse. In several expeditions to Horgoš, Palić lake, Kikinda, Dobanovci and Kamen Brjag in Bulgaria the majority of the staff took part.

The "Large Refractor", that is ZEISS 65/1055 cm equatorial, has been employed for micrometer and CCD(ST-6) measurements of double and multiple stellar systems (G. Popović, V. Trajkovska). Veselka Trajkovska published in Serbian Astronomical Journal results of CCD measurements of 105 double and multiple stars. On the visual telescope of the Ascania astrograph of 13,5/160 cm, photographic observations have been performed with CCD ST-6 and ST-8 cameras. During 43 nights, about 250 CCD exposures of new comets and minor planets have been secured by V. Protić-Benišek. Results of comets C/1998 M5 (LINEAR), C/1998 P1 (WILLLIAMS), P/1998 U3 (JÄGER), C/1999 H1 (LEE), C/1999 S3 (LINEAR) and asteroids 1998 WS, 1240 Centenaria observations have been reported in eight IAU Circulars. On the Solar Spectrograph (ZEISS 20/302 cm equatorial), the observations of the radiation flux for 31 Solar spectral line, the measurements of their equivalent widths and the analysis of results obtained have been performed (I. Vince, L. Č. Popović, S. Erkapić, E. Bon, N. Stanić). At the Belgrade Observatory D. Jevremović performed spectral observations of RS CVn type stars in order to map active regions and Lj. Skuljan observed stars similar to the Sun.

During 1999, Miodrag Dačić defended at the Belgrade University his Ph D thesis *Analysis of the Stellar Coordinate Errors Influence on Determinations in Geodetic Astronomy*, and Darko Jevremović obtained Ph D degree at the Faculty of Sciences of the Queen's University of Belfast (North Ireland) with the thesis *Hydrogen Balmer Lines in Stellar Flares*. Predrag Jovanović obtained at Belgrade University the M. Sc. degree with the thesis entitled *The Solar Activity Influence on Earth's Rotation*.

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