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

Knežević, Ch. Froeschlé, A. Lemaitre, A. Milani and A. Morbidelli (1995) made a comparison between two theories for the calculation of proper elements; the first theory, purely analytical, has been developed by Milani and Knežević; the second one, a semi-numerical approach, is due to Lemaitre and Morbidelli. The analytical theory, based on series expansions in eccentricity and inclination, is particularly suitable for low inclination and low eccentricity orbits, while the semi-numerical one is devoted to orbits with either large eccentricities or large inclinations. The orbits of the minor planets 3710, 1021, 387, 980, 185 have been computed numerically for 4.5 Myrs, and the proper elements have been derived by both algorithms. The RMS values of the changes of the proper elements with time are taken as a measure of the instability. The results confirm the theoretical predictions, namely the Milani and Knežević (MK) proper elements are more stable at low e and I, while the stability of the Lemaitre and Morbidelli (LM) proper elements depends very little upon eccentricity and inclination. As a result, the MK elements should be used below about 15° of inclination, and the LM elements should be used above about 17° of inclination. The region between 15° and 17° should be considered as a transition region where both methods have roughly the same stability; therein the use of both data sets and the comparison of the results are recommended. The small values of the instabilities confirm that their long term research program, aimed at providing proper elements for the purpose of asteroid family identification, has been successful to the point that reliable proper elements are now available for all the regions of the asteroid main belt (and also beyond the main belt, taking into account other available results).

At the 65cm refractor of Belgrade Observatory regular measurements of double and multiple stars have been performed by G. M. Popović and R. Pavlović. For 783 triple systems, the probability of the belonging of the component to the system has been estimated.

In connection with the Hypparcos space mission, Damljanović has analyzed observations with the zenith telescope. Obtained results have been sent to the International Working Group for the Earth's Rotation Parameters within the Hypparcos reference frame.

The strongest Fe II lines correspond to 4s-4p and 3d-4p transitions in $3d^6nl$ and $3d^54snl$ configurations, covering some 1500 observed lines and accounting for the main part of the intensity of the Fe II spectrum. However, if one wishes to perform more sophisticated calculations of the corresponding Stark broadening parameters needed in astrophysics and laboratory plasma diagnostics, it is not easy to collect the

sufficiently complete energy level set and to avoid the additional difficulties due to configuration interaction and violation of the LS selection rules. The best situation is just with 4s-4p sextets, whose Stark broadening parameters have been determined experimentally recently, where the sufficiently complet energy level set exists and there are not pronounced configuration interactions or critical violations of the LS selection rules, so that the semiclassical calculations may provide more reliable Stark broadening parameters.

By using the semiclassical - perturbation formalism Dimitrijević (1995a) has calculated Stark broadening parameters for singly-ionized iron a^6D - z^6P^o, a^6D - z^6D^o and a^6D - z^6F^o multiplets, covering 34 lines within 2328.11-2632.108 Å range. The present theoretical full half-widths have been compared with experimental results as well as with the calculations performed by using the modified semiempirical approach and with simple theoretical estimates based on regularities and systematic trends. In such a way, reliable Stark broadening data for astrophysically important Fe II lines have been provided.

Within the same approach, Dimitrijević (1995b) has analyzed Stark broadening parameters for two lines withins Ni II a^4F - z^4G^o multiplet. Spectral lines of ionized nickel have been found for example in the spectra of Gamma Geminorum and 7 Sextantis, stars of A0 V type, where the main pressure broadening mechanism is the Stark effect. Consequently, the corresponding Stark broadening parameters are of astrophysical interest. The recently performed first experimental determination of Ni II Stark widths and shifts is in strong disagreement with available simple estimates. This disagreement has been considered within more sophysticated semiclassical perturbation theory. In spite of the fact that the agreement between the theory and experiment is better now, the differences are still such that a new experiment is of interest.

Stark-broadening parameters for neutral magnesium lines are of interest for laboratory plasma diagnostics and have been investigated experimentally and theoretically. Moreover, lines of neutral magnesium are present in the solar spectrum and the corresponding Stark broadening parameters are of interest for their analysis as well as for the diagnostic of solar plasma. Particularly the infrared lines of Mg I have been observed in the solar spectrum at Kitt Peak and during the Atmos experiment on Spacelab. Due to the fact that with the increase of the principal quantum number the importance of the Stark broadening increases as well, the corresponding Stark widths and shifts are of importance for the structure of solar atmosphere diagnostics. By using the semiclassical - perturbation formalism, Dimitrijević and Sahal - Bréchot (1995a) have calculated electron-, proton-, and ionized argon-impact line widths and shifts for 99 Mg I multiplets. The results for Mg I, along with a comparison with experimental data and other theoretical results and the corresponding analysis have been presented.

The astrophysical interest of oxygen is obvious due to its high cosmical abundance and presence of its different ionization stages in stellar atmospheres. Stark broadening of O IV and O V spectral lines has been investigated several times theoretically and experimentally. In previous theoretical evaluations various approximate approaches have been used or the more sophysticated semiclassical calculations have been performed

only for particular lines. Dimitrijević and Sahal - Bréchot (1995b) have investigated within the semiclassical - perturbation formalism, Stark broadening within O IV and O V spectrum at the instance of 5 O IV and 19 O V multiplets, in order to continue their research of multiply charged ion line Stark broadening parameters. The comparison with available experimental data shows good agreement between experimental and semiclassical values.

Ermolaev, Mihajlov, Ignjatović and Dimitrijević (1995) have presented a detailed study of the ion - atom continuous emission from weakly ionized H, He and some alkali metal plasmas, at thermal velocities of the atomic (ionic) species. The radiative cross sections for photo-associations and charge transfer required in these calculations, have been obtained from a quasistatic model, within the semiclassical adiabatic theory of relative symmetrical ion - atom collisions. The quasistatic two - term model remains valid at temperatures which are much lower than those considered in this work. However, the intensity of continuous emission rapidly falls off as T decreases and the bulk of the radiative energy loss in plasma is channelled through line and band emission from the molecular component of the plasma. Ermolaev et al. (1995) have applied the theory to the calculation of the spectral coefficients of the continuous emission from the H plasma (characteristic of stars), He plasma (characteristic of hydrogen deficient helium rich stars), Li and Na plasmas, in a wide range of physical conditions. By comparing the intensity of continuous emission due to ion - atom collisions with that owing to electron - ion/atom radiative collisions (emissivity ratio F), they have been able to estimate the relative importance of the ion - atom radiative collisions in the total balance of the continuous plasma radiation, over a wide range of T and p, for the near - UV, visible and near - IR parts of the spectrum. It has been established that, for helium plasma, F may reach a value of 5 - 7 in the UV region, whereas for hydrogen plasma F is smaller by an order of magnitude. The suppression of F in the case of hydrogen plasma is due to the dominating photocapture into stable atomic negative ions H^-. In this respect, the hydrogen and helium plasmas represent two different optical types of gaseous media. The results obtained for the helium plasma are expected to remain qualitatively valid in the case of other inert gases. Calculations of emission coefficients for Li and Na plasmas suggest that, under certain conditions, the contribution of ion - atom radiative collisions to the continuous radiation may be significant. The results are presented in the tabular and graphical forms convenient for applications.

The effect of the processes of radiative charge transfer and photoassociation during $He^+ + He$ collisional processes, as well as the process of the photodissociation of He_2^+ molecular ion, on the formation of continuous spectrum of the DB white dwarf atmospheres with $T_{eff} = 12000 - 30000$ K, for $\log g$ (gravities) =7 and 8, is studied by Mihajlov, Dimitrijević, Ignjatović and Djurić (1995) within the wavelenght range $\lambda = 200 - 800$ nm. It is shown that for for $T_{eff} \leq 16000$ K, DB white dwarf photospheres continuous spectra must be formed under the important influence of the considered ion-atom radiative processes, while for larger T_{eff} the basic role have the electron-atom and the electron-ion processes. This is the consequence of the fact that the effect of the considered ion - atom radiative processes increases quickly when the T_{eff} decreases around $T_{eff} = 16000$ K. It is found as well, that the influence of

the radiative ion-atom processes increases quickly when λ decreases, especially at the transition from the visible to the UV spectral range. From the shown results it follows that for $T_{eff} \leq 16000$ K and $\lambda \leq 400$ nm, ion-atom radiative processes may affect significantly the energetic balance and optical characteristic (opacity and optical depth) of white dwarf atmospheric layers where $\log(\tau) \leq 1$. Especially important is the influence on the optical depth values calculated with and without taking into account the considered ion - atom radiative processes. Presented facts suggest the necessity to include ion-atom radiative processes for the white dwarf atmosfere modeling from the begining and not as an *a posteriori* correction, since they change the reference optical depth greed for the tabulated model parameters. All elements needed for the inclusion of the considered ion - atom radiative processes in the DB white dwarf atmospheres modelling, are presented.

The gravitational field effect on the spectral line shapes is considered by Popović, Vince, Atanacković - Vukmanović and Kubičela (1995) first for the case of an optically thin region near a massive galactic nucleus since the analysis is simpler and because the results thus obtained are useful in a qualitative analysis. In this case the gravitational field causes redshift, broadening and asymmetry of the spectral line profile. A more realistic case of an optically thick region, taking into account the radiative transfer effects, shows qualitatively similar results, except that the broadening is negligible for the considered H_β spectral line. While reduced redshift decreases, the other two effects (broadening and asymmetry) increase with the wavelength of the spectral line. They also depend very much on the distance of the emitting slab from the massive galactic nucleus and, as the considered example of H_β line shows, the redshift and asymmetry of the spectral line are not negligible for the distances less than about 10^2 Schwartzschild radii (R_S). When the optically thin region was assumed, besides the two mentioned effects, the broadening of the spectral lines is considerable at distances less than $5 \cdot 10^2 R_S$. From the present results one may conclude that the gravitational effect may become observable and should be taken into account in analyses of spectral lines originating in sufficiently dense regions around massive nuclei of active galaxies.

Djeniže, Skuljan and R. Konjević (1985) present the construction of a plasma source for improving the accuracy of Stark shift measurements. The impulse (AC) discharge was superimposed on the glow (DC) discharge. This allows simultaneous measurements of the profile and the center position of the investigated spectral lines emitted from the same plasma volume, in the case of a DC discharge when the line is unshifted (because of the small electron density), and in the case of a DC + AC discharge with a higher electron density ($> 10^{22} m^{-3}$), when Stark broadening is the main pressure broadening mechanism. The Stark shift was determined from the difference between spectrum positions of the same spectral line centers registered in DC and DC + AC discharge, at several given electron temperatures and densities in the decaying DC + AC plasma. A large number of experimental papers deal with the broadening of neutral helium and argon spectral lines. However, the only published experimental data for Stark shifts at T > 22,000 K, are those of 5876. and 3889, Å. Djeniže et al (1995) have measured Stark shift values for four He I lines at the electron temperature two times higher in comparison to the temperature in existing experimental data, and six Ar I spectral lines, which are important for the diagnosis of astrophysical and

laboratory plasmas. Obtained results are compared to the existing experimental and theoretical data.

On the basis of the observations of double star spectral line profile modulation, by the method of indirect imaging of stars, stellar surface structures have been studied (Jankov).

Regular observations of the stellar radiation optical polarization and spectral observation of the Solar radiation flux for 31 selected spectral lines, have been performed (Vince, Kubičela, Arsenijević, Popović, L.Č., Jevremović, Erkapić, Marković - Kršljanin).

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