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Review paper

MEASURED, CALCULATED AND PREDICTED STARK WIDTHS OF THE SINGLY IONIZED C, N, O, F, Ne, Si, P, S, Cl AND Ar SPECTRAL LINES

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SUMMARY: In order to find reliable Stark width data, needed in plasma spectroscopy, comparision between the existing measured, calculated and predicted Stark width values was performed for ten singly ionized emitters:C, N, O, F, Ne, Si, P, S, Cl and Ar in the lower lying 3s – 3p, 3p – 3d and 4s – 4p transitions.These emitters are present in many cosmic light sources. On the basis of the agreement between mentioned values 17 spectral lines from six singly ionized spectra have been recommended, for the first time, for plasma spectroscopy as spectral lines with reliable Stark width data. Critical analysis of the existing Stark width data is also given.

1. INTRODUCTION

For the case of elements from the second and the third period of the Periodic system, that show large abundance in the various types of the cosmic emitters, the knowledge of the Stark HWHM (half-width at half intensity maximum, w) of the spectral lines that belong to the singly ionized atoms is of great importance(Griem 1974: Dimitrijević 1989; Lessage and Fuhr 1998). Namely, information on the chemical evolution of the elements in stars and stellar associations (Cuhna and Lambert 1994; Luenhagen and Hamann 1998) and on the kinetics, dynamics and structure of the galaxies (Bland-Hawthorn *et al.* 1997), can be supplied on the basis of the singly ionized spectral lines. If the Stark broadening is the principal pressure broadening mechanism in plasmas (with $10^{22} - 10^{27}$ m^{-3} electron density), on the basis of Stark width values it is possible to obtain other basic plasma parameters e.g. electron temperature (T) and density (N), essential in the modeling of the stellar atmospheres (Lesage 1994; Seaton 1987). It is of interest to find spectral lines with well-known Stark width values, convenient in the plasma diagnostics. In this respect, the singly ionized, strong, spectral lines that belong to the lower lying transitions: 3s-3p and 3p-3d in the case of the emitters from the second period, and 4s-4p transition in the case of the emitters from the third period of the Periodic system, can be used for the diagnostics purposes. The aim of this paper is to make comparison, for the first time, between existing measured, calculated and anticipated Stark width values. Namely, from the agreement between these values, for the particular spectral line, might follow their recommendation for the plasma spectroscopy. In this order, Stark width values for spectral lines from ten singly ionized emitters (C, N, O, F, Ne, Si, P, S, Cl and Ar) in the lower lying 3s-3p, 3p-3d and 4s-4p transitions have been mutually compared. On the basis of the found agreement between these values 17 spectral lines, from six singly ionized spectra, would be recommended as spectral lines with reliable Stark width data needed in plasma spectroscopy up to 50 000 K electron temperature. On the other hand, disagreement between these values can offer possibility for the critical analysis of the existing Stark width data.

2. MEASUREMENTS

The existing experimental works, devoted to the investigated spectral transitions, have been presented in Lesage and Fuhr (1998), Konjević and Wiese (1976), Konjević *et al.* (1984) and Konjević and Wiese (1990). The common characteristics of these experiments are the observed electron temperature and density ranges up to 50 000 K and 2×10^{23} m^{-3}, respectively.

3. CALCULATIONS

For comparison with experimental values, the existing results of various theoretical approximations have been used.In the majority of cases they were the semiclassical (Griem 1974) (SC) and the modified semiempirical (Dimitrijević and Konjević 1980; Blagojević *et al.* 1999) (SEM) approaches. In the case of the most investigated Ar II spectral lines, theoretical results of other authors (Sahal-Bréchot 1970; Davies and Roberts 1968; Roberts 1970; Jones *et al.* 1971) also have been taken into account.

4. ESTIMATIONS

The simplest way to estimate values of Stark HWHM is to use established regularities of w along the isonuclear (INS) sequences and within one transition array (RT) for the given type of quantum transition. It was found (Djeniže *et al.* 1988; 1989; 1990; 1999; Djeniže 2000; Purić *et al.* 1988a,b) that simple analytical relationship exists between w and corresponding upper-level ionization potential (I) of a particular spectral line, for certain type of transitions. The found relationship, normalized to a $N = 10^{23}$ m^{-3} electron density, is of the form:

$$w = az^2T^{-1/2}I^{-b} \qquad \text{(rad/s).} \qquad (1)$$

The upper-level ionization potential I (in eV) and net core charge $z(z = 1, 2, 3, 4, ...$ for neutral, singly, doubly, triply,... ionized atoms,respectively; N I, N II, N III, N IV,... as an example) specifies the emitting ion, while the electron temperature T (in K) characterizes the assembly. The coefficients a and b are independent of I and T. In the case of RT regularities, for the particular emitters, z is constant and can be included in the coefficient a. The validity of the Eq. (1) in developing a fast and reliable method to find the Stark widths of spectral lines has been confirmed in the cases of the carbon (Djeniže *et al.* 1988; Purić *et al.* 1988 b), nitrogen (Djeniže *et al.* 1990; Djeniže and Labat 1996), oxygen(Purić *et al.* 1988 a; Djeniže *et al.* 1990; Djeniže and Labat 1996), fluor (Purić *et al.* 1988 b), neon (Purić *et al.* 1988 b; Djeniže *et al.* 1990), silicon (Purić *et al.* 1988 b; Djeniže *et al.* 1990; 1992 a), phosphorus (Srećković *et al.* 1990), sulfur (Purić *et al.*1988 b; Srećković *et al.* 1990), chlorine (Purić *et al.* 1988 b) and argon (Djeniže and Srećković 1998) isonuclear (INS) sequences and in the case of the regularities within one transition array (Djeniže *et al.* 1989) (RT) in nine singly ionized spectra (Djeniže *et al.* 1999; Djeniže 2000) (C II, N II, O II, F II, Ne II, P II, S II,Cl II and Ar II). The found forms of Eq. (1) for various emitters and types of the transition are given in Table 1. The necessary atomic data were taken from Wiese *et al.* (1966, 1969).

5. RESULTS AND DISCUSSION

In order to make easy comparison between measured, calculated and estimated Stark width values, in Figs. 1-10, the dependence of $2w$ full width at half maximum (FWHM) values on the electron temperatures at 10^{23} m^{-3} electron density is illustrated. Theoretical predictions (dashed lines) present only electron contribution to the Stark width. Estimated Stark width values (INS and RT) are presented by solid lines. Measured Stark widths are corrected to the mean wavelength ($\bar{\lambda}$) in the multiplet.

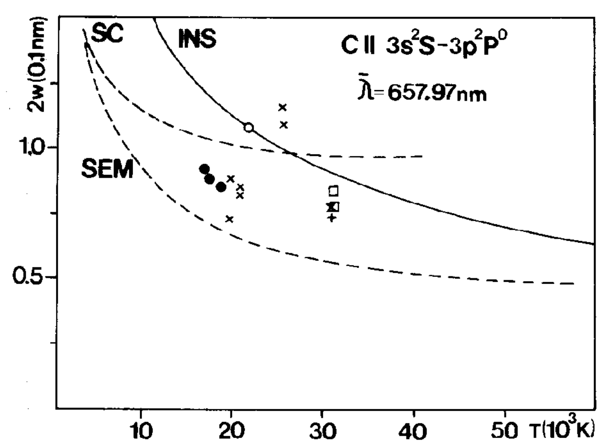

Fig. 1. *Stark FWHM vs. electron temperature at 10^{23} m^{-3} electron density for the C II $3s^2S - 3p^2P^0$ transition. Experiments: □, Huges and El-Farra (1983); +, Djeniže et al. (1988); ×, Sarandaev and Salakhov (1995); o, Perez et al. (1991); •, Blagojević et al (1999). Theory: SC, Griem (1974); SEM, Dimitrijević and Konjević (1980); and Blagojević et al. (1999). Estimations: INS, Table 1, No. 1.*

Table 1. Estimated Stark width values at 10^{23} m^{-3} electron density versus electron temperature T (in K) for the mean wavelengths ($<\lambda>$) in multiplets. INS and RT denote the type of the used regularities. $z=2$ for the singly ionized atoms by INS sequence. The upper-level ionization potentials I (in eV) are taken from Wiese *et al.* (1966, 1969). a, Djeniže *et al.* (1988); b, Djeniže and Labat (1996); c, Djeniže *et al.* (1999); d, Djeniže *et al.* (1990); e, Purić *et al.* (1988ab); f, Djeniže *et al.* (1992ab); g, Srećković *et al.* (1990).

Transition	Stark HWHM (w in rad/s)	Ref.	$<\lambda>$ (nm)	Stark FWHM (2w in m)	No.
C II $3s^2S-3p^2P^0$	$1.42\ 10^{14}z^2T^{-1/2}I^{-1.34}$	a	657.97	INS:$1.60\ 10^{-8}T^{-1/2}$	1
N II $3s^3P^0-3p^3D$	$5.01\ 10^{13}z^2T^{-1/2}I^{-1.05}$	b	567.94	INS:$6.87\ 10^{-9}T^{-1/2}$	2
	$6.03\ 10^{16}\ T^{-1/2}I^{-3.70}$	c	567.94	RT :$6.19\ 10^{-9}T^{-1/2}$	3
N II $3p^3D-3d^3F^0$	$1.28\ 10^{14}z^2T^{-1/2}I^{-1.58}$	d	500.45	INS:$7.13\ 10^{-9}T^{-1/2}$	4
	$5.55\ 10^{17}\ T^{-1/2}I^{-5.37}$	c	500.45	RT :$6.65\ 10^{-9}T^{-1/2}$	5
O II $3s^2P-3p^2D^0$	$6.60\ 10^{13}z^2T^{-1/2}I^{-1.15}$	b	441.81	INS:$4.44\ 10^{-9}T^{-1/2}$	6
	$2.17\ 10^{15}\ T^{-1/2}I^{-2.10}$	c	441.81	RT :$4.60\ 10^{-9}T^{-1/2}$	7
O II $3p^2D^0-3d^2F$	$8.90\ 10^{21}\ T^{-1/2}I^{-10.68}$	c	470.39	RT :$6.77\ 10^{-9}T^{-1/2}$	8
F II $3s^3S^0-3p^3P$	$8.90\ 10^{13}z^2T^{-1/2}I^{-1.31}$	e	402.50	INS:$3.32\ 10^{-9}T^{-1/2}$	9
Ne II $3s^2P-3p^2D$	$1.20\ 10^{14}z^2T^{-1/2}I^{-1.44}$	e	371.30	INS:$2.57\ 10^{-9}T^{-1/2}$	10
	$6.54\ 10^{14}\ T^{-1/2}I^{-1.58}$	c	371.30	RT :$2.59\ 10^{-9}T^{-1/2}$	11
Ne II $3p^2D^0-3d^2F$	$2.63\ 10^{14}z^2T^{-1/2}I^{-1.99}$	d	341.49	INS:$3.35\ 10^{-9}T^{-1/2}$	12
Si II $4s^2S-4p^2P^0$	$3.35\ 10^{14}z^2T^{-1/2}I^{-1.93}$	f	635.51	INS:$1.66\ 10^{-8}T^{-1/2}$	13
P II $4s^3P^0-4p^3D$	$2.39\ 10^{14}z^2T^{-1/2}I^{-1.65}$	g	605.20	INS:$1.54\ 10^{-8}T^{-1/2}$	14
	$7.29\ 10^{14}\ T^{-1/2}I^{-1.57}$	c	605.20	RT :$1.37\ 10^{-8}T^{-1/2}$	15
S II $4s^4P-4p^4D^0$	$1.22\ 10^{14}z^2T^{-1/2}I^{-1.49}$	e	546.83	INS:$7.69\ 10^{-9}T^{-1/2}$	16
	$8.13\ 10^{22}\ T^{-1/2}I^{-11.02}$	c	546.83	RT :$5.91\ 10^{-9}T^{-1/2}$	17
Cl II $4s^5S^0-4p^5P$	$1.80\ 10^{14}z^2T^{-1/2}I^{-1.58}$	e	480.61	INS:$6.81\ 10^{-9}T^{-1/2}$	18
Ar II $4s^4P-4p^4P^0$	$5.90\ 10^{13}z^2T^{-1/2}I^{-1.27}$	e	487.50	INS:$4.00\ 10^{-9}T^{-1/2}$	19
	$1.35\ 10^{15}\ T^{-1/2}I^{-2.05}$	c	487.50	RT :$4.35\ 10^{-9}T^{-1/2}$	20
Ar II $4s^4P-4p^4D^0$	$5.90\ 10^{13}z^2T^{-1/2}I^{-1.27}$	e	436.14	INS:$3.35\ 10^{-9}T^{-1/2}$	21
	$1.35\ 10^{15}\ T^{-1/2}I^{-2.05}$	c	436.14	RT :$3.76\ 10^{-9}T^{-1/2}$	22
Ar II $4s^4P-4p^4S^0$	$5.90\ 10^{13}z^2T^{-1/2}I^{-1.27}$	e	380.14	INS:$2.73\ 10^{-9}T^{-1/2}$	23
	$1.35\ 10^{15}\ T^{-1/2}I^{-2.05}$	c	380.14	RT :$3.18\ 10^{-9}T^{-1/2}$	24

5.1 C II spectrum

Five experiments(Blagojević *et al.* 1999; Djeniže *et al.* 1988; Hughes and El-Farra 1983; Perez *et al.* 1991; Sarandaev and Salakhov 1995) deal with the Stark width investigations in the $3s^2S - 3p^2P^0$ transition in the electron temperature range between 17 000 K and 32 000 K. The SC and SEM theoretical values in this temperature range differ mutually up to 70%. The estimated INS values agree (within 15% accuracy) with results from experiments of Djeniže *et al.*(1988), Huges and El-Farra (1983), Perez *et al.* (1991) and Sarandaev and Salakhov (1995) (see Fig.1). The newly measured values (Blagojević *et al.* 1999) favor the trend between SC and SEM theoretical values.In any case, new experimental investigations of the Stark widths between 20 000 K and 30 000 K electron temperature would be helpful.

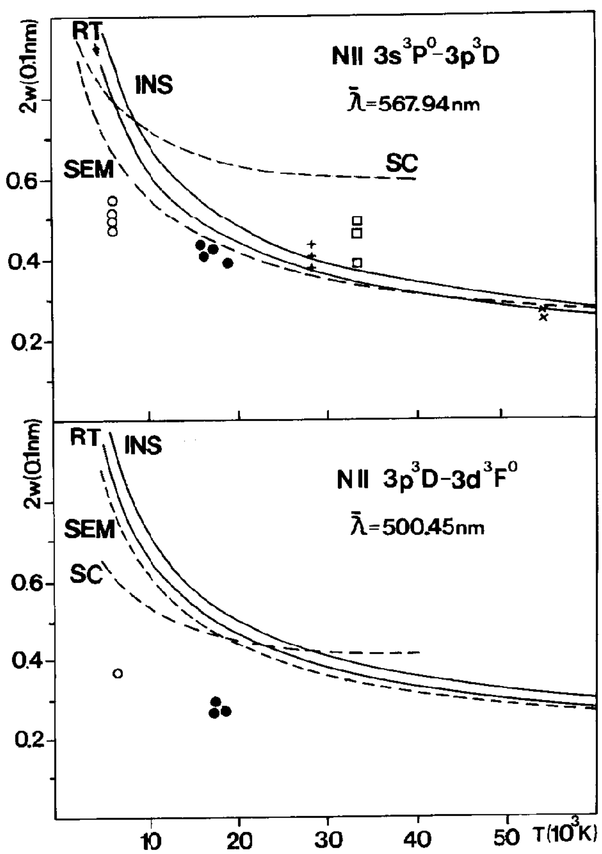

Fig. 2. *Stark FWHM vs. electron temperature at 10^{23} m^{-3} electron density for the N II $3s^3P^0 - 3p^3D$ and N II $3p^3D - 3d^3F^0$ transitions. Experiments: □, Purcell and Barnard (1984); +, Djeniže et al. (1992b); ×, Milosavljević and Djeniže (1998); o, Perez et al. (1997); •, Blagojević et al. (1999). Theory: SC and SEM. Estimations: INS, Table 1: No. 2 and No. 4; RT, Tab. 1: No. 3 and No. 5.*

5.2 N II spectrum

Five experiments (Blagojević *et al.* 1999; Purcell and Barnard 1984; Djeniže *et al.*1992; Perez *et al.* 1997; Milosavljević and Djeniže 1998ab) involve the Stark width investigations in the $3s^3P^0 - 3p^3D$ transition and only two (Blagojević *et al.* 1999; Perez *et al.* 1997) the investigations in the $3p^3D - 3d^3F^0$ transition. The SC and SEM theoretical values show total mutual disagreement in the case of the $3s^3P^0 - 3p^3D$ transition in the electron temperature range between 10 000 K and 40 000 K. SC values are highest up to factor 2 (see Fig. 2). The estimated INS and RT values follow the SEM predictions. Except the experimental values from Perez *et al.* (1997), other experimental data agree well (within 13% accuracy) with SEM, INS and RT predictions in a wide range of the electron temperatures (16 000 K – 54 000K). On the basis of these agreements the 567.96 nm, 566.66 nm and 567.60 nm N II spectral lines, that belong to the $3s^3P^0 - 3p^3D$ transition, can be used in plasma spectroscopy as spectral lines with reliable (SEM, INS and RT) Stark width data.

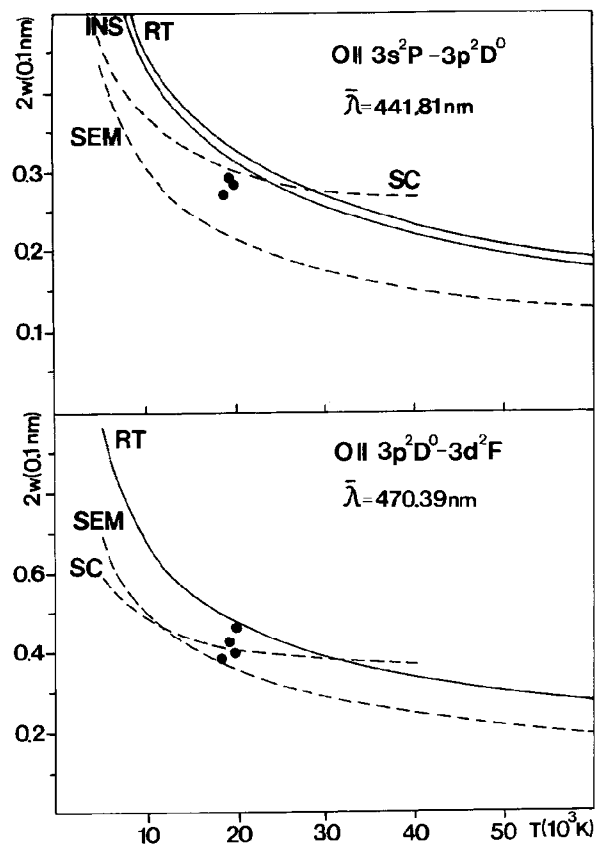

Fig. 3. *Stark FWHM vs. electron temperature at 10^{23} m^{-3} electron density for the O II $3s^2P - 3p^2D^0$ and O II $3p^2D^0 - 3d^2F$ transitions. Experiment: •, Blagojević et al. (1999). Theory: SC and SEM. Estimations: INS, Table 1: No.6; RT, Table 1: No. 7 and No. 8.*

In the case of the $3p^3D - 3d^3F^0$ transition the situation is different. The SC, SEM, INS and RT predictions show mutual agreement (within 12% accuracy) between 10 000 K and 40 000 K electron temperatures. Conversely, experiments (Blagojević *et al.* 1999; Perez *et al.* 1997) give noticeable lower values. In this respect, new Stark width measurements in the $3p^3D - 3d^3F^0$ transition are necessary.

5.3 O II spectrum

Only one experiment (Blagojević *et al.* 1999) pertains to the Stark width investigation in the $3s^2P - 3p^2D^0$ and $3p^2D^0 - 3d^2F$ transitions about 19 000 K electron temperature. Measured values confirm the SC, INS and RT predictions (within 12% accuracy) in the $3s^2P - 3p^2D^0$ transition and the SC, SEM and RT predictions (within 10% accuracy) in the $3p^2D^0 - 3d^2F$ transition (see Fig. 3).

On the basis of these agreements there follows the recommendation of the 441.49 nm, 441.70 nm, 470.54 nm and 469.92 nm O II spectral lines for the plasma spectroscopy at about 20 000 K electron temperature. In order to extend their application up to 50 000 K electron temperature new measurements would be helpful.

5.4 F II spectrum

Only one experiment (Blagojević *et al.* 1999) deals with the Stark width investigation in the $3s^3S^0 - 3p^3P$ transition at about 19 000 K electron temperature. The measured values agree with the SEM theoretical values. Both other predictions, SC and INS furnish higher Stark width values in this temperature domain (see Fig. 4).

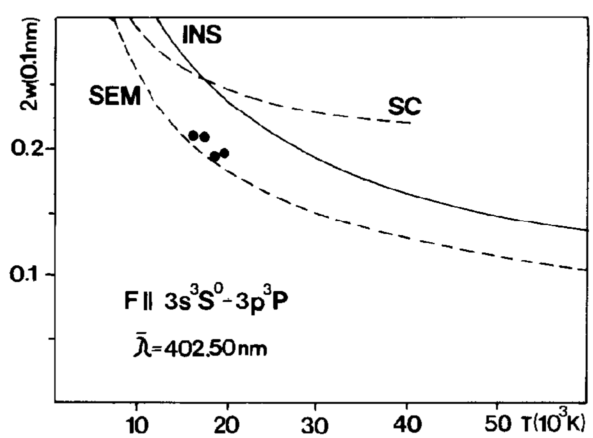

Fig. 4. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the F II* $3s^3S^0 - 3p^3P$ *transition. Experiment:* •, *Blagojević et al. (1999). Theory: SC and SEM. Estimations: INS, Table 1: No. 9.*

5.5 Ne II spectrum

Three experiments (Blagojević *et al.* 1999; Purić *et al.* 1987; Platiša *et al.* 1978) deal with the Stark width investigations in the $3s^2P - 3p^2D^0$ transition and two(Blagojević *et al.* 1999; Purić *et al.* 1987) with the investigations in the $3p^2D^0 - 3d^2F$ transition. In the case of the $3s^2P - 3p^2D^0$ transition measured values agree very well (within 8% accuracy) with the SC, INS and RT values in the 19 000 K – 40 000 K electron temperature range. The SEM values lie under all the other Stark width data (see Fig. 5). From these agreements follows the applicability of the 371.31 nm and 372.71 nm Ne II spectral lines in the plasma spectroscopy up to 40 000 K electron temperature.

In the case of the $3p^2D^0 - 3d^2F$ transition the situation is similar. The SC Stark width values lie between SEM and INS values and agree with the data from two existing experiments (Blagojević *et al.* 1999; Purić *et al.* 1987).

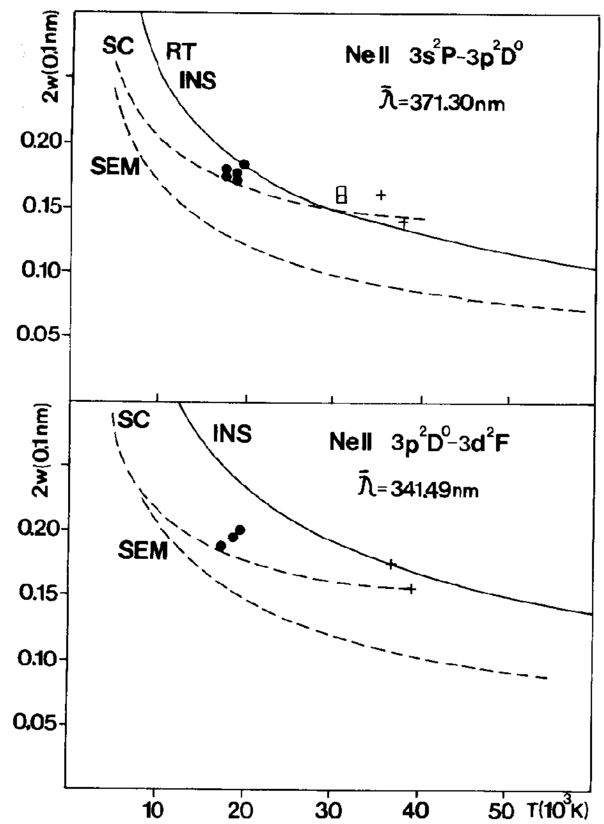

Fig. 5. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the Ne II* $3s^2P - 3p^2D^0$ *and Ne II* $3p^2D^0 - 3d^2F$ *transitions. Experiments:* •, *Blagojević et al. (1999)* +, *Purić et al. (1987);* □, *Platiša et al. (1978). Theory: SC and SEM. Estimations: INS, Table 1: No. 10 and No. 12; RT, Table 1: No. 11.*

5.6 Si II spectrum

Six experiments (Chiang and Griem 1978; Purić *et al.* 1974; Lesage and Sahal-Bréchot 1977; Lesage *et al.* 1983; Konjević *et al.* 1970abc; Perez *et al.* 1993) deal with the Stark width investigations in the $4s^2S - 4p^2P^0$ transition in the electron temperature range between 9 000 K and 32 000 K. The scatter between these data is above the factor 2. The SC values lie above all the experimental data except the one from Chiang and Griem (1978). Estimated INS values lie under SC values (see Fig. 6). The new experimental data in Perez *et al.* (1993) follow the trend predicted by SC theory. However, establishing any statement about these Stark width values presupposes new measurements.

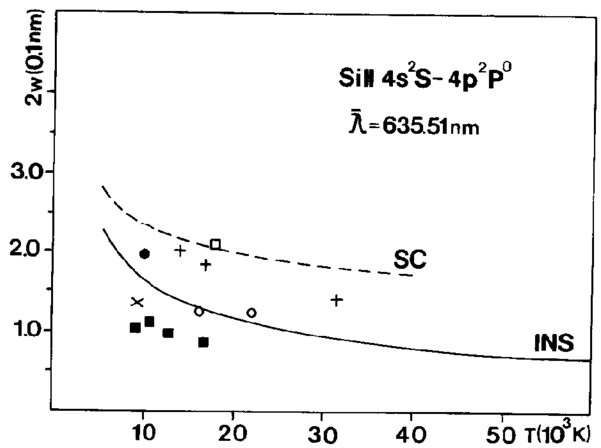

Fig. 6. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the Si II* $4s^2S - 4p^2P^0$ *transition. Experiments:* □, *Chiang and Griem (1978);* +, *Perez et al. (1993);* ×, *Konjević et al. (1970a); o, Lesage et al. (1983);* •, *Lesage and Sahal-Bréchot (1977);* ■, *Purić et al. (1974). Theory: SC. Estimations: INS, Table 1: No. 13.*

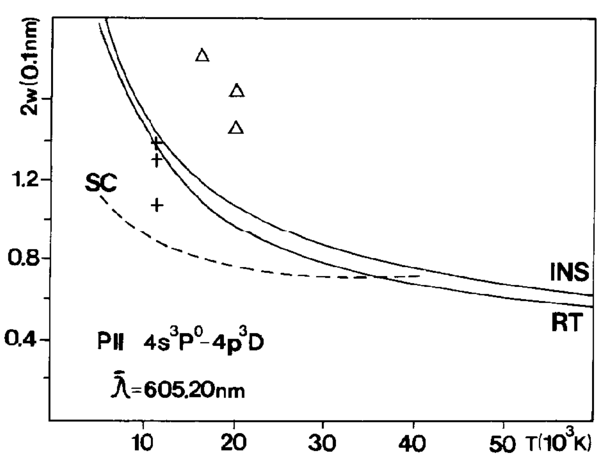

Fig. 7. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the P II* $4s^3P^0 - 4p^3D$ *transition. Experiments:* +, *Miller et al. (1985);* △, *Purić et al. (1985). Theory: SC. Estimations: INS, Table 1: No. 14.; RT, Table 1: No. 15.*

5.7 P II spectrum

Only two experiments (Miller *et al.* 1985; Purić *et al.* 1985) deal with the Stark width investigations in the $4s^3P^0 - 4p^3D$ transition. The estimated INS and RT values show very good mutual agreement. The latter, also, with the experimental data from Miller *et al.* (1985) (see Fig. 7). The SC theory provides values under all the existing Stark width data. Data from Purić *et al.* (1985) lie far above the theoretical predictions. New measurements are necessary.

5.8 S II spectrum

Five experiments (Miller *et al.* 1985; Bridges and Wiese 1967; Mar *et al.* 1985; Miller 1968; Kobilarov and Konjević 1990) deal with the Stark width investigations in the $4s^4P - 4p^4D^0$ transition. Excellent agreement exists among all experimental, theoretical (SEM) and predicted (INS and RT) Stark width values (within 8% accuracy) in a wide range of the electron temperatures (10 000 K – 32 000 K) (see Fig.8).

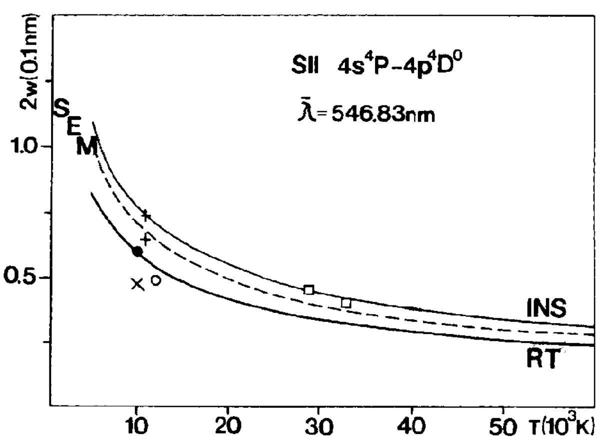

Fig. 8. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the S II* $4s^4P - 4p^4D^0$ *transition. Experiments:* +, *Miller (1968);* •, *Bridges and Wiese (1967); o, Mar et al. (1985);* ×, *Miller et al. (1985);* □, *Kobilarov and Konjević (1990). Theory: SEM. Estimations: INS, Table 1: No. 16; RT, Table 1: No. 17.*

From this fact one evaluates the applicability of the 545.38 nm, 543.28 nm and 542.86 nm S II spectral lines in the plasma spectroscopy.

5.9 Cl II spectrum

Four experiments (Purić et al 1988 a; Konjević *et al.* 1970 b; Konjević *et al.* 1971; Bengston 1968) deal with the Stark width investigations in the $4s^5S^0 - 4p^5P$ transition. The SC and INS values have similar course between 13 000 K and 40 000 K electron temperatures (within 12% accuracy) and in this temperature domain agree well with experimental values (see Fig. 9). Acordingly, the 479.45 nm and 481.01 nm Cl II spectral lines can be recommended for the plasma spectroscopy.

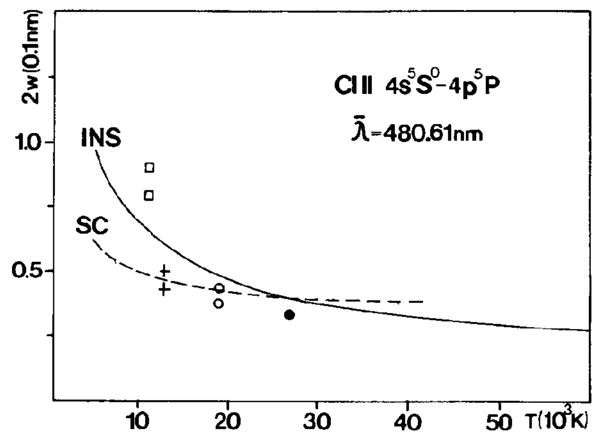

Fig. 9. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the Cl II* $4s^5S^0-4p^5P$ *transition. Experiments: +, Konjević et al. (1970b); •, Purić et al. (1988a); o, Konjević et al. (1971); □, Bengston (1968). Theory: SC Estimations: INS, Table 1: No. 18.*

5.10 Ar II spectrum

Ten experiments (Mazing and Vrubljovskaia 1962; Chapelle *et al.* 1968; Konjević *et al.* 1970 c; Labat *et al.* 1974; Nick and Helbig 1986; Vitel and Skowronek 1987; Vaessen *et al.*1985; Dzieržegaand Musiol 1994; Pellerin *et al.* 1977; Aparicio *et al.* 1998) deal with the Stark width investigations in the $4s^4P-4p^4P^0$, $4s^4P-4p^4D^0$ and $4s^4P-4p^4S^0$ transitions. The existing theoretical approximations (R, (Roberts 1970) J, (Jones *et al.* 1971), D (Davies and Roberts 1968), SC and SB (Sahal-Bréchot 1970) provide various Stark width values (see Fig. 10) in the same range of the electron temperatures. Experimental results show similar scatter. Estimated INS and RT values show, in the cases of the $4s^4P-4p^4P^0$ and $4s^4P-4p^4D^0$ transitions, steeper course depending on the electron temperature in comparison with the theoretical predictions. In the case of the $4s^4P-4p^4S^0$ transition the results of five experiments, (Djeniže *et al.* 1989; Chapelle *et al.* 1968; Labat *et al.* 1974; Aparicio *et al.* 1998; Dzieržega and Musiol 1994) theories (R and J) and estimations (INS and RT) have similar dependence on the electron temperature. The mentioned experimental results lie (within 10% accuracy) between INS and RT values and confirm, also, the predictions based on the J theory (Jones *et al.* 1971). Stark widths of the Ar II spectral lines: 372.93 nm, 385.06 nm and 392.86 nm, that belong to this transition, present reliable atomic data in plasma spectroscopy up to 30 000 K electron temperature.

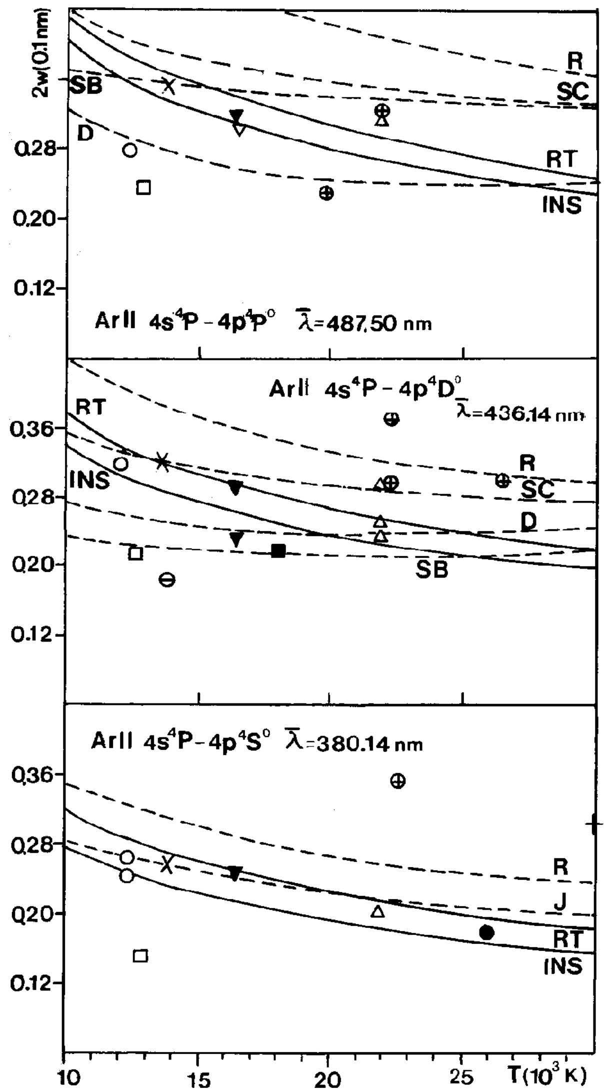

Fig. 10. *Stark FWHM vs. electron temperature at* 10^{23} m^{-3} *electron density for the Ar II :* $4s^4P-4p^4P^0$, $4s^4P-4p^4D^0$ *and* $4s^4P-4p^4S^0$ *transitions. Experiments: +, Mazing and Vrubloskaia (1962); ×, Chapelle et al. (1968); ∇, Konjević et al. (1970c);▼, Labat et al.(1974); □, Nick and Helbig (1986); •, Djeniže et al. (1989); ■, Vitel and Skowronek (1987); Θ, Vaessen et al. (1985); o, Dzieržega and Musiol (1994); △, Pellerin et al. (1997); ⊕, Aparicio et al. (1998). Theory: SC; SB (Sahal-Bréchot (1970)); D, (Davies and Roberts (1968)) R, (Roberts (1970)) J, (Jones et al. (1971)). Estimations: INS, Table 1: No. 19, No. 21 and No. 23; RT, Table 1: No. 20, No. 22 and No. 24, respectively for the investigated transitions.*

6. CONCLUSION

On the basis of the agreement between the existing measured, calculated and estimated Stark width values, the spectral lines:

– 566.66, 567.60 and 567.96 nm in N II spectrum (Table 1: No. 2, No. 3),

– 441.49 and 441.70 nm in O II spectrum (Table 1: No. 6, No. 7),

– 469.92 and 470.54 nm in O II spectrum (Table 1: No. 8),

– 371.31 and 372.71 nm in Ne II spectrum (Table 1: No. 10, No. 11),

– 542.86, 543.28 and 545.38 nm in S II spectrum (Table 1: No. 16, No. 17),

– 479.45 and 481.01 nm in Cl II spectrum (Table 1: No. 8),

– 372.93, 385.06 and 392.86 in Ar II spectrum (Table 1: No. 23, No. 24)

should be recommended, for the first time, as spectral lines with reliable Stark width data applicable in the plasma spectroscopy up to 50 000 K electron temperature. It should be pointed out that the three N II and Ar II spectral lines are, also, recommended by Konjević (1999). On the other hand, in order to eliminate the existing disagreement between the measured, calculated and estimated Stark width values, their new measurements are recommended in cases of the spectral lines that belong to the investigated singly ionized C II, F II, Si II and P II spectra.

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МЕРЕНЕ, РАЧУНАТЕ И ПРЕДВИЂЕНЕ ШТАРКОВЕ ШИРИНЕ СПЕКТРАЛНИХ ЛИНИЈА ИЗ СПЕКТАРА ЈЕДНОСТРУКО ЈОНИЗОВАНОГ C, N, O, F, Ne, Si, P, S, Cl И Ar

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Прегледни рад

У жељи да се нађу поуздане вредности Штаркових ширина потребних у спектроскопији плазме међусобно су упоређене постојеће вредности мерених, рачунатих и предвиђених Штаркових ширина за спектралне линије из десет спектара једноструко јонизованих емитера: C, N, O, F, Ne, Si, P, S, Cl и Ar из нижележећих прелаза као што су 3s-3p, 3p-3d и 4s-4p. Линије из тих спектара се могу наћи у многим космичким изворима зрачења. На основу утврђених слагања између мерених, рачунатих и предвиђених вредности Штаркових ширина препоручују се 17 спектралних линија из шест спектара једноструко јонизованих емитера, за потребе спектроскопије плазме као линије са поузданим Штарковим ширинама. Критичка анализа постојећих Штаркових ширина је такође приложена.