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Preliminary report

INFLUENCE OF DIFFERENT COLLISIONAL PROCESSES ON THE STARK BROADENING WITHIN SPECTRAL SERIES: THE O VI CASE

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SUMMARY: Using a semiclassical perturbation approach, behavior of Stark broadening parameters within spectral series has been investigated on the O VI case. The behavior of inelastic, elastic and strong collision contribution to line widths within a spectral series has been studied also.

1. INTRODUCTION

Stark broadening of strong multicharged ionic lines plays a non-negligible role in the calculation of the opacities, especially in the UV. Stark broadening data for these lines are very few numerous and many data are missing. The semiclassical-perturbation theory offers an interesting possibility for calculating numerous data, with an acceptable accuracy and without excessive computational time consuming. However, in the cases as e. g. stellar opacity calculations, when a lot of data are needed and where only a good average accuracy for a large set of lines is required, approximate methods are very useful. One such possibility provides knowledge about Stark broadening regularities and systematic trends (see e. g. Furić et al., 1991 and the references therein). In order to continue the investigation of systematic trends for Stark broadening parameters within spectral series (Dimitrijević and Sahal-Bréchot, 1984ab, 1985, 1987, 1990, 1992; Dimitrijević et al., 1991ab), the aim of this paper is to investigate Stark broadening parameter regularities within 2p - ns, 2s - np and ns - np (n = 3, 4, 5, 6) O VI spectral series, as well as the behavior of inelastic, elastic and strong collision contribution within the mentioned series.

2. RESULTS AND DISCUSSION

Using semiclassical-perturbation approach (Sahal-Bréchot, 1969 a b), inelastic, elastic and strong collision contribution to the Stark full half width (W) within 2p - ns, 2s - np and ns - np (n = 3, 4, 5, 6) O VI spectral series, has been calculated. Moreover, Stark broadening data from recently calculated comprehensive set of O VI Stark broadening parameters (Dimitrijević and Sahal-Bréchot, 1992) has also been used. In Figs. 1 and 2 the behavior of the electron and proton full halfwidths within the 2p $^2P^0$ - ns ^2S series are illustrated. We see the variation of the results for different plasma temperatures and different perturber type (electrons and protons). By inspecting the energy separation between the upper level and the principal perturbing levels (see the Grotrian diagrams in Bashkin and Stoner, 1975), we

find that this separation decreases gradually within a spectral series. This is the reason why we obtain a gradual change of Stark widths. In Figs. 3 and 4 we can see the same situation in the case of the shift. In Figs. 5 - 13 are presented inelastic, elastic and strong contribution to the electron-impact width for the case of 2p $^2P^0$ - ns ^2S O VI series as well as cases of 2s ^2S - np $^2P^0$, and ns ^2S - np $^2P^0$ series. We can see that inelastic and elastic contribution change very regularly in all cases examined. In the case of strong contribution there is a irregular jump for the highest member of 2p $^2P^0$ - ns ^2S series. This however, does not have signicant influence on the general behavior, due to the relatively small strong collision contribution for the case considered. Moreover, one must take into account that the strong collision contribution is one of the weakest points of the semiclassical theory. The demonstrated regular behavior might be used for the critical evaluation of existing resultsas well as for the interpolation of new data needed in astrophysics.

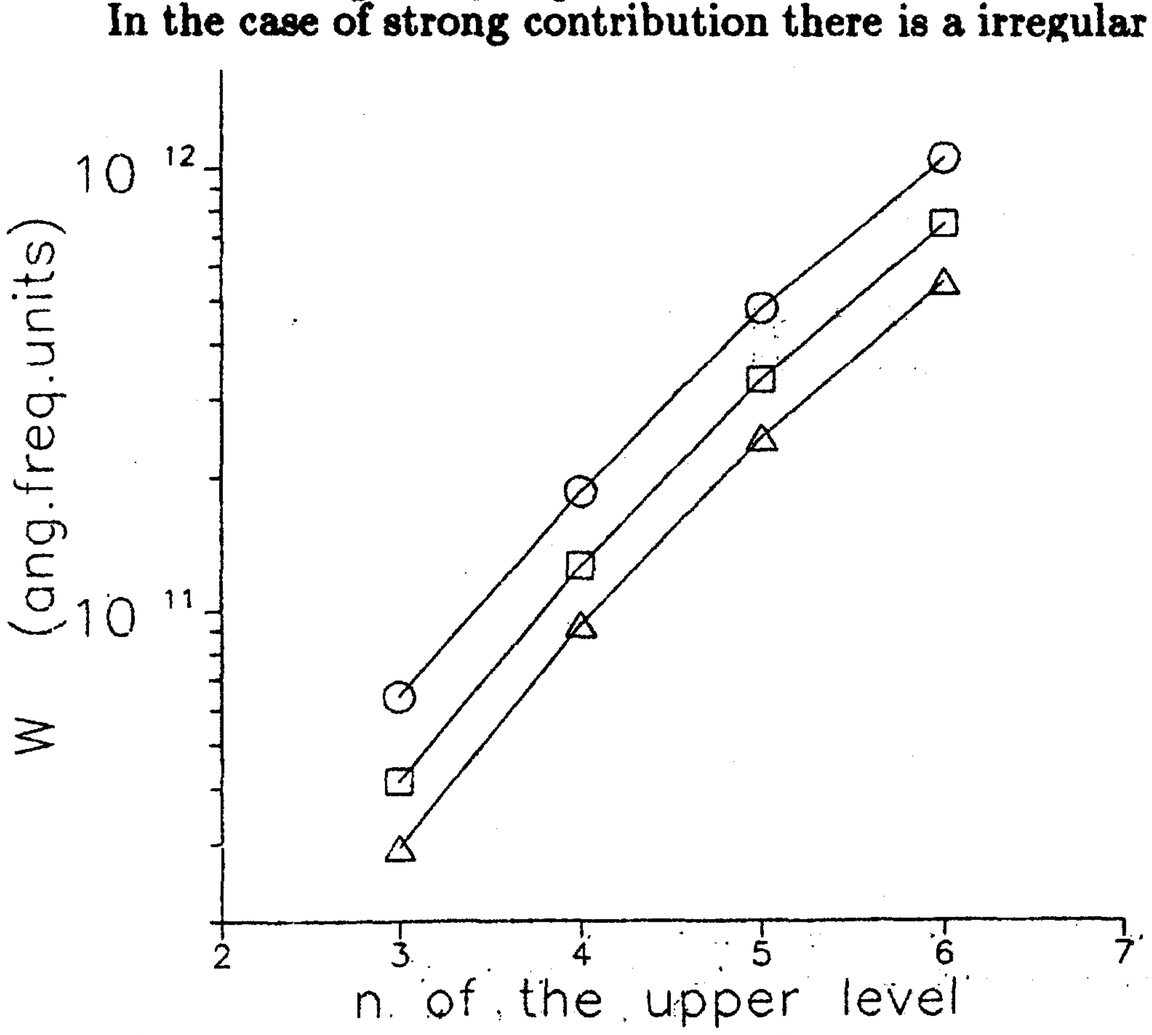

Fig. 1. Electron-impact widths (angular frequency units) along the O VI 2p $^2P^0$ - ns ^2S series as a function of n for T = 100,000 K (o); 300,000 K (□) and 800,000 K (△) at N = 10^{15} cm^{-3}.

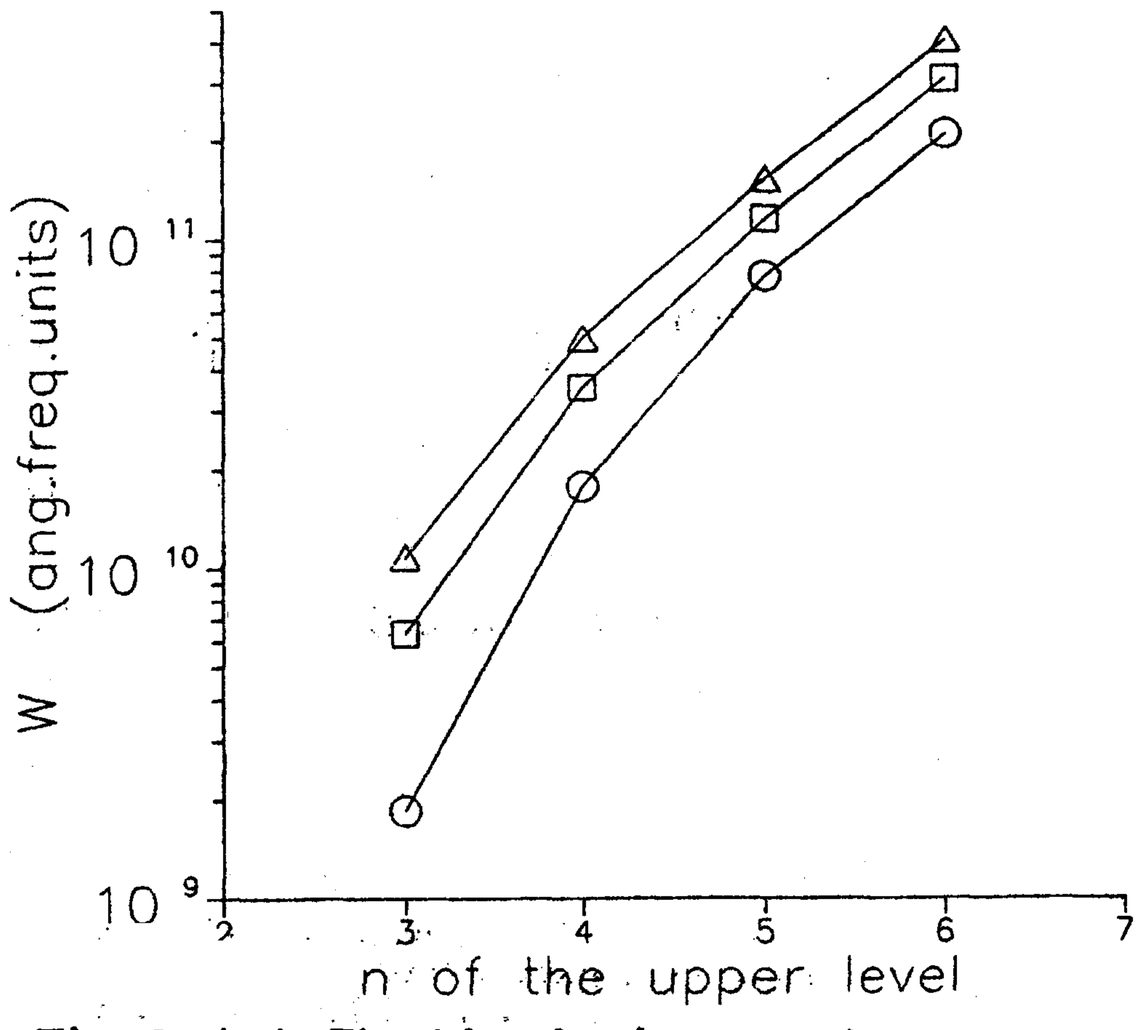

Fig. 2. As in Fig. 1 but for the proton-impact widths.

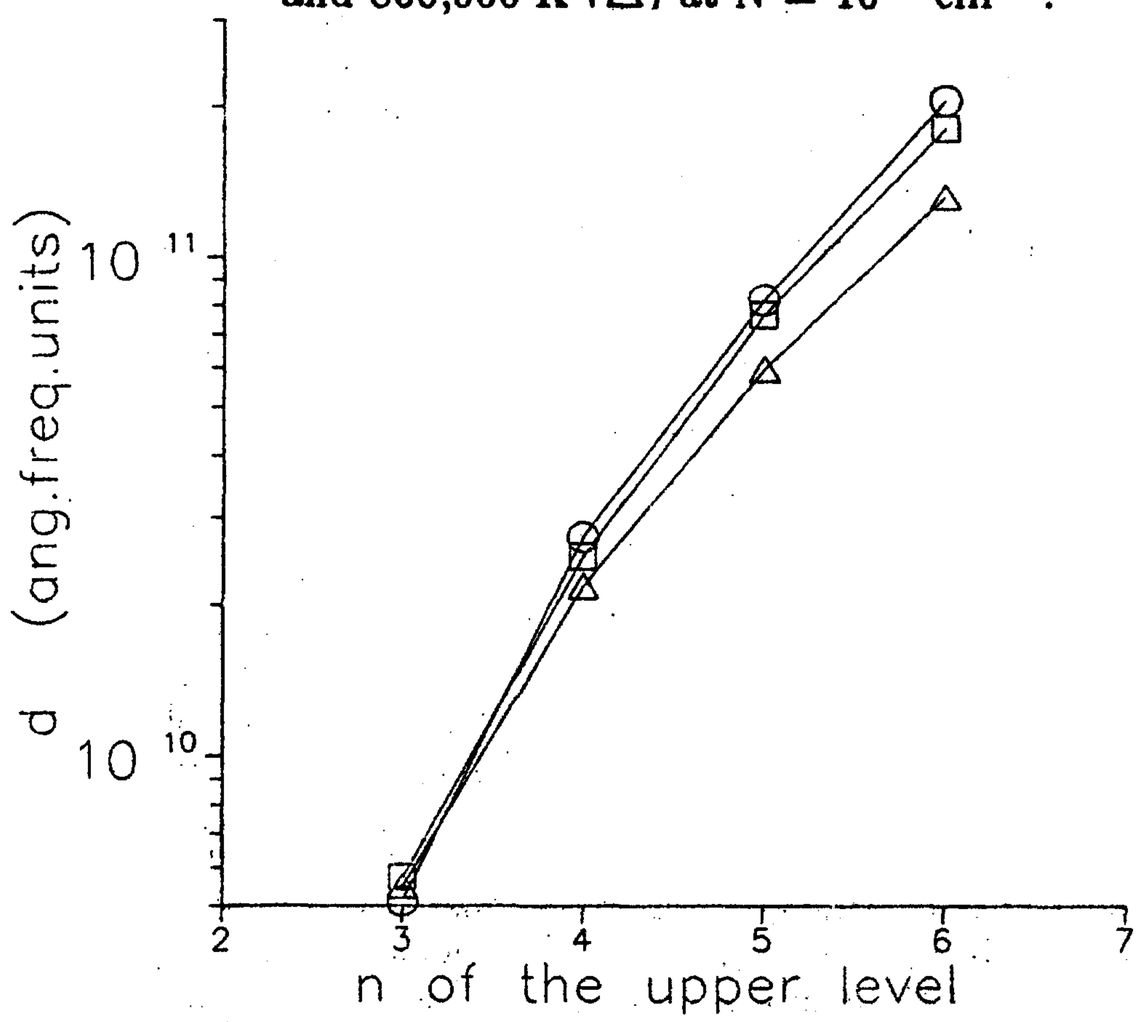

Fig. 3. As in Fig. 1 but for the electron-impact shifts.

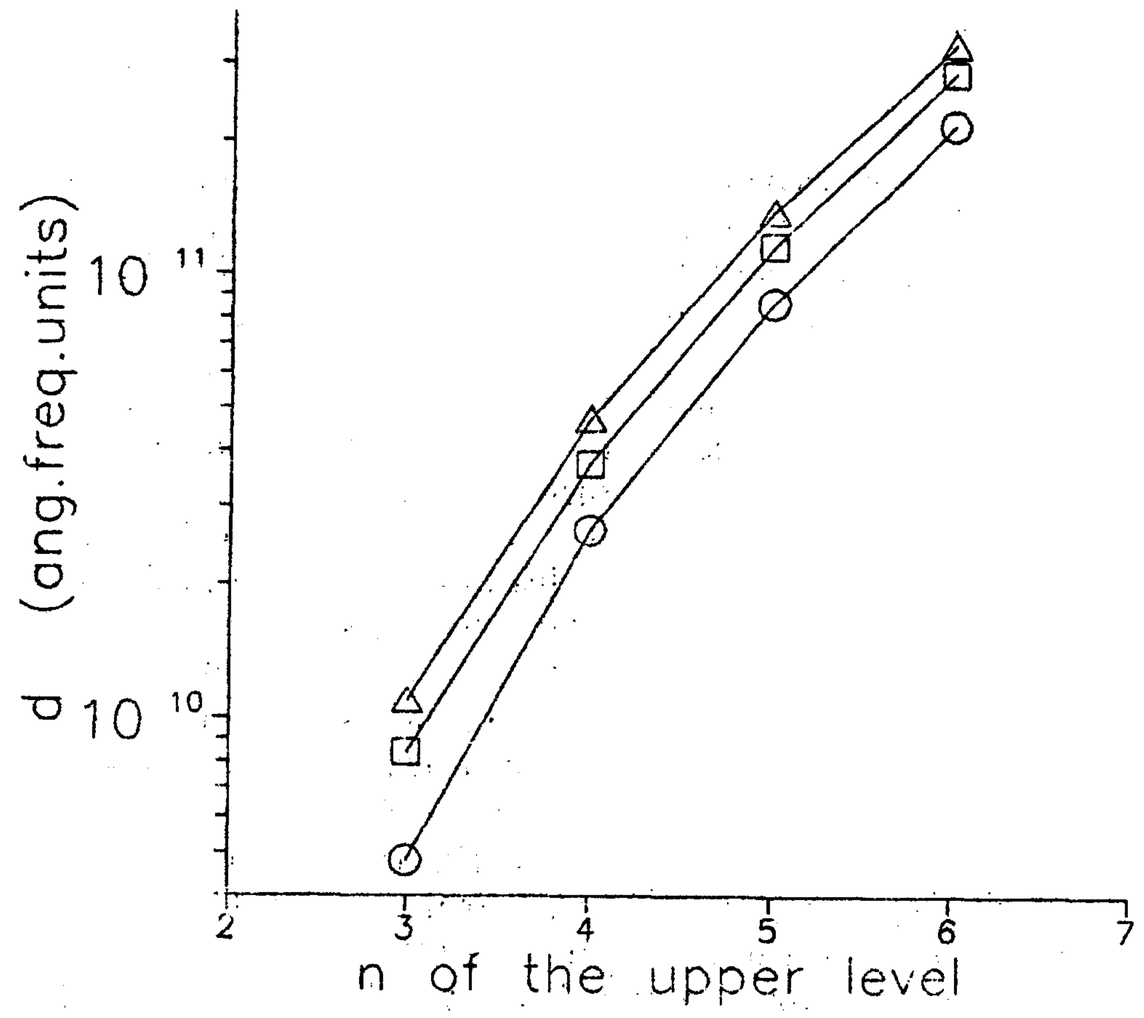

Fig. 4. As in Fig. 1 but for the proton-impact shifts.

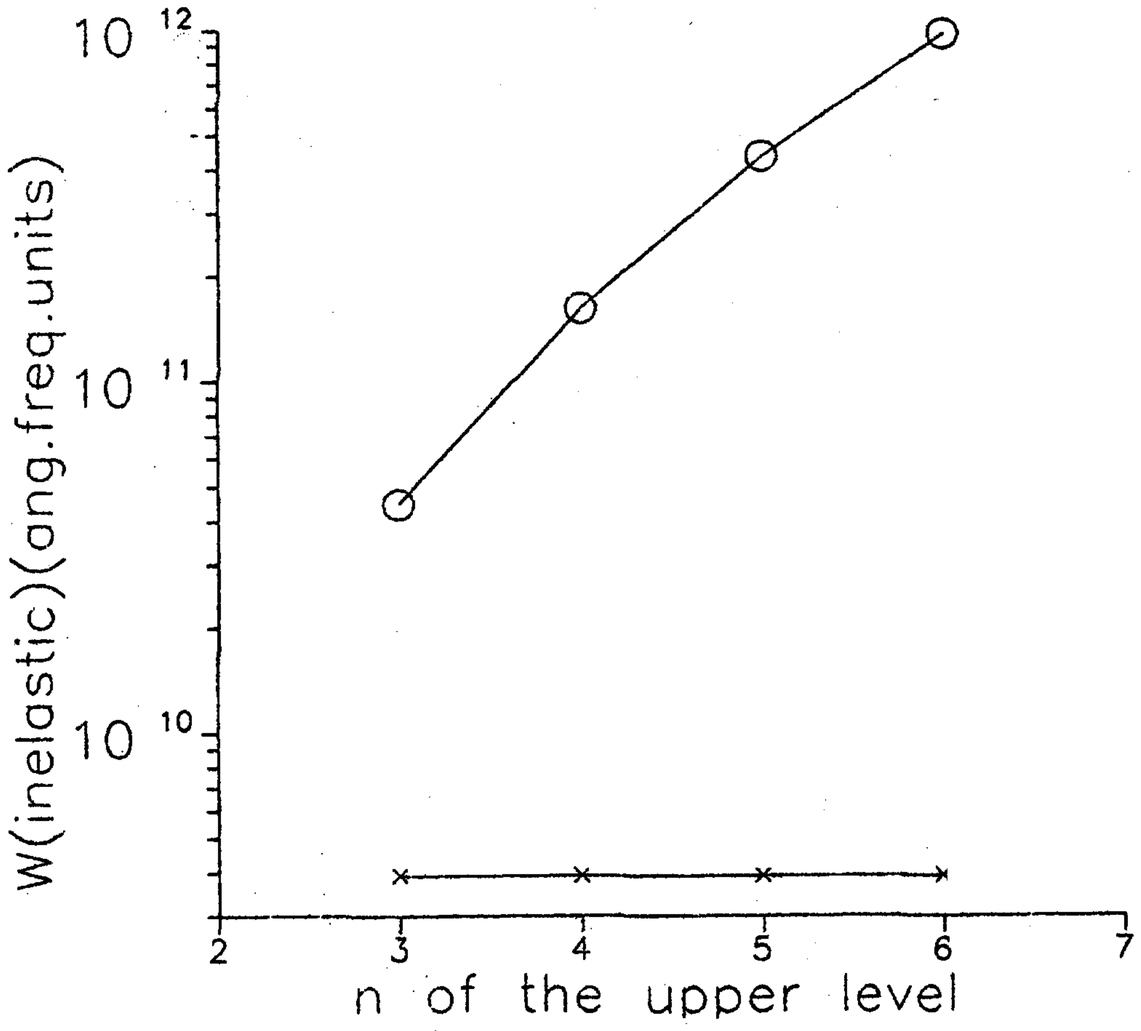

Fig. 5. As in Fig. 1 but for the inelastic collision contribution to the electron-impact widths. Here, (o) is for the upper level and (x) for the lower level
T = 100,000 K.

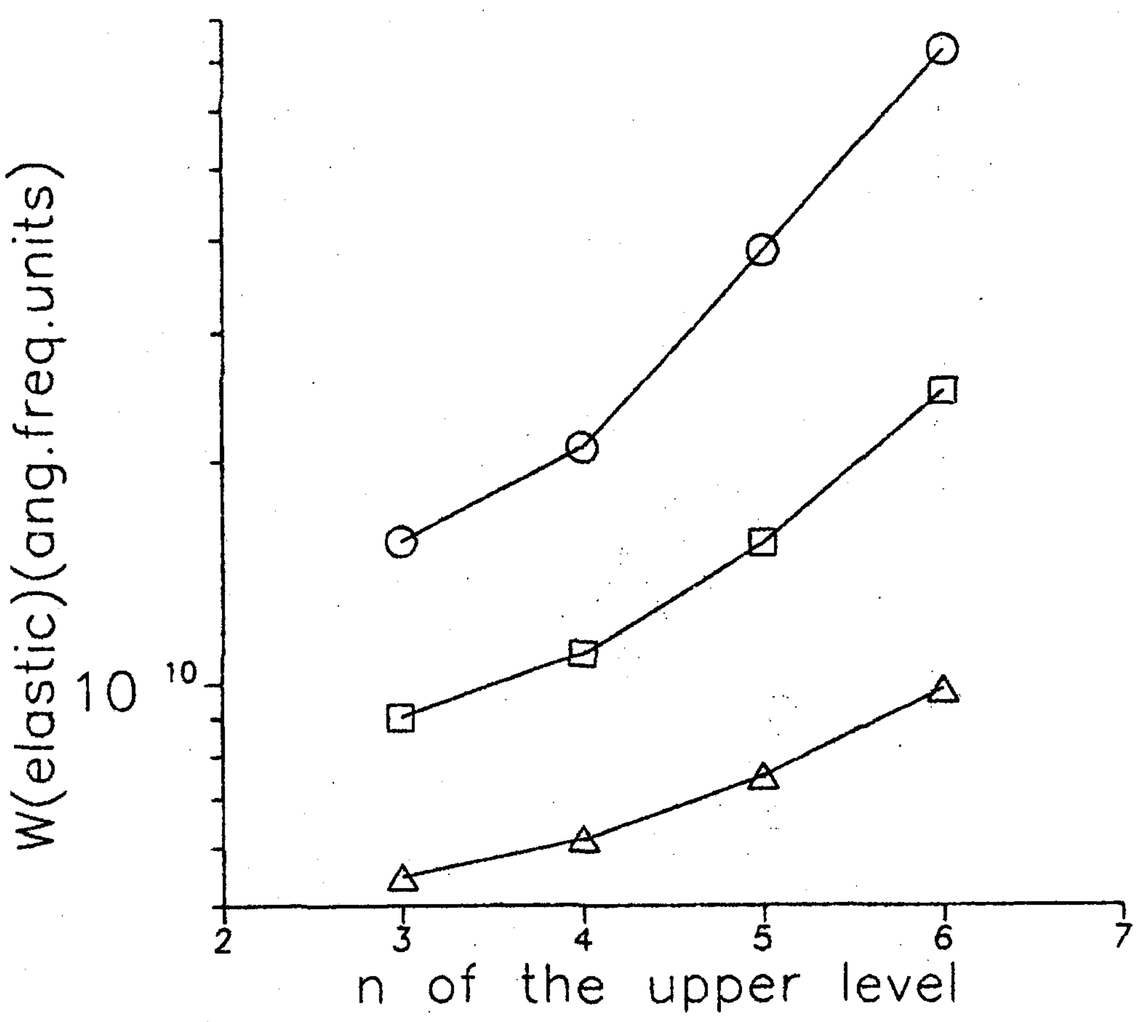

Fig. 6. As in Fig. 1 but for the elastic collision contribution to the electron-impact width.

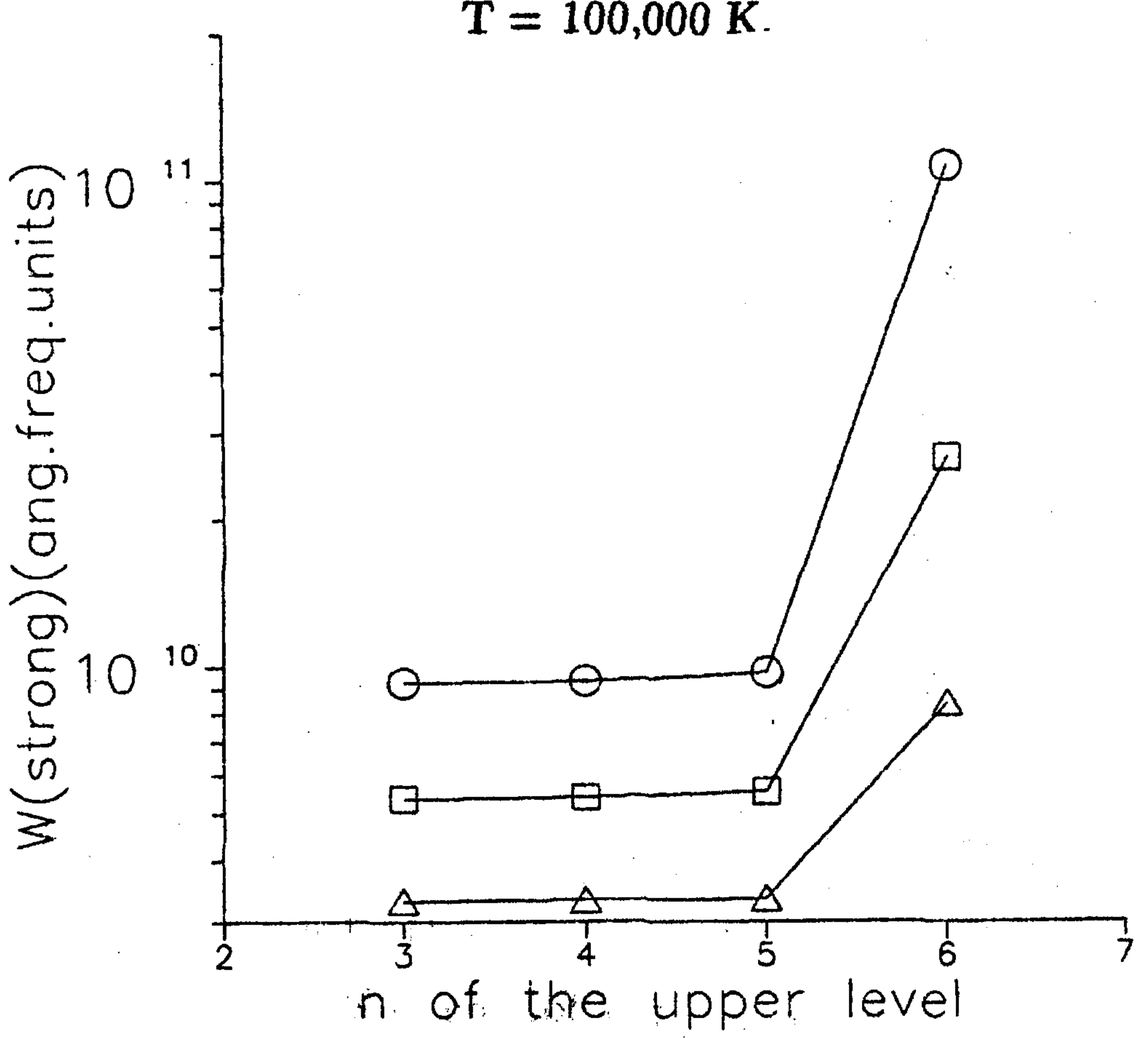

Fig. 7. As in Fig. 1 but for the strong collision contribution to the electron-impact width.

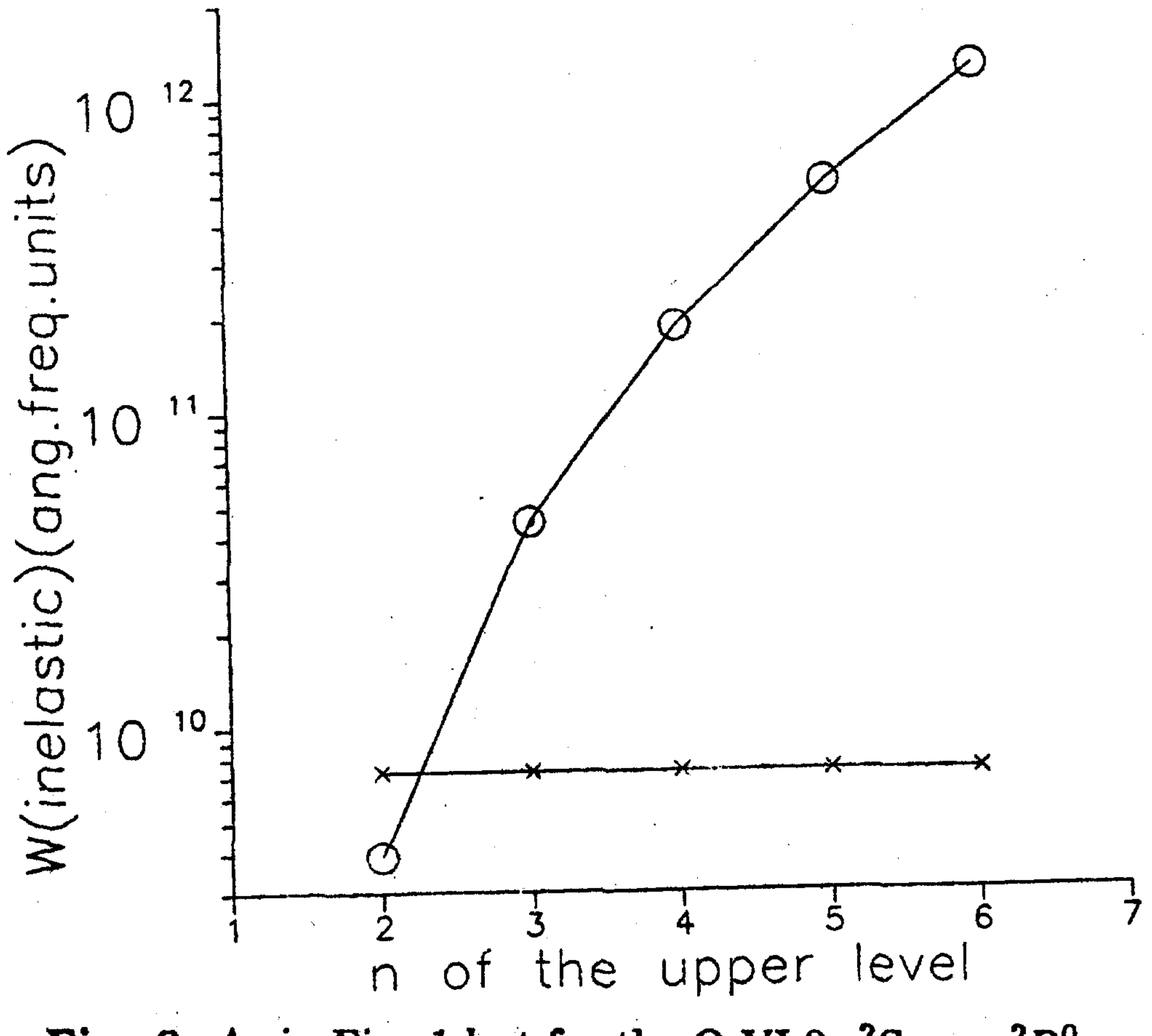

Fig. 8. As in Fig. 1 but for the O VI 2s ^{2}S - np ^{2}P^0 series and for inelastic collision contribution to the electron-impact widths. Here, (o) is for the upper level and (x) for the lower level T = 100,000 K.

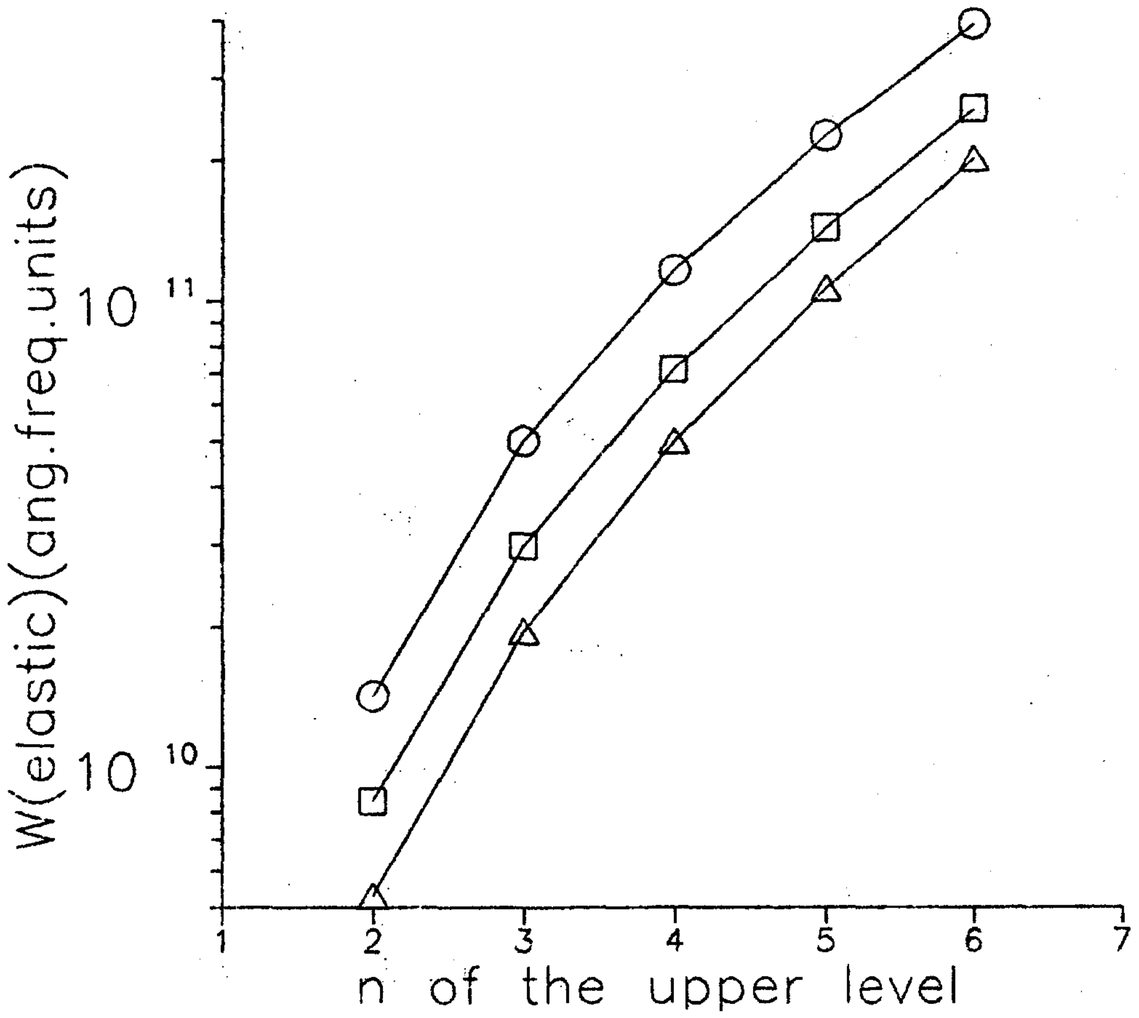

Fig. 9. As in Fig. 1 but for the the O VI 2s ^{2}S - np ^{2}P^0 series and for the elastic collision contribution to the electron-impact width.

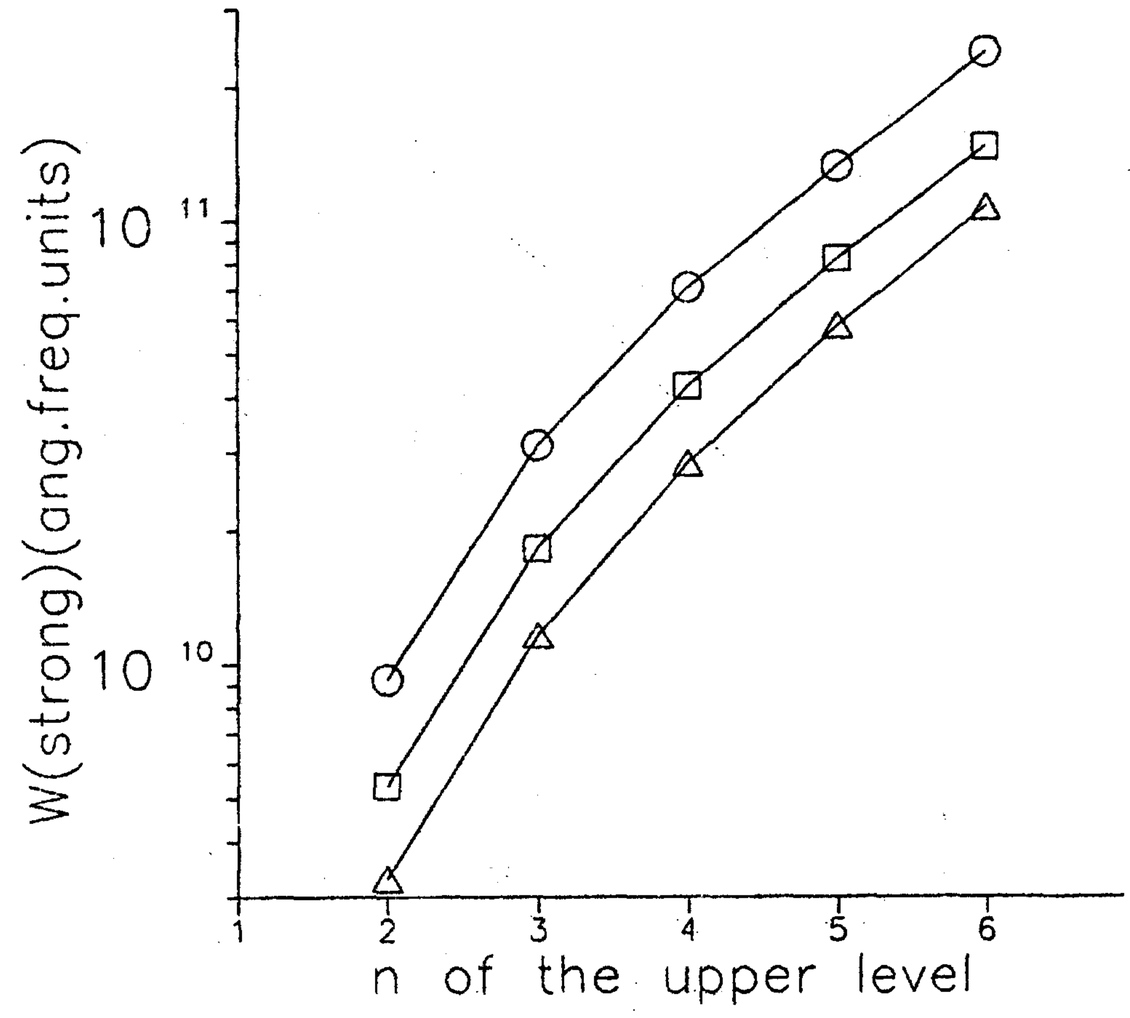

Fig. 10. As in Fig. 1 but for the O VI 2s ^{2}S - np ^{2}P^0 series and for the strong collision contribution to the electron-impact width.

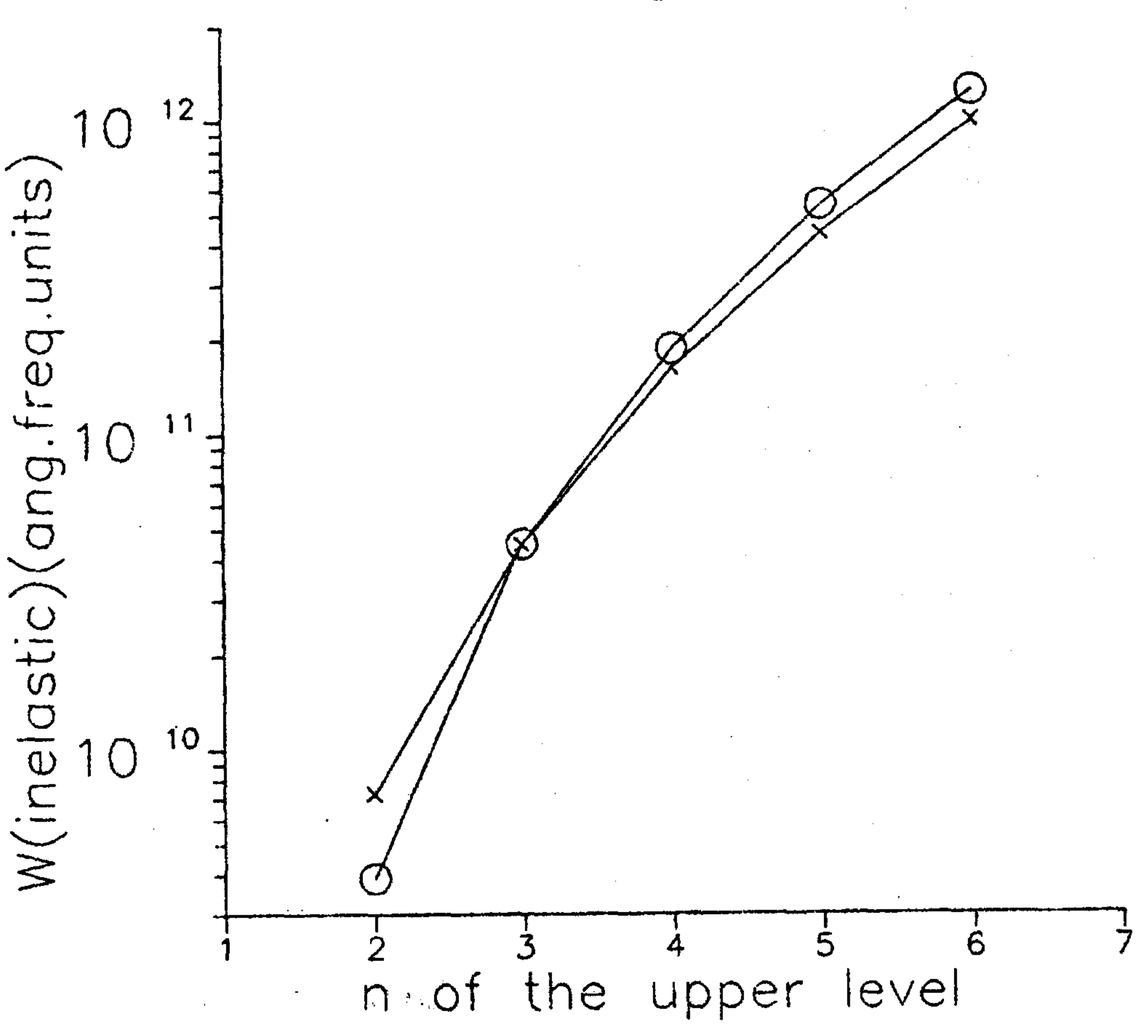

Fig. 11. As in Fig. 1 but for the O VI ns ^{2}S - np ^{2}P^0 series and for inelastic collision contribution to the electron-impact widths Here, (o) is for the upper level and (x) for the lower level T = 100,000 K.

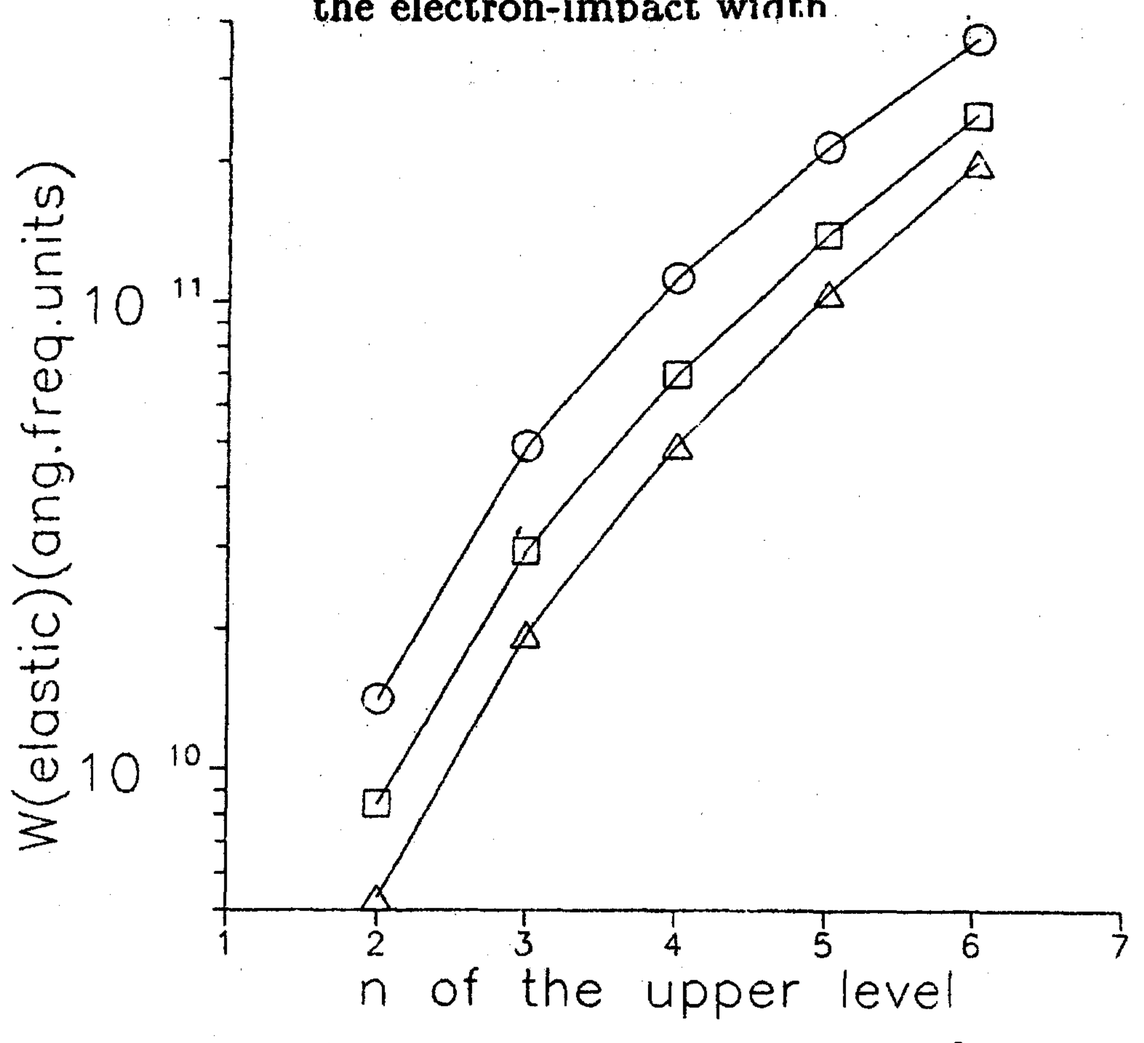

Fig. 12. As in Fig. 1 but for the O VI ns ^{2}S - np ^{2}P^0 series and for the elastic collision contribution to the electron-impact width.

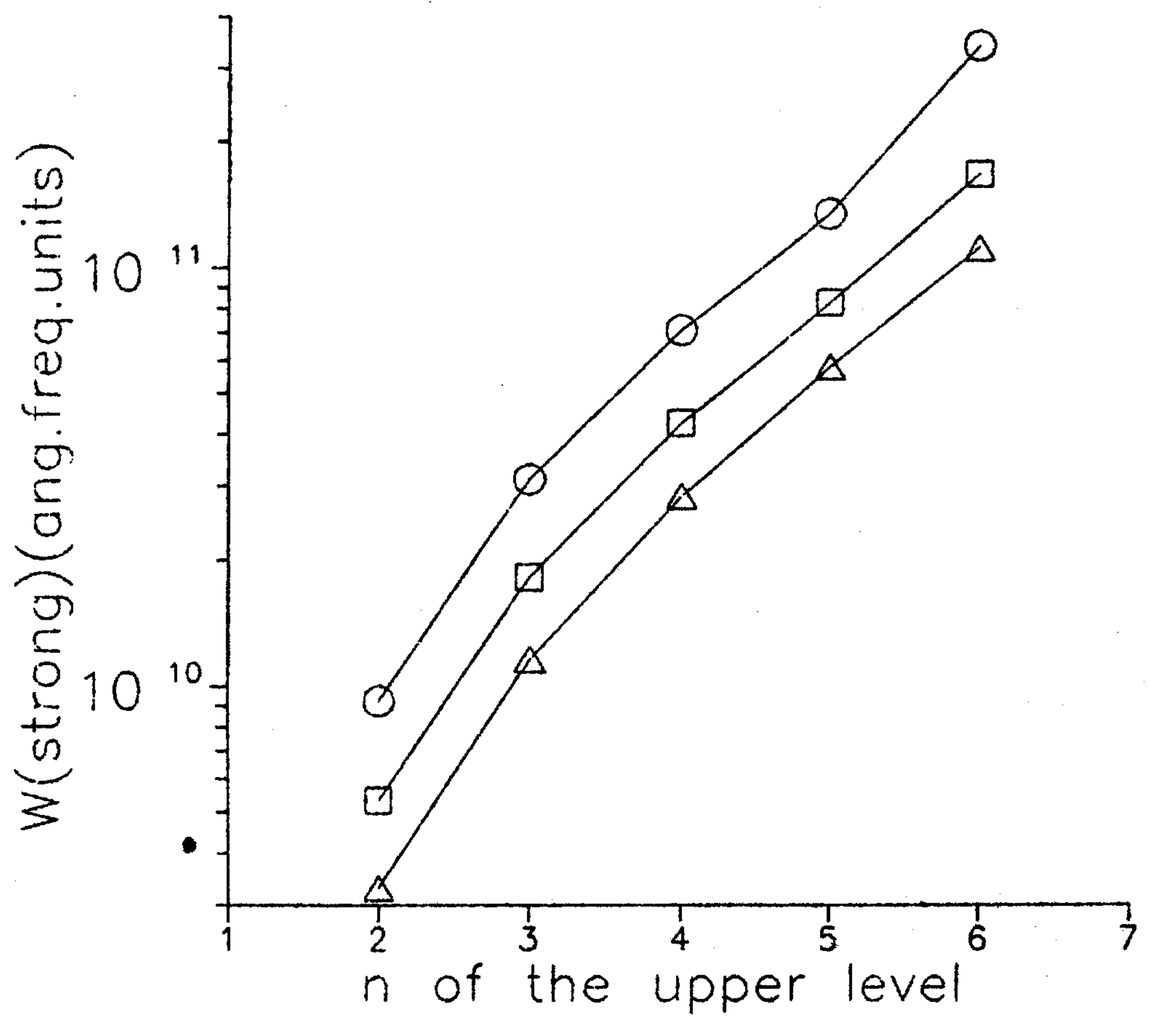

Fig. 13. As in Fig. 1 but for the the O VI ns^2 S - np $^2P^0$ series and for the strong collision contribution to the electron-impact width.

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УТИЦАЈ РАЗЛИЧИТИХ СУДАРНИХ ПРОЦЕСА НА ШТАРКОВО ШИРЕЊЕ У СПЕКТРАЛНИМ СЕРИЈАМА: СЛУЧАЈ O VI

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Претходно саопштење

Користећи семикласичан прилаз, истражено је понашање параметара Штарковог ширења у спектралним серијама на случају O VI. Такође је испитано понашање у спектралној серији утицаја нееластичних, еластичних и јаких судара на ширину спектралне линије.