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STARK BROADENING OF LITHIUM ION LINES IN ASTROPHYSICAL AND LABORATORY PLASMAS

M. S. DIMITRIJEVIĆ
Astronomical Observatory, Volgina 7, 11050 Belgrade, Yugoslavia
E–mail mdimitrijevic@aob.aob.bg.ac.yu

S. SAHAL-BRECHOT
Observatoire de Paris, 92195 Meudon Cedex, Frcnce
E–mail sahal@obspm.fr

Abstract. Using a semiclassical approach, we have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 37 Li II multiplets. The resulting data have been compared with existing theoretical values.

1. INTRODUCTION

Profiles of neutral and ionized lithium lines are of interest to astrophysicists since the surface content (abundance) of lithium involves problems correlated with nucleogenesis and with mixing between the atmosphere and the interior (Boesgaard 1988).They should also be of interest for the study of deep Li depletions in the mid-F stars, which were first observed in the Hyades (Boesgaard, Trippico 1986).Even for the study of stars in the late stage of evolution, Stark broadening is of interest since its influence increases with an increase in the principal quantum number (n) of the initial energy level (Vince *et al.* 1985), because the bond between the optical electron and the core becomes weaker and the influence of external electric microfields increases.

Stark-broadening parameters for singly charged lithium lines are of interest for Stark broadening theory investigations as well, since the He-like Li II spectrum is suitable for theoretical research. They are of interest for the examination of regularities and systematic trends within He isoelectronic sequence as well.

By using the semiclassical-perturbation formalism (Sahal-Bréchot 1969ab), we have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 37 Li II multiplets. A summary of the formalism is given in Dimitrijević *et al.* (1991). Here, we discuss the obtained results for Li II, along with a comparison with other theoretical results (Jones *et al.* 1971, see also Griem 1974).

2. RESULTS AND DISCUSSION

All details of calculations as well as the tables of Stark-broadening parameters due to electron-, proton- and ionized-helium impacts for perturber densities of 10^{15} – $10^{17}\mathrm{cm}^{-3}$ and temperatures T = 5,000 - 40,000 K, will be published elsewhere (Dimitrijević and Sahal-Bréchot 1995ab).

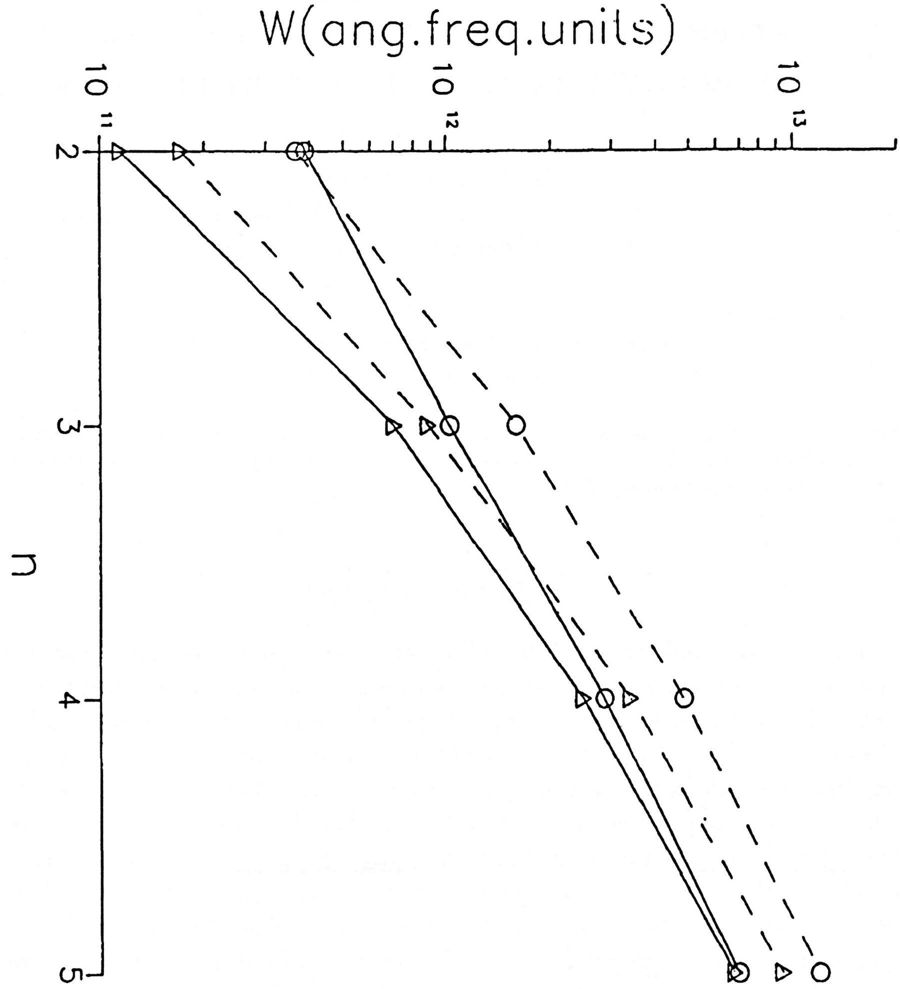

Fig. 1. Electron-impact full half-widths (in angular frequency units) for Li II $2s^3S$ - np^3P^o lines as a function of n for T = 5,000 K (o) and 40,000 K (Δ) at Ne = 10^{17} cm^{-3}. With (___) are denoted present calculations and with (– – –) semiclassical calculations of Jones *et al.* (1971, see also Griem 1974).

In Figs. 1 and 2 the electron-impact full half widths and shifts within the $2s^3S$ - np^3P^o series have been compared with semiclassical results of Jones *et al.* (1971, see also Grem 1974). We can see gradual change of Stark broadening parameters permitting the interpolation of new data or critical evaluation of mutual consistency of existing data, as in our previous analyses (Dimitrijević *et al.* 1991).

We see in Figs. 1-2 that the agreement between present calculation and calculations of Jones *et al.* (1971, see also Griem 1974) is better at higher temperatures, when the inelastic contribution to the width dominates, than at lower ones, when differences in cut-off procedure and the symmetrization influence are more significant. Due to the difference of calculated values, especially for shifts, it is of interest to determine Li II Stark broadening parameters experimentally at different temperatures in order to test the differences in applied theoretical models.

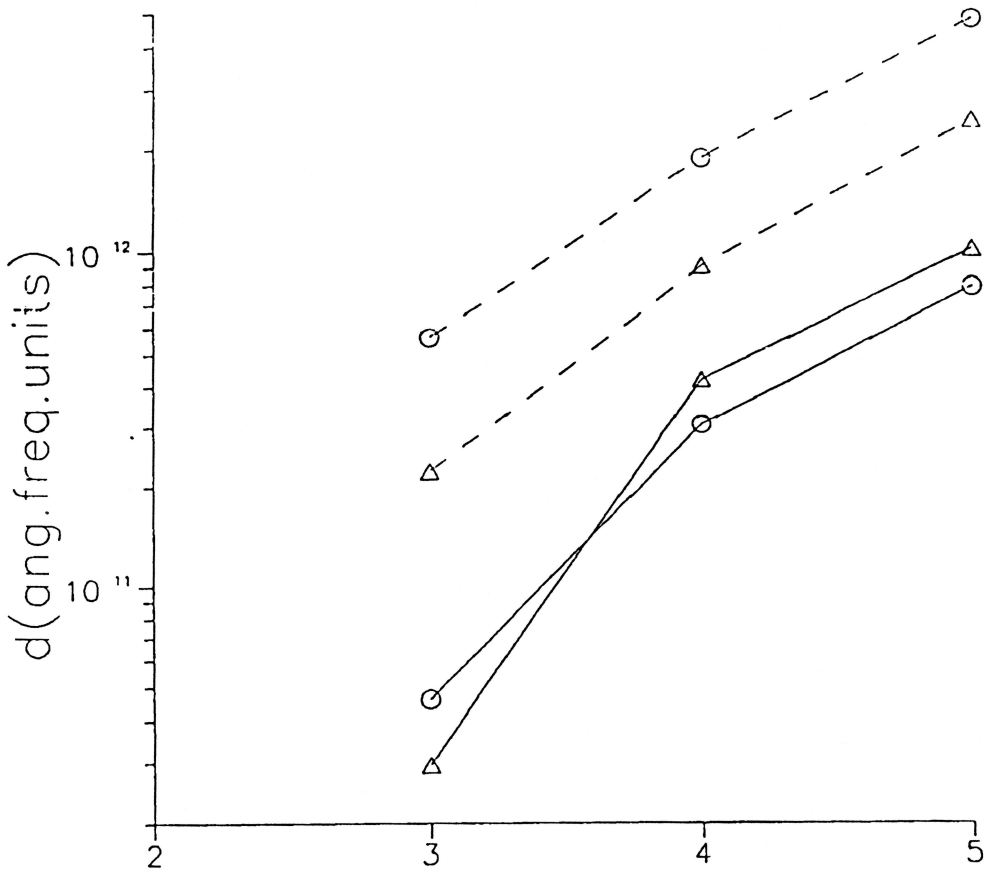

Fig. 2. As in Fig. 1 but for the electron-impact shift.

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