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THE ELECTRON-IMPACT EFFECT IN Hg-Mn STARS: ASTROPHYSICAL IMPORTANT Zr III LINES

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1. INTRODUCTION

As it is very well known the Hg-Mn stars are non-magnetic late B type stars. In their spectra unusually strong lines of many heavy ions are present (see e.g. Preston 1971, Heacox 1979, Dworetsky 1980, Adelman 1987, Lecrone et al. 1993, Wahlgren et al. 1995). In A and B type stars the electron-impact broadening is the main pressure broadening mechanism (e.g. Dimitrijević 1989). Considering that the resonant lines of ionized heavy elements (z>30) are located in the ultraviolet spectral region, the abundance analysis of these elements has become possible due to satellite observations by high resolution spectrograph as e.g. International Ultraviolet Explorer (IUE) satellite or Goddard High Resolution Spectrograph (GHSR) installed at Hubble Space Telescope. The number of heavy ion lines observations with the higher photometric quality and spectral resolution is growing up. Consequently, experimental and theoretical spectroscopic data for modeling of these lines are required.

In order to investigate the Hg-Mn star atmospheres as well as other types of hot stars, the Stark broadening parameters for heavy ion lines are needed. Zr III lines are presented in spectra of Hg-Mn stars. E.g. in spectra of Chi Lupi, a B-type star, well-resolved lines of Zr III λ = 1937.22 Å, 1940.24 Å and 1941.06 Å have been observed. Here we present the electron-impact broadening parameters for these four astrophysical important Zr III lines as a function of temperature, calculated by using the modified semi-empirical approach (Dimitrijević and Konjević 1980, Popović and Dimitrijević 1996).

2. RESULTS AND DISCUSSION

The atomic energy levels needed for the calculations were taken from Reader and Acquista (1997). Oscillator strengths have been calculated by using the method of Bates and Damgaard (1949) and the tables of Oertel and Shomo (1968). For calculation of Stark broadening widths the modified semi-empirical apporach has been used (Dimitrijević and Konjević 1980, Popović and Dimitrijević 1996)

Results obtained using the MSE approach for electron – impact line widths and shifts for three Zr III lines as a function of temperature are presented in Tables 1. The calculations have been performed for a perturber density of $10^{23}m^{-3}$, since within the MSE formalism, the results for the electron-impact broadening parameters are linear with electron density.

Table 1. Stark widths (FWHM) of Zr III spectral lines at an electron density of $10^{23}m^{-3}$ as a function of temperature.

Transition	T (K)	W (nm)
$a^3P_1 - z^3P_1^0$	5000	.452E-02
	10000	.317E-02
	20000	.220E-02
λ=194.662 nm	30000	.178E-02
	40000	.153E-02
	50000	.137E-02
$a^3P_0 - z^3P_1^0$	5000	.447E-02
	10000	.314E-02
	20000	.218E-02
λ=193.665 nm	30000	.176E-02
	40000	.152E-02
	50000	.136E-02
$a^3P_2 - z^3P_2^0$	5000	.474E-02
	10000	.332E-02
	20000	.231E-02
	30000	.187E-02
λ=194.106 nm	40000	.161E-02
	50000	.144E-02
$a^1G_4 - z^1F_3^0$	5000	.459E-02
	10000	.321E-02
	20000	.224E-02
	30000	.181E-02
λ=194.020 nm	40000	.156E-02
	50000	.140E-02

There is no experimental data for the Stark broadening parameters of Zr III spectral lines, and such data will be of importance for the refinement of the Stark broadening theory for spectral lines from complex spectra.

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