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Data Descriptor

Stark Width Data for Tb II, Tb III and Tb IV Spectral Lines

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Abstract: A dataset of Stark widths for Tb II, Tb III and Tb IV is presented. To data obtained before, the results of new calculations for 62 Tb III lines from 5d to $6p_j(6,j)^o$, a transition array, have been added. Calculations have been performed by using the simplified modified semiempirical method for temperatures from 5000 to 80,000 K for an electron density of 10^{17} cm^{-3}. The results were also used to discuss the regularities within multiplets and a supermultiplet.

Dataset: Supplementary File

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1. Introduction

For many different topics in astrophysics [1–3], laser physics [4,5], laboratory plasma diagnostics [6] and inertial fusion plasma investigations [7], and for different plasma technologies [8], data on the broadening of spectral lines by impacts with charged particles, i.e., Stark broadening, might be of interest. In astrophysics such data are very useful for the analysis of stellar atmospheres where data for spectral lines of many atoms and ions are needed due to various chemical compositions and the presence of spectral lines of different species. Additionally, with the development of astronomy, spectral line profiles with increasingly high resolution and accuracy are becoming available so that even the data for trace elements are significant.

Terbium is one of lanthanides, also known as rare earth elements (REE). They also form the rare-earth peak in the cosmic abundance distribution of chemical elements, and a considerable number of spectral lines of these elements have been found in stellar spectra and will be observed in the future, because of the development of astronomy and new very large terrestrial telescopes.

Tb I and Tb II spectral lines are found in stellar spectra. As examples, we can cite the derivation of the terbium abundance for the moderately r-process-enhanced star CS 30315-029 [9], by using three weak Tb II lines, and the observation of Tb III lines in ro Ap star HD 213637 [10] and in ro Ap star 10 Aql [11]. Additionally, Tb I, Tb II and Tb III lines have been observed in the spectrum of extreme roAp star HD 101065, known also as Przybylski's star [12].

In order to provide the needed data for Stark broadening, we have recently calculated Stark full widths at half maximum (FWHM) for five multiplets of Tb II, eight multiplets of Tb IV [13] and 26 transitions of Tb III [14], by using the simplified modified semiempirical method [15], because for more sophisticated calculations the reliable atomic data are missing.

Here, we calculated Stark widths due to collisions with electrons for 62 additional Tb III lines from 5d–$6p_j(6,j)^o$, a transition array, and added the new data to the previously calculated data. Thus, besides the new calculations we present here Stark broadening data for Tb II, Tb III and Tb IV spectral lines.

2. Data Description

We present here a dataset containing Stark widths W (FWHM) due to impacts with electrons for five multiplets of Tb II published in [13], 88 transitions in Tb III (26 from [14] and 62 calculated here) and eight multiplets of Tb IV determined in [13], for a standard electron density $N = 10^{17}$ cm^{-3} and for temperatures T = 5000, 10,000, 20,000, 40,000 and 80,000 K in the cases of Tb III and Tb IV. In the case of Tb II temperatures were 5000, 10,000 and 20,000 K, since for them the method used is valid. In some cases T = 40,000 K is included, when the validity condition is satisfied. This validity condition is shown in the table as the quantity $3kT/2\Delta E$, for each of the temperatures. Here, k is the Boltzmann constant, ΔE is the smaller energy difference between the closest perturbing level and the initial (i) or final (f) energy levels. In order for the method used to be valid, the value of $3kT/2\Delta E$ should be less than or equal to two. One value when this quantity is greater than two is given for better interpolation. In the considered dataset, transitions and wavelengths λ calculated from energy level values are also given. For electron densities N smaller than 10^{17} cm^{-3} the dependence of W on N is linear, so the value from the dataset should be simply multiplied by N and divided by 10^{17}, while for higher electron densities the dependence is linear if the influence of Debye screening is negligible or reasonably small.

3. The Method of Research

For calculation of Stark widths W presented in the considered dataset, the simplified modified semiempirical formula (SMSE) [15] is used. It can be applied to isolated singly and multiply charged ion lines if the above-mentioned validity condition—$(3kT/2\Delta E)_{\mathrm{Max}} \leq 2$—is satisfied. According to [15], Stark full width at half maximum is

$$W = 2.2151 \times 10^{-8} \frac{\lambda^2(\mathrm{cm}) N(\mathrm{cm}^{-3})}{T^{1/2}(\mathrm{K})} (0.9 - \frac{1.1}{Z}) \times$$
$$\times \sum_{\mathrm{j=i,f}} (\frac{3n_{\mathrm{j}}^*}{2Z})^2 (n_{\mathrm{j}}^{*2} - \ell_{\mathrm{j}}^2 - \ell_{\mathrm{j}} - 1). \quad (1)$$

where width (FWHM) W is in Ångströms (Å), $Z - 1$ is the ionic charge, n^{*2} is the effective principal quantum number and ℓ_{j} (j = i,f) is the orbital angular momentum quantum number. In [15], the accuracy of this method has been checked by comparisons of experimental results for the number of lines of N III, O III, Si III, S III, Cl III, Ar III, C IV, Si IV, S IV and Ar IV. The average ratio of measured–calculated Stark widths was 1.04. An additional check was made with experimental values for Ne III, Ar III, Kr III and Xe III, and the differences between experimental and calculated values were within the limits of 21%. In the cases of Tb II, Tb III and Tb IV, there were no other experimental or theoretical data for comparison, so such measurements will be very useful to test the accuracy of calculations. Since these spectra are more complicated, we can expect that the average difference will be worse—within the limit of 50%, we assume. For some particular lines, these differences could be greater.

4. Results and Discussion

In this study, full Stark widths at half intensity maxima for 62 transitions of Tb III were calculated with the help of a simplified modified semiempirical (SMSE) method. Atomic energy levels and ionization energy needed for calculations have been taken from [16,17]. These data are not sufficient for some more advanced methods of calculations. Thus, the SMSE method, needing less atomic data, was the most adequate method and could be successfully applied.

One should note that spectra of Tb II, Tb III and Tb IV are very complex. Additional complications are that some atomic energy levels are described within the LS coupling scheme and other levels within Jj coupling. An additional difficulty is that some observed energy levels are not connected with a designated term and that some levels are mixtures of two or even several configurations without any dominant ones. When it was necessary, we calculated the averaged term energies using existing energy levels and expression:

$$E = \frac{\sum\limits_{J}(2J+1)E_J}{\sum\limits_{J}(2J+1)}, \quad (2)$$

where E is the averaged term energy and E_J and J are the energy and total angular momentum of a particular energy level. For example, the average energy obtained in such a way for the term $6p_{1/2}(6,1/2)^o$ of Tb III is 52,154.1 cm^{-1} and for $6p_{3/2}(6,3/2)^o$ is 57,405.3 cm^{-1}.

The Stark FWHM, calculated here for 62 Tb III transitions, are shown in Table 1. These values have been added to the dataset of Tb II, Tb III and Tb IV Stark widths.

Additionally, we used the obtained data to check the similarities of Stark widths within multiplets and a supermultiplet, because this enabled us to see whether we could use this fact to estimate the missing values from known ones. In [18], it has been demonstrated that when Stark line widths are expressed in angular frequency units, they are usually very similar in a multiplet, whereas in a supermultiplet the differences are within the limit of about 30% and up to 40% within a transition array. In [14], we checked such similarities within the Tb III 6s–6p transition array and we found that for Stark widths in angular frequency units (s^{-1}) the highest value is only 12% larger than the lowest one. If we look separately sextets and octets, i.e., the two different supermultiplets, the difference was 10%. The difference between them was only 3.5% on average, and was in all considered cases well within the maximal limits predicted in [18] on the basis of an examination of existing experimental data. Here we analyze regularities within supermultiplet $5d^8L$—$6p_j(6,j)^o$, in the spectrum of Tb III. In order to avoid the influences of different wavelengths, we transformed the Stark widths in Å-units to angular frequency units, with the help of relation:

$$W(\AA) = \frac{\lambda^2}{2\pi c} W(s^{-1}), \quad (4)$$

where c is the speed of light.

Table 1. Full width at half intensity maximum (W) for Tb III lines from the transition array 5d–6p, broadened by collisions with electrons. Transitions and wavelengths calculated from energy level are also given in here. The electron density was 10^{17} cm^{-3} and temperatures were from 5000 to 80,000 K. Additionally, quantity 3kT/2ΔE is given, where ΔE is the energy difference between the closest perturbing level and the closer of the initial and final levels. In order for the method used to be valid, this quantity should be less than or equal to two. One value for temperatures when 3kT/2ΔE is greater than two is given for better interpolation.

Transition	T [K]	W [Å]	3kT/2ΔE
Tb III $5d^8G$—$6p_{1/2}(6,1/2)^o$ λ = 2369.9 Å	5000.	0.0784	0.215
	10,000.	0.0554	0.431
	20,000.	0.0392	0.861
	40,000.	0.0277	1.72
	80,000.	0.0196	3.45
Tb III $5d^8G$—$6p_{3/2}(6,3/2)^o$ λ = 2107.6 Å	5000.	0.0707	0.177
	10,000.	0.0500	0.354
	20,000.	0.0354	0.708
	40,000.	0.0250	1.42
	80,000.	0.0177	2.83

Table 1. *Continued.*

Transition	T [K]	W [Å]	3kT/2ΔE
Tb III $5d^8D$—$6p_{1/2}(6,1/2)^o$ λ = 2498.1 Å	5000.	0.0881	0.215
	10,000.	0.0623	0.431
	20,000.	0.0441	0.861
	40,000.	0.0312	1.72
	80,000.	0.0220	3.45
Tb III $5d^8D$—$6p_{3/2}(6,3/2)^o$ λ = 2208.4 Å	5000.	0.0785	0.177
	10,000.	0.0555	0.354
	20,000.	0.0392	0.708
	40,000.	0.0277	1.42
	80,000.	0.0196	2.83
Tb III $5d^8F$—$6p_{1/2}(6,1/2)^o$ λ = 2668.7 Å	5000.	0.102	0.215
	10,000.	0.0722	0.431
	20,000.	0.0510	0.861
	40,000.	0.0361	1.72
	80,000.	0.0255	3.45
Tb III $5d^8F$—$6p_{3/2}(6,3/2)^o$ λ = 2340.7 Å	5000.	0.0893	0.177
	10,000.	0.0631	0.354
	20,000.	0.0446	0.708
	40,000.	0.0316	1.42
	80,000.	0.0223	2.83
Tb III $5d^8H$—$6p_{1/2}(6,1/2)^o$ λ = 2783.6 Å	5000.	0.112	0.215
	10,000.	0.0792	0.431
	20,000.	0.0560	0.861
	40,000.	0.0396	1.72
	80,000.	0.0280	3.45
Tb III $5d^8F$—$6p_{3/2}(6,3/2)^o$ λ = 2428.6 Å	5000.	0.0969	0.177
	10,000.	0.0685	0.354
	20,000.	0.0484	0.708
	40,000.	0.0342	1.42
	80,000.	0.0242	2.83
Tb III $5d^6F_{11/2}$—$6p_{1/2}(6,1/2)^o$ λ = 2880.5 Å	5000.	0.121	0.215
	10,000.	0.0855	0.431
	20,000.	0.0604	0.861
	40,000.	0.0427	1.72
	80,000.	0.0302	3.45
Tb III $5d^6F_{11/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2502.0 Å	5000.	0.103	0.177
	10,000.	0.0732	0.354
	20,000.	0.0517	0.708
	40,000.	0.0366	1.42
	80,000.	0.0259	2.83
Tb III $5d^6F_{9/2}$—$6p_{1/2}(6,1/2)^o$ λ = 2996.0 Å	5000.	0.132	0.215
	10,000.	0.0932	0.431
	20,000.	0.0659	0.861
	40,000.	0.0466	1.72
	80,000.	0.0330	3.45
Tb III $5d^6F_{9/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2588.7 Å	5000.	0.112	0.177
	10,000.	0.0789	0.354
	20,000.	0.0558	0.708
	40,000.	0.0395	1.42
	80,000.	0.0279	2.83

Table 1. *Continued.*

Transition	T [K]	W [Å]	3kT/2ΔE
Tb III $5d^6F_{7/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3111.3 Å	5000.	0.143	0.215
	10,000.	0.101	0.431
	20,000.	0.0717	0.861
	40,000.	0.0507	1.72
	80,000.	0.0358	3.45
Tb III $5d^6F_{7/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2674.3 Å	5000.	0.120	0.177
	10,000.	0.0848	0.354
	20,000.	0.0600	0.708
	40,000.	0.0424	1.42
	80,000.	0.0300	2.83
Tb III $5d^6F_{5/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3206.6 Å	5000.	0.153	0.215
	10,000.	0.108	0.431
	20,000.	0.0766	0.861
	40,000.	0.0542	1.72
	80,000.	0.0383	3.45
Tb III $5d^6F_{5/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2744.5 Å	5000.	0.127	0.177
	10,000.	0.0898	0.354
	20,000.	0.0635	0.708
	40,000.	0.0449	1.42
	80,000.	0.0318	2.83
Tb III $5d^6F_{3/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3277.2 Å	5000.	0.161	0.215
	10,000.	0.114	0.431
	20,000.	0.0804	0.861
	40,000.	0.0568	1.72
	80,000.	0.0402	3.45
Tb III $5d^6F_{3/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2792.5 Å	5000.	0.132	0.177
	10,000.	0.0935	0.353
	20,000.	0.0661	0.707
	40,000.	0.0467	1.41
	80,000.	0.0330	2.83
Tb III $5d^6G_{13/2}$—$6p_{1/2}(6,1/2)^o$ λ = 2941.6	5000.	0.127	0.215
	10,000.	0.0895	0.431
	20,000.	0.0633	0.861
	40,000.	0.0448	1.72
	80,000.	0.0317	3.45
Tb III $5d^6G_{13/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2545.1 Å	5000.	0.108	0.177
	10,000.	0.0761	0.353
	20,000.	0.0538	0.707
	40,000.	0.0380	1.41
	80,000.	0.0269	2.83
Tb III $5d^6G_{11/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3100.6 Å	5000.	0.142	0.215
	10,000.	0.101	0.431
	20,000.	0.0711	0.861
	40,000.	0.0503	1.72
	80,000.	0.0356	3.45
Tb III $5d^6G_{9/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3224.6 Å	5000.	0.155	0.215
	10,000.	0.110	0.431
	20,000.	0.0776	0.861
	40,000.	0.0548	1.72
	80,000.	0.0388	3.45

Table 1. *Continued.*

Transition	T [K]	W [Å]	3kT/2ΔE
Tb III I5d^{6}G$_{9/2}$—6p$_{3/2}$(6,3/2)^o λ = 2757.6 Å	5000.	0.128	0.177
	10,000.	0.0908	0.354
	20,000.	0.0642	0.708
	40,000.	0.0454	1.42
	80,000.	0.0321	2.83
Tb III 5d^{6}G$_{7/2}$—6p$_{1/2}$(6,1/2)^o λ = 3323.7 Å	5000.	0.166	0.215
	10,000.	0.117	0.431
	20,000.	0.0829	0.861
	40,000.	0.0586	1.72
	80,000.	0.0415	3.45
Tb III 5d^{6}G$_{11/2}$—6p$_{3/2}$(6,3/2)^o λ = 2829.8 Å	5000.	0.136	0.177
	10,000.	0.0961	0.354
	20,000.	0.0680	0.708
	40,000.	0.0481	1.42
	80,000.	0.0340	2.83
Tb III 5d^{6}G$_{5/2}$—6p$_{1/2}$(6,1/2)^o λ = 3403.7 Å	5000.	0.175	0.215
	10,000.	0.124	0.431
	20,000.	0.0874	0.861
	40,000.	0.0618	1.72
	80,000.	0.0437	3.45
Tb III 5d^{6}G$_{5/2}$—6p$_{3/2}$(6,3/2)^o λ = 2887.6 Å	5000.	0.142	0.178
	10,000.	0.100	0.356
	20,000.	0.0711	0.713
	40,000.	0.0502	1.43
	80,000.	0.0355	2.85
Tb III 5d^{6}G$_{3/2}$—6p$_{1/2}$(6,1/2)^o λ = 3457.9 Å	5000.	0.181	0.215
	10,000.	0.128	0.431
	20,000.	0.0905	0.861
	40,000.	0.0640	1.72
	80,000.	0.0452	3.45
Tb III 5d^{6}G$_{3/2}$—6p$_{3/2}$(6,3/2)^o λ = 2926.5 Å	5000.	0.146	0.181
	10,000.	0.104	0.362
	20,000.	0.0732	0.724
	40,000.	0.0518	1.45
	80,000.	0.0366	2.90
Tb III 5d^8$_{P9/2}$—6p$_{1/2}$(6,1/2)^o λ = 2994.7 Å	5000.	0.132	0.215
	10,000.	0.0931	0.431
	20,000.	0.0659	0.861
	40,000.	0.0466	1.72
	80,000.	0.0329	3.45
Tb III 5d^8$_{9/2}$—6p$_{3/2}$(6,3/2)^o λ = 2587.8 Å	5000.	0.112	0.177
	10,000.	0.0788	0.354
	20,000.	0.0558	0.708
	40,000.	0.0394	1.42
	80,000.	0.0279	2.83

Table 1. *Continued.*

Transition	T[K]	W[Å]	3kT/2ΔE
Tb III $5d^8P_{7/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3240.6 Å	5000.	0.157	0.215
	10,000.	0.111	0.431
	20,000.	0.0784	0.861
	40,000.	0.0554	1.72
	80,000.	0.0392	3.45
Tb III $5d^8P_{7/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2769.4 Å	5000.	0.130	0.177
	10,000.	0.0916	0.354
	20,000.	0.0648	0.708
	40,000.	0.0458	1.42
	80,000.	0.0324	2.83
Tb III $5d^8P_{5/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3427.8 Å	5000.	0.177	0.215
	10,000.	0.125	0.431
	20,000.	0.0887	0.861
	40,000.	0.0627	1.72
	80,000.	0.0444	3.45
Tb III $5d^8P_{5/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2904.9 Å	5000.	0.144	0.179
	10,000.	0.102	0.359
	20,000.	0.0720	0.718
	40,000.	0.0509	1.44
	80,000.	0.0360	2.87
Tb III $5d^6H_{15/2}$—$6p_{1/2}(6,1/2)^o$ λ = 2997.8 Å	5000.	0.132	0.215
	10,000.	0.0934	0.431
	20,000.	0.0660	0.861
	40,000.	0.0467	1.72
	80,000.	0.0330	3.45
Tb III $5d^6H_{15/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2590.1 Å	5000.	0.112	0.177
	10,000.	0.0790	0.354
	20,000.	0.0559	0.708
	40,000.	0.0395	1.42
	80,000.	0.0279	2.83
Tb III $5d^6H_{13/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3203.7 Å	5000.	0.153	0.215
	10,000.	0.108	0.431
	20,000.	0.0765	0.861
	40,000.	0.0541	1.72
	80,000.	0.0382	3.45
Tb III $5d^6H_{13/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2742.4 Å	5000.	0.127	0.177
	10,000.	0.0897	0.354
	20,000.	0.0634	0.708
	40,000.	0.0448	1.42
	80,000.	0.0317	2.83
Tb III $5d^6H_{11/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3340.3 Å	5000.	0.168	0.215
	10,000.	0.119	0.431
	20,000.	0.0838	0.861
	40,000.	0.0593	1.72
	80,000.	0.0419	3.45

Table 1. *Continued.*

Transition	T[K]	W[Å]	3kT/2ΔE
Tb III $5d^6H_{11/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2841.8 Å	5000.	0.137	0.177
	10,000.	0.0970	0.354
	20,000.	0.0686	0.708
	40,000.	0.0485	1.42
	80,000.	0.0343	2.83
Tb III $5d^6H_{9/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3458.5 Å	5000.	0.181	0.215
	10,000.	0.128	0.431
	20,000.	0.0905	0.861
	40,000.	0.0640	1.72
	80,000.	0.0452	3.45
Tb III $5d^6H_{9/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2926.9 Å	5000.	0.146	0.181
	10,000.	0.104	0.362
	20,000.	0.0732	0.724
	40,000.	0.0518	1.45
	80,000.	0.0366	2.90
Tb III $5d^6H_{7/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3553.3 Å	5000.	0.192	0.215
	10,000.	0.136	0.431
	20,000.	0.0960	0.861
	40,000.	0.0679	1.72
	80,000.	0.0480	3.45
Tb III $5d^6H_{7/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2994.5 Å	5000.	0.154	0.186
	10,000.	0.109	0.372
	20,000.	0.0770	0.744
	40,000.	0.0545	1.49
	80,000.	0.0385	2.98
Tb III $5d^6H_{5/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3628.2 Å	5000.	0.201	0.215
	10,000.	0.142	0.431
	20,000.	0.101	0.861
	40,000.	0.0711	1.72
	80,000.	0.0503	3.45
Tb III $5d^6H_{5/2}$—$6p_{3/2}(6,3/2)^o$ λ = 3047.6 Å	5000.	0.160	0.190
	10,000.	0.113	0.380
	20,000.	0.0801	0.760
	40,000.	0.0566	1.52
	80,000.	0.0400	3.04
Tb III $5d^6D_{9/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3329.1 Å	5000.	0.166	0.215
	10,000.	0.118	0.431
	20,000.	0.0832	0.861
	40,000.	0.0588	1.72
	80,000.	0.0416	3.45
Tb III $5d^6D_{9/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2833.7 Å	5000.	0.136	0.177
	10,000.	0.0964	0.354
	20,000.	0.0682	0.708
	40,000.	0.0482	1.42
	80,000.	0.0341	2.83

Table 1. *Continued.*

Transition	T[K]	W[Å]	3kT/2ΔE
Tb III $5d^6D_{7/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3419.9 Å	5000.	0.177	0.215
	10,000.	0.125	0.431
	20,000.	0.0883	0.861
	40,000.	0.0624	1.72
	80,000.	0.0441	3.45
Tb III $5d^6D_{7/2}$—$6p_{3/2}(6,3/2)^o$ λ = 2899.2 Å	5000.	0.143	0.179
	10,000.	0.101	0.358
	20,000.	0.0717	0.716
	40,000.	0.0507	1.43
	80,000.	0.0358	2.86
Tb III $5d^6D_{5/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3576.0 Å	5000.	0.195	0.215
	10,000.	0.138	0.431
	20,000.	0.0974	0.861
	40,000.	0.0689	1.72
	80,000.	0.0487	3.45
Tb III $5d^6D_{5/2}$—$6p_{3/2}(6,3/2)^o$ λ = 3010.7 Å	5000.	0.156	0.187
	10,000.	0.110	0.374
	20,000.	0.0779	0.749
	40,000.	0.0551	1.50
	80,000.	0.0390	3.00
Tb III $5d^6D_{3/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3672.4 Å	5000.	0.207	0.215
	10,000.	0.146	0.431
	20,000.	0.103	0.861
	40,000.	0.0730	1.72
	80,000.	0.0516	3.45
Tb III $5d^6D_{3/2}$—$6p_{3/2}(6,3/2)^o$ λ = 3078.7 Å	5000.	0.164	0.192
	10,000.	0.116	0.385
	20,000.	0.0819	0.769
	40,000.	0.0579	1.54
	80,000.	0.0409	3.08
Tb III $5d^6P_{7/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3680.2 Å	5000.	0.207	0.215
	10,000.	0.147	0.431
	20,000.	0.104	0.861
	40,000.	0.0734	1.72
	80,000.	0.0519	3.45
Tb III $5d^6P_{7/2}$—$6p_{3/2}(6,3/2)^o$ λ = 3084.2 Å	5000.	0.164	0.193
	10,000.	0.116	0.385
	20,000.	0.0822	0.771
	40,000.	0.0581	1.54
	80,000.	0.0411	3.08
Tb III $5d^6P_{5/2}$—$6p_{1/2}(6,1/2)^o$ λ = 3918.3 Å	5000.	0.238	0.215
	10,000.	0.168	0.431
	20,000.	0.119	0.861
	40,000.	0.0842	1.72
	80,000.	0.0595	3.45

Table 1. *Continued.*

Transition	T[K]	W[Å]	3kT/2ΔE
Tb III $5d^6P_{5/2}$—$6p_{3/2}(6,3/2)^o$ λ = 3249.6 Å	5000.	0.184	0.205
	10,000.	0.130	0.410
	20,000.	0.0922	0.821
	40,000.	0.0652	1.64
	80,000.	0.0461	3.28
Tb III $5d^6P_{3/2}$—$6p_{1/2}(6,1/2)^o$ λ = 4130.8 Å	5000.	0.267	0.216
	10,000.	0.189	0.433
	20,000.	0.134	0.866
	40,000.	0.0945	1.73
	80,000.	0.0668	3.46
Tb III $5d^6P_{3/2}$—$6p_{3/2}(6,3/2)^o$ λ = 3394.5 Å	5000.	0.203	0.216
	10,000.	0.144	0.433
	20,000.	0.102	0.866
	40,000.	0.0718	1.73
	80,000.	0.0508	3.46

In Table 2 Stark FWHM is expressed both in Ångströms and in angular frequency units for a temperature of 10,000 K and electron density of 10^{17} cm^{-3}. We can see that when expressed in Ångströms, the maximal values of Stark widths within the considered supermultiplet are 150% larger than the minimal ones; in angular frequency units this difference is 23%. We note that this difference is within the uncertainty limits predicted in [18]. If we look at transitions with terms $(6,1/2)^o$, the highest value of W is 7.52% greater than the lowest one, and for transitions including the terms $(6,3/2)^o$, this difference is 7.55%. This could help to predict missing values on the basis of such regularities.

Table 2. Electron-impact (Stark) full widths at half intensity maximum (W) for the Tb III $5d^8L$—$6p_j(6,j)^o$, supermultiplet, for a perturber density of 10^{17} cm^{-3} and a temperature of 10,000 K, in [Å] and in [10^{12} s^{-1}].

Transition	λ [Å]	W [Å]	W [10^{12} s^{-1}]
Tb III $5d^8G$—$6p_{1/2}(6,1/2)^o$	2369.9	0.0554	0.186
Tb III $5d^8G$—$6p_{3/2}(6,3/2)^o$	2107.6	0.0500	0.212
Tb III $5d^8D$—$6p_{1/2}(6,1/2)^o$	2498.1	0.0623	0.188
Tb III $5d^8D$—$6p_{3/2}(6,3/2)^o$	2208.4	0.0555	0.214
Tb III $5d^8F$—$6p_{1/2}(6,1/2)^o$	2668.7	0.0722	0.191
Tb III $5d^8F$—$6p_{3/2}(6,3/2)^o$	2340.7	0.0631	0.217
Tb III $5d^8H$—$6p_{1/2}(6,1/2)^o$	2783.6	0.0792	0.193
Tb III $5d^8F$—$6p_{3/2}(6,3/2)^o$	2428.6	0.0685	0.219
Tb III $5d^8P9/2$—$6p_{1/2}(6,1/2)^o$	2994.7	0.0931	0.196
Tb III $5d^8P9/2$—$6p_{3/2}(6,3/2)^o$	2587.8	0.0788	0.222
Tb III $5d^8P7/2$—$6p_{1/2}(6,1/2)^o$	3240.6	0.111	0.199
Tb III $5d^8P7/2$—$6p_{3/2}(6,3/2)^o$	2769.4	0.0916	0.225
Tb III $5d^8P5/2$—$6p_{1/2}(6,1/2)^o$	3427.8	0.125	0.200
Tb III $5d^8P5/2$—$6p_{3/2}(6,3/2)^o$	2904.9	0.102	0.228

5. Conclusions

Here, dataset of Stark widths for Tb II, Tb III and Tb IV lines is presented. From the previously Stark widths for 62 transitions in the spectrum of Tb III have been calculated by using SMSE method [15] and added to to the previously calculated [13,14] dataset. The obtained data have been used to check similarities within the Tb III $5d^8L$—$6p_j(6,j)^o$ supermultiplet. It was confirmed that such similarities could be used for rough estimates of the missing values. It is not possible to compare the data obtained here with other results, since experimental or theoretical data for Stark broadening of Tb III lines do not exist. The dataset presented here may be of interest for stellar physics, especially for the consideration of spectral lines of rare earth elements and the determination of their abundances in atmospheres of white dwarfs and stars of A spectral type, especially the chemically peculiar ones. Of course, these data may be of interest for laboratory plasma diagnostics and for investigations of laser produced plasma and lasers. A detailed analysis of the usage of published Stark broadening data was published in [19,20].

Supplementary Materials: The following data are available online at https://www.mdpi.com/2306-5729/6/3/28/s1. Table S1: Stark full widths at half intensity maximum due to collisions with electrons for Tb II, Tb III and Tb IV spectral lines for electron density of 10^{17} cm^{-3} and temperatures from 5000 to 80,000 K.

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