E1 transitions in Ni II

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Abstract. We have undertaken an extensive CI calculation of E1 transitions between all levels of the $3d^9$, $3d^84s$, $3d^74s^2$ and $3d^84p$, $3d^74s4p$ configurations of Ni II. Many of these lines are observed in a variety of astronomical objects, and so atomic data is needed, with a good level of accuracy, for the analysis of the observational data. To date, only a limited number of extensive calculations have been undertaken for this ion [1,2] while experimental [3,4,5] or observationally derived [6,7] atomic data are limited to an even smaller selection of lines.

In this work, we have used the general CI code CIV3 [8] in which relativistic effects are incorporated using the Breit-Pauli approximation. In addition, *ab initio* results are enhanced by our fine-tuning process which seeks to bring the calculated energy levels into line with experimental levels.

For many of the lines studied, our results are in good agreement with those of [1,2]. But it is not always so. This is illustrated below for oscillator strengths (length form) of a very small selection of 4s – 4p lines, with a common lower level.

Transition	Oscillator strengths		
	This work	[1]	[2]
$3d^8(^3P)4s\ ^2P^o_{0.5} - 3d^8(^3P)4p\ ^2P^o_{1.5}$	0.0870	0.2264	0.2511
$3d^8(^3P)4s\ ^2P^o_{0.5} - 3d^8(^1D)4p\ ^2P^o_{1.5}$	0.0602	0.0321	0.0271
$3d^8(^3P)4s\ ^2P^o_{0.5} - 3d^8(^3P)4p\ ^2D^o_{1.5}$	0.3904	0.3062	0.3008
$3d^8(^3P)4s\ ^2P^o_{0.5} - 3d^8(^3P)4p\ ^4S^o_{1.5}$	0.0098	0.0035	0.0002
Total	0.5474	0.5682	0.5782

so, although the total of the four f-values is almost the same, there is a significant variation in the distribution of the oscillator strength, due to different CI mixings in the upper levels. For example, for the $3d^8(^3P)4p\ ^2P^o_{1.5}$ level, the main percentage compositions are

Our work	$45\%(3d^8(^3P)4p\ ^2P^o_{1.5}) + 29\%(3d^8(^1D)4p\ ^2P^o_{1.5}) + 14\%(3d^8(^3P)4p\ ^4S^o_{1.5})$
Kurucz	$69\%(3d^8(^3P)4p\ ^2P^o_{1.5}) + 15\%(3d^8(^1D)4p\ ^2P^o_{1.5}) + 9\%(3d^8(^3P)4p\ ^2D^o_{1.5})$

Further results and discussion will be presented at the conference.

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