Abstract. A new set of radiative and electron collisional data for Fe XII was presented in two earlier papers. In the present work, we derive level populations and theoretical line intensities for a range of plasma densities and temperatures. Observations of Fe XII lines obtained with the *Solar EUV Rocket Telescope and Spectrograph* are analysed both as a check on the quality of the new atomic data and to determine the electron density in active regions and the quiet Sun. The discrepancy between the electron density values determined from Fe XII line intensity ratios and those obtained from other ions is investigated.

Key words: Sun – atomic data – UV spectrum – plasma diagnostics

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A comparison between theoretical and solar Fe XII UV line intensity ratios

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Transition ($3s\,3p^4 \rightarrow 3s^2\,3p^3$)	Wavelengths (Å)	A (sec^{-1})
$^4P_{5/2} - {}^4S^o_{3/2}$	364.47	1.589 (9)
$^4P_{3/2} - {}^4S^o_{3/2}$	352.11	1.728 (9)
$^4P_{1/2} - {}^4S^o_{3/2}$	346.85	1.814 (9)
$^2D_{3/2} - {}^4S^o_{3/2}$	294.33	3.834 (6)
$^2D_{5/2} - {}^4S^o_{3/2}$	292.65	7.599 (6)
$^2P_{3/2} - {}^4S^o_{3/2}$	256.63	4.124 (7)
$^2P_{1/2} - {}^4S^o_{3/2}$	253.58	3.877 (7)
$^2S_{1/2} - {}^4S^o_{3/2}$	243.66	7.977 (7)
$^4P_{5/2} - {}^2D^o_{3/2}$	429.52	1.156 (7)
$^4P_{3/2} - {}^2D^o_{3/2}$	412.46	8.332 (5)
$^4P_{1/2} - {}^2D^o_{3/2}$	405.27	4.818 (6)
$^2D_{3/2} - {}^2D^o_{3/2}$	335.34	3.330 (9)
$^2D_{5/2} - {}^2D^o_{3/2}$	333.17	3.260 (7)
$^2P_{3/2} - {}^2D^o_{3/2}$	287.26	8.917 (8)
$^2P_{1/2} - {}^2D^o_{3/2}$	283.45	7.272 (9)
$^2S_{1/2} - {}^2D^o_{3/2}$	271.12	2.948 (8)
$^4P_{5/2} - {}^2D^o_{5/2}$	430.05	2.132 (7)
$^4P_{3/2} - {}^2D^o_{5/2}$	420.32	3.916 (6)
$^2D_{3/2} - {}^2D^o_{5/2}$	340.51	4.769 (7)
$^2D_{5/2} - {}^2D^o_{5/2}$	338.28	2.759 (9)
$^2P_{3/2} - {}^2D^o_{5/2}$	291.05	7.561 (9)
$^4P_{3/2} - {}^2P^o_{1/2}$	476.42	1.124 (5)
$^4P_{1/2} - {}^2P^o_{1/2}$	466.86	8.777 (6)
$^2D_{3/2} - {}^2P^o_{1/2}$	376.43	2.838 (8)
$^2P_{3/2} - {}^2P^o_{1/2}$	316.90	3.686 (8)
$^2P_{1/2} - {}^2P^o_{1/2}$	312.26	3.231 (9)
$^2S_{1/2} - {}^2P^o_{1/2}$	297.36	1.001 (9)
$^4P_{5/2} - {}^2P^o_{3/2}$	515.84	2.094 (6)
$^4P_{3/2} - {}^2P^o_{3/2}$	491.43	9.149 (6)
$^4P_{1/2} - {}^2P^o_{3/2}$	481.25	1.382 (6)
$^2D_{3/2} - {}^2P^o_{3/2}$	385.73	1.241 (7)
$^2D_{5/2} - {}^2P^o_{3/2}$	382.87	5.535 (8)
$^2P_{3/2} - {}^2P^o_{3/2}$	323.46	6.773 (8)
$^2P_{1/2} - {}^2P^o_{3/2}$	318.64	1.231 (7)
$^2S_{1/2} - {}^2P^o_{3/2}$	303.14	7.252 (9)

Table 2. Spontaneous transition probabilities for all electric dipole fine structure transitions between the ground $3s^2\,3p^3$ and the first excited $3s\,3p^4$ configurations in Fe XII. Numbers in parenthesis are powers of 10. Wavelengths are taken from CHIANTI (Dere et al. 1997, Landi et al. 1999).

Transition ($3s^2\,3p^2\,3d \rightarrow 3s^2\,3p^3$)	Wavelength (Å)	A (s^{-1})	Transition ($3s^2\,3p^2\,3d \rightarrow 3s^2\,3p^3$)	Wavelength (Å)	A (s^{-1})
$(^3P)\,^4F_{3/2} - {}^4S^o_{3/2}$	*237.95*	1.399 (7)	$(^1D)\,^2F_{7/2} - {}^2D^o_{5/2}{}^a$	*244.02*	7.315 (3)
$(^3P)\,^4F_{5/2} - {}^4S^o_{3/2}$	*235.84*	2.717 (7)	$(^1D)\,^2G_{7/2} - {}^2D^o_{5/2}$	*224.31*	2.212 (8)
$(^1D)\,^2F_{5/2} - {}^4S^o_{3/2}$	*228.73*	1.016 (8)	$(^3P)\,^2P_{3/2} - {}^2D^o_{5/2}$	*219.44*	4.540 (10)
$(^3P)\,^4D_{1/2} - {}^4S^o_{3/2}$	*227.11*	6.299 (7)	$(^3P)\,^4P_{5/2} - {}^2D^o_{5/2}$	214.40	1.292 (9)
$(^3P)\,^4D_{3/2} - {}^4S^o_{3/2}$	*226.55*	2.581 (8)	$(^3P)\,^4P_{3/2} - {}^2D^o_{5/2}$	212.47	2.829 (8)
$(^3P)\,^4D_{5/2} - {}^4S^o_{3/2}$	*224.19*	2.767 (8)	$(^1S)\,^2D_{3/2} - {}^2D^o_{5/2}$	208.32	6.089 (9)
$(^3P)\,^2P_{3/2} - {}^4S^o_{3/2}$	199.28	2.406 (8)	$(^1S)\,^2D_{5/2} - {}^2D^o_{5/2}$	203.27	3.080 (10)
$(^3P)\,^4P_{5/2} - {}^4S^o_{3/2}$	195.12	8.638 (10)	$(^1D)\,^2D_{3/2} - {}^2D^o_{5/2}$	196.87	9.306 (9)
$(^3P)\,^2P_{1/2} - {}^4S^o_{3/2}$	194.61	5.086 (9)	$(^1D)\,^2D_{5/2} - {}^2D^o_{5/2}$	196.65	4.070 (10)
$(^3P)\,^4P_{3/2} - {}^4S^o_{3/2}$	193.52	8.901 (10)	$(^3P)\,^2F_{5/2} - {}^2D^o_{5/2}$	188.45	5.721 (9)
$(^3P)\,^4P_{1/2} - {}^4S^o_{3/2}$	192.39	8.807 (10)	$(^1D)\,^2P_{3/2} - {}^2D^o_{5/2}$	188.09	5.617 (8)
$(^1S)\,^2D_{3/2} - {}^4S^o_{3/2}$	190.07	2.955 (9)	$(^3P)\,^2F_{7/2} - {}^2D^o_{5/2}$	186.88	1.067 (11)
$(^1S)\,^2D_{5/2} - {}^4S^o_{3/2}$	185.86	2.563 (9)	$(^3P)\,^2D_{5/2} - {}^2D^o_{5/2}$	179.26	4.552 (9)
$(^1D)\,^2D_{3/2} - {}^4S^o_{3/2}$	180.50	2.536 (5)	$(^3P)\,^2D_{3/2} - {}^2D^o_{5/2}$	178.77	2.169 (8)
$(^1D)\,^2D_{5/2} - {}^4S^o_{3/2}$	180.31	6.934 (7)	$(^3P)\,^4F_{3/2} - {}^2P^o_{1/2}$	*288.89*	1.585 (7)
$(^1D)\,^2P_{1/2} - {}^4S^o_{3/2}$	175.77	4.606 (7)	$(^3P)\,^4D_{1/2} - {}^2P^o_{1/2}$	*273.07*	3.259 (7)
$(^3P)\,^2F_{5/2} - {}^4S^o_{3/2}$	193.39	3.300 (8)	$(^3P)\,^4D_{3/2} - {}^2P^o_{1/2}$	*272.35*	6.624 (6)
$(^1D)\,^2P_{3/2} - {}^4S^o_{3/2}$	173.09	5.912 (7)	$(^3P)\,^2P_{3/2} - {}^2P^o_{1/2}$	233.81	1.419 (9)
$(^1D)\,^2S_{1/2} - {}^4S^o_{3/2}$	172.52	1.074 (5)	$(^3P)\,^2P_{1/2} - {}^2P^o_{1/2}$	227.41	8.293 (9)
$(^3P)\,^2D_{5/2} - {}^4S^o_{3/2}$	165.58	3.866 (8)	$(^3P)\,^4P_{3/2} - {}^2P^o_{1/2}$	225.92	6.352 (6)
$(^3P)\,^2D_{3/2} - {}^4S^o_{3/2}$	165.12	7.179 (7)	$(^3P)\,^4P_{1/2} - {}^2P^o_{1/2}$	224.39	4.868 (8)
$(^3P)\,^4F_{3/2} - {}^2D^o_{3/2}$	*264.06*	1.417 (8)	$(^1S)\,^2D_{3/2} - {}^2P^o_{1/2}$	221.23	1.003 (8)
$(^3P)\,^4F_{5/2} - {}^2D^o_{3/2}$	*261.45*	1.641 (7)	$(^1D)\,^2D_{3/2} - {}^2P^o_{1/2}$	208.37	6.636 (9)
$(^1D)\,^2F_{5/2} - {}^2D^o_{3/2}$	*252.76*	8.246 (5)	$(^1D)\,^2P_{1/2} - {}^2P^o_{1/2}$	202.09	6.422 (10)
$(^3P)\,^4D_{1/2} - {}^2D^o_{3/2}$	*250.78*	3.738 (8)	$(^1D)\,^2P_{3/2} - {}^2P^o_{1/2}$	198.56	1.850 (10)
$(^3P)\,^4D_{3/2} - {}^2D^o_{3/2}$	*250.09*	6.449 (5)	$(^1D)\,^2S_{1/2} - {}^2P^o_{1/2}$	197.82	5.149 (8)
$(^3P)\,^4D_{5/2} - {}^2D^o_{3/2}$	*247.22*	2.377 (6)	$(^3P)\,^2D_{3/2} - {}^2P^o_{1/2}$	188.19	7.028 (10)
$(^3P)\,^2P_{3/2} - {}^2D^o_{3/2}$	217.28	1.855 (10)	$(^3P)\,^4F_{3/2} - {}^2P^o_{3/2}$	*294.34*	1.055 (6)
$(^3P)\,^4P_{5/2} - {}^2D^o_{3/2}$	212.34	3.433 (8)	$(^3P)\,^4F_{5/2} - {}^2P^o_{3/2}$	*291.12*	9.382 (6)
$(^3P)\,^2P_{1/2} - {}^2D^o_{3/2}$	211.73	4.323 (10)	$(^1D)\,^2F_{5/2} - {}^2P^o_{3/2}$	*280.36*	5.128 (6)
$(^3P)\,^4P_{3/2} - {}^2D^o_{3/2}$	210.44	2.251 (8)	$(^3P)\,^4D_{1/2} - {}^2P^o_{3/2}$	*277.93*	1.379 (8)
$(^3P)\,^4P_{1/2} - {}^2D^o_{3/2}$	209.11	4.060 (9)	$(^3P)\,^4D_{3/2} - {}^2P^o_{3/2}$	*277.09*	2.499 (7)
$(^1S)\,^2D_{3/2} - {}^2D^o_{3/2}$	206.37	9.166 (9)	$(^3P)\,^4D_{5/2} - {}^2P^o_{3/2}$	*273.57*	2.479 (6)
$(^1S)\,^2D_{5/2} - {}^2D^o_{3/2}$	201.42	7.277 (8)	$(^3P)\,^2P_{3/2} - {}^2P^o_{3/2}$	237.37	4.585 (9)
$(^1D)\,^2D_{3/2} - {}^2D^o_{3/2}$	195.13	5.712 (10)	$(^3P)\,^4P_{5/2} - {}^2P^o_{3/2}$	231.48	2.026 (6)
$(^1D)\,^2D_{5/2} - {}^2D^o_{3/2}$	194.91	2.271 (9)	$(^3P)\,^2P_{1/2} - {}^2P^o_{3/2}$	230.77	1.422 (10)
$(^1D)\,^2P_{1/2} - {}^2D^o_{3/2}$	189.62	2.064 (9)	$(^3P)\,^4P_{3/2} - {}^2P^o_{3/2}$	229.24	1.397 (8)
$(^3P)\,^2F_{5/2} - {}^2D^o_{3/2}$	186.85	1.002 (11)	$(^3P)\,^4P_{1/2} - {}^2P^o_{3/2}$	227.66	5.717 (8)
$(^1D)\,^2P_{3/2} - {}^2D^o_{3/2}$	186.50	1.423 (9)	$(^1S)\,^2D_{3/2} - {}^2P^o_{3/2}$	224.41	2.939 (8)
$(^1D)\,^2S_{1/2} - {}^2D^o_{3/2}$	185.85	8.178 (9)	$(^1S)\,^2D_{5/2} - {}^2P^o_{3/2}$	218.57	2.978 (9)
$(^3P)\,^2D_{5/2} - {}^2D^o_{3/2}$	177.82	7.159 (7)	$(^1D)\,^2D_{3/2} - {}^2P^o_{3/2}$	211.19	2.913 (8)
$(^3P)\,^2D_{3/2} - {}^2D^o_{3/2}$	177.33	2.814 (8)	$(^1D)\,^2D_{5/2} - {}^2P^o_{3/2}$	210.93	4.270 (9)
$(^3P)\,^4F_{3/2} - {}^2D^o_{5/2}$	*267.26*	1.532 (6)	$(^1D)\,^2P_{1/2} - {}^2P^o_{3/2}$	204.74	5.724 (8)
$(^3P)\,^4F_{5/2} - {}^2D^o_{5/2}$	*264.60*	4.171 (7)	$(^3P)\,^2F_{5/2} - {}^2P^o_{3/2}$	*201.52*	2.252 (8)
$(^3P)\,^4F_{7/2} - {}^2D^o_{5/2}$	*260.80*	2.091 (7)	$(^1D)\,^2P_{3/2} - {}^2P^o_{3/2}$	201.12	4.989 (10)
$(^1D)\,^2F_{5/2} - {}^2D^o_{5/2}{}^a$	*255.69*	4.992 (3)	$(^1D)\,^2S_{1/2} - {}^2P^o_{3/2}$	200.36	6.209 (10)
$(^3P)\,^4D_{7/2} - {}^2D^o_{5/2}$	*253.26*	2.886 (7)	$(^3P)\,^2D_{5/2} - {}^2P^o_{3/2}$	191.05	9.023 (10)
$(^3P)\,^4D_{3/2} - {}^2D^o_{5/2}$	*252.96*	3.048 (8)	$(^3P)\,^2D_{3/2} - {}^2P^o_{3/2}$	190.49	2.220 (10)
$(^3P)\,^4D_{5/2} - {}^2D^o_{5/2}$	*250.02*	8.309 (7)			

Table 3. Spontaneous transition probabilities for all electric dipole fine structure transitions between the ground $3s^2\,3p^3$ and the second excited $3s^2\,3p^2\,3d$ configurations in Fe XII. the numbers in parenthesis in the column of A values are powers of 10. For ^{a} see text. Wavelengths are taken from the CHIANTI database (Dere et al. (1997), Landi et al. (1999)). Wavelengths in italics are calculated from theoretical energy levels, as no experimental energy is available.

Transition	Wavelength (Å)	Transition type	A (sec^{-1})
$^2D^o_{3/2} - {}^4S^o_{3/2}$	2406.45	M1	4.419 (1)
$^2D^o_{5/2} - {}^4S^o_{3/2}$	2169.76	M1	1.826 (0)
$^2P^o_{1/2} - {}^4S^o_{3/2}$	1349.38	M1	1.665 (2)
$^2P^o_{3/2} - {}^4S^o_{3/2}$	1242.01	M1	3.214 (2)
$^2D^o_{5/2} - {}^2D^o_{3/2}$	22060.45	M1	8.945 (-1)
$^2P^o_{1/2} - {}^2D^o_{3/2}$	3071.91	M1	6.427 (1)
$^2P^o_{3/2} - {}^2D^o_{3/2}$	2566.74	M1	1.799 (2)
$^2P^o_{1/2} - {}^2D^o_{5/2}$	3568.88	E2	2.971 (-1)
$^2P^o_{3/2} - {}^2D^o_{5/2}$	2904.70	M1	7.277 (1)
$^2P^o_{3/2} - {}^2P^o_{1/2}$	15607.93	M1	2.069 (0)

Table 4. Spontaneous transition probabilities for the 10 optically forbidden fine structure transitions within the ground $3s^2\,3p^3$ configuration of Fe XII. Numbers in parenthesis are powers of 10. The wavelengths are from CHIANTI.

Transition	A (sec^{-1})
$3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2} - 3s^2\,3p^3\ ^2D^o_{5/2}$	2.759(1)
$3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2} - 3s\,3p^4\ ^4P_{5/2}$	4.451(1)
$3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2} - 3s\,3p^4\ ^2D_{5/2}$	1.422(-1)
$3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4F_{5/2}$	5.068(-5)
$3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4F_{7/2}$	8.168(0)
$3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2}$	5.916(-15)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^3\ ^2D^o_{5/2}$	2.178(1)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s\,3p^4\ ^4P_{5/2}$	7.614(0)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s\,3p^4\ ^2D_{5/2}$	1.494(1)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4F_{5/2}$	8.834(-2)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4F_{7/2}$	6.249(1)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4F_{9/2}$	1.188(2)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^1D)\,^2F_{5/2}$	1.266(-5)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4D_{7/2}$	4.459(0)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^3P)\,^4D_{5/2}$	3.454(-4)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^1D)\,^2F_{7/2}$	9.599(0)
$3s^2\,3p^2\,3d\,(^1D)\,^2G_{9/2} - 3s^2\,3p^2\,3d\,(^1D)\,^2G_{7/2}$	2.783(-1)

Table 5. Spontaneous transition probabilities from the metastable levels in $3s^2\,3p^2\,3d$ of Fe XII. Numbers in parenthesis are powers of 10.