CLASSIFICATION OF NEW SPECTRAL LINES OF Fe XVII OBSERVED IN SOLAR ACTIVE REGIONS

R. J. HUTCHEON

Dept. of Physics, University of Leicester, England

Summary. This summary reports new emission lines of Fe XVII observed in two coronal active regions (McMath regions 12624, 12628). The lines were recorded by a Bragg plane crystal spectrometer collimated to 3′ FWHM, with a gypsum crystal scanning the wavelength range 8–14 Å. This spectrometer, part of a three spectrometer package previously used by Parkinson (1972, 1973), was mounted aboard a Skylark rocket (SL 1206) launched from Woomera at 0535 UT on 26th November 1973. One of the active regions studied (12624) was observed about 60 minutes after the peak of an importance $-N$ class CO flare.

TABLE I

Measured and predicted wavelengths for newly identified Fe XVII transitions

Classification		Wavelength	
Pair coupling notation	LS coupling notation (upper level)	Predicted	Observed
$2s^2\,2p^6\,{}^1S_0 - 2s^2 2p^5(^2P_{3/2})\,4s[3/2]_2$	$2p^5 4s\ {}^3P_2$	12.696	12.698
$2p^5(^2P_{3/2})\,5s[3/2]_2$	$2p^5 5s\ {}^3P_2$	11.422 ⎫	11.419 B
$2p^5(^2P_{3/2})\,5s[3/2]_1$	$2p^5 5s\ {}^3P_1$	11.415 ⎭	
$2p^5(^2P_{1/2})\,5s[1/2]_1$	$2p^5 5s\ {}^1P_1$	11.282	11.285 B
$2p^5(^2P_{3/2})\,7s[3/2]_2$	$2p^5 7s\ {}^3P_2$	10.545 ⎫	10.544
$2p^5(^2P_{3/2})\,7s[1/2]_1$	$2p^5 7s\ {}^3P_1$	10.543 ⎭	
$2p^5(^2P_{1/2})\,7s[1/2]_1$	$2p^5 7s\ {}^1P_1$	10.429	10.431
$2p^5(^2P_{1/2})\,7d[3/2]_1$	$2p^5 7d\ {}^1P_1$	10.382	10.385
$2p^5(^2P_{1/2})\,8d[3/2]_1$	$2p^5 8d\ {}^1P_1$	10.217	10.217

B: Blend (see text)

The new lines are listed in Table I with their measured and predicted wavelengths. The proposed classifications are given in the pair coupling notation as this is the most appropriate. (The statement by Kastner *et al.* (1967) that the LS coupling scheme best describes the $2p^5 3d$ terms in Fe XVII does not apply to the other $2p^5$ ns, nd terms). However since the LS designations of many Fe XVII terms appear in the literature, the corresponding LS classifications are also given to aid reference.

Each wavelength was measured twice, once in each active region, except the 10.431 Å and 10.544 Å lines which were only observed in the decaying flare region. The measured wavelengths given for the other lines are the average of two values which generally differed by less than 0.005 Å. The final uncertainty is probably within 0.003 Å.

Sharad R. Kane (ed.), Solar Gamma-, X-, and EUV Radiation, 69–70. *All Rights Reserved. Copyright © 1975 by the IAU.*

https://doi.org/10.1017/S0074180900071564 Published online by Cambridge University Press

The predicted wavelengths were extrapolated from previously known Fe XVII terms (Swartz *et al.*, 1971; Tyren, 1938) by Ritz's Law (Edlen, 1964). To satisfy one requirement of this procedure the base and predicted terms were limited to those described by the same vector coupling scheme (pair coupling). The predicted wavelengths should be accurate to within 0.005 Å, the main source of uncertainty being that in the base wavelengths, and therefore agree satisfactorily with experiment. These identifications are supported further by the smooth decrease of intensities towards the series limit.

The 11.285 Å and 11.419 Å features coincide in wavelength with laboratory lines classified as Fe XVIII $2p^5$–$2p^4 4d$ transitions by Swartz *et al.* (1971). The intensities of other Fe XVII and Fe XVIII lines observed in our results suggest that these features are blends with significant contributions from the Fe XVIII transitions mentioned above and the Fe XVII transitions shown in Table I. The lines between 10.2 Å and 10.6 Å may possibly be blended with currently unknown Fe XVIII $2p^5$–$2p^4 5d$ transitions which are expected to lie in this region. It is intended to discuss this further in a future publication.

The lines at 10.217 Å and 11.419 Å in our scans may account for lines at 10.23 Å and 11.41 Å reported, but not identified, by Neupert *et al.* (1973). However, their 10.23 Å feature may also be due to Ne X Lβ (at 10.239 Å). These authors also report a line at 10.86 Å. This may be due to the Fe XVII transition $2p^6\,{}^1S_0$–$2p^5\,({}^2P_{3/2})\,6s[\frac{1}{2}]_1$, for which we predict the wavelength 10.849 Å.

References

Edlen, B.: 1964, 'Atomic Spectra', in *Handbuch der Physik* **27**, Ed. by S. Flügge, Springer-Verlag, Berlin, p. 80.

Kastner, S. O., Omidvar, K., and Underwood, J. H.: 1967, *Astrophys. J.* **148**, 269.

Neupert, W. M., Swartz, M., and Kastner, S. O.: 1973, *Solar Phys.* **31**, 171.

Parkinson, J. H.: 1972, *Nature (Phys. Sci.)* **236**, 68.

Parkinson, J. H.: 1973, *Astron. Astrophys.* **24**, 215.

Swartz, M., Kastner, S. O., Rothe, E., and Neupert, W. M.: 1971, *J. Phys. B.* **4**, 1747.

Tyren, F.: 1938, *Z. Phys.* **111**, 314.

https://doi.org/10.1017/S0074180900071564 Published online by Cambridge University Press