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The M Absorption Limits of the Tungsten X-Ray Spectrum

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The method is simple, rapid and accurate. The controlling field is uniform over a large space so that an exceedingly small magnet is not needed and its adjustment in position is not critical. No deflections have to be measured.

The effect of torsion in the suspending system and damping is discussed.

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THE M ABSORPTION LIMITS OF THE TUNGSTEN X-RAY SPECTRUM

R. V. ZUMSTEIN

(*ABSTRACT*)

The x-ray spectrum of tungsten has been investigated from 7 to 3 Angstrom Units, using a metal x-ray tube and a vacuum spectrometer.

The voltage on the tube was about three thousand volts and the power input about one kilowatt. The tube did not exhibit any space charge effects. It is thought that this was due to the presence of mercury vapor from the diffusion pump. A serious disadvantage of the mercury vapor was that the tungsten filaments sputtered readily. A 25 mil tungsten filament had to be replaced about every twenty hours. An important benefit from this sputtering was that the water-cooled copper target soon became coated with a thin layer of tungsten. This was of value in obtaining the tungsten emission spectrum. Due to the high atomic weight of tungsten it was an ideal source of continuous radiation for absorption spectra. It was necessary to remove water vapor from the x-ray tube with phosphorus pentoxide.

The x-ray was separated from the spectrometer by a thin collodion window which contained just enough lamp black to keep the light from the filament from fogging the photographic plate in the spectrometer. To obtain the absorption spectrum of tungsten in this region, an additional collodion window was used which contained a small quantity of the yellow oxide of tungsten, finely powdered.

The exposures were about 6 hours for remission spectra and 100 hours for absorption spectra.

In the emission spectrum of tungsten the strong lines α , β and γ were found to have a fine structure as noted by Hjalmar.¹ The

¹ Zeit. für Physik 15, p. 65, 1923.

most recent theories of x-ray spectra predict about 20 lines in this region.² It is very interesting to note the great intensity of these three lines and the entire absence of the other predicted lines. On several plates two faint lines were observed. They seem to be due to tungsten.

Five absorption lines were observed. The first and second absorption lines M_1 and M_2 are considerably shifted from their predicted positions. M_3 , M_4 and M_5 are as predicted. M_3 shows a distant component which has not been anticipated from theory. M_5 is so faint that it is hardly visible. The wave lengths of the complete M series of tungsten, as known at present, follow:

EMISSION SPECTRUM IN A° U.		ABSORPTION SPECTRUM IN A° U.	
α	6.973	M_1	6.708
α'	6.948	M_2	6.475
	6.857	M_3	5.418
α	6.789	M'_3	5.380
β	6.745	M_4	4.800
β'	6.720	M^5	4.365
γ	6.085		
γ'	6.066		

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² Bohr and Coster. Zeit. für Physik 12, p. 342, 1922.