37. *Reversal of Neon Lines.*

By Hantaro NAGAOKA, M.I.A. and Tadao MISHIMA.

Institute of Physical and Chemical Research.

(Rec. Feb. 10, 1927. Comm. March 12, 1927.)

The present study of the reversal of neon lines was begun with the object of finding inverse Zeeman effect. The visibility of the lines was examined by Perard¹⁾ from the metrological standpoint, while a more careful study of the reversal with interferometer was made by Buisson²⁾ and Jausseran. K. W. Meissner³⁾ also measured the absorption of neon lines, presumably connected with the reversals.

Buisson and Jausseran used a tube of 10 mm diam. and 50 cm length, and the air plate of the interferometer was 30 mm thick. We used an H-shaped tube, the legs being of 15 mm diam. and the capillary tube connecting them of 0.3 inner diam. and 4 cm length. For studying the reversals, echelon spectroscope (number of plates 35; thickness 9.35 mm; step 1 mm; resolving power 435000 for $\lambda = 0.5 \mu$) and Lummer-Gehrcke plate (thickness 9.985 mm; length 20 cm; resolving power 400000 for $\lambda = 0.5 \mu$) were used. The reversal of individual lines was studied with the echelon, by focussing the end of the capillary tube, which was placed horizontally, on the slit of the spectroscope. Fig. 1 shows the enlarged photograms of 6402 and 6507, which were taken in few sec., with the reversed portion in the middle. There is a small difference when the side part of the end of the capillary is focussed from that of the diametral portion. The tube was excited either by a transformer of 20 kilv or by an induction coil, without showing marked difference. For examining the red and the yellow portion of the spectrum simultaneously the echelon was placed horizontal; Fig. 2 shows a photogram so taken in 5 sec. Of course different exposures are necessary, as the intensities of the lines are various. The lines are sharply defined when observed with the echelon spectroscope, and reversals difficult to see with Fabry-Perot interferometer can be ascertained.

The light to be examined was also focussed to a slit of a collimator

1) Perard: C. R. 176 (1923) 375.

2) Buisson a. Jausseran: 180 (1925) 505

3) Meissner: Ann. Phys. 76 (1925) 124; Phys. Zeit. 26 (1925) 687.

adjusted to infinity, and received on the L.G. plate placed horizontally ; it then passed through a constant deviation prism. The interference so obtained can be observed with an eye or photographed. Fig. 3 shows a photogram obtained with light coming from the legs of the neon tube placed in the direction of the collimator, and excited by interposing a small leiden-jar in the transformer circuit, in which a short spark gap was introduced. By this mode of excitement, the capillary is almost dark, while the wide part of the tube (50 times wider than the capillary) shines with bright yellowish light. The pressure of neon in the tube was about 10 mm. That there is no difference in the reversal with the mode of excitation nor with the width of the tube can be seen from the measurement of the intervals between the reversed lines, the echelon referring to the capillary and the L.G. plate to the wide tube. Obviously the electric field is much greater in the former than in the latter. The coincidence is remarkably good for such measurements except for the line 6266. It is to be remarked that 5401 is singularly free from reversal, which can hardly be observed with the optical appliances at our disposal. The light issuing laterally from the tube does not show any appreciable reversal except 6402, as already remarked by different experimenters.

Series Relation (Pa schen)	λ	$\delta\lambda$		Absorption (Meissner)	Zeeman- comp.
		Echelon	L.G. Plate		
$1s_2-2p_1$	5852	43 mA	—	4	3
$1s_3-2p_2$	5882	32 „	32 mA	43	9
$1s_3-2p_4$	5945	35 „	38 „	56	12
$1s_4-2p_3$	6074	37 „	37 „	7	3
$1s_4-2p_4$	6096	47 „	45 „	6	9
$1s_5-2p_6$	6143	53 „	53 „	62	12
$1s_3-2p_2$	6164	27 „	27 „	38	3
$1s_3-2p_3$	6266	44 „	35 „	49	3
$1s_5-2p_8$	6334	44 „	45 „	56	12
$1s_4-2p_7$	6381	52 „	49 „	4	6
$1s_5-2p_9$	6402	68 „	72 „	74	15
$1s_4-2p_8$	6507	63 „	55 „	8	9
$1s_3-2p_7$	6532	34 „	—	40	3
$1s_2-2p_2$	6599	57 „	—	5	6
$1s_2-2p_4$	6678	55 „	—	5	9
$1s_2-2p_3$	6717	44 „	—	3	3
$1s_2-2p_6$	6930	55 „	—	3	9
$1s_5-2p_{10}$	7032	52 „	—	56	9

The reversals are slightly asymmetric. For the sake of comparison of δ_λ with absorption, Meissner's determination is given in the table, from which it will be seen that no definite relation exists; only the most absorbing line 6402 shows most reversal, and is separated into 15 components in the magnetic field, as given in the last column. The lines belonging to $1s_2-2p_m$ show *diffuse* reversals, perhaps due to low absorp-

Fig. 2.

Echelon. (Mag. 8)
Exp. 5 sec.

Fig. 3.

L. G. Plate (Mag. 9)
Exp. 1 m.

Fig. 1. Echelon (Mag. 17)

tion, those in $1s_3-2p_m$ are generally *narrow*, those in $1s_4-2p_m$ are *finely defined*, and those in $1s_5-2p_m$ are *sharp* when m is even, probably due to high absorption.

So far as the present experiment goes, no definite conclusion can be drawn as to the connection of the reversal with the mode of excitement, electric field, magnetic separation, and absorption of the lines.

Important investigation by Dorgelo on the life of metastable s_5 and s_3 of neon must be closely connected with the reversals of lines belonging to $2s_5-2p$ and $2s_3-2p$, although the mechanism of reversal is not yet clear.

1) Dorgelo: Zeit. f. Phys. 34 (1925) 766.