64. Can Neon Lines be used as Secondary Standards of Wavelength?

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In the Astronomical Union of 1922, it was proposed to use neon lines as standards of wavelength, and determinations of 20 lines in the red and yellow portion of the neon spectrum were given in the Union of 1925; this number was increased to 24 in 1927.

When a neon tube is observed end-on, the lines mostly show strong reversal, which is slightly asymmetric in nearly all of them. The line 6402 seems to have been omitted on that account. According to the interferometric study of the neon spectrum, conducted at the temperature of liquid air, each line consists of two components, arising from the isotopes Ne(20) and Ne(22). The latter component is much weaker than that of the former, and has not been observed till recent years. The measurement shows the weak component to be shorter by 30 mA to 20 mA in the region above cited. Briefly, the difference can be summarized by the following term notations.

For $1s_2 - 2p_h$ ($h = 1, 2, 4, 5, 6$) \[ \delta \lambda = -47.2 \cdot 10^{-7} \lambda \]

,, $1s_3 - 2p_h$ ($h = 2, 5, 7$) \[ \delta \lambda = -34.9 \cdot 10^{-7} \lambda \]

,, $1s_4 - 2p_h$ ($h = 1, 2, 3, 4, 6, 7, 8$) \[ \delta \lambda = -34.8 \cdot 10^{-7} \lambda \]

,, $1s_5 - 2p_h$ ($h = 2, 4, 5, 6, 7, 8, 9, 10$) \[ \delta \lambda = -34.5 \cdot 10^{-7} \lambda \]

The difference cannot escape even the rough observation; the wavelengths usually relate to lines excited at ordinary temperature and are approximately those of Ne(20). Owing to the feebleness of Ne(22) lines, they can be distinctly observed only by sufficiently cooling the tube. The photograms taken with Fabry-Perot interferometer of 3 cm to 4 cm thickness at ordinary temperature show fringes, which fade away gradually towards shorter wavelength side. Examining them with a microphotometer, the fringes are broader than when the tube is cooled, and indicate asymmetry at the base of the peak. Actual measurements of these fringes obtained at ordinary temperature and those obtained with tube immersed in liquid air show difference of 1

or 2 mA for Ne(20) lines. With tubes such as are manufactured by A. Hilger, it is convenient to excite the lines at 200 volts, but as the tube is seen end-on, there is much broadening of lines owing to reversals, that it is rather difficult to reach the accuracy of 1 mÅ; examination of the measurements by different spectroscopists indicate deviations, which are mainly due to this cause. The yellow line 5852, which is bright and often used for comparison, is especially broadened at ordinary temperature, and it has the Ne(22) component distant by 26 mÅ; it can be used as standard when the feeble component is completely suppressed. Moreover the line is weakened by high cycle excitation.

The presence of the component Ne(22) accompanying the lines for Ne(20) makes the adoption of Ne-lines as secondary standards somewhat delusive. How far the measurement is affected by the doublet character is difficult to correct, as it depends on the pressure of the gas in the discharge tube and the temperature.