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## Investigation of the rotational lines of A–X and C–A band systems of aluminium deuteride molecule using sunspot umbral spectra(Article)

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### Abstract

A high-resolution sunspot umbra spectrum recorded in National Solar Observatory, Kitt Peak, in the visible and infrared wave number range was used to search the rotational lines of A $^1\Pi$–X $^1\Sigma^+$ (0,0), (0,0), (1,0), (1,1), (1,2) and (1,3) and C $^1\Sigma^+$–A $^1\Pi$ (0,0) and (1,1) bands of aluminium deuteride (AlD) molecule. The spectral wave number range used in the present study was from 20,750 to 24,410 $cm^{-1}$. By using a reliable line identification method, the chance coincidence was evaluated for the selected bands of A $^1\Pi$–X $^1\Sigma^+$ and C $^1\Sigma^+$–A $^1\Pi$ systems of AlD molecule. By adopting the identification method, the results of number of chance of coincidences were compared with I-parameter values. The equivalent widths were calculated for the well-resolved rotational lines using triangle approximation method. The effective rotational temperatures were then calculated for the bands (0,0), (0,1), (1,0), (1,2) and (1,3) of A $^1\Pi$–X $^1\Sigma^+$ and (0,0) & (1,1) of C $^1\Sigma^+$–A $^1\Pi$ system of AlD molecule. The rotational temperature values calculated for these bands were found to be in the range from 900 to 1500 K which agrees well with the effective rotational temperatures reported for other diatomic molecules in sunspot umbrae. More number of rotational lines of AlD were identified in the sunspot spectra, and the favourable rotational temperatures were also obtained. The results of the present study revealed that there is a high chance for the detection of AlD molecule in umbral region of sunspot. © 2022, The Author(s), under exclusive licence to Società Italiana di Fisica and Springer-Verlag GmbH Germany, part of Springer Nature.

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