THE ASTROPHYSICAL JOURNAL, 207:L17–L19, 1976 July 1

THE BL LACERTAE OBJECT AP LIBRAE IN 1975

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Received 1976 March 15

ABSTRACT

Observations of the spectrum and energy distribution of AP Lib have been continued in 1975. The emission lines visible in 1972 were not detected; however, absorption due to the Ca II H and K lines and the Fe I resonance blend at 4383 Å were found at wavelengths confirming the redshift of $z = 0.0486$. Image dissector scanner observations show the core to be distinctly bluer than the underlying galaxy in which AP Lib occurs.

Subject headings: BL Lacertae objects

I. INTRODUCTION

The BL Lacertae object AP Librae (PKS 1514−24) has been recently shown (Disney, Peterson, and Rodgers 1974) to be composite in nature, consisting of a galaxy with $M_v \approx -21.4$ and a starlike core which in 1974 radiated 70 percent of the visual light. Spectroscopic observations of AP Lib stretching back to 1971 showed AP Lib to have weak absorption lines of Ca II K and H, Mg I *b*, and Na I D redshifted by $z = 0.0486$. Transitory emission lines of [O III] λ4959 and 5007 Å were detected on spectrograms obtained in 1972 April at the same redshift.

The purpose of this note is to describe observations of the spectrum of AP Lib in 1975 and to present further observations of its structure.

II. THE OBSERVATIONS

The observations consisted of image-tube spectrograms obtained with the Cassegrain spectrographs of the 2 m and 4 m telescopes at Mount Stromlo and Siding Spring Mountain, respectively, image dissector scans (IDS) obtained with the 4 m Anglo-Australian Telescope, and a continuum energy distribution obtained with the multichannel scanner at the Mount Stromlo 2 m telescope. The highest-resolution (~3 Å) data derive from the spectrograms. The IDS data have a resolution of 8 Å, and a 40 Å passband was used for the multichannel scanner observations. While the spectrograms and continuum scans were centered on AP Lib, the IDS was also used to study the differential colors of the nucleus and background galaxy.

III. SPECTRAL LINE RESULTS AND THE REDSHIFT OF AP LIBRAE

Two spectra of AP Lib were obtained, one with the 4 m and one with the 2 m telescope, both with a resolution of 3 Å at a 10 percent modulation level. The spectra are reproduced at the same scale in Figure 1 (Plate L3). We can visually identify only one absorption which is common to both of the original spectrograms. It has an observed wavelength of 4597 Å. On microphotometer tracings of the spectra we have found a feature at 4515 Å in addition to the 4597 Å line, but we are unable to convince ourselves visually of the validity of this observation.

AP Lib was also observed with the image dissector scanner of the Anglo-Australian Observatory. In Figure 2 we present copies of these scans. We assert that the scan shows the characteristic H and K break of Ca II centered on 4145 Å. At this wavelength the redshift of AP Lib is consistent with the value $z = 0.0486$ previously found by us. The assertion is strengthened by the consequent identification of the absorptions at 4597 and 4515 Å as the redshifted blends due to the G band of CH and to the Fe I resonance line 4383 Å. We conclude that the 1975 scans and spectra support the line identifications made previously (Disney, Peterson, and Rodgers 1974).

IV. THE SPECTRAL ENERGY DISTRIBUTION

AP Lib was observed with the multichannel scanner of the 2 m telescope at Mount Stromlo on 1975 May 6. The resulting energy distribution is shown in Figure 3. Comparison with the 1974 photometry (cf. Fig. 3 and

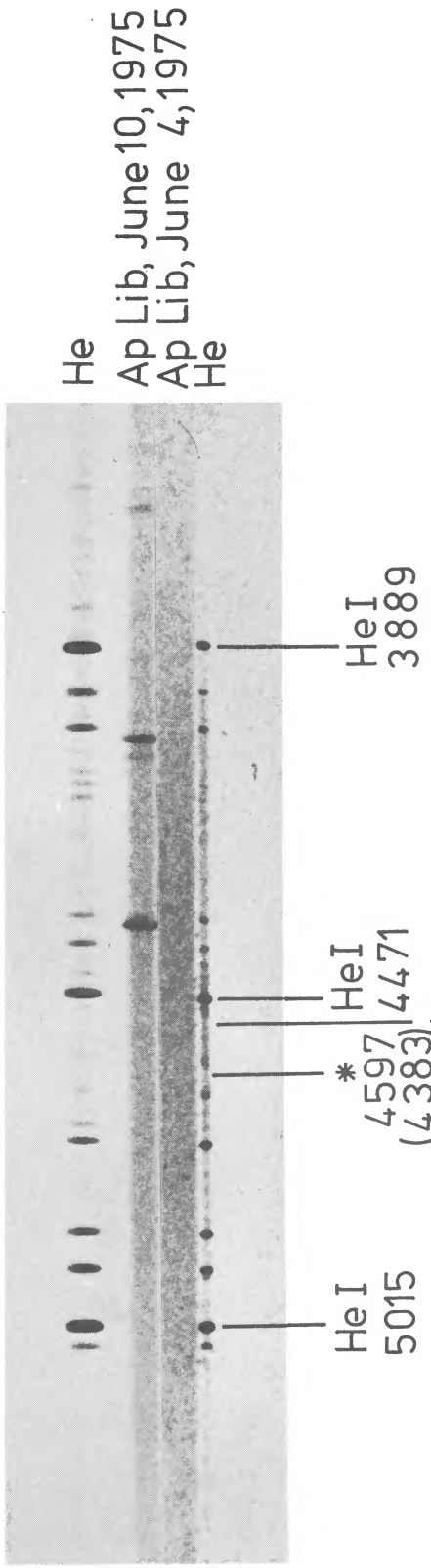

FIG. 1.—Spectrograms of AP Lib obtained with the 4 m (June 4) and 2 m (June 11) telescopes. We can visually identify the feature at 4597 Å (Fe I λ4383) on both spectrograms. The redshifted G band is found on microphotometer tracings of both plates, but we cannot clearly see it on the plates. The strong emission lines on the June 11 plate are due to night sky.

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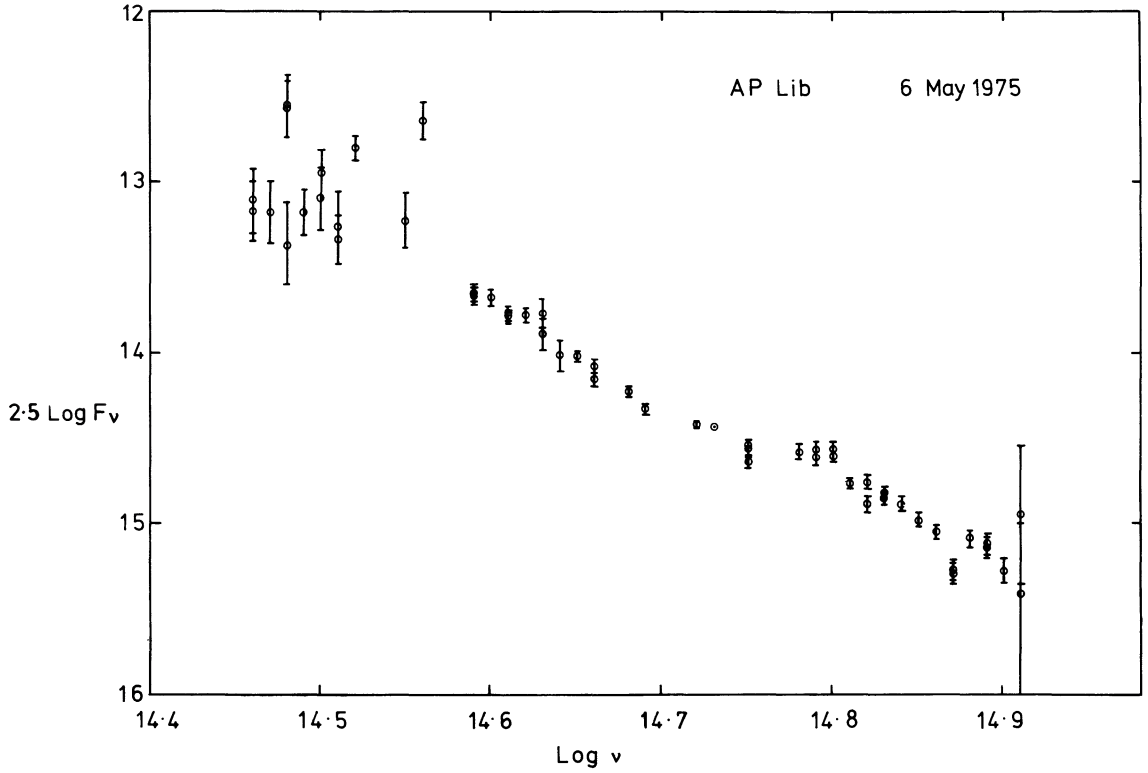

FIG. 2.—Copies of IDS scans nebula 6″ from nucleus of AP Lib and the night sky on same intensity scale. The redshifted Ca II H, K break is marked.

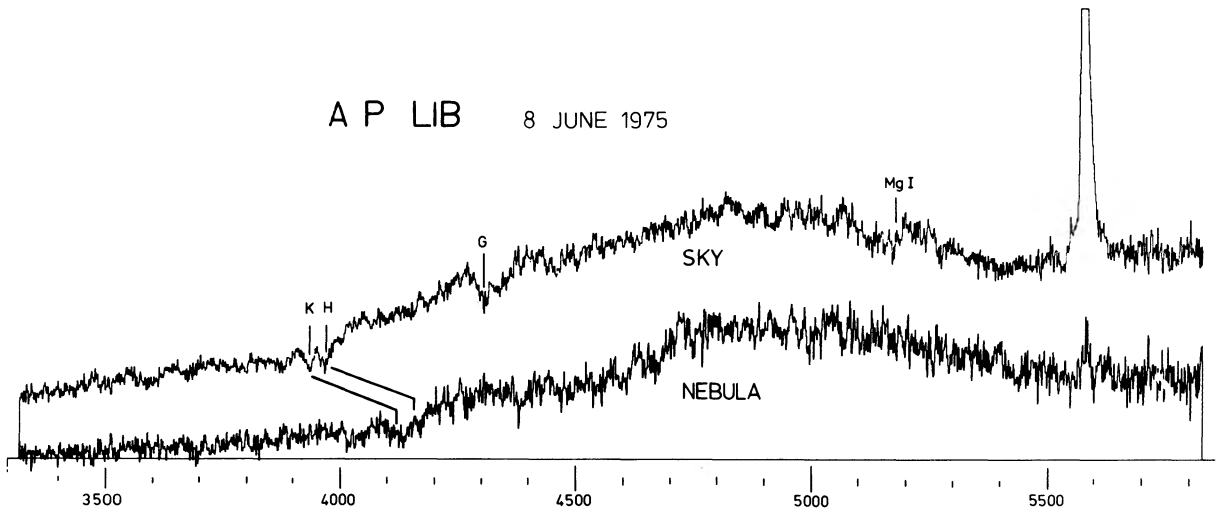

FIG. 3.—The energy distribution of AP Lib, 1975 May 6. The bandwidth is 43 Å for $\lambda < 5700$ Å, and 86 Å for $\lambda > 5700$ Å. The aperture size used is 20 arcsec diameter.

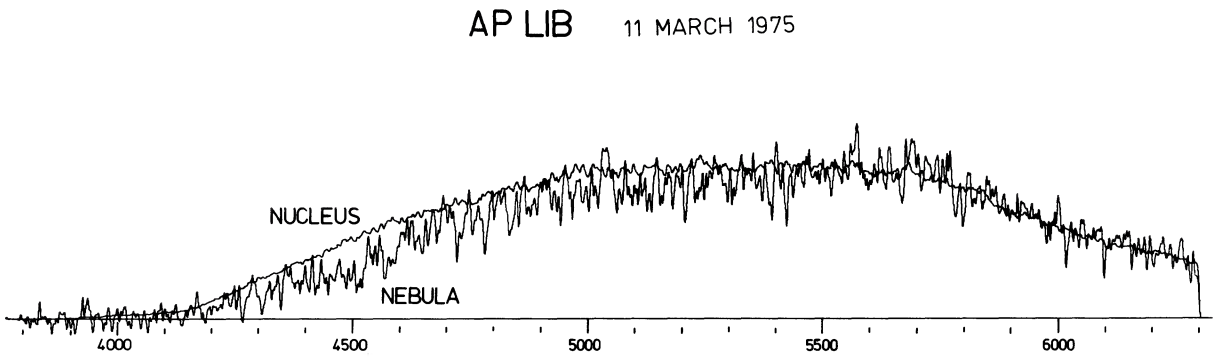

FIG. 4.—Superposed IDS scans of AP Lib normalized in the red to show the excess blue radiation of the nucleus

Table 2 of Disney *et al.*; note there is an error of 1.0 mag in all the tabulated U values) shows AP Lib to have brightened by 0.4 ± 0.1 mag in V and 0.9 ± 0.3 mag in U. This increased linearity of the energy distribution with an increase in V magnitude is to be expected when a power-law spectral dependence of the nonthermal component of AP Lib is increased relative to the background galaxy energy distribution. The brightening explains the lack of visibility of the [O III] emission lines in 1975 and the decreased visibility of bluer absorption lines. When [O III] was visible in AP Lib in 1972, photometry (Andrews, Glass, and Hawarden 1974) showed it to be 1 mag fainter in V.

To determine the differential colors of the nucleus and disk of AP Lib, IDS observations were made, in good seeing, of the nucleus and of a $3'' \times 4''$ area $6''$ from it. These scans are shown in Figure 4. It is quite clear that the nucleus is significantly bluer than the disk of AP Lib, confirming the composite nature of the object.

V. CONCLUSIONS

Observations in 1975 show a weakening of the absorption lines and an absence of [O III] emission in the spectrum of AP Lib. This weakening is accompanied by an increase in brightness, and we hypothesize that the lines have been additionally swamped by a continuum originating in the nucleus, particularly since 1972. In spite of their weakness, we believe we have confirmed the identifications of some absorption features in AP Lib which are consistent with a mean redshift of $z = 0.0486$.

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