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AF Sco – A MIRA STAR, NOT A NOVA

AF Sco (= Harvard Variable 1108) is a poorly known object. It was first listed as a variable by Leavitt (1904). Swope (1932) published a finding chart, on which only the position of the star is indicated. Since it had not been seen (or rather re-observed) since the turn of the century, the 4th edition of the GCVS classified AF Sco as a nova. Some time ago, the Harvard plates were re-examined by B. Fuhrmann (Sonneberg), who put a list of positive and negative observations at my disposal. The object had brightness maxima on 1896 May 14 ($m_{pg} = 14.0$), 1897 June 4 (13.2) 1899 July 6 (12.2?), 1900 September 5 (12.9) and around 1901 September 8 (13.3). 33 plates taken between 1902 mid-April and 1929 May, sometimes reaching limiting magnitude 17, do not show the star. An image of $m_{pg} = 17.5$ is possibly visible on a plate taken on 1929 April 25.

The outburst image of the variable coincides with a quite bright star on the ESO/SERC plates, but the different times of Schmidt telescope observations make a determination of the colour impossible.

Spectroscopic observations (360 – 700 nm), made on 1995 June 25 with EFOSC1 at the ESO 3.6m telescope show that AF Sco has a spectral type M9 III, based on comparisons with spectrophotometric scans of standard stars (Turnshek et al. 1985). The large range in magnitudes on the Harvard plates (m_{pg} between 12.5 and 17.5) makes mira variability likely. From the brightenings observed between 1896 and 1901, a preliminary period of 388 days was derived. Making use of the fact that the star was not seen at the times when the later plates were taken, several trial runs with slightly different periods were made. The period that ‘avoids’ times of maximum light during observations made in later years leads to the preliminary light elements

$$t_{\max} = \text{J.D. } 2414858 + 385 \times E \text{ days}$$

which should be improved by present-day observations.

Previously, the object has been preliminarily identified with the IRAS source 16473–2528, and an IRAS spectrum is shown in Olton & Raimond (1986). te Lintel Hekkert et al. (1991) have detected OH maser emission at 1612 MHz from it. The velocity separation $\Delta V = 10$ km/s and the period of 385 days fits well into the trend in ΔV observed in mira variables of different periods and spectral types (Nguyen-Q-Rieu et al. 1979). By comparing the IRAS flux of AF Sco at $12\mu\text{m}$ with normalized fluxes of miras in the period range 370...400 days (Sivagnanam et al. 1988), we derive a distance estimate of 1300^{+600}_{-250} pc. Using period – absolute magnitude calibrations (Duerbeck & Seitter 1982), we predict a visual magnitude at maximum between $m_{\text{vis}} = 9.1$ and 10.4 (neglecting interstellar absorption, which should be less than 1 magnitude). Thus the determination of the precise period and an up-to date epoch of maximum light should be an easy task for amateur astronomers. A finding chart, based on the Digitized Sky Survey, is shown in Figure 1.

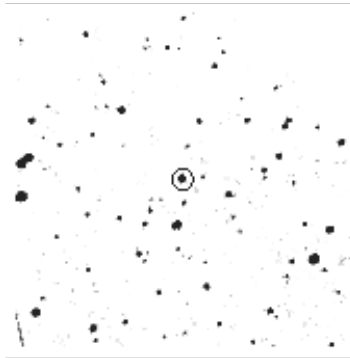


Figure 1. The field of AF Sco. Its size is $4'5 \times 4'5$, north is up and east to the left. The variable is marked with a circle. Its coordinates are RA = $16^{\text{h}}50^{\text{m}}25^{\text{s}}$, Decl. $-25^{\circ}33'38''$, in good agreement with the IRAS position RA = $16^{\text{h}}50^{\text{m}}25^{\text{s}}.4$, Decl. $-25^{\circ}33'37''$ (eq. J2000). This image is based on a 4 minute exposure through a V-filter, taken with the UK Schmidt on 1988 April 14.

Summing up, the positional coincidence of the outbursting object with the presently observed late type star confirm the IRAS identification, and the observed light variations lead to a reclassification of AF Sco as a mira star.

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