

## PROBABLE ASSOCIATION OF UX PISCUM WITH A GALAXY\*

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The poorly observed SRa-type variable star UX Psc appears to coincide with a sixteenth-magnitude galaxy. Although the limited observations given in this paper do not support the reported variability, further photometric observations are needed to clarify the nature of this object.

*Key words:* variable star—photometry—galaxy

## I. Introduction

During the course of selection of stars for inclusion in the Lick proper-motion program with respect to galaxies (Vasilevskis 1973; Deutsch and Klemola 1974), the variable star UX Piscium was noted to lie very near a sixteenth-magnitude elongated nonstellar object which is probably a galaxy. This juxtaposition raised the interesting possibility that the poorly observed variable star coincides with the galaxy itself. The rather sparse observations by Cragg (1961), who discovered the variable star, suggested a long-period red variable of visual magnitude range 13.4–15.2 with a period of about 300 days. However, Cragg (1961) made no note of a galaxy near the object denoted C1 on his chart. The *General Catalogue of Variable Stars* (Kukarkin et al. 1968) lists the type SRa for UX Psc. It is the purpose of this note to provide some simple observations which may help in clarifying the nature of this object which lies at intermediate galactic latitude ( $l = 129^{\circ}13$ ,  $b = -40^{\circ}45$ ).

## II. Astrometric Observations

The first step was to establish that Cragg's object C1 was indeed situated on or very near the observed galaxy. Initial visual comparison of the chart (Cragg 1961) with direct photographs taken with the Lick 51-cm double astrograph supported such an association. Subsequently the precise position of the galaxy was measured on a Lick astrograph plate with epoch of observation 1974.94 using ten stars from the AGK3 for the definition of the positional reference frame. This position ( $01^{\text{h}}09^{\text{m}}03^{\text{s}}.78$ ,  $+21^{\circ}48'13''.3$ ), with estimated uncertainty  $\pm 0.2$  arc sec, agrees reasonably well with the position for UX Psc listed in the *General Catalogue of Variable Stars* (Kukarkin et al. 1968) precessed to equinox 1950.0 ( $01^{\text{h}}09^{\text{m}}08^{\text{s}}$ ,  $+21^{\circ}48'17''$ ). The uncertainty in the position listed by Kukarkin et al. (1968) is not specified but appears to be whole seconds of time in right ascension and some decimal part of an arc minute in declination. There appear

to be no other candidate objects near the position of C1, other than the galaxy itself, on the astrograph plates which reach blue magnitude near 19.

Examination of both the blue and red Palomar Sky Survey plates shows no star in the immediate vicinity of the galaxy which could be taken as a reasonable alternative candidate for C1.

## III. Photometric Observations

As further support for identification of Cragg's object, C1, with the galaxy, existing direct photographs taken with the blue lens of the Lick astrograph since 1947 and supplemented by a new series taken in 1982 were examined for possible light variations of the galaxy. Although the plate material in Table I is inhomogeneous owing to variations in exposure and seeing conditions, inter-comparisons of the iris photometer measurements of the galaxy and 14 stars in its immediate vicinity on each plate revealed that the galaxy is constant in blue magnitude to within the estimated error of about  $\pm 0.2$  magnitude. The exposure of the galaxy on the plate of 1982 August 24 was too weak to be used in these comparisons,

TABLE I  
Data for Blue Photographic Plates (Lick/POSS)

Epoch (UT)	Plate	Telescope	Exp (min)
1947 Nov. 09	AB-0680	Lick 51-cm	120
1947 Nov. 17	AB-0694	Lick 51-cm	120
1953 Oct. 12	0-0857	POSS 122-cm	12
1974 Dec. 10	AB-7915	Lick 51-cm	120
1975 Sep. 12	AB-8084	Lick 51-cm	120
1982 Aug. 24	AB-9263	Lick 51-cm	20
1982 Sep. 12	AB-9274	Lick 51-cm	20
1982 Nov. 17	AB-9291	Lick 51-cm	30
1982 Dec. 12	AB-9320	Lick 51-cm	30

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leaving seven astrograph plates for the study of the galaxy. For these comparisons a graphical procedure was adopted where one plate was taken as a standard and each of the other plates compared with it in turn. It should be pointed out that no photometric standard stars were involved in the comparisons. Experience in photometric reductions of blue plates taken with the astrograph shows that a reasonable transformation from iris photometer readings to a blue magnitude scale for well-exposed images can be made through multiplication by a standard scale factor. This should be adequate to test for possible changes of magnitude, since the value for the blue magnitude itself is not sought. There is the well-known difficulty in measuring magnitudes of extended objects. In the present case the galaxy exhibits a predominant core with weak extensions directed in opposite directions, possibly indicative of an edge-on spiral. The photometric measurements refer mainly to this core.

The present limited photographic observations point to probable constancy in brightness for the galaxy with blue magnitude near 16. It would seem remarkable that seven randomly selected epochs of observation spanning 35 years would show constancy in magnitude to  $\pm 0.2$  magnitude, if the object were really a variable with amplitude of 1.8 magnitudes, and period about 300 days as reported by Cragg (1961). The identity of UX Psc with a semiregular variable star must be questioned. The association of UX Psc with the galaxy appears reasonable.

It is noteworthy that the galaxy appears far brighter by nearly two magnitudes on the Palomar Sky Survey blue plate compared to the Lick astrograph blue plates at all observed epochs. It is not clear that this difference is a measure of real light variation or, as is more likely from experience in comparing Lick astrograph ( $f/7.0$ ) against Palomar Schmidt ( $f/2.44$ ) images, it is a consequence of photography of extended objects with telescopes of substantially different  $f$ -ratios. The conclusion is that variability of the galaxy still remains unproven on the basis of the examined plate material. Demonstration of the case for variability will have to be made from other observational material. Examination of the field on plates in observatory archives could be valuable in this context.

#### IV. Spectroscopic Observations (Osterbrock)

As a further guide in understanding this object, Osterbrock (1983) kindly provided his conclusions based on spectrophotometric observations of the galaxy made on 1976 November 22 (UT) with the 3-m Shane reflector. At that time he reported red and blue magnitudes of  $\sim$

16. The extragalactic nature of the object was confirmed from the measured redshift of  $Z = 0.0456 \pm 0.0002$  in the rest system of the sun. Further, Osterbrock (1983) examined the spectrum over the recorded wavelength range from about 3800 Å to 6900 Å and found that it was not unusual, showing absorption lines of H, K, G, H $\beta$ , b, D, and Na I characteristic of a normal galaxy. The H $\alpha$  line was hidden by the atmospheric O<sub>2</sub>B band.

#### V. Conclusions

We are left with various possible interpretations for the observations. One possibility, which needs to be demonstrated beyond doubt, is that the galaxy which is identified with UX Psc is optically variable but is not evident in this study because of the chance positioning of epochs at times of same brightness. The second possibility is that the reported variability for UX Psc is not real and that the discovery observations refer to the faint galaxy. Such an interpretation may be possible if visual observations of an extended object were made near the magnitude limit of the unspecified instrumentation used by Cragg (1961). Finally there still remains the possibility that a faint galactic variable star is projected on or very near the galaxy and that it was too faint or blended with the bright core of the galaxy to be noted on the plates examined in this study. However, this possibility appears less likely from the fact that the spectrophotometric observations indicate the presence of only a normal galaxy. It is interesting to note that negative observations discounting optical variability have been reported in the somewhat similar case of AU Leonis (Bond, Green, and Huchra 1974).

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