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Photometry of X-ray selected quasars from Einstein medium sensitivity survey

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Abstract. We present a few photometric measurements of quasars in the Einstein Medium Sensitivity Survey (EMSS). The measurements are a part of an ongoing programme of CCD photometry of quasars in the southern sky and are based on observations with the Vainu Bappu Telescope.

1. Introduction

A large number (835) of new X-ray sources have been discovered in the Einstein Medium Sensitivity Survey (EMSS) (Gioia *et al.* 1990). The survey is in the energy range of 0.3-3.5 keV and has flux limit of 8×10^{-14} ergs cm^{-2} s^{-1}. The typical error circle (90% confidence) for the position is 50 arcsec. A large fraction, $\simeq$ 51.1%, of these sources have been identified, based on their f_x/f_v ratio and moderate resolution optical spectroscopy, with quasars and active galactic nuclei (AGN's) (Stocke *et al.* 1991). These quasars constitute a homogeneous flux limited sample that is very useful for statistical studies of their multi-wavelength properties. Precise photometric measurements of the AGNs south of –20° declination are not available, however (Gioia *et al.* 1990).

We have initiated broad-band photometry of some of these objects which are south of –20° declination, using a CCD at the prime focus of the 2.3m Vainu Bappu Telescope (VBT) at Kavalur near Bangalore. Our observations are expected to provide the first accurate measurement of their magnitudes and colours and help in studying their statistical properties and in characterizing their multi-wavelength spectra.

The two quasars reported here are MS0941.7-2348 and MS1030.2-2757. The properties of the two quasars, as reported by Stocke *et al.* (1991), are given below :

(i) *MS0941.7 – 2348*

X-ray flux $f_x = 1.03 \times 10^{-13}$ ergs cm^{-2} s^{-1}; V-magnitude = 19.0; X-ray to optical flux ratio, $\log f_x/f_v = 0.0$; redshift, $z = 0.615$; radio flux f_r (5 GHz) < 0.6 mJy (5 σ upper limit).

(ii) *MS 1030.2 – 2757*

X-ray flux $f_x = 14.6 \times 10^{-13}$ ergs cm^{-2} s^{-1}; V-magnitude = 16.0; X-ray to optical flux ratio, $\log f_x/f_v = -0.06$; redshift, $z = 0.148$; radio flux, f_r (5 GHz) < 0.6 mJy (5 σ upper limit).

2. Details of observations

The two quasars reported here were observed on 1991 March 18 with a front illuminated CCD, GEC P8603 coated for better response in the blue, at the prime focus of the Vainu Bappu Telescope using *B*, *V* and *R* filters. Two exposures were obtained using each filter. The details of the CCD and its standardization based on calibration with the stars in the "dipper asterism" of an open cluster, M67 are given in Bhat *et al.* (1990) and Bhat *et al.* (1992).

The quasar MS0941.7-2348 was observed for 300s and 600s with the *R*, 600s and 900s with the *V*, and 1200s and 1800s with the *B* filters. The exposure times for the quasar MS1030.2-2757 were 120s and 240s in the *R*, 300s and 480s in the *V*, and 600s and 1200s in the *B*-band. The point spread function during the observations was ~ 2.7″ (FWHM). A southern standard LTT 3218 was also monitored during the observations.

3. Analysis and results

The CCD frames were bias subtracted and analyzed using standard IRAF software package and the photometric measurement was done using the tasks in the DAOPHOT package (Stetson, 1987), and following the procedures in Bhat *et al.* (1992) and Anupama *et al.* (1993). Our measurements provide the following :

(i) *MS0941.7 – 2348*

$V = 18.54 \pm 0.07$; $B - V = -0.117 \pm 0.25$; $V - R = 0.2345 \pm 0.09$.

(ii) *MS1030.2 – 2757*

$V = 15.85 \pm 0.02$; $B - V = 0.332 \pm 0.045$; $V - R = 0.025 \pm 0.02$.

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