Discovery of an X-ray Selected Optically Highly Variable Quasar

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Abstract

In the course of a programme of optical identification of serendipitous EXOSAT sources we have discovered a quasar (EXO033041–2613.1, referred to here as ‘Gepu’; $z = 0.67$) which varied by more than 3 magnitudes between November 1985 and February 1988. We present the results of optical spectroscopy and CCD photometry of the quasar which were obtained during 1988. We complement the recent data with historical observations (both photometric and spectroscopic) in order to investigate the long term behaviour of this object. It is hard to make a classification of Gepu with the limited data available, and further optical monitoring is planned.

Discovery and identification

We are engaged in a large programme of optical identifications of serendipitous soft X-ray sources extracted from the EXOSAT CMA database (Giommi et al. 1989). About 40 of these were examined during a 3-week observing run with the 4m William Herschel Telescope (WHT) and the Faint Object Spectrograph (FOS) at the La Palma Observatory in February 1988. Secure identifications were obtained for 80 percent of the objects.

EXO033041–2613.1 is one of the sources examined. The finding chart constructed from the blue Palomar Observatory Sky Survey (POSS) print shows an optical object of approximately 18th magnitude within the X-ray error circle. From comparison with the red POSS print the star appears slightly blue; thus we considered it a likely candidate for the X-ray source counterpart. We adopted the short name ‘Gepu’ for the star and this we use throughout the paper.

We observed the field of Gepu on 3 consecutive nights (1988, February 8, 9 and 10) with the WHT acquisition TV camera in good weather and with seeing between 1 and 2 arcsec. No trace of Gepu could be found. The other stars in the field were clearly visible, at the same relative brightness as in the POSS print.
On the night of February 16, with 1 arcsec seeing, we made a new attempt at observing Gepu: this time the star was visible, but very faint. It is conceivable that the lack of detection at the same level one week earlier was due to poorer seeing conditions.

The flux-calibrated FOS spectrum of Gepu taken on February 16 is shown in Fig. 1. The FOS optical system has a resolution of 13 Å FWHM, and a dispersion of 8.7 Å pixel$^{-1}$ in the first order (4800 – 9700 Å) and of 4.3 Å pixel$^{-1}$ in the second (3500 – 4800 Å). Redshifted emission lines of MgIIλ2798, Hγ, Hβ and [OIII]λ4959 and 5007 can be easily identified. Their relative intensities and wavelength displacements indicate that Gepu is a quasar at redshift $z = 0.67$. Its rest frame 0.02 – 2.5 keV luminosity is $10^{46}$ erg s$^{-1}$ for a power-law spectrum of energy index $\alpha = 1$ and an amount of Galactic absorption in the line of sight equal to $1.5 \times 10^{20}$ cm$^{-2}$ (Stark et al., 1989, in preparation). This is obtained taking $q_0 = 0$ and $H_0 = 50$ km s$^{-1}$ Mpc$^{-1}$.

**Magnitude determinations**

From the FOS spectrum we determine the colours of Gepu to be $B = 20.9$, $V = 21.0$ and $R = 20.7$. The $B$ magnitude does not contain the flux of the MgII emission line and the $B$–$V$ index of $-0.1$ is that of the continuum only.