PKS 2005-489: A VERY BRIGHT BL LAC OBJECT IN A NEARBY GALAXY*

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The galaxy identified with the flat-spectrum radio source PKS 2005-489 has a bright stellar nucleus with V ≃ 13 mag. Optical, UV and X-ray observations indicate variability and power-law continua in each of these wavebands, leading to the conclusion that PKS 2005-489 is one of the brightest BL Lac objects known.

The remarkable nature of the object is apparent in Fig 1. The image is clearly nebulous but diffraction spikes emerge from the centre of the image to indicate the stellar nature of the nucleus and its domination of the total light from the system. CCD photometry shows that the object varied by at least 0.5 mag over a year; in Aug 1982 V = 12.9 mag, putting PKS 2005-489 among the 3 or 4 brightest BL Lac objects known, brighter than others for which the nebulosity is clearly visible. Optical spectra obtained between 1980 and 1985 yield power-law continua with varying spectral indices ranging from α ($S_\nu \propto \nu^{-\alpha}$) = 0.3 to 1.6. None of these observations provides a convincing estimate of the redshift.

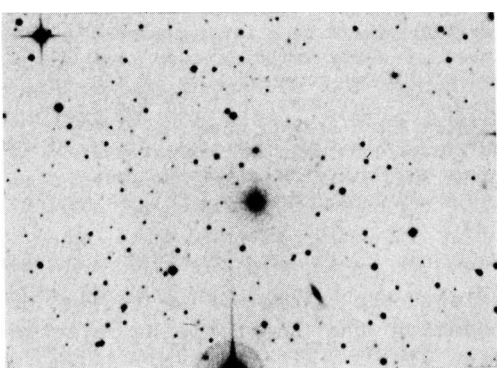

Fig 1. The image of PKS 2005-489 as reproduced from a copy of the UKST survey. NE is up and left. The faint lenticular to the SW has z = 0.136; if the redshift of PKS 2005-489 is similar, the host galaxy would be exceptionally luminous at M_B ~ -24 mag (H_o = 50 km s^{-1} Mpc^{-1})

Ultraviolet observations carried out with IUE (Fig 2) show a power-law spectrum with α = 1.4. All 3 interstellar lines marked in the figure have large equivalent widths (W_λ ≃ 2 to 4 Å). The line-of-sight to PKS 2005-489, at its closest to the Galactic centre, passes 5.5 kpc below the plane. The strong absorption lines, similar to those

* Discussion on p.61

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found in halo stars with sight-lines passing <2 kpc from the centre, indicate that the halo associated with the inner regions of the Galaxy extends to several kpc from the plane.

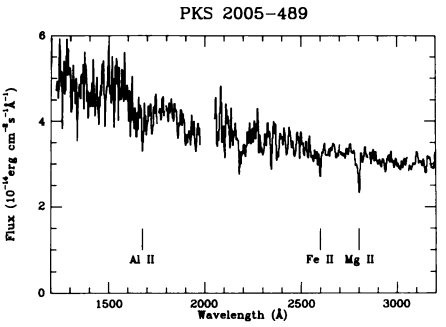

Fig 2. The UV spectrum of PKS 2005-489 from IUE observations in March 1984. There is no obvious 2200 Å feature, limiting E(B-V) to < 0.04 mag. The only definite features are absorption lines at low velocities, presumably formed in the ISM of our Galaxy.

X-ray observations from EXOSAT (September 1984) show an extremely steep power-law spectrum ($\alpha \simeq 2.1$), even for a BL Lac object. One month later the source was 2.5 times brighter and the spectrum had hardened markedly. Long-term variability is indicated by the absence of PKS 2005-489 from Uhuru, Ariel V, and HEAO-1 catalogues, its 1984 intensity being far above the limit of each of these. The X-ray measurements are consistent with a column density for HI of $N_H \sim 6 \times 10^{20}$ cm^{-2}. Direct measurements of Galactic HI at 21 cm yield $N_{HI} = 4.7 \times 10^{20}$ cm^{-2}, and the column density intrinsic to the object must therefore be small.

If the X-ray excess in the composite spectrum (Fig 3) is due to the synchrotron self-Compton process, then the X-ray spectrum should

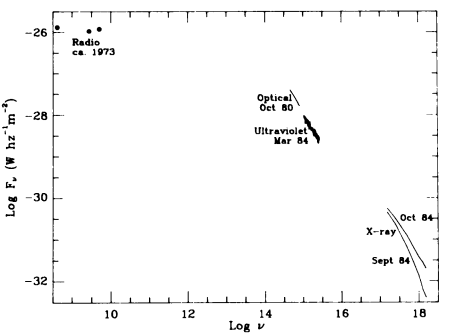

Fig 3. The composite (non-contemporaneous) spectrum of PKS 2005-489. There is a large apparent excess of X-ray emission over that predicted from extrapolation of the optical-UV spectrum, and this X-ray emission has a steeper spectrum than the optical-UV; in this respect the object differs from other BL Lacs with known X-ray excesses.

reflect the slope of a region of (presumably synchrotron) spectrum producing the Comptonizing electrons. That it does not suggests a more likely alternative: the entire optical to X-ray band is synchrotron emission, the discontinuity between UV and X-ray regions reflecting the non-simultaneity of observation. This interpretation is supported by the variable slope in the optical region and the hardening of the X-ray spectrum with increased X-ray output. It carries the exciting implication that substantially greater UV (and perhaps optical) output occurs than at the epochs observed. There are thus substantial incentives for continued, additional and simultaneous observations of PKS 2005-489, which may bear on the intrinsic nature of emission, the nature of the surrounding nebulosity, and the nature of the interstellar medium of our Galaxy.

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