DELAYED INFRARED EMISSION FROM LUMINOUS SEYFERT 1 GALAXIES

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Five Seyfert 1 galaxies of high absolute luminosity (ranging from 28 to 65 times that of NGC4151 at 3.5 µm) have been monitored since 1984 (or earlier) at JHK & L (1.25, 1.65, 2.2 & 3.5 µm). The results are shown in the accompanying figures. Where the variations were of sufficient amplitude, changes in L are seen to have been delayed ~ 500 days compared to those at shorter wavelengths. In all cases, even in 3A 0557-383 where the amplitude of variation is small, each galaxy traces out loops with time if magnitudes at two different wavelengths are plotted against each other. The loops are always described in the same sense (clockwise as plotted here), such that variations at the longer wavelengths are seen to be retarded compared to those at the shorter. Plots of this kind appear to be a sensitive way to detect delays even when the data are too sparse to support a credible cross-correlation.

Clavel, Wamsteker & Glass (Astrophys. J., in press, & this meeting) have cross-correlated the infrared output of F-9 with its UV continuum at 1338A, finding a delay of 400 ± 100 days. They suggest that the UV heats dust particles at 200-400 light-days radius to just below the sublimation temperature of graphite. If the fluxes at the shorter IR wavelengths from the other luminous Seyfert 1's are varying at least in part with the exciting UV continua, the same process occurs in them also.

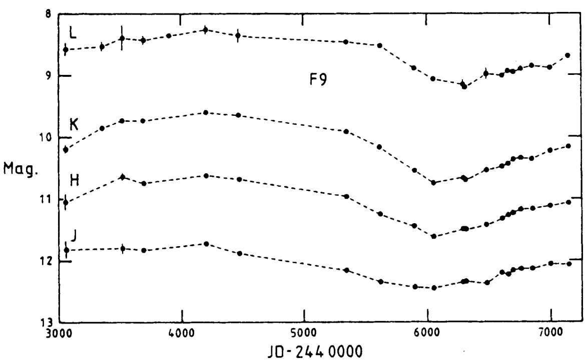
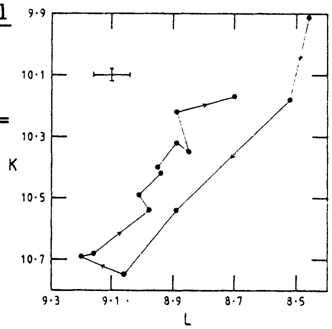


Fig. 1

F-9

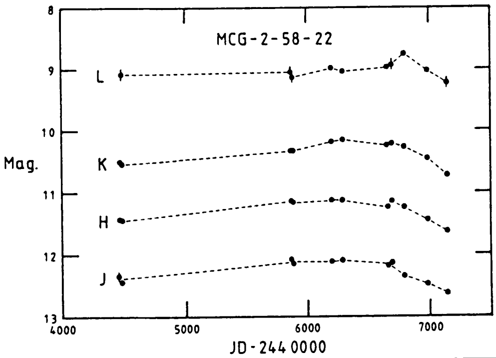
$z^2 f_L$ = 0.26 mJy



Variations at JHK & L vs time

K mag / L mag diagram

D. E. Osterbrock and J. S. Miller (eds.), Active Galactic Nuclei, 382–384.



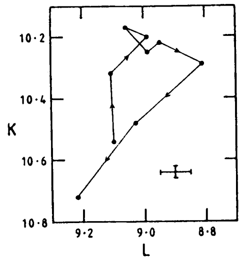
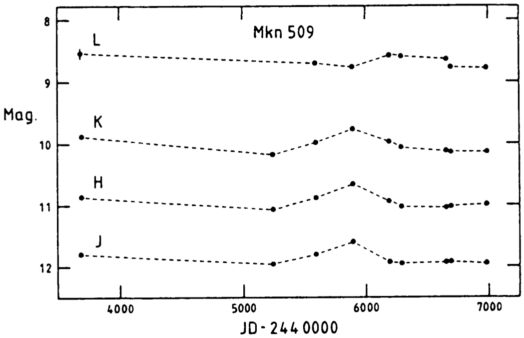


Fig. 2

MCG-2-58-22
(=Mkn 926)

$z^2 f_L$ = 0.19 mJy



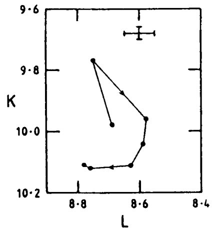
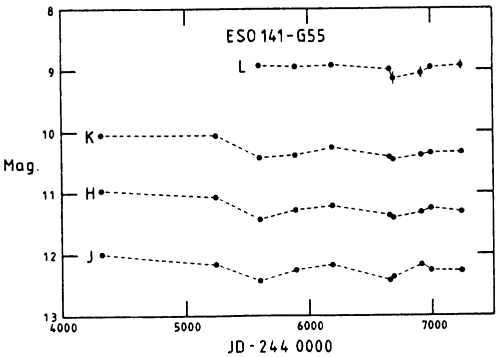


Fig. 3

Mkn 509

$z^2 f_L$ = 0.14 mJy



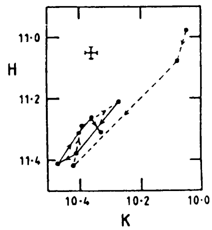


Fig. 4

ESO 141-G55

$z^2 f_L$ = 0.11 mJy

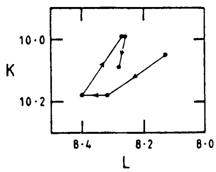
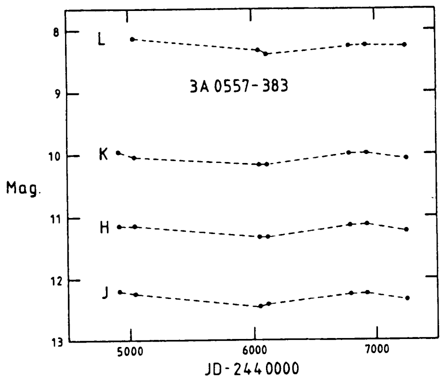


Fig. 5

3A0557-383

$z^2 f_L$ = 0.18 mJy



Note: The same scales are used for the diagrams throughout so as to facilitate intercomparisons.

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DISCUSSION

GOODRICH Do you see any evidence for evaporation of the dust as the continuum source brightens?

GLASS I think that the inner boundary of the dust is determined by the maximum luminosity that the ultraviolet radiation from the nucleus has reached over time scales long compared to a few years. Thus, evaporation will only occur when this maximum is exceeded.

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