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FAR INFRARED PECULIAR BEHAVIOR OF QUASARS *

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ABSTRACT

Many quasars possibly have nebulous envelopes with far infrared radiation. These nebulosities may be similar to fuzz in the optical region in morphology. These quasars have many properties in common.

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INTRODUCTION

179 quasars in the Catalogue of Quasars and Active Nuclei (Veron-cetty and Veron,1985) have been detected by the IRAS deep survey (G. Neugebauer et al. 1986), of which 45 quasars may possibly be influenced by extra-radiation of cirrus and/or confusing source. Galactic cirrus are mainly concentrated at low galactic latitudes (C. A. Beichman et al., 1985). Galactic cirrus at high latitudes reveal themselves in three ways (F.J. Low et al.,1984): (1) thermal radiation of gas and dust in HII region (2) large, extended sources of infrared emission along the zodiac (3) cold clouds emitting in the infrared.

Often the effects of cirrus and confusing sources were indistinguishable (G. Neugebauer et al., 1986).

The apparent fluxes of quasars are generally much weaker than those of galactic cirrus considering the remoteness of quasars. So the bulk of quasars may have been lost in the radiation of the foreground galactic cirrus, therefore cirrus may not exist in the direction where quasars have been detected by IRAS, or the IRAS quasars are those with unusually intense IR emission.

In this paper we suggest that the "cirrus and/or confused quasars" should also be interpreted in terms of some complex morphological structure in the infrared intrinsic to the quasars in question.

Quasars are not influenced by cirrus at low galactic latitudes because quasars are situated at high latitues.

For convenience, we shall use the word "dirty" to indicate the quasars influenced by cirrus and/or confusing sources, and use the word "clean" to denote those which are not.

Figure 1 shows the distribution of all 179 quasars in galactic coordinate system. The dotted curve in the picture is the zodiac and the HI denote high density regions of HI. We can see from figure 1 that these quasars have not been influenced by galactic cirrus because of : (1) almost no quasars have been found at HI regions (2) one finds only "clean" quasars but not "dirty" ones on the zodiac (3) some "dirty" quasars show "clean" quasars in their immediate vicinity. As a matter of fact, galactic cirrus are large extended sources, they should contaminate each quasar at the same time so long as all these quasars are seen in nearly the same direction.

All these facts show that the smudgy appearance of some quasars are unlikely caused by objects in the Galaxy. But where do they come from? Do they come from the intersteller medium or other infrared sources? In consideration of the fact that optical data of quasars are based on the observation of single source free from the influence of other infrared sources, we have selected 60 quasars with UBV data available from the total of 179 quasars. Figure 2 is a UBV color-color diagram. We are led to the conclusion that the "dirty" sources are not suffering

from the influence of intersteller reddenning, but exhibit on the contrary distinctly violet color, with U-B >-0.46. Consequently the smudgy appearance is more likely a phenomenon related to the quasars themselves.

In consideration of the intrinsic luminosities of quasars as a function of cosmic time (G. Mathez, 1976, R.A. Laing et al., 1983), let us examine figure 3 which shows the luminosities of quasars at 60μm vs. the redshifts. A sample of 77 quasars is included here. 70 out of the 77 were detected with signal-to-noise ratios greater than 3.9. The remaining 7 quasars are "clean" ones which have signal-to-noise ratios greater than 2.57. The other 102 quasars can not be accepted here because of their unreliable flux data.

The distribution of quasars in the picture may well be interpreted by the evolution curve. The curve shows that the quasars were very bright at early epoch, and then decline in luminosity exponentially with time.

$L=L'\exp[-10.6t(z,z')]$

Where H_o =75kms^{-1} Mpc has been assumed and an initial redshift of z'=10.0 is adopted. If we take cosmic curvature k=0, look back time will be $t=(1+z)^{-3/2}-(11.0)^{-3/2}$, and adopt initial luminosity $L' = 10^{14}L_\odot$, the curve will coincide with the "dirty" quasars very well. If such an evolutionary law of "dirty" quasars are correct, we can understand the "clean" quasars being evolved more or less slowly, so they appear brighter than the "dirty" ones.

The research for morphology of quasars recently show that many quasars have nebulous envelopes (J.B. Hutchings 1982,1984). Owing to the influence of atmospheric agitation and resolution limit of telescope, only fuzz structures of the quasars which have low redshifts can be observed in optical region. About one third of the fuzz quasars have radio structure. 25 "dirty" quasars have redshifts smaller than 0.6 in the sample of IRAS quasars. Up to now, 19 out of 25 "dirty" quasars have been discoved having structures of the optical fuzz. So, we predict that many quasars of high redshifts which are "dirty" in far infrared radiation region may have infrared nebulosities and may also have the structures of optical fuzz.

To sum up, our analysis support the view that the "dirty" quasars in the far infrared may be a kind of special quasars with quantities of matter or companion objects residing in their outer parts. These extra-materials should have powerful far infrared radiation. These "dirty" quasars are analogous in morphology to the quasars with optical fuzz or they may be termed quasars with infrared fuzz.

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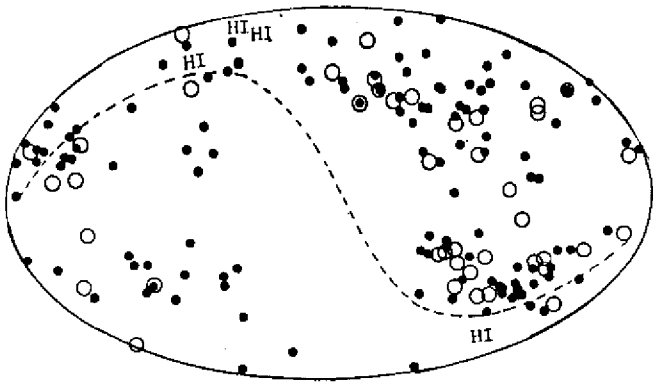

Fig. 1 The distribution of IRAS quasars in galactic coordinates. The filled dots indicate the "clean" quasars, the open dots indicate the "dirty" quasars. The dotted curve symbolizes the zodiac.

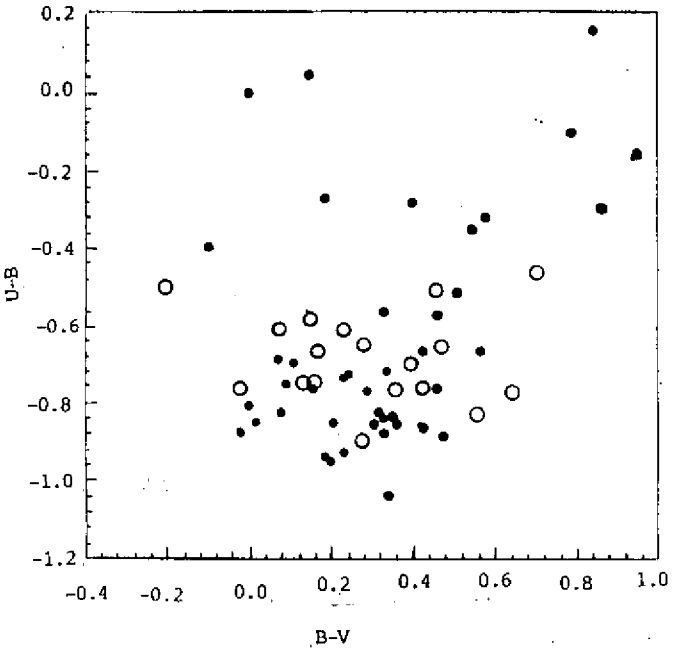

Fig. 2 The UBV color-color diagram. The filled dots indicate "clean" quasars, the open dots indicate the "dirty" quasars.

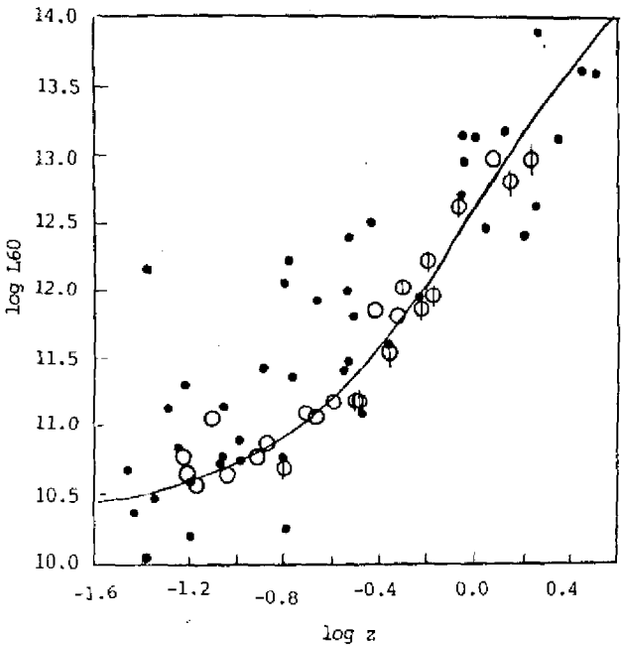

Fig. 3 The luminosities of quasars at 60μm as a function of redshits. The filled dots is the "clean" quasars. The open dots symbolize the "dirty" quasars. The distribution of these quasars coincide with the exponential evolution curve of quasars.

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