Origin of Far-Infrared Emission in Seyfert and Starburst Galaxies(Abstracts of Doctral Dissertations)

著者	MOURI Hideaki
journal or publication title	The science reports of the Tohoku University. Ser. 8, Physics and astronomy
volume	14
number	2/3
page range	239-240
year	1994-01-31
URL	http://hdl.handle.net/10097/25817

Origin of Far-Infrared Emission in Seyfert and Starburst Galaxies

Hideaki MOURI

Meteorological Research Institute

Abstract

The origin of far-infrared (FIR) emission in active galactic nuclei (AGNs) and starburst nuclei (SBNs) is investigated by means of correlation analyses. The 25 to 60 μm spectral index [α(25,60)], the intensity ratio of [OI]6300 to Hα ([OI]/Hα), that of H_2 v = 1-0 S(1) 2.12 μm to Brγ [S(1)/Brγ], and that of 3.28 μm feature to Brγ (3.28μm/Brγ) are submitted to the analyses. Here [OI]/Hα is a well-known discriminator between AGNs and SBNs; AGNs are distinguished from SBNs by their large values of [OI]/Hα.

First, we show that S(1)/Brγ is linearly correlated with [OI]/Hα (Fig.1). As in the case of [OI]/Hα, S(1)/Brγ is enhanced in AGNs over SBNs. Thus S(1) line provides a good discriminator between AGNs and SBNs, as the [OI] line does. Utilizing the S(1)-[OI] correlation, we discuss the excitation mechanisms of S(1) emission. In AGNs, X-ray heating is the most plausible excitation mechanism for S(1) and [OI], while they appear to be shock-excited in SBNs (see ApJ,346,L73 for the details).

Next, α(25,60) is compared with [OI]/Hα and S(1)/Brγ (Fig.2). In SBNs, α(25,60) correlates well with these line ratios. To explain the correlations, we adopt the following excitation mechanisms: (1) 25 μm emission is emitted by dust in ionized gas heated by Lyα and ionizing photons; (2) 60 μm emission is emitted by dust in molecular clouds heated by nonionizing photons; and (3) [OI] and S(1) are powered by supernovae. Nonionizing photons are from O and B stars (supernova progenitors), while ionizing photons are from O stars. Therefore, with an increase in the number of B stars relative to O stars, the 25-60 μm slope becomes steeper, and the ratios of [OI]/Hα and S(1)/Brγ become larger. In this way, the α(25,60)-[OI]/Hα and α(25,60)-S(1)/Brγ correlations are attributable to a sequence of relative content of high-mass stars.

On the other hand, AGNs scatter widely in the plots of α(25,60) versus [OI]/Hα and of α(25,60) versus S(1)/Brγ. In these plots, AGNs with starburst activity display steep 25-60 μm slopes, and follow the correlations obtained for SBNs. Thus FIR emission in AGNs is a mixture of the flat component from a nonthermal source and the steep component from dust heated by young stars, with their fractions varying from one to another. Notably, some AGNs show steeper 25-60 μm slopes than SBNs, indicating the predominance of B stars. This

suggests the difference in starburst activity between SBNs and AGNs (see ApJ,386,68 for the details).

Finally, 3.28μm/Brγ is compared with S(1)/Brγ. SBNs show a good correlation between these ratios. Since the 3.28 μm emission is excited by nonionizing UV photons from OB stars, the S(1)-3.28 μm correlation can be explained by the same scenario as applied to the α(25,60)-S(1)/Brγ one. The S(1)-3.28 μm correlation is also followed by AGNs having intense starbursts. However, other AGNs exhibit smaller intensity ratios of 3.28 μm to S(1). This trend is due to the excitation of S(1) and the destruction of 3.28 μm-emitting material by X-rays from Seyfert nuclei. Hence 3.28μm/S(1) indicates the relative importance of OB stars and Seyfert activity in individual galaxies (see ApJ, 356,L39 for the details).

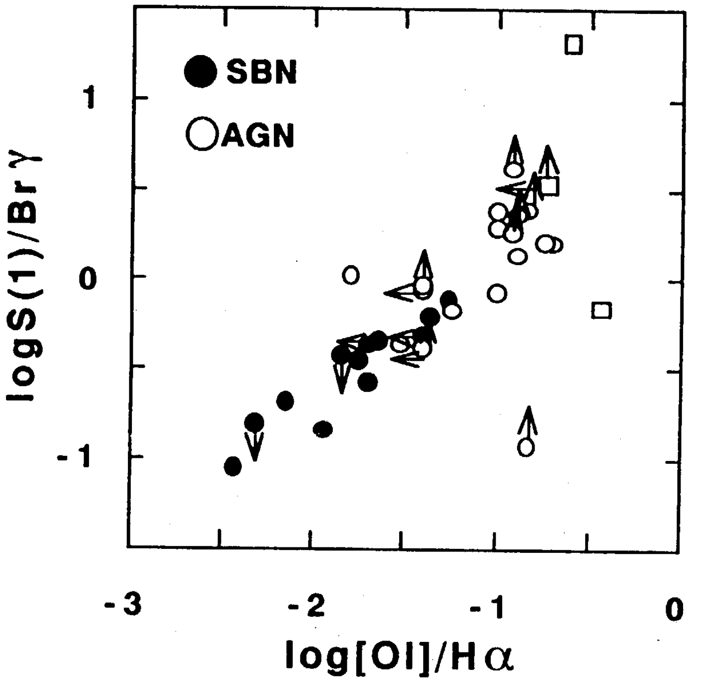

Fig.1 [OI]/Hα versus S(1)/Brγ. Filled circles, open circles, and open squares stand for SBNs, AGNs, and LINERs (low-ionization nuclear emitting regions), respectively.

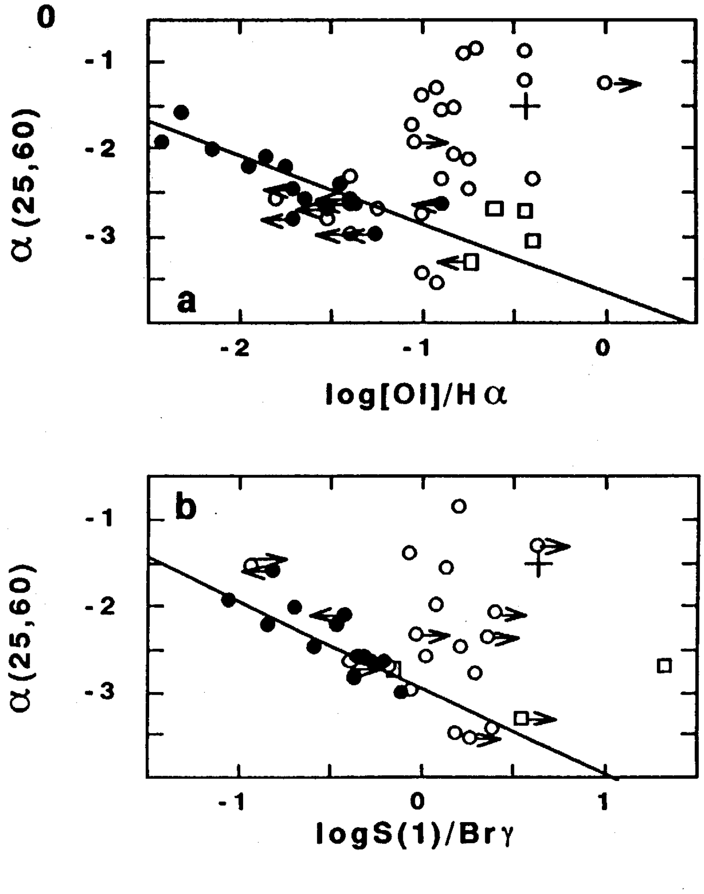

Fig.2 a) α(25,60) vs. [OI]/Hα; b) α(25,60) vs. S(1)/Brγ. Symbols are the same as in Fig.1. The straight lines are the least-squares fit to the SBN data. The cross in Panel (a) indicates the powet-law photoionization model of Stasinska (1984, A&A,135,341). The cross in Panel b) indicates the power-law X-ray heating model of Lepp & McCray (1983, ApJ, 269,560).