PROCEEDINGS OF SCIENCE

AKARI/IRC Imaging Observations of the Merger Remnant NGC 2782

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We present the observations of the peculiar galaxy NGC 2782 at six infrared bands of the Infrared Camera (IRC) onboard *AKARI*. NGC 2782 is known as a merger remnant and shows a large HI gas tail ($\sim$ 50kpc) in the western side of the galaxy. Another tail ($\sim$ 25kpc) is also seen in the eastern side. It is thought that NGC 2782 underwent a violent merger event, in which unequal mass galaxies made a nearly head-on collision. Most of the gas component of the companion galaxy, which collided with the main galaxy from the west and went through it, has been stripped off in the collision, making the eastern tail of the HI gas and leaving a relic of the stellar component at the east of the main galaxy. The IRC images show that the distribution at S7 (7μm) and S11 (11μm), both of which contain the PAH emission at 6.2 and 7.7μm, and 11.3μm, respectively, has an extended structure very similar to the HI eastern tail. Also the S7 to S11 color, which is supposed to be sensitive to the ionization fraction of PAHs, is found to remain almost constant in the galaxy. We try to fit the observed fluxes using the `DustEM` code. The nuclear region ($< 15''$) shows strong emission at 15 and 24 μm, which can be accounted for either by an increase of very small grains or an increase of the incident radiation field intensity. In the eastern tail region, the SED can be fitted with a weak interstellar radiation field and a decrease in the abundance of large dust grains or an increase of PAHs. The latter suggests that PAHs are selectively stripped along with the HI gas. In this case PAHs must survive for more than a few 100 Myr after the merger event probably because of the weak stellar radiation.

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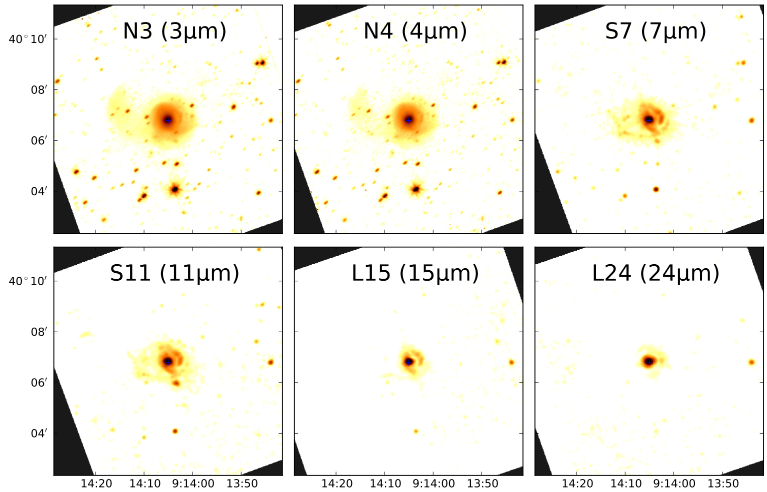

Figure 1: *AKARI*/IRC images of NGC 2782. While the objects in near-infrared images (N3, N4) are dominated by stellar components, those in mid-infrared images (S7, S11, L15, L24) indicate the distribution of PAHs and very small grains.

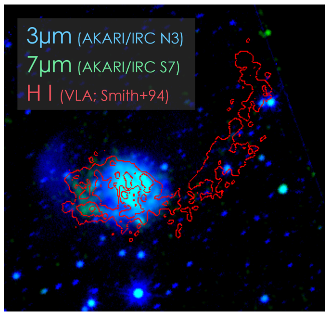

Figure 2: HI 21cm contour [3] on the N3 and S7 images. The PAH distribution indicated by S7 image is in excellent agreement with the HI gas component in the eastern tail.

1. Introduction

Galaxy mergers are interesting objects for the study of physics of interstellar dust. Gravitational interactions between galaxies cause dynamical and chemical evolution of interstellar dust grains. Although it was difficult to observe mergers at mid-infrared wavelengths in the past, recent infrared space telescopes such as *AKARI* and *Spitzer* can make observations with sufficient sensitivity and spatial resolution [1, 2].

NGC 2782 is a merger remnant at a distance of 34 Mpc. This galaxy has a large HI gas tail ($\sim$50 kpc) located in the western side of the object. On the eastern side, there is another tail ($\sim$25 kpc) formed by stellar components without any molecular gas. These structures are considered to be formed by a nearly head-on collision of two disk galaxies with a mass ratio of $\sim$0.25 at least a few 100 Myr ago [3, 4]. This galaxy shows structures of ripples and arcs, which are commonly seen in galactic mergers. Previous studies have revealed that it also contains an AGN, a nuclear bar and the two dust lanes which extend from each edge of the nuclear bar [3, 5]. However, a direct observation of dust emission from the dust lanes has not yet been done.

The Infrared Camera (IRC [6]) on the *AKARI* satellite [7] has six band-pass filters from near-infrared (NIR) to mid-infrared (MIR). The MIR filters enable detailed analysis of the distribution of Polycyclic Aromatic Hydrocarbons (PAHs) and dust grains. We conducted imaging observations of NGC 2782 with higher spatial resolution than ever before in MIR wavelengths.

2. Observations

We observed NGC 2782 with *AKARI*, which was a part of the mission program, “ISM in our Galaxy and Nearby Galaxies" (ISMGN [8]). The AOT02 (astronomical observation template) was used for these observations. Figure 1 shows the images of NGC 2782 with the six band-pass filters. The N3 and N4 images show the eastern tail consisting of stellar components. Another structure can be seen at the eastern tail in the S7 and S11 images, both of which contain the PAH emission at 6.2 and 7.7μm, and 11.3μm, respectively. In addition, there is a slightly extended structure from the center to the north and south in the mid-infrared images, which corresponds to the dark lanes in optical images [5]. Hunt et al.[4] reported that CO gas also exists at the same place and is falling into the nuclear bar. Figure 2 shows a clear correlation between the H I eastern tail and the distribution of the PAH component, which is expressed in the 7μm image. This suggests that the PAHs were stripped with the H I gas as a result of the galaxy collision.

We also retrieved the IRS and MIPS data from the *Spitzer* archive. The spatial distribution of the nuclear region can be fitted with a Gaussian function. The extracted IRS SL and LL spectra were adjusted to the intensity obtained by *AKARI*. For the MIPS data, the aperture photometry was carried out, assuming that all of the far-infrared flux originates from the nuclear region. The results are displayed in Figure 3.

3. Analysis

We try to fit the observed fluxes using the `DustEM` code [9], which predicts the emission and extinction of dust grains, such as polycyclic aromatic hydrocarbons (PAH), very small grains (VSG) and large grains (LG). Figure 3 shows the fitting results and Table 1 summarizes the fitted values of dust composition and the radiation field intensity in the nuclear region, within 15 arcseconds of the center. The strong emission around 20μm can be accounted for by an increase of the very small amorphous carbon grains (#1) or an increase of the incident radiation field (#2).

Figure 4 shows the fitting result of the the eastern tail region. The data points are given by aperture photometry for the *AKARI* images. Though there is a large uncertainty at the 24 μm data, the SED of the tail can be reproduced by the PAH emission in a weak interstellar field alone, which is similar to the diffuse interstellar medium at high-galactic latitudes (DHGL [9]). This suggests that the eastern tail region has a large abundance of PAHs relative to the VSGs probably because PAHs are selectively stripped along with the H I gas component.

Acknowledgments

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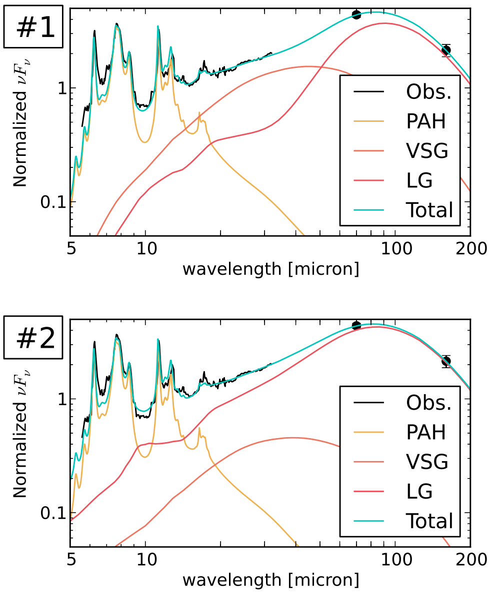

Figure 3: The SED of the nuclear region obtained by *Spitzer*/IRS and MIPS (black) and the fitted SEDs by `DustEM` (color lines). The upper panel (#1) displays a fitting result under the condition that the maximum incident radiation field (U_{max}) is fixed to 10^6, and the lower panel (#2) without any restriction.

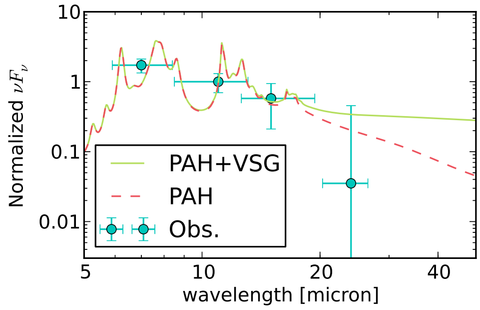

Figure 4: The SED of the eastern tail region given by the *AKARI*/IRC imaging data. The color lines are model SEDs in the diffuse interstellar medium at high-galactic latitudes (DHGL).

Table 1: The best parameters for the nuclear region.

	NGC 2782		DHGL
	#1	#2	
	Dust abundance ratio		
PAH	4.4 %	3.1 %	7.7 %
VSG	7.1 %	1.7 %	1.6 %
LG	88.5 %	95.2 %	90.7 %
	Incident radiation field		
U_{min}	7.6	4.5	1.0
U_{max}	(10^6)	2.1×10^6	-
γ	0.017	0.28	-

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