A new detection of the cold dust component in the bipolar planetary nebula Mz3 with miniTAO/MAX38 31 micron image

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We present a mid-infrared 31 micron image of bipolar planetary nebula (PN) Mz3, observed by miniTAO/MAX38 (Mid-infrared Astronomical eXplorer). In this observation, we found a large amount of new cold dust surrounding the central star of Mz3.

PNe are a low to intermediate mass star as the star makes the transition from red giant to white dwarf. The number of low to intermediate mass star is so large in our galaxy thus PNe play an important role in interstellar dust formation. In addition, PNe have wide variety of shapes (Balick & Franck 2002) and no one can succeed to explain completely how these shapes are formed by now, especially for bipolar PN. Their shapes strongly depend on their mass-loss histories, but the details of the history are still unknown. In order to understand the mechanism of their formation, it is important to understand to dust distribution in PN.

Warm dust components in PN have been studied well in visible and near-infrared (NIR) wavelength, while their cold dust component, especially at around 100K, have not been studied well. This is because there are only a few instruments in the world which can obtain MIR emission from such cold dust with high spatial resolution. We obtained a 31 micron image of Mz3 which is one of the most famous bipolar planetary nebula, with miniTAO/MAX38 in May 2011. MAX38 is a mid-infrared camera for imaging in 8–38 micron wavelength range. This is the only instrument which can access the 30-micron wavelength region from the ground.

Applying aperture photometry to the 31 micron image of Mz3, we find that a large amount of cold dust is distributed around central star. Surprisingly, it corresponds to $1.6\times10^{-3}\mathrm{M}_\odot$, a half of total dust. Our result is different from that of Smith et al. (2005) who conclude almost all cold dust components of Mz3 are located in bipolar lobe as shown in Table1 (Smith+ 2005). The difference between our result and Smith et al. (2005) can be explained by the fact that they were not able to trace such cold dust with their 18 micron images.

		Smith+ 2005	this work
warm component around central star	dust mass [$\mathrm{M}_\odot$]	1.1×10^{-6}	1.0×10^{-6}
	temperature [K]	320	230
cold component around central star	dust mass [$\mathrm{M}_\odot$]	none	1.0×10^{-3}
	temperature [K]	none	70
cold component in bipolar lobe	dust mass [$\mathrm{M}_\odot$]	2.6×10^{-3}	1.6×10^{-3}
	temperature [K]	110	80

Table 1: A new detection of cold dust component

References

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Chesneau,O., et al. 2007, A&A, 473L, 29C