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Comparison between Dust Color Temperature Distribution of Far Infrared Cavities Located Nearby WD0432+269 and WD1814+248

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Abstract **- We have studied the variation of dust color temperature of cavities located nearby WD0432+269 and WD1814+248. It is found that the respective temperatures of these cavities are (18.00 ± 2.11) K to (23.73 ± 0.76) K and (23.16 ±1.34) K to (31.25 ±2.85) K. The dust color temperature contour map, the flux density at 60μm versus 100 μm plot, and Gaussian plot of dust color temperature around both white dwarfs is discussed..The possible cause of variation in both cavities will be presented.**

Keywords **- White dwarfs, Dust color temperature, Cavity**

I. INTRODUCTION

White dwarfs are mostly composed of carbon, oxygen and helium. During Main sequence star and Post main sequence star its mass is 2-8M_{sun} and 0.6-1.4M_{sun} respectively. No white dwarf is formed when mass is greater than 1.4M_{sun}.This is called Chandrasekhar limit. The mass of tea spoonful white dwarf is about 5 metric ton. During giant phase when the central helium is exhausted, helium burning moves over to a shell. At the same time, outer part expands and star loses some its mass. The expanding envelope forms a planetary nebula. The star in the centre of nebula becomes a white dwarf.

The region between white dwarf, neutron star, blackhole and normal star is called interstellar medium (ISM). The main component of ISM is interstellar gas, interstellar dust and interstellar molecules. As a mass fraction, the dust consists of 0.1% in ISM. These are solid particles having dimension 0.1 to 1μm and made of mainly silicate, graphite, ice etc. Dusts take main role to absorb radiation and re-radiation. Physical properties around white dwarf can be studied by measuring temperature and mass of dust around it [1, 2].

II. LITERATURE REVIEW

Mebold et al. (1985) takes support for identifying the Draco cloud as an high velocity cloud falling onto the galactic plane, illuminated by ambient stellar radiation, and interacting with the local interstellar medium (ISM) [3].They put forward that the Draco cloud represents an intermediate phase of the evolution of halo or extragalactic gas cloud the process of merging with our Galaxy. The Infrared Astronomical Satellite (IRAS) identified a large scale "cirrus" component (Low et al.1984) that dominates the infrared sky at 100μm. [4] Weiland et al. (1986) have confirmed that the brightest cirrus features are also coincident with some of the high latitude CO clouds recently detected by Blitz, Magnani, and Mundy (1984) [5,6]. These CO clouds are accepted to be within nearly 100 pc of the sun, have sizes nearly 1 pc and are probably not gravitationally bound.

Collimated jets are observed in a variety of astrophysical objects. They have been noticed in quasars, active galactic nuclei, stellar binaries, young stellar objects, planetary nebulae (PNe) and pulsars. However, despite large efforts, there is still no definite concurrence as to the mechanisms that give rise to the acceleration and to collimation of these jets. Herbig-Haro (HH) jets (Bally & Reipurth 2002) and jets in PNe (Sahai 2002) are among the best studied classes and there is growing evidence that both probably not only share morphological similarities, but also the same basic physical principles[7,8]. R. Weinberger and B.

Armsdorfer (2004) detected these adjacent objects while systematically searching for large dust structures around PNe and white dwarfs on IRAS 12-100 µm maps (via sky view virtual observatory).The objects - which morphological closely resemble HH jets - are visible at 60 and 100 µm only. Although the IRAS mission took place two decades ago, the maps are still not exhausted of their riches, as they could demonstrate by e. g. the discovery jet like structures (size ~9° each) found in the far infrared [9].

B. Aryal and R. Weinberger (2006) presented a large new high galactic latitude cone like far infrared nebula (RA=08^h 27^m 5^s, Dec=+25° 53' 59" (J2000)) at 100µm and 60µm IRAS images. With SIMBAD they found three possible candidates, namely an M-type emmisionstar (RX J082605.8+262740) carbon white dwarf star (WD 0824+288) and pulsar (PSR B0823+26). These were selected because (1) all of them are rather nearby, (2) they might emit a wind in the course of evolution (3) the show some pecular properties, and (4) they are placed at a suitable apparent location with respect to the nebula [10].

In the present work we intend to compare the dust color temperature in two far infrared cavities located nearby white dwarfs WD0432+269 and WD1814+248. These cavities are expected to be formed by these white dwarfs during their evolution.

III. MATERIALS AND METHODS

We have compiled a database of 1978 number of white dwarfs which are listed in the catalogue of Holberg et. al. [11]. Out of which we have compared WD0432+269 and WD1814+248 here. We have carried out a systematic search of IRAS maps available in the sky view virtual observatory (http://skyview.gsfc.nasa.gov). These sample white dwarfs have the right ascension of 04^h 35^m 59^{s}and 18^{h}16^m 08^{s}and declination of +27° 02^m 05^s and +24°54^m 48^s respectively in equatorial coordinate system. The following input parameters were used for the search: (1) Coordinate: J2000, (2) Projection: Gnomonic (Tan), (3) Image size (pixel): 500×500 (4) Image size (degrees): $0.5^0 \times 0.5^0$ (5) Brightness Scaling: Histogram Equilization (HistEq) (6) Colour Table: Stern Special.

We have downloaded Flexible Image Transport System (FITS) v3 image of the selected region. We selected FITS format of $0.5^0 \times 0.5^0$ at 60 and 100µm for the image processing. Using ALADIN v2.5 software the FITS image carries the information concerning the flux density, temperature, position, etc for each pixels.

Aladin v2.5 is an interactive sky atlas developed and maintained by the Center de Donne's astronomiques de Strasbourg (CDS) for the identification of astronomical sources through visual analysis of reference sky images. Aladin v2.5 allows the user to visualize digitized images of any part of the sky, to superimpose entries from the CDS astronomical catalogues and tables, and to interactively access related data and information from SIMBAD, NED or other archives of all known objects in the field.

In ordered to separate the region of minimum flux density region, contours are drawn at 60 and 100 µm respectively. Because we are interested to study temperature of the region. We intend to study the cavity - like structure at 60 µm and 100 µm.

In both white dwarfs, measured flux density is subtracted with the background values. Background flux is the flux emitted by other sources lying nearby the region of interest (not from the region of interest). The average value of the background flux is obtained by noting and summing up of the minimum flux densities around the region of interest and dividing the sum by total number of pixel with this minimum flux density. When this background flux is subtracted from the obtained flux density of each pixels in the region of interest, it is said to be background flux density.

Dust color temperature can be estimated by using following relation [12]

$$T_d = -96 \frac{1}{ln\{R \times 0.6^{(3+\beta)}\}} \quad \text{……(3.1)}$$

Where, R is given by

$$R=\frac{F(60\ \mu m)}{F(100\ \mu m)} \qquad \ldots\ldots(3.2)$$

$F(60\ \mu m)$ and $F(100\ \mu m)$ are the flux densities at 60 μm and 100 μm, respectively. Here, we use β=2 for cloud of shape crystalline, dielectric or metals [13].

IV. RESULT AND DISCUSSION

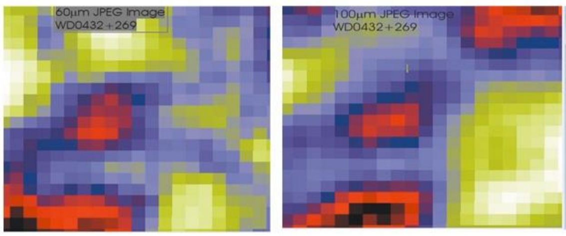

Fig. 4.1 0.5 ^{0}×0.5^{0} JPEG image of the region centered at Right Ascension (J2000)=04^{h} 35^{m} 59^{s},Declination. (J2000) = +27^{0} 48^{s} 02^{m} 05^{s} at 60µm (left) and 100µm (right) of WD 0432+269

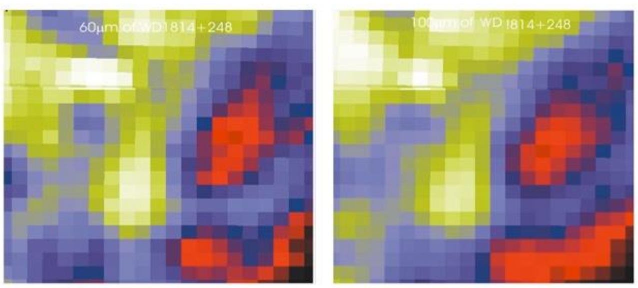

Fig. 4.2. 0.5^{0}×0.5^{0} JPEG image of the region centered at Right Ascension (J2000)=18^{h} 16^{m} 08^{s},Declination (J2000)=+24 ^{0}54^{m} 48^{s} at 60µm (left) and 100µm (right) of WD 1814+248

In both figures 4.1 and 4.2, black color represents region of minimum flux but white color represents region of maximum flux.

Fig. 4.3. Cavity formed in white dwarfs WD0432+269 (left) and in WD1814+248 (right) of contour level in 80 and 47 respectively. The size of image is 0.5^{0}×0.5^{0} at 100 µm IRAS maps.

Fig. 4.3 represents that the white dwarf is inside the cavity in the first case and white dwarf outside the cavity in the second case. The region of maximum flux is represented by black color and minimum by white color in both figures.

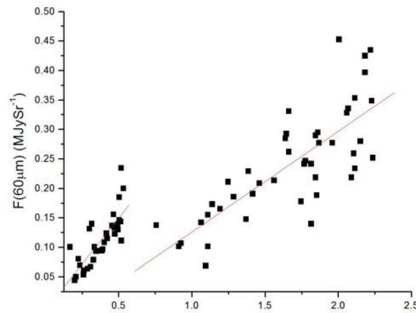

Fig. 4.4 Linear graph drawn relative flux density,F(wavelength at 60 micron) veruss F(wavelength at 100 micron) in white dwarfs WD0432+269 (right) and in WD1814+248 (left)

Fig. 4.4 represents the relative flux density of concerned white dwarfs. The left linear curve has slope(R) = 0.31 and correlation coefficient =0.60.The average temperature is 25.84K where as individual temperature of each pixel varies 23.16 to 31.25K.The right linear curve has slope (R)=0.17 and correlation coefficient=0.60. The average temperature of cavity is 22.22K where as individual temperature of each pixel varies 18K to 23.73K.

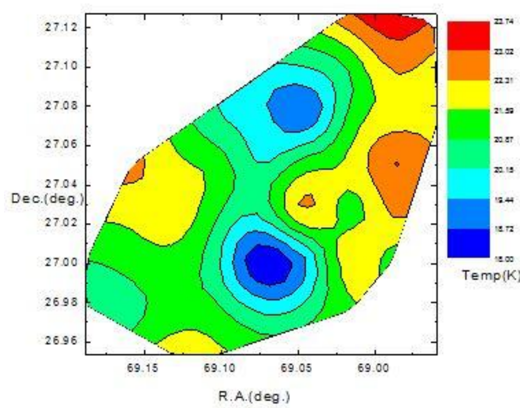

Fig. 4.5 Contour map of dust color temperature of white dwarfs WD0432+269

Fig. 4.5 represents dust color temperature with respect to right ascension (R.A.) and declination (dec.). The blue color indicates the minimum temperature in two pole and red color in the north direction has maximum temperature.

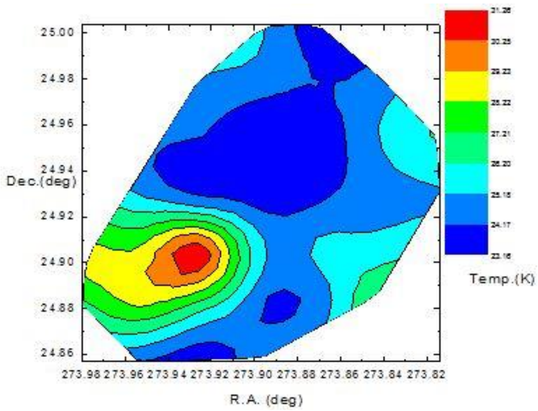

Fig. 4.6 Contour map of dust color temperature of white dwarfs WD1814+248 at R.A. (J2000)=04^{h} 35^{m} 59^{s}, Dec. (J2000)=+27

Fig. 4.6 also represents two dimensional scatter plot with projection of temperature in X and Y plane. The north and south region of the cavity is covered by minimum temperature (i.e blue color).The maximum temperature (i.e red color) in the cavity is in the north east direction.

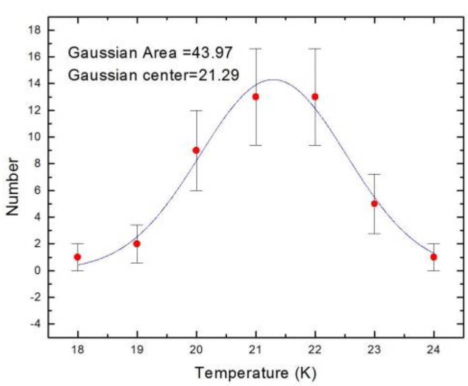

Fig. 4.7 Distribution of dust color temperature of white dwarfs WD0432+269. The blue solid curve represents the Gaussian fit and the ±1σ statistical error bars (i.e. red) are shown. Also σ=√n.

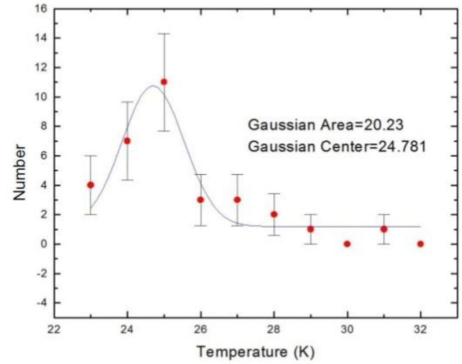

Fig. 4.8 Distribution of dust color temperature of white dwarfs WD1814+248. The blue solid curve represents the Gaussian fit and ±1σ statistical error bars (i.e .red) are shown. Also σ=√n.

Fig. 4.7 indicates that the Gaussian distribution is symmetric and the cavity formed around the white dwarf WD0432+269 is in thermal equilibrium and is stable. But fig. 4.8 indicates that Gaussian distribution is not symmetric and the cavity formed outside the white dwarf WD1814+248 is not in thermal equilibrium and the cavity formed by external sources i.e. White dwarf , Supernova explosion etc .

V. CONCLUSION

The average temperature of the cavity formed outside the WD1814+248 and WD0432+269 are found to be 25.84 K and 22.22K respectively. The dust mass in the former white dwarf is more than that of later white dwarf. The curve of distribution of dust color temperature indicates that the cavity near to WD1814+248 possibly form due to high pressure event (e.g., supernova explosion) whereas cavity formed around WD0432+269 is due to natural phenomenon. Also the size of cavity formed around it is large.

VI. REFERENCES

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