ALMA Band 3 で捉えたHD 142527 の連続波とCO分子輝線
Band 3 continuum and CO molecular line observations towards HD 142527 with ALMA

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We present the observational results of dust continuum, $^{13}C^{16}O$ J = 1 −0, and $^{12}C^{16}O$ J = 1 −0 emissions from the disk surrounding a Herbig Fe star, HD 142527, taken in Band 3 (~ 100 GHz) with ALMA in its Cycle 2. This study is the first to show the spatially and spectrally resolved J = 1 −0 rotational emissions of the CO molecules. The synthesized beams of the observations are approximately 50 mas, and the spectral resolutions for the CO molecular observations are 0.04 km s^{-1}.

The dust disk is observed to be divided into two parts, an inner disk and an outer disk, by a dust-depleted region. While the former is not resolved by the beam, the outer disk is detected out to a radius of 2 arcsec from the central star, and depending on the position angle its inner radius ranges from 0.5 arcsec to 1 arcsec. HD 142527 is known for its crescent-like outer disk in the millimeter and longer wavelengths, and our observation reveal the same non-axisymmetric features, where the disk northern region is brighter than the southern region. The peak intensity of the outer disk, as a function of position angle *P.A.* and radius *r*, shows a maximum of 11.5 mJy beam^{-1} at *P.A.* = 10°, *r* = 1.1 arcsec, and a minimum of 0.2 mJy beam^{-1} at *P.A.* = 237°, *r* = 1.3 arcsec; the contrast in intensity is thus about 60 between the two direction. The gas spatial distribution traced by $^{13}C^{16}O$ J = 1 −0 line emission resembles that of the J = 3 −2 of the same molecule; its integrated intensity is more axisymmetric and does not differ by more than a factor of two in the azimuthal direction.In addition, $^{13}C^{16}O$ is most probably optically thick as its brightness temperature is as high as 40 K even at 1 arcsec from the star. On the other hand, the distribution of the $^{12}C^{18}O$ J = 1 −0 integrated intensity, unlike its J = 3 −2 counterpart which shows an axisymmetric distribution around the central star, departs substantially from the azimuthal symmetry; its emission concentrates in the northern part of the disk that is about 25 K in brightness temperature, with almost no appreciable detection above a signal-to-noise ratio of 5 in the southern half. The distribution is therefore similar to the continuum emission.

We perform a quick analysis to derive the gas column density of the disk by assuming a gas-to-dust ratio of 100 and a uniform T_{ex} = 35 K (the brightness temperature, and physical temperature if optically thick, of $^{13}C^{16}O$ at the peak continuum emission) in the disk. We use the prescribed dust opacity by Beckwith et al. 1990, where the opacity is $\kappa = 0.1(\nu/10^{12}\ \mathrm{Hz})^{\beta}$ cm^2 g^{-1}. A certain degree of grain growth is expected in the disk, thus we let the spectral slope β to be unity. The resulting opacity is $\kappa = 0.01$ cm^2 g^{-1} at 99.5 GHz. We derived the gas column density to be 21 g cm^{-2} and 0.3 g cm^{-2} at the location of the maximum and the minimum peak intensity, respectively. However, we understand that since the dust is most likely to sediment at the disk midplane and the gas-to-dust ratio may vary across the disk, estimation of the gas mass can be improved by using the results of CO molecular lines, which will be discussed in the

presentation.

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