

Dust Polarization Study of Prestellar and Protostellar Sources in OMC-3 with ALMA

柳, 玉華

<https://hdl.handle.net/2324/7182303>

出版情報 : Kyushu University, 2023, 博士 (理学) , 課程博士
バージョン :
権利関係 :



氏 名 : 柳 玉華

論 文 名 : Dust Polarization Study of Prestellar and Protostellar Sources in OMC-3 with ALMA

(ALMA による OMC-3 における原始星と星なし天体ダスト偏波研究)

区 分 : 甲

論 文 内 容 の 要 旨

Magnetic fields are considered to play an important role in regulating star formation. Polarized emission from dust grains at (sub)millimeter wavelengths is used as an effective tracer to probe configuration of magnetic fields (e.g., Shu et al. 1987; Hildebrand 1988; Crutcher et al. 2012; Hull & Zhang 2019). Recent Atacama Large Millimeter/submillimeter Array (ALMA) observations has achieved better sensitivity and resolution enabling the dust polarization observations on the small scale ($\sim 10\text{--}100$ au), and these observations suggest that there are alternative mechanisms producing polarized emission such as self-scattering of thermal dust emission (e.g., Kataoka et al. 2015, 2017; Stephens et al. 2017; Yang et al. 2017). These observations suggest that there are alternative mechanisms producing polarized emission such as self-scattering of thermal dust emission (e.g., Kataoka et al. 2015, 2017; Yang et al. 2017) and radiative torque (Tazaki et al. 2017). Polarization due to self-scattering could be detected at the inner region of the disk (Kataoka et al. 2016b). Therefore, dust polarization due to self-scattering is also an effective tool to constrain the dust grain size in the optically thick region (Kataoka et al. 2016b). Grain size constraints are important because they are related to the dust growth, which is the first step towards understanding the composition and properties of protoplanetary disks and the formation of planets within them.

This study presents the ALMA observations of linearly polarized 1.1 mm continuum emission at present the ALMA observations of linearly polarized 1.1 mm continuum emission at $\sim 0.14''$ (55 au) resolution and CO ($J=2-1$) emission at $\sim 1.5''$ (590 au) resolution towards one prestellar (MMS 4), four Class 0 (MMS 1, MMS 3, MMS 5, and MMS 6), one Class I (MMS 7), and one flat-spectrum (MMS 2) sources in the Orion Molecular Cloud 3 (OMC-3) region. The dust disk-like structures and clear CO outflows are detected towards all sources except for MMS 4. The diameters of these disk-like structures are estimated based on the deconvolved sizes obtained from two dimensional (2D) Gaussian fitting, ranging from 16 au to 97 au. Polarized emissions are detected towards MMS 2, MMS 5, MMS 6, and MMS 7, while no polarized emission is detected towards MMS 1, MMS 3, and MMS 4. Organized polarization vectors aligned with the minor axes of the disk-like structures are detected towards MMS 2, MMS 5, and MMS 7 and their mean polarization fractions are between 0.6% and 1.2%. One of the Class 0 sources, MMS 6, exhibited complex polarization orientations and a remarkably high polarization fraction of $\sim 10\%$ around the Stokes I peak, and 15-20% on the

arm-like structure, as reported by Takahashi et al. (2019). The origins of the polarized emission, such as self-scattering and dust alignment due to the magnetic field or radiative torque, are discussed for individual sources. Some disk-like sources exhibit a polarized intensity peak shift towards the nearside of the disk, which supports that the polarized emission originates from self-scattering.