

Near-infrared Imaging Observations of Circumstellar Disk around HD 169142 with Subaru/HiCIAO

MOMOSE, Munetake¹, MORITA, Ayaka¹, FUKAGAWA, Misato², MUTO, Takayuki³, TAKEUCHI, Taku⁴, HASHIMOTO, Jun^{2/5}
 HONDA, Mitsuhiro⁶, KUDO, Tomoyuki², OKAMOTO, Yoshiko K.¹, KANAGAWA, Kazuhiro D.⁷, TANAKA, Hidekazu⁸
 GRADY, Carol A.^{9/10/11}, SITKO, Michael L.^{12/13}, AKIYAMA, Eiji², CURRIE, Thayne², FOLLETTE, Katherine B.¹⁴
 MAYAMA, Satoshi¹⁵, KUSAKABE, Nobuhiko^{2/5}, ABE, Lyu¹⁶, BRANDNER, Wolfgang¹⁷, BRANDT, Timothy D.¹⁸
 CARSON, Joseph C.¹⁹, EGNER, Sebastian², FELDT, Markus¹⁷, GOTO, Miwa²⁰, GUYON, Olivier², HAYASHI, Yutaka²
 HAYASHI, Masahiko², HAYASHI, Saeko S.², HENNING, Thomas¹⁷, HODAPP, Klaus W.²¹, ISHII, Miki², IYE, Masanori²
 JANSON, Markus²⁴, KANDORI, Ryo², KNAPP, Gillian R.²³, KUZUHARA, Masayuki⁴, KWON, Jungmi²⁴, MATSUO, Taro²⁵
 McELWAIN, Michael W.⁹, MIYAMA, Shoken²⁶, MORINO, Jun-Ichi², MORO-MARTIN, Amaya^{23/27}, NISHIMURA, Tetsuo²
 PYO, Tae-Soo², SERABYN, Eugene²⁸, SUENAGA, Takuya^{2/15}, SUTO, Hiroshi², SUZUKI, Ryuji², TAKAHASHI, Yasuhiro H.^{2/24}
 TAKAMI, Michihiro²⁹, TAKATO, Naruhisa², TERADA, Hiroshi², THALMANN, Christian³⁰, TOMONO, Daigo²
 TURNER, Edwin L.^{23/24}, WATANABE, Makoto³¹, WISNIEWSKI, John³², YAMADA, Toru³³, TAKAMI, Hideki²
 USUDA, Tomonori², TAMURA, Motohide^{2/5/24}

1: Ibaraki University, 2: NAOJ, 3: Kogakuin University, 4: Tokyo Tech., 4: ABC, 6: Kurume University, 7: Szczecin University, 8: Tohoku University, 9: Goddard Space Flight Center, 10: Eureka Scientific, 11: Goddard Center for Astrobiology, 12: Space Science Institute, 13: University of Cincinnati, 14: University of Arizona, 15: Sokendai, 16: Université de Nice-Sophia Antipolis, 17: Max Planck Institute for Astronomy, 18: Institute for Advanced Study, Princeton, 19: College of Charleston, 20: Universitäts-Sternwarte München, 21: University of Hawaii, 22: Stockholm University, 23: Princeton University, 24: University of Tokyo, 25: Osaka University, 26: Hiroshima University, 27: CAB-CSIC/INTA, 28: Jet Propulsion Laboratory, 29: Institute of Astronomy and Astrophysics, Academia Sinica, 30: University of Amsterdam, 31: Hokkaido University, 32: University of Oklahoma, 33: ISAS/JAXA

HD 169142 is a Herbig Ae star (A8 Ve) located at a distance of 145 pc from the Sun [1]. Interferometric observations at millimeter and submillimeter wavelengths revealed a circumstellar disk around HD 169142, with the radius of 1.4" (≈ 200 au) and with its inclination angle of 13° [2,3]. Near-infrared imaging with the HST coronagraph also detected scattered light with similar size [1]. The amount of excess emission at mid-infrared wavelengths is small, suggesting that the outer disk is truncated at $\sim 0.15''$ (~ 20 au) from the star [4,5]. We carried out polarization differential imaging (PDI) of the disk scattered light in H-band with Subaru/HiCIAO.

Figure 1 shows the obtained polarized intensity (PI) image. The emission scattered by dust particles at the disk surface in $0.2'' \leq r \leq 1.2''$, or $29 \leq r \leq 174$ au, is successfully detected. The azimuthally-averaged radial profile of the PI, shown in Figure 2, manifests a double power-law distribution, in which the PIs in $r = 29\text{--}52$ au and $r = 81.2\text{--}145$ au respectively show r^{-3} -dependence. These two power-law regions are connected smoothly

with a transition zone, exhibiting an apparent gap in $r = 40\text{--}70$ au.

The observed radial profile of the PI is reproduced by a minimally flaring disk with an irregular surface density distribution or with an irregular temperature distribution or with the combination of both. The depletion factor of surface density in the inner power-law region ($r < 50$ au) is derived to be ≥ 0.16 from a simple model calculation. The obtained PI image also shows small scale asymmetries in the outer power-law region. Possible origins for these asymmetries include corrugation of the scattering surface in the outer region, and shadowing effect by a puffed up structure in the inner power-law region.

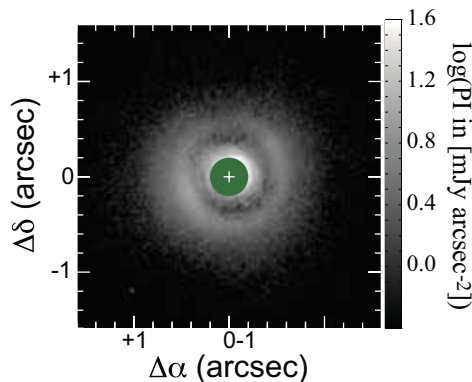


Figure 1: PI image with HiCIAO. Green circle and white cross indicate the masked region and stellar position, respectively.

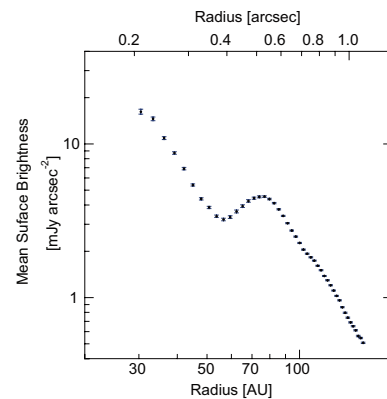


Figure 2: Azimuthally-averaged radial profile of PI surface brightness.

References

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