X49a Chandra and ALMA Study of X-ray Irradiated Inter Stellar Media in the Central 100 pc of Circinus Galaxy

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We report a study of X-ray irradiated inter stellar media in the central ∼100 pc of Circinus galaxy based on *Chandra* and ALMA high spatial resolution (≈ 1 arcsec or 20 pc at 4.2 Mpc) data. The ALMA data in Band 6 and 7 cover five molecular gas emission lines: CO(3–2), HCN(3–2), HCN(4–3), HCO^+(3–2), and HCO^+(4–3). The ∼300 ksec *Chandra*/ACIS data are utilized to produce maps of iron lines around 6 keV, tracing X-ray irradiated dense gas. They are compared with that of HCO^+(4–3), observed most precisely among all the lines. Its high critical density is indeed beneficial to particularly focus on the gas that likely associates with the nuclear, dense gas region. We find that the molecular gas emission is suppressed in iron line bright regions, and seems to be bright preferably beyond the outer limbs. This fact evokes the molecular gas dissociation by the X-ray emission. We quantitatively discuss this according to an X-ray dominated region (XDR) model by Maloney (1996), where the effective ionization parameter ($\xi_{\rm eff} = L_{\rm X}/(R^2 n_{\rm H2} N_{\rm H}^{1.1})$) determines fractional abundances of molecular and atomic species. The hydrogen molecular gas density ($n_{\rm H2}$) is estimated by fitting the observed molecular line ratios to those predicted from a non-LTE model. Then, by assuming the X-ray luminosity ($L_{\rm X}$) and the attenuating column density ($N_{\rm H}$) for the incident X-ray, we constrained it at the limbs, or $R \approx 60$ pc. The resultant ionization parameters are consistent with that where the transition from atomic to molecular hydrogen gas is predicted, thus supporting the X-ray dissociation.