P139a Chemical layered structures and the ionisation rates in the disk around a low-mass Class 0 protostar NGC 1333 IRAS 4C: FAUST

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Recent ALMA's molecular line observations have revealed structures in which the chemical composition changes with height in the disk vertical direction and radial ionization rate distributions in Class I/II disks. However, the existence of such chemical layered structures in Class 0 disk and envelope systems has not yet been investigated well. In the 2023 Spring Annual Meeting (Z120a), we reported the results of molecular line observations of the edge-on disk and envelope around the Class 0 low-mass protostar NGC 1333 IRAS 4C, as part of the ALMA large program FAUST. We discussed that the molecules generated by photochemical reactions (CCH and c-C_3H_2) are distributed in the low density upper layers of the disk, while $C^{18}O$ and H_2CO are distributed in the high density regions around the protostar, indicating a chemically layered structure in the disk vertical direction. Here we report the results of our further analyses, in which we estimate the disk radial ionization rate distributions from the $H^{13}CO^+$ and $C^{18}O$ line emission. The column density ratios of HCO^+/CO are $\sim 10^{-5} - 10^{-4}$ in the inner disk ($r < 150$ au) and $\gtrsim 10^{-4}$ in the outer disk ($r \gtrsim 150$ au), which is basically consistent with the trends in Class II disks (e.g., Aikawa et al. 2021). The ionization rates are estimated to be larger in the outer disk ($\sim 10^{-17} - 10^{-16}$ s^{-1}) than those in the inner disk ($\lesssim 10^{-18}$ s^{-1}).