Quiescent Giant Molecular Cloud Cores in the Galactic Center

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We have used the Long Wavelength Spectrometer aboard the Infrared Space Observatory to map the far-infrared continuum emission (45–175 μm) toward several massive Giant Molecular Cloud (GMC) cores located near the Galactic center. The observed far-infrared and submillimeter spectral energy distributions imply low temperatures (~13–20 K) for the bulk of the dust in all the sources, consistent with external heating by the diffuse interstellar radiation field (ISRF) and suggest that these GMCs do not harbor high-mass star-formation sites, in spite of their large molecular mass. Observations of far-infrared atomic fine structure lines of CII and OI indicate an ISRF enhancement of ~1000 in the region. Through continuum radiative transfer modeling we show that this radiation field strength is in good agreement with the observed far-infrared and submillimeter spectral energy distributions, assuming external heating of the dust. Spectroscopic observations of millimeter-wave transitions of H_2CO, CS, and $C^{34}S$ carried out with the Caltech Submillimeter Observatory and the Institut de Radio Astronomie Millimétrique 30-meter telescope indicate a gas temperature of ~80 K, significantly higher than the dust temperatures, and density of $\sim 1\times10^5$ cm^{-3} in GCM0.25+0.01, the brightest submillimeter source in the region. We suggest that shocks caused by cloud collisions in the turbulent interstellar medium in the Galactic center region are responsible for heating the molecular gas. This conclusion is supported by the presence of widespread emission from molecules such as SiO, SO, and CH_3OH, which are considered good shock tracers. We also suggest that the GMCs studied here are representative of the "typical", pre-starformation cloud population in the Galactic center.