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Far-infrared and Molecular CO Emission From the Host Galaxies of Faint Quasars at z~6

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We present new millimeter and radio observations of nine z~6 quasars discovered in deep optical and near-infrared surveys. We observed the 250 GHz continuum in eight of the nine objects and detected three of them. New 1.4 GHz radio continuum data have been obtained for four sources, and one has been detected. We searched for molecular CO (6-5) line emission in the three 250 GHz detections and detected two of them. We study the FIR and radio emission and quasar-host galaxy evolution with a sample of 18 z~6 quasars that are faint at UV/optical wavelengths (rest-frame 1450A magnitudes of m_1450\ge20.2). The average FIR-to-AGN UV luminosity ratio of this faint quasar sample is about two times higher than that of the bright quasars at z~6 (m_1450<20.2). A fit to the average FIR and AGN bolometric luminosities of both the UV/optically faint and bright z~6 quasars, and the average luminosities of samples of submillimeter /millimeter-observed quasars at z~2 to 5, yields a relationship of L_{FIR} {L_{bol}}^{0.62}. Five of the 18 faint z~6 quasars have been detected at 250 GHz. These 250 GHz detections, as well as most of the millimeter-detected optically bright z~6 quasars, follow a shallower trend of L_{FIR} {L_{bol}}^{0.45} defined by the starburst-AGN systems in local and high-z universe. The millimeter continuum detections in the five objects and molecular CO detections in three of them reveal a few x10^8 M_sun of FIR-emitting warm dust and 10^10 M_sun of molecular gas in the quasar host galaxies. All these results argue for massive star formation in the quasar host galaxies, with estimated star formation rates of a few hundred M_sun yr^{-1}. Additionally, the higher FIR-to-AGN luminosity ratio found in these 250 GHz-detected faint quasars also suggests a higher ratio between star formation rate and supermassive black hole accretion rate than the UV/optically most luminous quasars at z~6.

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