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Title

Gas and Dust in a Submillimeter Galaxy at z = 4.24 from the Herschel Atlas

Source

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Abstract

We report ground-based follow-up observations of the exceptional source, ID 141, one of the brightest sources detected so far in the Herschel Astrophysical Terahertz Large Area Survey cosmological survey. ID 141 was observed using the IRAM 30 m telescope and Plateau de Bure interferometer (PdBI), the Submillimeter Array, and the Atacama Pathfinder Experiment submillimeter telescope to measure the dust continuum and emission lines of the main isotope of carbon monoxide and carbon ([C I] and [C II]). The detection of strong CO emission lines with the PdBI confirms that ID 141 is at high redshift (z = 4.243 +/- 0.001). The strength of the continuum and emission lines suggests that ID 141 is gravitationally lensed. The width (V_{FWHM} ~ 800 km s⁻¹) and asymmetric profiles of the CO and carbon lines indicate orbital motion in a disk or a merger. The properties derived for ID 141 are compatible with an ultraluminous (L_{FIR} ~ (8.5 +/- 0.3) x 10¹³ _L⁻¹ L, where _L is the amplification factor), dense (n 10⁴ cm⁻³), and warm (T_{kin} 40 K) starburst galaxy, with an estimated star formation rate of (0.7-1.7) x 10⁴ ⁻¹_L M yr⁻¹ . The carbon emission lines indicate a dense (n 10⁴ cm⁻³) photon-dominated region, illuminated by a far-UV radiation field a few thousand times more intense than that in our Galaxy. In conclusion, the physical properties of the high- z galaxy ID 141 are remarkably similar to those of local ultraluminous infrared galaxies. (69 References).