The APEX-CHAMP+ view of the Orion Molecular Cloud 1 core

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Introduction & Observations

The Orion Molecular Cloud 1 (OMC-1) is a complex region of the interstellar medium stretching over more than 2.4 pc (20', roughly north-south) on the sky. Its densest part, toward which the Great Orion Nebula (M42), a classical compact “blister” Hill region, and its associated Orion Nebular Cluster (ONC) appear in projection, is one of the best-studied regions in astronomy. It is a test bed for studies of (proto)stars and clusters and the formation of low-, intermediate-, and high-mass stars. Much of this region’s prominence is due to its distance of just 414 ± 7 pc (Menten et al., 2007), which makes the OMC and OMC-1 the closest regions of recent (few million years old) and ongoing high-mass star formation.

We use the term “OMC-1 core” for the roughly 8’ × 8’ or 1 pc²-sized dense molecular cloud region, which is located closely (0.1–0.2 pc) behind M42 and most of the stars in the ONC. The OMC-1 core region may be divided into three main zones, all of which show bright (sub)millimeter wavelength emission from warm dust and molecular gas: the Becklin-Neugebauer/ Kleinmann-Low (BN/KL) region, Orion South (OMC-1S or Orion-S) and the Orion Bar.

We have imaged the line emission from the multiple transitions of several carbon monoxide (CO) isotopologues over the OMC-1 core region with the Atacama Pathfinder Experiment telescope (APEX). Our observations employed the 2 × 7 pixel submillimeter CHAMP+ array to produce maps (~300′′ × 350′′) of 12CO, 13CO, and C18O from mid-J transitions (J = 6 – 5 to 8 – 7). We also obtained the 13CO and C18O J = 3 – 2 images toward this region.

Orion Bar

The Orion Bar is a well-described photon-dominated region (PDR) located at the side of the OMC-1 core, facing M42, which is heated and partially ionized by far-ultraviolet photons from the young massive stars (most of them from 8′′ θ1, a spectral type O5–O7 star) that form the “Trapezium” at the center of the ONC. In addition, the Orion Bar appears to be located at the edge of the HI blister, tangential to the line of sight. The prominent straight Orion Bar PDR actually appears connected to the Orion South region, forming a mirrored letter L shape.

We present the first large-scale images of highly excited 12CO, 13CO, and C18O lines in the OMC-1 core (see Peng et al., 2012, for more details). The high excitation temperatures (~150–200 K) reveal a hot enclosed structure which is mostly heated by the Trapezium cluster. We found a typical density of 10⁵–10⁶ cm⁻³ in this region. The clear dense ridge in the north-south direction is seen and is offset from the high temperature enclosed structure. Orion BN/KL and Orion South are located at this dense ridge, and the Orion Bar is part of the high temperature enclosed structure. The estimated mass of total warm gas is 86–285 M☉, assuming different geometries for different regions. In addition, the higher-J CD lines trace most of the molecular gas in the OMC-1 core.