Using LTE Modeling to Find Unique Molecular Tracers for Star Formation Processes in the Central Molecular Zone of the Milky Way

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In the Milky Way's Central Molecular Zone (CMZ), dense and extreme conditions render molecules that typically act as tracers for processes associated with star formation in the interstellar medium (ISM) ineffective, as the molecules' emission is widespread and therefore not unique to these star formation events. The Brick, a prototypical dense cloud that does not exhibit signatures of widespread star formation, is a useful place to identify novel tracers for at least four ISM processes of interest: protostellar outflows, pre- and protostellar cores, turbulent shocks, and diffuse/ quiescent molecular gas. Analysis of a wideband (4:1) blind spectral line survey will used to build a toolkit of molecular tracers that uniquely identify these processes and apply this toolkit both in the CMZ and in galaxies with a high star formation rate. In this research, molecular spectra from a core area of The Brick was analyzed and modeled using the eXtended CASA Line Software Suite (XCLASS) to determine the characteristics of the molecules that were identified in the line spectra. Understanding the characteristics of these molecules, we can identify features that exhibit higher intensity that may be able to be used as unique molecular tracers for these star formation events. Furthermore, a program was developed that compared the spectral data from the core region to the surrounding medium in order to find molecules that were unique to the hot protostellar core. This allowed us to determine which molecules functioned as molecular tracers for star formation in the CMZ.

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