The Effects of the Star-forming Environments on the Thermal and Chemical Evolution of Protostellar Cores

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Stars form from clouds with wide ranges of surface densities. In the core accretion theory, such initial and environmental conditions may affect the evolution of the protostars and their cores, which further affects the chemical conditions of these cores. We explore such possibility by constructing evolution models of stars forming from cores embedded in different star formation environments. Each evolutionary track is built from three initial conditions: environmental surface density (which sets the pressure on the core), initial core mass, and its initial rotation. The model self-consistently calculates the collapse of the envelopes, growth of the accretion disks, gradually opening of the outflow cavities, and evolution of the protostars. We use continuum radiation transfer simulation to predict the dust temperature profile inside the core and its time evolution. By coupling such a physical model with chemical simulations, we are able to further predict the distribution of the molecules inside the protostellar core at a given evolutionary stage. The model shows that the star-forming environment strongly affects the thermal and chemical conditions of the cores which can be tested by observations. We present the preliminary results of our ALMA observation of 8 massive cores/regions. While the focus of this project is on the (sub-)strucutres of the cores and filaments, it also reveals rich information on the chemical conditions of these cores which are in different environments and evolutionary stages.

References