Scale dependent structural changes in star forming clouds: insights from wavelet based cross-correlation analysis

Tigran Arshakian and Volker Ossenkopf
Universität zu Köln, Cologne, Germany

Mapping observations of molecular clouds in different chemical tracers, different transitions of the same tracer or different velocity channels within one transition reveal structural changes in the clouds such as phase transitions, temperature profiles, and patterns of turbulent velocities.

We present a wavelet-based weighted cross-correlation (WWCC) method to study the correlation between two maps of a molecular cloud and the mutual displacement of the structures contained as a function of their spatial scale. The method includes a weighting function that allows us to deal with non-uniform noise often present in the maps. The WWCC is a powerful statistical tool allowing us to compare different maps and trace scales with prominent structures, chemical and phase transitions, providing insight into the physical conditions of interstellar gas.

The WWCC is tested for simulated maps containing circular and fractal structures. We discuss the advantages and limitations of the WWCC, results of its application to observed emission line maps of molecular clouds such as the G333, Perseus, and IC348, observed evidence for chemical and phase transitions on particular spatial scale, and the multi-layer displacements between structures.