Thermalization of interstellar gas through cosmic rays

The dense interstellar gas in galaxies fuels their star formation and constitutes, therefore, a crucial component of our understanding of galaxy formation and evolution. The ability of the gas to form stars depends on the density and temperature of the gas, which in turn is set by the equilibrium thermal state of the various heating and cooling mechanisms operating on the gas. Cosmic rays, i.e., relativistic high-energy elementary particles (primarily electrons, protons and atomic nuclei) permeate galaxies and are the dominant heating mechanism deep inside dense gas clouds where (UV) photons can reach. Analytic prescriptions exist for the heating rate of cosmic rays inside dense clouds.

However, such analytic equations date back to the 1970s, and since then, computational power has increased a lot allowing us to study the accuracy of such models and even extend them to different cosmic rays energies, and gas compositions.

The idea of this project is to develop a particle simulation tracing cosmic rays, secondary showers and their energy transfer onto/from the ambient gas medium. The project will consist of literature study on particle-in-cell methods as well as about numerical schemes for particle collisions. The goal will be to describe how the ambient gas is heated by cosmic rays relevant, which in turn is could have major implications for our understanding of the star formation in galaxies. ...

If we have caught your attention, please contact christoph.koehn@tu-dortmund.de to obtain more information.