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UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Cosmic-ray Astrochemistry

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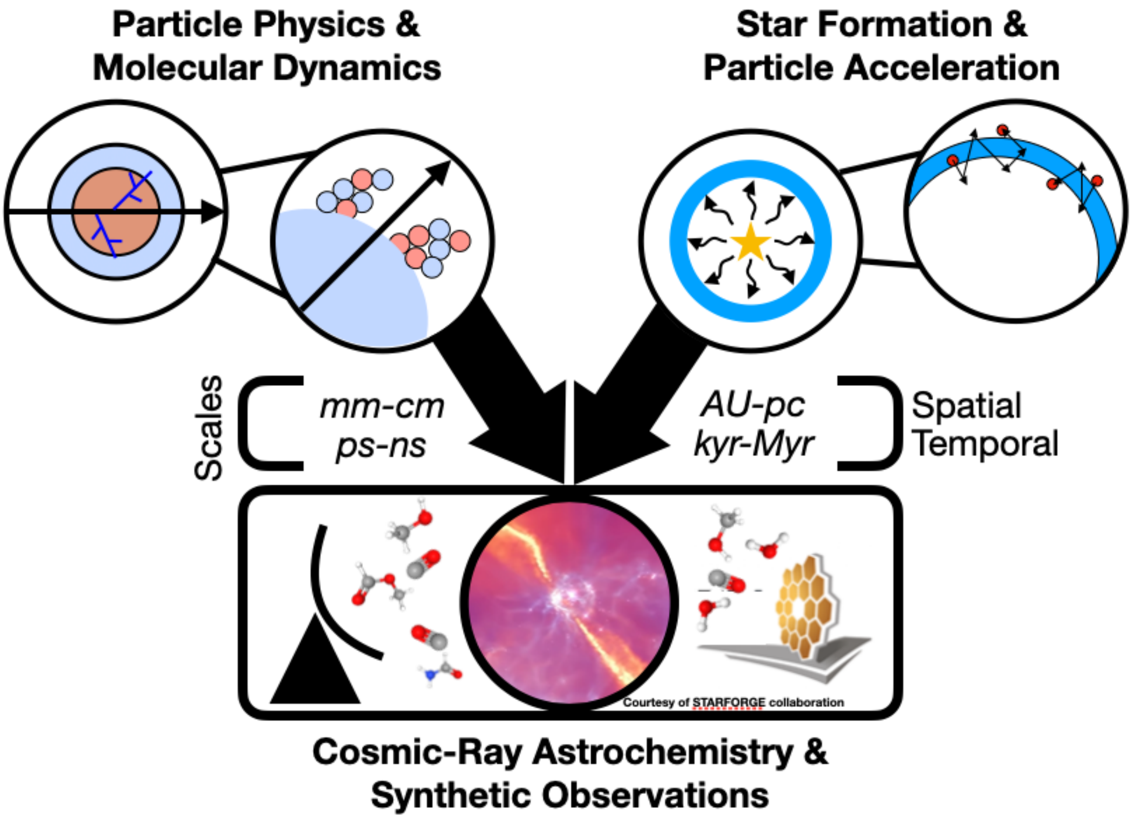

In the local universe, star and planet formation occur ubiquitously in cold, dense molecular gas, with gas temperatures dropping to 10 - 30 Kelvin, and densities exceeding 100 particles/cc. Due to the low temperatures, the gas-phase molecular chemistry is driven by ion-neutral reactions. In regions shielded from ultraviolet radiation, energetic, charged particles, dubbed cosmic rays, in particular protons and electrons, are the dominant source of ionization. The cosmic-ray ionization rate, a statistical quantization of the average number of ionizations per second, is one of the fundamental parameters of astrochemical models. Further, cosmic rays and their induced radiation can interact with icy dust grains, heating and charging the grain and stimulating complex chemistry in their ice. Despite their importance in chemistry, cosmic rays are still often treated very simply, with models generally assuming a constant ionization rate. As cosmic rays travel through molecular clouds, they lose energy, leading to the formation of ionization gradients, a behavior typically ignored in astrochemical models. I will present an overview of cosmic-ray-driven astrochemistry, in particular from the point of view of theoretical modeling. During my presentation, I will highlight key results on identifying and studying potential acceleration sources of energetic particles in star-forming gas, and their role on gas-phase chemistry. I will also introduce a new database which has the largest number of electron-impact ionization cross sections for atoms and molecules of astrochemical interest. Finally, I will showcase future plans in my group for investigating the role of cosmic rays on the gas- and ice-phase chemistry of star-forming gas from the atomic to astrophysical scales.