

The interplay between chemistry and nucleation in the formation of carbonaceous dust grains

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The formation of the seeds of cosmic dust is a key astrophysical process, since it is at the basis of the formation of any solid structure in the Universe. Contrary to the nucleation of most phase transition on Earth, astrophysical nucleation takes place ideally, in the absence of condensation nuclei. This makes nucleation a process that starts as a chemical reaction and gradually transitions to a physical process. We present the combined results of a new approach to nucleation and growth of pure carbon clusters in stellar explosions. Our approach includes *ab-initio* calculations of the structure of carbon clusters and molds the kinetic nucleation approach to a chemical network to follow the growth of dust grains even in the presence of weathering agents.

Within this framework, nucleation of carbonaceous grains is delayed and proceeds more smoothly than in classical calculations, possibly providing a better fit to observations. We will finally discuss the possibility and challenges of extending this methodology to multi-species nucleation, such as the seeding and growth of silicate grains.