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Mimicking cosmic dust in the laboratory. The STARDUST machine

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Cosmic dust grains are believed to play an essential role in the emergency of chemical complexity in the universe. In particular, it may catalyze new chemical reactions with the circumstellar and interstellar gases. In addition, accretion of volatiles on dust grain surfaces leads to the formation of icy mantles, whose processing in the interstellar medium (ISM) also contributes to the large variety of molecular species found in the ISM. Albeit its importance, much remains unknown on the cosmic dust formation processes and laboratory astrochemistry using ultra-high-vacuum (UHV) technologies and characterization techniques, may provide an excellent workbench for these studies.

Here, we present the STARDUST machine, an innovative experimental station devoted to the engineering, production, manipulation, processing and in-situ analysis of a wide variety of clusters and nanoparticles, particularly designed to mimic the travel of cosmic dust seeds towards the interstellar medium. Its original design offers unique possibilities for nanoparticle growth, namely a very high throughput with controlled size, control of the composition and structure in a clean ultra-high vacuum environment, by using a scaled-up multiple ion cluster source with an implemented design. The nanoparticles generated can be processed in-flight by annealing, acceleration, or interaction with background gasses and the resulting nanoparticles can be further analyzed in-situ by means of different surface science techniques.

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