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Nanocosmos and Laboratory Astrophysics: from molecules to dust

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Evolved stars are the factories of interstellar dust. This dust is injected into the interstellar medium and plays a key role in the evolution of astronomical objects from galaxies to the embryos of planets. However, the processes involved in dust formation and evolution are still a mystery. The increased angular resolution of the new generation of large telescopes, is providing for the first time a detailed view of the conditions in the dust formation zone of evolved stars, as shown by our first observations with ALMA (Cernicharo et al. 2013, Agúndez et al. 2017).
The aim of the NANOCOSMOS project is to take advantage of these new observational capabilities to change our view on the origin and evolution of dust grains. We are combining
astronomical observations, modelling, and top-level experiments to produce star dust analogues in the laboratory and identify the key species and steps that govern their formation. We have built two innovative setups: the Stardust chamber to simulate the physical conditions of the atmosphere of evolved stars, and the gas evolution chamber to identify novel molecules in the dust formation zone.
We are also improving existing laboratory setups and combine different techniques to achieve original studies on individual dust grains, their processing to produce complex polycyclic aromatic hydrocarbons, the chemical evolution of grain precursors and how dust grains interact with abundant astronomical molecules. Our simulation chambers have been equipped with state-of-theart in situ and ex situ diagnostics.
Our astrophysical models, improved by the interplay between observations and laboratory studies, provide powerful tools for the analysis of the wealth of data provided by the new generation of telescopes. The synergy between astronomers, vacuum and microwave engineers, molecular and plasma physicists, surface scientists, and theoreticians in NANOCOSMOS is the key to provide a cutting-edge view of cosmic dust.

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