# PAHs from circumstellar environments to the interstellar medium. The Nanocosmos project

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Polycyclic aromatic hydrocarbon (PAH) molecules are the best carriers for the strong aromatic IR bands (AIBs) at 3.3, 6.2, 7.7, 8.6, 11.3 and 12.7 microns that are observed in emission in many astronomical environments where UV photons are available. It has been shown that these UV photons not only trigger the AIB emission but also play a role in the chemical production of the band carriers. In photodissociation regions associated to star formation, a scenario has been proposed in which gas-phase PAHs are produced by photoevaporation of very small grains, which could be PAH clusters ([1] and references therein). In evolved stars, which are the major sites of dust formation in our Galaxy, PAH emission is only observed when the central star emits strongly in the UV, which happens while the object evolves from the AGB to the planetary nebula (PN) phase. The evolution of the IR spectrum suggests that UV-processing induces the destruction of fragile aliphatic bonds and the formation of a more aromatic material that is likely the precursor of PAHs [2].

The Nanocosmos ERC Synergy project aims at investigating the physical and chemical conditions that lead to complex hydrocarbon chemistry and ultimately to the formation of PAHs and other large carbonaceous molecules such as $C_{60}$. Observations are planned with ALMA for prototype stars in transition between the AGB and PN phases, in order to understand whether the formation of large hydrocarbons is spatially associated with the dense torus as well as the role of radical-radical reactions versus ion-molecule reactions. In the laboratory, we will investigate various chemical routes to form PAHs and related species involving both gas-phase and gas-grain interactions. For instance, recent studies have suggested the role of crystalline silicates [3] or SiC grains [4] in the formation of PAHs. Our laboratory studies will take benefit from setups and reactors already in operation in Toulouse and in Spain. They will also involve the development of new simulation chambers. Studying the processing of the formed species by UV photons (which often requires access to synchroton VUV beamlines) as well as recording their IR spectroscopy in cosmic conditions are also key aspects of the project.

*The Nanocosmos ERC Synergy project (2014-2020) is led by the three PIs: J. Cernicharo and J. A. Martín-Gago (ICMM, CSIC, Madrid) and C. Joblin (IRAP, CNRS, Toulouse). Several research teams and institutes are involved on both sides. In Toulouse, IRAP, LCAR, LCPQ and LAPLACE laboratories carry the activity.*

**References**

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