# Report on the outcomes of a Short-Term Scientific Mission[1]

**Action number: CA21126**

**Grantee name: Bouhlala Aicha**

## Details of the STSM

**Title: Introductory Study of Dust Formation in AGB Stellar Environments and its Relation to Cosmic Carbon Nanoparticles**

**Start and end date: 05/09/2026 to 15/09/2026**

## Description of the work carried out during the STSM

During the Short-Term Scientific Mission at INAF – Osservatorio Astronomico di Roma, under the supervision of Dr. Paolo Ventura and Dr. Claudio Gavetti, I carried out a study of dust formation in Asymptotic Giant Branch (AGB) stellar environments, with particular emphasis on the production of carbon-rich dust and its relevance to cosmic carbonaceous material.

The work focused on the analysis of theoretical AGB evolutionary models taken from the Rome library, and their associated dust-formation outputs, published in a series of papers from the Rome team, partly in collaboration with IAC scientists. We analysed models with different metallicities, namely Z = 0.001, 0.002, 0.004, 0.008 and 0.014. (solar), and considered different initial stellar masses, spanning the 0.8-4 $M_{sun}$ range.

Since the focus of the study was the production of carbonaceous dust species, particular attention was given to the stars that are expected to become carbon-stars during the AGB lifetime. To this aim, the evolutionary tracks were examined individually, to identify for each of the metallicities investigated the range of initial masses of the stars that eventually reach the C-star stage, during which the surface C/O ratio becomes larger than unity (C/O > 1). The evolution of the stellar mass, mass-loss and carbon dust production rates during the C-rich phases was carefully monitored.

The analysis was performed on the basis of the available results from the combination of dust formation and dust production modelling, examined with the practical use of tools including Graphica and SuperMongo. The dust-formation outputs were examined in order to follow the

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the Grant Holder Manager to verify the grant documents compliance and proceed with the payment.

evolution of carbon-rich dust production and its relation to the stellar mass and the mass loss rate.

The models were compared in order to investigate the dependence of carbon-rich dust formation on stellar initial mass and metallicity. This analysis provided a better understanding of the connection between stellar evolution, surface chemical enrichment, mass loss and the formation of carbon-rich dust in AGB stellar winds.

The STSM also provided practical training in astrophysical modelling and data analysis, allowing me to extend my previous experience in computational materials physics toward the study of astrophysical dust and carbonaceous material.

**Description of the STSM main achievements and planned follow-up activities**

The STSM achieved its main objective by providing practical experience in the study of AGB stellar evolution and carbon-rich dust formation. I analysed AGB models with different metallicities and stellar masses and studied the carbon-rich phases, mass-loss rates and dust production.

The STSM also allowed me to gain experience with the tools and model outputs used for the analysis of stellar evolution and dust formation. This work is relevant to COST Action CA21126 NanoSpace through its focus on carbon-rich dust and cosmic carbonaceous material.

The results obtained during the STSM will be further analysed with Dr. Paolo Ventura and Dr. Claudio Gavetti. The planned follow-up activity is to develop these results into a paper on carbon-rich dust production in AGB stellar environments, to be submitted to the Journal Universe.