COSMIC DUST II (PRIN2022 PROJECT): COSMOCHEMISTRY AND SPACE TWEEZERS TECHNOLOGIES FOR SOLAR SYSTEM SCIENCE AND EXPLORATION.

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We will present our two-year research project recently funded by the Italian Ministry of University and Research through the PRIN 2022 Programme and entitled *Cosmic Dust II: Cosmochemistry and Space Tweezers Technologies for Solar System Science and Exploration*.

The project builds upon the success of our previous MUR, EC and ASI projects [e.g. 1, 2, 3] by undertaking: 1) systematic analysis of unique collections of small (down to 400nm) interplanetary dust particles (IDPs) and large (up to 3mm) micrometeorites (MMs) to bridge gaps in our knowledge of the composition of the inner Solar System interplanetary dust complex, which depends on particle size; 2) the development of novel photonic-acoustic tools for the contactless, non-invasive analysis of particulate matter, as required for the detection of extraterrestrial organics and biosignatures in cosmic dust.

We will achieve the first goal through a detailed cosmochemical study of the DUSTER (Dust in the Upper Stratosphere Tracking Experiment and Retrieval) IDP [4] and the TAM (Transantarctic Mts) MM collections available in our laboratories. Focus will be placed on size fractions >700µm and <20µm, which are well represented in the above collections and largely unexplored. Analyses will be conducted using state-of-the-art instrumentation for mineralogical, organic, isotopic and spectroscopic analyses down to the nanoscale, available on site and through international collaborations established during previous projects.

We will achieve the second goal by developing Space Tweezers – a long term project initiated in 2020 with the support of ASI. Based on focused laser beams, Space Tweezers enable trapping, manipulation and spectroscopic analysis of a wide range of microscopic and nanoscopic particles in different media. The tool will be tested on synthetic and natural functional analogs.

Results will contribute to the definition of the interplanetary dust flux to Earth (size, type, source bodies), providing an unprecedented world-reference dataset for cosmic dust studies. This will serve as ground truth for investigating timely and controversial issues in planetary science, including: the composition of the interplanetary dust complex in the inner Solar System; the geology of all the dust-producing bodies including asteroids, comets and perhaps planets and their satellites; the dynamic evolution of interplanetary dust; the contribution of extraterrestrial matter to the geochemical and organic budget of our planet; variations in the cosmic dust flux to Earth in the Earth's sedimentary record through time (with significant implications for celestial mechanics of the minor bodies in the Solar System, such as enhanced cometary activity or asteroid collisional break-ups); the possible input of interstellar grains to the Solar System composition. We will aslo contribute to the development of optical/acoustic tweezers for the high-resolution, non-destructive and contactless (and thus “clean”) micromanipulation and spectroscopic analyses of planetary and interplanetary dust. This will open new perspectives for future applications of Space Tweezers in curation facilities for sample-return missions or in extraterrestrial environments.

References: [1] Suttle, M. and Folco, L. (2020) *J. Geophys. Res. Planets*, 125, e2019JE006241. [2] Dionnet, Z. et al. (2020) *Meteorit. Planet. Sci.* 1–19 (2020) [3] Magazzu, A. et al. (2023) *Astrophys. J.*, 942:11. [4] Della Corte, V. et al. (2012) *Space Sci. Rev.* 169, 159–180. [5] Rochette P. et al. (2008), *PNAS* 105, 206–211.

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