Intrinsic Dynamics of Emulsion, from Experiments on Earth and in Microgravity

Emulsions are colloidal dispersions of two or more immiscible liquids. They are central in a great number of processes and products where effective methodologies are required, either for their stabilization or destabilization. Despite their pervasiveness, much of our knowledge about emulsions is empirical, while the basic principles need to be deepened. This could lead to more rational formulations and processes, using less energy or less polluting chemicals.

Microgravity allows to address the intrinsic drop dynamics, which features dynamic transitions and transients associated to the processes influencing emulsions stability (e.g., drop aggregation, coalescence, Ostwald ripening). On ground, all this is normally convoluted with the predominant gravity-induced dynamics of drop creaming/sedimentation.

This PhD Project focuses on experiments approved by ESA to be conducted on the International Space Station, using the facility Soft Matter Dynamics (SMD) [1] to investigate emulsions in microgravity by Diffusing Wave Spectroscopy (DWS) [2-4] within an international team (SEEDS collaboration), with the possibility of carrying out part of the thesis abroad, at:

- Virginia Commonwealth University (Richmond, VA - USA)
- Tokyo University of Science (Tokyo, JP)
- Aristotle University of Thessaloníki (GR)
- Airbus – Friedrichshafen (D).

References

[1] P. Born et al., Review of Scientific Instruments, 2021, 92, 124503.
[2] V. Lorusso et al., Advances in Colloid and Interface Science, 2021, 288, 102341.
[3] V. Lorusso et al. J. of Colloid and Interface Science, 2025, 677, 231
[4] D. Orsi et al. Current Opinion in Colloids and Interface Science, 2025, 75, 101892

Contact: luigi.cristofolini@unipr.it