IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

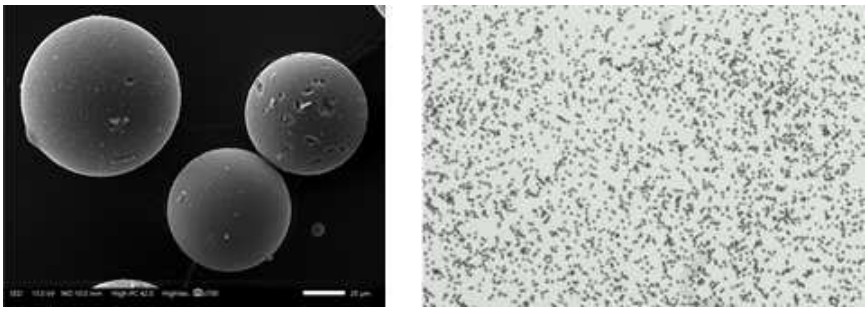
GEPEA
UMR CNRS 6144

INRAE

# PhD position

*Initial moments of particle resuspension: investigation and modeling for an accelerated airflow*

**Research area:** Two-phase fluid mechanics / Aerosol physics



*Examples: of Scanning Electron Microscopy observation of glass microparticles used to study the resuspension, and of an initial particle deposit*

**Context:**
This subject concerns the risks for human health associated with airborne microparticles, which nature can be very diverse (inert, chemical, biological or radioelements). It is more particularly about understanding the mechanisms at the origin of the resuspension of microparticles from free surfaces, when they are subjected to aerodynamic transient events (acceleration of the mean flow). This study aims at contributing to a better control of the risks related to airborne contaminations in indoor environments by improving the modeling of the resuspension phenomenon.

**Objectives :**
This topic aims to better understand and model the resuspension mechanisms of microparticles exposed to accelerated airflows. It builds upon experimental works conducted during two PhD works jointly supervised by IMT Atlantique and INRAE OPAALE (Corentin Cazes in 2023, and Mélanie Baptiste in 2026). These previous works led to the development of an experimental setup and yielded several results concerning the links between flow dynamics and the resuspension of spherical particles. The resuspension phenomenon relies on the competition between the forces holding the particles deposited on the solid surface (adhesion and gravitational forces) and the forces tending to detach them from this surface (aerodynamic and/or mechanical forces). Resuspension therefore depends on the air properties, as well as numerous parameters related to the particles themselves (size, morphology, surface properties), the surface on which these particles are initially deposited (roughness, electrostatic charge, etc.), and any aerodynamic forces to which they may be subjected. Recent work on the subject has clarified the links between flow properties and resuspension, but the nature of the initial particle motion (rolling or sliding along the surface, lift-off in the airflow, rebound(s), collisions between particles, etc.) remains difficult to determine, particularly when initial concentrations are high. Current models lack precision

and would benefit from being enhanced by incorporating the nature of the initial motion and the associated probability of resuspension. The thesis will therefore focus on: - continuing and enriching the stochastic modeling of resuspension using previously acquired measurements, based on Monte Carlo models developed in collaboration with the University of San Luis (Argentina), and incorporating the parameters studied in previous work; - measuring the dynamics of particles more precisely during the initial moments of resuspension using three high-speed cameras, simultaneously incorporating flow dynamics, in order to complete the modeling.

**Location :** The PhD will be conducted at the INRAE OPAALE research unit in Rennes (ACTA team), in co-supervision with the TEAM team (from the GEPEA laboratory) / Energy Systems and Environment Department of IMT Atlantique in Nantes, where some supplementary experiments may be carried out. Regular exchanges will take place with the University of San Luis in Argentina regarding stochastic modeling.

https://www.imt-atlantique.fr/en/about/departments/energy-and-environmental-systems
https://eng-opaale.rennes.hub.inrae.fr/

**Required skills:** Fluid mechanics (two-phase flow, turbulence), Stochastic modeling, Particle statistics

**Profile:**
To successfully complete this PhD, the candidate must have a solid understanding of fluid mechanics or aerosol physics (understanding of particle transport and interactions between inclusions and the carrier fluid), as well as skills in statistics and stochastic modeling (applied mathematics or statistical physics). The candidate must be at the interface between physics and applied mathematics, with at least one specialization in one of these two fields and a strong interest in the other. While the experimental component remains important, it is well-managed internally. Thus, while experimental expertise is not essential, a certain aptitude for experimental methods and data processing is necessary to successfully complete this project. The candidate must be autonomous and demonstrate a strong sense of initiative. Fluency in both French and English is essential.

**Starting date:** from October 2026
**Deadline to apply :** 29 March 2026

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