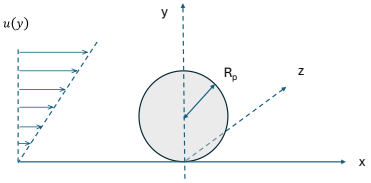
ASNR Autorité de sûreté nucléaire et de radioprotection

INTERNSHIP OFFER

Development of a Monte Carlo Code simulating particles detachment by turbulent airflow





Location:	Paris-Saclay FRANCE (https://www.cea.fr/Documents/plans-des-centres/cea_saclay_map.pdf)
Laboratory:	ASNR – Aerosol Physcics and Metrology Laboratory Laboratoire de physique et de métrologie des aérosols (LPMA) | IRSN
Contract	6 Months, Master M2/ Master Degree Internship
Availability:	**Between March and September 2027**

The French Authority for Nuclear Safety and Radiation Protection (ASNR) oversees civil nuclear activities in France on behalf of the French State. It also carries out research, expert assessments, training, and public information in the fields of nuclear safety and radiation protection.

Context:

The internship will take place in the Aerosol Physics and Metrology Laboratory (Paris-Saclay, France), and the student will work within an interdisciplinary research team in close collaboration with the Granular Materials Laboratory (GML) belonging to the University of San Luis and to the CONICET in Argentina. This internship is part of a research project to improve assessment of the sources for airborne particulate contamination driven by turbulent flows in normal operation and for different accident scenarios in nuclear facilities. Such phenomenon is also studied for other applications such as contamination and cleaning of solar panels and embedded systems, atmospheric pollution, ventilation ducts.

Mission:

The GML has historically developed Monte Carlo algorithms to simulate particle detachment from surfaces by airflow under diverse conditions, such as monodisperse and polydisperse particle size distributions, different models of particle–surface adhesion according to particle shape (spherical or irregular), particle materials, and a range of aerodynamic conditions. All codes, along with their associated subroutines, have been written in C++.

Building upon the development already carried out during the previous internship, the aim of the present work is to extend the rebuilt the Python-based version of the code to include a new transition rate describing particle detachment interaction between particles during collisions.

This will require implementing a second block in the code to handle single particle and cluster deposits, aerodynamic conditions, model initialization, time loop configuration, and other related aspects.

In addition, it is needed to pursuit the development of a user-friendly interface to facilitate operational calculations under different aerodynamic resuspension scenarios and to make the complete code openly available to the scientific community. The programming should ensure that the code remains flexible and adaptable to evolving user needs over time.

The first step will consist of understanding the functionality of each code block already implemented in Python for the cases of spherical particles and doublets. This stage also includes improvement of the existing user-friendly interface to assist potential users in exploring and defining key technical parameters. Verification of the results obtained with the existing Python code will also be performed.

The second step will focus on extending the code by adding the new block for single sphere and random spheres doublet orientation, also adding new transition rate to account for fourth detachment mechanism involving particle-particle interaction. This will involve defining collisional parameters, modifying aerodynamic forces accordingly, and selecting appropriate adhesion models. Validation of this new block will be required to ensure reproducibility and consistency with the results obtained from the original C++ versions. Finally, the third step will be to extend the user interface with additional options for potential users.

Partnership:

The candidate will have to report on the progress of his/her work, write notes, present his work and will interface with GML (UNSL-CONICET) and ASNR laboratories.

Skills: Python, Algorithm design and optimization, Monte Carlo and numerical methods, computer science, applied mathematics. The candidate should have strong Python skills and, importantly, a genuine interest in the underlying physics to be modelled (aerodynamic forces and adhesion of micron-sized particles deposited on a surface). This latter point is particularly important, as it will allow the candidate for a reasonable degree of autonomy during the internship

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