

# PhD Position in Automatic Fungal Spore Detection: The use of Particle Imaging, Fluorescence, and Machine Learning for Agricultural Applications

**Institution:** Université Clermont Auvergne (UCA)

**Département:** Laboratoire de Météorologie Physiques (LaMP)

Laboratoire Microorganismes: Génome Environnement (LMGE)

**Location:** Clermont Ferrand, France

**Duration:** 3-4 years

**Start Date:** Décembre 2024/Early 2025

**Application Deadline:** Octobre 31, 2024

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## Description:

We are seeking a highly motivated and curious PhD candidate to join our interdisciplinary research team on the study of the physical, chemical, and biological processes in the atmosphere within the LaMP and the LMGE laboratory (LaMP and LMGE, UCA). The focus of this project is on developing advanced methods for the automatic detection of fungal spores using cutting-edge particle imaging, fluorescence techniques, and machine learning algorithms. The aim is to develop and refine detection algorithms that can be used to accurately identify specific fungal spore types so that they can be used in agricultural environments to improve crop monitoring and disease prevention.

This project combines our expertise in microbiology and atmospheric physics to increase the capacity of airborne detection tools for pathogenic microorganisms of interest. The project focuses on fungal spores, which will be quantified and characterized in near-real time using a new generation of fluorescence laser detection instruments. This instrument uses artificial intelligence to classify biological aerosols. The aim of this project is to optimize machine learning algorithms to efficiently detect these fungal species and, ultimately, provide datasets for developing operational predictive numerical models of crop invasion by fungal pathogens.

## Project Overview:

Airborne biological particles are an important class of aerosol particles contributing up to 20% of the total aerosol mass in the atmosphere. They exist in a wide range of sizes from several nanometers to a few hundred micrometers. Primary biological aerosol particles (PBAP) are made up of particles from living or dead organisms, including micro-organisms, and can potentially contain viruses, bacteria, fungal spores, pollen and animal and plant debris.

Bioaerosols pose significant health concerns due to the pathogens, allergens and lung irritants associated with the oxidative potential of microbial aerosols. In agriculture, many plant pathogens are generally dispersed in the atmosphere and can have a significant impact on crop yields. *Puccinia graminis*, an airborne fungal pathogen responsible for wheat stem rust, can cause wheat production losses of 50-90% in some regions. Having the ability to prove an early and accurate detection of these species is crucial for effective disease management. This PhD project will explore innovative approaches to online spore detection by integrating:

- **Particle Imaging:** Development and optimization of imaging systems to capture high-resolution images of fungal spores in various environmental conditions.
- **Fluorescence Techniques:** Application of fluorescence-based methods to distinguish between different types of fungal spores and other airborne particles.
- **Machine Learning:** Implementation of advanced machine learning algorithms to automatically classify and quantify spore concentrations based on imaging and fluorescence data.

**Key Responsibilities:**

- Conduct literature reviews and stay updated on the latest advancements in fungal spore detection, imaging, and machine learning.
- Design and implement machine learning models for the classification and quantification of fungal spores.
- Perform field experiments to validate the developed system in real-world agricultural settings.
- Collaborate with an interdisciplinary team of researchers, including experts in agriculture, biology, and computer science.
- Publish research findings in high-impact journals and present at international conferences.

**Qualifications:**

- A Master's degree in atmospheric sciences, physical science, engineering, environmental science, or a related field.
- Strong background in image processing, machine learning, and data analysis
- Experience with programming languages such as Python, MATLAB, or R.
- Knowledge of fluorescence techniques and agricultural applications is a plus.
- Excellent analytical and problem-solving skills.
- Proactive, collaborative, good communication skills and the ability to work independently as well as in a team.

**What We Offer:**

- A fully funded PhD position, 2300€ brut per month
- Access to state-of-the-art research facilities and resources.
- Opportunities for professional development through workshops, conferences, and collaborations.
- The chance to contribute to cutting-edge research with real-world applications in agriculture.

**How to Apply:**

Interested candidates should submit the following documents, preferably in a single PDF file:

- A cover letter outlining your motivation and relevant experience.
- A detailed CV, including a list of publications (if applicable).
- Where possible copies of academic transcripts.
- Contact information for at least two academic referees.

Please send your application to [evelyn.freney@uca.fr](mailto:evelyn.freney@uca.fr) and [Pierre.amato@uca.fr](mailto:Pierre.amato@uca.fr) with the subject line "PhD Application – Fungal Spore Detection" by October 31

If you have questions or require more information, please don't hesitate to get in touch

Evelyn FRENEY and Pierre AMATO at [evelyn.freney@uca.fr](mailto:evelyn.freney@uca.fr) , [Pierre.amato@uca.fr](mailto:Pierre.amato@uca.fr)

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University of Clermont Auvergne is committed to promoting diversity and inclusivity in the workplace. We encourage applications from all qualified candidates, regardless of gender, ethnicity, or disability.

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