Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Institute for Atmosphere and Climate Sciences
D-USYS

ETH Zürich
Dr. Zamin A. Kanji
Group Leader/Senior Scientist
Atmospheric Physics Laboratory
CHN O16.3
Universitätstrasse 16
8092, Zürich, Switzerland

Phone +41 44 633 61 61
Fax +41 44 633 10 58
zamin.kanji@env.ethz.ch
www.iac.ethz.ch/people/zkanji

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PhD position at ETH Zurich - Atmospheric Physics group in "Ice Nucleation of Aircraft Turbine Soot Particles" starting July 2020

The atmospheric physics group at the Institute for Atmospheric and Climate Sciences at ETH Zurich (IAC-ETH) invites applications for a 3 year PhD position integrated into a European (Horizon 2020) Research and Innovation Action Project ACACIA (Advancing the Science for Aviation and Climate). The project involves a collaboration with the ZHAW (Drs. Julien Anet and Lukas Durdina) who will provide access to a unique sampling and measurement system at the aircraft engine testing facility at SR Technics, Zurich airport. The system will be used to sample and measure physical and chemical properties as well as the cloud forming potential of exhaust soot particles. The core activity in this project will require the PhD candidate to partake in measurement campaigns at SR Technics and co-ordinate measurement times during the initial 1.5 – 2 years of the PhD.

The overall goal of this project is to understand how cloud processing affects the fate of aircraft turbine soot particles in the upper troposphere with respect to cirrus cloud or contrail formation. The PhD project will involve researching and developing novel methods to quantify the morphology of soot particles to understand the role of physical properties for ice nucleation in the temperature regime below 233 K. Furthermore, understanding how soot aggregate size and primary particle size, control or contribute to the relevant ice nucleation mechanism will be important. In this context, plume modelling to understand the probability and occurrence of large soot aggregates in the upper troposphere from aggregation and coagulation of ice crystals and resulting soot residuals will be considered.

The cloud processing will be simulated using a set-up of two cloud chambers in series separated by an aerosol transition device whose humidity and temperature can be controlled to mimic cloud-free conditions. The first chamber is used to expose soot particles - sampled directly at the turbine facility at Zurich Airport - to contrail conditions and the second chamber is used to test the same particles for their ice cloud forming ability, after being exposed to cloud free conditions in the transition device. The instruments to be used are already available and have been used successfully in a similar set up before.

Techniques that will be important and involved are: operation of flow systems, continuous flow cloud chambers, aerosol sizing and counting instruments and optical particle counting systems. Furthermore, to characterise the soot particles, we can make use of spectroscopy, dynamic vapour sorption, scanning electron microscopy (SEM) image analysis, near-edge x-ray absorption fine structure (NEXAFS), spectroscopy, all techniques available here at ETH through our existing collaborations. In the ice nucleation group at ETH we have a variety of ice nucleating particle counters, aerosol instruments, mass spectrometers, and optical detection devices for aerosols and cloud hydrometeors.

The successful candidate in addition to holding a MSc (or equivalent) in chemistry, physics, engineering, atmospheric/environmental sciences, or a related field, should be interested in aerosol experimental and field observations. Knowledge of oral and written English is expected. Data analysis in Igor, MATLAB, Python or similar software is highly desired, and some knowledge of LabVIEW would be an asset, but not necessary. Applications will be accepted until the position is filled. To apply, please use the online portal. Only applications through the portal will be considered. Please contact me if you have additional questions regarding the project.

Sincerely,
Zamin Kanji