



## SÉMINAIRE DE PHYSIQUE CORPUSCULAIRE

**SUJET:** Aerosol particle formation in the atmosphere: the CLOUD experiment at CERN, the possible influence of galactic cosmic rays, and comparison to field observations

**PAR:** Dr Urs Baltensperger  
Laboratory of Atmospheric Chemistry, PSI

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Boulevard d'Yvoy, 1211 Genève 4

### RÉSUMÉ:

Atmospheric aerosol particles are liquid or solid particles suspended in the atmosphere, with a size of approximately 0.001 - 100  $\mu\text{m}$ . Atmospheric aerosols are of interest mainly because of their effects on health and climate. Concerning health, many epidemiological studies have shown a link between increased mortality/morbidity and increased  $\text{PM}_{10}$  or  $\text{PM}_{2.5}$  (particulate matter with an aerodynamic diameter  $<10$  and  $2.5$   $\mu\text{m}$ , respectively). Concerning climate, aerosol particles scatter and absorb light (known as the direct effect on climate), and modify cloud properties (with a variety of effects known as indirect effects). These effects are influenced by the chemical and physical properties of the aerosol particles, which makes these properties important to be measured.

Atmospheric aerosol particles are produced by a large variety of sources, and are either emitted as primary particles (i.e., they are directly emitted as particles into the atmosphere) or formed by secondary processes (i.e., by transformation of emitted precursor gases). Depending on the conditions, the latter may either result in homogeneous nucleation of new particles or condensation of species on the pre-existing aerosol. The mechanisms of new particle formation are still subject of debates, but with the CLOUD chamber at CERN a facility is now available where the relevant processes can be investigated without the artefacts of previous studies [1]. Besides sulfuric acid, which for a long time has been known as an important driver of nucleation, several other components have been identified that increase nucleation rates by many orders of magnitude compared to a pure sulfuric acid/water system, including ammonia [1], amines [2], and organics [3]. The possible influence of galactic cosmic rays is explored, and a comparison to field observations is made.

#### References

[1] J. Kirkby et al., Role of sulphuric acid, ammonia and galactic cosmic rays in atmospheric aerosol nucleation, *Nature*, 476, 429-433, 2011.

[2] J. Almedia et al., Molecular understanding of sulphuric acid-amine particle nucleation in the atmosphere, *Nature*, 502, 359-363, 2013.

[3] F. Riccobono et al., Oxidation products of biogenic emissions contribute to nucleation of atmospheric particles, (soon to be) accepted in *Science*, 2014.

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ORGANISATEURS: Prof. [Teresa.Montaruli@unige.ch](mailto:Teresa.Montaruli@unige.ch), Prof. [Giuseppe.Iacobucci@unige.ch](mailto:Giuseppe.Iacobucci@unige.ch)