Summer School *Basic Aerosol Science* – Program

Sunday, 7 July 2024 – Saturday, 13 July 2024

University of Vienna, Faculty of Physics
Ludwig-Boltzmann Lecture Hall, ground floor
Strudlhofgasse 4, 1090 Wien

SUNDAY, 7 July 2024 **(Room: Ludwig-Boltzmann Lecture Hall, ground floor)**

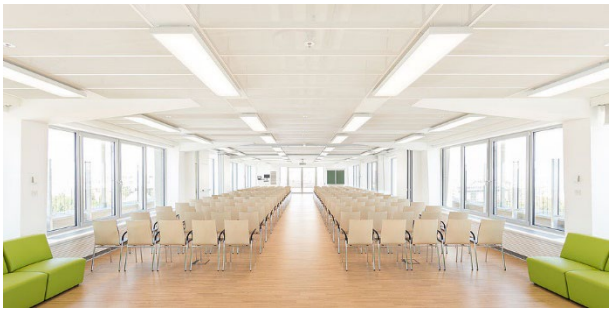
16:00	**Registration**
16:30-17:00	**Welcome, presentation of participants, opening (Bernadett Weinzierl)**
17:00-18:30	**Introduction to aerosol & the atmospheric aerosol (Bernadett Weinzierl):** atmospheric aerosol system, size range, main constituents, sources and sinks of atmospheric particles, vertical distribution, residence time, natural and anthropogenic greenhouse effect, role of aerosols in the climate system, temporal trends, aircraft measurements
19:00	**Heuriger**

MONDAY, 8 July 2024 – BASICS **(Room: Ludwig-Boltzmann Lecture Hall, ground floor)**

08:30-09:00	**Registration & coffee**
09:00-10:30	**Aerosol mechanics (Agnieszka Straus)**: shape of aerosol particles, equivalent diameters, Knudsen number, Stokes' law, settling velocity, slip correction, stopping distance, Stokes number, diffusion, Maxwell-Boltzmann distribution of molecular velocities, Fick's diffusion laws, Brownian motion, diffusion coefficient, coagulation
10:30-11:00	**Coffee break**
11:00-12:30	**Aerosol optics (Carlos Toledano)**: interaction of light with particles: scattering, absorption, extinction, Mie theory, phase function, mixed particles
12:30-14:00	**Lunch break**
14:00-15:30	**Particle statistics (Imre Salma)**: particle number, surface and mass size distributions, lognormal distribution function, modes of size distributions, important size intervals, average diameters, moments of size distributions, inversion problem, applications
15:30-16:00	**Coffee break**

Walk to Sky Lounge of the University of Vienna (12th floor, Oskar-Morgenstern-Platz 1, 1090 Wien)

17:15	**Keynote Lecture (Charles A. Brock): Exploring the stratospheric aerosol: natural processes and human impacts from geoengineering, aircraft, and rockets**
18:30	**Ice Breaker & Get-Together, Sky Lounge University of Vienna**




Sky Lounge and Terrace © Universität Wien / Der Knopfdrücker (left) and Gebhard Sengmüller (right).

TUESDAY, 9 July 2024 - BASICS **(Room: Ludwig-Boltzmann Lecture Hall, ground floor)**

09:00-10:30 **Nucleation and condensation – basics (Paul Wagner)**: formation of aerosol particles, homogeneous nucleation, Kelvin relation, heterogeneous nucleation, cluster geometry, (microscopic) contact angle, line tension, nucleation theorem

10:30-11:00 **Coffee break**

11:00-12:30 **Electrical properties of aerosols (Jyrki Mäkelä)**: ions, electrical mobility, particle charging mechanisms and charge limits, mobility distribution, Fuchs' charging theory, diffusion chargers as aerosol monitors

12:30-14:00 **Lunch break**

14:00-15:30 **Aerosol sampling and measurement (Imre Salma)**: principles and major methods for off-line and on-line measurements, collection of samples: inlets, sampling devices, sampling artifacts and their correction; overview of major types of instruments

15:30-16:00 **Coffee break**

16:00-17:30 **Aerosol generation (Gerhard Steiner)**: dispersions of powders, atomization of liquids, electrospray atomization, condensation methods, generation of ion clusters, generation of calibration aerosols with a DMA

WEDNESDAY, 10 July 2024 - MEASUREMENT METHODS **(Room: Ludwig-Boltzmann Lecture Hall)**

09:00-10:30 **Nucleation and condensation - measurements (Paul Winkler)**: homogeneous and heterogeneous nucleation: experiments, condensation nuclei counters

10:30-11:00 **Coffee break**

11:00-12:30 **Electrical aerosol measurement (Jyrki Mäkelä)**: electrical mobility analysers, differential mobility analyser - DMA: particle sizing, measurement procedure, response with various sensors, data acquisition and data reduction, SMPS versus DMPS; other instruments based on electrical properties of aerosols

12:30-14:00 **Lunch break**

14:00-15:30 **Optical particle measurements (Wladyslaw Szymanski)**: elastic light scattering domains, single vs. multiple particle detection, optical particle counters and spectrometers, impact

of scattering geometry on particle sizing, multivalued response, resolution, detection limits, coincidence errors, calibration rules, low-cost optical particle sensors, configurations and measurement related issues

15:30-16:00 **Coffee break**

16:00-17:30 **Aerosol remote sensing (Josef Gasteiger)**: remote sensing techniques and platforms, photometer, lidar, satellite, spectral ranges, measurement geometry, optical and radiative transfer modeling, retrieval approaches, sensitivity, instrument networks

THURSDAY, 11 July 2024 - AEROSOL CHEMISTRY, MEASUREMENT METHODS (Room: Ludwig-Boltzmann LH)

09:00-10:30 **Particle deposition: particle impaction, diffusion and filtration (Christoph Asbach):** impactor, flow through nozzle, efficiency curve of impacting jet, design criteria for impactors, virtual impactors, cyclone, aerodynamic particles sizer, deposition by diffusion, deposition in ducts, diffusion batteries, diffusion denuders, filters: types of and artifacts, filtration theory, selection of filter media, EU PM standard, sampling for analysis

10:30-11:00 **Coffee break**

11:00-12:30 **Aerosol chemistry (Anne Kasper-Giebl)**: Chemistry basics, chemical composition (major and minor constituents, traces), chemical composition and size, organic tracers/marker compounds and their use for source identification, identifying markers and aiming at a chemical mass balance

12:30-14:00 **Lunch break**

14:00-15:30 **Aerosol mass spectrometry (Johannes Schneider):** introduction to mass spectrometry, overview of on-line aerosol mass spectrometry techniques, single particle mass spectrometry vs bulk, data analysis strategies, positive matrix factorization

15:30-16:00 **Coffee break**

16:00-17:30 **Modern spectroscopy as a tool for aerosol characterization (Frank Keutsch)**: analytes of interest in modern aerosol science: nanostructured particles, bioaerosol, micro-encapsulated particles, chemical surface characterization: electron spectroscopy for chemical analysis (ESCA), bulk characterization: total reflection X-ray fluorescence, FT-IR spectroscopy, Raman spectroscopy

FRIDAY, 12 July 2024 – ATMOSPHERIC AEROSOLS, HEALTH ISSUES (Room: Ludwig-Boltzmann Lecture Hall)

09:00-10:30 **Measurement methods for black and brown carbon (Andreas Petzold)**: carbonaceous species, "terminology", measurement methods (thermo-optical, thermal, optical, on-line, off-line), measurement intercomparisons

10:30-11:00 **Coffee break**

11:00-12:30 **Aerosol transport modelling (Andreas Stohl)**: types of models, in-cloud scavenging, below-cloud scavenging, dry deposition, gravitational settling, meteorological input data, aerosol lifetimes, long-range transport episodes

12:30-14:00 **Lunch break**

14:00-15:30	**Primary biological aerosol in the atmosphere (Hinrich Grothe):** introduction to biological aerosol particles, biosphere – atmosphere interaction, bioaerosol – cloud interaction, effects in the atmosphere (water uptake, freezing efficiency), measuring strategies
15:30-16:00	**Coffee break**
16:00-17:30	**Aerosol & respiratory system (Lea Ann Dailey)**: structure of the human respiratory tract, physical deposition mechanisms, fluid dynamics in the lung, computational deposition models, experimental deposition methods, particle/vapor interaction, particle clearance and retention

SATURDAY, 13 July 2024 - FIELD EXPERIMENT

08:30-10:30	**Short introduction to field experiment (Bernadett Weinzierl)**
10:30-11:00	**Coffee break**
11:00	Departure by bus from Boltzmanngasse 5, Vienna, to mount **Hohe Wand**
13:00	**Field experiment at Hohe Wand** (details tbc)
16:30	Departure from Hohe Wand
17:00	**Presentation of results, general discussion**
17:30	**Heuriger**
20:00	Departure from Möllersdorf
21:00	Arrival at Boltzmanngasse 5, Vienna

List of Lecturers (in alphabetical order)

Name	Institution	Topic
Prof. Dr. Christof Asbach	Institut für Umwelt & Energie, Technik & Analytik e. V. (IUTA), Duisburg, Germany	Particle deposition: particle impaction, diffusion and filtration
Dr. Charles A. Brock	NOAA Chemical Sciences Laboratory 325 Broadway, R/CSL2 Boulder, CO 80305 USA	Keynote Lecture
Prof. Dr. Lea Ann Dailey	University of Vienna, Faculty of Life Sciences, Department of Pharmaceutical Sciences, Austria	Aerosol & respiratory system
Dr. Josef Gasteiger	Hamtec Consulting GmbH / EUMETSAT, Darmstadt, Germany	Aerosol remote sensing
Prof. Dr. Hinrich Grothe	TU Wien, Institute of Materials Chemistry, Austria	Primary biological aerosol in the atmosphere
Prof. Dr. Anne Kasper-Giebl	TU Wien, Institute of Chemical Technologies and Analytics, Austria	Aerosol chemistry
Prof. Dr. Frank Keutsch	Harvard University, Department of Chemistry and Chemical Biology, USA	Modern spectroscopy
Prof. Dr. Jyrki Mäkelä	Tampere University, Aerosol Physics Laboratory, Finland	Electrical properties of aerosols, electrical aerosol measurement
Prof. Dr. Andreas Petzold	Research Center Jülich, Institute for Energy and Climate Research, Germany	Measurement methods for black and brown carbon
Prof. Dr. Imre Salma	Etövös University, Institute of Chemistry, Budapest, Hungary	Particle statistics, aerosol sampling and measurement
Dr. Johannes Schneider	Max Planck Institute for Chemistry, Mainz, Germany	Aerosol mass spectrometry
Dr. Gerhard Steiner	GRIMM Aerosol Technik, Ainring, Germany	Aerosol generation
Prof. Dr. Andreas Stohl	University of Vienna Faculty of Earth Sciences, Geography and Astronomy, Department of Meteorology and Geophysics, Austria	Aerosol transport modelling
Dr. Agnieszka Straus (Kupc)	University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics, Austria	Aerosol mechanics
Prof. Dr. Wladyslaw Szymanski	University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics, Austria	Optical particle measurements
Prof. Dr. Carlos Toledano	Universidad de Valladolid, Grupo de Óptica Atmosférica, Spain	Aerosol optics
Prof. Dr. Paul Wagner	University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics, Austria	Nucleation and condensation – basics
Prof. Dr. Bernadett Weinzierl	University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics, Austria	Introduction to aerosol & the atmospheric aerosol, field experiment

Prof. Dr. Paul Winkler	University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics, Austria	Nucleation and condensation - measurements