

Copernicus Medal Laudation for Yafang Cheng

Ulrich Pöschl, Max Planck Institute for Chemistry, Mainz, Germany

EGU General Assembly, Vienna, 29 April 2025

Outline

Yafang Cheng

- medal citation & nomination
- education, research & achievements

Selected Scientific Highlights

- haze formation, aerosol acidity, nanoparticle phase transitions
- climate & health effects of black carbon & respiratory particles

Personal & Historic Perspectives

- Max Planck Institute for Chemistry: people & research
- science & philosophy for a prosperous Anthropocene

Copernicus Medal 2025

Citation: Professor Yafang Cheng receives the Copernicus Medal in recognition of fundamental insights, groundbreaking advances, and impactful public outreach in understanding atmospheric **aerosols & their effects on air quality, health, and climate**.

Nomination: Professor Yafang Cheng is an outstanding scholar & leading expert in the fields of **aerosol science & Earth system chemistry**.

Her research aims at a mechanistic understanding & quantitative prediction of aerosol processes & effects in the Earth system **while advancing the fundamental theory & physical chemistry of nanoparticles & microdroplets**.

Yafang Cheng

Education & Career

www.mpic.de/3599133/Profile_Y_Cheng

1997–2001	**Wuhan University**, Wuhan, China, BSc Environmental Sciences
2001–2007	**Peking University (PKU)**, Beijing, China, PhD Atmospheric Chemistry
2004–2009	**Leibniz Institute for Tropospheric Research (TROPOS)**, Leipzig, Germany, PhD Exchange Student, Postdoctoral Researcher
2009–2011	**University of Iowa (UI)**, Iowa City, Iowa, USA, Postdoctoral Fellow
2011–2013	**Peking University (PKU)**, Beijing, China, Assistant Professor (*100 Talent*), Guest Professor, since 2023
since 2012	**Max Planck Institute for Chemistry (MPIC)**, Mainz, Germany, Visiting Scientist, 2012-2013, Research Group Leader, 2013-2014 Independent Minerva Research Group Leader, 2014-2024 **Director, Aerosol Chemistry Department,** since 2024
since 2021	**University of Science & Technology China (USTC)**, Hefei, China, Distinguished Guest Professor

Publications, Honors & Leadership, Teaching & Mentoring (Selected)

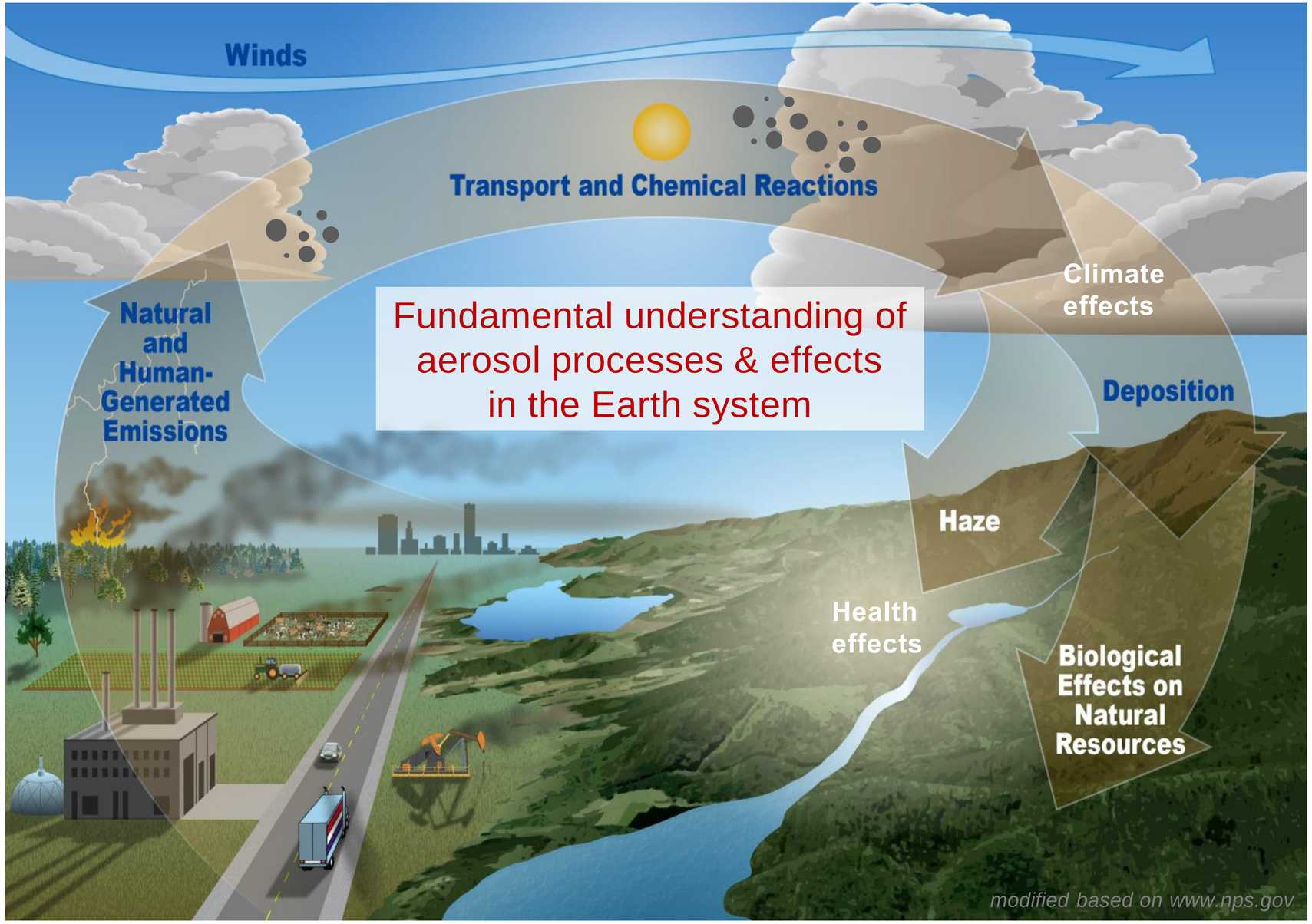
Over 190 publications; >19,000 citations (GS), h-index 72, m-index 4; >20 articles in interdisciplinary highlight journals (5 *Science,* 15 first/corr. author*);* 6 hot & 15 highly cited papers (top 0.1%/1%, WoS); Highly Cited Researcher (top 0.1%, WoS 2021/22)

Fellow & Joanne Simpson Medal, American Geophysical Union (AGU); Member, Academia Europaea; Fellow, American Association for the Advancement of Science (AAAS); Breakthrough Award, Falling Walls Foundation; Schmauss Award, GAeF; Highest Impact Research Award, Chinese Academy of Science (CAS); 100 Talent Award & Group Funds, Peking University (PKU)

Editor-in-Chief, JGR Atmospheres; Senior Editor, ACP; Session convener, panelist, reviewer for AGU, EGU & other organizations

Mentored over 17 PhD students & 20 postdocs; guidance to major achievements & successful careers: top quality papers; faculty members/senior scientists (12), 1000 Young Talent Awards; ACS, EGU, CSC Awards

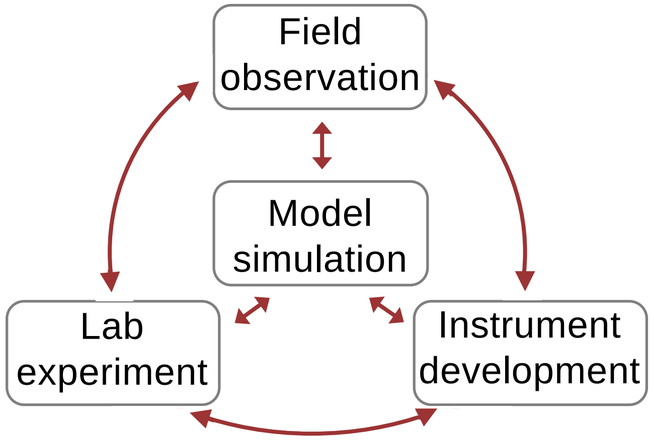
Aerosol Science & Earth System Chemistry



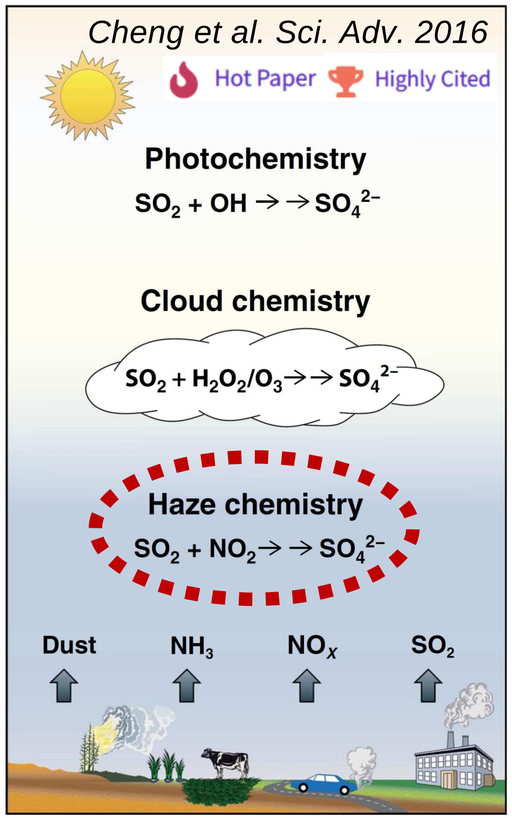
Subject: Aerosols play important roles in the Earth system, but the **underlying processes are not fully understood**.

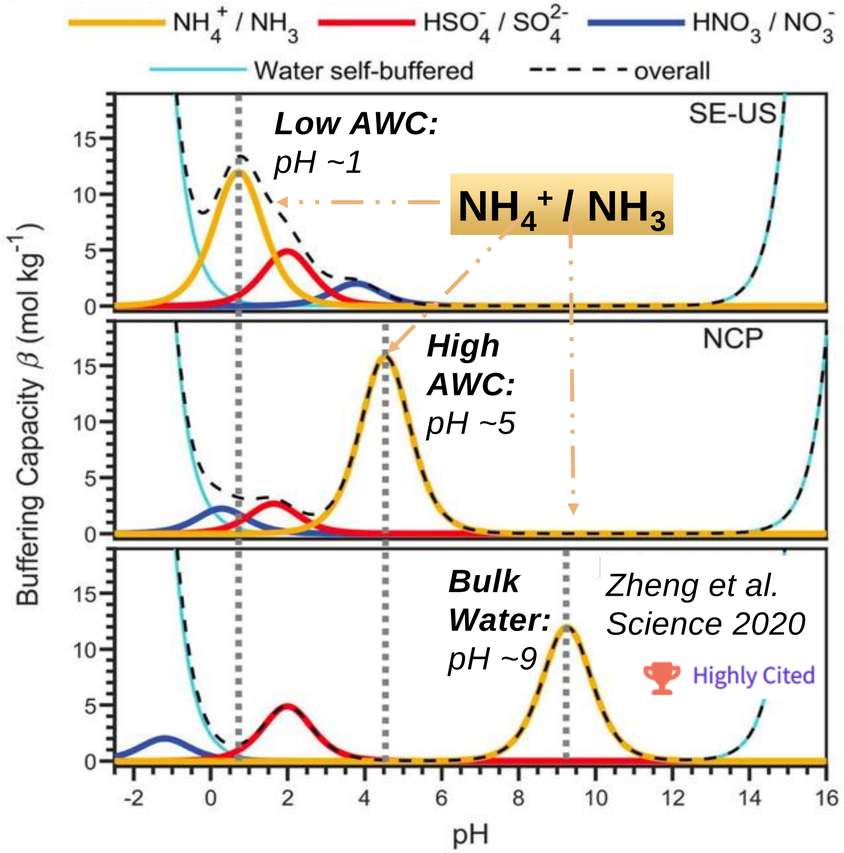
Goal: Fundamental & predictive understanding of the interactions & effects of aerosol particles from **molecular to global scales**.

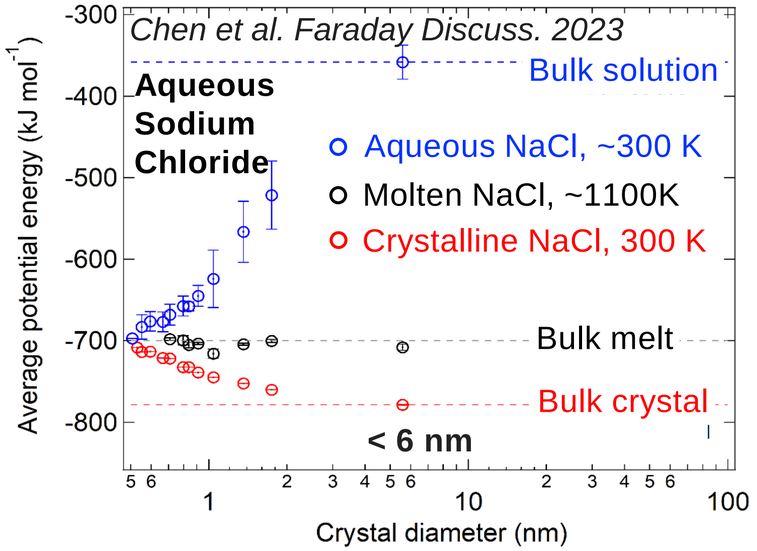
Approach: multi-scale integration of **field, lab & model studies**.

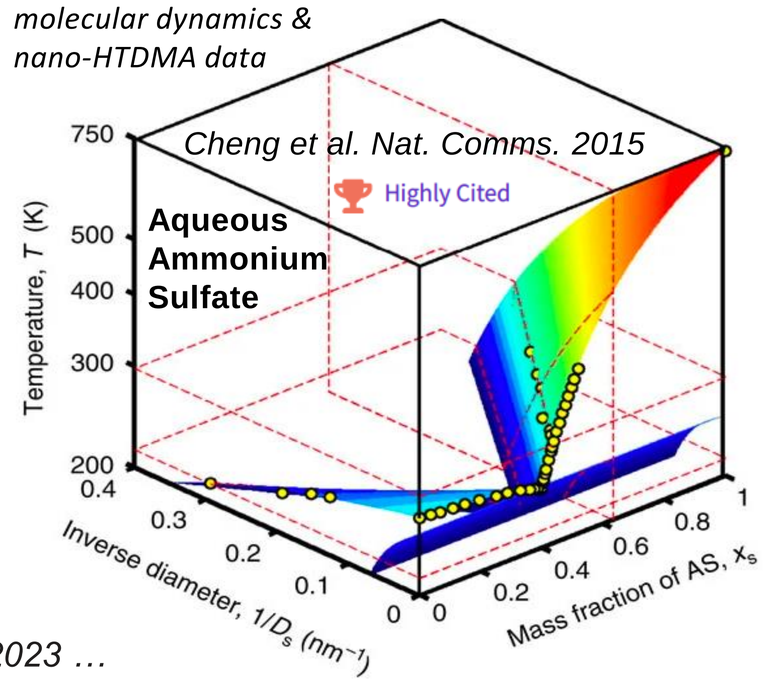


Haze Formation, Aerosol Acidity & Nanoparticle Phase Transitions







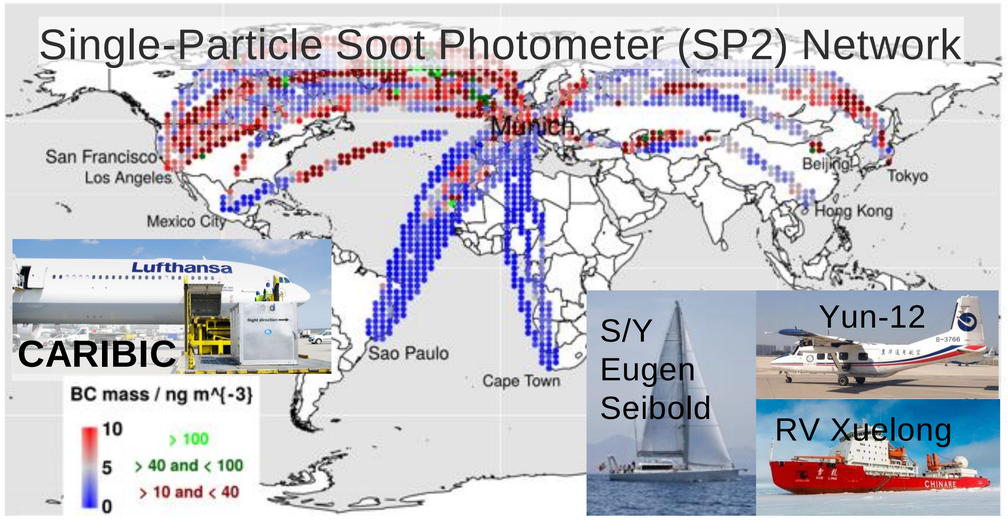


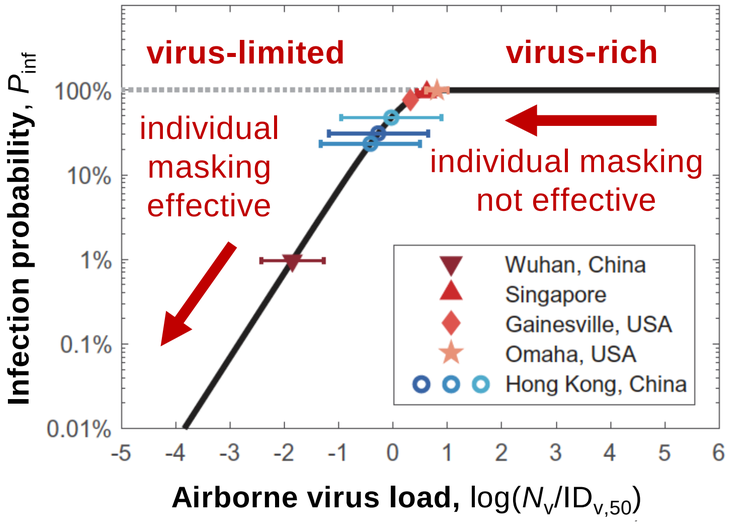
Discovered sulfate production & self amplification by reactive nitrogen chemistry (NO_2+SO_2) in aerosol water at high ion activity, *Cheng et al. Sci. Adv. 2016, >1000 citations; Xiang et al. ACP 2021, Li et al. EST 2022, Chem 2023 …*

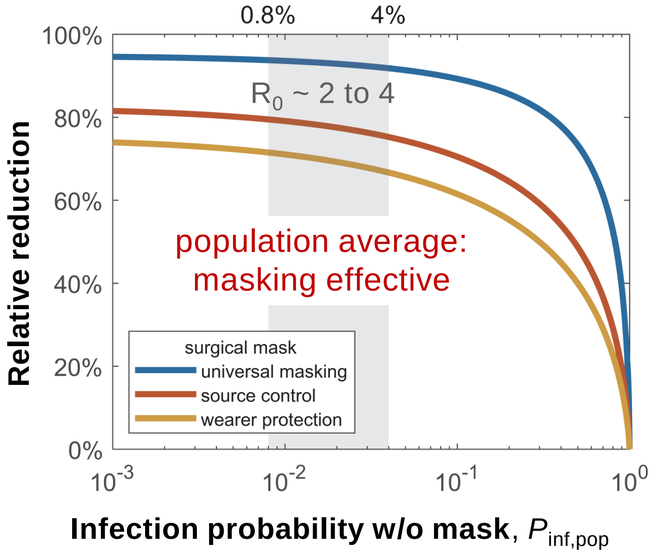
Developed new multiphase buffer theory: single agent/pair (NH_3/NH_4^+) buffers at different pH levels depending on aerosol mass & water, *Zheng et al. Science 2020, ACP 2022 …*

Nanoparticle phase transitions: developed 3D phase diagram ($1/D_p$), discovered convergence of dissolution & melting, *Cheng et al. Nat. Comms. 2015; Chen et al. Faraday Discuss. 2023 …*

Climate & Health Effects of Black Carbon & Respiratory Aerosols







Black Carbon & Climate

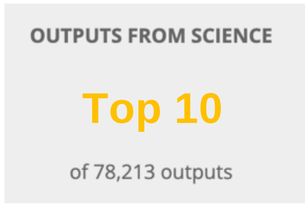
- Global measurements to constrain & quantify climate effects, focusing on remote regions, high altitudes & **wildfires**
- Modeling of impacts on atmospheric circulation & boundary layer decoupling (extreme haze events)

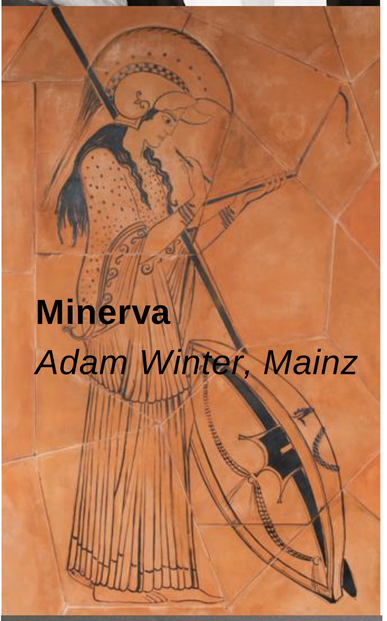
Cheng et al. JGR 2006; 2009, ACP 2012; Ditas et al. PNAS 2018; Ding et al. Nat. Comms. 2021; Chen et al. ACP 2020; Yue et al. One Earth 2022; Zhang et al. ACP 2019, One Earth 2023; Li et al. Chem 2022 ; Wang et al. JGR 2022; etc.

Respiratory Aerosols & Infection Control

- Identify & answer open questions according to **critical rationalism**, beyond advocacy for textbook knowledge
- Efficacy of masking depends on **regime of virus abundance**, explains inconclusive/contradictory earlier results (RCT) & synergies with other protective measures (ventilation etc.)

Cheng et al. Science 2021 Highly Cited





Minerva
Adam Winter, Mainz

Max Planck Institute for Chemistry (MPIC)

1911/12 foundation/opening first institute of MPG/KWG in Berlin Dahlem (with FHI)

Lise Meitner first female scientific member, **1913**

Minerva logo of MPG/KWG, **1926**

1944/49 Relocation from Berlin via Tailfingen to Mainz

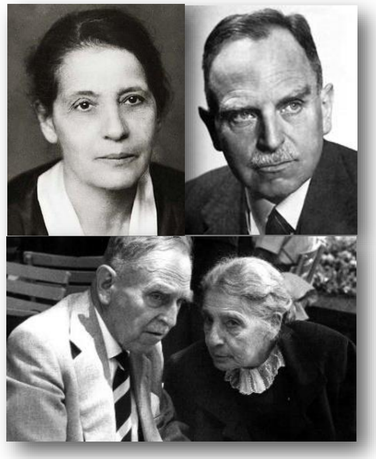
O. Hahn first president of MPG, 1948

2011/12 Relocation to new bldg., Hahn-Meitner-Weg 1

Yafang Cheng first female director & second scientific member, **2024**; *111 years after Lise Meitner (elf)*

Organic & Inorganic Chemistry
1915 Nobel Prize R. Willstätter: Chlorophyll
(first Nobel Prize for MPG/KWG)

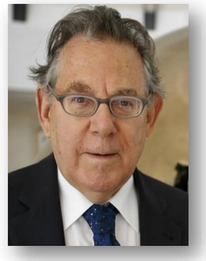
Radiochemistry & Nuclear Physics
1944 Nobel Prize O. Hahn: Nuclear Fission



Physical Chemistry
Mass spectrometry & isotopes

Geo- & Cosmochemistry
Earth mantel, meteorites, Moon & Mars

Atmospheric & Biogeochemistry
1995 Nobel Prize P. Crutzen: Ozone Chemistry

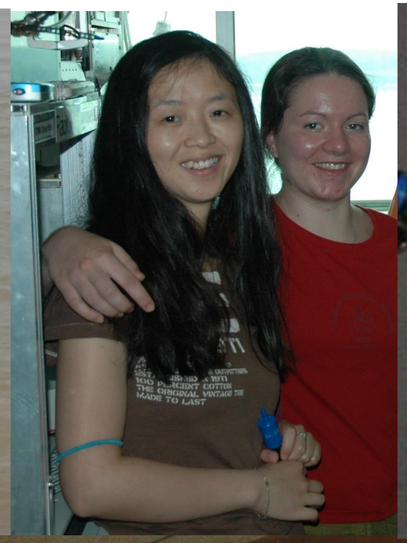


Earth System Chemistry
Integral scientific understanding of chemical processes in the Earth system:
- molecular to global scales
- climate & health
- Earth history & Anthropocene

www.mpic.de

MAX PLANCK INSTITUTE
FOR CHEMISTRY

From the Yangtse via Pearl River to the Rhine



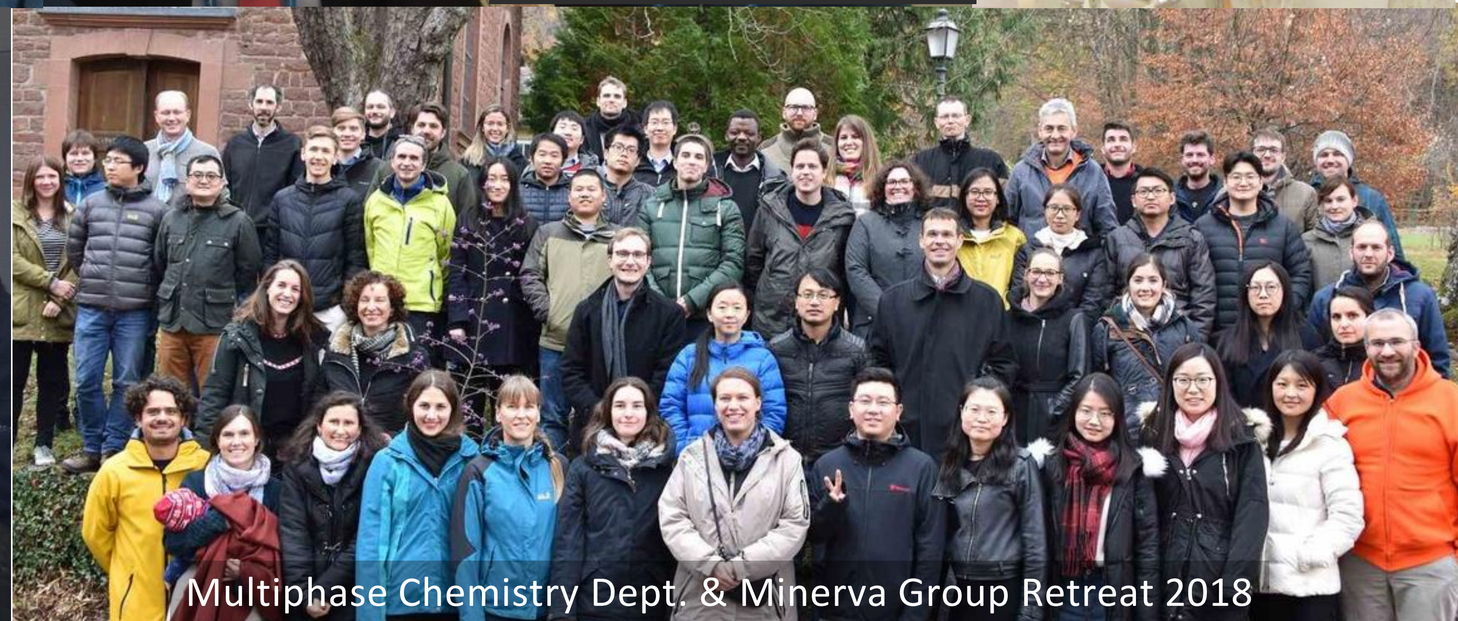
Settling in Mainz/Europe with Family & Friends


Vienna 2013


Mainz 2015

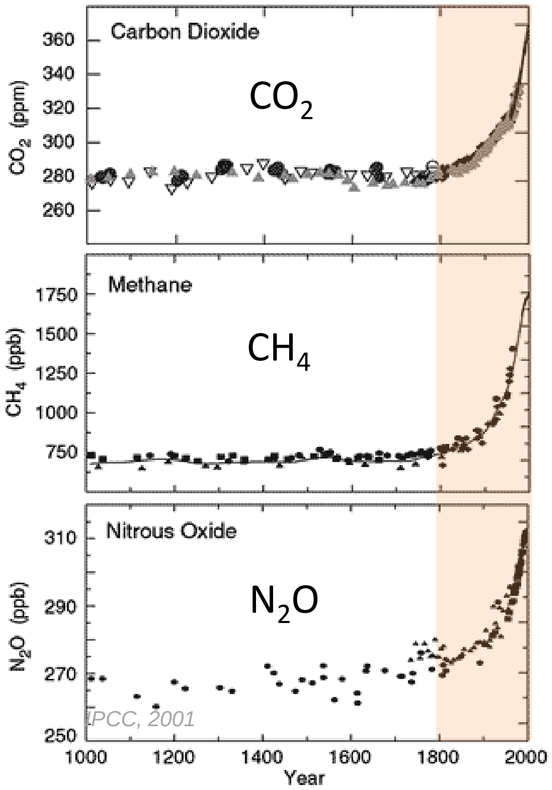

EGU 2013, Awards Dinner


MPIC 2015


Multiphase Chemistry Dept. & Minerva Group Retreat 2018

Building New Department & Contacts for MPIC

The Anthropocene: A new epoch in Earth history driven by human activity



THE ANTHROPOCENE

Globally pervasive & steeply increasing anthropogenic influence on planet Earth:

scientific curiosity & discovery meet practical challenges & philosophical questions (**critical rationalism**) – from air quality, ozone hole & climate change to public health & human well-being (**“planetary health”**)

Scientific & societal message: we are shaping the planet, so let’s try to get it right

Crutzen Nature 2002; Pöschl et al. Chem Rev 2015, PAS 2017, Springer 2020, 2021; www.mpic.de/4677594/trauer-um-paul-crutzen#Condolences

Conclusion

Dear Yafang:

Many thanks for your important scientific achievements;

Congratulations for the well-deserved Copernicus Medal; and

Success on the continued way to & through a
prosperous, sustainable & equitable Anthropocene !