JOINT MASS SPECTROMETRY CENTRE

Implications of photochemical ageing for health effects of wood combustion aerosol

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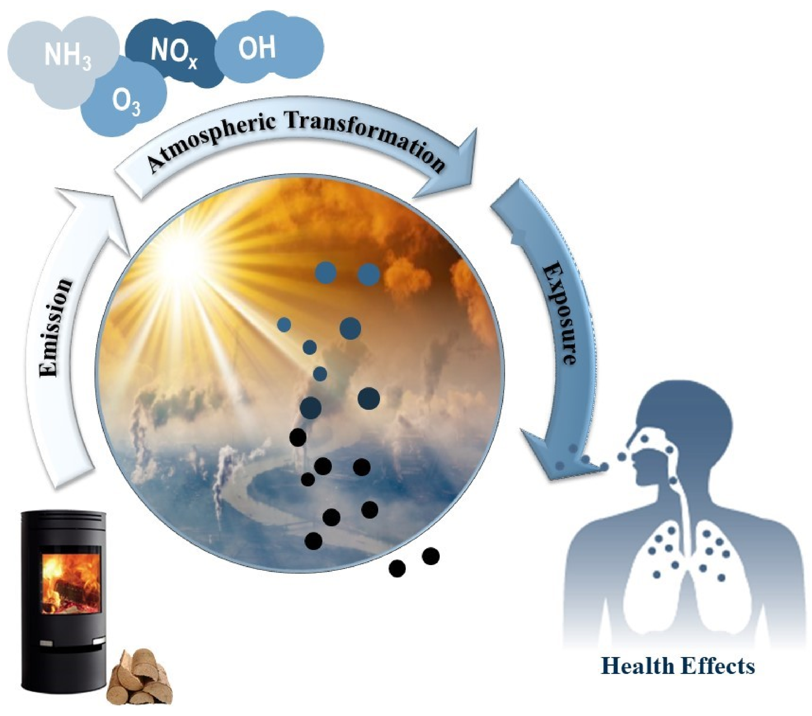
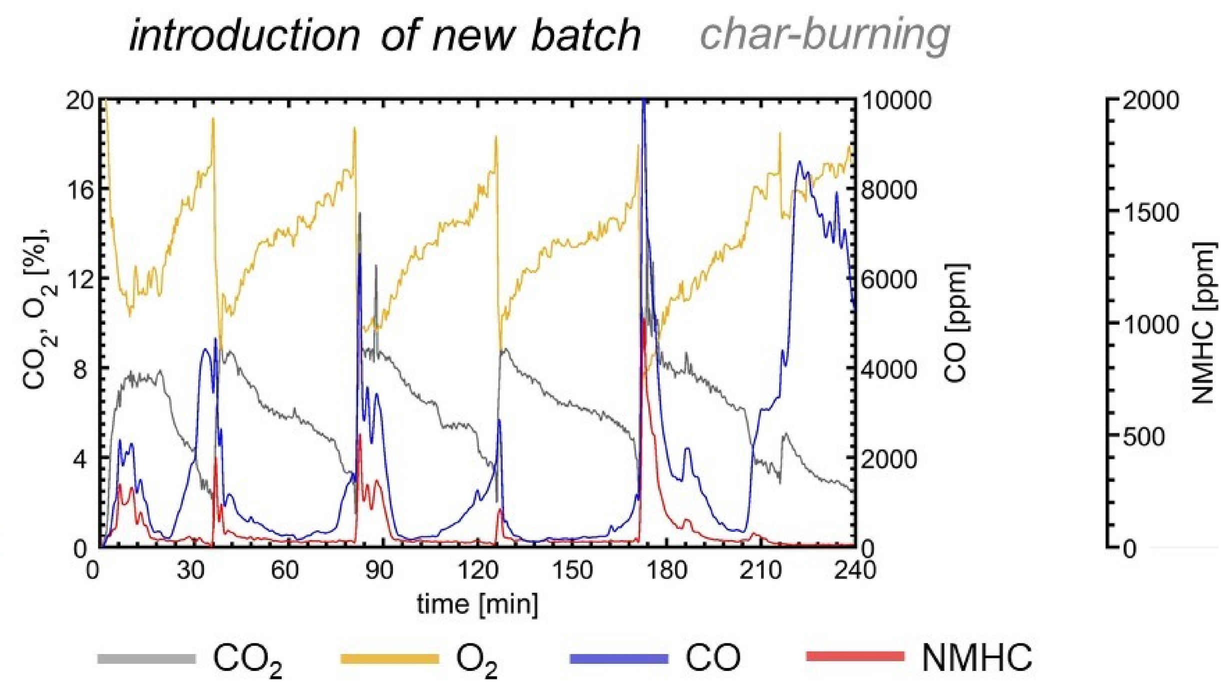
Introduction

- Usage of firewood for energy production is increasing encouraged by political, ecological and economical reasons
- Wood combustion is among the major sources of air pollution in Europe especially during winter
- Wood combustion aerosols cause harmful effects on human health and exhibit substantial potential for the formation of Secondary Organic Aerosol (SOA)

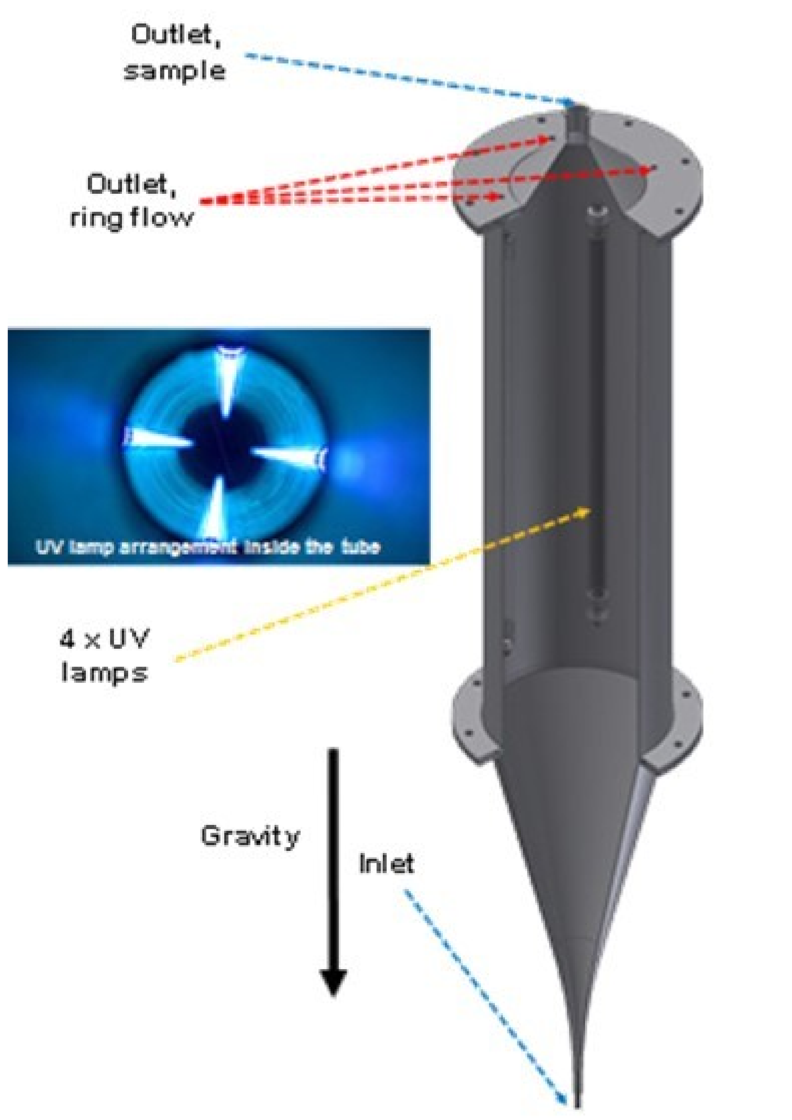


Combustion Source

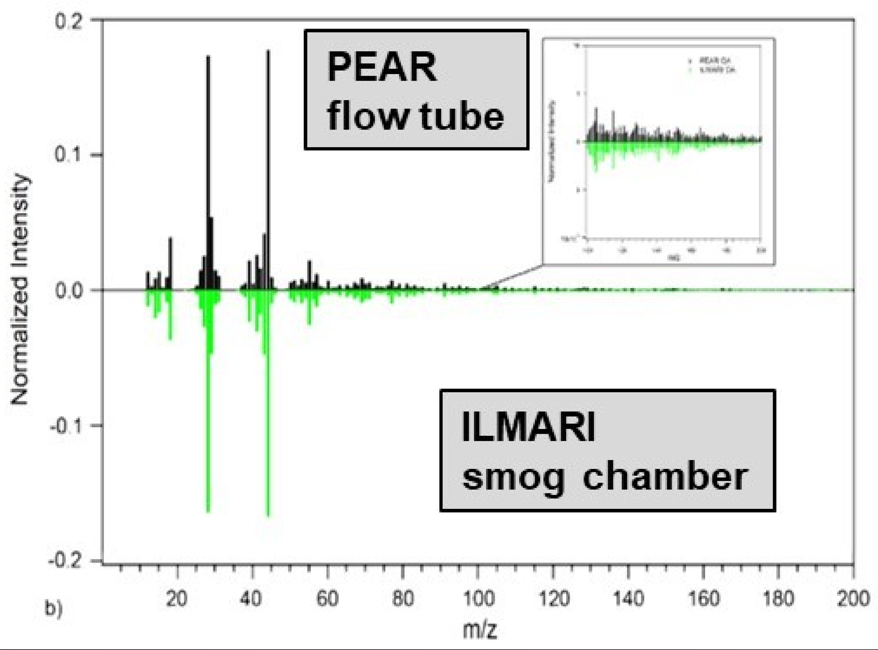
- Non-heat-retaining iron stove (Aduro 1.1, 6 kW)
- Five consecutive batches of 2 kg of spruce logwood for 45 min
- Stoking of glowing ember, char-burning phase for remaining 30 min



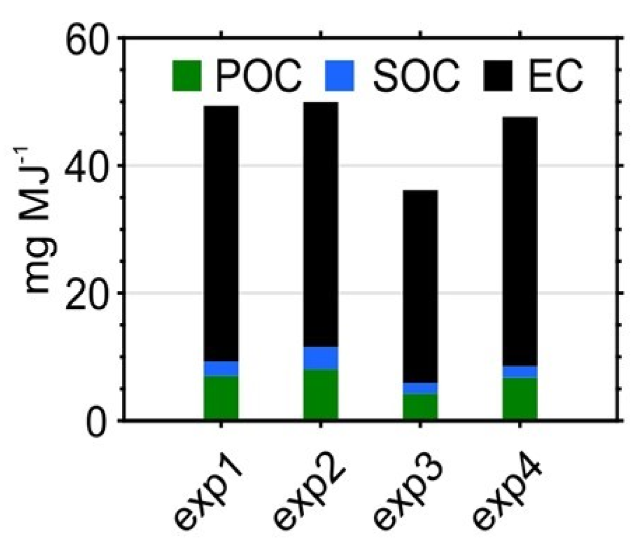
Ageing of wood combustion aerosol with a flow tube reactor

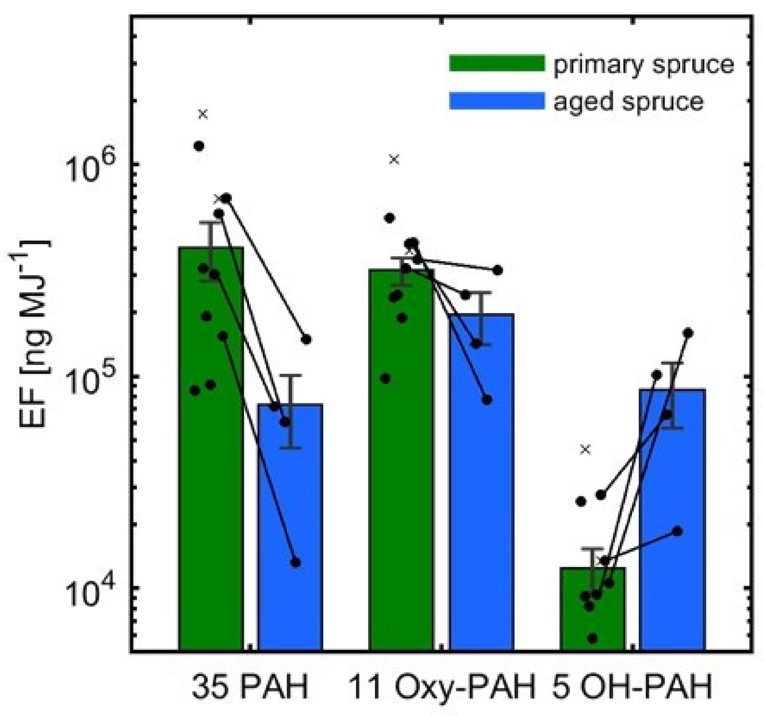


- Volume of 139 L
- Laminar flow profile
- Low inner surface-to-volume ratio
- Flow rates of 50 – 200 L min^{-1}
- External feed of ozone
- Flexible UV light intensity



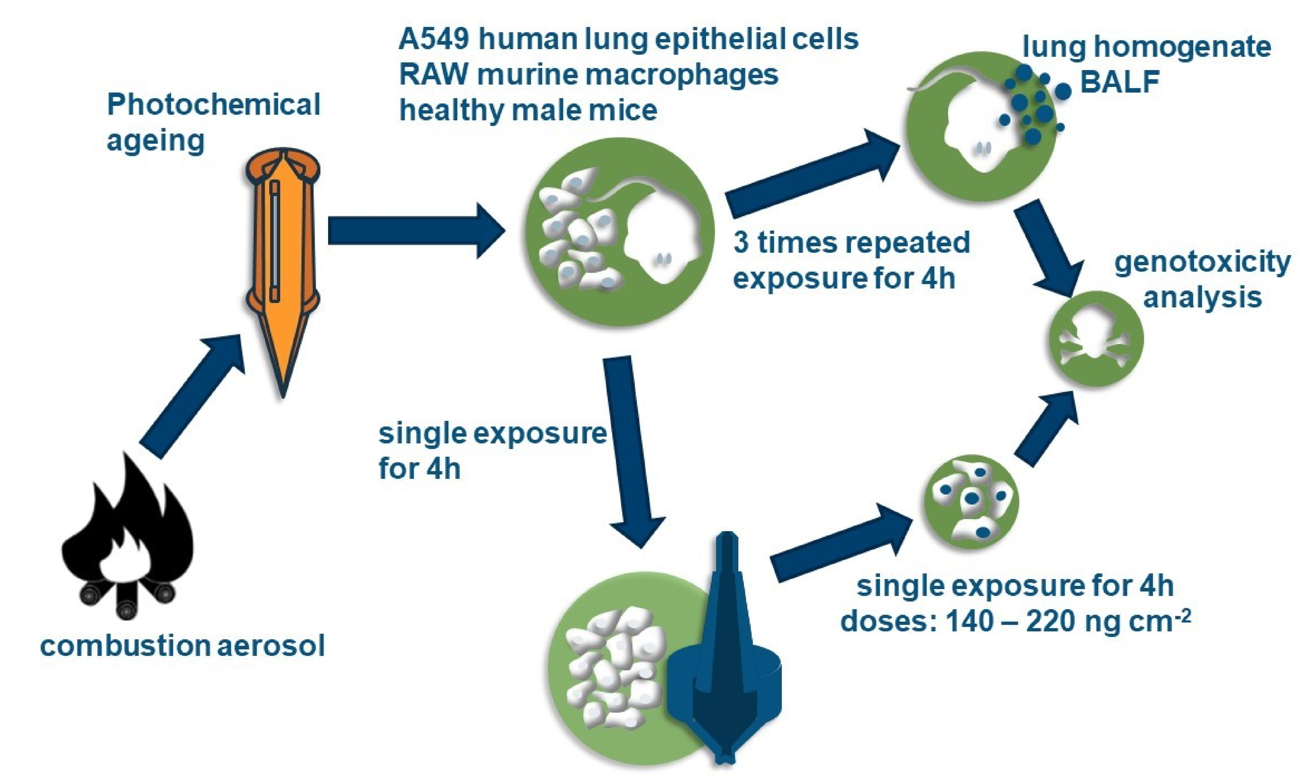
- 100 L min^{-1} → 62 s mean residence time
- Ozone concentration of 4 ppm
- Photon flux at 254 nm of 3 * 10^{16} photons cm^{-2} s^{-1}
- 50% relative humidity
- Equivalent photochemical ages of 1.7 - 2.5 days

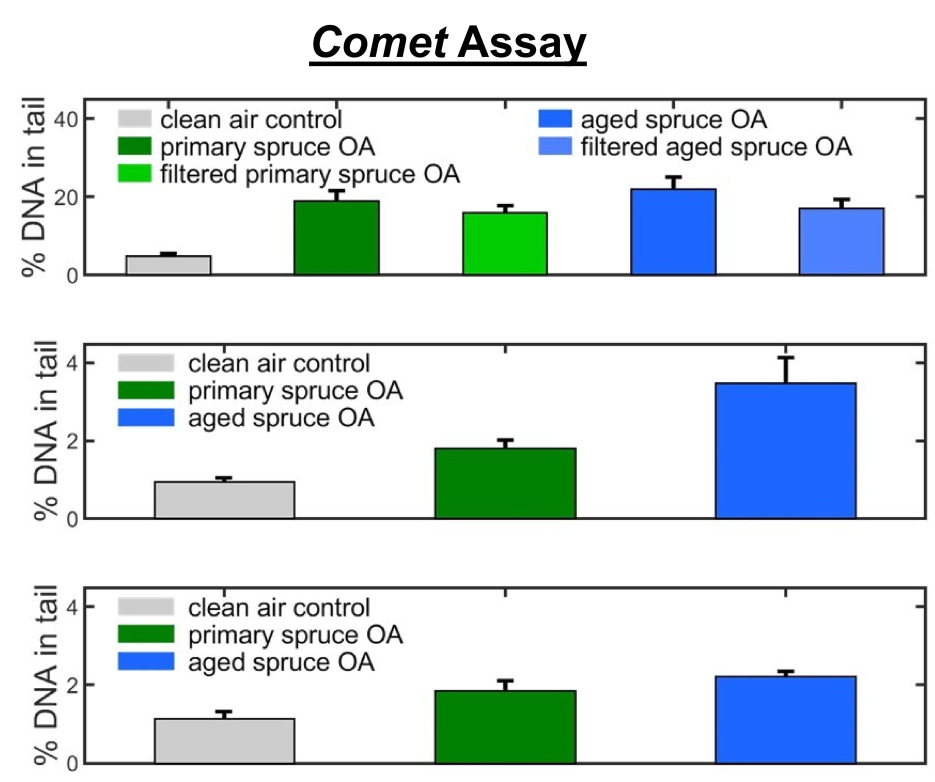




- With ageing:
- ~90% degradation of PAH
- ~50% degradation of Oxy-PAH
- ~600% increase of OH-PAH

In vitro and in vivo exposure experiments

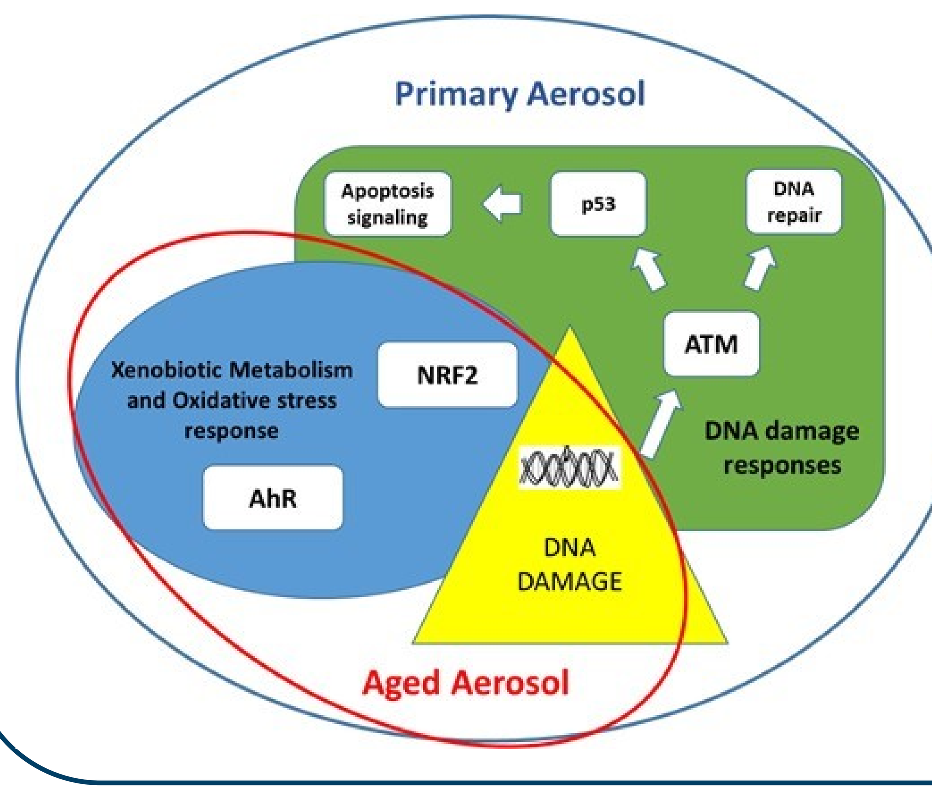




A549 human lung epithelial cells:
- primary ≈ aged
- gas phase effects

repeated exposure of mice (BALF):
- stronger effects from aged aerosol

repeated exposure of mice (lung homogenate):
- primary ≈ aged



- **Pathway analysis**: oxidative stress (NRF2) and xenobiotic metabolism (AhR)
- **Primary aerosols**:
  - DNA double strand breaks (ATM signalling), activation of DNA damage responses (p53 and apoptosis signalling)
  - DNA damage more efficiently repaired
- **Hypothesis**: DNA oxidation from aged aerosol

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