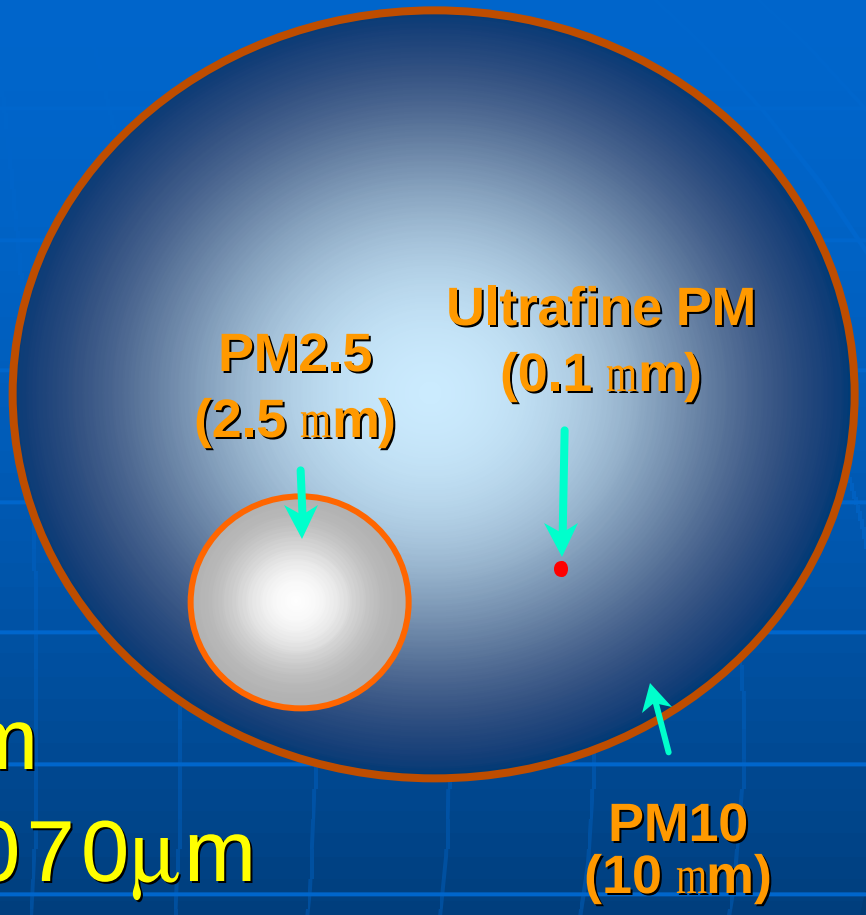
Current Issues in Ultrafine Particle Research:
The ARB's Health and Exposure Research Program

July 20, 2006

Air Resources Board

California Environmental Protection Agency

Relative particle size



- Ultrafine Particles: less than 0.1µm
- Viruses: 0.002 – 0.070µm
- Bacteria: 3 – 50µm
- Red Blood Cell: 7.5µm
- Human Hair: 60µm

Why are we concerned about ultrafine particles?

Contain little mass, but:

- Possess a large surface area and high numbers
- Have a high deposition rate in the lung
- Can enter the circulatory system and move from the lungs to other organs
- Contain toxic components
- May initiate harmful oxidant injury

Health Effects
Recent Findings

- Ultrafine PM has been associated with premature death, cardiovascular disease, and respiratory illness
  - Detroit and Erfurt, Germany
  - Animal and cellular studies

Health Effects
Research Issues

- How much of the health effects associated with PM2.5 are actually caused by ultrafine PM?
  - Cardiovascular effects in the elderly (UC Irvine)
  - Cardiovascular effects from on-road exposures (UCLA)
  - Role in atherosclerosis (UC Irvine)
- USEPA PM Centers at UCLA, Rochester, and Harvard focus on ultrafine particle research

Exposure
Recent Findings

- Exposure to ultrafine particles varies by location and time
  - Local sources can have a major impact
  - Ultrafine particle levels fall off rapidly near roadways
  - Much of your exposure occurs during daily commute

Exposure
Research Issues

- What are community levels of ultrafine particles?
  - Ultrafine particles at LAX (UCLA)
  - Harbor Communities Monitoring Project
    - Community level monitoring (USC)
    - Mobile monitoring of spatial gradients (UCLA)

Indoor Exposure
Recent Findings

- Indoor sources can be important to ultrafine particle exposures
  - Indoor combustion sources contribute to ultrafine particle exposures
  - Indoor Air Chemistry: Ultrafine particles and formaldehyde are produced by terpene – ozone reactions

Indoor Exposure
Research Issues

- How much of the indoor exposure is due to indoor sources and how much to infiltration of outdoor particles?
  - Measurement of ultrafine particulate matter in classrooms and homes (UC Berkeley)
  - Emissions from office machines (UC Berkeley)

Emissions and Controls
Recent Findings

- Sources:
  - Combustion, condensation, photochemistry, indoor sources
- Findings: The internal combustion engine is a prominent source of ultrafine particles
  - Gasoline/CNG/Diesel/Jet engines/etc.

Emissions and Controls
Research Issues

- Characterization and quantification of mobile source emissions are still needed
  - Toxicity of emissions from heavy-duty and light-duty vehicles (USC)
  - Evaluation of the European Particle Measurement Program (PMP) protocol (UC Riverside)
  - Source apportionment (UC Davis)

Conclusion

- Ultrafine particles are a concern
- ARB is active in research into all aspects of ultrafine particles
- We will continue our research effort in the future