

SECOND HAND SMOKE EXPOSURE: THE REAL TRUTH

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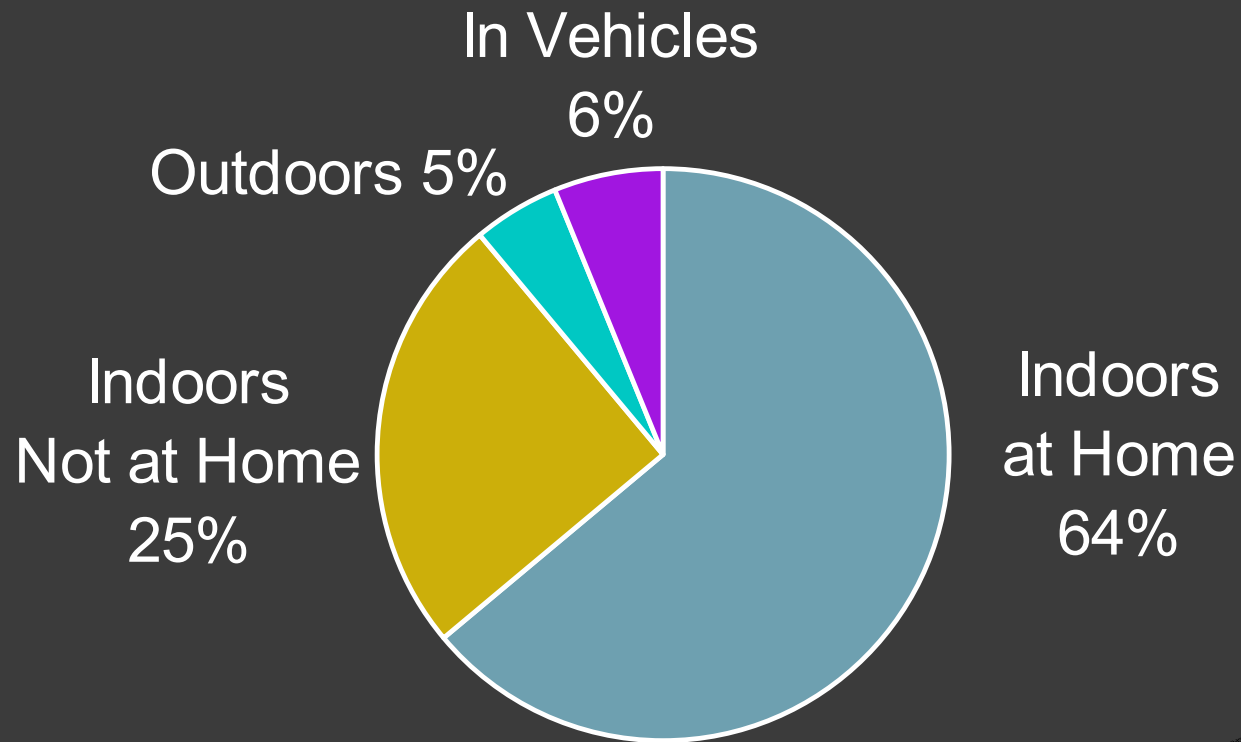
Outline

- ⊙ Basics of indoor air quality
 - Understanding importance of indoor air quality
 - Transport
 - Sources and that can impact indoor air quality
 - Resuspension
- ⊙ Second Hand Smoke (SHS)
 - ⊙ What is it?
 - ⊙ Facts about SHS
 - ⊙ Who is affected by SHS?
 - ⊙ Methods for monitoring and measuring SHS
 - ⊙ Case Studies
- ⊙ Overall conclusions

Importance of Understanding Indoor Air Quality?

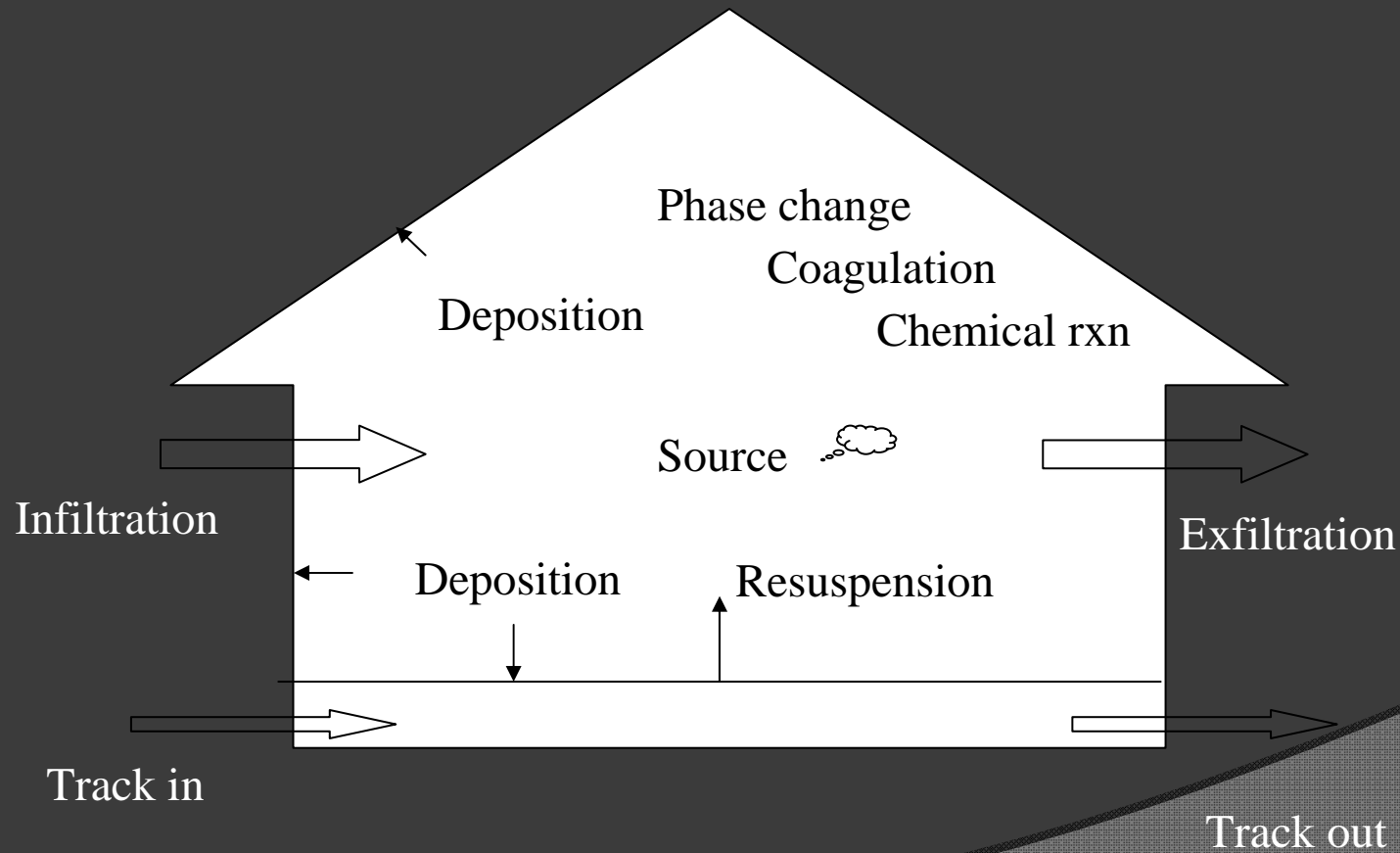
- ⦿ People spend 90-95% of their time indoors
 - Work, home, automobile
- ⦿ Mechanism of Transport of Pollutants Indoors
 - Tracking in, out, *personal cloud, infiltration of pollutants
- ⦿ Different sources can impact indoor air quality
 - *Traffic combustion, *cooking, *cleaning, household appliances, wood stoves, gas stoves, new furniture, carpet, resuspension, *primary and/or second hand smoke (SHS)
- ⦿ *Key is to understand your indoor environment to better protect the health of yourself and those around you.

Percentage of Time Spent Indoors, Outdoors and in Vehicles in the United States

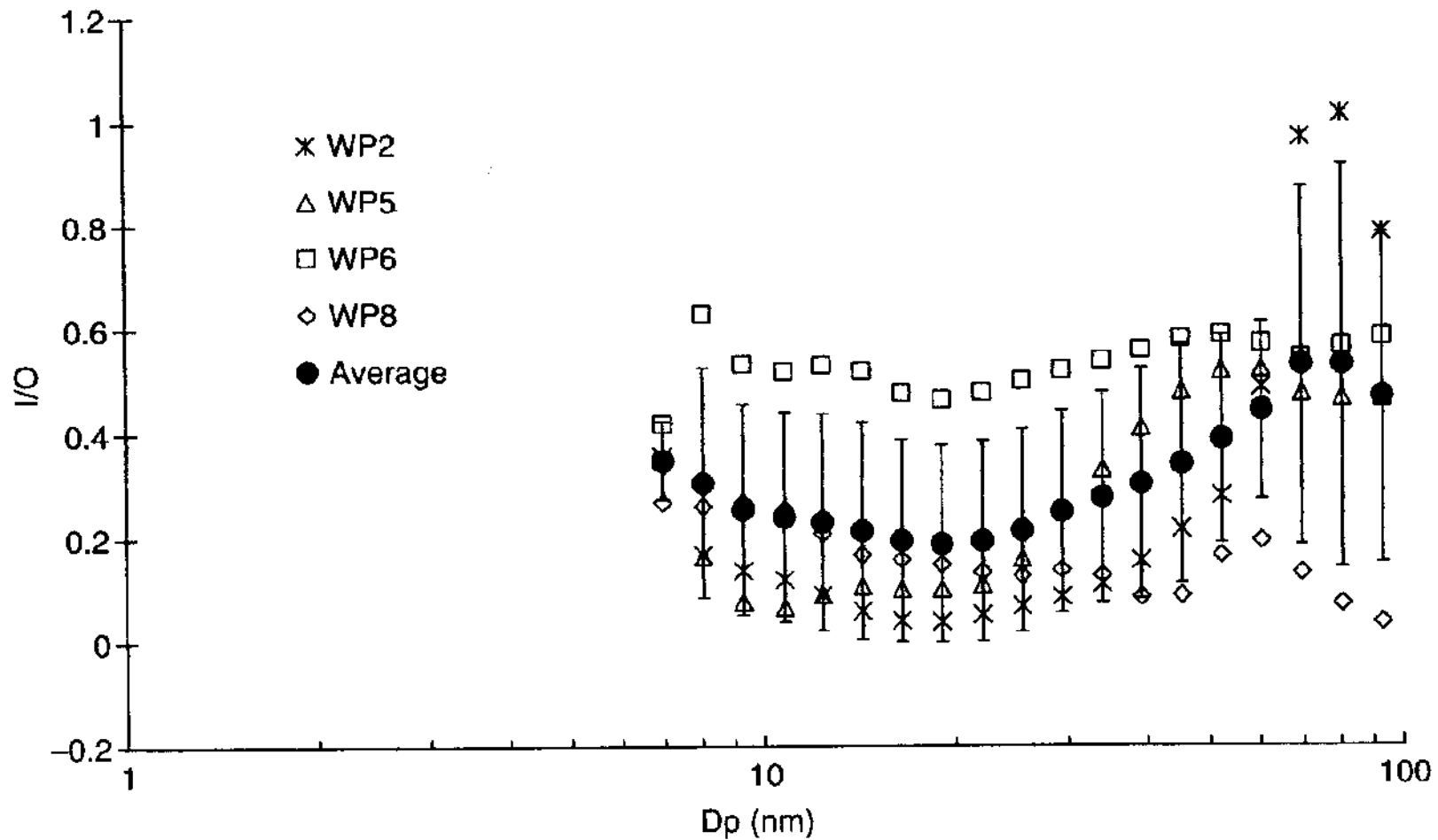


Source: (Robinson et al., 1991)

Mechanism of Transport of Pollutants Indoors



Ambient (Combustion) Impacts on Indoor Air Quality



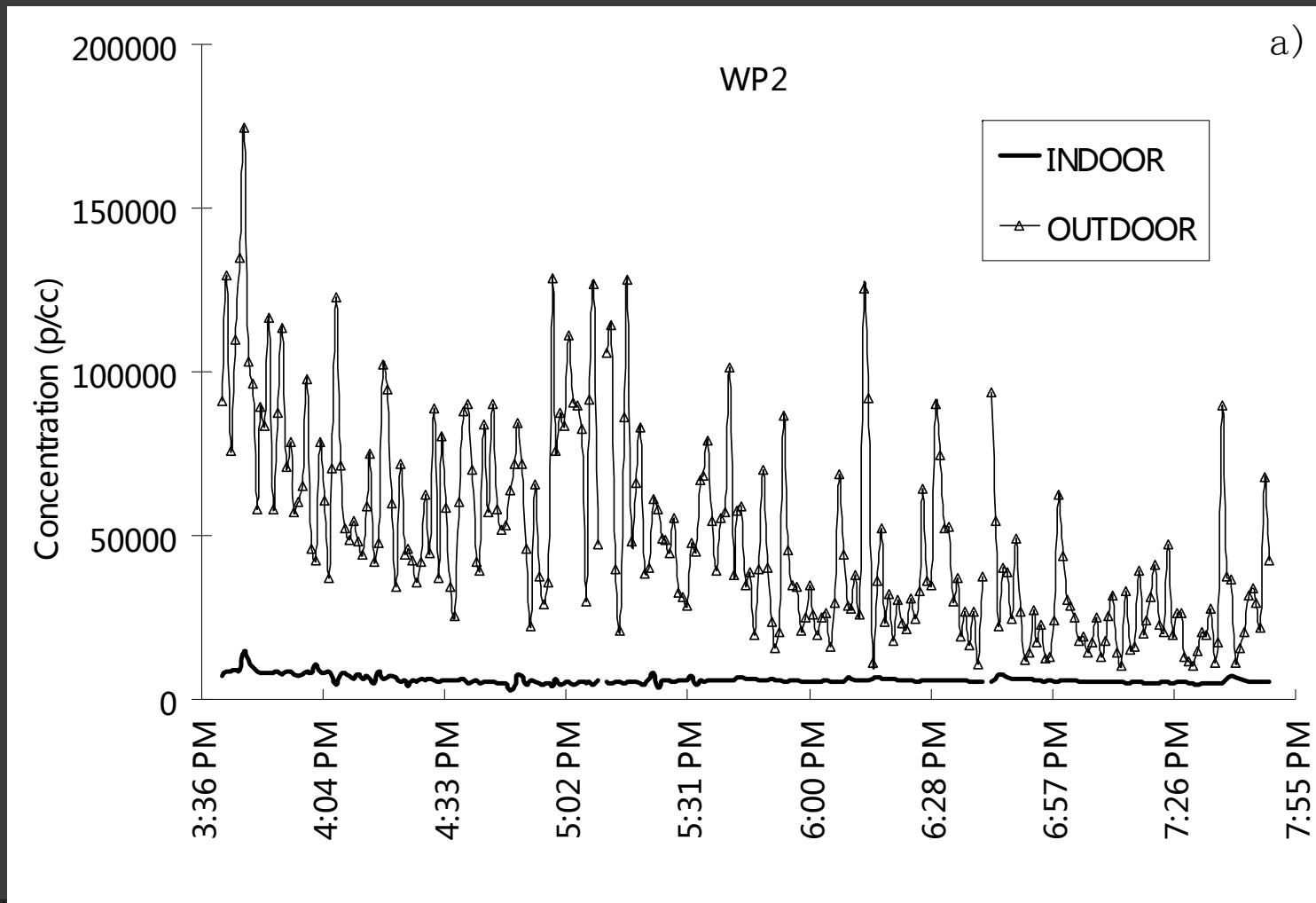
Conditions of Varying Indoor Air Quality

- ⊙ During times of **NO** indoor sources
 - (e.g., cooking & smoking)

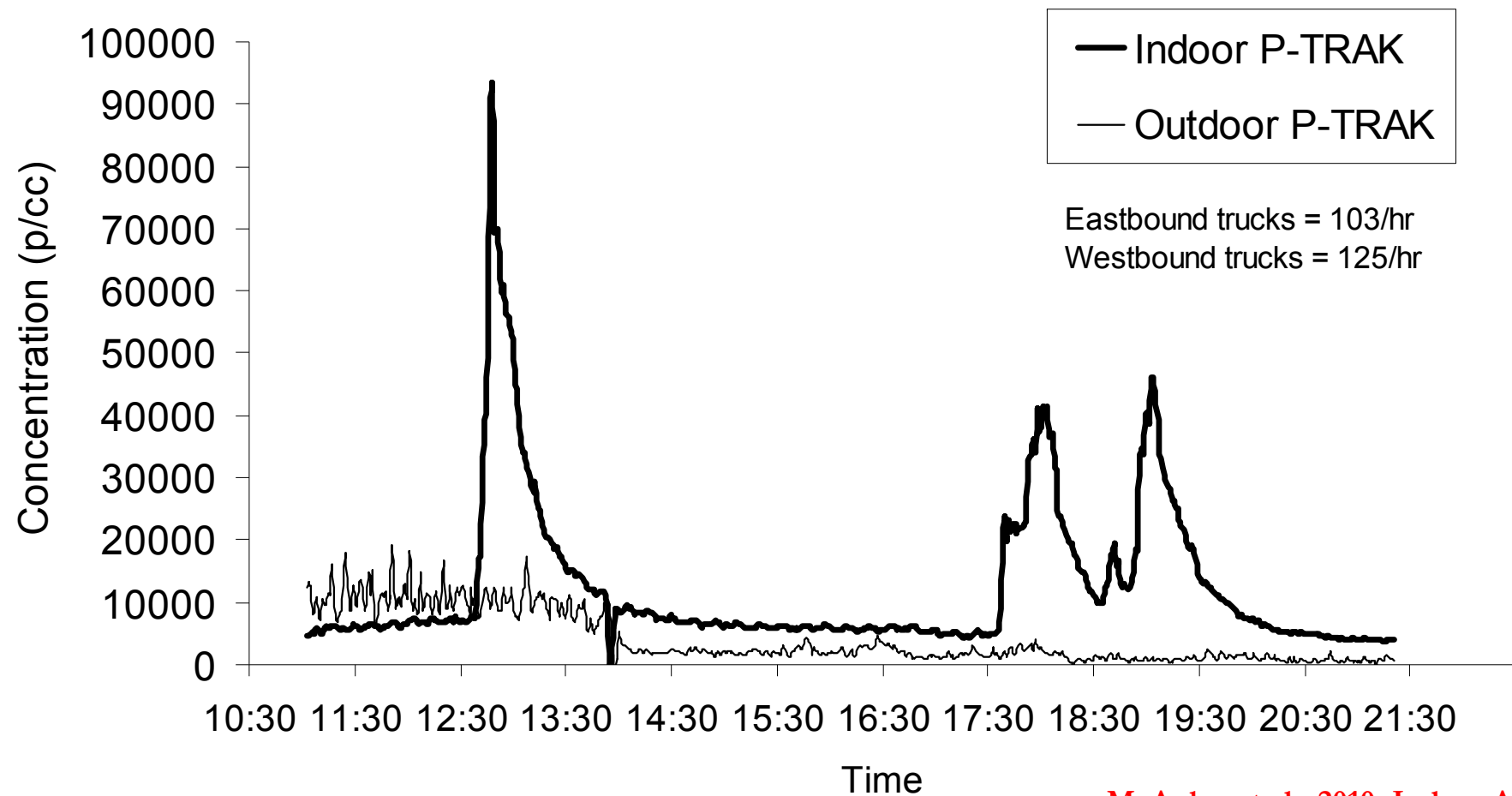
- ⊙ During times of indoor sources
 - (e.g. cooking and cleaning)

- ⊙ Resuspension of particles from human activity (e.g., walking) that are comprised of metals, allergens, and persistent organic pollutants

Ultrafine Particles During No Indoor Source Episodes

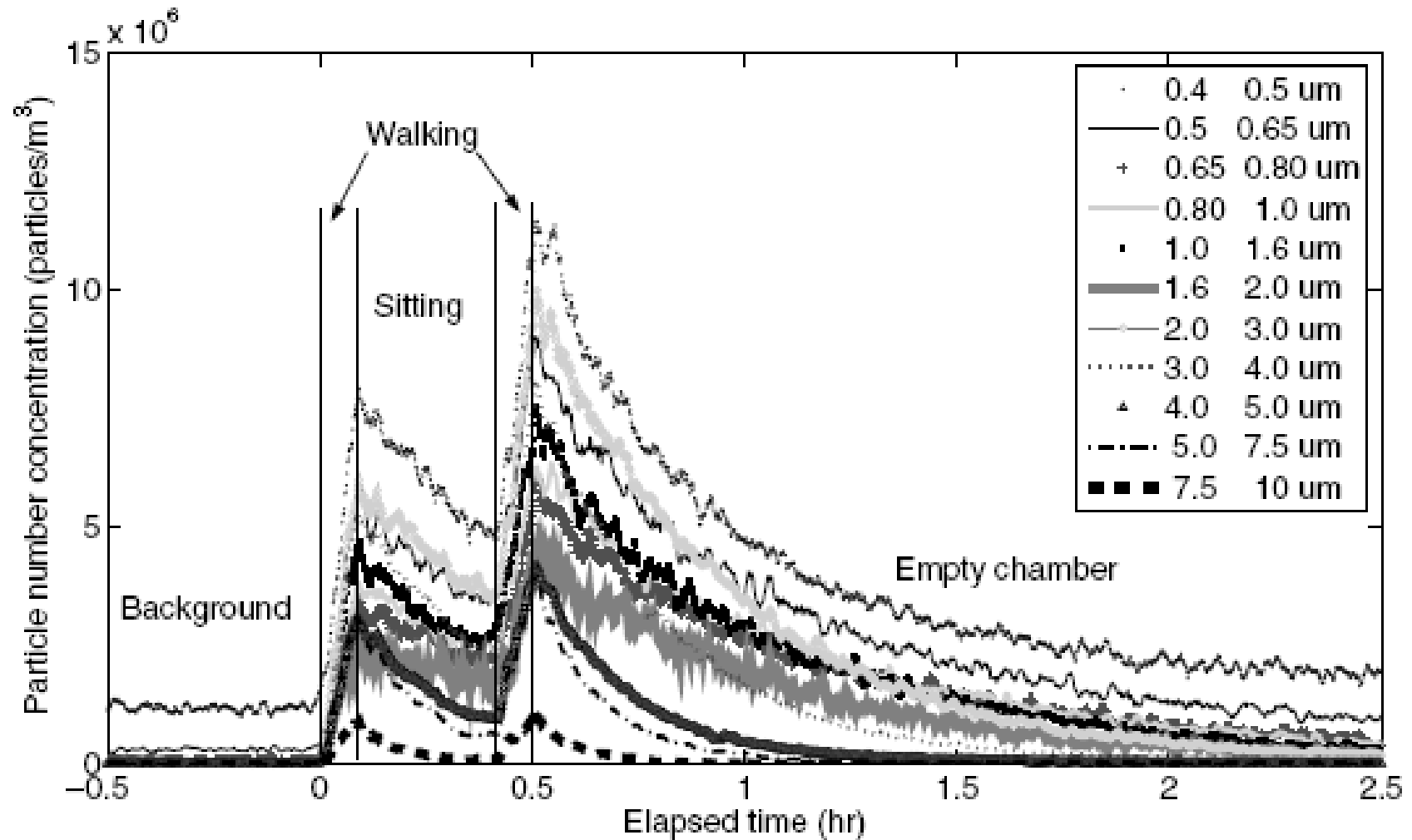


Ultrafine Particles During Smoking and Cooking Episodes

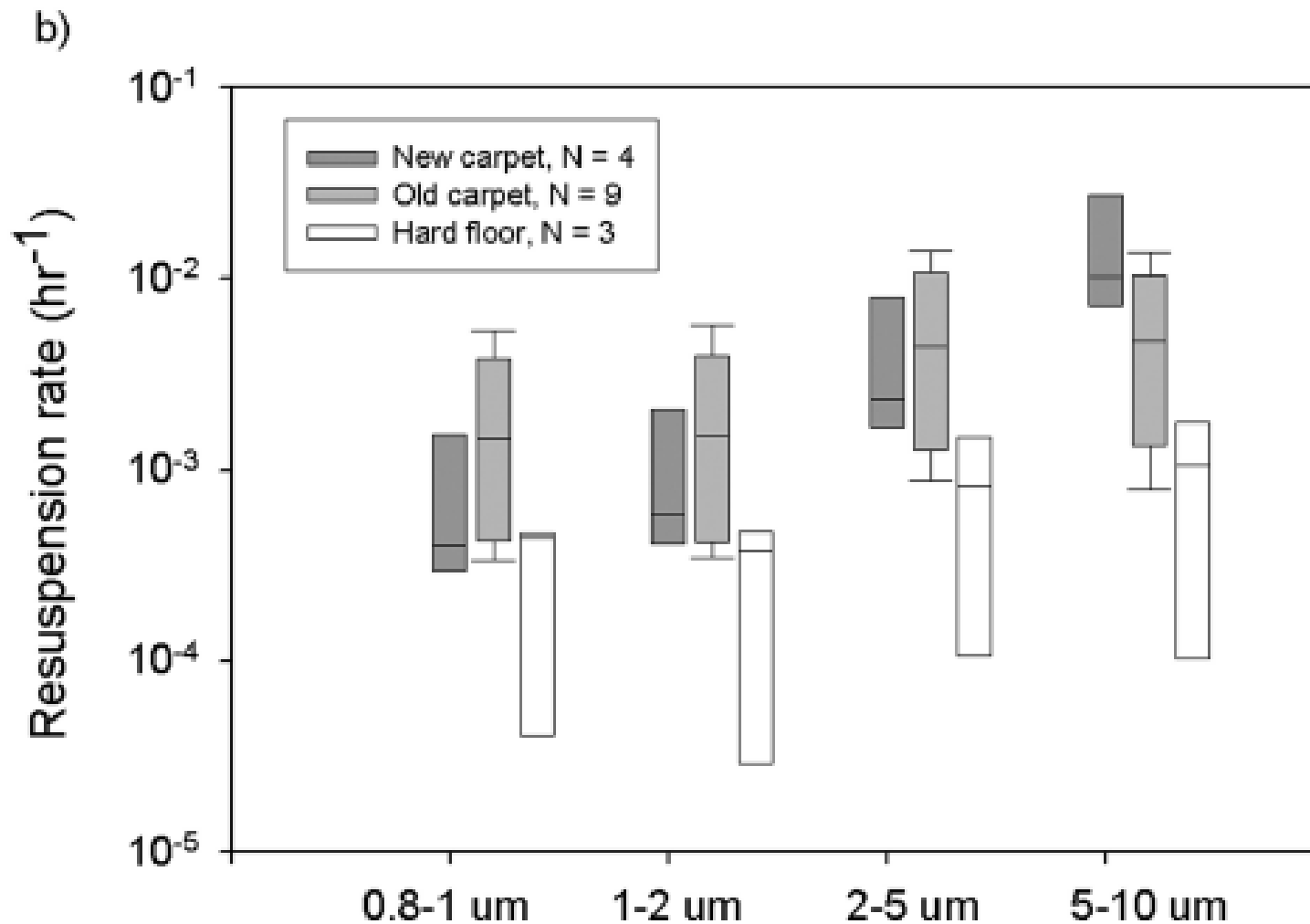


McAuley et al., 2010, Indoor Air

Resuspension (Walking)



Resuspension (Carpet vs. Hardwood)



Summary of Importance of IAQ

- ① Because much time is spent indoors it is very important to understand the different sources that can impact the air quality.
- ① Combustion sources are a dominant source of small particles that can result in long impacts on air quality.
 - Indoor and outdoor
- ① Ventilation is very important.
- ① Controlling indoor air sources can help further mitigate or contribute to additional sources that can result in adverse health impacts that when combined with current sources can become very problematic.
 - (e.g., second hand smoke)

Second Hand Smoke (SHS)

What is Second Hand Smoke (SHS)?

- ◎ **NUISANCE!**
- ◎ Mixture of the smoke exhaled by the smoker and the smoke given off by the burning of the end of the pipe, cigar, or cigarette.
 - Main stream
 - combination of inhaled and exhaled smoke after taking a puff on a lit cigarette, pipe, or cigar;
 - Side stream
 - smoke coming off the end of a burning cigarette, pipe, or cigar)
- ◎ a.k.a. Environmental Tobacco Smoke (ETS)
- ◎ Exposures to SHS are often referred to as “involuntary” or “passive smoking.”

Facts about Second Hand Smoke

- Global public health concern
- Breathing in cigar, cigarette, pipe can make you and your children sick.
- Opening windows or using fans or air conditioners will not stop second hand smoke exposure.
- Comprised of more than 4,000 different chemicals/compounds some of which are known carcinogens.
 - (e.g., Benzo(a)pyrene) along with different carbonyls, VOC's, nitrosamines, nicotine , and PAH's
- Responsible for about 3,000 lung cancer deaths per year in non-smokers (EPA, 2011).
- Second hand smoke can cause lung and heart disease.
- **There are no safe levels of exposure!**

Who is Affected by Second Hand Smoke Exposure?

- ◎ **Everyone!**
- ◎ **Susceptible Populations**
 - Elderly
 - Immuno-compromised
 - Pre disposed breathing/heart conditions
 - Blood disorders (CO can greatly impact O₂ levels in the blood)
- ◎ **Children** in many studies have been shown to be greatly impacted from exposures to second hand smoke.
 - Why?
 - In early stages of lung development
 - Current conditions can be exacerbated more rapidly and result in more pronounced acute and chronic health effects.
 - Asthma
 - Lower respiratory tract infections
 - Sudden Infantile Death Syndrome
 - Pneumonia and Bronchitis
 - Middle ear infections

Am I being exposed to Second Hand
Smoke and what can I do to test for
these exposures?

Methods of Testing for Second Hand Smoke

- ◎ Physical Smell
 - If you can smell it, it is there, and you are being exposed!

- ◎ Ultrafine Particle Testing
 - PTRAK (TSI)
 - Can provide important background concentrations of indoor air quality during times of physical smell of SHS;

- ◎ PM_{2.5} Particle Testing
 - TSI Side Pak
 - SKC Personal Exposure Monitor (PEM) Filter Measurements

- ◎ Nicotine Badges
 - Published method for capturing airborne nicotine to SHS
 - Specific only to nicotine and not dependent on other indoor sources
 - Captures concentrations representing long term exposures for better quantifying results.

PTRAK™ (TSI) Particle Counter

- Easy to use and lightweight
- Extensively published **continuous** particle counter
- Captures particles in size range of 10 nm – 1,000 nm (.01 um-1um)
- Designed for short term indoor air quality studies
- Requires recharging of reagent grade IPA every 4 hrs.
- Requires batteries for remote operation, but can also be plugged in for operation.

PM_{2.5} SIDEPAK AM510 Personal Aerosol Monitor

- ⦿ Impactor that can be installed for sampling either PM_{1.0}, PM_{2.5}, and PM₁₀.
- ⦿ Lightweight and user friendly
- ⦿ **Continuous** monitoring method that requires batteries for remote operation, but can also be plugged in for operation.
- Data output provides statistics functions: max, min. and average readings, elapsed time and 8-hour TWA.

SKC Personal Exposure Monitor (PEM)

- Very lightweight
- **Active** sampling method (i.e., requires pump) for measuring either PM_{2.5} or PM₁₀.
- Worn near the breathing zone for estimating inhalation and deposition
- Filters are pre and post weighed for calculation total mass
- EPA Referenced Method (EPA IP-10A for indoor air particles)

Nicotine Badge

- Established in 1987 at the University of California at Berkeley and have been used internationally and published extensively.
- Used for area and personal exposure sampling for nicotine derived from cigarette, pipe, or cigar smoke.
- Very long shelf post sampling
- Very light weight and virtually undetectable
- **Passive** method for air sampling (i.e., no pump required) and able to sample large coverage areas due to dispersion of ETS in the indoor air.
- Captures only airborne nicotine and is not impacted by other indoor air sources and is effective for trace levels of nicotine capture.

CASE Study #1

SHS Reported Exposure Case Study #1 (Phase I)

- ⦿ Multi-unit dwelling located in Boston, MA
- ⦿ Building was renovated in 1990's
 - Built originally in 1910's (no HVAC system or central heating/cooling)
 - Many old pocket doors and heating vents were still intact
- ⦿ Many open air spaces inside pocket door frame and around heating pipes.
- ⦿ Subject complained of constant exposure to SHS in her study next to the open areas of the pocket doors and heating vents.
 - Subject lived in Apartment 4A.
 - Smelled SHS in her bedroom, living room, and dining room
 - Only smoker (*according to other tenants too tenant in 1A was a very heavy smoker*) in building lived directly under her three floors down in apartment 1A.

SHS Reported Exposure Case Study #1 (Phase I) cont...

◎ Phase I

- Particle number concentrations accompanied by physical smell comprised first round of sampling
 - Baseline number concentrations during no smell were conducted for all units to be sampled near doors and vents
 - Outside of 1A was conducted before and during times of SHS smell in 4A.
 - Monitoring conducted day and night for capturing patterns of smoking from 1A
 - Tenant in 2A allowed monitoring to be conducted in their units near the pockets doors and heating vents.
- ◎ Study was conducted over a period of a few days with monitoring plan set up to capture SHS in the two apartments above 1A (i.e., 4A & 2A).

*Apartment 3A was vacant at the time.

Results from SHS Case Study #1 (Phase I)

Summary Table 9/1/2009-9/2/2009	Mean UFP p/cc (+/-) SD	*N
<i>Background</i>		
4A (0215AM -0710 AM)	4,625 (+/-) 564	305
2A (19:29PM -19:55 PM)	6,921 (+/-) 900	26
<i>Indoor SHS Measurements</i>		
4A (00:38AM-00:52 AM)	11,736 (+/-) 2,336	12
2A (00:01 AM – 00:31 AM)	43,360 (+/-) 17,352	30
Outside of 1A (00:56 AM-01:00 AM)	36,970 (+/-) 13,305	4

*Number of one-minute samples

Summary Table 8/31/2009-9/1/2009	Mean UFP p/cc (+/-) SD	*N
<i>Background</i>		
4A (16:15 PM-20:15 PM)	6,713 (+/-) 1,563	240
2A (20:11PM - 22:15 PM)	10,623 (+/-) 1,354	108
<i>Indoor SHS Measurements</i>		
4A	No Measurements	
2A (23:59 PM -00:07 AM)	41,079 (+/-) 14,875	8

*Number of one-minute samples

Results from SHS Case Study #1 (Phase II)

◎ Phase II

- Due to continued strong SHS smell in 4A nicotine badges were then used as board requested additional evidence.
 - Badges were placed near pocket doors and heating vents inside units and inside the bedroom and dining area in 4A.
- ◎ Unlike Phase I, tenant in 2A was not home during follow up sampling, so badges were not able to be deployed.
 - ◎ Nicotine badge was exposed in areas of concern for 2 weeks.
 - ◎ Results indicated that no nicotine was detected in the bedroom or dining areas.
 - ◎ Nicotine was found at detectable levels above the LOD (0.005 ug) near both the pocket doors and heating vents confirming SHS in the indoor air.

Conclusions Case Study #1

- Phase I and II studies showed the impacts of smoking on indoor air quality for tenants residing above the 1A unit.
- Background particle concentrations were significantly lower during times of no SHS than during times of physical smell in 2A and 4A.
- This study confirmed that the tenant in 4A was impacted by SHS from 1A via inhalation exposure to SHS.
- Study shows how nicotine as a tracer and particles can be transported and detected several stories above the known source.
- Open spaces serve as a means for providing exposures to other tenants.



CASE Study #2

SHS Reported Exposure Case Study #2

- Multi-unit condominium building located in Boston, MA
- Building was constructed in 1930's
 - HVAC system and central heating/cooling in the building
- No open air spaces given newer construction renovation.
 - Solid walls above and below units so no open air spaces.
 - Transport is side to side as no escape up.
- Subject on floor 2 complained of constant SHS throughout the hallway including outside his unit from his unit up to the unit of concern (100 feet between units)
 - Building has a no smoking policy and unit of concern has been identified as the only unit to be actively smoking.
 - Only access to each floor was an elevator and stairs.
- Four nicotine badges were deployed for capturing nicotine in the hallway with 2 badges placed inside the client's unit.
 - Badges placed in lights outside of unit in the hallway of concern up to client's unit being exposed including in the client's unit.
 - In unit, badges placed in living room and just inside doorway.

Results from Case Study #2

- Nicotine badge analysis (4 samples) from the hallway samples confirmed strong air nicotine concentrations increasing exponentially from outside client's unit up to unit of concern.
- Air concentrations in hallway were found to be slightly less directly outside unit of concern when compared to outside other units.
 - Hallway (outside client unit = 0.05 ug, unit 0.06 ug, 0.09 ug, outside unit of concern 0.08 ug)
 - Stairs and elevator door outside unit of concern provided some means of dispersion.
- Hallway concentrations found to be an order of magnitude higher than the limit of detection (0.005 ug)
- Badges in unit were lower than hallway concentrations, but nicotine concentrations were found to be above LOD showing penetration into the client unit.

Conclusions Case Study #2

- ⦿ Nicotine badges were able to capture sufficient concentrations for detection over the sampling period.
 - Hallway and inside unit
- ⦿ Evidence from the study was able to support the impacts from the unit of concern.
- ⦿ This study like case study #1 shows how second hand smoke can be monitored and measured at further distances from the source and therefore impact the lives and health of those in surrounding areas.

Overall Conclusions

- ◎ It is important to understand what sources can impact your indoor air quality and how to best control them.
- ◎ What are the best means to reduce and/or eliminate excess risk to SHS exposures for yourself and/or your children?
 - Protect your indoor air quality by making all indoor areas smoke free!
 - Do not allow any friends, family, or visitors smoke in your home or car.
 - Do not allow your children to visit or ride in any car where someone is smoking.
 - If you have to smoke, think of others and smoke outside and not near entry doorways or other locations where pressure gradients can transport smoke inside.
- ◎ **Stop smoking!!**
 - **The real truth is that you are exposing those around you! Opening windows and doors is not solving the issue.**

Clients of SHS Exposure Testing

- ⊙ Real Estate Agents
- ⊙ Landlords of single and multi unit dwellings
- ⊙ Boards of Public Health
- ⊙ Public Health Educators
- ⊙ Schools
- ⊙ Golf Course Pro Shops and lounges
- ⊙ Private and public institutions
- ⊙ Homeowners
- ⊙ Universities
- ⊙ Environmental consultants
- ⊙ Exposure research scientists

Corporate Information

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Questions & Comments

Thank you!