

Analysing Nanoparticle Emissions from Non-exhaust Emissions

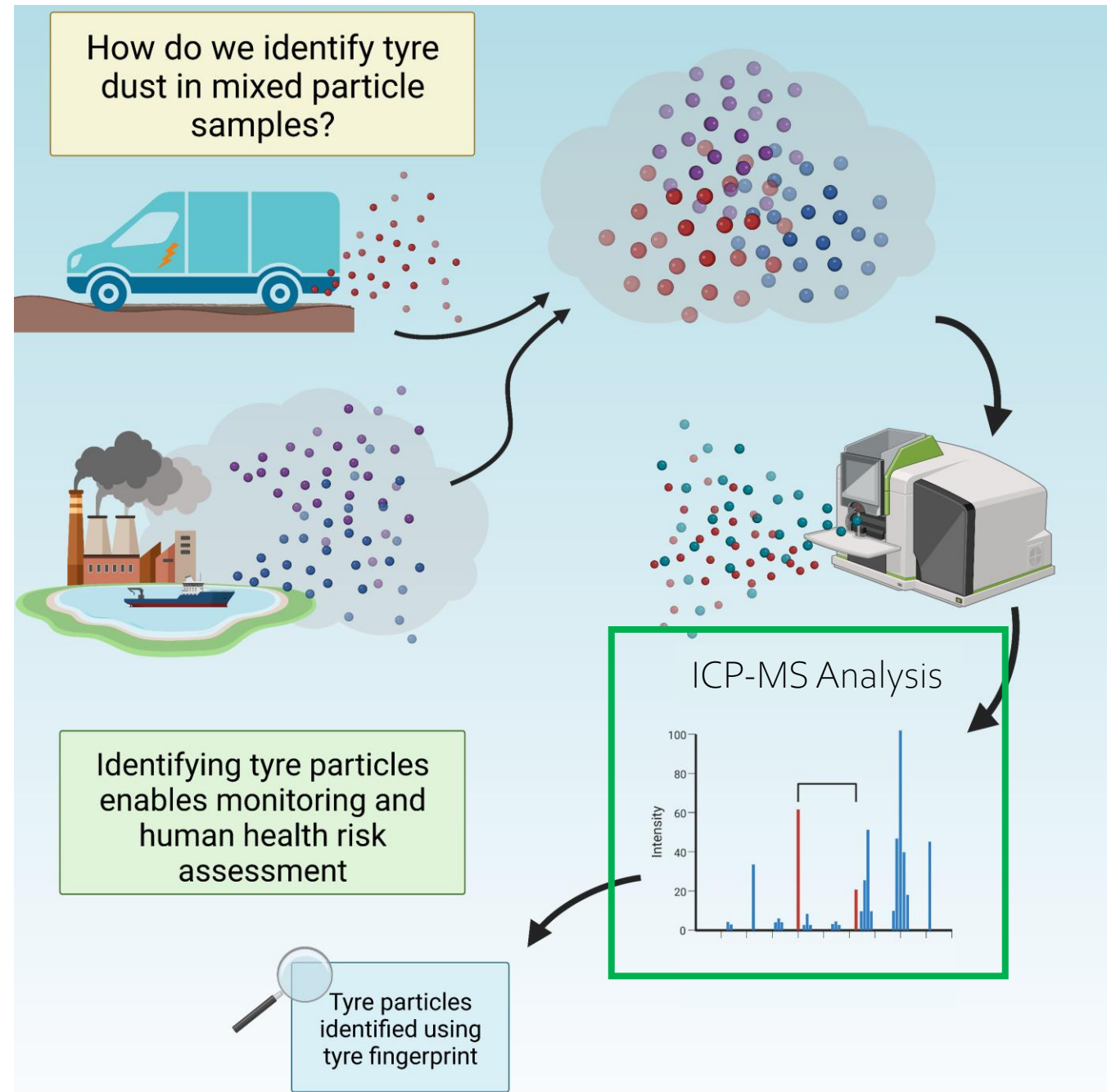
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Research Highlights

- Chemical analysis of unworn tires show high concentrations of Zn, Al, Fe, Mg
- Relative abundances help with non-exhaust emission source apportionment
- Nanoparticles generated from tire wear emissions are hard to quantify – lots has been done for micron particles
 - Understanding nanoparticle toxicity is difficult
- Determining composition of non-exhaust nanoparticles faces challenges:
 - Collecting enough mass for ICP-MS
 - Limits of detection for SEM
 - Substrate requirements eliminate some offline analyses

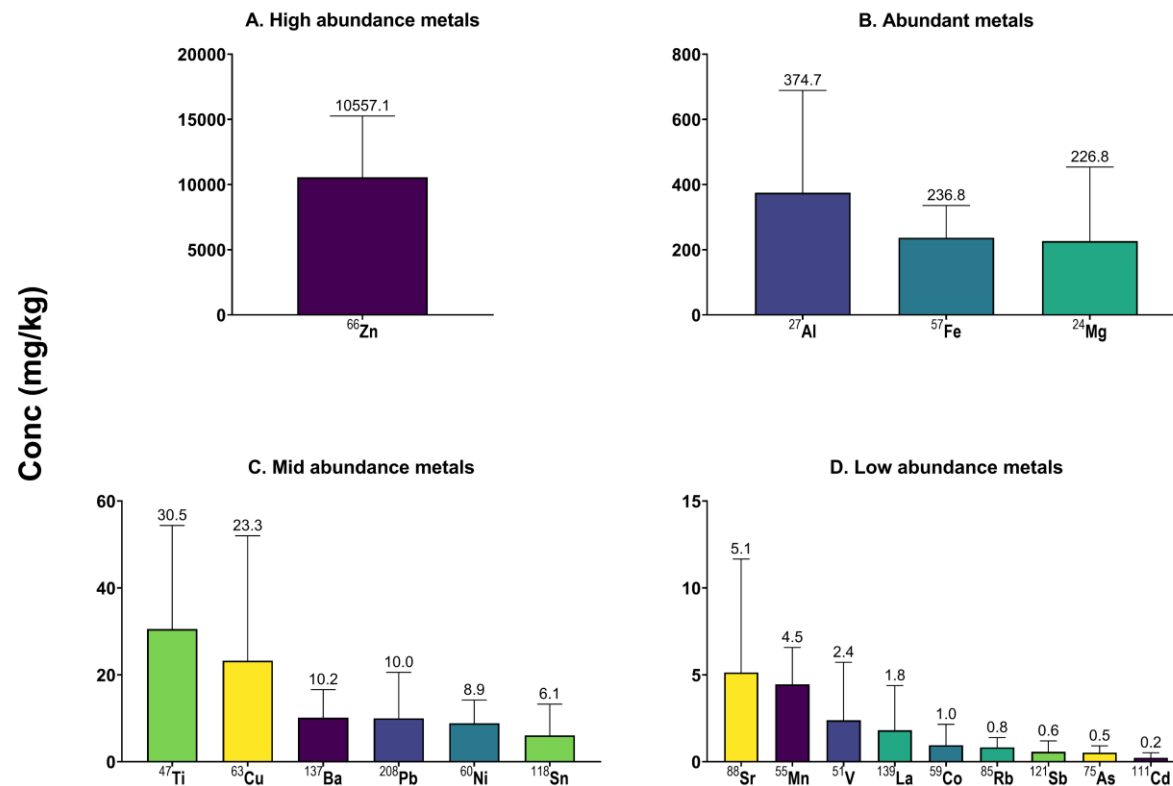
ICP-MS results give fingerprint for ambient non-exhaust emission tracer

- In-lab tests eliminate variables for initial chemical fingerprint of tires
- Results confirm what metals *could* be coming from tires



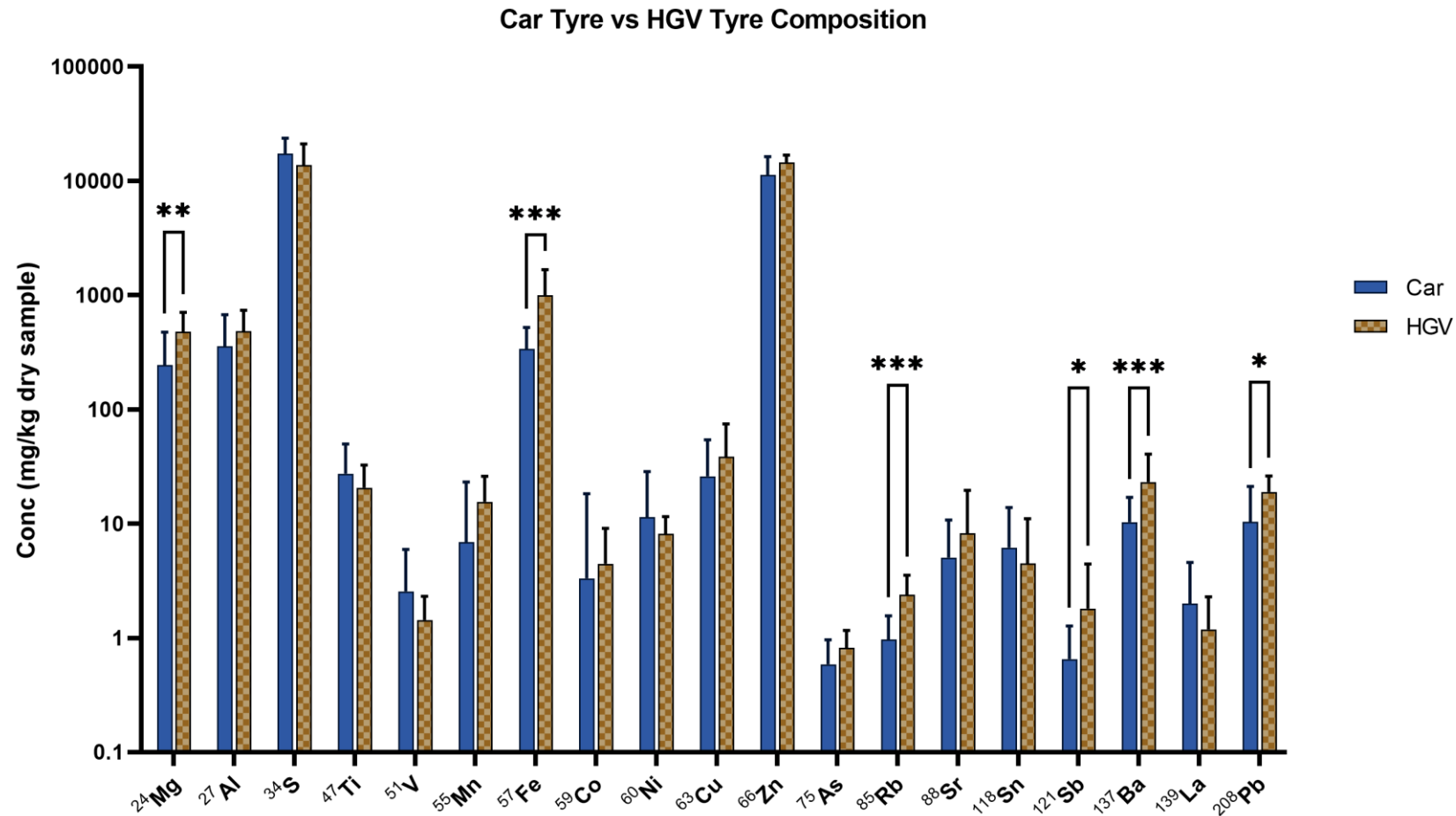
Elemental Analysis shows Zn, Al, Fe and Mg are the most abundant metals but low-abundance signatures are valuable

Car Tyre Analysis

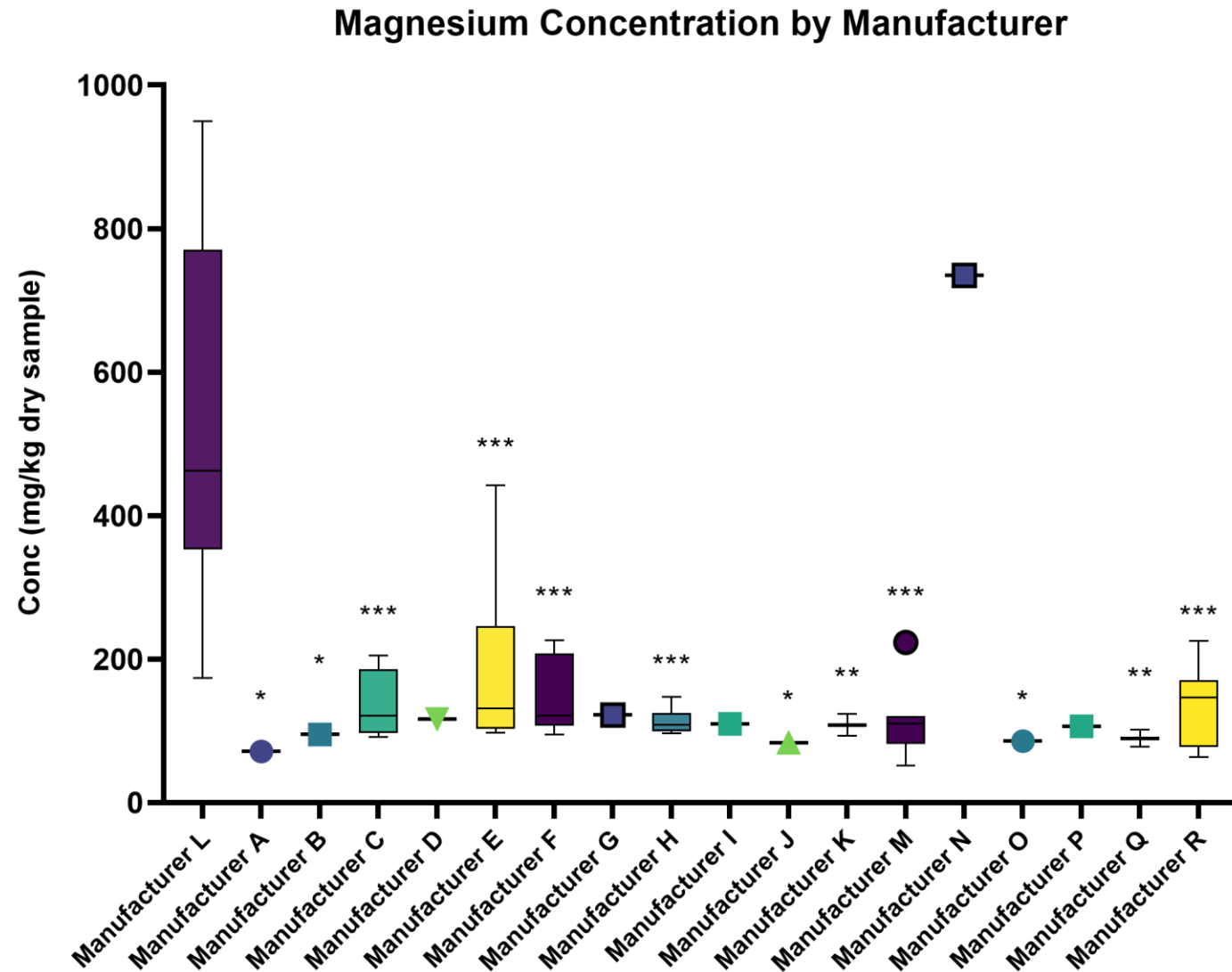


- Elemental analysis for all tires was conducted for 77 different tires
 - 60 LDV
 - 17 HGV
- ICP-MS for 25 different elements
- Absolute and relative abundance in metals
- Correlations can provide a basis for an on-road tracer

HGVs and Cars have statistically significant differences for Mg, Fe, Rb, Sb, Ba and Pb meaning these fingerprints could identify type of vehicle in ambient measurements



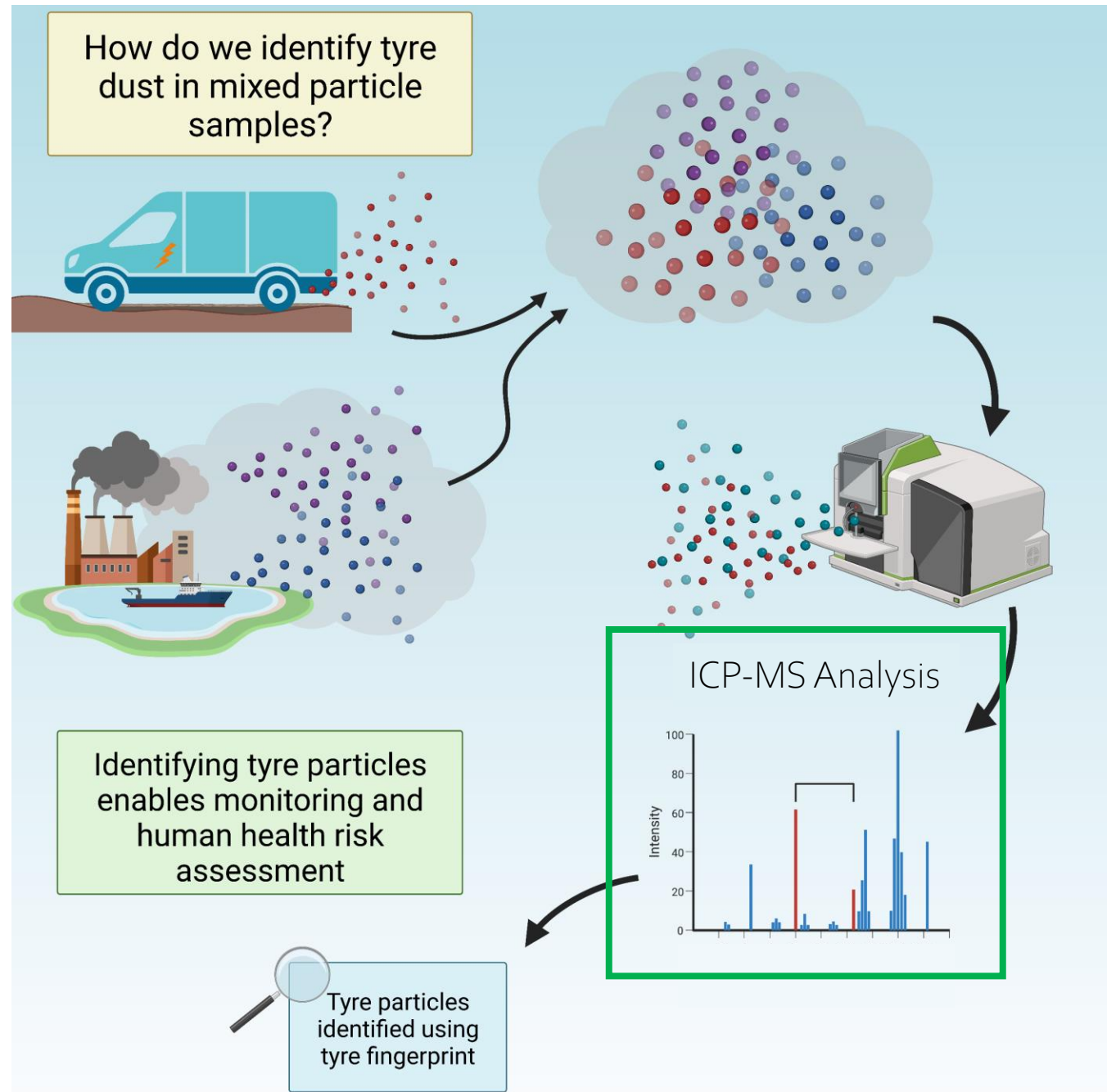
Metal concentrations could range by manufacturer but more work is needed in this area



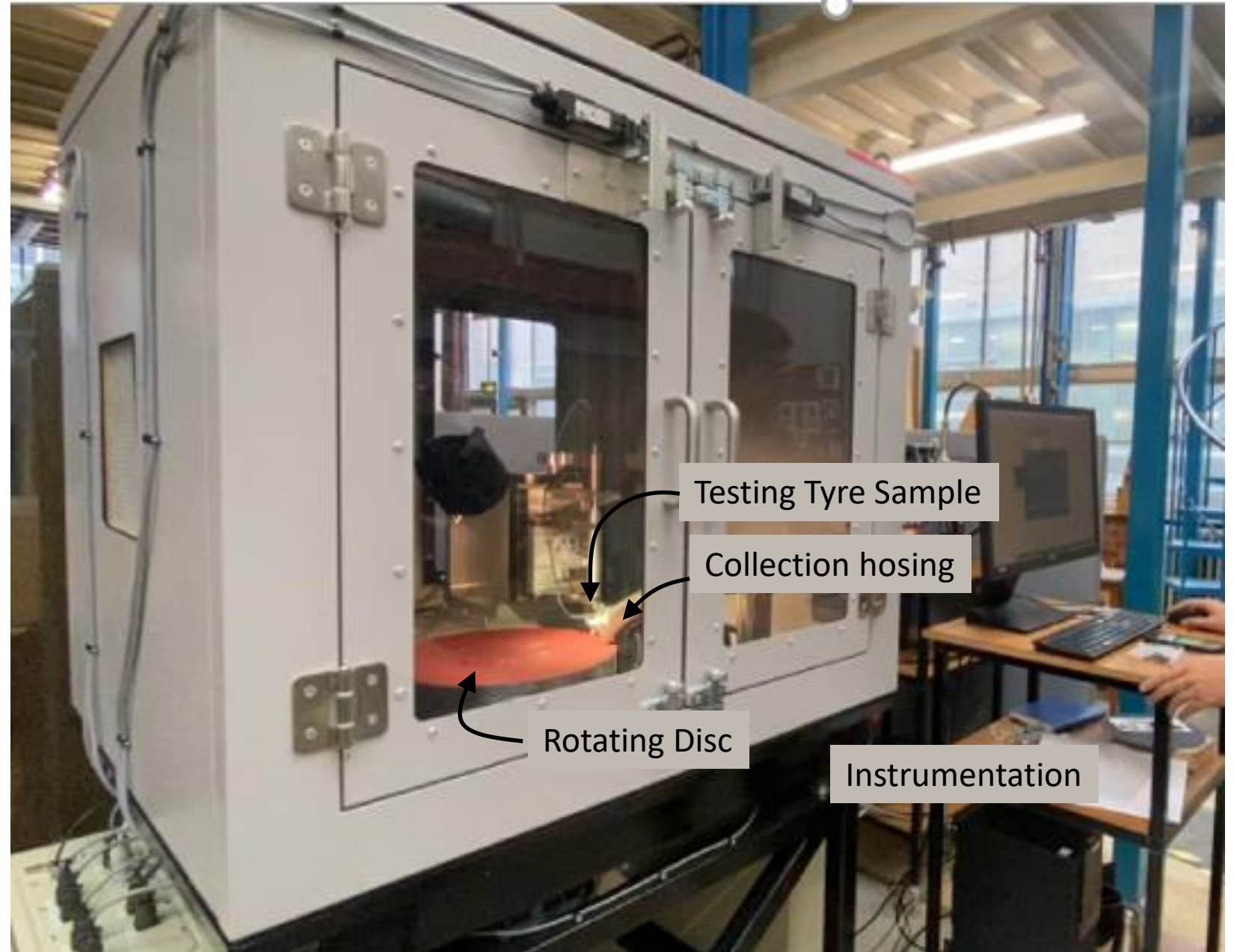
Research Highlights

- Relative metal concentrations can help with non-exhaust emission source apportionment
- Significant differences in metal components for heavy-goods vehicles and passenger vehicles
- Differences by manufacturer could help identify high-emitters

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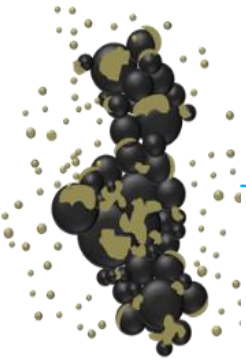


In-lab Generation of Tyre-wear Particles



Instrumentation

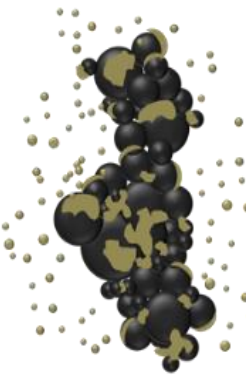
Particles
Generated



Total Particle
Concentration



Solid + Semi-
Volatile
Component



All particles
from tire and
road wear

350°C



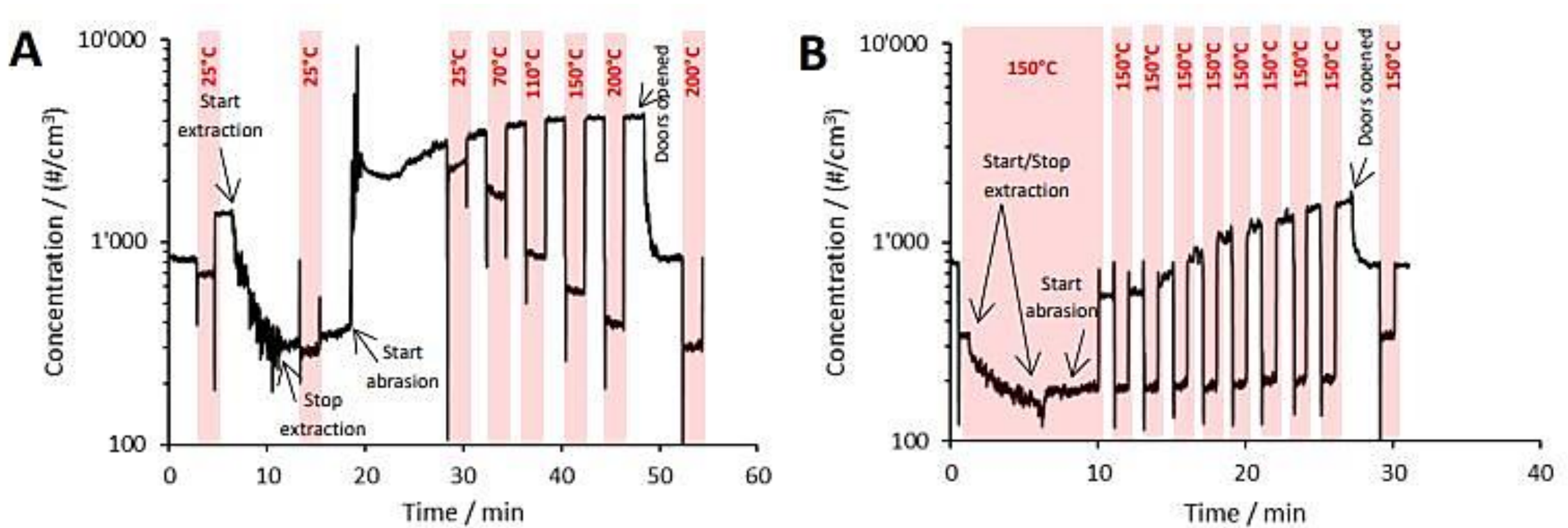
Solid Component



Solid Particle
Concentration

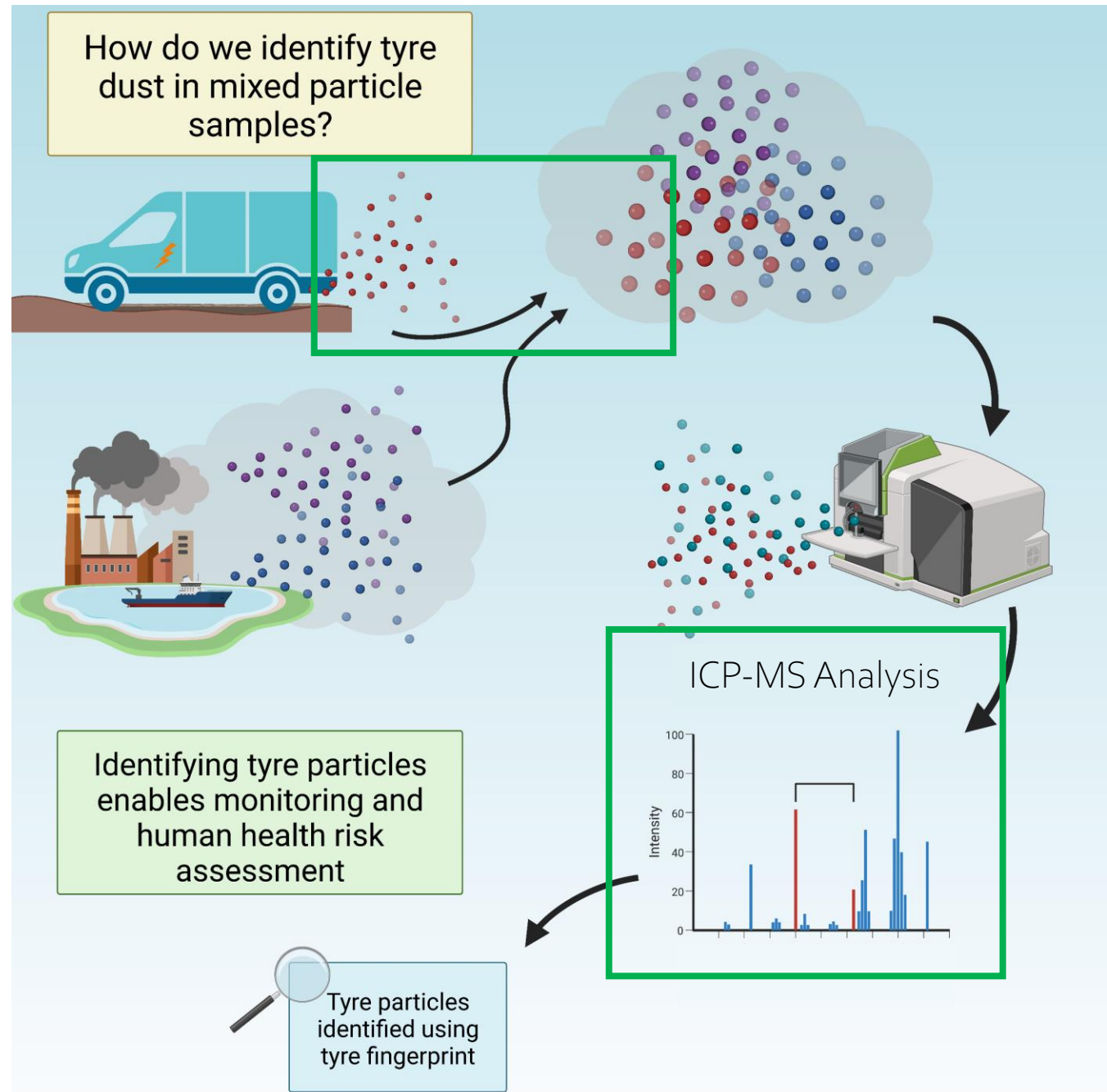


Semi-volatile nature of tyre emissions



Research Highlights

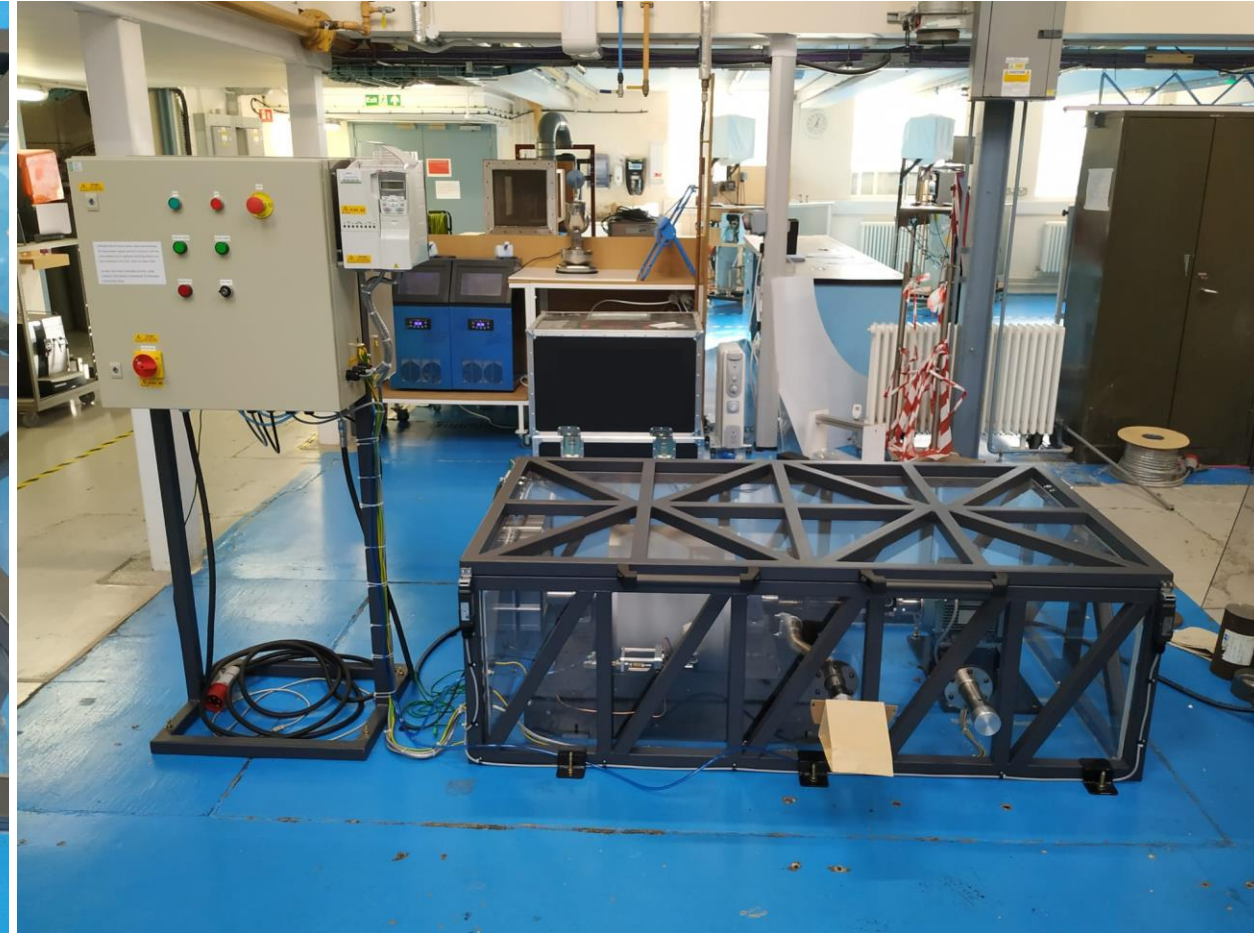
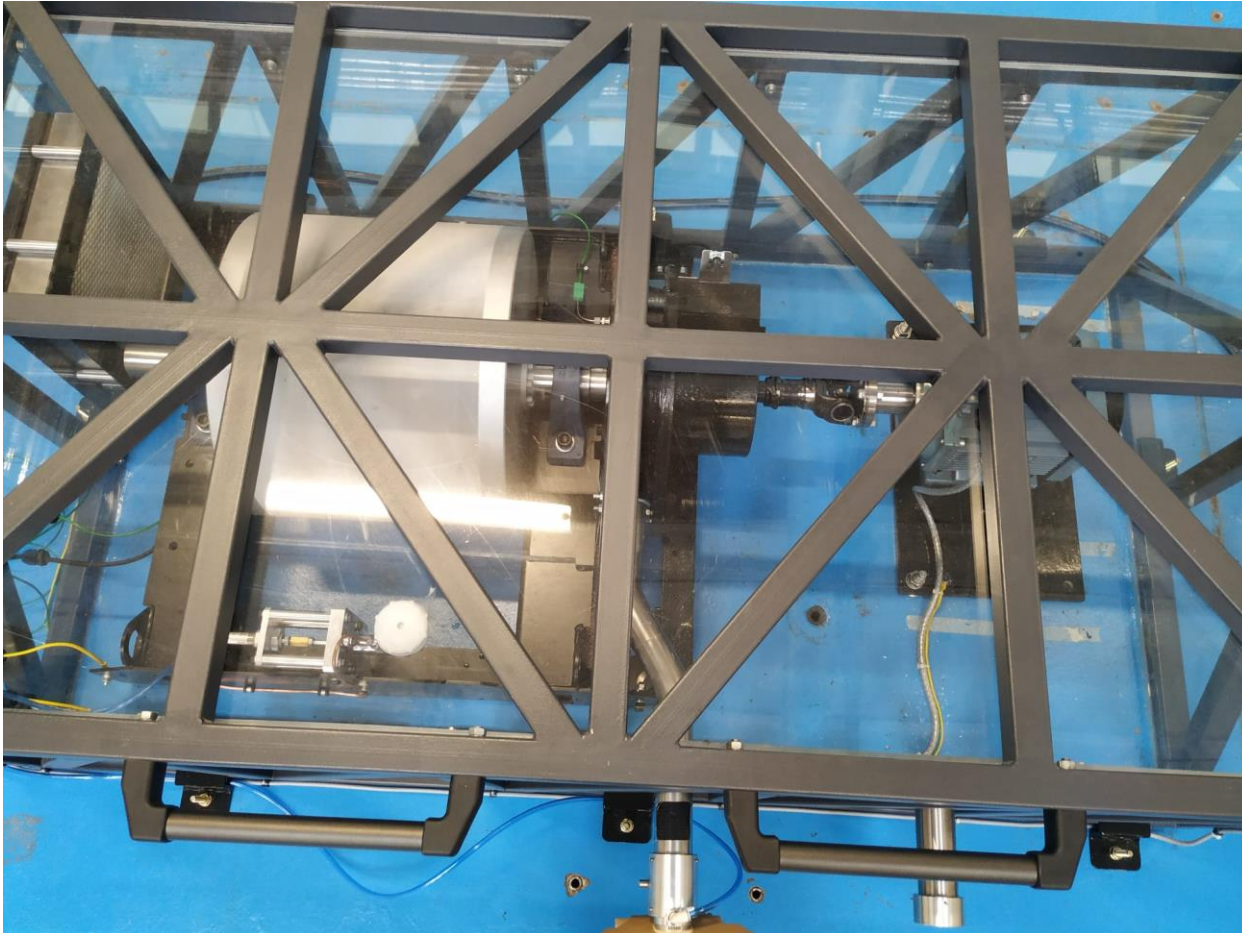
- Relative metal concentrations can help with non-exhaust emission source apportionment
- Nanoparticles generated from tire wear emissions come with challenges
 - Understanding nanoparticle toxicity is difficult
 - Recreating real-world conditions
 - Low mass properties of nanoparticles
 - Semi-volatile in nature
 - Relatively low abundance compared to tailpipe emissions



Future Work

- Collecting enough mass for chemical analysis and toxicology studies from tyre rig
- Compare rig data to TIP data collected at KIT
- Starting work with brake rig
 - Particle size distribution
 - Collect mass for toxicology studies

Brake Rig Development



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