



# Competence Center for Gas Exchange



”Charging for the future”



**VOLVO**

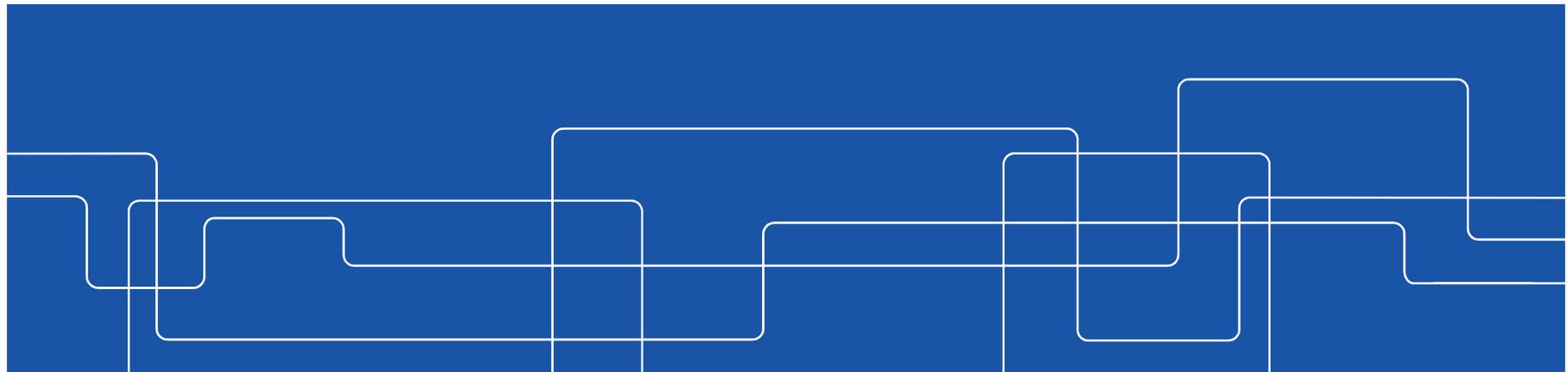


**BorgWarner**



# Research Area: Exhaust AfterTreatment (EAT)

Coordinator: Mikael Karlsson



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# Exhaust Aftertreatment: CCGEx view

## Scope:

Fluid mechanics, heat transfer, acoustics but not catalysis downstream of the turbine  
Interaction with engine control/strategy

## Two research projects

1. Atomization and mixing of Urea-Water-Solution in automotive SCR systems (SCR)
2. Particle characterization and agglomeration (PCA)



# Atomization and Mixing of Urea Water Solution

## PROJECT CONTENT/SCOPE:

Investigation of the sensitivity of UWS droplets mixing to input data and modelling strategies.

Experimental data base

## PROJECT Highlights

- Identification of the most suitable modeling framework for the numerical simulation of UWS sprays.
- Analysis of the most important injection parameters for a better mixing.
- Experimental data base (started)

## FUTURE PLAN SHORT & LONG TERM:

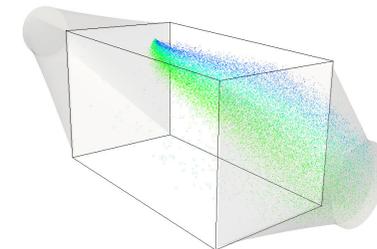
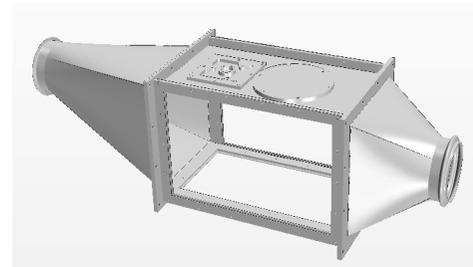
- Finalize experimental data base
- Project proposal based on experience from pre-study



Mireia Altimira, PhD

## Reference group:

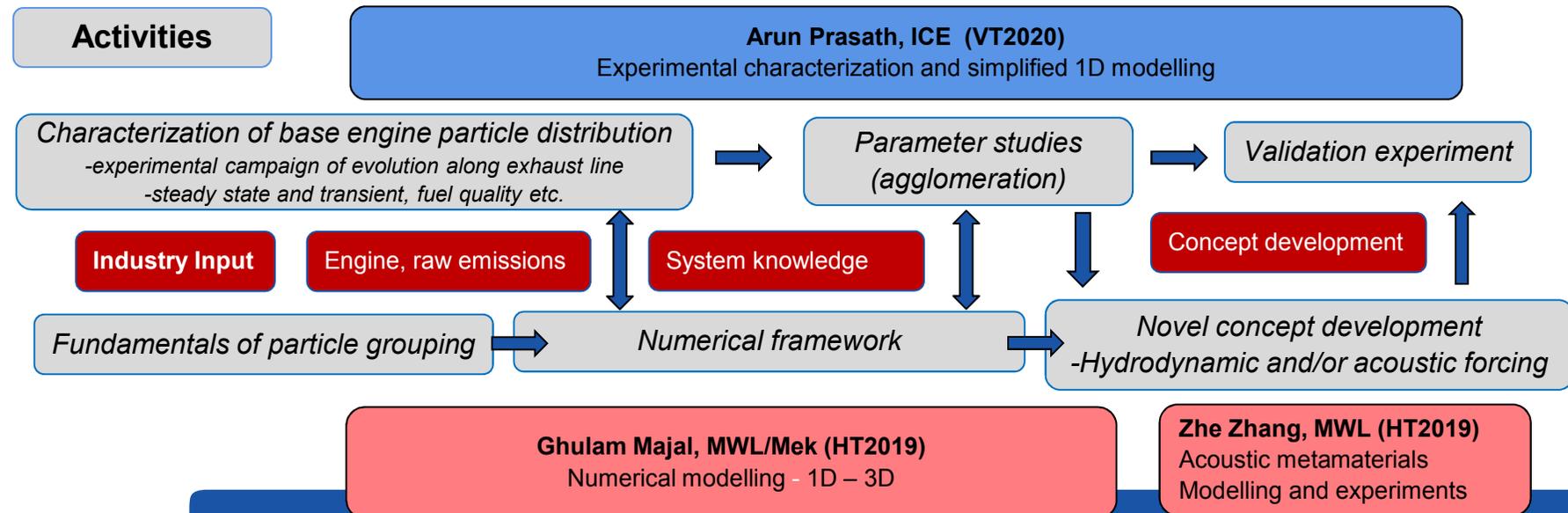
Sharif Nahidh, Volvo GTT  
Mats Laurell, Volvo Cars  
Klas Olofsson, Scania





# Overview: EAT-Particle agglomeration

<b>GOAL</b>	Remove health critical sub-micron particles
<b>STRATEGY</b>	Build knowledge on particles evolution along the exhaust line of IC engines. Develop innovative methods to stimulate and promote the agglomeration of particles for easier removal
<b>TOOLS</b>	<ul style="list-style-type: none"><li>▪ Simulations (high-fidelity as well as 1D)</li><li>▪ Detailed experiments (lab-scale as well as engine cell)</li><li>▪ System integration (close cooperation with industry partners)</li></ul>





# EAT-PCA: Overall aims

- ❑ Characterize and understand particle evolution along the exhaust line
  - high-fidelity simulations and experiments
  - Steady state and transients
- ❑ Understand particle agglomeration due to hydrodynamic and acoustic forcing
  - 1D to high fidelity simulations and validation experiments in generic designs
- ❑ Novel concepts for particle agglomeration
  - ❑ Hydrodynamic and/or acoustic
  - ❑ Acoustic metamaterials

**PhD Students / Postdoc:**

Ghulam Majal, (CFD), MWL/Mek  
Arun Prasath (Exp), ICE  
Zhe Zhang, (Acoustics), MWL

**Reference group:**

Mats Laurell, Volvo Cars  
Sharif Nahidh, Volvo GTT  
Klas Olofsson, Scania



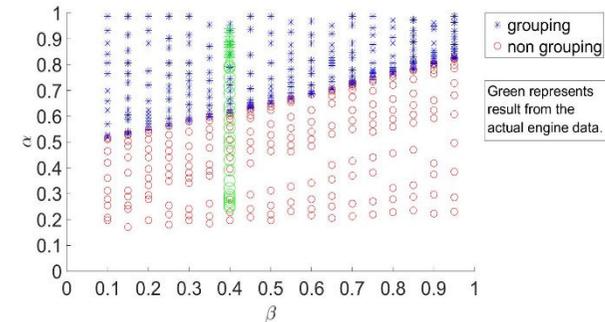
# EAT-PCA: Individual projects



*Control of particle agglomeration with relevance to after-treatment gas processes*

**Doctoral student:**  
Ghulam Majal (CFD), MWL/Mek

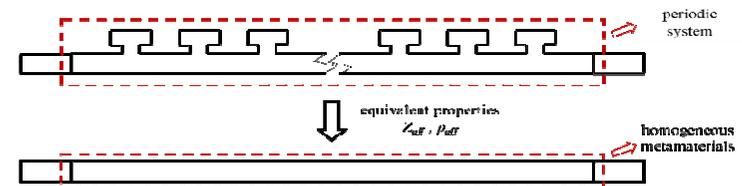
**Supervisors:**  
Mihai Mihaescu, Mats Åbom, Mikael Karlsson and Lisa PrahL Wittberg



*Control of particle agglomeration with the direct application of engine noise and acoustic metamaterials*

**Doctoral student:**  
Zhe Zhang (Sim and exp), MWL

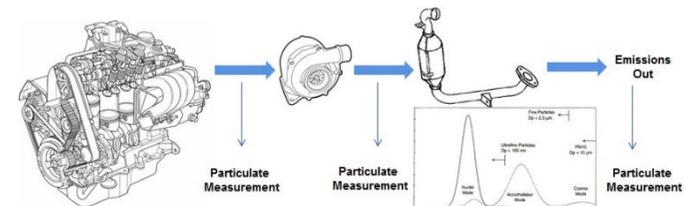
**Supervisors:**  
Mats Åbom, Hans Bodén



*Characterization of particulates in the gas exchange system of DI/SI engines*

**Doctoral student:**  
Arun Prasath (Exp), ICE

**Supervisors:**  
Anders Christiansen Erlandsson





## EAT: Highlights

- ❑ SCR prestudy – basis for further studies
- ❑ Experimental database of UWS sprays in cross-flows
- ❑ 1D particle agglomeration model
  - ❑ Implemented and used for parameter studies
  - ❑ Now includes acoustic forcing as well
- ❑ Concept for particle agglomeration using acoustic metamaterials



## EAT: Near-future Plans

- ❑ Startup of engine test bed for particle characterisation
- ❑ Base line characterisation of particles (steady state) in:
  - ❑ Exhaust line
  - ❑ Reference agglomeration device
  - ❑ Generic components (bends, expansions etc)
- ❑ Experimental validation of slow sound
- ❑ Validation of 1D code against experiments (as above)
- ❑ 3D modelling of particle agglomeration
- ❑ Apply for funding, including EU project calls & other national/international funding opportunities, e.g. Marie Skłodowska-Curie actions, Innovative Training Networks (ITN/ETN); H2020-MSCA-ITN-2017



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