



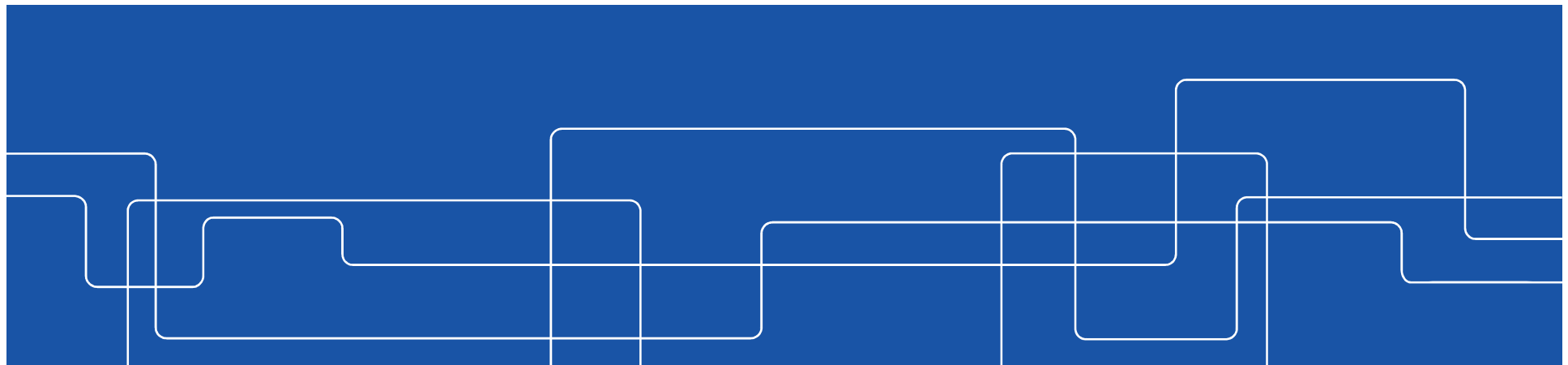
# Exhaust Aftertreatment (EAT) Research area

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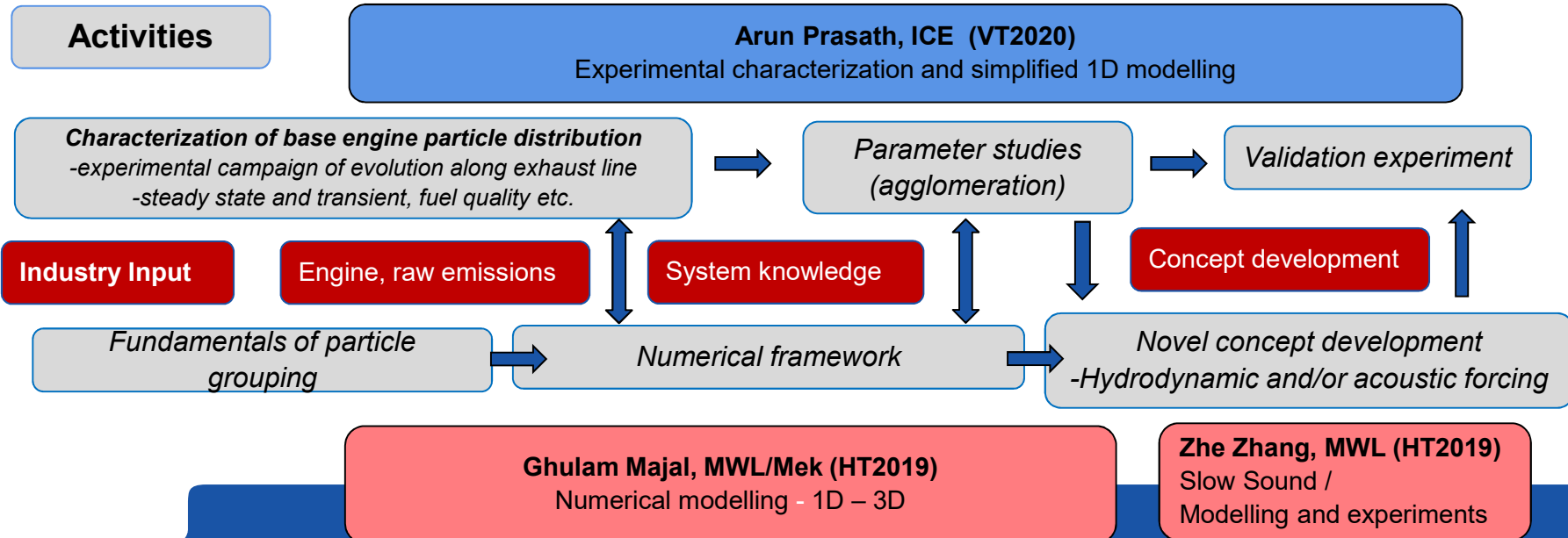
11.10.2018, CCGEx – Research Day





# Particle characterization & 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.<br>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> |





# Characterization of particles in the gas exchange system of DI/SI engines

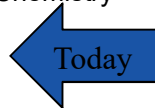
## PROJECT CONTENT/SCOPE:

1. Evolution of particle characteristics (PM, PN, size distribution etc) along the exhaust system components and connections
2. Influence of transients and fuel quality on the particulates
3. Concept development for particle agglomeration

## PROJECT RESULTS

### Overall:

- ✓ Literature review
- ✓ Usage of Microsoot sensor, Particle counter and EEPS(Engine Exhaust Particle Sizer Spectrometer)
- ✓ First concept studies of Aerosol Physics, Aerosol Chemistry
- ✓ First Experimental Campaign- Agglomeration Pipe



## FUTURE PLAN SHORT & LONG TERM:

- ✓ Experimental Campaign- Component level
- ✓ Particle evolution along the after treatment devices
- ✓ Updated agglomeration concept



Ph.D. Student:  
Arun Prasath



# Noise control and particle agglomeration using "slow sound"

## PROJECT CONTENT/SCOPE:

- ✓ Manipulate the acoustic and flow field by applying "slow sound" to achieve particle agglomeration in the ICE flow exhaust system
- ✓ Build the theoretical framework concerning particle motion and grouping in oscillatory flows and acoustic fields
- ✓ Study optimal solutions ("Cremer impedance") for noise control in ducts

## PROJECT RESULTS

### Overall:

- ✓ Incorporate acoustic field into the existing model
- ✓ First concept studies – agglomeration with acoustic metamaterials. See SAE paper:

Zhang, Z., Abom, M., Boden, H., Karlsson, M. et al., "Particle Number Reduction in Automotive Exhausts Using Acoustic Metamaterials," *SAE Int. J. Engines* 10(4):1566-1572, 2017, <https://doi.org/10.4271/2017-01-0909>.

- ✓ Acoustic evaluation of agglomeration prototype

Zhang, Z, Tiikoja, H., Bodén, H. and Abom, M., "EXPERIMENTAL ANALYSIS OF WHISTLE NOISE IN A PARTICLE AGGLOMERATION PIPE", Proceedings of the 2018 ASME International Conference and Exposition on Noise Control Engineering NCAD2018 August 26-29, 2018, Chicago, IL, USA. Paper 1699.

## FUTURE PLAN SHORT & LONG TERM:

- ✓ Work on optimal solutions for noise control

Experimental Analysis on the 'Exact' Cremer Impedance in Rectangular Ducts Z Zhang, H Tiikoja, L Peerlings, M Abom  
SAE Technical Paper 2018-01-1523



Ph.D. Student:  
Zhe Zhang





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



Ph.D. Student:  
Ghulam Mustafa Majal.

## PROJECT CONTENT/SCOPE:

1. Build the theoretical framework concerning particle motion and grouping in oscillatory flows and/or acoustic fields.
2. Enhance understanding of particle behavior under flow/acoustic forcing using advanced computational models and tools. Method development integral part of the work.
3. Find methods to reduce the number of particles (e.g agglomeration) based on the manipulation of hydrodynamic and acoustic fields in the ICE flow exhaust system.

## PROJECT RESULTS:

### Overall:

- ✓ 1D-study completed and presented at SAE WCX18

Majal, G., Karlsson, M., Mihaescu, M., and Katoshevski, D., "Particle Number Reduction in Automotive Exhausts by Controlled Grouping," SAE Technical Paper 2018-01-0330, 2018, <https://doi.org/10.4271/2018-01-0330>.

- ✓ First set of CFD results completed for two geometric configuration



## FUTURE PLAN SHORT & LONG TERM:

- Licentiate date set to 30/10/2018.
- Further the 3D numerical study with pulsative flow and particle-particle interaction
- Numerical validation of physical prototype





# Competence Center for Gas Exchange



”Charging for the future”



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