



# 1<sup>st</sup> International Workshop on Reacting Particle-Gas Systems

## Collaborative Research Center 287 – BULK-REACTION

Ruhr-Universität Bochum

Program for Tuesday 7<sup>th</sup> June 2022:

**07:00 pm** “Welcome Reception” in the Mercure Hotel Bochum City

Program for Wednesday 8<sup>th</sup> June 2022:

All keynote lectures will take place in **Hall 2 a** of the **VZ** (Veranstaltungszentrum)

<b>09:00 am</b>	<b>Introduction CRC – Prof. Dr.-Ing. Viktor Scherer</b>	
<b>09:30 am</b>	<b>Keynote IV – Prof. Jennifer Curtis</b> (University of California, USA): Irregular soil particle shape modelling	
10:30 am	Coffee break	
<b>11:00 am</b>	<b>Session I</b> Hall 2 a	<b>Session II</b> Hall 1
12:20 pm	Lunch in “RUB Mensa”	
<b>01:20 pm</b>	<b>Keynote II – Prof. Dr. Bernhard Peters</b> (University of Luxembourg, LUX): Recent developments and challenges in reacting granular multi-phase flows	
<b>02:20 pm</b>	<b>Session III</b> Hall 2 a	<b>Session IV</b> Hall 1
03:40 pm	Coffee break	
<b>04:10 pm</b>	<b>Session V</b> Hall 2 a	<b>Session VI</b> Hall 1
<b>05:30 pm</b>	<b>Bus transport to “Museum unter Tage”</b>	
from	<b>Guided tour “Museum unter Tage”</b>	
<b>06:30 pm</b>	<b>Conference Dinner Baristoteles</b>	
	Bus transport to the Hotels and Bochum HBF (main station)	

Program for Thursday 9<sup>th</sup> June 2022:

<b>09:00 am</b>	<b>Keynote III – Prof. Jonathan Seville</b> (University of Birmingham, UK): Positron emission imaging methods in process engineering	
<b>10:00 am</b>	<b>Poster session</b> and Coffee break	
<b>11:20 am</b>	<b>Session VII – Examples from industry</b> - -Hall 2a	
12:00 pm	Lunch in “RUB Mensa”	
<b>01:00 pm</b>	<b>Keynote I – Prof. Jim Wild</b> (University of Sheffield, UK): Methods and applications of hyperpolarised <sup>129</sup> Xe magnetic resonance	
<b>02:00 pm</b>	<b>Session VIII</b> Hall 2 a	<b>Session IX</b> Hall 1
03:20 pm	Wrap-Up	
03:40 pm	End of workshop	



## Details Sessions:

### 8<sup>th</sup> June, 11:00 am – Sessions:

Session I	Chairperson: A. Dieguez Alonso
11:00 am	<b>CFD-DEM simulation of raceway dynamics and coke combustion in an ironmaking blast furnace</b> <u>Shuai Wang</u> Organization(s): University of New South Wales, Australia
11:20 am	<b>Coke-Air interactions in the raceway region of an iron-making blast-furnace</b> <u>Navid Aminnia, Bernhard Peters</u> Organization(s): University of Luxembourg, Luxembourg
11:40 am	<b>Reduction and sintering behaviour of combusted iron powder in a packed bed reactor</b> <u>Conrad Hessels<sup>1</sup>, Chih-Chia Huang<sup>1</sup>, Anke Smeets<sup>1</sup>, Giulia Finotello<sup>1,2</sup>, Yali Tang<sup>1,2</sup>, Tess Homan<sup>1,2</sup>, Niels Deen<sup>1,2</sup></u> Organization(s): 1: Power and Flow Group, Department of Mechanical Engineering, Eindhoven University of Technology, P.O. Box 513, 5600MB Eindhoven The Netherlands; 2: Eindhoven Institute of Renewable Energy Systems (EIRES), P.O. Box 513, 5600MB Eindhoven, The Netherlands
12:00 am	<b>Modelling of a biomass-based iron ore direct reduction process</b> <u>Tao Wang, Oliver Mirgoux, Fabrice Patisson</u> Organization(s): University of Lorraine, France

Session II	Chairperson: K. Zähringer
11:00 am	<b>In situ characterisation of particle formation in spray flame synthesis using wide-angle light scattering</b> <u>Franz Johann Thomas Huber, Simon Aßmann, Peter Lang, Stefan Will</u> Organization(s): Lehrstuhl für Technische Thermodynamik (LTT) and Erlangen Graduate School in Advanced Optical Technologies (SAOT), Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany (FAU)
11:20 am	<b>Turbulence effects on the formation and growth of nano-particles in premixed and non-premixed flames</b> <u>Luis Cifuentes, Irenaeus Wlokas, Andreas Kempf</u> Organization(s): Chair for Fluid Dynamics, Institute for Combustion and Gas Dynamics (IVG), University of Duisburg-Essen
11:40 am	<b>Secondary Motion of Non-spherical Particles in Gas-Solid Flows</b> <u>Cihan Ates, Rainer Koch, Hans-Jörg Bauer</u> Organization(s): Institute of Thermal Turbomachinery, Karlsruher Institut für Technologie
12:00 am	<b>Ignition and flame propagation in lean hybrid mixtures of flammable dusts and gases</b> <u>Ulrich Krause<sup>1</sup>, Zaheer Abbas<sup>2</sup>, Dieter Gabel<sup>1</sup></u> Organization(s): 1: Otto von Guericke University Magdeburg, Germany; 2: Roche Diagnostics GmbH, Penzberg, Germany



8<sup>th</sup> June, 02:20 pm – Sessions:

Session III	Chairperson: M. Mönnigmann
02:20 pm	<p><b>Eulerian-Lagrangian simulation of dense reactive gas-particle flows in fluidized beds</b> Junjie Lin, <u>Kun Luo</u>, Jianren Fan Organization(s): State Key Laboratory of Clean Energy Utilization, Zhejiang University (ZJU), Hangzhou 310027, China</p>
02:40 pm	<p><b>Microstructural aspects of combusted iron powder for green energy carrier application</b> <u>Laurine Choisez</u><sup>1</sup>, Niek van Rooij<sup>2</sup>, Conrad Hessels<sup>2</sup>, Alisson da Silva<sup>1</sup>, Yan Ma<sup>1</sup>, Isnaldi Souza Filho<sup>1</sup>, Philip de Goey<sup>2</sup>, Hauke Springer<sup>1,3</sup>, Dierk Raabe<sup>1</sup> Organization(s): 1: Max-Planck Institut für Eisenforschung GmbH, Germany; 2: Eindhoven University of Technology, Netherlands; 3: RWTH Aachen University, Germany</p>
03:00 pm	<p><b>Modelling of the laminar droplet-laden reactive flow around a vaporizing aluminum particle using a population balance approach</b> <u>Jannis Finke</u>, <u>Fabian Sewerin</u> Organization(s): Otto-von-Guericke-Universität Magdeburg, Germany</p>
03:20 pm	<p><b>Flowsheet Simulation of a Chemical Looping Combustion Process for Solid Fuels</b> <u>Lennard Lindmüller</u>, Stefan Heinrich Organization(s): Hamburg University of Technology, Germany</p>

Session IV	Chairperson: J. Barowski
02:20 pm	<p><b>Simulation of Flow Mixing in Packed Beds using Porous Media Model and Resolved Particle Model with experimental Validation</b> <u>Eckehard Specht</u> Organization(s): Otto-von-Guericke-Universität Magdeburg, Germany</p>
02:40 pm	<p><b>Jet dispersion and velocity measurements in a packed bed using 3D printing, LIF and stereoscopic-PIV</b> <u>Afrinbanu Mehboob Merchant</u>, Frank Beyrau, Berend van Wachem Organization(s): OVGU, Germany</p>
03:00 pm	<p><b>Investigating the inflow into a granular bed using a locally resolved method</b> <u>Maximilian Brömmer</u>, Maik Scharnowski, Siegmund Wirtz, Viktor Scherer Organization(s): Ruhr Uni Bochum, Germany</p>
03:20 pm	<p><b>Investigation of porous drag and permeability at porous-fluid interface</b> <u>Wojciech Sadowski</u>, Francesca di Mare Organization(s): Chair of Thermal Turbomachines and Aeroengines, Ruhr-University Bochum</p>



8<sup>th</sup> June, 04:10 pm – Sessions:

Session V	Chairperson: I. Rolfes
04:10 pm	<p><b>Numerical Study of Heat Transfer Phenomena within an Array of Fixed Cylinders using Thermal-Compressible Lattice Boltzmann Method: Comparison with Experimental Results</b>  <u>Reza Namdarkedenji</u><sup>1</sup>, Hesameddin Safari<sup>2</sup>, Mohammadhassan Khodsiani<sup>3</sup>, Seyed Ali Hosseini<sup>2,4</sup>, Benoit Fond<sup>3,5</sup>, Frank Beyrau<sup>3</sup>, Fathollah Varnik<sup>1</sup>, Dominique Thévenin<sup>2</sup>                      Organization(s): 1: Interdisciplinary Centre for Advanced Materials Simulation (ICAMS), Ruhr-University Bochum, 44801 Bochum, Germany; 2: Laboratory of Fluid Dynamics and Technical Flows, University of Magdeburg “Otto von Guericke”, D-39106 Magdeburg, Germany; 3: Laboratory of Technical Thermodynamics, Otto-von-Guericke-Universität Magdeburg, Universitätsplatz 2, 39106 Magdeburg, Germany; 4: Department of Mechanical and Process Engineering, ETH Zürich, 8092 Zürich, Switzerland; 5: Department of Aerodynamics, ONERA the French Aerospace Lab, 92190 Meudon</p>
04:30 pm	<p><b>Microstructured-based prediction of drag forces in particle-laden flows: Characterisation of local anisotropy using Minkowski tensors and Voronoi diagrams</b>                      Nelly El Achkar, Fabien Evrard, Victor Chéron, Berend van Wachem                      Organization(s): OVGU, Germany</p>
04:50 pm	<p><b>Modelling adsorptive mass transfer properties of oxyfuel gases in porous biomass chars</b>                      Carsten Wedler<sup>1</sup>, Markus Richter<sup>2</sup>, Roland Span<sup>3</sup>                      Organization(s): 1: Department of Chemical Engineering, Imperial College London, United Kingdom; 2: Applied Thermodynamics, Chemnitz University of Technology, Germany; 3: Thermodynamics, Ruhr University Bochum, Germany</p>
05:10 pm	<p><b>Numerical study of pneumatic conveying of flexible elongated biomass particles through a pipe bend by DEM-CFD</b>                      Darius Markauskas, Stefan Platzk, Harald Kruggel-Emden                      Organization(s): TU Berlin, Germany</p>

Session VI	Chairperson: D. Thévenin
04:10 pm	<p><b>Quantitative Imaging of Gas Adsorption Equilibrium and Dynamics by X-ray Computed Tomography</b>                      Ronny Pini<sup>1</sup>, Sayed Alireza Hosseinzadeh Hejazi<sup>2</sup>                      Organization(s): 1: Imperial College London, United Kingdom; 2: Amirkabir University of Technology, Islamic Republic of Iran</p>
04:30 pm	<p><b>Development of a Cost-effective PET-like Detector System for Particle Tracking in Granular Assemblies</b>                      Josephine Oppotsch, Antonios Athanassiadis, Fritz-Herbert Heinsius, Thomas Held, Matthias Steinke, Miriam Fritsch, Ulrich Wiedner                      Organization(s): Ruhr-University Bochum, Germany</p>
04:50 pm	<p><b>Applying Ray Tracing Based Reconstruction to Particle Image Velocimetry Measurements of Gaseous Flow in Packed Beds</b>                      Christin Velten<sup>1</sup>, Mirko Ebert<sup>2</sup>, Christian Lessig<sup>2</sup>, Katharina Zähringer<sup>1</sup>                      Organization(s): 1: Laboratory of Fluid Dynamics and Technical Flows, University of Magdeburg, Universitätsplatz 2, 39106 Magdeburg, Germany; 2: Department of Computer Science, University of Magdeburg, Universitätsplatz 2, 39106 Magdeburg, Germany</p>
05:10 pm	<p><b>Magnetic Resonance Relaxometry and susceptibility of contemporary 3D printing materials</b>                      Mariia Anikeeva<sup>1</sup>, Maitreyi Sangal<sup>2</sup>, Maryia S Pravdivtseva<sup>1,3</sup>, Hendrik Mattern<sup>2</sup>, Oliver Speck<sup>2,4,5,6</sup>, Jan-Bernd Hövener<sup>1,3</sup>                      Organization(s): 1: Section Biomedical Imaging, Molecular Imaging North Competence Center (MOIN CC), Kiel University, Kiel, Germany; 2: Department of Biomedical Magnetic Resonance, Otto-von-Guericke-University Magdeburg, Magdeburg, Germany; 3: Department of Radiology and Neuroradiology, University Medical Center Schleswig-Holstein (UKSH), Kiel, Germany; 4: Center for Behavioral Brain Sciences, Magdeburg, Germany; 5: German Centre for Neurodegenerative Diseases, Magdeburg, Germany; 6: Leibniz Institute for Neurobiology, Magdeburg, Germany</p>



9<sup>th</sup> June, 10:00 am – Postersession:

1	<p><b>Experimental investigations on the adsorptive mass transfer of H<sub>2</sub>O vapor on HTC char particles</b> Tim Eisenbach<sup>1</sup>, Horacio A. Duarte<sup>2</sup>, Carsten Wedler<sup>3</sup>, Roland Span<sup>1</sup> Organization(s): 1: Ruhr University Bochum, Germany; 2: Texas A&amp;M University Kingsville, USA; 3: Imperial College London, UK</p>
2	<p><b>Dielectrical and micro-structural properties of pyrolyzed biomass</b> Nicole Vorhauer-Huget<sup>1</sup>, Jakob Seidenbecher<sup>1</sup>, Supriya Bhaskaran<sup>1</sup>, Francesca Schenkel<sup>2</sup>, Lucas Briest<sup>1</sup>, Jan Barowski<sup>2</sup>, Alba Dieguez Alonso<sup>1</sup> Organization(s): 1: Otto von Guericke University, Germany; 2: Ruhr University Bochum, Germany</p>
3	<p><b>Effect of boundary reactions on biomass char conversion under pulverized fuel combustion conditions</b> Hao Luo<sup>1</sup>, Weigang Lin<sup>2</sup>, Hao Wu<sup>2</sup> Organization(s): 1: Wuhan University of Science and Technology, China; 2: Technical University Of Denmark, Denmark</p>
4	<p><b>Incorporation of Flamelets Generated Manifold method in coarse-grained Euler-Lagrange simulations of pulverized coal combustion</b> Chih-Chia Huang<sup>1</sup>, Yali Tang<sup>1,2</sup>, Jeroen van Oijen<sup>1,2</sup>, Niels G. Deen<sup>1,2</sup> Organization(s): 1: Power &amp; Flow group, Department of Mechanical Engineering, Eindhoven University of Technology, PO Box 513, 5600 MB, Eindhoven, the Netherlands; 2: Eindhoven Institute of Renewable Energy Systems (EIRES), Eindhoven University of Technology, PO Box 513, 5600 MB, Eindhoven, the Netherlands</p>
5	<p><b>Concepts Towards a Microwave Imaging System for Particle Localization in Bulk Material</b> Francesca Schenkel<sup>1</sup>, Jonas Schorlemer<sup>1</sup>, Birk Hattenhorst<sup>2</sup>, Marcel van Delden<sup>2</sup>, Jan Barowski<sup>1</sup>, Thomas Musch<sup>2</sup>, Ilona Rolfes<sup>1</sup> Organization(s): 1: Institute of Microwave Systems, Ruhr University Bochum, Universitätsstraße 150, 44801 Bochum, Germany; 2: Institute of Electronic Systems, , Ruhr University Bochum, Universitätsstraße 150, 44801 Bochum, Germany</p>
6	<p><b>Spatially resolved drying kinetics of single particles using adaptive pore structures</b> Xiang Lu, Jing Chen, Abdolreza Kharaghani Organization(s): Thermal Process Engineering, University of Magdeburg</p>
7	<p><b>Investigation of thermal radiation propagation within a generic packed bed configuration with simplified particle geometries</b> Matthias Tyslik<sup>1</sup>, Mirko Ebert<sup>2</sup>, Christian Lessig<sup>2</sup>, Siegmund Wirtz<sup>1</sup>, Martin Schiemann<sup>1</sup> Organization(s): 1: Ruhr-University Bochum, Germany; 2: University of Magdeburg, Germany</p>
8	<p><b>NeuroPNM: Model Reduction of Pore Network Models using Neural Networks</b> Robert Jendersie<sup>1</sup>, Ali Mjalled<sup>2</sup>, Xiang Lu<sup>3</sup>, Lucas Reineking<sup>2</sup>, Abdolreza Kharaghani<sup>3</sup>, Martin Mönnigmann<sup>2</sup>, Christian Lessig<sup>1</sup> Organization(s): 1: Otto-von-Guericke-Universität Magdeburg, Germany; 2: Ruhr University Bochum, Germany; 3: Otto-von-Guericke-Universität Magdeburg, Germany</p>
9	<p><b>A Eulerian description of aluminum dust combustion in a laminar counterflow flame</b> Fabian Sewerin, Jannis Finke Organization(s): Otto-von-Guericke-Universität Magdeburg, Germany</p>
10	<p><b>Particle temperature distribution in granular assemblies using luminescence thermometry and radiative transfer simulation</b> Guangtao Xuan<sup>1</sup>, Mirko Ebert<sup>1</sup>, Simson Julian Rodrigues<sup>1</sup>, Christian Lessig<sup>1</sup>, Nicole Vorhauer-Huget<sup>1</sup>, Benoît Fond<sup>1,2</sup> Organization(s): 1: Otto-von-Guericke-Universität Magdeburg; 2: Office National d'Etudes et de Recherches Aérospatiales (ONERA)</p>
11	<p><b>A combined flue gas cleaning system with a novel entrained flow SCR using an online synthesized catalyst</b> Janis Beimdiek, Sascha Schiller, Hans-Joachim Schmid Organization(s): Paderborn University, Germany</p>
12	<p><b>Storage Effects on the Properties of Biomass Pellets</b> Abdullah Sadeq, Swantje Pietsch-Braune, Maksym Dosta, Stefan Heinrich Organization(s): Hamburg University of Technology, Germany</p>
13	<p><b>Configuration-related errors in numerical and experimental studies of gaseous flow in packed beds</b> Christin Velten<sup>1</sup>, Wojciech Sadowski<sup>2</sup>, Katharina Zähringer<sup>1</sup>, Francesca di Mare<sup>2</sup> Organization(s): 1: Laboratory of Fluid Dynamics and Technical Flows, Otto-von Guericke-University Magdeburg, Universitätsplatz 2, 39106 Magdeburg, Germany; 2: Chair of Thermal Turbomachines and Aeroengines, Ruhr-University Bochum, Universitätsstraße 150, 44780 Bochum, Germany</p>



14	<b>Influence of particle shape on mixing on a batch stoker grate: A comparison of spheres and dodecahedrons</b> Nikoline Hilse, Max Kriegeskorte, Viktor Scherer Organization(s): Ruhr-University Bochum, Germany
15	<b>Decomposition kinetics of lumpy dolomite particles for carbon dioxide absorption from flue gas</b> Waliyu Abdulkadir Aliyu Organization(s): Otto von Guericke Universität Magdeburg, Germany
16	<b>Going beyond multiphase CFD — On recent developments towards real fluid behaviour and material interactions</b> Holger Marschall Organization(s): Technische Universität Darmstadt, Germany
17	<b>Combining the Multi-Level Coarse-Grain Model of the DEM with an Unreacted Shrinking Core Model for Simulations of Iron Ore Reduction</b> Daniel Queteschiner <sup>1</sup> , Thomas Lichtenegger <sup>1</sup> , Simon Schneiderbauer <sup>1,2</sup> , Stefan Pirker <sup>1</sup> Organization(s): 1: Department of Particulate Flow Modelling, Johannes Kepler University Linz, Austria; 2: Christian Doppler Laboratory for Multi-Scale Modelling of Multiphase Processes, Johannes Kepler University Linz, Austria
<b>15 informational posters – Subprojects CRC 287</b>	

9<sup>th</sup> June, 11:20 am – Session: Examples from industry

Session VII	Chairperson: E. Tsotsas
11:20 am	<b>Methane pyrolysis: CO<sub>2</sub> free production of hydrogen from natural gas</b> David Schlereth, Clemens Thomas Chan-Braun, Rouven Weiler, Grigorios Kolios, Johannes Bode, Dieter Flick Organization(s): BASF SE, Ludwigshafen, Germany
11:40 am	<b>The challenge of simulating industrial fluidised beds</b> Adlan Omer, Martin Weng Organization(s): aixprocess GmbH, Germany





9<sup>th</sup> June, 02:00 pm – Sessions:

Session VIII	Chairperson: V. Scherer
02:00 pm	<p><b>Experimental study of regeneration of iron fuel using hydrogen in a lab-scale fluidized bed</b> Xin Liu<sup>1</sup>, Xu Zhang<sup>2,3</sup>, Jun Li<sup>2</sup>, Qingshan Zhu<sup>2,3</sup>, Niels Deen<sup>1,4</sup>, Yali Tang<sup>1,4</sup> Organization(s): 1: Power and Flow Group, Department of Mechanical Engineering, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands; 2: State Key Laboratory of Multiphase Complex Systems, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China; 3: School of Chemical Engineering, University of Chinese Academy of Sciences, Beijing 100049, China; 4: Eindhoven Institute for Renewable Energy Systems (EIRES), Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands</p>
02:20 pm	<p><b>Bulk particle process simulation with parametrized reduced single particle models</b> Lucas Reineking<sup>1</sup>, Jonas Fischer<sup>2</sup>, Enric Illana<sup>2</sup>, Siegmund Wirtz<sup>2</sup>, Viktor Scherer<sup>2</sup>, Martin Mönnigmann<sup>1</sup> Organization(s): 1: Automatic Control and Systems Theory, Ruhr-University Bochum, Germany; 2: Energy Plant Technology, Ruhr University Bochum, Germany</p>
02:40 pm	<p><b>Study of the thermally thin and thermally thick particle approaches on the Eulerian modelling of an internally cooled biomass combustor</b> César Álvarez-Bermúdez, Miguel Ángel Gómez, Sergio Chapela, Jacobo Porteiro Organization(s): CINTECX-GTE, Universidade de Vigo, Lagoas-Marcosende s/n, Vigo, Pontevedra, 36310, Spain</p>
03:00 pm	<p><b>Particle-resolved transient simulations of reactive transport in non-adiabatic packed bed reactors</b> Claire Claassen, Vishak Chandra, Maike Baltussen, Frank Peters, Hans Kuipers Organization(s): Eindhoven University of Technology, Netherlands</p>

Session IX	Chairperson: F. di Mare
02:00 pm	<p><b>On the discrepancies in results of gas-solid kinetics by TGA: the cases of biomass combustion and iron ore reduction</b> Osvolda Senneca<sup>1</sup>, Francesca Cerciello<sup>2</sup> Organization(s): 1: CNR, Italy; 2: RUB, Germany</p>
02:20 pm	<p><b>CFD-based kinetic analysis of thermochemical conversion in a high-pressure TGA</b> Fengbo An, Felix Küster, Stefan Guhl, Andreas Richter Organization(s): TU Bergakademie Freiberg, Germany</p>
02:40 pm	<p><b>Effective thermal conductivity in packed beds of polyhedral particles</b> Simson Julian Rodrigues, Nicole Vorhauer-Huget, Evangelos Tsotsas Organization(s): Thermal Process Engineering, Otto von Guericke University Magdeburg, Germany</p>
03:00 pm	<p><b>Experimental investigation of the interaction between the flame and the particles in packed beds</b> Mohammadhassan Khodsiani<sup>1</sup>, Reza Namdarkedenji<sup>2</sup>, Hesameddin Safari<sup>1</sup>, Seyed Ali Hosseini<sup>1,3</sup>, Frank Beyrau<sup>1</sup>, Dominique Thévenin<sup>1</sup>, Fathollah Varnik<sup>2</sup>, Benoît Fond<sup>1,4</sup> Organization(s): 1: Chair of Technical Thermodynamics, Otto-von-Guericke Universität Magdeburg, 39106 Magdeburg, Germany; 2: Interdisciplinary Centre for Advanced Materials Simulation (ICAMS), Ruhr-University Bochum, 44801 Bochum, Germany; 3: Department of Mechanical and Process Engineering, ETH, Zürich, 8092 Zürich, Switzerland; 4: ONERA - The French Aerospace Lab - Centre de Meudon 8, rue des Vertugadins - 92190 MEUDON</p>