Dr. ès Sciences Patrick C. Le CLERCQ

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center
Institute of Combustion Technology
Pfaffenwaldring 38-40
D-70569 Stuttgart, Germany
Tel. +49 711 6862 441
Patrick.LeClercq@dlr.de

EDUCATION

National Engineering School for Space and Aeronautics (SUPAERO) — Toulouse, France
Ph.D. in Mechanical Engineering, with distinction — Dec. 2000

Pierre and Marie Curie University (Paris VI) — Paris, France
Master's degree in Mechanical Engineering, with distinction — Jun. 1995
Bachelor's degree in Mathematics and Physics — Jun. 1994

RESEARCH EXPERIENCE

German Aerospace Center (DLR), Institute of Combustion Technology — Stuttgart, Germany
Head of Department Multiphase Flows and Alternative Fuels — Jan. 2015 – present
Group Leader Multiphase flows — Jun. 2007- Dec. 2014
Research Scientist — Jun. 2004- May 2007

Leading research concerning sustainable aviation fuels (SAF) to mitigate the environmental and climate impact of aviation

- Prescreening SAF candidates with respect to safety and technical feasibility
- Support the approval process
- Assess SAFs potential benefits with respect to combustion system performance and emissions
- Perform and organize research for knowledge-based fuel design and optimization: impact of real fuel composition on physical and chemical properties, how they affect key sub-processes (fuel placement, ignition, pollutants formation, etc.), and combustion systems.

California Institute of Technology, Jet Propulsion Laboratory (NASA-JPL) — Pasadena, CA, USA
Postdoctoral Scholar — Jan. 2001- Dec. 2003

- Developed a multicomponent-fuel drop evaporation model based on Continuous Thermodynamics (statistical approach) for real fuels (Diesel, gasoline and kerosene).
- Performed DNS to investigate the influence of vapor composition on the transition to turbulence of a compressible temporal mixing-layer laden with millions of fuel droplets.

French National Aerospace Research Establishment (ONERA) — Toulouse, France
Aerodynamics and Energetics Modeling Department — Oct. 1997- Dec. 2000
Research Assistant

- Conducted non-intrusive and simultaneous measurements of surface temperature, velocity, and diameter of drops before and after bouncing of a heated wall using infrared temperature measurement, phase doppler analyzer, and CCD camera.

- Identified essential physical processes involved during droplet spheroidal (Leidenfrost) evaporation.
- Modeled the spontaneous heat, mass, and momentum transfers occurring at the liquid-gas interface during the droplet-wall interaction process using Continuum Mechanics and Non-equilibrium Thermodynamics.

PROJECT MANAGEMENT

- Principal Investigator (PI) of ECLIF (Emission and CLimate Impact of alternative Fuels), including the ECLIF-I and ECLIF-II/ND-MAX measurement campaigns with NASA, FAA, NRC-Canada, Aerodyne, and Missouri S&T — 2015 – 2018
- Initiator and first coordinator of EU H2020 project JETSCREEN (JET fuel SCREENing and optimization) — 2017 - 2020
- Sub-project leader of **"**In-depth Characterisation of Synthetic GTL Jet Fuel Combustion Performance in Current & Future Gas Turbine Engines", funded by the Qatar Science and technology Park. Partners Shell (UK), Rolls-Royce Plc (UK), Texas A&M Qatar station (QA), Sheffield University (UK). — 2010 - 2013
- Sub-project leader, EU FP7 projects ALFA-BIRD, KIAI and, SOLAR-JET
- Work package leader in the EU DG MOVE study SWAFEA

LANGUAGES

French, native speaker
English and German, fluent

SELECTED SCIENTIFIC PUBLICATIONS

Märkl, R. S., Voigt, C., Sauer, D., Dischl, R. K., Kaufmann, S., Harlaß, T., Hahn, V., Roiger, A., Weiß-Rehm, C., Burkhardt, U., Schumann, U., Marsing, A., Scheibe, M., Dörnbrack, A., Renard, C., Gauthier, M., Swann, P., Madden, P., Luff, D., Sallinen, R., Schripp, T., and Le Clercq, P.: Powering aircraft with 100 % sustainable aviation fuel reduces ice crystals in contrails, Atmos. Chem. Phys., 24, (2024), https://doi.org/10.5194/acp-24-3813-2024

Voigt C., Kleine J., Sauer D., Moore R.H., Bräuer T, Le Clercq P. *et al.* Cleaner burning aviation fuels can reduce contrail cloudiness. Commun Earth Environ 2, 114 (2021). https://doi.org/10.1038/s43247-021-00174-y

Heyne J., Rauch B., Le Clercq P., Colket M., Sustainable aviation fuel prescreening tools and procedures, Fuel, 290 (2021). https://doi.org/10.1016/j.fuel.2020.120004

Eckel G., Grohmann J., Cantu L., Slavinskaya N., Kathrotia T., Rachner M., Le Clercq P., Meier W., Aigner M., LES of a swirl-stabilized kerosene spray flame with a multi-component vaporization model and detailed chemistry, Combustion and Flame, 207 (2019). https://doi.org/10.1016/j.combustflame.2019.05.011

Rauch, B., Calabria, R., Chiariello, F. et al. Accurate analysis of multicomponent fuel spray evaporation in turbulent flow. Exp Fluids 52, (2012). https://doi.org/10.1007/s00348-011-1169-0

Le Clercq P.C. and Bellan J. Direct Numerical Simulation of gaseous mixing layers laden with multicomponent-liquid drops: Liquid-specific effects, *J. of Fluid Mech*. 533, (2005).

Le Clercq P.C. and Bellan J. Direct Numerical Simulation of a transitional temporal mixing layer laden with multicomponent-fuel evaporating drops using continuous thermodynamics, *Phys. Fluids,* 16(6), (2004).

Le Clercq P.C. and Bellan J. Modeling of multicomponent-fuel drop-laden mixing layers having a multitude of species, *Proceedings of the Combustion Institute*, 30, (2004)