

Yacine Babou, Ph.D.

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CURRENT POSITION

Professor, Fellowship CONEX

2014

Bioengineering and Aerospace Engineering Department, Universidad Carlos III de Madrid

LAST POSITION

Senior Research Engineer

2008-2014

Aeronautic and Aerospace department, von Karman institute, Belgium

- Coordination of European Space Agency Research Projects
- R&D of techniques for aerospace flows diagnosis
- R&D of plasma flow control methods
- Supervision of research master students

EDUCATION

Ph.D.	University of Orsay, Paris XI, France Plasma Physics: <i>cum laude</i> PhD director: Anouar Soufiani, Ph.D. thesis: Radiative transfers in CO ₂ -N ₂ plasmas: spectroscopic databases, experimental study, atmospheric entry applications	2004-2007
Master	University of Orsay, Paris XI, France Plasma Physics: <i>cum laude</i>	2001-2003
Bachelor	University of Orsay, Paris XI, France Computer Science	2000-2001
Bachelor	University of Orsay, Paris XI, France Fundamental Physics	1999-2000

RESEARCH EXPERIENCE

Senior Research Engineer

2008-Present

Location: von Karman institute, Belgium

Department of Aeronautic and Aerospace (AR)

- Topics:
- Optical methods to characterize high temperature plasmas
 - Laser-based methods to characterize high-speed flow
 - Plasma flow control

Postdoctoral fellow

2007-2008

Location: von Karman institute, Belgium

Department of Aeronautic and Aerospace (AR)

- Topics:
- Thermal plasma thermometry by mean of Optical Emission Spectroscopy
 - Collisional-Radiative processes in plasma behind shockwaves

Ph.D. student

2003-2007

Location: Laboratory "Energétique Macroscopique et Moléculaire, Combustion",
at École Centrale Paris, France

Scholarship: University of Orsay, Paris XI, France

Research group: Physics of Transfers

Ph.D. director: Dr. Anouar Soufiani, Senior Scientist at CNRS, France

- Topics:
- Development of spectroscopic databases for carbonaceous diatomic molecules
 - Building and characterization of a microwave plasma source
 - Derivation of a self-consistent multi-temperature model of high temperature plasma optical properties

AWARDS

EREA European Research Establishments in Aeronautics

2008

Award for the best innovative project: «Turbine Shocks Modulation with Plasma Actuators »

PROJECTS EXPERIENCE

Coordinator of European Spatial Agency projects in the frame of the Basic Technology Research Programme (ESA/TRP):

- Implement effective and economical project management
- Organize workflow execution
- Monitor activity progress and budget
- Review scientific and technical reporting
- Secretariat administration (schedule meetings, minutes preparation and distribution...)

Project: Aerothermo-Chemistry Models for Re-Entry Applications

Partners: Ecole Polytechnique Fédérale de Lausanne (Switzerland), Ecole Centrale Paris (France), University of Queensland (Australia), High Performance Space Structure Systems (Germany) and Deutsches Zentrum für Luft und Raumfahrt (Germany)

Project outline: The project addresses the development of operational validated codes for the computation of high enthalpy flow fields coupled with radiation and ablation. The major focus is on radiation in the presence of ablation products in the case of entry in Earth or Titan atmosphere. Three facilities are used to produce experimental data required for the validation task. Namely, Plasmatron and L2K plasma wind tunnels located respectively in Belgium and Germany, and the shock tube facility in Australia.

Project: Validation of Aerothermodynamics Experimental and Computational Tools for the Support of Future Mars Missions

Partners: Fluid Gravity Engineering (United Kingdom) and CORIA laboratory (France)

Project outline: The project is aimed to achieve three major points: the development of a reliable Collisional-Radiative (CR) model for carbonaceous kinetic reactions, the integration of the CR model in an engineering code and its validation on the basis of experimental data obtained in the frame of a dedicated test campaigns conducted with the Plasmatron facility at VKI.

Work Package contributor to European Commission projects FP7 - 7th Framework Programme of Research, Technological Development and Demonstration:

Project: Planetary Entry Integrated Models

Designation: Phys4Entry; Grant no 242311

Coordinator: University of Bari (Italy)

Description of work: Thermodynamic characterization of a non-equilibrium supersonic plasma jet produced by Plasmatron facility to enhance the assessment of non-equilibrium and compressible plasma flows.

Project: Design of INNOvative CROR blade and pylon

Designation: DINNO-CROR; Grant no 255878

Coordinator: Airbus (France)

Description of work: Evaluate the actual potentials of plasma flow actuators, based on Dielectric Barrier Discharge DBD, for reduction of noise produced by Counter Rotating Open Rotor and pylon during taking-off and landing phases (Test-Readiness Level 1).

Project: Advanced Ablation Characterization and Modelling

Designation: ABLAMOD; Grant no 312987

Coordinator: Deutsches Zentrum für Luft und Raumfahrt (Germany)

Description of work: Development of new optical measurement approach to characterize the ablation phenomena under extreme incident convective and radiative heat flux conditions.

Work Package contributor to the project NANO funded by the Wallonia region in Belgium

Project outline: Design and build pilot facility for industrial nanoparticle production on the basis of Inductively Coupled Plasma technology.

Description of work: Design and development of a optical system integrated to the industrial process to determine in real time the temperature in the plasma jet to tune finely the plasma conditions.

PEDAGOGICAL AND TEACHING ACTIVITIES

Activities in the frame of the pedagogical commitment at von Karman institute:

- Supervision of graduate research students in the frame of projects
- Teaching seminars on radiative transfer in high temperature plasmas
- Co-supervision of a Ph.D. thesis in collaboration with “Laboratoire Arc Électrique et Plasmas Thermiques” at Blaise Pascal University, France.

Labclass teaching assistant in Mechanical and Aerospace Engineering department, at École Centrale Paris:

- Experimental Methodology (smoke visualization, Pitot tube measurements)
- Acquisition and Signal Processing (hotwire, thermocouple)
- Heat transfers (conduction, convection)
- MATLAB programming (basics of structured programming)

List of project supervised at VKI

- [M12] “Differential interferometry for measurement of density fluctuations and fluctuation-induced transport”, P. Gomez Garcia, 2013
- [M11] “Tunable diode laser absorption spectroscopy as a method for diagnostics of CO₂ plasma flows”, C. Tekin, 2012
- [M10] “Boundary layer control using a DBD plasma actuator: numerical investigations”, J. Leyvastre, 2011
- [M9] “Boundary layer control using dielectric barrier discharge plasma actuator: experimental investigations”, I. Gerphagnon, 2011
- [M8] “A program on the interpolation of plasma electron density from stark broadened emission lines”, S. Kessler, 2011
- [M7] “Hypersonic flow characterization with tuneable diode laser absorption spectroscopy”, I. Sakaraker, 2010
- [M6] “Unsteadiness characterizations of plasma flows”, L. Rodrigues, 2010
- [M5] “Plasma flow characterization by means of optical emission diagnostics”, A. Cipullo, 2009
- [M4] “Flow control Flow control using DBD plasma actuators: experimental investigation”, L. Barbato, 2009
- [M3] “First experimental investigations of a dielectric barrier discharge based plasma actuator for flow control applications”, A.E. Kerlo, 2009
- [M2] “Boundary layer control using a DBD plasma actuator: experimental investigation”, S. Meyniel, 2009
- [M1] “Investigations of plasma jet unsteady features”, M. Aleo, I. Benito, 2008

SERVICES AND SOCIAL COMMITMENT

Director of lecture series

May 2014: “Spectroscopy and spectroscopic measurement techniques for aerospace flows”, to be edited by D. Giordano and Y. Babou.

February 2011: “Plasma flow control: fundamentals modelling and applications”, edited by Y. Babou and G. Paniagua, ISSN0377-8312.

Key contributor to ESA/CNES workshops on Radiation of High Temperature Gases

Workshops organized every 2 years by ESA (European Space Agency) and CNES (French space agency):

- Responsible of definition and documentation of experimental test cases
- Responsible of team work synthesis and communication

Reviewer activity

- Journal of Quantitative Spectroscopy and Radiative Transfer
- Journal of Experimental Thermal and Fluid Science
- IEEE Transactions on Plasma Science
- Conferences: ASME, ESA

INVITED TALKS

2009-2013: « Spectroscopic measurement techniques », yearly lectures given at the von Karman Institute in the frame of the lecture series “Introduction to Measurements Techniques”, Belgium.

September 2012: « Plasma wind tunnel experiments », International School of Quantum Electronics, 53rd Course Molecular Physics and Plasmas in Hypersonics, Ettore Majorana Centre, Italy.

July 2010: « Introduction to plasma flow diagnostics by means of spectroscopy techniques» (12 hours lecture series), Universitat Politècnica de València, Spain.

Mars 2010: «Plasmas optical diagnostics with emission spectroscopy» (one day lecture), Collective centre of the Belgian technological industry (SIRRIS), Belgium.

December 2008: «Plasmas optical diagnostics with emission spectroscopy» (one day lecture), Collective centre of the Belgian technological industry (SIRRIS), Belgium.

PUBLICATIONS IN PEER-REVIEWED JOURNALS

- [J8] B. Helber, C. O. Asma, Y. Babou, A. Hubin, O. Chazot, T. E. Magin, “*Material response characterization of a low density carbon-composite ablator in high-enthalpy plasma flows*”, Journal of Material Science, accepted
- [J7] Y. Babou, D. Lequang, O. Chazot, S.T. Surzhikov, A.S. Dikaljuk, A. Panarese, S. Longo, J. Hoffman, Z. Szymanski, A. Kaminska, M. Dudeck, D. Vacher, “*Thermodynamic characterization of high-speed and high-enthalpy plasma flows*”, The Open Plasma Physics Journal, in press
- [J6] R. Sobbia, P. Leyland, Y. Babou, D. Potter, L. Marraffa, “*Plasma radiation for atmospheric entry at Titan: emission spectroscopy measurements and numerical rebuilding*”, Journal of Plasma Physics, published online January 2013, DOI: <http://dx.doi.org/10.1017/S0022377812000888>
- [J5] D. Lequang, Y. Babou, P. André « Experimental assessment of local Thermodynamic equilibrium in VKI Plasmatron air Plasma jet », Journal of Technical Physics, 50(3), 151-162, 2009
- [J4] Y. Babou, Ph. Rivière, M-Y. Perrin, A. Soufiani, “*High-Temperature and Non-equilibrium Partition Function and Thermodynamic Data of Diatomic Molecules*”, International Journal of Thermophysics, 30(2), 416-438, 2009
- [J3] Y. Babou, Ph. Rivière, M-Y. Perrin, A. Soufiani, “*Spectroscopic data for the prediction of radiative transfer in CO₂ – N₂ plasmas*”, Journal of Quantitative Spectroscopy and Radiative Transfer, 110, 89-108, 2009
- [J2] Y. Babou, Ph. Rivière, M-Y. Perrin, A. Soufiani, “*Spectroscopic study of microwave plasmas of CO₂ and CO₂–N₂ mixtures at atmospheric pressure*”, Plasma Sources Science and Technology, 17, 2008
- [J1] J-M. Lamet, Y. Babou, Ph. Rivière, A. Soufiani, M-Y. Perrin, “*Radiative transfer in gases under thermal and chemical nonequilibrium conditions: Application to earth atmospheric re-entry*”, Journal of Quantitative Spectroscopy and Radiative Transfer, 109, 235-244, 2008

PUBLICATIONS IN CONFERENCE PROCEEDINGS

- [P24] Y. Babou, F. Cannat, D. Lequang, “*Tomography of thermal plasma flows by means of single CCD camera*”, EUCASS 2013, 5th European Conference of Aeronautics and Space Sciences, Munich, Germany, July 1-5, 2013
- [P23] T. Regert, Y. Babou, O. Marxen, M. Avelar Camarinha, O. Chazot, “*Investigation of flat plate transitional boundary layer in hypersonic flow by means of naphthalene based PLIF*”, EUCASS 2013, 5th European Conference of Aeronautics and Space Sciences, Munich, Germany, July 1-5, 2013
- [P22] D. Lequang, Y. Babou, P. André, “*Investigations of a microwave plasma source operating with air, N₂, CO₂ and argon gases*”, IOP Conference Series: Materials Science and Engineering, 29(1), IOP Publishing, 2012

- [P21] Y. Babou, F. Cannat, D. Lequang, “*Tomography of thermal plasma flows by mean of single CCD camera*”, 5th International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, Barcelona, Spain, October 16-19, 2012, ESA SP 714, December 2012
- [P20] D. Lequang, Y. Babou, O. Chazot, P. André, “*Investigation of supersonic air plasma jet produced in the VKI plasmatron facility*”, 5th International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, Barcelona, Spain, October 16-19, 2012 ESA SP 714, December 2012
- [P19] Y. Babou, G. Paniagua, P. Rocandio, “*Airfoil Base Region Control with Dielectric Barrier Discharge*”, 48th AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit, Atlanta, USA, eISBN: 978-1-60086-935-8, 2011
- [P18] B. Helber, Y. Babou, F. Panerai, O. Chazot, A. Hubin, T. E. Magin, “*Investigation of the gas-surface interaction of innovative carbon composite ablators in the VKI plasmatron*”, 7th European Symposium on Aerothermodynamics, Brugge, Belgium, May 9-12, 2011
- [P17] A. Bultel, Y. Babou, J. Annaloro, D. Lequang, “*CORAM-CO2 code: a tool devoted to the prediction of the excited states population densities of CO and C2 in CO2 plasma flows produced in ground test facilities*”, 7th European Symposium on Aerothermodynamics, Brugge, Belgium, May 9-12, 2011
- [P16] B. Helber, C. O. Asma, Y. Babou, O. Chazot, T. E. Magin, “*Experimental Investigation of the Material Response of Carbon Composite Ablators in the VKI Plasmatron Facility*”, 17th AIAA Space Planes and Hypersonic Systems and Technologies Conference, San Francisco, USA, April 11-14, 2011, AIAA 2011-2302
- [P15] D. Lequang, Y. Babou, P. André, “*Investigations of a new microwave plasma source operating with air, N2, CO2 and argon gases*”, 7th European Symposium on Aerothermodynamics, Brugge, Belgium, May 9-12, 2011
- [P14] D. Lequang, Y. Babou, A. Bultel, L. Marraffa, “*Thermodynamic characterization in CO2 plasma jet produced by VKI plasmatron facility*”, 7th European Symposium on Aerothermodynamics, Brugge, Belgium, May 9-12, 2011
- [P13] A. Munafò, M. Panesi, Y. Babou, O. Chazot, “*Chemical relaxation behind a CO2-N2 mixture shock investigation*”, Fourth International Symposium on Non-equilibrium Processes, Plasma, Combustion, and Atmospheric Phenomena (NEPCAP-2009), Sochi, Russia, October 2009
- [P12] S. Depraz, A. Soufiani, M-Y. Perrin, Y. Babou, “*An experimental set-up for IR gaz radiative property measurements at temperatures up to 6000K: Application to CO2 and CO2-N2 mixtures*”, Proceedings of ASME Heat Transfer Conference, 2009
- [P11] Y. Babou, A.E. Kerlo, S. Menyiel, S. Paris, “*Experimental investigations of a simple DBD-based flow actuator*”, Bulletin of the American Physical Society, vol. 54, 2009
- [P10] I. Benito, M. Aleo, Y. Babou, “*VKI Plasmatron facility performances: I. Air plasma jet unsteadiness*”, Proceedings of the 3th International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, Heraklion, Greece, September 2008
- [P9] Y. Babou, “*VKI Plasmatron facility performances: II. Air plasma jet thermodynamic state*”, Proceedings of the Third International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, Heraklion, Greece, September 2008

- [P8] A. Munafò, M. Panesi, Y. Babou, O. Chazot, “*Contribution to TC3: Mars entries*”, Proceedings of the Third International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, Heraklion, Greece, September 2008
- [P7] M. Panesi, A. Bultel, A. Bourdon, O. Chazot, Y. Babou, “*Collisional Radiative Modelling in flow Simulation*”, Lecture series von Karman Institute, Hypersonics, 3-8 September 2008
- [P6] M. Panesi, Y. Babou, O. Chazot, “*Predictions of nonequilibrium radiation: analysis and comparison with EAST experiments*”, Proceedings of the AIAA 40th Thermophysics Conference, Seattle, Washington, June 2008
- [P5] J-M. Lamet, Y. Babou, Ph. Rivière, A. Soufiani, M-Y. Perrin, “*Radiative transfer in gases under thermal and chemical nonequilibrium conditions: Application to earth atmospheric re-entry*”, Proceedings of the Fifth International Symposium on Radiative Transfer, Bodrum, Turkey, June 2007
- [P4] Y. Babou, Ph. Rivière, A. Soufiani, M-Y. Perrin, “*Prediction of radiative flux distribution over the front shield of a vehicle entering martian atmosphere-Contribution to test case TC3*”, Proceedings of the 2nd International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, Rome, Italy, September 2006
- [P3] J-M. Lamet, Y. Babou, Ph. Rivière, A. Soufiani, M-Y. Perrin, “*Radiative transfer in earth re-entry: application to the project FIRE II experiment*”, Proceedings of the 2nd International Workshop on Radiation of High Temperature Gases in atmospheric entry, Rome, Italy, September 2006
- [P2] Y. Babou, Ph. Rivière, A. Soufiani, M-Y. Perrin, “*Relative contributions of diatomic electronic systems to radiative transfer in Mars atmospheric entries*”, Proceedings of the International Conference High-Speed Flow: Fundamental Problems, Zhukovsky, Moscow region, Russia, September 2004
- [P1] Ch. Deron, Y. Babou, A. Soufiani, M.-Y Perrin, “*Radiative Transfer in an Argon Atmospheric Plasma : Modelling and Comparisons with Experiments*”, Proceedings of the XVth International Conference on Gas Discharges and their Applications, France, Toulouse, September 2004