

UNIVERSITÀ DEGLI STUDI DELL'AQUILA *M&MOCS International Research Center on* MATHEMATICS AND MECHANICS OF COMPLEX SYSTEMS



LAUDATIO FOR PROFESSOR THIERRY PAUL

Thierry Paul is currently First Class Director of Research at French National Center of Scientific Research (CNRS), in the site of Laboratoire Jacques-Louis Lions (LJLL) at Sorbonne University.

In 1984 he completed his thesis on the just born wavelets theory at University of Paris 6 under the supervision of Alex Grossmann, one of its founders, at the Centre de Physique Théorique where he entered CNRS in 1985.

In the two years period 1998-1999 he was Researcher at the Centre de Recherche en Mathématiques de la Décision (CEREMADE) of CNRS; from 1999 to 2009 Director of Research at Département de mathématiques et applications (DMA) of Paris Ecole Normale Superieure (ENS); from 2009 to 2013 Research Director of Center of Mathematics Laurent Schwartz (CMLS) of Paris Ecole Polytechnique, the same position that became First Class from 2013 to 2019.

He directed 5 PhD Thesis and 4 "Post-Doc" from 2001 and 2015.

He was Coordinator of the team "Analyse et équations aux dérivées partielles (EDP) at CMLS from 2010 to 2019 ; he was co-coordinator of the RTP (Reseau Thematique Pluridisciplinaire) "PhenoMath" (philosophie / mathematique) of CNRS from 2010 to 2015.

He was member of the Scientific Committee at Laboratoire International Associé LYSE from 2016 to 2022; member of the Editorial Board of "Asymptotic Analysis" Journal from 2012 to 2017; member of the "Mathematical Structures in Computer Science" Journal Editorial Board at Cambridge University from 2009 to 2016; Member of "Collectif Histoire-Philosophie-Sciences" of ENS (2001-2009).

He was Scientific Coordinator of the CEREMADE Library (1995-1999); Scientific Coordinator of the DMA Library (2000-2006).

After graduating he continued in the field of semiclassical methods (microlocal analysis with small parameter) for quantum mechanics (spectral analysis, trace formula, perturbations methods, long time behaviour, low regularity), but also for number theory (Poincaré series), topology (low dimension, topological quantum field theory), oceanography (Rossby waves) and fluid dynamics (boundary layer, internal waves).

In a later stage of his path he was also concerned with applied mathematics methods for quantum mechanics (time-splitting, random batch), semiclassical evolution with low regularity potentials, quantum optimal transport, chemotaxis in the meanfield regime and large number of agents systems.

In almost 40 years of career he has ranged in various fields of activity, traced by the approximately 150 scientific publications, with subjects from Wave functions (1984) to Mathematical Models and Methods in Applied Science (2022), and co-edition of 5 books: Questions de phrase (Hermann, 2011), Le formalisme en action: aspects mathematiques et philosophiques (Hermann, 2012) Le

presque (Hermann, 2015), Rigueur (Spartacus, 2021) and Theoretical Physics, Wavelets, Analysis, Genomics: An Indisciplinary Tribute to Alex Grossmann (Springer Series: Applied and Numerical Harmonic Analysis (ANHA) 2023, currently on press).

Main results of his research, among the others:

- Wavelets: group theoretic generalization, with A. Frossmann et al (reprinted in Fundamental Papers in Wavelet Theory", Princeton University Press 2006), and I. Daubechies (Inverse Problems);
- Gutzwiller trace formula: first mathematical proof, with a. Uribe (CRAS 1991 and JFA 1995), extension to criticla level with A. Uribe et al (Duke M. J. 1995), quantum normal forms, with V. Guillemin (CMP 2010);
- Poincaré series in modular form theory, proof of their non-vanishing by microlocal techniques with A. Uribe et al (Inventiones Mat. 1995);
- Mean-field limit with Coulomb interactions: derivation of EulerPoison from quantum dynamics, with F. Golse (CPAM in press);
- Oceanography: Semiclassical and spectral analysis of Rossby waves, with L. Saint-Raymond et al (Duke M. J. 2021)
- Semiclassical: classical limit of Wigner functions, with P.-L. Lions (Revista Mat. Ibero 1994), semiclassically uniform meanfield theory with F. Golse (CMP 2019, ARMA 2017);
- Semiclassical beyond Cauchy-Lipschitz: classical limit for 'a la Di Perna-Lions" quantum evolution, with L. Ambroio, A. Figalli et al (CPAM 2011, Indiana M. J. 2013);
- Low dimension topology: large number of colors asymptotics for topological quantum field theory, with J. Marché (Trans. Amer. Math. Soc. 2015);
- Semiclassical: quantitative approximation with only Cauchy-Lipschitz regularity, with F. Golse (J. Math. Pures et Appliquées 2021);
- Boundary layers: with microlocal methods, with D. Gérard-Varet (CPDE 2008);
- Classical meanfield: an approach using correlation errors estimates, with S. Simonella et al (ARMA 2019);
- Quantum Wassersetin: definition, with C. Mouhot et al (CMP 2016), application to optimal transport with E. Caglioti (J. Stat. Phys. 2020, Annali della Scuola normale superiore di Pisa (in press) and with F. Golse (JFA in press);
- Time splitting and random batch methods in quantum dynamics: with S. Jin et al (Found. of Comp. Math. 2021 and J. Comp. Math. (in press));
- Cucker-Smale and chemotaxis: meanfield approaches, with R. Natalini (DCDS B, doi: 10.3934/dcdsb.2021164 and SIAM J. Math. Analysis (in press));
- Agent systems: meanfield approach and applications to the graph limit and partciles systems associated to general PDEs, with E. Trélat (preprint <u>https://arxiv.org/abs/2209.08832</u>).

The innovative character of his entire activity, the attention paid to fields that are apparently distant from each other, the direct, concrete application of its results in the scientific field, his interest in the interactions between mathematics and theoretical physics with music and philosophy make him one of the most influential scientists of this era.

For the relevant, international value of all his commitment the Scientific Committee of the Levi-Civita Prize in Mechanical and Mathematical Sciences is honored to propose Thierry Paul as the Recipient of the 2021 Prize Edition.