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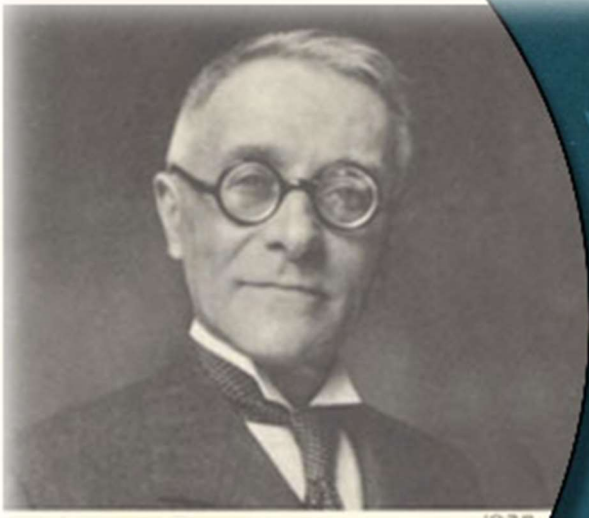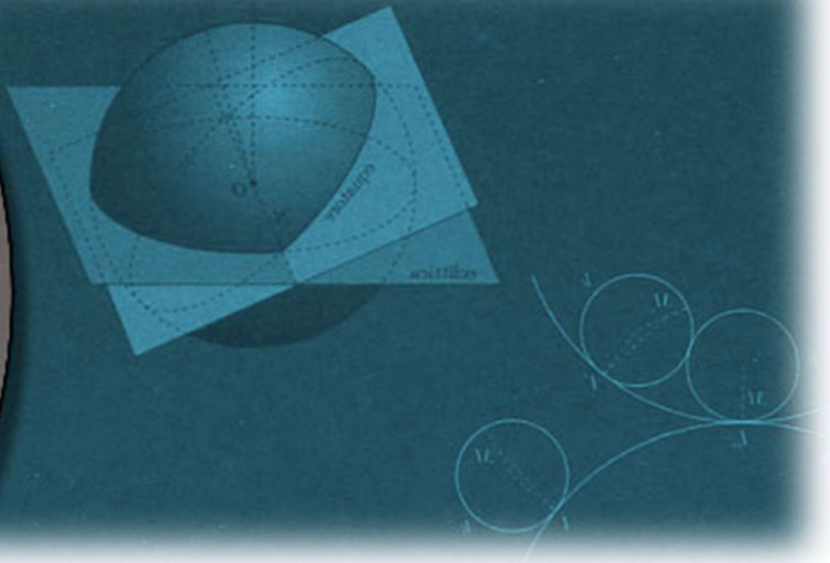
International Research Center for the MATHEMATICS AND MECHANICS OF COMPLEX SYSTEMS

TULLIO LEVI CIVITA INTERNATIONAL PRIZE 2023

LAUDATIO FOR PROF. LAURE SAINT RAYMOND

Mother of 6 children, Laure Saint-Raymond is currently Professor of Mathematics at Institut des Hautes Études Scientifiques, in Bures-sur-Yvette (France).

She is Member of the French Academy of Sciences, elected on 10 December 2013, the youngest ever.

Since 2015 she is Member of Academia Europaea; since 2021 she is Permanent Professor at the Institut des Hautes Études Scientifiques, the first woman to hold that position in the history of the Institute.

In 2022 she was elected as an International Member to the United States National Academy of Sciences.

She studied in Paris, entering École Normale Supérieure in 1994. In 1996, she received a Master degree in plasma physics from Versailles Saint-Quentin-en-Yvelines University and in applied mathematics from Pierre and Marie Curie University; in 2000 she received her Ph.D. in applied mathematics at Paris Diderot University, under the supervision of François Golse.

In 2002 she was named, at the age of 27, Full Professor of Mathematics at Pierre and Marie Curie University, position she held until 2007, when she moved to École Nationale Supérieure (ENS) of Paris. Until 2017 she was Full Professor at the ENS Département de Mathématiques et Applications and, from 2011 to 2014, Deputy director of the Mathematics Department.

In the two-year period 2014-2015 she was Visiting Professor at Harvard University and at MIT (Massachussets Institute of Technology) Center of Mathematical Sciences.

From 2017 to 2022 she was Professor of Mathematics at École Nationale Supérieure of Lyon.

One of the most brilliant young mathematicians in her generation, she is well known for her work and outstanding results on nonlinear partial differential equations in the dynamics of gases, plasma and fluid dynamics. Together with various collaborators, she has made groundbreaking contributions to the problem of a mathematical axiomatization of fundamental model of physics connecting atomic to macroscopic scales. Her work has shown rigorously that there is a continuous transition between non-equilibrium statistical physics models and the equations of fluid mechanics, and more recently she has studied the validity of these statistical models based on Newtonian mechanics. In parallel, she works on fluid mechanics models describing ocean currents, including the influence of rotation and stratification on wave propagation and boundary layer phenomena.

Her work has been recognized by many prestigious international honours and awards, including:

- 2003: Louis Armand Prize of the French Academy of Sciences;
- 2004: Claude-Antoine Peccot Award of Collège de France;
- 2004: Pius XI Medal of the Pontifical Academy of Sciences;
- 2006: Prize of the City of Paris for Young Scientists;
- 2008: Prize of the European Mathematical Society, with her citation reading:
  "Saint-Raymond is well known for her outstanding results on nonlinear partial differential equations in the dynamics of gases and plasmas and also in fluid dynamics. [...] Saint-

Raymond is at the origin of several outstanding and difficult results in the field of nonlinear partial differential equations of mathematical physics.";

- 2009: Ruth Lyttle Satter Prize in Mathematics of the American Mathematical Society. Her work was summarized by The Committee as:
  "Her research has focused on the study of problems in mathematical physics, including the Boltzmann equation and its fluid dynamic limits, the Vlasov-Poisson system and its gyrokinetic limit, and problems of rotating fluids coming from geophysics. [...]";
- 2010: Invitation to the Abel Symposium, Norwegian Mathematical Society;
- 2011: Irène Joliot-Curie Prize of the "Young Scientist Woman", French ministry of Research and Education & French Academy of Sciences;
- 2014: Invitation to the International Congress of Mathematicians, Seoul;
- 2015: Plenary lecture at the International Congress of Mathematical Physics, Chile;
- 2015: Fermat Prize by the Institut de Mathématiques de Toulouse, France;
- 2019: Knight in the French National Order of the Legion of Honour;
- 2020: Bôcher Memorial Prize for: "her transformative contributions to kinetic theory, fluid dynamics, and Hilbert's sixth problem".

Her work has been summarized up to now in about 100 scientific publications, including:

- Convergence of solutions to the Boltzmann equation in the incompressible Euler limit, Arch. Ration. Mech. Anal. (2003);
- The Navier-Stokes Limit of the Boltzmann Equation for Bounded Collision Kernels, with F.Golse, Inventiones Math. (2004);
- Mathematical study of the betaplane model: equatorial waves and convergence results, with I.Gallagher, Mémoires de la SMF (2006);
- Hydrodynamic limits of the Boltzmann Equation, Lecture Notes in Mathematics, Springer (2009);
- From Newton to Boltzmann : the case of short-range potentials, with I. Gallagher and B.Texier; Zürich Lectures in Adv. Math., European Mathematical Society (EMS), Zürich, (2013);
- Mathematical study of degenerate boundary layers, with A.-L. Dalibard, Memoirs of the American Mathematical Society (2015).
- The Brownian motion as the limit of a deterministic system of hard-spheres, with T. Bodineau and I. Gallagher, Inventiones Math. (2015).
- Dynamics of dilute gases: a statistical approach, with T. Bodineau, I. Gallagher and S. Simonella, Proceedings of the ICM 2022.
- Statistical dynamics of a hard sphere gas: fluctuating Boltzmann equation and large deviations, with T. Bodineau, I. Gallagher and S. Simonella, Ann. Math. (2023).
- Long-Time Correlations for a Hard-Sphere Gas at Equilibrium, with T. Bodineau, I. Gallagher and S. Simonella, Comm. Pure and Appl. Math. (2023).

Alongside 'core' activity, to be underlined her significant commitment as:

- PhD advisor;
- Member of editorial boards;
- Member of hiring and evaluation committees in France and abroad;
- Member of scientific committees and organizational teams of international conferences.

For the scientific value, the original approach and results gained on 'secular' problems, for her 20 years now of greatly recognized activity as 'young among young' teacher and scientist, the Scientific Committee of the Levi-Civita Prize in Mechanical and Mathematical Sciences is honored to propose Laure Saint-Raymond as the Recipient of the 2022 Prize Edition.