PONTIFICIA ACADEMIA SCIENTIARVM

THE AWARD

OF THE

PIUS XI GOLD MEDAL

2014

Prof. Cédric Villani

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The aim of the Pontifical Academy of Sciences, which was founded on 28 October 1936 by the Holy Father Pius XI, is to honour pure science, wherever this may be found, to ensure its freedom, and to support the research essential for the progress of applied science.

On 28 October 1961, on the occasion of the 25th anniversary of the foundation of the Pontifical Academy of Sciences, the Holy Father John XXIII established the Pius XI Gold Medal in honour of the founder of the Academy. The medal should be awarded to a young scientist who has already gained an international reputation.

The Council of the Academy unanimously decided to award the "Pius XI Gold Medal" for the year 2014 to

Prof. Cédric Villani

in recognition of his great merits as a scholar and the important contribution of his research to scientific progress.


PIVS · XI · PONTIFEX · MAXIMVS · FVNDATOR
PONTIFICIA · ACADEMIA · SCIENTIARVM
CÉDRIC VILLANI
A.D.
MMXIV

CÉDRIC VILLANI

BIOGRAPHICAL DATA

Full Name: Cédric Villani

Professional Address:
Institut Henri Poincaré
11 rue Pierre et Marie Curie
F-75231 Paris Cedex 05, France

Date of Birth: 5 October 1973

Place of Birth: Brive-la-Gaillarde (France)

Wife and Children: Married to Claire Calmet; Neven, Aelle

Academic Qualifications:
1998: PhD Thesis, University Paris-Dauphine
2000: Habilitation à Diriger des Recherches, University Paris-Dauphine

Scientific Discipline:
Mathematics

Previous Positions:
Ecole Normale Supérieure de Lyon (Professor, 2000-2010)
Visiting Professor in Georgia Tech, Atlanta (1999)
Berkeley (2004, 2013), Princeton (2009), Providence (2012)

Current Professional Activity/Occupation:
Professor of Lyon-I University
Director of the Institut Henri Poincaré (Paris)

Membership of Professional Societies:
French Academy of Sciences
French Mathematical Society, French Society for Applied and Industrial Mathematics

Positions held:

From 2000 to 2010 I was a Professor of Mathematics at the École Normale Supérieure de Lyon, where I did research and teaching up to graduate level (in probability, analysis, partial differential equations, information theory and statistics). In September 2010 I moved to the Université Claude Bernard Lyon I.

Since July 2009 I have been the Director of the Institut Henri Poincaré (Paris).

Invited member of the Institute for Advanced Study, Princeton (January-June 2009)

Visiting Research Miller Professor at the University of Berkeley (January-May 2004)

Visiting Assistant Professor at the Georgia Tech Institute, Atlanta (Fall 1999)

Student, then agrégé-préparateur ("tutor") at the ENS, Paris (1992-2000)

Diplomas, titles and awards:

Fields Medal (2010)

Fermat Prize (2009)

Gigli Prize (2012)

Peano Prize (2013)

Doob Prize (2014)

François-Mauriac Prize of the Académie française (2013)

Henri Poincaré Prize of the International Association of Mathematical Physics (2009)

Prize of the European Mathematical Society (2008)

Jacques Herbrand Prize of the Academy of Sciences (2007)

Institut Universitaire de France (2006)

Harold Grad lecturer (2004)

Peccot-Vimont Prize and Cours Peccot of the Collège de France (2003)

Louis Armand Prize of the Academy of Sciences (2001)

PhD Thesis (1998; advisor P.-L. Lions); Habilitation dissertation (2000)

Scientific and administrative responsibilities:

I belong to the Conseil Stratégique de la Recherche, advising the French Prime Minister; and to the Scientific Board of the President of the European Commission.

I belonged to the steering committee of the Assises de la Recherche (2012), auditing the whole French Higher Education system.

Director-in-second of my laboratory (2005-2008) (temporary director in Sept-Oct 2005).

Editor for *Inventiones Mathematicae*, *Journal of Functional Analysis (JFA)*, *Journal of Mathematical Physics (JMP)*, *Journal of Statistical Physics (JSP)*. Former editor of *SIAM Journal of Mathematical Analysis* (2004-2007), *Annals of Institut H. Poincaré* (2006-2008).

Member of the hiring committees of the ENS Lyon in mathematics (president 2001-2006) and physics (2005-2007); of the Lyon-I and Grenoble Universities in mathematics.

I belonged for several years to the Planning Committees of the Institut Henri Poincaré, the États de la Recherche of the French Mathematical Society, the FRUMAM in Marseille, and several CNRS Research projects (CHANT, AEDP). I participated in the organization of several conferences, including the generalistic geometric conference *Glimpses in Geometry* in Lyon (2008).

Research training, PhD advising:

Clément Mouhot (2004; now lecturer in Cambridge)

François Bolley (2005; now Professor in UPMC, Paris)

Alessio Figalli (jointly with Ambrosio, 2007; now Professor in Austin)

Rémi Peyre (2010; now Assistant Professor in Nancy)

Thomas Gallouët (2012)

Max Fathi (to be defended)

RESEARCH INTERESTS

My research activity lies between analysis, probability theory, statistical physics and more recently differential geometry. I have invested a lot of research in the kinetic theory of the Boltzmann equation, and optimal transport of measures, two very rich subjects. I have presented my results to audiences of analysts, PDEsts, probabilists, geometers, physicists.

My main results concerned the following topics: the solution of the "Cercignani conjecture", a functional inequality relating entropy and entropy production for the Boltzmann equation; the study of the regularizing effects of grazing collisions; estimates of convergence to equilibrium and the field of hypocoercivity; logarithmic Sobolev inequalities and more general "isoperimetric-type" inequalities; the synthetic theory of Ricci curvature bounds; the Ma-Trudinger-Wang curvature tensor in relation with the regularity of optimal transport and the shape of tangent cut locus; the first mathematical treatment of Landau damping in the nonlinear long-time regime.

I have written several books, all of them presenting recent research results while striving to be readable by nonspecialists:

A Review of Mathematical Topics in Collisional Kinetic Theory (230 pp), Handbook of Mathematical Fluid Dynamics, Friedlander & Serre, Eds, North-Holland, 2002

Topics in Optimal Transportation (360 pp), American Mathematical Society, Graduate Studies in Mathematics series, vol. 58 (2003).

Optimal Transport, Old and New (1000 pp): Springer-Verlag, Grundlehren der mathematischen Wissenschaften no. 338 (2008).

SELECTED RESEARCH PAPERS

With G. Toscani: Sharp entropy dissipation bounds and explicit rate of trend to equilibrium for the spatially homogeneous Boltzmann equation. *Comm. Math. Phys. 203*, 3 (1999), 667-706.

With F. Otto: Generalization of an inequality by Talagrand, viewed as a consequence of the logarithmic Sobolev inequality. *J. Funct. Anal. 173*, 2 (2000), 361-400.

With R. Alexandre, L. Desvillettes and B. Wennberg: Entropy dissipation and long-range interactions. *Arch. Rat. Mech. Anal. 152* (2000), 327–355.

With L. Desvillettes: On the trend to global equilibrium in spatially inhomogeneous systems. Part I: linear Fokker–Planck equation. *Comm. Pure Appl. Math. 54* (2001), 1-42.

Cercignani's conjecture is sometimes true and always almost true. *Commun. Math. Phys. 234* (2003), 455-490.

With J. Lott: Ricci curvature for metric-measure spaces via optimal transport. *Annals of Math. 169*, 3 (2009), 903-991.

Hypocoercivity. *Mem. Amer. Math. Soc. 202* (2009), no. 950.

With A. Figalli and L. Rifford: Nearly round spheres look convex. *Amer. J. Math. 134*, 1 (2012), 109-139.

With C. Mouhot: On Landau damping. *Acta Mathematica 207*, 1 (2011), 29-201.

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