Juan J. L. Velázquez

Academic career

1990	PhD, Mathematics, Complutense University of Madrid, Spain
1991 - 1992	Postdoctoral stay, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN, USA
1992 - 1997	Associate Professor, Applied Mathematics Department, Complutense University of Madrid, Spain
1997 - 2008	Professor, Applied Mathematics Department, Complutense University of Madrid, Spain
2008 - 2011	Research Professor, Institute of Mathematical Sciences (ICMAT), Spanish National Research Council (CSIC), Madrid, Spain
Since 2011	Professor (W3), University of Bonn

Honours

2005	A. v. Humboldt-J. C. Mutis Research Award (Alexander von Humboldt Foundation)

Invited Lectures

1999	Keynote speaker, Equadiff Congress, Berlin
2006	PDE session, International Congress of Mathematicians, Madrid, Spain
2007	Keynote speaker, Equadiff Congress, Vienna, Austria

Research Projects and Activities

Responsible of two grants of the Spanish Government about “Partial Differential Equations in Mathematical Physics”
2004 - 2007 and 2007 - 2010
Collaborative Research Center SFB 1060 “The mathematics of emergent effects”

Research profile

My field of expertise is the analysis of Partial Differential Equations. In particular, I have been concerned with the study of singularities arising in Nonlinear Differential Equations and the study of the asymptotic behaviour of their solutions in a neighbourhood of the singular points.
My main current research interests is the study of several equations arising in Kinetic Theory. Specific equations in which I have worked recently are in the study of the bosonic Nordheim-Boltzmann equation, the kinetic equations describing Wave Turbulence, and coagulation equations. Some problems which I have studied about these models are the onset of singularities in finite time, the construction of self-similar behaviour which describe the long time asymptotics of the solutions of some of these equations and to determine if they are unique. I am also interested in the study of coarsening models for systems of particles interacting by means of short range potentials, in the study of screening effects in many particle systems and in the study of the properties of large chemical networks as the ones which arise often in problems of Mathematical Biology.
Concerning my future resarch plans, besides continuing with the study of the properties of the Kinetic Models mentioned above, I am interested in understanding the precise connection between the kinetic equations and the underlying particle systems which the equations are expected to approximate. Some specific problems which I intend to address in the future include the study of the mechanical properties of systems described by the Boltzmann equation

and the analysis of systems with long range interactions. I am also interested in understanding possible oscillatory behaviours arising in Smoluchowski equations, as well as in the study of coarsening models interacting by means of short range potentials for which might be possible to prove rigorously that the distribution of particle sizes behaves in a probabilistic manner.

Editorships

- SIAM Journal on Mathematical Analysis (2001 - 2005)
- Revista Matemática Iberoamericana (2001 - 2008)

Research Area B One of my research directions is the study of pattern formation, in particular aggregation patterns in biological systems (cf. [16], [15], [10]). In these papers questions related to the formation of singularities for classical models describing chemotaxis in biological systems. Recently, I have studied the patterns that arise in models in which the interactions between organisms take place by means of local signals (cf. [13], [11], [9]).
I am also interested in the study of coagulation models as well as kinetic models with fluxes of particles between different regions of the phase space. Well-posedness results for coagulation equations as well as for the quantum Boltzmann equation can be found in [14], [12], [8], as well as in other forthcoming papers.

Supervised theses

Master theses: 6
PhD theses: 5, currently 2

Selected PhD students

Marco A. Fontelos (1997): “Problemas de frontera libre para fluidos viscosos”,
now Professor (on leave), Autonomous University of Madrid, and Researcher, Spanish National Research Council (CISC), Spain
Gerardo Oleaga (2000): “Dinámica de fracturas”,
now Professor (Profesor Contratado Doctor), Complutense University of Madrid, Spain
María Vela (2011): “Ant foraging and minimal paths in simple graphs”,
now Professor, Universidad Europea de Madrid, Spain
Arthur Kierkels (2016): “On a kinetic equation arising in weak turbulence theory for the nonlinear Schrödinger equation”

Selected publications

[1] Michael Helmers, Barbara Niethammer, and Juan J. L. Vel'azquez. Mathematical analysis of a coarsening model with local interactions. *J. Nonlinear Sci.*, 26(5):1227–1291, 2016.
[2] A. H. M. Kierkels and J. J. L. Vel'azquez. On self-similar solutions to a kinetic equation arising in weak turbulence theory for the nonlinear schrödinger equation. *J. Stat. Phys.*, 163(6):1350–1393, 2016.
[3] B. Niethammer, S. Throm, and J. J. L. Vel'azquez. Self-similar solutions with fat tails for smoluchowski's coagulation equation with singular kernels. *Ann. Inst. H. Poincar'e Anal. Non Lin'eaire*, 33(5):1223–1257, 2016.
[4] M. Escobedo and J. J. L. Vel'azquez. Finite time blow-up and condensation for the bosonic nordheim equation. *Invent. Math.*, 200(3):761–847, 2015.
[5] M. Escobedo and J. J. L. Vel'azquez. On the theory of weak turbulence for the nonlinear schrödinger equation. *Mem. Amer. Math. Soc.*, 238(1124):v+107, 2015.
[6] B. Niethammer and J. J. L. Vel'azquez. Self-similar solutions with fat tails for smoluchowski's coagulation equation with locally bounded kernels. *Comm. Math. Phys.*, 318(2):505–532, 2013.
[7] S. Luckhaus, Y. Sugiyama, and J. J. L. Vel'azquez. Finite time blow-up and condensation for the bosonic nordheim equation. *Arch. Rat. Mech. Anal.*, 206:31–80, 2012.
[8] Miguel Escobedo and J. J. L. Vel'azquez. On the fundamental solution of a linearized homogeneous coagulation equation. *Comm. Math. Phys.*, 297(3):759–816, 2010.
[9] Kyungkeun Kang, Angela Stevens, and Juan J. L. Vel'azquez. Qualitative behavior of a keller-segel model with non-diffusive memory. *Comm. Partial Differential Equations*, 35(2):245–274, 2010.
[10] Elio Eduardo Espejo Arenas, Angela Stevens, and Juan J. L. Vel'azquez. Simultaneous finite time blow-up in a two-species model for chemotaxis. *Analysis (Munich)*, 29(3):317–338, 2009.
[11] Kyungkeun Kang, Benoit Perthame, Angela Stevens, and J. J. L. Vel'azquez. An integro-differential equation model for alignment and orientational aggregation. *J. Differential Equations*, 246(4):1387–1421, 2009.
[12] M. Escobedo, S. Mischler, and J. J. L. Vel'azquez. Singular solutions for the uehling-uhlenbeck equation. *Proc. Roy. Soc. Edinburgh Sect. A*, 138(1):67–107, 2008.

[13] A. Stevens and J. J. L. Vel'azquez. Partial differential equations and non-diffusive structures. *Nonlinearity*, 21(12):T283–T289, 2008.
[14] M. Escobedo, S. Mischler, and J. J. L. Vel'azquez. On the fundamental solution of a linearized uehling-uhlenbeck equation. *Arch. Ration. Mech. Anal.*, 186(2):309–349, 2007.
[15] J. J. L. Vel'azquez. Point dynamics in a singular limit of the keller-segel model. i. motion of the concentration regions. *SIAM J. Appl. Math.*, 64(4):1198–1223, 2004.
[16] Miguel A. Herrero and Juan J. L. Vel'azquez. Singularity patterns in a chemotaxis model. *Math. Ann.*, 306(3):583–623, 1996.