Mathematics in México

·Sociedad Matemática Mexicana·

MATHEMATICS IN MEXICO

Research Mathematics as a profesión in México started when the Instituto de Matemáticas (Institute of Mathematics) of the Nacional University of Mexico (UNAM), and the Sociedad Matemática Mexicana (Mexican Mathematical Society, SMM) were founded in 1942 and 1943, respectively. This was the outcome of amazing work previously done by various people, such as Sotero Prieto, Alfonso Nápoles Gándara and Alberto Barajas.

In 1945, Solomon Lefschetz came to Mexico for the first time, when he was a Professor at Princeton, and since that time, until he died in 1972, he visited our country frequently and for extended periods of time. He was certainly an important actor in the fundations of Mexican mathematics. Amongst his students were people like Emilio Lluis, Humberto Cárdenas, José Adem, Samuel Gitler, Santiago López de Medrano, Francisco Gonzalez Acuña and Alberto Verjovsky, who have been all important in the development of mathematics in our country. Lefschetz had an enormous influence on the development of several areas in Mexico, for example Algebraic Topology and Differential Equations. It is significant that in 1957, with his leadership Mexico organized the Internatinal Symposium on Algebraic Topology whose memoirs published by the AMS contain many of the seminal papers in Algebraic Topology published by Thom, Serre, Milnor, Chern, Adem, Bott, Hurewics, Hirzebruch, Cartan and many others.

Of course there have also been other important personalities that have left their mark in Mexican Mathematics, most notably professors Victor Neumann-Lara (combinatorics), Roberto Vazquez (algebraic topology), Jorge Ize (PDEs), who haved already passed away, and many others who are active mathematicians and are named below.

MAIN CURRENT AREAS AND RESEARCH SCHOOLS:

Nowadays Mexico has several solid Research Centers. Each one of these Research Centers we have several consolidated lines of research, top level research schools with world leading mathematicians and with graduates programs. Let us mention some of these, indicating the main academic leaders.

i.   Algebra: Raimundo Bautista, José Antonio de la Peña, Roberto Martinez, Christoff Geiss. Humberto Cardenas, Emilio Lluis, Rafael Heraclio Villareal.

ii.   Combinatorics and Discrete Geometry: This area started with Victor Neumann-Lara, and has been continued with people like Luis Montejano, Javier Bracho, Jorge Urrutia, Gelasio Salazar.

iii.   Probability: Luis Gorostiza, Maria Emilia Caballero and Victor Pérez Abreu, former President of the Bernoulli Society.

iv.   Dynamical Systems and Complex Geometry: Xavier Gómez-Mont, Alberto Verjovsky, José Seade, Piotr Makienko, Renato Iturriaga, Gonzalo Contreras.

v.   PDEs: Mónica Clapp, Antón Maria Minzoni, Pablo Padilla and Jorge Ize, who passed away recently.

vi.   Topology: Samuel Gitler and Ernesto Lupercio in Algebraic topology; Francisco Gonzalez Acuña, Mario Eudave and José Carlos Gómez Larrañaga in low dimensional topology. Santiago López de Medrano, relations with geometry, and Alejandro Illanes, Richard Wilson, Michael Hrusak in General Topology.

vii.   Análisis: Salvador Pérez-Esteva, Pavel Naumkin, Enrique Ramirez de Arellano.

MAIN RESEARCH CENTERS:

We have strong schools of mathematics, disseminated throughout the country. Let us mention briefly the main ones:

Universidad Nacional Autónoma de México (UNAM): This hosts:

a) The Institute of Mathematics; b) The Institute of Applied Mathematics and Systems; c) The Department of Mathematics of the Faculty of Sciences; d) The Center of Mathematical Sciences at Morelia; e) The Unidad Cuernavaca; and f) two new research Centres in Queretaro and Oaxaca.

All these instituttions of the UNAM have a joint graduate program, which is very solid. Below, a few words about each of these institutions.

a) The Institute of Mathematics (in Mexico City): This is the mother institution in Mexico, from which all other major research Centers in mathematics have sprung. It has strong research groups in various areas of mathematics, most notably in:

Algebra (Chistoff Geiss), combinatorics and discrete geometry (Luis Montejano, Javier Bracho, Jorge Urrutia), PDEs (Mónica Clapp) and topology (Santiago López de Medrano, Alejandro Illanes, Carlos Prieto, Marcelo Aguilar, Mario Eudave).

In the late years, this institute has begun developping two new poles, one in the nearby city of Querétaro (200 km. North of Mexico City) and another in Oaxaca (400 km. South of Mexico City). The one in Queretaro is growing fast and is very promising.

b) The Institute of Applied Mathematics and Systems (in Mexico City). This has a strong tradition in PDs (Antón Maria Minzoni, Pablo Padilla), mathematical physics (Ricado Weder), probability and statistics (Federico O'Reilly), and applied mathematics (Susana Gómez).

c) The Center of Mathematical Sciences (in Morelia). This began in the early 1990s as a part of the Institute of Mathematics, and has recently become and independent research center, that works together with the local University of the State of Michoacán. Its main research areas are: Algebra (Raimundo Bautista, Humberto Cárdenas and Roberto Martinez), Analysis (Elena Kaikina, Pavel Naumkin), mathematical physics (Alejandro Corichi), topology (Daniel Juan and Michael Hrusak) and number theory (Florian Luca and Moubariz Garaev). It is a very productive center and has a very successful graduate program.

d) Cuernavaca Unit. This is part of the Institute of Mathematics in Mexico City, but it is a consolidated research centre on its own, with a graduates program. Its main areas are: Dynamical systems and geometry (Alberto Verjovsky, José Seade), mathematical physics (Natig Atakishiev, Carlos Villegas), analysis (Salvador Pérez-Esteva) and topology (Francisco Gonzalez Acuña).

I.   CINVESTAV. This the acronym for Centro de Investigaciones Avanzadas. Its Departament of Mathematics was founded by José Adem in 1961 and has ever had a strong tradition in algebraic topology, which today is still leaded by Samuel Gitler, together with Ernesto Lupercio and others. There are also strong people in probability (Luis Gorostiza), control theory (Onésimo Hernández) and algebra (Rafael Heraclio Villareal).

II.   CIMAT. This is the acronym for Centro de Investigación en Matemáticas. It is located in the city of Guanajuato, 400 km to the Northwest of Mexico City. This center was founded in the early 1980s and it has fastly become one of the strongest centers of mathematics in Latin America. It is the strongest place in Mexico for algebraic and differential geometry, and it has strong people and a strong graduates program in several areas. Amongst its academic leaders are: Xavier Gómez-Mont, Victor Pérez Abreu, Adolfo Sánchez Valenzuela, José Antonio

de la Peña, Renato Iturriaga, Gonzalo Contreras and José Carlos Gómez Larrañaga.

III.   OTHER CENTERS: Besides those listed above, there are solid mathematics groups all over the country, though most of them are still small and need to increase their level. Here we name the main ones, where good mathematics are being done:

a. In the North: Chihuahua, Hermosillo, Durango, Aguscalientes and San Luis Potosí (This last one has already got several strong people that produce top level mathematics and graduate students)

b. West coast. Colima, Ensenada (Baja California) and Acapulco (Guerrero)

c. East of México City: Puebla and Xalapa.

d. South and Southeast: Oaxaca,Tuxtla Gutierrez (Chiapas), Villahermosa (Tabasco) and Mérida (Yucatán).

Now a days, a big amount of young, brilliant, Mexican mathematician are having a postdoctoral position at the leader research institutions of the word, like for instance: Oxford, Harvard, Bonn, Paris, Barcelona, etc.

INTERNATIONAL PRIZES AND DISTINCTIONS:

• Onésimo Hernández: Thomson Reuters Prize 2009

• Onésimo Hernández: Scopus Prize (Elsevier), 2008

• Leonid Fridman Scopus Prize (Elsevier), 2010

- Víctor Pérez Abreu: President of the BERNOULLI SOCIETY for Mathematical Statistics and Probability.

- Luis Montejano, Steklov Institute, Russian Academy Science. 2001.

- José Antonio de la Peña: Scopus Prize (Elsevier), 2007.

- José Antonio de la Peña: TWAS prize 2002.

- José Antonio de la Peña: President of UMALCA

- José Seade: Ferran Sunyer i Balaguer Prize 2005.

- Angel Cano, Juan-Pablo Navarrete and José Seade: Ferran Sunyer i Balaguer Prize 2012

- Ernesto Lupercio. Ramanujam Prize 2009.

INTERNATIONAL MEETINGS:

Mexico has a long tradition for organizing top level academia meetings. This started with two superb Internacional Symposia organizad by Solomon Lefschetz in Mexico in the late 1950s: One on algebraic topology, and the other on differential equations. Alter that, have continuously been top level meetings. The list of such meeting is immense, so we mention some of these below, and further down we give a list of some of the Proceedings of meetings held in Mexico, which have been Publisher in the top World series.

i) The Mexican Mathematical Society has been holding regularly Joint Meeting with the AMS. The first of these was held In Mérida, Yucatán, Mexico, in 1993. The 7th Joint Meeting of these two societies was held in 2011, and the 8th was scheduled to be in

2014, but this has given its place to the 1st Mathematical Congreso of the Americas, to be held in Guanajuato, Mexico, in August 2013.

ii) The Mexican Mathematical Society has been holding regularly a Joint Meeting with the Real Mathematical Society of Spain. The first meeting was held in Oaxaca, Mexico, in 2010, the second was in Spain in February 2012, and the third one will take place in México in 2014.

iii) The Mexican Mathematical Society has been holding regularly a Joint Meeting with the Canadian Mathematical Society.

iv) Mexico has been holding Joint topology conferences with Japan. The first of these was in Morelia, Mexico, in 1999, and the last such meeting, the 5th one, took place in Colima, Mexico, in 2010; the proceedings of that meeting have been published as a issue of the journal Topology and its Applications, vol. 159, Issue 4, 2012.

v) The 2nd Congreso de Matemáticas de América Latina y el caribe (CLAM) took place in Cancún, Mexico in 2004.

vi) The First North American Meeting on Industrial and Applied Mathematics (NAMIAM 2010) took place in Mexico in December of 2010, and it was a joint meeting of the Mexican Mathematical Society with SIAM (USA) and CAIMS (Canada).

vii) The CIMPA (France) has organizad several "Schools" in Mexico, as for instance the CIMPA School on Vector Bundles, CIMAT, Guanajuato, December 4-8, 2006.

viii) The National Academy of Sciences (USA) frequently supports meeting held in Mexico, as for instance the NSA-CINVESTAV Lectures that take place every three years.

ix) The Solomon Lefschetz Centenal conference took place in Mexico City in 1984, with the participation of professors R. Bott, F. Hirzebruch, D. Sullivan, N. Hithcin and many others.

x) ACCOTA (Combinatorial and Computational Aspects of Optimization, Topology, and Algebra) is a Mathematics conference celebrated in Mexico since 1995, bi-anually since 1996. It has been held in Guanajuato (1995), Taxco (1996), Oaxaca (1998,2008), Merida (2000), San Cristobal de las Casas (2002), San Miguel de Allende (2004), Puerto Vallarta (2006), and Playa del Carmen (2010). The 2012 edition was celebrated in Huatulco, on December 3-7. The conference themes emphasize, as its name indicates, the interaction of Discrete Mathematics with other branches of Mathematics. ACCOTA has attracted along the years some of the very best researchers in the field. ACCOTA has had a great impact in the Mexican mathematical community, giving the opportunity to young researchers to hear from the experts about the state-of-the-art in the field, as well as to establish long-lasting ties with colleagues from around the world.

PROCEEDINGS OF SOME INTERNATIONAL MEETINGS HELD IN MEXICO

Sundararaman, D. (ed.)

The Lefschetz centennial conference on algebraic geometry, algebraic topology and differential equations, held at the Centro de Investigación y de Estudios Avanzados, Mexico City, Mexico, December 10- 14, 1984. Proceedings. Part I: Algebraic geometry. Contemporary Mathematics, 58. Providence, R.I.: American Mathematical Society (1986).

Gitler, S. (ed.)

The Lefschetz centennial conference on algebraic geometry, algebraic topology and differential equations, held at the Centro de Investigación y de Estudios Avanzados, Mexico City, Mexico, December 10-14, 1984. Proceedings. Part II: Algebraic topology. Contemporary Mathematics, 58(2). Providence, RI: American Mathematical Society (1987)

Verjovsky, A. (ed.)

The Lefschetz centennial conference on algebraic geometry, algebraic topology and differential equations, held at the Centro de Investigación y de Estudios Avanzados, Mexico City, Mexico, December 10-14, 1984. Proceedings. Part III: Differential equations. Contemporary Mathematics, 58(3). American Mathematical Society (1987).

Gomez-Mont, Xavier (ed.); Verjovsky, Alberto (ed.); Seade, José A. (ed.)

Holomorphic dynamics. Proceedings of the second international colloquium on dynamical systems, held in Mexico, July 1986. Lecture Notes in Mathematics, 1345. Springer-Verlag (1988).

Hamiltonian Systems and Celestial Mechanics (Advanced Series in Nonlinear Dynamics) by Mexico) International Symposium on Hamiltonian Systems and Celestial Mechanics (3rd: 1998: Patzcuaro, E. A. Lacomba and Jaume Llibre (Jun 1993).

Pérez-Esteva, Salvador (ed.); Villegas-Blas, Carlos (ed.)

"1st summer school in analysis and mathematical physics. Quantization, the Segal-Bargmann transform and semiclassical analysis". Cuernavaca Morelos, Mexico, June 8-18, 1998. Contemporary Mathematics. 260, AMS (2000).

Pérez-Esteva, Salvador (ed.); Villegas-Blas, Carlos (ed.)

"Second summer school in analysis and mathematical physics. Topics in analysis: harmonic, complex, nonlinear and quantization". Proceedings, Cuernavaca Morelos, Mexico, June 12-22, 2000. Contemporary Mathematics. Aportaciones Matemáticas. 289, AMS (2001).

Arizmendi, Hugo (ed.); Bosch, Carlos (ed.); Palacios, Lourdes (ed.)

"Topological algebras and their applications". Proceedings of the 4th international conference, Oaxaca, Mexico, July 1–5, 2002. Contemporary Mathematics. Aportaciones Matemáticas. 341, AMS (2004).

Eells, James (ed.); Ghys, Etienne (ed.); Lyubich, Mikhail (ed.); Palis, Jacob (ed.); Seade, José (ed.)

"Geometry and dynamics. International conference in honor of the 60th anniversary of Alberto Verjovsky", Cuernavaca, Mexico, January 6–11, 2003. Contemporary Mathematics 389. Aportaciones Matemáticas, AMS (2005).

Brasselet, Jean-Paul (ed.); Cisneros-Molina, José Luis (ed.); Massey, David (ed.); Seade, José (ed.); Teissier, Bernard (ed.)

"Singularities I. Algebraic and analytic aspects". Proceedings of the international conference "School and workshop on the geometry and topology of singularities" in honor of the 60th birthday of Lê Dũng Tráng, Cuernavaca, Mexico, January 8–26, 2007. Contemporary Mathematics 474 AMS (2008).

Brasselet, Jean-Paul (ed.); Cisneros-Molina, José Luis (ed.); Massey, David (ed.); Seade, José (ed.); Teissier, Bernard (ed.)

Singularities II. Geometric and topological aspects. Proceedings of the international conference "School and workshop on the geometry and topology of singularities" in honor of the 60th birthday of Lê Dũng Tráng, Cuernavaca, Mexico, January 8–26, 2007. Contemporary Mathematics 475 AMS (2008).

Villegas-Blas, Carlos (ed.)

"Fourth summer school in analysis and mathematical physics. Topics in spectral theory and quantum mechanics", Cuernavaca, México, May 2005. Contemporary Mathematics 476; Aportaciones Matemáticas, AMS (2008).

SOME SELECTED RESEARCH PAPERS

- Adem, José. "The iteration of the Steenrod squares in algebraic topology". Proc. Natl. Acad. Sci. USA 38, 720-726 (1952)

- Torres, Guillermo. "On the Alexander polynomial". Ann. Math. (2) 57, 57-89 (1953)

- Torres, Guillermo.; Fox, R.H. "Dual presentation of the group of a know". Ann. Math. (2) 59, 211-218 (1954)

- Lluis, Emilio. "Sur l'immersion des variétés algébriques". Ann. Math. 62, 120-127 (1955).

- Gitler, S.; Handel, D. "The projective Stiefel manifolds. I". Topology 7, 39-46 (1968).

- Gitler, S. "The projective Stiefel manifolds. II: Applications". Topology 7, 47-53 (1968).

- Ramírez de Arellano, Enrique. Ein Divisionsproblem und Randintegraldarstellungen in der komplexen Analysis. Math. Ann. **184** (1969/1970), 172-187.

- Bott, Raoul; Gitler, S.; James, I.M. "Lectures on algebraic and differential topology". Lecture Notes in Mathematics. 279. Springer-Verlag. 174 p. (1972).

- Gonzalez-Acuña, Francisco. "Homomorphs of knot groups". Ann. Math.102, 373-377 (1975)

- Gonzalez-Acuña, Francisco; Montesinos, J. M. "Ends of knot groups". Ann. Math. (2) 108, 91-96 (1978).

- Montejano, Luis. "Beta-homotopy equivalences have alpha-cross sections". Mem. Am. Math. Soc. 274, 37 p. (1983).

- Martinez-Villa, R.; de la Peña, J.A. "Automorphisms of representation finite algebras". Invent. Math. 72, 359-362 (1983).

- Bautista, R.; Gabriel, P.; Roiter, A.V.; Salmerón, L. "Representation-finite algebras and multiplicative bases". Invent. Math. 81, 217-285 (1985).

- Gómez-Mont, Xavier. "The transverse dynamics of a holomorphic flow". Ann. Math. (2) 127, No.1, 49-92 (1988).

- Gorostiza, Luis G.; Wakolbinger, Antón. "Persistence criteria for a class of critical branching particle systems in continuous time". Ann. Probab. 19, 266-288 (1991).

- Gómez-Mont, Xavier; Luengo, Ignacio. "Germs of holomorphic vector fields in $\mathbb{C}^3$ without a separatrix". Invent. Math. 109, No.2, 211-219 (1992).

- J. Ize, I. Massabo and A. Vignoli. "Degree Theory for equivariant maps, the general S1-action". Memoirs of the AMS, Vol 100, 1992.

- Esnault, Hélène; Seade, José; Viehweg, Eckart. "Characteristic divisors on complex manifolds". J. Reine Angew. Math. 424, 17-30 (1992).

- Muciño-Raymundo, Jesús. "Deformations of holomorphic foliations having a meromorphic first integral". J. Reine Angew. Math. 461, 189-219 (1995)

- De la Peña, J.A.; Skowroński, A. "Geometric and homological characterizations of polynomial growth strongly simply connected algebras". Invent. Math. 126, No. 2, 287-296 (1996).

- L. Montejano and E. Schepin. On periodic homeomorphism of spheres. Algebraic and Geometric Topology Vol.1 (2001), 435-444. Best Resarch paper, Steklov Institute, Russian Academy Science. 2001.

- Meersseman, Laurent; Verjovsky, Alberto. "A smooth foliation of the 5-sphere by complex surfaces". Ann. Math. (2) 156, No.3, 915-930 (2002).

- Hernandez,O; X. Guo. "Continuous-time controlled Markov chains", Ann. Appl. prob. 13 (2003), 363-388.

- A. Castro, M. Clapp. "The effect of the domain topology on the number of minimal nodal solutions of an elliptic equation at critical growth in a symmetric domain". Nonlinearity 16 (2003), 579-590

- Quiroga-Barranco, Raul. "Isometric actions of simple Lie groups on pseudo-Riemannian manifolds". Ann. Math. (2) 164, No. 3, 941-969 (2006).

- Caballero, M.E.; Chaumont, L. "Weak convergence of positive self-similar Markov processes and overshoots of Lévy processes". Ann. Probab. 34, 1012-1034 (2006).

- Geiss, Christof; Leclerc, Bernard; Schröer, Jan. "Rigid modules over preprojective algebras". Invent. Math. 165, No. 3, 589-632 (2006).

- Arocha, J.L.; Bracho, J.; Montejano, L. "Flat transversals to flats and convex sets of a fixed dimension". Adv. Math. 213, No. 2, 902-918 (2007)

- Bojdecki, Tomasz; Gorostiza, Luis G.; Talarczyk, Anna. "A long range dependence stable process and an infinite variance branching system". Ann. Probab. 35, No. 2, 500-527 (2007).

- Guillot, Adolfo. "Sur les équations d'Halphen et les actions de $\mathrm{SL}_2(\mathbb{C})$". Publ. Math., I. H. E. S. 105, 221-294 (2007).

- De Fernex, Tommaso; Lupercio, Ernesto; Nevins, Th.; Uribe, Bernardo. "Stringy Chern classes of singular varieties". Adv. Math. 208, No. 2, 597-621 (2007).

- Bernard, Patrick; Contreras, Gonzalo. "A generic property of families of Lagrangian systems". Ann. Math. (2) 167, No. 3, 1099-1108 (2008).

- Meersseman, Laurent; Verjovsky, Alberto. "On the moduli space of certain smooth codimension-one foliations of the 5-sphere by complex surfaces". J. Reine Angew. Math. 632, 143-202 (2009).

- Cisneros-Molina, J.L.; Seade, J.; Snoussi, J. "Refinements of Milnor's fibration theorem for complex singularities". Adv. Math.222, No. 3, 937-970 (2009).

- S. Cingolani, M. Clapp. "Intertwining semiclassical bound states to a nonlinear magnetic Schrödinger equation" Nonlinearity 22 (2009), 2309-2331.

- Contreras, Gonzalo. "Geodesic flows with positive topological entropy, twist maps and hyperbolicity". Ann. Math. (2) 172, No. 2, 761-808 (2010).

- P. Bose, P. Morin, I. Stojmenovic, J. Urrutia, Routing with guaranteed delivery in ad hoc wireless networks. Wireless Networks 7 (2011), no. 6, 609-616.

- Cesar Hernandez-Velez, Gelasio Salazar, Robin Thomas. Nested cycles in large triangulations and crossing-critical graphs. Journal of Combinatorial Theory Series B 102 (2012), no. 1, 86-92.

- Callejas-Bedregal, R; Morgado, M; Seade, J. "Lê cycles and Milnor classes". To be Published in Inventiones Matematicae.

SOME SELECTED BOOKS AND RESEARCH MONOGRAPHS:

López de Medrano, S. "Involutions on manifolds". Ergebnisse der Mathematik und ihrer Grenzgebiete. 59. Berlin-Heidelberg-New York: Springer-Verlag, 102 p. (1971).

Hernández, Onésimo. "Adaptive Markov Control Processes". Springer-Verlag, New York, 1989.

Hernández, Onésimo, J.B. Lasserre."Further Topics on Discrete-Time Markov Control Processes". Springer-Verlag, New York, 1999.

Aguilar, Marcelo; Gitler, Samuel; Prieto, Carlos. "Algebraic topology from a homotopical viewpoint". Universitext. Springer, 2002.

Hernández, Onésimo, J.B. Lasserre. "Markov Chains and Invariant Probabilities". Birkhauser, Basel, 2003.

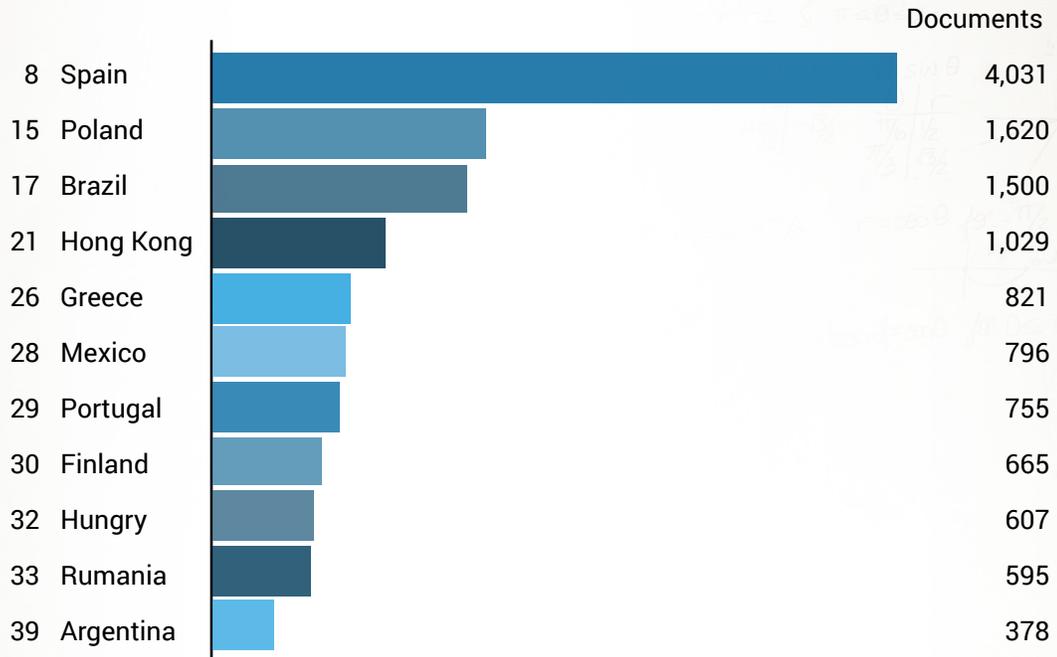Seade, José. "On the topology of isolated singularities in analytic spaces". Progress in Mathematics 241, 2006.

Brasselet, Jean-Paul; Seade, José; Suwa, Tatsuo. "Vector fields on singular varieties". Lecture Notes in Mathematics 1987, 2009.

R. Bautista, L. Salmeron and R. Zuazua. Differential Tensor Algebras and their Module Category. Cambridge University Press 2009

COUNTRY RANKING

The following table contains a country ranking according with the SJR-International Science Ranking SCOPUS. We include in the table, for comparison, only few countries

sorted by the number of published mathematical documents and its ranking number. January 2014.

		Documents
8	Spain	4,031
15	Poland	1,620
17	Brazil	1,500
21	Hong Kong	1,029
26	Greece	821
28	Mexico	796
29	Portugal	755
30	Finland	665
32	Hungry	607
33	Rumania	595
39	Argentina	378

POS-GRADUATE PROGRAMS

Mexico has more than 80 master's and doctoral programs in different areas of mathematics and applied mathematics distributed throughout its territory, many of them newly created but all officially certified for quality.

For its age, the number of international quality research tutors and the number of graduates the following doctoral programs in mathematics and applied mathematics are well recognized internationally for their quality and the academic performance or their graduates
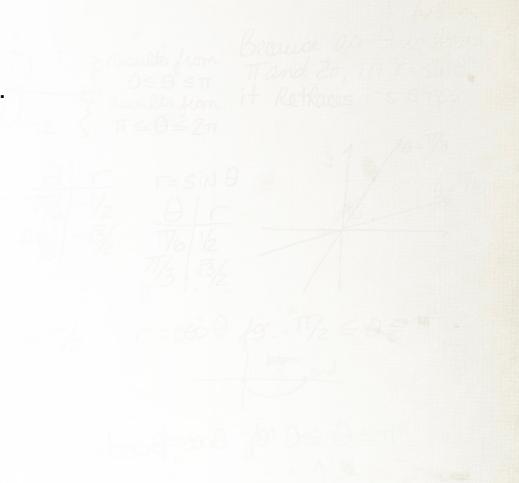
Universidad Nacional Autónoma de Mexico UNAM.

Centro de Matemáticas A.C. CIMAT, Guanajuato.

Centro de Investigation y de Estudios Avanzados del IPN, CINVESTAV.

Universidad Autónoma Metropolitana.

Universidad Michoacana de San Nicolas de hidalgo, Morelia.

Benemerita Universidad de Puebla, Puebla.

Luis Montejano
President SMM