

Omar León Sánchez

Department of Mathematics, University of Manchester

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Academic Positions

Lecturer of Pure Mathematics. University of Manchester, Department of Mathematics. October 2020–

Turing Research Fellow. University of Manchester, Department of Mathematics. October 2016–September 2020.

Postdoctoral Fellow. McMaster University. Department of Mathematics and Statistics. September 2013–August 2016.

Academic Degrees

PhD in Pure Mathematics. University of Waterloo, 2013. Thesis: “Contributions to the model theory of partial differential fields”. Advisor: Rahim Moosa.

Master’s Degree in Mathematics. Benemérita Universidad Autónoma de Puebla, 2008. Thesis: “A new Clifford-Fourier transform and Paley-Wiener type theorems”. Advisors: Arnoldo Bezanilla and Garret Sobczyk.

Bachelor’s Degree in Mathematics and Economics. Universidad de las Américas Puebla, 2006. Thesis: “A modular approach to rational interpolation”. Advisor: Garret Sobczyk.

Research Interests

Algebra and Model Theory. Especially the interactions between them.

Refereed Publications

D. Hoffmann and O. León Sánchez. *Model theory of differential fields with finite group actions*. Journal of Mathematical Logic. To appear (<https://arxiv.org/pdf/2012.14376.pdf>).

F. Boulier, S. Falkensteiner, M. P. Noordman and O. León Sánchez. *On The Relationship Between Differential Algebra and Tropical Differential Algebraic Geometry*. Proceedings of Computer Algebra in Scientific Computing 2021. To appear (<https://hal.inria.fr/hal-03225922/>).

O. León Sánchez and M. Tressl. *Differential Weil descent*. Communications in Algebra. Published Online. <https://tinyurl.com/ukxnxcwm>.

P. Eleftheriou, O. León Sánchez and N. Regnault. *Coincidence of dimensions in closed ordered differential fields*. Notre Dame Journal of Forma Logic, 62(2):257–268, 2021. <https://tinyurl.com/cd9ahpmv>

O. León Sánchez and Anand Pillay. *Differential Galois cohomology and parameterized Picard-Vessiot extensions*. Communications in Contemporary Mathematics. To appear (arXiv:1911.06165).

J. Freitag, O. León Sánchez and W. Li. *Effective definability of Kolchin polynomials*. Proceedings of the Amer. Math. Soc., 148(4):1455–1466, 2020. <https://tinyurl.com/sf2ued8>

S. Launois and O. León Sánchez. *On the Dixmier-Moeglin equivalence for Poisson-Hopf algebras*. Advances in Mathematics, 346:48–69, 2019. <https://tinyurl.com/y2ugymqo>

O. León Sánchez and R. Moosa. *Isolated types of finite rank: an abstract Dixmier-Moeglin equivalence*. Selecta Mathematica, 25(10):1–10, 2019. <https://tinyurl.com/y6r6xopy>

O. León Sánchez. *Estimates for the coefficients of differential dimension polynomials*. Mathematics of Computation, 88(320):2959–2985, 2019. <https://tinyurl.com/y5orb4wz>

O. León Sánchez. *Algebro-geometric axioms for $\text{DCF}_{0,m}$* . Fundamenta Mathematicae, 243:1–8, 2018. <https://tinyurl.com/y79zt76v>

R. Gustavson and O. León Sánchez. *Effective bounds for the consistency of differential equations*. Journal of Symbolic Computation, 89:41–72, 2018. <https://tinyurl.com/y8ekf3of>

J. Bell, O. León Sánchez and R. Moosa. *D-groups and the Dixmier-Moeglin equivalence*. Algebra and Number Theory, 12(2):343–378, 2018. <https://tinyurl.com/y8ouz12s>

O. León Sánchez and A. Pillay. *Some definable Galois theory and examples*. The Bulletin of Symbolic Logic, 23(2):145–159, 2017. <http://tinyurl.com/y8ewcsyw>

J. Bell, S. Launois, O. León Sánchez and R. Moosa. *Poisson algebras via model theory and differential algebraic geometry*. Journal of the European Mathematical Society, 19:2019–2049, 2017. <http://tinyurl.com/ybcf455b>

- O. León Sánchez and R. Moosa. *The model companion of differential fields with free operators*. The Journal of Symbolic Logic, 81(2):493–509, 2016. DOI:10.1017/jsl.2015.76
- R. Gustavson and O. León Sánchez. *A new bound for the existence of differential field extensions*. Proceedings of the 6th International Conference in Mathematical Aspects of Computer and Information Sciences. Vol. 9582 of Lecture Notes in Computer Science, 358–361, Springer 2016.
- O. León Sánchez and J. Nagloo. *On parameterized differential Galois extensions*. Journal of Pure and Applied Algebra, 220(7):2549–2563, 2016. <http://tinyurl.com/h2kwz2o>
- O. León Sánchez and A. Ovchinnikov. *On bounds for the effective differential Nullstellensatz*. Journal of Algebra, 449:1–21, 2016. <http://tinyurl.com/h769rkt>
- J. Freitag and O. León Sánchez. *Effective uniform bounding in partial differential fields*. Advances in Mathematics, 218:308–336, 2016. <http://tinyurl.com/hbgsqwh>
- O. León Sánchez. *On the model companion of partial differential fields with an automorphism*. Israel Journal of Mathematics, 212(1):419–442, 2016. <http://tinyurl.com/j6sehq5>
- J. Freitag, O. León Sánchez and W. Simmons. *On linear dependence over complete differential algebraic varieties*. Communications in Algebra, 44(6):2645–2669, 2016. <http://tinyurl.com/zhmbxd2>
- O. León Sánchez. *Relative D-groups and differential Galois theory in several derivations*. Transactions of the Amer. Math. Soc., 367(11):7613–7638, 2015. <http://tinyurl.com/gqoswf6>
- O. León Sánchez. *Geometric axioms for differentially closed fields with several commuting derivations*. Journal of Algebra, 362:107–116, 2012. <http://tinyurl.com/z39vuea>
- A. Bezanilla and O. León Sánchez. *The Clifford-Fourier transform \mathcal{F}_0 and monogenic extensions*. Advances in Applied Clifford Algebras, 21(4):757–772, 2010. <http://tinyurl.com/h3zg6e9>
- O. León Sánchez and G. Sobczyk. *Fundamental Theorem of Calculus*. Advances in Applied Clifford Algebras, 21(1):221–231, 2010. <http://tinyurl.com/ho76zml>

Papers Under Review

- O. León Sánchez, D. Meretzky and Anand Pillay. *More on Galois cohomology, definability and differential algebraic groups*. Submitted for publication. <https://arxiv.org/pdf/2105.13053.pdf>

O. León Sánchez and S. Sierra. *A Poisson basis theorem for symmetric algebras of infinite-dimensional Lie algebras*. Submitted for publication. <https://arxiv.org/pdf/2008.02845.pdf>

O. León Sánchez and M. Tressl. *Differentially large fields*. Submitted for publication. <https://arxiv.org/pdf/2005.00888.pdf>

Teaching Experience

- **I am a Fellow of the Higher Education Academy, UK**

Foundations of Pure Mathematics B (278 students). University of Manchester. Fall 2020.

Foundations of Pure Mathematics B (216 students). University of Manchester. Fall 2019.

Galois Theory (33 students). University of Manchester. Fall 2018.

Galois Theory (27 students). University of Manchester. Winter 2018.

Mini-course on Differential Galois Theory. Presented jointly with Alexey Petukhov. University of Manchester. Summer 2017.

Topics Course: Introduction to ω -stable theories. University of Manchester. Fall 2016.

Calculus II for Integrated Sciences (60 students). McMaster University. Winter 2016.

Calculus I for Integrated Sciences (60 students). McMaster University. Fall 2015.

Linear Algebra for Engineering (300 students). McMaster University. Winter 2015.

Calculus I for the Life Sciences (200 students). McMaster University. Fall 2014.

Calculus I for the Life Sciences (450 students). McMaster University. Winter 2014.

Calculus I for the Life Sciences (150 students). McMaster University. Fall 2013.

Calculus II for Engineering (80 students). University of Waterloo. Winter 2012.

Calculus I for the Sciences (110 students). University of Waterloo. Winter 2011.

PhD Student Supervision

PhD Student. Cas Burton. University of Manchester, Fall 2021 – .

PhD Student. Shezad Mohamed. University of Manchester, Fall 2020 – .

PhD Student. Kai Ino. University of Manchester, Winter 2019 – .

UG and MSc Student Supervision

LMS UG Research Bursary. Alberto Gomez. *On the model theory of bounded differential fields*. University of Manchester, Summer 2021 (8 weeks).

MSc Project. Kathleen Lamont. *On primitive element theorems*. University of Manchester, Winter 2021.

MMath Project. Tabitha Fistein. *Noetherian non-commutative rings*. University of Manchester, Winter 2021.

MMath Project. Ronik Shah. *Constructible numbers (Semester 1) and Differential Algebra (Semester 2)*. University of Manchester, Fall 2019 and Winter 2020.

MSc Project and Dissertation. Sudharsan Sivaramakrishnadas. *Differentially closed fields, ω -stability, and model theoretic ranks*. University of Manchester, Winter and Summer 2019.

MSc Project and Dissertation. Xuan Gao. *Differential algebra, the Ritt-Raudenbush and primitive element theorems*. University of Manchester, Fall 2017 and Summer 2018.

PhD Theses Examinations

External Examiner. Rachael King, PhD Thesis. *Difference algebraic geometry: Morphisms of difference schemes with an exceptional property*. Queen Mary University of London. Fall 2020.

Internal Examiner. Ulla Karhumaki, PhD Thesis. *On certain groups with finite centralizer dimension*. University of Manchester. Spring 2020.

Internal Examiner. Zoltan Kocsis, PhD Thesis. *Development of Group Theory in the Language of Internal Set Theory*. University of Manchester. Fall 2019.

External Examiner. Nathalie Regnault, PhD Thesis. *A geometrical axiomatization of existentially closed differential topological fields*. University of Mons, Belgium. Fall 2019.

Internal Examiner. Harry Gulliver, PhD Thesis. *The injective spectrum of a right noetherian ring*. University of Manchester. Summer 2019.

UG and PGT Student Examinations

2nd Marker. Shuanshuang Shu. MSc Project. University of Manchester. Winter 2021.

2nd Marker. Deacon Linkhorm. PhD Third year report. University of Manchester, Summer 2020.

2nd Marker. Indra Herdiana. MSc Dissertation. University of Manchester. Summer 2020.

2nd Marker. Andrew Webb. Level 3 MMATH Project. University of Manchester. Spring 2020.

2nd Marker. Raymond Mcculloch. PhD First year report. University of Manchester, Summer 2019.

2nd Marker. Fotios Rafail Tsaganos. MSc Project and Dissertation. University of Manchester. Winter and Summer 2019.

2nd Marker. Ziyang Ni. Level 3 MMATH Project. University of Manchester. Winter 2019.

2nd Marker. Shi-Qiu. PhD First, Second and Third year report. University of Manchester, Summer 2017, 2018 and 2019.

2nd Marker. Richard Pitts. Level 3 MMATH Project. University of Manchester. Spring 2018.

2nd Marker. Ulla Karhumaki. PhD First year report. University of Manchester, Summer 2017.

Academic Service

Teaching Lead of the Pure Math Group. University of Manchester Logic Seminar, August 2021–

Organizer of the University of Manchester Logic Seminar, February 2017–

Tutor of MSc Programme in Pure Mathematics and Mathematical Logic, University of Manchester, November 2020–

Representative of the London Mathematical Society in the Department of Mathematics, University of Manchester, August 2019–

Host of the 2019 Dame Kathleen Ollerenshaw Visiting Professor (A. Pillay) to the School of Mathematics, University of Manchester. Summer 2019.

Member of the Equality, Diversity and Inclusion Committee of the Department of Mathematics, University of Manchester, Fall 2018–

Internal Judge of the 2017 *Mathematics Research Students Conference*, School of Mathematics, University of Manchester.

Organizer of the McMaster University Logic Seminar, September 2014–June 2016.

Outreach and Public Engagement

Meet the Mathematicians Event: *Why can we solve polynomial equations of degree 2,3 and 4 but not 5?* Presented online to A-level and GCSE students, March 2021.

Academic Guest Lecture on *Why can we solve polynomial equations of degree 2,3 and 4 but not 5?* Presented at Bolton School Girls Division, November 2019.

Academic Guest Lecture on *Why can we solve polynomial equations of degree 2,3 and 4 but not 5?* Presented at Trinity Church of England High School, November 2019.

Supervisor of Loreto Sixth Form College Student Calvin Smith for Work Experience in July 2019. Project on *Constructible Numbers*, School of Mathematics, University of Manchester.

Event Organization

Organizer of the mini-workshop *Topological and differential expansions of o-minimal structures*. October 2020, Oberwolfach, Germany. (Cancelled due to COVID19)

Organizer of the *Logic and Universal Algebra Session* of the 2019 Latinamerican Algebra Colloquium in Mexico City, August 2019.

Organizer of the conference *Interactions between representation theory and model theory*. July 2019, School of Mathematics, Statistics and Actuarial Sciences, University of Kent, Canterbury.

Organizer of the conference *Applications of the model theory of fields with operators*. June 2019, School of Mathematics, University of Manchester.

Organizer of the conference *Model-theoretic methods in number theory and differential algebraic equations*. August 2018, School of Mathematics, University of Manchester.

Organizer of the *Differential and Difference Algebra* Special Session of the 2017 Spring Eastern Sectional Meeting of the AMS in Hunters College, NY.

Organizer of the *Model Theory* Scientific Session of the 2014 Canadian Mathematical Society Winter Meeting in Hamilton, ON.

Awards and Grants

EPSRC New Investigator Award £431,771(GBP): To fund a 3 year research project “Model theory of \mathcal{D} -large fields and connections to representation theory”.

London Mathematical Society UG Research Bursary £1720(GBP): To support an 8 week research project undertaken by an undergraduate student of the University of Manchester (Alberto Gomez).

Heilbronn Institute for Mathematical Research Sponsorship £4,500(GBP): To partially support the organization of the meeting *Applications of the model theory of fields with operators*, June 2019, University of Manchester.

London Mathematical Society Research in Pairs Grant £700(GBP): To partially support a collaborative research visit of Professor Rahim Moosa in May 2019, School of Mathematics, University of Manchester.

London Mathematical Society Conference Grant £5,200(GBP): To partially support the organization of the meeting *Model-theoretic methods in number theory and differential algebraic equations*, August 2018, University of Manchester.

Martin Murray Prize \$5,000(CAD): For best research paper by a graduate student in the Faculty of Mathematics of the University of Waterloo, 2014.

Invited Colloquium, Conference, and Workshop Talks

Differentially large and PAC-differential fields. Workshop on Trends in Pure and Applied Model Theory. Fields Institute, Toronto, July 2021.

A division algorithm for Poisson algebras of graded Lie algebras. Computational Differential and Difference Algebra and its Applications. Special Session of Applications of Computer Algebra – ACA 2021.

TBA. Antalya Algebra Days. Izmir, Turkey. May 2020. (Postpone to due to COVID19)

Isolated types in totally transcendental theories. LYMOTS. University of Manchester. March 2019.

Differentially large fields and a bit on CODFs. Workshop on *Tame expansions of o-minimal structures*, University of Konstanz, October 2018.

Effective bounds in the realm of differential polynomials. 2018 Differential Algebra and Related Topics IX. University of Leeds.

Nonisolated types in DCF and CCM. Model Theory Special Session of the 2017 CMS Winter Meeting. University of Waterloo.

An introduction to differential Galois theory. Workshop on *Differential Galois theory and differential algebraic groups*, Fields Institute, Toronto. July 2017.

Representation theory of Poisson algebras via model theory. Model theory and differential Galois theory. Barcelona. June 2017.

The algebraic theory of differential equations. Pure Mathematics Colloquium. University of Manchester. March 2017.

Isolated types of finite rank in ω -stable theories and applications. LYMOTS. University of Leeds. March 2017.

A bound for typical differential dimension. 2016 Differential Algebra and Related Topics VII at CUNY, NY.

An introduction to model theory and some applications. Mathematics Departmental Colloquium CIMAT, Mexico. April 2016.

Order bounds for differential polynomials. Differential Algebra, CUNY. April 2016.

Differential fields with free operators. 2015 Joint Mathematics Meetings, AMS Special Session on Model Theory and Applications.

Parameterized logarithmic equations and their Galois theory. ACA 2014 meeting in Fordham University, New York. Special Session on Computational Differential and Difference Algebra.

On the Galois theory of logarithmic differential equations. 2013 Differential Algebra and Related Topics V at Polytech'Lille, France.

The model companion of partial differential fields with an automorphism. Model Theory Special Session of the 2013 ASL North American Meeting. University of Waterloo.

Invited Seminar Talks

Differentially large fields. Logic Seminar, University of Notre Dame. May 2020.

Differentially large fields. Kolchin Seminar in Differential Algebra. The City University of New York. Oct 2019.

On differentially large fields. Logic Seminar, Università degli Studi della Campania, Caserta, May 2019.

On differentially large fields. Pure Mathematics Seminar, University of East Anglia, Norwich. March 2019.

On differentially large fields. Geometrie at Theorie des Modeles Seminaire, Paris. December 2018.

The Dixmier-Moeglin equivalence: a differential and a model-theoretic version. Maximals Seminar. University of Edinburgh. April 2018.

Poisson algebra representations via model theory. Models and Sets Seminar. University of Leeds. June 2017.

On the differential Dixmier-Moeglin equivalence. Logic Seminar. University of Oxford. June 2017.

On definability of ranks in differential fields. Logic Seminar. UCLAN. April 2017.

The differential Dixmier-Moeglin equivalence. Model Theory Seminar, University of Konstanz. January 2017.

The Dixmier-Moeglin equivalence for differential Hopf algebras. Algebra Seminar, University of Kent, Canterbury. January 2017.

Galois theory of algebraic differential equations. Algebraic Geometry Seminar, CIMAT. April 2016.

Effective bounds for the consistency of differential equations. Geometry and Model Theory Seminar, Fields Institute. November 2015.

A differential Hensel's lemma for local algebras. Kolchin Seminar in Differential Algebra. The City University of New York. May 2015.

Bezout-type computations for (algebraic) PDE's. Algebra Seminar, University of Kent, Canterbury. April 2015.

Effective bounds of finite solution sets of PDE's. Algebra Seminar, University of Waterloo. September 2014.

Effective bounds for finite differential-algebraic varieties. Kolchin Seminar in Differential Algebra. The City University of New York. September 2014.

Partial differential fields with an automorphism. UC Berkeley Model Theory Seminar. April 2014.

On differential algebraic, but not constrained, families. Kolchin Seminar in Differential Algebra. The City University of New York. April 2014.

Extending differential free operators. Kolchin Seminar in Differential Algebra, The City University of New York, December 2013.

Model companions of differential fields with free operators. Mini Conference on Differential Algebra and Model Theory, University of Notre Dame. November 2013.

A conjecture on isolated types in DCF_0 . Model Theory and Groups Seminar, Université Paris Diderot - Paris 7. October 2013.

Model theory of (partial) differential fields with an automorphism. Logic Seminar, Ohio State University. May 2013.

Differential D -groups and Galois theory. Kolchin Seminar in Differential Algebra, The City University of New York. March 2013.

The model-companion of partial differential fields with an automorphism. Geometry and Model Theory Seminar, Fields Institute. February 2013.

Relative D -groups in partial differential Galois theory. Model Theory Seminar, McMaster University. November 2011.

Partial D -groups in differential Galois theory. Model Theory and Descriptive Set Theory Seminar, University of Illinois at Urbana-Champaign. November 2011.

Relative D -groups in partial differential Galois theory. Logic Seminar, University of Notre Dame. November 2011.

Generalized strongly normal extensions in several derivations. Logic Seminar, University of Illinois at Chicago. November 2011.

Invited Participation at Institute Workshops

Algebraic Dynamics and its Connections to Difference and Differential Equations. BIRS. Banff, Canada. November 2020.

Model Theory of Differential Equations, Algebraic Geometry, and their Applications to Modelling. BIRS. Banff, Canada. May 2020.

Model theory combinatorics and valued fields. CIRM. Luminy, France. January 2018.

Neostability theory. BIRS-CMO. Oaxaca, Mexico. July 2015.

Model theory difference/differential equations and applications. CIRM. Luminy, France. April 2015.