Curriculum Vitae

Juan Felipe Méndez-Valderrama

Contact Information

Address:	314 Jadwin Hall, Department of Physics Princeton University Princeton, NJ, 14850
Phone:	+1 607 3791310
email:	jfmv343@gmail.com, jm9648@princeton.edu
Citizenship:	Colombian

Research Interests

My research is often guided by experiment and aims broadly at understanding quantum phases of matter where strong interactions drive unconventional orders which fall outside the scope of conventional weak coupling analyses. Topics that I am engaged in include: Strong correlations and unconventional superconductivity in moiré systems, Non-Fermi-liquid transport, development of numerical techniques focusing on different flavors of quantum Monte Carlo. Topics that interest me include: hybrid classical-quantum algorithms for near term quantum hardware, quantum spin liquids, disordered systems.

Education

Aug 2018- Aug 2024	**Ph.D. In Physics** at Cornell University Ithaca, NY.
May 2021	**MSc. In Physics** at Cornell University Ithaca, NY.
Aug 2016- Jun 2018	**MSc. In Physics** at Universidad de los Andes , Bogota, Colombia GPA: 4.84/5.
Aug 2012-Jul 2016	**BSc. In Physics** at Universidad de los Andes , Bogota, Colombia. GPA: 4.33/5.
Aug 2014-Jul 2016	**Minor in Mathematics** at Universidad de los Andes , Bogota, Colombia. GPA: 4.33/5.

Academic Appointments

Aug 2024 - Now	Postdoctoral Research Associate at the Princeton Center for Complex Materials (PCCM), Princeton University, Princeton, New Jersey, USA.

Honors

Aug 2024	Princeton Center for Complex Materials (PCCM) postdoctoral fellowship, Princeton University, Princeton, New Jersey, USA.
Aug 2022	Feinberg Graduate School fellowship , Weizmann Institute of Science, Rehovot, Israel.
Aug 2018	Cornell Fellowship, Cornell University, Ithaca, New York, USA.
Jun 2016	Uniandes SURF program, (Beneficiaries are funded to conduct research at Cornell University for a period of two months)
July 2012	Quiero Estudiar Fellowship Universidad de los Andes, Bogota, Colombia

Thesis

PhD. Thesis	Strong Coupling Approaches for Electronic Transport and Superconductivity Under supervision of Prof. Debanjan Chowdhury at Cornell University
Msc. Thesis	Quantum Szilard Engines and Breakdown of Adiabaticity Under supervision of Prof. Gabriel Tellez Acosta at U. de los Andes
Bsc. Thesis	Polarization effects in a two-dimensional two-component plasma and a test charge Under supervision of Prof. Gabriel Tellez Acosta at U. de los Andes

Manuscripts under preparation

1. Johannes S. Hofmann, J.F. Méndez-Valderrama, J.Y. Lee, Erez Berg and Debanjan Chowdhury
   Monte Carlo study of the electron-phonon problem in twisted bilayer graphene

Publications

Google Scholar, Arxiv, ORCID: https://orcid.org/0000-0003-3026-8940

* Authors contibuted equally

1. J.F. Méndez-Valderrama, Dan Mao, and Debanjan Chowdhury
   Low-Energy Optical Sum Rule in Moiré Graphene
   Phys. Rev. Lett. 133, 196501 (2024)

2. Dan Mao, J.F. Méndez-Valderrama, and Debanjan Chowdhury
   Intertwined Magnetism and Superconductivity in Isolated Correlated Flat Band
   Phys. Rev. B 110, L041105 (2024)

3. J.F. Méndez-Valderrama*, Sunghoon Kim*, and Debanjan Chowdhury
   Correlated Topological Mixed-Valence Insulators in Moiré Hetero-Bilayers
   arXiv, cond-mat.str-el 2407.14583 (2024)

4. Sunghoon Kim*, J.F. Méndez-Valderrama*, Xuepeng Wang*, and Debanjan Chowdhury
   Theory of Correlated Insulator(s) and Superconductor at $\nu = 1$ in Twisted WSe_2
   arXiv, cond-mat.str-el 2406.03525 (2024)

5. Xuepeng Wang, J.F. Méndez-Valderrama, Johannes S. Hofmann, and Debanjan Chowdhury
   Intertwined Magnetism and Superconductivity in Isolated Correlated Flat Band
   Phys. Rev. B 110, L041105 (2024)

6. Colin R. Bundschu, Mahdi Ahmadi, J F. Méndez-Valderrama, Yao Yang, Héctor D. Abruña, Tomás A. Arias
   The Oxygen Reduction Pathway for Spinel Metal Oxides in Alkaline Media: An Experimentally Supported Ab Initio Study

Journal of the American Chemical Society 146 (7), 4680-4686 (2023)

7. J.F. Méndez-Valderrama*, E. Tulipman* , E. Zhakina, A.P. Mackenzie, E. Berg and Debanjan Chowdhury
   T-linear resistivity from magneto-elastic scattering: application to $PdCrO_2$
   Proceedings of the National Academy of Sciences 120 (36) e2305609120 (2023).

8. E. Zhakina, R. Daou, A. Maignan, P.H. McGuinness, M. Konig, H. Rosner, S. Kim, S. Khim, R. Grasset, M. Konczykowski, E. Tulipman, J.F. Méndez-Valderrama, Debanjan Chowdhury, E. Berg, and A.P. Mackenzie
   Investigation of Planckian behavior in a high-conductivity oxide: $PdCrO_2$
   Proceedings of the National Academy of Sciences , 120 (36) e2307334120 (2023).

9. A.J. McRoberts*, J.F. Méndez-Valderrama*, R. Moessner and Debanjan Chowdhury
   An intermediate scale theory for electrons coupled to frustrated local-moments
   Physical Review B 107 , L020402 (2023).(**Letter**)

10. J.F. Méndez-Valderrama, Debanjan Chowdhury
    Bad metallic transport in geometrically frustrated models
    Physical Review B 103 , 195111 (2021).

11. J.F. Méndez-Valderrama*, Y.A. Kinkhabwala*, J. Silver, I. Cohen, T.A. Arias
    Density-functional fluctuation theory of crowds
    Nature communications 9 (1), 3538 (2018)

12. Santiago Aguirre, Juan Diego Arango-Montoya, David Jaramillo-Duque, J.F. Méndez-Valderrama, Nicolás Morales-Durán, Mateo Restrepo
    A quantum random number generator implementation with polarized photons
    Emergent Scientist 1 2 (2017)

Press articles

1. Revealing the superconducting limit of twisted bilayer graphene By Kate Blackwood for Phys.org on November 4, 2024
2. Revealing the superconducting limit of 'magic' material By Kate Blackwood for Cornell Chronicle on November 4, 2024
3. Comparing 'sister' compounds may hold key to quantum puzzle By Kate Blackwood for Cornell Chronicle on August 30, 2023, 2023
4. Fruit flies and electrons: Researchers use physics to predict crowd behavior By Linda B. Glaser for Phys.org on August 30, 2018
5. Physics theory used to predict crowd behavior By Linda B. Glaser for Cornell Chronicle on August 30, 2018

Talks

Jan 2024	Flatiron Insitute, Superconductivity and Strong Interactions in Twisted Bilayer Graphene: Insights from Sum-Rules and Monte Carlo Studies.
Jun 2023	LASSP/AEP Student Seminar Series, Monte Carlo Studies of Moire Graphene
Mar 2023	APS March Meeting, Linear-in-temperature resistivity in $PdCrO_2$ from magneto-elastic interactions
Jun 2022	Quantum Matters Today, Weizman Institute student seminar, Semi-quantum regimes for unconventional metallic transport
Mar 2022	APS March Meeting, Frustration induced non-Fermi liquid behavior.
Mar 2021	APS March Meeting, Bad metallic transport in geometrically frustrated models

Schools and Events

Jun 2024	Gordon Research Conference, Strongly correlated electrons Mount Holyoke College, South Hadley, MA, USA **Poster** A theory for the low-energy optical sum-rule in moiré graphene
Jun 2024	Gordon Research Seminar, Strongly correlated electrons Mount Holyoke College, South Hadley, MA, USA **Poster** A theory for the low-energy optical sum-rule in moiré graphene
Mar 2024	American Physical Society (APS) March Meeting, Minneapolis, MN, USA. **Talk** Exact results for low-energy many-body optical sum-rule in moiré graphene
Sept 2023	Electron Correlations beyond the Quasiparticle Paradigm: Theory and Experiment, Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA.
Sept 2023	KITP program: Quantum Materials With and Without Quasiparticles, Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA.
Jul 2023	PCCM Summer School 2023: Fractionalization, criticality and unconventional quantum materials Zoom
Mar 2023	American Physical Society (APS) March Meeting, Las Vegas, NV, USA. **Talk** Linear-in-temperature resistivity in $PdCrO_2$ from magneto-elastic interactions
Dec 2022	A Quantum Many-Body Handshake: Theory and Simulation meet Experiment Weizmann Institute of Science, Rehovot, Israel. **Poster** A Monte Carlo study of the electron-phonon problem in twisted bilayer graphene **Poster** $T-$linear resistivity from magneto-elastic scattering: application to $PdCrO_2$
Oct 2022	Weizmann-Max Planck Young researcher Workshop Weizmann Institute of Science, Rehovot, Israel.

Aug 2022	PCCM Summer School 2022: Hidden Correlations in Flat Bands, Zoom
Jun 2022	Gordon Research Conference, Strongly correlated electrons Mount Holyoke College, South Hadley, MA, USA **Poster** Semi-quantum regimes of unconventional metallic transport
Jun 2022	Gordon Research Seminar, Strongly correlated electrons Mount Holyoke College, South Hadley, MA, USA **Poster** Semi-quantum regimes of unconventional metallic transport
Mar 2022	American Physical Society (APS) March Meeting, Zoom. **Talk** Frustration induced non-Fermi liquid behavior
Jun 2020	PCCM Summer School 2020: Magnetism in Quantum Materials, Zoom
Feb 2019	Gapless Fermions - from Fermi liquids to strange metals school, MPIPKS, Dresden, Germany **Poster** An intermediate scale incoherent metal on the triangular lattice
Jan 2019	Quantum Matter Without Quasiparticles , Maglab Winter school
Feb 2019	CABES Scientific Advisory Board (SAB) meeting **Poster** Alkaline Fuel Cell Design Using Joint Density-Functional Theory
Dec 2017	Course on Dynamics of Quantum Systems out of Equilibrium, U. de los Andes, Bogota
Apr 2017	Gothenburg Physics Centre International Physicist's Tournament , University of Gothenburg, Chalmers, Gothenburg, Sweden
July 2016	Summer school on Random Geometries, U. de los Andes, Bogota
Apr 2016	French physical society International Physicist's tournament , ESPCI ParisTech Paris, France
July 2015	Summer school on Topological Quantum Matter, U. de los Andes, Bogota
May 2012	Continued Education Course Quantum Universe, U. de los Andes, Bogota

Computer Skills

Programming Languages:	Python, C++, FORTRAN, LaTeX, Mathematica.
Basic Knowledge On:	Julia, Octave/Matlab
Packages:	ALF (algorithms for lattice fermions), jDFTX.
Other:	Git
Operating Systems:	UNIX based systems;

Grants/External Funding

1. Provided preliminary calculations and input for the NSF-ACCESS grant: Quantum Monte Carlo studies of strongly correlated phases and superconductivity in moirè materials and beyond. Listed as a user for the development of the research under supervision of prof. Debanjan Chowdhury and prof. Erez Berg and in collaboration with Dr. Johannes S. Hofmann who is also the allocation Mangaer
   Awarded Resources:
   SDSC Expanse Projects Storage: 2,730.0 GB
   SDSC Expanse CPU: 4,900,000.0 Core-hours

Teaching

Jan - May, 2023	TA for PHYS1112, Physics I: Mechanics and Heat Cornell U., Ithaca, NY under the supervision of Prof. Robert Fullbright
Jan - May, 2022	TA for PHYS1112, Physics I: Mechanics and Heat Cornell U., Ithaca, NY under the supervision of Prof. Robert Fullbright
Aug - Dec, 2021	Grader for PHYS6572 Quantum Mechanics I Cornell U., Ithaca, NY under the supervision of Prof. Eana Flannagan
Jan - May, 2021	TA for PHYS2214 Physics III: Oscillations, Waves and Quantum Physics Cornell U., Ithaca, NY under the supervision of Prof. Dan Ralph
Jan - Jun, 2021	Grader for PHYS6574 Applications of Quantum Mechanics II Cornell U., Ithaca, NY under the supervision of Prof. Debanjan Chowdhury
Aug - Dec, 2020	TA for PHYS2213 Physics II: Electromagnetism Cornell U., Ithaca, NY under the supervision of Prof. Ivan Bazarov
Aug - Dec, 2019	TA for PHYS1112, Physics I: Mechanics and Heat Cornell U., Ithaca, NY under the supervision of Dr. Phil Krasicky
Aug - Dec, 2018	TA for PHYS1112, Physics I: Mechanics and Heat Cornell U., Ithaca, NY under the supervision of Prof. Jeevak Parpia
Sep - Dec, 2017	TA for the Computational Tools course U. de los Andes, Bogota under the supervision of Prof. Veronica Arias
Sep - Dec, 2017	TA for the Laboratory for Computational Physics U. de los Andes, Bogota under the supervision of Prof. Veronica Arias
Aug -Dec, 2016	TA for the Experimental physics I course at U. de los Andes, Bogota under the supervision of Prof. Bensamin Oostra
Aug -Dec, 2016	TA for the Experimental physics I course at U. de los Andes, Bogota under the supervision of Prof. Bensamin Oostra
Jan, 2016- May, 2016	TA for the Experimental physics II course at U. de los Andes, Bogota under the supervision of Prof. Juan Gabriel Ramirez
Jul, 2015-Jul, 2016	Grader for the Statistical physics course at U. Andes, Bogota under the supervision of Prof. Gabriel Tellez Acosta
Jan, 2016-Jul, 2016	Grader for Solid state physics at U. de los Andes, Bogota under the supervision of Prof. Luis Quiroga Puello
Jan, 2015-Jun, 2015	TA for Computational physics at U. de los Andes, Bogota under the supervision of Prof. Sebastian Perez Saaibi

Additional Information

May-Aug 2017	Reaserch intern at Cornell University, Arias group.
Apr 2017	14th Place International Physicists' Tournament 2017, Sweden.
Jun-Aug, 2016	Research intern at Cornell University, Ithaca, NY under the supervision of Prof. Tomas Arias
Jan,2016	Team captain of the Colombian for the International Physicists' Tournament
Dec 2016	1st Place Colombian Physicists' Tournament 2016.
Apr 2016	11th Place International Physicists' Tournament 2016.
Apr 2016	11th Place International Physicists' Tournament 2016.
Jan-Jun, 2015	Social service volunteer at U. Andes, Bogota Taught physics and mathematics to high school students under the supervision of David Felipe Parga Alonso
Sep 2014-Aug, 2015	Tutor at Clínica de Problemas at U. de los Andes, Bogota Helped first and second year students of introductory physics courses (Physics I, II, Waves and Fluids, Modern Physics) with solutions to homework problems and course content related issues under the supervision of Simon Mejia Moreno

Scientific Outreach

Nov 2024 Dia de la ciencia at the Princeton Center for Complex Materials (PCCM), Princeton University, Princeton, New Jersey, USA.

Languages

English: Fluent, TOEFL:107 Reading:30 Listening:29 Speaking:23 Writing:25
Spanish: First language