

Workshop IV: Algebraic Varieties and Electronic Structure

May 24 - 27, 2027

Scientific Overview

Electronic structure theory is the study of correlated fermionic quantum many-body systems. In this framework, algebraic varieties in high-dimensional spaces are a language for expressing the polynomials and tensors that describe these systems and for revealing the symmetries in their structure. These algebraic and geometric structures are only partially understood, offering opportunities for discovery at the interface of quantum chemistry and algebraic geometry. In the workshop, attention will be given to how new mathematics can bring about computational strategies for simulating correlated quantum systems.

This workshop will bring together researchers from these fields to develop new algebraic frameworks and computational tools for strongly correlated systems. Topics will include the tensor structures and representation theory of many-body wave functions, where Hamiltonians and ground states of quantum systems lead to the study of Kalman varieties. Coupled-cluster theory gives rise to truncation varieties, including Grassmannians, flag varieties, and their spin adaptations. Discussions will address polynomial optimization, differential algebra for many-body Green's function methods, and the complexity of computational algebraic geometry methods in electronic structure theory. Additional topics will include Weyl algebras and their applications to bosonic systems.

This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop.

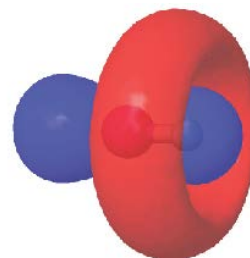
Long Program Schedule

Numerical Algebraic Geometry and Correlated Electrons: Generalized Grassmannians, Response Functions and Excited States (ALG2027)

- ALG2027 - Tutorials : March 9-12, 2027
- Workshop I: Numerical Algebraic Geometry : March 30 - April 2, 2027
- Workshop II: Extended Systems and Boundary Conditions : April 19-22, 2027
- Workshop III: Response Functions, Time-Dependent Properties and Parameterizations : May 6, 2027
- **Workshop IV: Algebraic Varieties and Electronic Structure : May 24-27, 2027**

Participation

Additional information about this workshop including links to register and to apply for funding, can be found on the webpage listed below. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission, and we welcome their applications.



Organizers

Fabian Faulstich (Rensselaer Polytechnic Institute)
Anna Seigal (Harvard University)
Luca Sodomaco (Max Planck Institute for Mathematics in the Sciences)
Bernd Sturmfels (Max-Planck Institute for Mathematics in the Sciences)
Svala Sverrisdottir (University of Oxford)

Speakers

Sandra Di Rocco (KTH Royal Institute of Technol)
Fabian Faulstich (Rensselaer Polytechnic Institute)
Evgeny Feigin (Tel Aviv University)
Vincenzo Galgano (Max Planck Institute of Molecular Cell Biology and Genetics)
Serkan Hosten (San Francisco State University)
Karol Kowalski (Pacific Northwest National Laboratory)
Julia Lindberg (Georgia Institute of Technology)
Luke Oeding (Auburn University)
Piotr Piecuch (Michigan State University)
Anna Seigal (Harvard University)
Luca Sodomaco (Max Planck Institute for Mathematics in the Sciences)
Svala Sverrisdottir (University of Oxford)
Michael Walter (University of Munich)
Max Wiesmann (Max Planck Institute for the Physics of Complex Systems)



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For more information, visit the program web page:
www.ipam.ucla.edu/ALGWS4