



## **L4G Seminar NANCY SANDLER 'Engineering Deformed Graphene Membranes: From Confined Charges and Valley Filters to Moire Structures and Tambourines'**

NANCY SANDLER

June 10, 2021

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L4G Seminar, June 10, 2021, 12:00. Online (Zoom)

**NANCY SANDLER**

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As an atomically thin membrane, graphene is a highly flexible material, a property that provides the opportunity to use strain engineering to control its electronic properties. Wrinkled or rippled graphene, either suspended or on a substrate, reveals inhomogeneous charge distributions originated by underlying strain fields. Scanning tunneling microscopy

(STM) measurements on deformed samples demonstrated electron confinement with peculiar charge distributions that break sublattice symmetry.

The phenomena that differentiate carbon atoms in each unit cell results in local valley currents with application in the field of valleytronics, i.e., the manipulation of the valley degree of freedom for electronic purposes. Because valley filtering properties in these structures are highly dependent on the type of deformation considered, we identified the relevant factors determining the optimal operation and detection of valley currents. We showed that extended deformations such as folds, in addition, to confine charges, also serve as electronic waveguides, a phenomenon confirmed by transport measurements. However, designing proper geometries is not enough to isolate valley states fully embedded in the continuum that makes graphene a semimetal.

We proposed that an external magnetic field makes it possible to separate these states from the continuum and provides the flexibility of positioning them at different locations in the sample, as observed in experiments.

More exciting is the possibility of developing band structure engineering protocols by designing substrates able to induce specific strain patterns. Results from our recent studies on supported and suspended samples exemplify these effects. For samples supported on regular arrays of deformations, we observe features characteristic of moire structures in images of electronic charge distributions. These systems exhibit narrow bands at low energies reminiscent of those observed in twisted bilayer structures, suggesting the possibility for the emergence of novel correlated physics in single graphene membranes. Suspended samples driven by periodic time-dependent deformations exhibit gaps in the band structure at energies determined by the frequency of the drive and amplitudes set by strain parameters.

**Bio:**

Professor Nancy Sandler is a faculty in the Department of Physics and Astronomy and a

member of the Nanoscale and Quantum Phenomena Institute (NQPI) at Ohio University (OU) in Athens, Ohio USA. Her research focuses on the equilibrium and non-equilibrium electronic properties of novel low-dimensional materials and the effects of strong correlations.

A native of Argentina, she obtained her Lic. en Ciencias Físicas degree from the Universidad Nacional de Buenos Aires. She continued her studies at the University of Urbana-Champaign in Illinois, USA, where she received her Ph.D. in theoretical physics (1998) under the supervision of Prof. E. Fradkin. After holding postdoctoral positions at ENS and Orsay (France) and Brandeis and BU (USA), she joined the Ohio University faculty in 2005. She was a visiting professor at the Dahlem Center for Complex Quantum Systems at Freie Universität, Berlin, Germany (2012-13), and is currently a visiting faculty in the Department of Physics at the Technical University of Denmark (DTU) and the Niels Bohr Institute (NBI) at the University of Copenhagen, Denmark.

Her other interests involve outreach and education activities that include serving as a board member in the Margaret Boyd Scholar Program, a leadership program for women undergraduates, and the physics science director in the NSF-funded NOYCE teacher fellowship program at OU.

[ZOOM LINK TO JOIN IN](#)

All interested may join this session. Participants will be asked to register upon entry. After registering, you will receive a confirmation email containing information about joining the meeting.

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**Hosted By Prof. Valerio Pruneri**

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