



## **Emergent Symmetries and Quantum Phase Transitions in Quantum Impurities Built From Quantum Dots**

David Goldhaber-Gordon

We are all familiar with spontaneously broken symmetry: the north pole of a magnetic needle will be at one end or the other, not a superposition of the two. Conversely, can a system possess at low energies a symmetry that the bare Hamiltonian does not? I'll discuss a case where such a symmetry emerges in measurements of a nanopatterned system of electrons: a double quantum dot (Ref. 1).

Then I will tell how a similar system with no obvious symmetry can be tuned using voltage on nanoelectrodes to a quantum critical point with an exact theoretical description even at finite temperature (Ref. 2). The excitations of nearby mobile electrons at the critical point are collective and look nothing like individual electrons: this is a non-Fermi liquid. Tuning across the critical point, the crossover from one phase to the other through the quantum critical region turns out to have surprising universal properties (Ref. 3).

I hope that this approach to many-body systems and quantum phase transitions -- engineering and building an artificial realization of a well-defined Hamiltonian, then probing its properties experimentally -- will drive theoretical and computational efforts, and ultimately will help us understand the richness of electronic materials such as heavy fermion metals.

1. A. J. Keller, S. Amasha, I. Weymann, C. P. Moca, I. G. Rau, J. A. Katine, Hadas Shtrikman, G. Zaránd and D. Goldhaber-Gordon, "Emergent SU(4) Kondo physics in a spin-charge-entangled double quantum dot" *Nature Physics* 10, 145 (2014).
2. R. M. Potok, I. G. Rau, H. Shtrikman, Y. Oreg, and D. Goldhaber-Gordon, "Observation of the two-channel Kondo effect" , *Nature* 446, 167-171 (2007).
3. A. J. Keller, L. Peeters, C. P. Moca, I. Weymann, D. Mahalu, V. Umansky, G. Zaránd & D. Goldhaber-Gordon, "Universal Fermi liquid crossover and quantum criticality in a mesoscopic system," *Nature* 526, 237-240 ( 2015).



THE BAT SHEVA DE ROTHSCHILD SEMINAR ON  
TOPOLOGY MEETS DISORDER AND  
INTERACTIONS:  
**PRESENT CHALLENGES, FUTURE PROMISES**

**27-31 MAY, 2018**

**RAMON INN  
MITZPE RAMON**

[Home](#) | [About](#) | [Invited Speakers](#) | [Venue](#) | [Registration](#) | [Program](#) | [Scientific Committee](#) | [Photos](#)