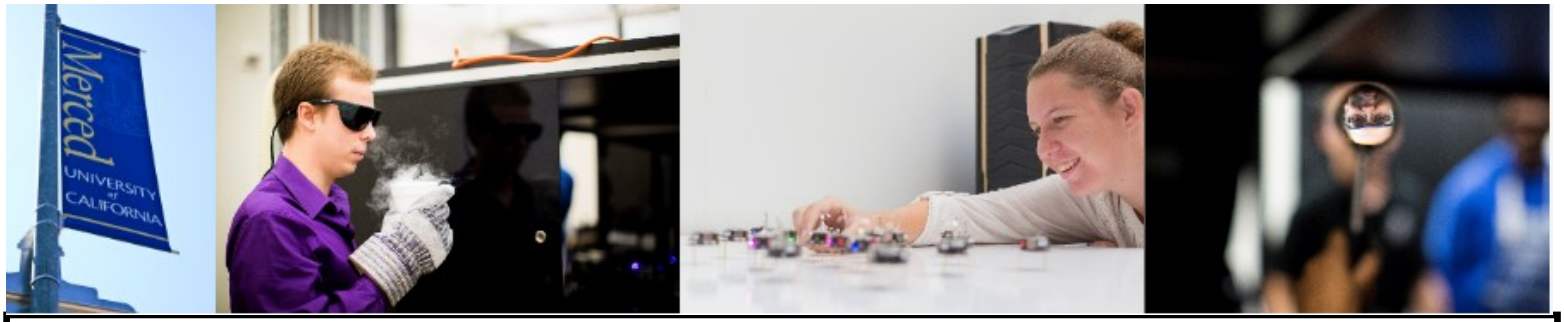

PHYSICS COLLOQUIUM:

A "Rough" View of Friction and Adhesion

Date: **11/8/2019**

Time: **10:30 AM**

Location: **COB2 140**

Mark Owen Robbins

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Abstract

Friction affects many aspects of everyday life and has played a central role in technology dating from the creation of fire by rubbing sticks together to current efforts to make nanodevices with moving parts. The friction "laws" we teach today date from empirical relationships observed by da Vinci and Amontons centuries ago. However, understanding the microscopic origins of these laws remains a challenge. While Amontons said friction was proportional to load and independent of area, most modern treatments assume that friction is proportional to the real area of contact where atoms on opposing surfaces are close enough to repel. Calculating this area is complicated because elastic interactions are long range and surfaces are rough on a wide range of scales. In many cases they can be described as self-affine fractals from nanometer to millimeter scales. The talk will first show that this complex problem has a simple solution. Dimensional analysis implies a linear relation between real contact area and load that can explain both Amontons' laws and many exceptions to them. Next the talk will explain why we can't climb walls like Spiderman even though the attractive interactions between atoms on our finger tips should provide enough force to support our weight. The talk will conclude by considering how forces in the contact area give rise to friction. Friction shows surprisingly counterintuitive and complex behavior in nanometer to micrometer scale contacts and only a few explanations are consistent with macroscopic measurements.

About the Speaker

Mark received his BA and MA degrees from Harvard University and then spent a year as a Churchill Fellow at Cambridge University. His PhD at University of California, Berkeley was followed by a postdoctoral fellowship at Exxon's Corporate Research Science Laboratory in New Jersey. He is currently on the faculty of the Department of Physics and Astronomy at Johns Hopkins, with a joint appointment in Mechanical Engineering. Robbins received a Presidential Young Investigator Award in 1986, a Sloan Foundation Fellowship in 1987, and a Simons Fellowship in Theoretical Physics in 2012 and 2019. He is a fellow of the American Physical Society and the American Association for the Advancement of Science.