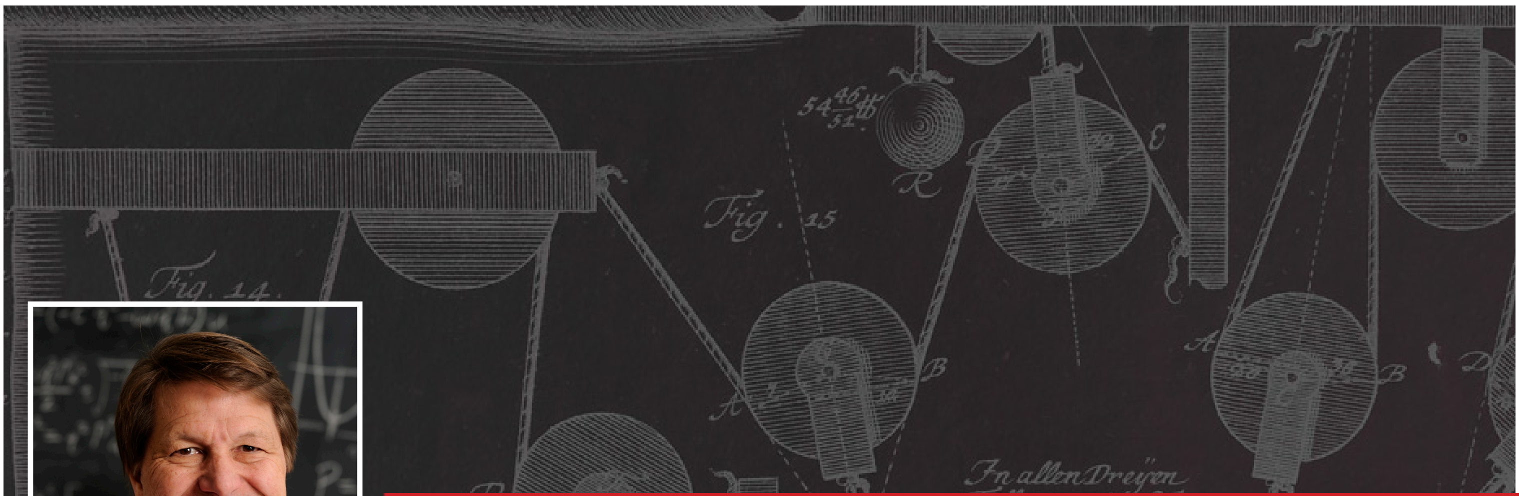
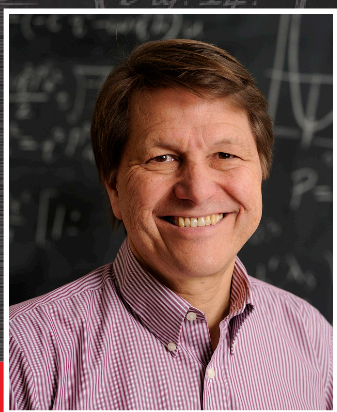
PHYSICS AND ASTRONOMY COLLOQUIUM SPEAKER SERIES





A “Rough” View of Friction and Adhesion

Friday, December 1
SB 142
4:00
Refreshments provided
Everyone is welcome!

Dr. Mark Robbins
Professor of Physics
Johns Hopkins University

Mark Robbins received his B.A. and M.A. degrees from Harvard University in 1977. He then spent a year as a Churchill Fellow at Cambridge University before completing his PhD at University of California, Berkeley in 1983. Following a postdoctoral fellowship at Exxon's Corporate Research Science Laboratory in New Jersey, he joined the Department of Physics and Astronomy at Johns Hopkins University in 1986. He was promoted to Assoc. Professor in 1988 and to Professor in 1992. Mark received a Presidential Young Investigator Award in 1986 and a Sloan Foundation Fellowship in 1987. He became a Fellow of the American Physical Society (APS) in 2000 and was awarded a Simons Fellowship in Physics for 2012-3. He served as Chair of the APS Group on Statistical and Nonlinear Physics and the Advisory Board of the Kavli Institute of Theoretical Physics (KITP) at the University of California, Santa Barbara and is on the Advisory Board of the Boulder School for Condensed Matter and Materials Physics. He has organized symposia and workshops for the Materials Research Society, the Aspen Center for Theoretical Physics, International Tribology Conference and KITP, and Chaired the 2010 Gordon Research Conference on Tribology. His research focuses on the atomic origins of macroscopic phenomena, especially in friction, adhesion and lubrication.

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 area 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.

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