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Velcro® as a Mesoscopic Model System for Stick-Slip Motion[1]

LISA MARIANI, CARA ESPOSITO, PIOTR HABDAS, PAUL ANGIOLILLO, Saint Joseph's University — The Amontons-Coulomb (AC) laws of friction, established during the 18^{th} Century, serve to explain many of the phenomenological observations of friction in the macroscopic world. The AC laws for friction do not adequately explain certain systems, which undergo stick-slip motion, however. The hook-and-loop system (Velcro), in particular, exhibits easily observed stick-slip motion. Velcro evinces clear evidence of stick-slip dynamics that is independent of sliding velocity in accordance with Coulomb but, the maximum static friction force $F_s^{\max}$ and kinetic friction F_k are keenly dependent on "area of contact" (hook number) in contrast to accepted law, but consistent with recent studies of frictional dynamics in nanoscopic systems. Both the $F_s^{\max}$ and F_k as a function of area follow power law dependences with an exponent of approximately 2/3. Moreover, the fluctuations of the kinetic friction F_k also follow a power law dependence with an exponent of approximately 1/2 in accordance with random walk theory. On the other hand, the $F_s^{\max}$ and F_k both follow a linear dependence with applied load in accordance with the classical theory of AC.

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