Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Breakdown of Amontons' Law of Friction in Sheared-Elastomer with Local Amontons' Friction HIROSHI MATSUKAWA, Department of Physics and Mathematics, Aoyama Gakuin University, 5-10-1 Fuchinobe, Sagamihara 252-5258, MICHIO OTSUKI, Retired — It is well known that Amontons' law of friction i.e. the frictional force against the sliding motion of solid object is proportional to the loading force and not dependent on the contact area, holds well for various systems. Here we show, however, the breakdown of the Amontons' law for the elastic object which have local friction obeying Amontons' law and is under uniform pressure by FEM calculation The external shearing force applied to the trailing edge of the sample induces local slip. The range of the slip increases with the increasing external force adiabatically at first. When the range reaches the critical magnitude, the slips moves rapidly and reaches the leading edge of the sample then the whole system slides. These behaviors are consistent with the experiment by Rubinstein et.al. (Phys. Rev. Lett. 98, 226103). The static frictional coefficient, the ratio between the static frictional force for the whole system and the loading force, decreases with the increasing pressure. This means the breakdown of Amontons' law. The pressure dependence of the frictional coefficient is caused by the change of the critical length of the local slip. The behaviors of the local slip and the frictional coefficient are well explained by the 1 dimensional model analytically.

Hiroshi Matsukawa
Dept of Physics and Mathematics, Aoyama Gakuin University,
5-10-1 Fuchinobe, Sagamihara 252-5258

Date submitted: 29 Nov 2011 Electronic form version 1.4