Rotational diffusion of a molecular cat ORI KATZ-SAPORTA, EFI
EFRATI, Weizmann Institute of Science — We show that a simple isolated system
can perform rotational random walk on account of internal excitations alone. We
consider the classical dynamics of a "molecular cat": a triatomic molecule connected
by three harmonic springs with non-zero rest lengths, suspended in free space. In
this system, much like for falling cats, the angular momentum constraint is non-
holonomic allowing for rotations with zero overall angular momentum. The geomet-
ric nonlinearities arising from the non-zero rest lengths of the springs suffice to break
integrability and lead to chaotic dynamics. The coupling of the non-integrability of
the system and its non-holonomic nature results in an angular random walk of the
molecule. We study the properties and dynamics of this angular motion analytically
and numerically. For low energy excitations the system displays normal-mode-like
motion, while for high enough excitation energy we observe regular random-walk. In
between, at intermediate energies we observe an angular Lvy-walk type motion asso-
ciated with a fractional diffusion coefficient interpolating between the two regimes.

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