Quantum Physics

Grand-mother clocks and quiet lasers

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Galileo noted in the 16th century that the period of oscillation of a pendulum is almost independent of the amplitude. However, such a pendulum is damped by air friction. The latter may be viewed as resulting from air molecules getting in contact with the pendulum. It follows that air friction, not only damps the oscillation, but also introduces randomness. In the so-called ``grand-mother'' clock, discovered by Huygens in the 18th century, damping is compensated for, on the average, by an escapement mechanism driven by a falling weight. The purpose of this paper is to show that such a clock is, in its idealized form, a quiet oscillator. By ``quiet'' we mean that in spite of the randomness introduced by damping, the dissipated power (viewed as the oscillator output) does not fluctuate slowly. Comparison is made with quiet laser oscillators discovered theoretically in 1984. Because the input power does not fluctuate in both the mechanical oscillator and the quiet laser oscillator, the output power does not fluctuate at small Fourier frequencies, irrespectively of the detailed mechanisms involved.

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