

Wave-chaos in Asymmetric Glass Microspheres

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Abstract: In 1910 Lord Rayleigh explained the phenomenon of the Whispering Gallery in the dome of St. Pauls Cathedral in London. This same effect, waves traveling along a curved surface with little loss, also enables a glass sphere to act as a high quality optical resonator. Things become more complex when the resonator is not spherical. When such resonators are analyzed in the geometrical optics limit they are found to exhibit chaos. Ray-tracing accurately explains many properties of asymmetric microresonators, however, the fundamental description of the system must clearly be based on the wave nature of light. A conflict arises because the wave equation is linear and does not allow chaos. This wave-chaos paradox also appears when we try to understand how chaotic dynamics can emerge from the wave-based quantum mechanical description of a mechanical system. Study of asymmetric optical resonators can help shed light on this fundamental problem with our understanding of the world.