Thermalization Frustration and Control of Intermodal Energy Flow in Graphene Nanoresonators

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Understanding and controlling the intermodal energy transfer are vital for nanoresonator applications. The main stream in the current literature is through the internal resonance mechanism by making the frequencies of the modes commensurate. Here, we report a new mechanism to control the intermodal energy flow, whose fingerprint is a thermalization frustration phenomenon, that the thermalization time can experience a drastic ten-fold increase, sticking out from the overall decreasing trend. This is due to a metamorphosis of the structure of intermodal energy flow channels created by the hierarchical symmetry and a dynamical instability. An experimentally feasible strain-based control is devised. The results uncover the decisive roles of symmetry in the fundamental thermalization dynamics at the nanoscale, and may also facilitate novel nanoresonator applications of the flexible manipulation of intermodal energy flow channels.