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Non-ergodic metallic and insulating phases of Josephson junction chains

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A many-body closed system may be unable to explore its whole available configuration space and fail to behave as predicted by Statistical Mechanics. This happens for a many-body localized state. Furthermore, it can also occur in a metallic regime. In this talk, I will show that certain Josephson Junction Arrays display a novel high temperature non-ergodic phase. With further increase of the temperature the system undergoes a transition to the fully localized state characterized by infinite resistance and exponentially long relaxation.

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Transmission of light in metallic nano-hole structures

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A large amount of research on plasmonics has been devoted to noble metal nanostructures, which to control electromagnetic energy flow on nanometer length scales. The interesting thing about metals is that they have free conduction electrons and their collective oscillations on the surface of metals create quantized particles called surface plasmons. In the presence of photons surface plasmons couple with photons to create new particles called surface plasmon polaritons (SPPs). The study of SPPs is called plasmonics. Metallic nanostructures have applications in biophotonics and sensing. Recently there is an interest in studying SPPs in metallic nano-hole structures experimentally and theoretically. They provide simple way to excite SPPs at perpendicular incidence without varying the angle of the incident beam. It is found that these structures transmit more radiation than that of incident light due to the presence of SPPs in these structures. We have investigated theoretically and experimentally the transmission of light in metallic nano-hole structures in the presence of SPPs. The transmission spectrum is measured for several samples having different radii and periodicities. We found that the spectrum has several peaks. The effective dielectric constants of this structure are calculated by using the transmission line theory. Using effective dielectric constant the SPPs are calculated using the transfer matrix method and it is found that the SPP energies are quantized. A theory of the transmission of light has also been developed using the quantum density matrix method. The transmission expression is compared with experimental results of three samples and a good agreement is found between the theory and these experiments. We found that the location of the transmission peaks in can be modified by changing the periodicity and radius of the nano-holes. This can be achieved by applying an external laser or pressure pulse on the structure. These results can be used to make nanosensors and nanoswitches for medical and engineering applications.

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