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Semiconductor Quantum Dots and their Environment

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For years semiconductor quantum dots (QD's) have been called « macro–atoms » because part of their electronic spectrum is discrete like in real atoms. However, recent experimental and theoretical efforts have clearly evidenced the limitations to this analogy.

We shall show that the carriers (electrons, holes, electron-hole pairs) interact in an unconventional fashion with the phonons in these nano-objects. The coherence of the optical transitions in QD's is severely limited by the carrier-phonon interactions but also by the electrostatic fluctuations. The latters are another example of the non insulation of the QD's from their environment.

The couplings between the QD's and their environment will severely hamper the implementation of quantum computing in actual life. A proper understanding of the carrier-phonon coupling is also necessary to the design of novel optoelectronic devices such as lasers and photo-detectors.

Personal information:

G. Bastard received his PhD degree in 1979, career: 1974-1979 Attaché de Recherche CNRS, 1979-1985 Chargé de Recherche CNRS, 1981 -1982 Post doctoral stay at the IBM T. J. Watson Research Center, Yorktown Heights, N. Y. (Dr. Esaki), since 1985 Directeur de Recherche CNRS. Awards and honors: 1980 Bronze medal CNRS, 1987 Louis Ancel Prize of the French Physical Society (Condensed Matter Physics), 1993 Fellow of the American Physical Society, 2000 Fujitsu Quantum Devices Award, 2000 Highly cited researcher, 2002 Prix des trois physiciens. His field of research are electronic properties of semiconductors with a special emphasis on heterostructures. He has published more than 140 papers, several review articles, and a textbook entitled "Wave mechanics applied to semiconductor heterostructures" (Les Editions de Physique, les Ulis, 1988)

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