## Amnon Aharony: summary of research activities

1) **Spintronics:** Electrons carry both charge and spin. A spin, represented by a two-component spinor, can be used as a *qubit* for *quantum computation and information storage*. We are studying nano-devices which are connected to two electron reservoirs. These devices can act as *spin filters*, so that an incoming beam of unpolarized electrons can exit fully polarized. The direction of polarization, contained in the components of the spinors, corresponds to writing the quantum information on these spins. At the same time, when polarized electrons enter the device, the charge current through the device depends on their polarization, allowing the *reading* of this information.
2) **Decoherence:** Nano-devices rely on *quantum coherence* of the electronic wave functions. This coherence can be destroyed by the interaction of the electrons with the environment. We undertook a comprehensive study of the types of decoherence and of the ways to fight against them. In particular, we have recently found conditions for *partial decoherence*, when some parts of the quantum information is not lost even after a long time, despite the coupling to the environment. This allows *retrieval of the quantum information* stored in qubits even after long times.
3) **Multiferoics:** These materials exhibit phases which are simultaneously *magnetic and ferroelectric*. Therefore, their state can be modified by both magnetic and electric fields. We study the physical origins of such phases, and their phase diagrams as functions of external fields and material characteristics.