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The investigation of pressure effect on the optical properties, spontaneous polarization and effective mass: *Ab initio* study

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Optical properties and spontaneous polarization of cubic perovskite $BaHfO_3$ under pressure have been investigated using the Full Potential Linear Augmented Plane Wave (FP-LAPW) method as implemented in the Wien2k code, in connection with the Generalized Gradient Approximation (GGA). The pressure is among the external factors that can affect physical properties of materials, we will show that the pressure affects the optical properties, more accurately it allows the reduction of band gap, and electronic polarization increases in a linear behavior. These results confirm that $BaHfO_3$ is a piezoelectric material. Optical absorption and effective mass have been also studied.

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A quantum network with trapped ions and optical cavities

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A quantum network consists of distant quantum nodes, each containing one or several quantum emitters, connected by photonic links. These photonic links enable one to entangle remote nodes and to transfer quantum states from one node to the other. Applications of such networks include scaling up quantum computers, and implementing quantum repeaters for long distance quantum communication. The technical requirements for the building blocks of a quantum network are demanding because coherent effects should dominate the systems' dynamics. One approach is to use optical cavities as efficient coherent quantum interfaces between photons and atoms. Here we report on the development of a two-node elementary quantum network based on calcium ions trapped in separate optical cavities. One node is based on a 2 cm long cavity and operates in a regime where coherent and dissipative processes have similar rates. In spite of this limitation, important quantum network protocols were demonstrated, including deterministic single-photon generation, tunable ion-photon entanglement, and heralded entanglement of two ions. The second node is under development and relies on a so-called fiber-cavity, i.e., an optical cavity defined between the facets of two optical fibers. The short cavity length, typically a few hundreds of micrometers, is designed so that the coherent interaction between the ion and the cavity field would dominate over dissipative processes, resulting in higher fidelities and efficiencies for the network protocols available at the first node.

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