

Current research programmes include the following:



## KwaZulu-Natal Node (University of KwaZulu-Natal)

### Open Quantum Systems:

The miniaturization of technological devices necessitates the manipulation of objects at the nanoscale level at which coherent quantum mechanical processes start to dominate the physical properties. The unavoidable interaction of these systems with their environment gives rise to dissipative mechanisms and a strong loss of quantum coherence, i.e. decoherence. Since perfect isolation of quantum systems is not possible, it is of central importance to incorporate the methods and tools of the theory of quantum systems in the exploration of quantum technologies. The KwaZulu-Natal node of NITheP has contributed to the development of the theory of open quantum systems, which is at the basis of recent quantum information technological applications.

densate systems coupled to thermal environments. These studies are relevant for the realization of atomic chips.

The most advanced new quantum technology is Quantum Cryptography. Following a quantum protocol a cryptographic key is encoded into the internal quantum states of single photons (qubits). The security of the transmission of the key between two parties is guaranteed by the laws of quantum mechanics. Security proofs of Quantum Key Distribution protocols as well as quantum communication are topics studied at the KwaZulu-Natal node of NITheP.

### Quantum Computers and Quantum Communication:

Various technologies have been proposed to realize quantum computers: quantum dots, Bose-Einstein condensates, cavity QED, atom chips, ion traps, circuit QED. The KwaZulu-Natal node of NITheP studies theoretical models of these physical systems based on the theory of open quantum systems. For example, we study decoherence in Bose-Einstein con-

For more information on these projects, contact Prof Francesco Petruccione at [petruccione@ukzn.ac.za](mailto:petruccione@ukzn.ac.za)

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