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Towards Entanglement at Macroscopic Scales

Although the birth of quantum theory brought with it numerous objections, it is nowadays well accepted as a theory describing the behavior of microscopic systems. Two photons for example, can be entangled so that they lose their individual properties and are described as a whole only. In principle, but so far without any demonstration, quantum theory applies at any scale, and even macroscopic objects can exhibit the properties of quantum particles, such as entanglement.

During this talk, I will present several attempts to detect quantum correlations in macroscopic systems. This will include proposals and corresponding experimental results in atomic and photonic systems. In particular, I will present in detail the first results of a project aiming to lay the basis for a new class of experiments interfacing quantum systems and biological detectors. This proposal could lead to the first experiment where entanglement is detected with the human eye. The success of this endeavor relies on coherent amplification techniques that can be used to upgrade the human eye up to the point where they can reveal the quantum nature of few photon entangled states. Beyond their fundamental interest, our amplification techniques might find applications in quantum technologies e.g. to upgrade widely available but rudimentary detectors to communicate securely and to generate certified randomness.