HEARNE EMINENT LECTURE SERIES

QUANTUM SHANNON THEORY - ON THE ULTIMATE PHYSICAL LIMITS OF COMMUNICATION

A **PUBLIC LECTURE** BY
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What are the ultimate limits of storing and communicating information? Since we believe that fundamentally everything is quantum, quantum mechanics gives some nontrivial answers to this question. Also, our existing communication technology is pushing us ever closer to the quantum realm. In fact, recent years have seen an explosion of ideas and results in the study of communication problems in a fully quantum mechanical setting. One of the most exciting developments in it is that the bit, the familiar and ubiquitous information unit in Claude Shannon's eponymous theory of information, now comes with exotic 'cousins' in the form of other elementary resources: the quantum bit (qubit), the entanglement unit (ebit), etc, besides what we now call the classical bit (cbit). Quantum Shannon theory thus not only aims to put a number to the ultimate communication capacity - or rather: capacities - of optical fibers and the like, but really becomes a theory of these fundamental resources and their interplay. From what we can glimpse of it, it has a rich, exciting and sometimes bewildering structure: from quantum teleportation, to unconditionally secure communication based on quantum principles, to paradoxical effects such as superactivation where two

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