A THEORY OF INFORMATION FOR PHYSICS

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When Claude Shannon devised his mathematical theory of information in 1948, the study of data processing, data transmission, and data storage were among the central applications he had in mind. Only relatively recently, it has been realized that concepts and notions originating from information theory are also of use in the area of physics.

However, the techniques of classical information theory (as well as their generalization to quantum information) rely on various assumptions. For example, in order to determine the capacity of a communication channel, one typically demands that the channel can be invoked arbitrarily often, and that its behavior in each use is *identical* and *independent* of the previous uses (this is known as the *iid assumption*). While such assumptions, or variations thereof, are well justified within the classical realm of data processing, this is usually not the case when studying problems in physics (where the requirement that the state of a composite system satisfies the iid assumption, for instance, is a rather severe restriction).

In this talk, I will present a recently developed theory of information that overcomes these limitations and, therefore, is particularly well suited for applications in physics, e.g., in statistical mechanics or thermodynamics. The theory relies on a novel entropic quantity, called *smooth entropy*, which generalizes established entropy measures (such as *Shannon* and *von Neumann entropy*).

Some of the central aspects of this generalized theory of information can be found in the introductory parts of [1, 2].

Keywords: Quantum information theory, entropy

[1] Fabian Furrer, Johan Aberg, and Renato Renner, Min- and max-entropy in infinite dimensions, *Communications in Mathematical Physics*, vol. 306, pp. 165-186, June 2011.

[2] Mario Berta, Matthias Christandl, and Renato Renner, The Quantum Reverse Shannon Theorem based on one-shot information theory, *Communications in Mathematical Physics*, vol. 306, pp. 579–615, August 2011.