Information without information: Quantum Physics and the Nature of Reality

Vlatko Vedral (keynote speaker)
Professor of Quantum Information Theory, Univs of Oxford & Singapore

In my talk I first plan to explain, in very simple terms, why the basic postulates of quantum physics have a strong information theoretic flavour. This statement, however, contains an important twist. When quantum systems are used to process information they lead to a different type of information theory to the one envisaged by Shannon; they also lead to a different type of a computer than the one envisaged by both Turin and von Neumann. Quantum information processing is, in general, more powerful than classical (i.e. that based on the laws of classical physics) and only reduces to classical information processing in a very special limit (which is of no direct relevance for my talk). Beyond this fascinating fact, namely that the laws of information processing depend on the laws of physics (which, incidentally, was completely neglected by the early pioneers such as Shannon, Turin and even von Neumann), lies another distinct property of quantum information. This is the fact that it is (in some well defined sense, to be specified in the talk) possible to create quantum information from no prior information. This, in turn, leads to a complete breakaway from the classical causality (which itself, broadly speaking, is based on the dictum *ex nihilo nihil fit)*. I would like to discuss in more detail why quantum physics allows us to think of creating information out of nothing. It is therefore tempting to try to think of information as a more fundamental building block in the fabric of the universe than the laws of physics (since the laws of physics cannot explain their own origin, while information does not need to!). I will talk about speculations how reality emerges from quantum information and finish by discussing possible consequences for any new physical theories to come.