Abstract: Physicists have become accustomed to the idea that a theory’s content is always most transparent when written in coordinate-free language. Sometimes, though, the choice of a good coordinate system can be useful for settling deep conceptual issues. This is particularly so for an information-oriented or Bayesian approach to quantum theory: One good coordinate system may be worth more than a hundred philosophical arguments. This talk will motivate and chronicle the search for such a coordinate system for finite dimensional quantum theory, the key arena for quantum information and computing. These are the so-called Symmetric Informationally Complete (SIC) quantum measurements. It has been an open mathematical problem for over 35 years, but great progress has been made recently in understanding them---for instance, it is now known that when they exist, such measurements are optimal for quantum state tomography. Moreover they have deep connections to the theory of quantum error correcting codes. What is particularly surprising however is how their existence would allow a rewriting of the quantum mechanical Born rule to be a formula purely in terms of probabilities, instead of as usual, a formula in terms of quantum states and operators. This suggests a new and powerful way to track the origin of the power of quantum information.

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