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Probabilities From Envariance: Born's Rule (And More) From Entanglement

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I shall discuss consequences of envariance (environment - assisted invariance), a symmetry exhibited by entangled quantum states [1]. I shall focus on the implications of envariance for the understanding of the origins and nature of ignorance, and, hence, for the origin of probabilities in physics. While the derivation of Born's rule for probabilities ($p_k = |\psi_k|^2$) is the principal accomplishment [1-3] of this research, I shall discuss the possibility that essentially all other symptoms of the quantum - classical transition that are now justified using decoherence (e.g. pointer states, einselection, etc.) can be understood as a direct consequence of envariance, without invoking Born's rule explicitly or implicitly (that is, without using "trace" or reduced density matrices). Thus, envariance appears to supply a new and deep foundation for the origin of quantum probabilities and, more generally, leads to a new understanding of the quantum origins of the classical [5]. [1] W. H. Zurek, PRL 90, 120404 (2003); RMP 75, 715 (2003). [2] H. Barnum, quant-ph/0312150; M. Shlosshauer & A. Fine, quant-ph/0312058 [3] W. H. Zurek, quant-ph/0405161