Weak measurement induced geometric phase: A topological transition

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The state of a quantum system, adiabatically driven in a cycle, may acquire a measurable phase depending only on the closed trajectory in parameter space. Such geometric phases are ubiquitous, and also underline the physics of robust topological effects such as the quantized Hall conductance. Equivalently, a geometric phase may be induced through a cyclic sequence of quantum measurements. Here we show that the application of a sequence of weak measurements renders the closed trajectories, hence the geometric phase, stochastic. We study the probability distribution of the geometric phase induced by a suitably designed sequence of measurements of a qubit. We show that the mapping between the sequence of measurements and the geometric phase undergoes a topological transition as function of the measurement strength. Our finding will impact the study of measurement-induced state distillation, trajectory manipulation, and active error correction|all crucial directions in the field of quantum information processing.