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Deriving classical and quantum mechanics in parallel

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Where do classical and quantum mechanics part ways? How do classical and quantum randomness fundamentally differ? Here we derive (nonrelativistic) quantum mechanics and classical (statistical) mechanics within a common axiomatic framework. The common axioms include conservation of average energy and conservation of probability current. Two axioms distinguish quantum from classical mechanics: a global, time-dependent random variable, and a constraint on allowed phase space distributions. With strength on the order of Planck's constant, they imply quantum entanglement and uncertainty relations.

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