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Negative probabilities and measurement disturbance LARS M. JOHANSEN, Buskerud University College — Feynman once said that "the only difference between a probabilistic classical world and the equations of the quantum world is that somehow or other it appears as if the probabilities would have to go negative". But what is the essential reason for probabilities going negative? Here it is demonstrated that negative probabilities are a direct consequence of measurement disturbance. The Margenau-Hill distribution, a quasiprobability taking negative values, is expressed in terms of the joint probability obtained in the successive measurement of two projectors. The quasiprobability takes negative values only if the measurement of the first projector disturbs the measurement of the second projector. The uniqueness of this quasiprobability follows by imposing a symmetry principle on measurement disturbance. The quasiprobability is made informationally complete by a complex extension. Conditions for informational completeness are derived. This quasiprobability also can be observed directly as a statistical average of pointer displacements in weak measurements.

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