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The three-box paradox revisited. (English summary)
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In the three-box paradox referred to here, a quantum system is prepared in some state, undergoes a non-demolition observation, and is then 'post-selected' for some final state. The latter is enforced by throwing away all samples for which the final-state boundary condition is not met at some detector. The arrangement is probably best understood as a variant of Young's double slit experiment as described by K. A. Kirkpatrick in [J. Phys. A **36** (2003), no. 17, 4891–4900; MR1984017 (2004f:81008)]. In that embodiment there are three equally-spaced slits labeled $1, 3, 2$, with 3 in the middle. The non-demolition detector d is placed at either 1 or 2. The final state detector D is placed on the symmetry axis downstream from the slits and at such a distance from the screen that it is at a node of the interference pattern if just 2 and 3 were to be illuminated (and therefore, by symmetry, also at a node of the interference pattern when just 1 and 3 are illuminated). The post-selection boundary condition is that the particle must also be observed at D. It follows that when d is placed at 1, the particle must be observed there with 100% certainty. The paradox is that the same must be true when d is placed at 2. (Arguably, in this embodiment, such behavior is seen to be paradoxical only in so far as is the 'business as usual' of quantum mechanics.)

In this paper the authors aim to reinforce their contention that the 3-box behavior is highly counterintuitive and genuinely paradoxical. Much of the content is given to countering an earlier work by Kirkpatrick, who had sought to cast the above gedanken-experiment as non-paradoxical by showing that (i) it is an easily understood property of quantum mechanics, and (ii) classical analogues exist. In the 2003 publication referenced above, Kirkpatrick had proposed an equivalent classical 'card game' that is analyzed in this paper in some detail. Here the authors conclude that the game does not have the same alleged paradoxical behavior as the quantum 3-box gedanken-experiment, and so is not equivalent. Their objection is that 'measurement' in Kirkpatrick's card game disturbs the system, whereas disturbance is not a property generally associated with classical measurement; if disturbance is prohibited, a classical system would not be able to reproduce the outcome of the quantum three-box paradox. They state that, in contrast, in the quantum 3-box paradox, the system is *only* observed at d, apparently implying (incorrectly if so) that this confers no such disturbance. Immediately following this article in the same issue of the journal [J. Phys. A **40** (2007), no. 11, 2883–2890; MR2325517], Kirkpatrick addresses that criticism, pointing out that the quantum system is disturbed by such observation, since, in the case of d being placed at 1 for example, it forces the wavefunction into just one of the two disjoint distributions: '1', or '2 and 3'.

Reviewed by *Michael Ibison*