## Physicists discuss quantum pigeonhole principle

July 26 2014, by Nancy Owano



## Credit: Wikipedia

The pigeonhole principle: "If you put three pigeons in two pigeonholes at least two of the pigeons end up in the same hole." So where's the argument? Physicists say there is an important argument. While the
principle captures the very essence of counting, the investigators said that they showed that in quantum mechanics it is not true.

Science writers reporting on the physicists' findings heard resonance with that other blogger-comment favorite, Schrödinger's cat. They suggested that those mulling over counterintuitive implications of quantum physics now have one more animal-related paradox to think about, in the form of pigeons, if any, found in pigeonholes. Physics World on Friday referred to "paradoxical pigeons" as the latest quantum conundrum. Scientists identified the paradox involving quantum pigeons; specifically, they have posed their findings on what the team calls the "quantum-pigeonhole effect." According to the team, when you put three pigeons in two pigeonholes, it is possible for none of the pigeons to share a hole. They found instances when three quantum particles, they wrote, put in two boxes "yet no two particple are in the same box."

The team from California and colleagues in Israel, Italy and the UK are authors of the paper, "The quantum pigeonhole principle and the nature of quantum correlations," by Y. Aharonov, F. Colombo, S. Popescu, I. Sabadini, D.C.Struppa, and J. Tollaksen. The research is described on the arXiv preprint server.
"It's one of those things that seem to be impossible," said co-author Jeff Tollaksen, physics professor at Chapman University, in Physics World, but it is a consequence of quantum mechanics.
"In conclusion," said the authors," we presented a new quantum effect that requires us to revisit some of the most basic notions of quantum physics-the notions of separability, of correlations and of interactions."

Marcus Woo, writing in Physics World on Friday, said, "They reckon that the effect will arise when an observer makes a sequence of measurements while trying to fit three particles in two boxes. First, you
make an initial, "pre-selection" measurement of the locations of the particles. Next, you can perform an intermediate measurement to see whether two particles share a box. Finally, you make a final, "postselection" measurement of the locations. You can make the pre-selection and post-selection measurements such that they are completely independent. In the intermediate step, you can make what's called a weak measurement to look at all three particles simultaneously. And when you do, it turns out that no two particles share a box.

## More information: arxiv.org/pdf/1407.3194v1.pdf <br> arxiv.org/abs/1407.3194

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