CEWQO 2019
Invited

Revealing quantumness without looking

Mauro Paternostro[1]
[1] School of Mathematics and Physics, Queen's University Belfast (UK)

Abstract

Your prankster friend gave you a box into which, he says, there is a quantum system. He asks you to hold the box for him, and not to ruin the fragile quantum system that is inside. But you do not trust him and want to find out if he is telling the truth or not. How would you ascertain that the system within your friend's box is indeed genuinely quantum?

As preposterous as this situation might sound, it is not far from conditions routinely found in quantum labs: the direct revelation of the non-classical properties of a system is often either too disruptive for the system itself (if you measure it, you ruin it!), or simply technically difficult to realise (the system might be difficult to access, just like the one in your friend's box).

In this talk I will illustrate a scheme based on quantum communication and the theory of quantum correlations, that allows you to "certify" the quantum nature of an inaccessible system. I will show how, besides its fundamental interest, the scheme is prone to verification in a number of experimental settings, including quantum optomechanics. Finally, I will conjecture that it can be used as a trojan horse to investigate the possible quantum nature of biological processes and gravity.

The work presented in this talk is based on the following papers:

[1] T. Krisnanda, M. Zuppardo, M. Paternostro, and T. Paterek, Phys. Rev. Lett. **119**, 120402 (2017)

[2] S. Bose *et al.*, Phys. Rev. Lett. **119**, 240401 (2017)
[see also Synopsis in Physics: https://physics.aps.org/synopsis-for/10.1103/PhysRevLett.119.240402]

[3] T. Krisnanda, C. Marletto, V. Vedral, M. Paternostro, and T. Paterek, npj Quant. Inf. **4**, 60 (2018)