VERIqTAS

Verification of Quantum Technologies, Applications and Systems

THE PROJECT

Quantum technologies require verification and certification tools

In recent years we observe a wave of novel quantum technologies such as quantum random number generators, quantum annealers or the first prototypes of quantum computers. These devices are believed to soon drastically change the way we process information and communicate, paving a way to important breakthroughs in many research disciplines, as diverse as mathematics, chemistry or even medicine. However, the promises of quantum technologies can be fulfilled only if the correct functioning of its components can be certified. This poses an extraordinary challenge to design suitable certification tools allowing the end-users to certify that the device they use operates according to its specification and generates the correct output. At the same time, it urges for thorough characterization of quantum phenomena from which these devices derive their power.

The objectives

In VERIqTAS, we address these challenges and develop versatile certification methods for current and future quantum technologies that:

- ✔ are experimentally friendly,
- ✔ are based on minimal sets of physically well-justified assumptions,
- ✔ acknowledge all limitations imposed by the devices,
- ✔ rely on information that is easily accessible in the underlying quantum systems.

Structure

WP1. *(ULB)* Certification of quantum networks and quantum communication protocols

WP2. *(ICFO)* Certification of interacting quantum systems and quantum computations

WP3. *(IQOQI)* Fundamentals and tools

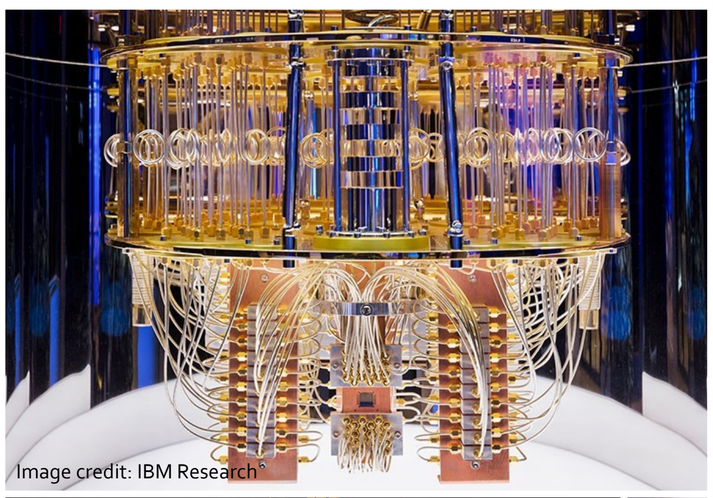

Image credit: IBM Research

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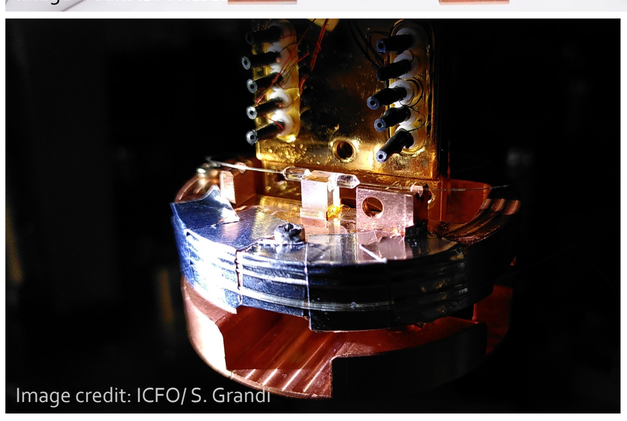

Image credit: ICFO/ S. Grandi

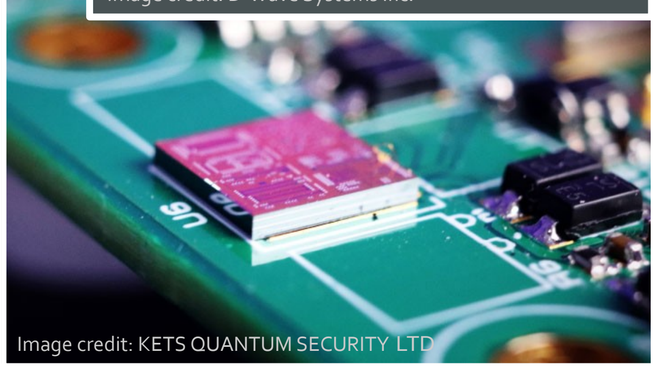

Image credit: KETS QUANTUM SECURITY LTD

CONSORTIUM

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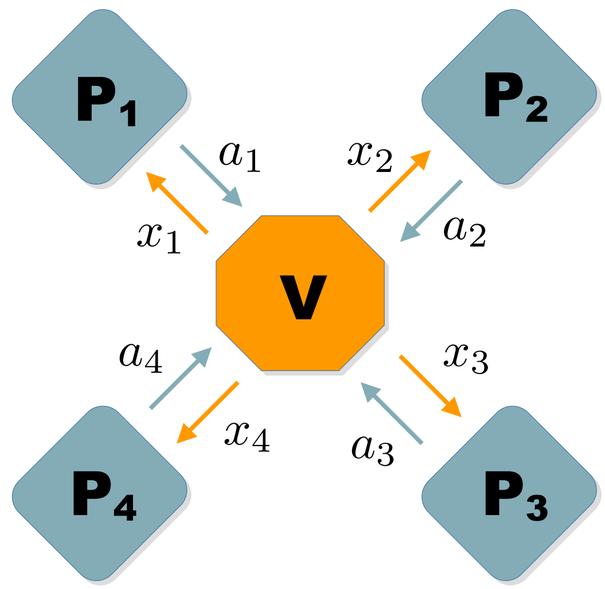
THE APPROACH

Device-independent certification

- A verifier (V) wishes to certify a particular property of the quantum resource shared by non-communicating provers.
- The verifier asks questions x_i to P_i and receives answers a_i .
- Based on the observed non-local correlations, the verifier makes non-trivial statements about that quantum property.



[F. Baccari *et al.*, PRL **125**, 260507 (2020)]

Relaxations of DI approach

- If necessary one can make some physically-motivated assumptions

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