

## Quantum Science and Technology for High Schools: a training school for secondary teachers

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**Abstract:** We report on “Quantum Science and Technology for High Schools”, a five-day school for in-service secondary teachers supported by NQSTI. The school is grounded in a two-state approach, integrating phenomenology, formalization, experimental sessions, and game-based activities through QTris board game.

In this communication we report on the design and implementation of “Quantum Science and Technology for High Schools”, a training school for secondary teachers held in July 2025 and supported by NQSTI. The aim of the school was to provide high school teachers with both conceptual and practical tools for introducing QM and quantum technologies in the classroom. It involved 41 participating teachers from across Italy and was delivered by a team of 10 instructors from different institutions affiliated with NQSTI.

The school was structured as a five-day immersive experience combining lectures, hands-on laboratories, and didactical discussion sessions, with a strong emphasis on the integration of physics, mathematics, and computational thinking. The course began with a phenomenological introduction to QM through Stern–Gerlach experiments, progressively formalized using the language of linear algebra and the postulates of the theory. A distinctive feature of the program was the use of *QTris* [1], an educational board game designed to teach and learn QM for systems of qubits in an intuitive yet rigorous way. A key component of the school was the experimental approach to quantum optics, where polarization of light is employed as a physical realization of qubits [2]. Through laboratory activities, participants reconstructed Malus’ law, implemented optical circuits, and interpreted classical light behavior in terms of single-photon quantum processes. These activities are complemented by modules on quantum computation, including teleportation protocols, quantum circuits, and Grover’s algorithm, as well as on foundational topics such as violation of Bell inequalities [3]. A session was devoted specifically to quantum technologies, presenting current physical platforms and applications in computation, communication, sensing, and simulation. Throughout the school, particular attention is devoted to pedagogical aspects, fostering critical reflection on how to effectively translate advanced quantum concepts into high school teaching practices.

To evaluate the effectiveness of the program we used a mixed approach, combining quantitative tools (such as questionnaires and structured feedback forms) with qualitative data collected through discussions, observations, and participant reflections. A preliminary analysis of the results indicates a positive impact on teachers’ motivation and engagement, particularly with respect to adopting new approaches to teaching QM at the secondary level. Participants reported increased confidence in addressing conceptually challenging topics and a strong interest in integrating modern quantum science and technology into their curricula. Beyond the summer school itself, the initiative fostered the creation of a motivated community of practice. A follow-up phase was organized through remote meetings, where participants and instructors collaboratively addressed the practical challenges of implementing the proposed activities in real classroom settings. During the 2025–2026 academic year, several teachers began piloting selected components of the program in their own schools, with ongoing support from members of the instructional team. This extended engagement highlights the sustainability of the initiative and its potential for concrete impact on teaching practices, bridging the gap between advanced quantum science and secondary education.

### References

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