

The future of technology runs on light: FBK showcases its research at the Single Photon Workshop 2026

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What do the security of our banking data, the early diagnosis of diseases, and the development of an ultra-secure internet have in common? There is only one answer: the ability to capture and control individual photons, the smallest particles of light.

At the international **Single Photon Workshop ([SPW 2026](#))**, organized by a consortium of Italian and international universities together with the European Society for Applied Superconductivity, INRIM, and Meditech, three young researchers from the [Center for Sensors and Devices](#) at **Fondazione Bruno Kessler** presented their innovations aimed at bringing these futuristic technologies into our everyday lives.

The significance of Fondazione Bruno Kessler's contribution to the workshop was also highlighted by **Richard Hall-Wilton, Director of the Center for Sensors and Devices**, who attended the event: *"FBK is a leader in single-photon detection. SPW2026 was a high-profile event where it was crucial to share the research results achieved by our foundation and stay up to date with scientific advances in this specific field of development,"* Hall-Wilton said.

Here are the presentations by the Foundation's three researchers and their innovative research projects.

Andrea Bonzi: Hacker-proof security keys

Whenever we shop online, our data is protected by secret codes based on random numbers. The problem is that traditional computers do not generate truly random numbers: one day, a quantum computer could be able to predict them.

Andrea Bonzi has designed a revolutionary microchip that solves this problem at its source. By taking advantage of the unpredictable behavior of light particles, his chip **generates truly random quantum numbers that are impossible to hack**. The real breakthrough? Andrea has succeeded in integrating this “quantum” technology into standard 22-nanometer chips, the same ones used in modern smartphones. This means that maximum security will soon be compact and affordable.

Gianpietro Maddinelli: Smart cameras for the medicine of the future

In biology and medicine, an advanced technique called FLIM is used to study cells by illuminating them and observing how they respond over time. However, this technique produces an enormous amount of data, slowing down diagnoses.

Gianpietro Maddinelli has found a way to make this process dramatically faster. He used a **special camera** (a dSiPM sensor) capable of **counting single photons** and made it “smart.” Through an internal memory, the camera switches off unnecessary pixels, capturing only the essential information. Thanks to this mathematical approach, it produces very high-resolution images while drastically reducing the amount of data generated.

It is a technology that will revolutionize rapid medical diagnostics and sensors for autonomous driving (LiDAR).

Elena Nieto Hernandez: The building blocks for the Internet of tomorrow

To enable information to travel across a future global quantum network, we need microscopic “light sources” capable of emitting exactly one photon at a time, on command and without errors.

Elena Nieto Hernandez’s research focuses on microscopic defects artificially created within tiny diamond crystals, known as germanium color centers . Elena has developed an innovative method for integrating these light emitters into **microscopic optical channels**. The result is a highly efficient system that channels and collects almost all the emitted light. This represents a fundamental step forward in building the computers and communication networks of the future.

With these three studies, FBK confirms its position as a global leader: not only does it study the physics of the future in its laboratories, but it also designs real technologies that will bring these innovations into the homes and businesses of us all.

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