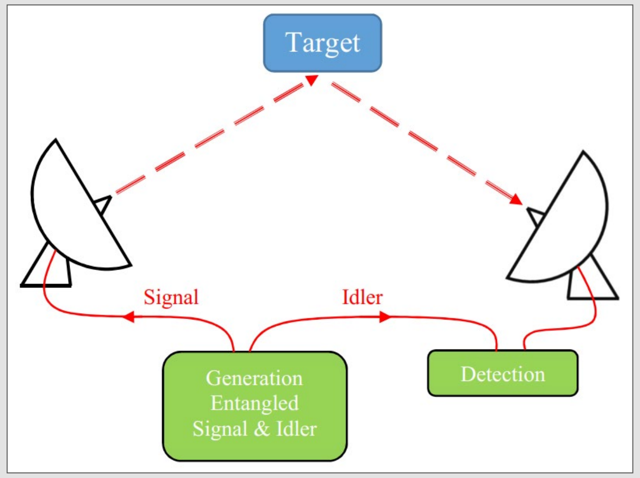
PROJECT QUANDO RF

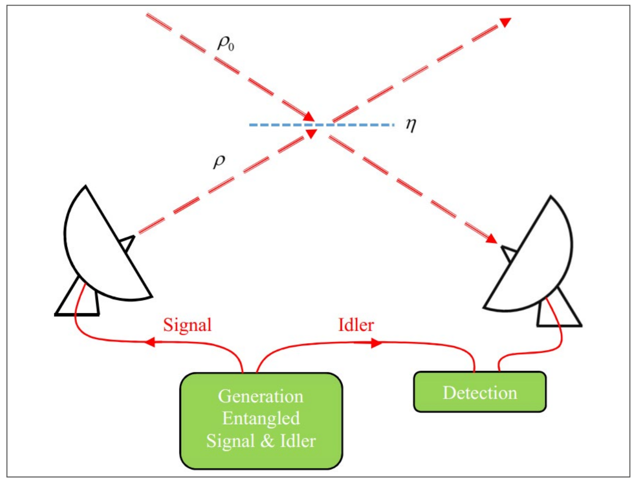
The First Quantum Revolution shaped the world we live in today: without mastering quantum physics, we could not have developed computers, telecommunications, satellite navigation, smartphones, or modern medical diagnostics.
Now a Second Quantum Revolution is unfolding, exploiting the enormous advancements in our ability to detect and manipulate "single quanta" (atoms, photons, electrons). The market availability of Quantum Sensors could lead to a paradigmatic shift in the design of future systems revolutionising Defence capabilities.
For the FWC QUANDO we assembled a consortium carefully structured to cover the entire value chain of innovation (from research organisations to innovative small and medium companies, including technology developers and integrators) with knowledge of state-of-the-art quantum sensing technologies and competences in military and defence applications.
To answer this novel service request, we have brought-in an additional subcontracting RTO with expertise in the application of quantum technologies to radar and surveillance systems.
As requested, we will perform a state-of-the-art analysis regarding quantum technology applications in the RF domain drawing on our consortium knowledge and expertise. Following we will concentrate on detection, tracking and recognition of challenging targets identifying and selecting the most promising quantum technologies. We will analyse the improvement brought about by these techniques with respect to naval based use cases. Building on our results from the FWC QUANDO we will assess common hardware and processing between quantumbased optronics and RF sensors. Our study will allow the definition of a clear roadmap for new project initiatives in both the field of RF sensor and optronics systems.

[3] M.Höijer, T. Hult and P. Jonsson, "Quantum Radar, a survey of the science, technology and literature". Technical report, December 2019, Swedish Defence Research Agency (FOI)

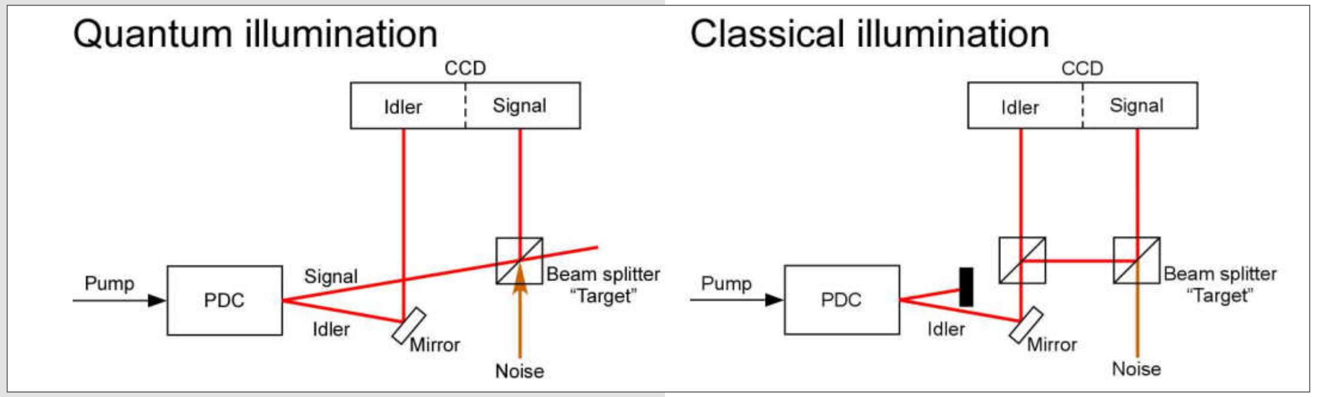
Technical Sheet
Funding institution:
EDA
Project partners
CNR, ONERA, TNO, FLYBY, HENSOLDT, LEONARDO, TECNOBIT, THALES, DLR, CNIT
Project duration
July 2021 - July 2022
Involved countries
Italy, France, Germany, Netherlands, Spain



(a) Principal sketch of a quantum radar. The difference to a classical radar is the signal and idler being entangled. The entanglement creates an enhanced correlation between (the part of) the signal being reflected back and the idler [3]



(b) A mathematical treatment of the quantum radar in (a) [3]



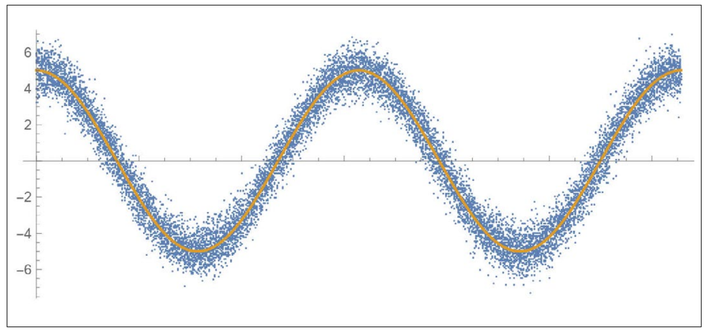
(c) The schematics of the setup used by Lopaeva et al. The signal and idler paths are arranged so they are equally long so the photons reach the CCD detector at the same time independently which path they took. CCD – charge-coupled device, PDC – parametric down-conversion [3].

PROJECT QUANTUM RADAR

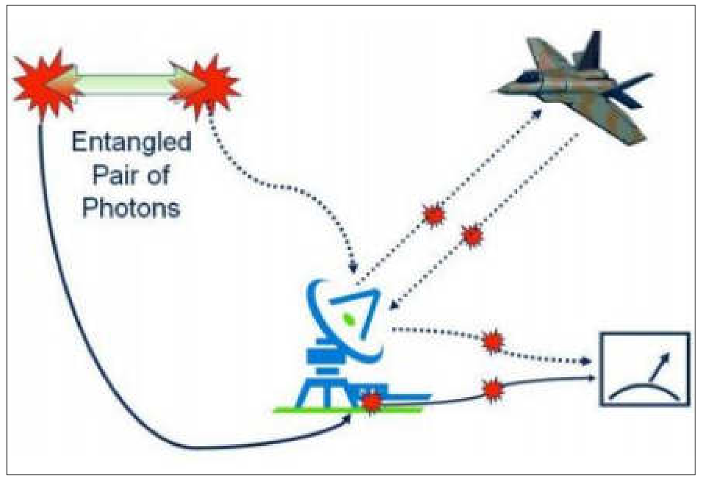
The project will investigate new techniques based on quantum states of microwave radiation in the range 1-10GHz, in particular regarding entanglement, for the realization of a prototype of a "Quantum Radar" with enhanced precision in interferometric measures with low SNR, mandatory to detect non-cooperating targets. With respect to optical systems, an active radar system can be quite expensive. We need to realize compact radar systems with the desired performances.
The project has 3 phases

- Phase 1: Quantum Metrology: Design, characterization and preliminary testing
- Phase 2: Quantum Design: design of the quantum radar system
- Phase 3: Quantum detection: detection of a stealth target with a Quantum Illumination Radar in the microwave range.

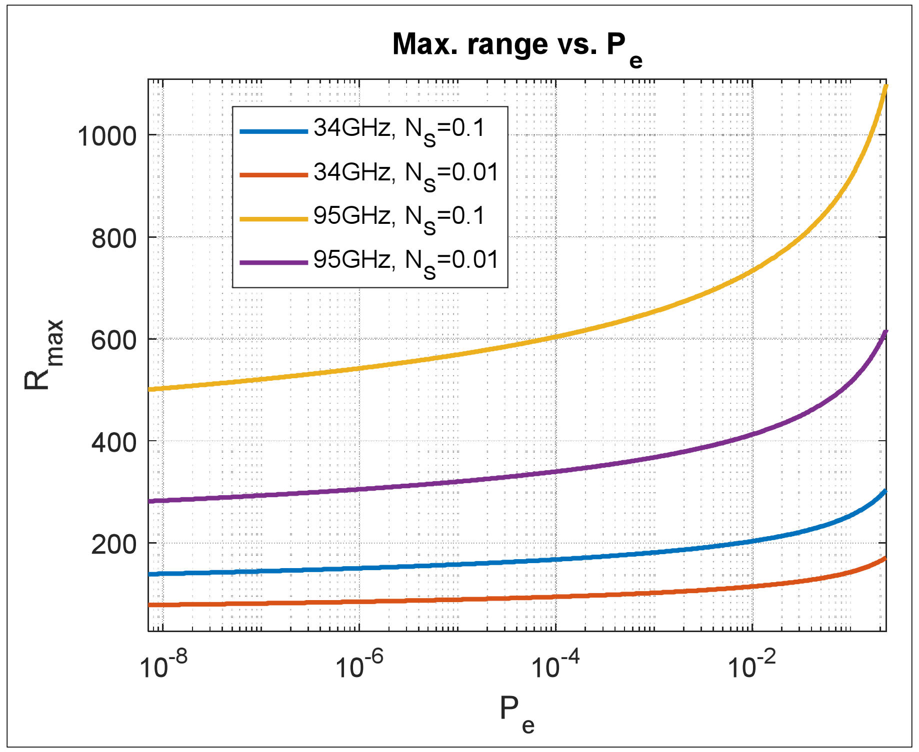
Technical Sheet
Funding institution:
Italian MoD
Project partners
CNIT, UniCAM, INRIM
Project duration
July 2021 - July 2025
Involved countries
Italy



(a) Orange curve is ideal measurement according to classical physics. Blue dots are noise due to quantum effects



(b) Qualitative scheme of a two-photon quantum illumination radar



(c) Quantum Radar maximum range vs. Error Probability