Quantum-enhanced Fibre Optic Gyroscopes (QFOGs).

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During long-term navigation without the presence of a GNSS signal, inertial positioning systems are required to maintain an accuracy of less than 10s of meters. Current technology faces limitations due to bias stability, drift, and Angular Random Walk. Recent research works have explored the use of atomic Raman amplification processes in hybrid atom-light gyroscopes, showing the potential to reduce some of those limitations [1-2]. As schematically represented in Figure 1, these devices are commonly realized with the use of an atomic ensemble of 87Rb contained in a suitable cell and an optical Sagnac loop. Their use can enhance the rotational sensitivity beyond the standard quantum limit [1], surpassing that of more conventional fiber-optic gyroscopes.

With the collaboration between the Leonardo Innovation Labs and GEM we are aiming to further develop this technology for the deployment in ship and aircraft navigation scenarios.

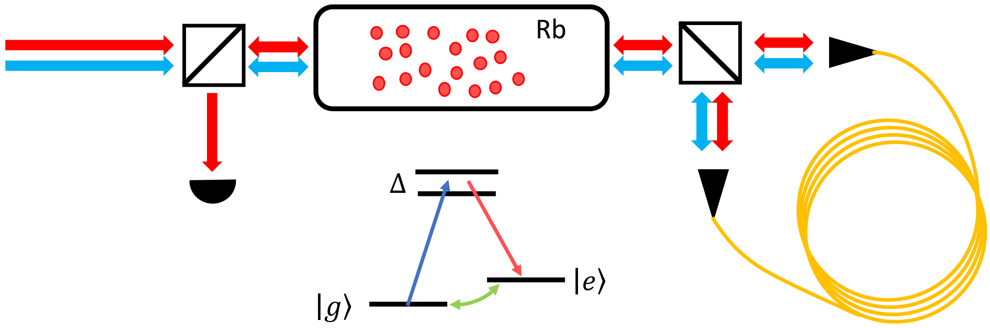

Figure 1: Schematic representation of the Quantum-enhanced FOG. A strong Raman write beam (blue) and a Stokes input field (red) in orthogonal polarization interact with a Λ-shaped atomic system to generate an amplified Stokes field and a correlated atomic spin wave. The amplified Stokes beam is sent back together with another strong write beam to the atomic cell after traveling into a Sagnac loop to recombine with the waiting atomic spin wave for superposition.

[1] Y. Wu et al, Atom-Light Hybrid Quantum Gyroscope, Phys Rev Applied, 064023, 14 (2020)

[2] L. Chen, Z. Y. Ou and W. Zhang, Atom-light hybrid interferometer, Progress in Electromagnetic Research Symposium (PIERS), 3965-3965 (2016)