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GINGERINO sensitivity and quantum noise

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Absolute angular rotation rate measurements with sensitivity better than prad/sec would be beneficial for fundamental science investigations. On this regard, large frame Earth based ring laser gyroscopes are top instrumentation as far as bandwidth, long term operation and sensitivity are concerned.
GINGERINO, the active ring laser prototype of the GINGER collaboration, has shown an unprecedented sensitivity close to 2×10^{-15} rad/sec for $\sim 2 \times 10^{5}$ s of integration time. This sensitivity is more than a factor 10 better than the shot–noise as defined by actually accounted theoretical prediction for ring lasers.
The usually adopted theoretical model relies on the strong hypothesis that the two counter propagating beams are completely independent so that their field variables are uncorrelated. In this context, the shot-noise for a ring laser is the sum of the shot-noise accounted for the two single beams.
In this contribution we will present the experimental determination of the GINGERINO noise limit in its present configuration and discuss possible novel approach for elaborating an amended theoretical model that account for the interaction of the two beams at a quantum level.

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