

Hanbury-Brown Twiss correlations to probe the population statistics of GHz photons emitted by conductors.

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It is a textbook result that a classical electrical current produces photons with a Poisson statistics, as if the photons were classical particles. Could one use deviations from Poisson statistics to characterize the quantum fluctuations in a fully phase-coherent conductor? That is the basic question underlying the research presented in this preprint.

Existing theory predicts that the deviation from Poisson statistics can go either way: Super-Poissonian fluctuations (signaling photon bunching) are the rule in conductors with a large number of scattering channels, while sub-Poissonian fluctuations (anti-bunching) are possible in few-channel conductors. For example, a single-channel quantum point contact with transmission probability T is predicted to produce sub-Poissonian photon noise if $T(1-T)$ exceeds $1/6$.

The experiment by Glattli and his group explores the super-Poissonian regime. Two detectors correlate the power fluctuations of microwave radiation emitted by a resistor in equilibrium at mK temperatures. Positive cross-correlations are observed, indicating bunching. This is very much like the optics experiment of Hanbury-Brown and Twiss, but now at GHz frequencies and in the regime of a low population number of the photon modes. As a control experiment, a classical radiofrequency generator is used as a source. The cross-correlations disappear, as expected for Poisson statistics.

By demonstrating that their experiment can distinguish the super-Poissonian radiation of thermal electrons from the Poissonian radiation of a classical current, Gabelli et al. have demonstrated the potential of their technique. To be sure, both findings rely on "ancient" physics (Einstein - 1909; Glauber - 1963) and are therefore not unexpected. The observation of sub-Poissonian radiation for a nanoscale conductor, which would be a breakthrough of a different nature, now seems within reach.