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## Quantum State Features of the FEL Radiation from the Occupation Number Statistics

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The coherence of free-electron laser (FEL) radiation has so far been accessed mainly through first and second order correlation functions. Instead, we propose to reconstruct the energy state occupation number distribution of FEL radiation, avoiding the photo-counting drawbacks with high intensities, by means of maximum likelihood techniques based on the statistics of no-click events. The theoretical framework, numerical results and the proposed experimental set-up for the verification of our predictions are illustrated. Though the ultimate goal regards the FEL radiation statistical features, the interest of the proposal also resides in its applicability to any process of harmonic generation from a coherent light pulse, ushering in the study of the preservation of quantum features in general non-linear optical processes.

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