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Electron-Beam Noise and spontaneous emission Suppression and the Fundamental Coherence Limits of Free Electron Radiators AVRAHAM GOVER, Tel-Aviv University — It is shown that the electron beam current noise can be reduced at optical frequencies below the classical shot-noise limit. This self-ordering phenomenon takes place due to longitudinal collective Coulomb interaction when the beam parameters are set to excite Langmuir plasma-wave single mode oscillation [1]. Full 3-D particle dynamics simulations confirm the theoretical model. Based on this result, it is shown that it is possible to obtain sub-radiance (in the sense of Dicke [2]) of spontaneous emission from electron-beam radiators. This results in fundamental limit expressions for the coherence of FELs and other e-beam radiators, analogously to the Schawlow-Towns limit [3]. Surpassing the shot-noise limit, the coherence of free electron laser radiation is limited by the e-beam energy spread at frequencies below the IR, and fundamentally limited by quantum noise at higher frequencies.

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