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Threshold Dynamics of a Semiconductor Single Atom Maser[1]

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Photon emission from single emitters provides fundamental insight into the detailed interaction between light and matter. Here we demonstrate a semiconductor single atom maser (SeSAM) that consists of a single InAs double quantum dot (DQD) that is coupled to a high quality factor microwave cavity. A finite bias results in population inversion in the DQD, enabling sizable cavity gain and stimulated emission. We develop a pulsed-gate approach that allows the SeSAM to be tuned across the masing threshold. The cavity output power as a function of DQD current is in good agreement with single atom maser theory once a small correction for lead emission is included. Photon statistics measurements show that the second-order correlation function of intra-cavity photon number, n_c, crosses over from $\langle n_c^2\rangle/\langle n_c\rangle^2 = 2.1$ below threshold to $\langle n_c^2\rangle/\langle n_c\rangle^2 = 1.2$ above threshold. Large fluctuations are observed at threshold.

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