Threshold Dynamics of a Semiconductor Single Atom Maser

YINYU LIU, Department of Physics, Princeton University, Princeton, New Jersey 08544

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.