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Steady State Ab Initio Laser Theory: Generalizations ALEXANDER CERJAN, YIDONG CHONG, Yale University, LI GE, Princeton University, A. DOUGLAS STONE, Yale University — We show that Steady-state Ab initio Laser Theory (SALT)[1] can be generalized to find the stationary multimode lasing properties of gain systems with N levels, and to include carrier diffusion. The former result is achieved by mapping the N-level rate equations to an effective two-level inversion equation of the type typically quoted in the Maxwell-Bloch equations.[2] The latter result is found by rewriting the SALT algorithm to non-linearly solve two coupled non-linear equations in the steady state, with one equation determining the modal field intensities, given the inversion and the other equation determining the inversion given the field intensities. In both cases we find excellent agreement with more computationally demanding Finite-Difference Time-Domain (FDTD) simulations for the steady state. These results generalize the SALT algorithm to handle more realistic lasing systems, including semiconductor lasers.

[1]L. Ge, Y. D. Chong, and A. D. Stone, Phys. Rev. A **82**, 063824 (2010).
[2]A. Cerjan, Y. D. Chong, L. Ge, and A. D. Stone, Opt. Express *in press*, arXiv: 1111.2279v1 [physics.optics]

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