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Langevin Bimolecular Recombination Kinetics of a Layered Exciton–Trion Gas FRANK CROWNE, ANTHONY BIRDWELL, Army Research Laboratory — The use of rate equations to describe various many-body kinetic processes in highly photoexcited layered semiconductors is discussed. In these systems, pairs of electrons and holes generated by photons from an external laser combine to form a multicomponent plasma whose time evolution is governed by gas dynamics and various recombination processes. At high levels of illumination this leads to a variety of secondary components in addition to neutral excitons, notably the so-called trions, which consist of exciton–electron and exciton–hole bound states. Although the recombination is modeled as bimolecular for all pairs of carrier species, the structure of the rate terms is sensitive to the dimensionality of the system due to the Langevin nature of encounters between carriers. It is demonstrated that charge neutrality does not apply to individual carrier species, e.g., electron and hole densities need not be equal in the presence of trions. In order to track the full time evolution from laser initiation to steady state, the system of rate equations is simulated numerically.

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