Reduced-Density-Matrix Approach for Coherent Linear and Non-linear Electromagnetic Interactions[1] VERNE JACOBS, Naval Research Laboratory — Reduced-density-matrix descriptions are developed for linear and non-linear electromagnetic interactions in quantized electronic systems, including atomic systems and semiconductors materials (bulk solids and heterostructures). Environmental decoherence and relaxation processes are treated on a formally equal footing with coherent electron-electron and electromagnetic interactions. Frequency-domain (resolvent-operator) and time-domain (equation-of-motion) formulations are self-consistently developed. Compact Liouville-space operator expressions are derived for the linear and arbitrary-order non-linear electromagnetic-response tensors, allowing for coherent initial electronic excitations and for the full tetradic-matrix form of the Liouville-space self-energy operator representing the environmental interactions.

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