I. INTRODUCTION

In our recent Letter [1] we predicted nanoscale field patterns (*stratification*) emerging in one-dimensional (1D) arrays and two-dimensional (2D) lattices of strongly interacting atoms, driven by a radiation nearly resonant to the atomic transition. We predicted excitation of so called *locsitons* and a host of related effects. A general formulation of the problem and a more detailed theory for 1D arrays was presented in our most recent paper [2]. The present paper is an extension of [1, 2] toward the theory of *2D lattices* of resonant atoms, which produce a much richer set of effects. We construct here a detailed theory of interactions in the system by developing different 2D versions of the nearest-neighbor approximation (NNA), including the "near-ring" approximation (NRA). We also derive dispersion relations for various lattice-polarization configurations for all locsiton wave vectors within the corresponding first Brillouin zones. Our theory predicts such phenomena as subwavelength multicell patterns, including multivortex locsiton excitations, and locsitons localized near lattice defects. Further on, we predict "magic shapes" of nanosize groups of atoms, which reverse the effect of a resonant locsiton suppression present in all but few configurations. The simplest magic configuration which can be cut out of a triangular lattice is a six-point star with an atom at its center, which makes the lowest "magic number" of atoms to be 13.

The predicted effects would be totally unexpected within the standard theory of local fields [3] going back to the works of Lorentz [4] and Lorenz [5]. That celebrated theory asserts that the microscopic electric field $\mathbf{E}_\mathrm{L}$ acting upon any given atom in a medium—the *local* field (LF)—differs from the macroscopic field $\mathbf{E}$ of the electromagnetic wave, because electric dipoles induced in neighboring atoms produce extra field to supplement the field of the incident wave. This difference is significant in dense media, where the interatomic interactions are sufficiently strong. Under such conditions, typical interatomic distances are much shorter than the optical wavelength, and the dipole-dipole interactions between atoms can be treated as quasistatic. The major point of the Lorentz-Lorenz theory (LLT) of local fields is that the LLT contains a fundamental assumption (which often remains implicit and unspoken in the literature) that the LF varies very insignificantly between neighboring atoms, much like the applied optical field on the subwavelength scale. Unsurprisingly, that theory results in the LF being proportional to the macroscopic electric field, $\mathbf{E}_\mathrm{L} = \mathbf{E}(\epsilon+2)/3$, where ϵ is the dielectric constant of the medium.