much less than the effective spin for magnetic dots not exceeding 10 or 15. It is also important that the size of magneto-active part of a single high-spin molecule is small compared to the total size of molecule; therefore the dipole interaction is weak.

Hence, magnetic dot arrays are specific new magnetic materials with purely two-dimensional and quite regular lattice structure and long distance dipolar coupling between magnetic moments, which are rather large and manifest at high temperature. From the point of view of dynamical properties this implies that for magnetic dot arrays the well-defined modes of collective oscillations characterized by definite quasimomentum should exist, while this is admittedly not the case for granular magnets or dilute solid solutions of paramagnetic ions. The direct measurement of the dependence $\omega(\vec{k})$ can be done by the Brillouin light scattering method. In the pioneering experiments[18–20] no indication for a band structure due to the periodic arrangement of the dots was found, see also review articles.[21,22] However, more recently the dispersion effects for dense arrays were clearly observed by the Brillouin light scattering method,[23,24] and time resolved scanning Kerr microscopy,[25] stimulating the development of the theory for these systems.

In first theoretical articles, the finite systems were investigated, sometimes with large enough number of dots N, such as $N \sim 10^3$-10^4, see Ref. 26 or even smaller systems.[27] The analytical calculations were performed using the Bloch theorem which is applicable to infinite arrays. The cases of spherical particles,[28–30] cylindrical particles in uniform state[31,32] and in the vortex state,[33] were also considered, see for review.[34])

In the present work we considered collective modes for a square lattice of rather small dots of nearly ellipsoidal shape in which magnetization can be considered as uniform within a single dot in the presence of an external bias magnetic field. Only the simplest magnetic states of the magnetic dot system, namely, FM state and chessboard AFM state are considered. The long-range character of interaction of magnetic dots leads to unique properties of collective excitations in this system, which are absent in both continuous thin films and for dipole coupled spins in the 3D lattice. Especially for the FM state it is clear that non-analytic dependence of collective mode frequencies on quasi-momentum $\vec{k}$, appears. Namely, as $\vec{k} \to 0$ the spectrum has a finite gap ω_0, but the dispersion law is nonanalytic $\omega \to \omega_0 + c|\vec{k}|$. For AFM state, the spectrum consists from two energy bands, which are connected at the border of the Brillouin zone of the lattice at zero magnetic field, but these two bands are well separated by an energy gap at finite fields. For this state the unusual