Electro- and Magneto-optical Functions of Rydberg Excitons

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The phenomenon of Rydberg Excitons has recently attracted considerable attention. After their detection in a natural crystal of copper oxide (cuprite) found at the Tsumeb mine in Namibia [1] an intensive research, both theoretical and experimental, started [2-7]. In the theoretical description, two methods were used. The first starts from the symmetry properties of the cuprite, which then results in an appropriate form of the Hamiltonian. The Schrödinger equation is solved, giving the excitonic resonances [2-4]. The second method is based on the effective-mass approximation and uses the so-called real density matrix approach. In this approach a constitutive equation is solved, giving both the resonances and the crystal dielectric function, from which the optical functions can be calculated [5-7]. Both methods are used to obtain the electro- and magneto-optical properties of Rydberg excitons. Here we use the real density matrix approach in order to obtain susceptibility, absorption, reflection and transmission. Having in mind the experimental results, we focus our attention on the optical spectra of Cu_2O under the influence of electric field (Fig. 1 a) or magnetic field (Fig. 1 b). We derive an analytical expression for the susceptibility, from which other optical functions can be obtained. Our numerical calculations are in agreement with experimental results obtained by Kazimierczuk *et al.* [1] and Thewes *et al.* [2].

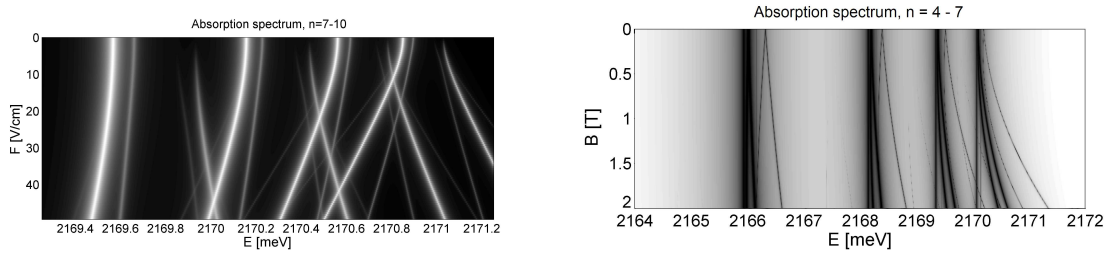

Figure 1: a) Absorption spectrum of Cu2O crystal, in the energetic region of n = 7-10 excitonic states as a function of the applied electric field strength. b) Magnetoabsorption spectrum for n=4-7 states.

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