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Review report on the PhD manuscript on
"Multiexcitons in semiconductor quantum dots"
presented by Maciej Molas

In his manuscript, Mr Maciej Molas presents the PhD work on the magnetospectroscopy of the exciton complexes confined in quantum dots in the (Ga,Al)As/AlAs heterostructure. The studied sample was very particular: with very low density of dots, relatively deep carrier confining potential and very efficient excitation channels. The choice of the sample has given unique possibilities of the studies of high-order excitonic complexes. The author fully used the opportunities and presents the results of advanced studies of individual dots with the detailed analysis of optical transitions which are difficult to be observed in more common systems. In particular, the new knowledge is brought by tracing the evolution of excitonic complexes in high magnetic fields and combining the photoluminescence data with photoluminescence excitation spectra.

The manuscript is organized into nine chapters. The first two contain short introduction to the subject of the thesis and brief description of simple models of carriers and exciton complexes in a quantum dot. The investigated sample is shortly described in chapter 3. The experimental setups and techniques are summarized in chapter 4. The hapter 5 is devoted to description of optical spectra of individual quantum dots. This chapter is partially based on the knowledge gained during the previous studies performed by other authors on the same sample. Nevertheless, the complete information on the photoluminescence spectra is very useful for understanding the next chapters. Author summarizes the information about the regimes of the optical excitation, presents the identification of the series of emission lines and discusses the observed changes of the averaged charge state of the dots. Particularly important is identification of the groups of lines related to complexes having the same charge state. The most important groups of lines are assigned to neutral, single positively and single negatively charged excitonic complexes. While neutral complexes might be easily recognized, the firm determination of the sign of single charged complexes is very difficult, if there is no design for applying an electrical bias. The author is aware of this problem, but gives convincing arguments supporting the proposed identification. Overall, the chapter is clear and complete.

The most significant experimental results are presented in chapters 6 and 7. Those chapters constitute the main part of the thesis and are devoted to studies of transitions related to neutral and positively charged families of lines, respectively. The methodology of studies is based on the comparison of the photoluminescence and photoluminescence excitation measurements performed in high magnetic fields, supported by the analysis of single photon correlation experiments. Among neutral complexes, the most interesting results are related to the identification of the 3X complex and its evolution in the magnetic field. The identification of the series of peaks observed in the PLE spectra detected on X line is original and interesting.

The most remarkable result of the thesis is described in chapter 7. The detailed analysis of different experiments, in particular a comparison of the PL and PLE spectra in magnetic fields reveal the presence of the excited resonance composed of two holes and electron from the *p*-shell (denoted by author as ${}^{p}X^{+*}$ or R^{*}). This attribution is based on solid arguments concluded from different experiments. Surprisingly, it is demonstrated that the complex is sufficiently long-living to give well visible peak in both emission and absorption. This finding opens a possibility of future interesting studies by means of time resolved spectroscopy. Generally, the presented analysis is convincing, and the results significantly extend the available data.

The last chapter describing the experimental results, (chapter 8), is quite short which reflects relatively modest structure of the spectra related to negatively charged complexes. In particular, no resonances were observed in the excitation spectra. This is explained as a result of the dominant mechanism of the excitation of the quantum dot. The last chapter of the thesis (chapter 9) gives very compact conclusions of the work.

The whole manuscript is interesting and based on data obtained in very difficult experiments. I will not judge on the language but I have had no problems with understanding it. Overall, the presentation as well as the scientific level of the experimental work is excellent, and I recommend the defense of the thesis, aiming to obtain the degree of Doctor in Physics from both the University of Warsaw and the Joseph Fourier University of Grenoble.

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