



Facultad de Ciencias

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Report by J.M. Calleja

The manuscript entitled:

“Multiexcitons in semiconductor quantum dots”

presented by **Mr. Maciej Molas** to obtain the PhD degree at the University Warsaw presents a complete and systematic study of the optical emission and absorption properties of single GaAlAs/AlAs quantum dots. The main goal of the work is the understanding of the level structure of excitonic complexes (both neutral and charged), by optical experiments, including mainly photoluminescence, photoluminescence excitation spectroscopy and photon correlation measurements. Also the study includes an important attempt to understand the trends appearing on varying the quantum dot properties, as emission energy, band splittings etc. as well as on applying an external magnetic field. The identification of three families of emission peaks corresponding to neutral, positively charged, and negatively charged excitonic complexes, and the explanation of their behavior in terms of simple ideas is one of the major results of the work.

The manuscript is organized in 9 chapters, starting with general considerations on the subject, then giving a description of the samples studied and the experimental techniques used, and finally presenting the experimental results, their interpretation and the general conclusions. It is clearly written (although not fully free from typographic errors) and well organized.

The material system studied (self-organized AlGaAs quantum dots) is very complicated because of the limited control on their morphological properties. Also the high optical



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excitation adds more difficulties because of the Coulomb interaction between the several photoexcited carriers. As a consequence, part of the experimental results presented cannot be fully understood without the help of a massive theoretical approach, which is out of the scope of this work. However, the manuscript represents a clear step forward in the understanding of highly excited semiconductor quantum dots. The experiments described are highly non-trivial, and need a large effort both in time and equipment. In particular, the high-resolution photoluminescence excitation measurements in magnetic field are both difficult and cumbersome. The satisfactory results obtained speak for the experimental skills and work capacity of the candidate.

In summary, I consider the present PhD work as “very good” and I strongly recommend it for presentation at the University Warsaw in view to obtain the PhD degree.

The dissertation fulfils the requirements of the act on academic degrees and titles, therefore I apply for admitting Mr. Maciej Molas for further stages of the procedure for a doctoral degree.

Madrid, 20 October 2014.

A handwritten signature in black ink, appearing to read 'José Manuel Calleja'.

Prof. José Manuel Calleja