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In the manuscript of his PhD Thesis, Jan Kunc has presented experimental studies of a two-dimensional electron gas (2DEG) embedded in single side modulation n-doped CdTe/CdMgTe and magnetic CdMnTe/CdMgTe quantum wells. The interest in these quantum wells comes from the fact that g factor (Zeeman splitting) differs significantly from the one of the well-known Ga/GaAlAs quantum wells. One expects therefore the important modification of the energy spectra and many body related phenomena, such as for example Fractional Quantum Hall Effect. The experimental investigation has been done by means of magneto-photoluminescence, photoluminescence excitation, longitudinal and Hall resistance measurements. Complementary techniques of far-infrared cyclotron resonance absorption and of Raman inelastic scattering were also used. The experimental studies were completed by the detailed analysis and compared with theoretical models based on both simple single particle models and more complex models of electron-electron many-body interactions.

In chapter 2, the author presents the theoretical overview. I find this chapter very well written. It can serve as introduction and can be very useful, especially for inexperienced readers. Chapter 3 presents the samples – the objects of studies. After description of technological parameters, the author presents – in chapter 4 - band structure calculations allowing the knowledge of the energy spectrum of confined states in QWs investigated. This chapter is very clearly written and demonstrates author's capabilities in band structure numerical calculations. Basic characterization of samples by means of far infrared absorption and inelastic Raman scattering is presented in chapter 5. These experiments help to determine the effective mass and effective g-factor of electrons. These are the main parameters used in a single particle description of spin resolved Landau levels of a 2DEG in a magnetic field. This chapter presents a rich set of experimental data that are only partially explored by the author.

Chapters 6 and 7 present magneto-transport and magneto-luminescence studies of CdTe/CdMgTe and CdMnTe/CdMgTe quantum wells. These are main chapters of the work. The author tries to answer in them if and how the change of the semiconductor matrix from GaAs to CdTe influences the effects of many-body interactions. In the part dedicated to low field transport, in addition to a classical Drude term – the weak localization and negative magneto-resistance terms (explained by semi-classical model of circling electrons) were clearly identified. Furthermore, the analysis of the amplitude of Shubnikov-de Hass oscillations allowed to conclude that long-range scattering mechanism is the dominating one. The high magnetic field magneto-transport has shown well developed fractional quantum Hall features in the Landau level N = 0 (ν = 5/3, 4/3) and N = 1 (ν =7/3, 8/3). The fractional quantum Hall (FQH) states 5/3

and 4/3 have been a subject of magneto-transport studies in a tilted magnetic field. It was found that the properties of these FQHE states are strongly influenced by the intrinsic Zeeman energy, resulting in the complete spin polarization, in agreement with a composite fermion approach for the FQHE effect.

Chapter 7 presents the studies of the spin gap enhancement of fully occupied Landau levels by means of magneto-photoluminesce in a wide range of magnetic fields and temperatures. Both field and temperature dependences have been successfully described with a proposed phenomenological model. Very interesting conclusion obtained by the author is that the spin gap enhancement does not occur only near the Fermi energy, but it occurs for all occupied Landau levels and that its magnitude is the same for all Landau levels up to the Fermi energy. Extensive studies of the polarization resolved PL intensity revealed several mechanisms influencing the efficiency of the radiative recombination and led to identification of the recombination mechanism in which a simultaneous electron and hole spin-flip takes place. Such processes have been attributed to phonon-assisted Bir-Aharonov-Pikus spin-relaxation mechanism. Magneto photoluminescence excitation spectra presented in chapter 8 revealed the characteristic band levels of the samples studied. Author's analysis points on the importance of the screening and internal electric field in the single side modulation doped QWs.

Concluding – the author presented an extensive magneto-optical and magneto-transport experimental study of a 2DEG in CdTe/CdMgTe and magnetic CdMnTe/CdMgTe quantum wells. He successfully interpreted a number of the observed phenomena and compared the results with those reported in the past on GaAs/AlGaAs structures. Numerical calculations and/or simulations supported the data interpretation.

I find the work of J.Kunc of very high scientific quality. His manuscript is clearly written and what is important contains relevant basic information. This may help an inexperienced reader (another PhD student) to get familiar with the theme studied. The goals and results are clearly described and critically analyzed. The employed experimental methods are very extensive: from low magnetic field transport, Raman scattering, infrared transmission to high field luminescence. In addition to superior experimental capabilities, the author demonstrated also a very good background in theory and good abilities in numerical calculations. References are appropriate and well organized. The conclusions are important for understanding of many-body interactions in quantum Hall effect systems. Notably, the critical analysis of the results allowed author to address several important but unresolved questions.

Summarizing: PhD work of J.Kunc is of very high scientific quality and fully qualifies him for a public PhD defense.

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EVALUATION

Nom du rapporteur : ……KNAP Wojciech…….
(*Name of the referee*)

Nom du doctorant : .....Jan KUNC.....
(*Name of the candidate*)

Niveau scientifique : *Mark*	Satisfaisant *Satisfactory*	Bon *Good*	Très bon *Very good*	Exceptionnel *Exceptionnel*
	□	□	□	x

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