Thesis "Hall effects in nonmagnetic systems: classical, quantum and fractional" submitted by Stáňa Tázlarů concerns three topics linked by the occurence of transversal voltage related to orbital rather than spin degrees of freedom. Using several different theoretical techniques, first the problem of classical Hall effect in metallic alloys is studied and then two cases of two-dimensional electron gas (2DEG) subject to quantising magnetic field are considered. The latter concern integer and fractional filling factors $\nu \propto 1/B$ and hence all three parts of the thesis can be understood as a sequence of selected problems starting with weak magnetic fields B that proceeds to strong fields (where ν is a small integer) and the strongest one with $\nu = 1/3$.

In this last section, the single mode approximation (SMA) of Girvin, MacDonald and Platzman is invoked to calculate the excitation spectrum of a many-body fractional quantum Hall system. While electron-electron interactions of the usual Coulomb type have been thoroughly studied before, short-range interaction (that is central to the understanding of the $\nu = 1/3$ incompressible ground state) could support mode softening as suggested by exact diagonalisation. Results presented in the thesis, namely Fig. 3.5, corroborate this. Further, the so called WYQ state (relevant to more exotic fractions such as $\nu = 4/11$) is investigated but SMA does not yield conclusive results regarding its stability; possible workarounds are nevertheless discussed in Appendix A.5

Section concerning integer quantum Hall effect is directed towards the problem of how electron spectrum of crystals is modified by strong magnetic fields beyond the well known example of 2D square lattice (where the result is known as the Hofstadter butterfly, Fig. 2.1). Methodology for this task is developed but the actual application to bcc lithium lattice has not been performed. Outline of further research in this direction is given in Sec. 2.2.

Most significant results presented in the submitted thesis have been achieved in towards the weak-field Hall effect. Motivated by the need to identify materials suitable for magnetic field sensors at ITER, a framework to calculate R_H of the classical Hall effect in alloys (based on the single-site coherent potential approximation) has been derived and applied to a tight-binding model. This model describes a simple alloy (two types of atoms on a square lattice) but offers the prospect of describing realistic systems A_xB_{1-x} where A and B are transition metals, with appropriate improvements. This direction of research would be suitable for a doctoral study in theoretical solid state physics.

The extent of present work is large and even if some parts call for some extra work that should have been done (e.g. the analysis of stability of WYQ state in Sec. 3.2.1) there is no doubt on my part that presented results safely exceed expectations for master thesis. Occasional mishaps in language (beginning of Sec. 1.1.1 for example: Inclusion of temperature ... is straightforward done) or awkward formulations (such as at the end of Sec. 1.2.3 or on the top of p. 40) which bear witness to a less-then-optimal project/time management, should not be taken as an obstacle to defend the thesis in front of professional public. It is clear that its author understands in detail the concepts she describes and also demonstrates her creativity (e.g. in applying the Gershgorin theorem in the context of CPA, see Fig. 1.11 or in analysing electronic structure of 2DEG subject to quantising magnetic fields in Sec. 2.1.1) so that her work constitutes a valuable addition to the state of knowledge in the field of quantum mechanical treatment of electrons subject to magnetic field. Therefore, I recommend the thesis for defence.

Two questions related to the research described in the thesis that can be discussed at the defence follow on next page.

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1. In Sec. 2.2, it is proposed that electronic structure of bcc lithium subject to quantising magnetic fields could be studied using methods developed in the thesis. What experiments are conceivable to detect the effect of magnetic field in this context? Can any estimates be made already at this stage about magnitude of effects that can be expected?

2. The final part of Sec. 3.2.1 concerns the nature of so called WYQ state. What fractional quantum Hall states could it be relevant to? (Which filling factors apart from the already mentioned $\nu = 4/11$ are pertinent?) Conclusions based on SMA are understandable to me but experimental background should also be given. Experimentally, what is known about about the fractions in question?