Thesis of Lukáš Beran, hereafter referred to as the candidate, submitted to the Faculty of Mathematics and Physics (Charles University, Prague) deals with optical and magneto-optical (MO) properties of certain magnetically ordered garnets. This experimental work touches on lively research fields of spintronics and photonics and constitutes a valuable contribution to both these and, more generally, to material science of magnetic insulators. Results presented are not directly relevant for industrial applications but, through the aforementioned relationship to other fields than material science, they may prove useful also in this respect one day. Scientific value of the presented work lies, in my opinion, in the successful preparation of thin layers of the particular doped garnets and its structural, magnetic (including MO) and optical characterisation. There is no doubt that it bears witness to a significant effort on the experimental side, however, I was somewhat disappointed by the lack of deeper scientific analysis (see my comments on Sec. 11 below) and also by the formal aspect of the text. The former is not really an objection — it is abundantly clear that some research topics prove more fruitful and others less — but as for the latter, language is poor in some parts of the thesis and one is tempted to start guessing which sections were candidate's least favourite ones and received less than necessary attention. Illustrative examples are given below among general comments, let me quote just a single one here: "periodic array of atoms and his colleges" (p. 19, second paragraph). I believe that theses submitted to Charles University deserve better.

The "theory-methods-results" structure sandwiched by introduction and conclusions is a time-honoured approach to organising scientific reports and I fully approve of how Lukas Beran assembled his thesis. High density of typos in part I aside, the introduction reads well and serves its purpose of explaining the choice of studied materials which are almost exclusively derived from iron garnets, the prime example of which is the yttrium-iron garnet (YIG). Basic concepts of optical and MO response are explained in Sec. 3 (entitled interaction of light and matter) and these two categories are briefly descibed, from theoretical viewpoint, in other two (preceding) Sections of part II. Again, this is a perfectly meaningful scheme and my only point of criticism is the density of typos (which is more serious than in part I given that now, they also occur in formulae). Finally, part III describes experimental methods: sample preparation (Sec. 4) and characterisation (Sec. 5-7) and here, I found little to nothing what could be added.

The body of original results is organised into four sections within part IV of the thesis. While sections 8 and 9 are introduced by different motivations (photonic and spintronic applications), this distinction is in fact largely arbitrary; this is also strikingly apparent when reading the Conclusions (part V) — majority of paragraphs there are simply devoted to individual material classes. In both mentioned sections of part IV, material by material are investigated by widely used optical (ellipsometry) and magneto-optical methods (such as MO Kerr effect). It is perhaps not the most novel and innovative approach to material research, yet it is by no means reducing the scientific value of the presented work. Quite opposite, it demonstrates the ability of the candidate to independently perform research in his chosen field of physics carefully. Section 10 picks two of the materials (cerium doped YIG and terbium iron garnet) and explores how the MO effects vary with temperature (with special emphasis on T_{comp}). The last mentioned material serves as the object of semiclassical modelling in section 11. Both these sections could be expanded to include also other materials explored elsewhere in this thesis and specifically the modelling leaves the frustrating impression that more could have been done towards gaining physical insight into the collected data on magnetooptics. All these slightly critical remarks notwithstanding, **the presented thesis** contains enough material by a safe margin to qualify for the award of PhD degree and, as stated above, **demonstrates the ability of the candidate to carry out scientific research**.

Questions and some additional detailed comments follow on next page.

Kutná Hora, May13 2020

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General comments

- the fundamental-science aspect of the performed research should in my opinion be highlighted; as much as it was worth mentioning how it could be related to anything interesting for industry I am not convinced by the presented arguments that, for instance, Eu iron garnet will ever be a part of any commercial spintronic device (this should not be understood as harsh criticism, it is rather a suggestion)

- more basic properties of undoped YIG should have been reviewed (see also Q#1); given the focus of this thesis, Subsec. 4.1 is minimalistic and the total of three references here to other works on various options for doping YIG is far below any reasonable expectation (further information scattered throughout the text, e.g. on p. 73, should be cross-referenced in Subsec. 4.1)

- abundant typos and awkward formulations: "the model suspects" and "dumping of motion" (p. 27), missing index of c_0 in Eq. 1.8 (p. 10), the first sentence of Sec. 5 (p. 41), "polariser is set to mach" (p. 5) to give a few more examples to what was already mentioned above — there are just too many of them

Particular comments

- p. 15: taking the step of Eq. (1.32) is *not* necessary to obtain a real measurable quantity (components of $\vec{E}$ are also a real measurable quantity)

- p. 22: other types of antiferromagnets than "simple two-sublattice collinear" should be mentioned in this overview

- p. 27: $\vec{E}$ is missing in Eq. (3.9)

- p. 30: n below Eq. 3.22 is not defined here

- p. 44: Jones coefficients, Eq. (1.30) could be cross-referenced here for convienience

- p. 45: the definition of FoM is truly 'well hidden' (neither could I easily find the reference through the list of acronyms on p. 129)

- p. 55: a reference to ellipsometry of Bi:YIG would be helpful at this place (Fig. 8.35 comes first $\sim$ 30 pages later)

- p. 75: it seems appropriate to compare data in Fig. 8.25 to those in Figs. 8.10, 8.15

- p. 89: why can't MO effects be measured above 4.25 eV?

- p. 103: MO model shows nothing about domains as far as I understand; that is a conclusion coming from magnetometry

Questions

1. Ce:YIG is claimed to have an indirect gap (p. 60); how were the transmission spectra analysed to produce this result?

2. in chapter 9, the effect of temperature-dependent lattice constants is promised to be discussed later. However, I only found such discussion for Ce:YIG in Sec. 10.1 — what substrate-strain effects are expected for TmIG, TbIG, EuIG?

3. why is PMA needed in spintronics? (p. 83) Can the motivation behind refs. 78, 79 be explained in detail? Is the dipole-dipole interaction significantly contributing to magnetocrystalline anisotropy (see e.g. Appendix A in Phys. Rev. B 97, 235111)?