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Reference letter for Libor Šmejkal's Ph.D thesis.

It is my pleasure to write this reference letter for Libor Šmejkal's Ph.D thesis. Libor has been an absolutely exceptional graduate student at the Faculty of Mathematics and Physics of the Charles University in Prague. His Ph.D. research has been carried out in the Institute of Physics of the Czech Academy of Sciences under my supervision and under co-supervision of Jairo Sinova from University of Mainz.

Libor has made outstanding achievements in his Ph.D research with a broad impact worldwide that would be exceptional even for a senior scientist. He has become the leading figure in the field of topological antiferromagnetic spintronics, thanks to his nine original papers, three review articles, and 13 invited talks at international conferences. Among his major contributions are the theoretical prediction of antiferromagnetic Dirac semimetals hosting topological metal-insulator transition and anisotropic magnetoresistance phenomena, and the spontaneous Hall effect due to a new crystal symmetry breaking mechanism in collinear antiferromagnets for which he coined the term crystal Hall effect. Libor is a theoretical physicist and during his thesis he worked with theory groups from his home institutions in Prague and Mainz, and from Forschungszentrum in Jülich, University of Göttingen, Max Planck Institute in Dresden, and University of Texas. Simultaneously, he has developed close collaboration links with experimentalists in Prague and Mainz, as well as with experimental groups from the University of Cambridge, University of Würzburg, Trinity College in Dublin, and Beijing University in Beijing. Among others, these collaborations have led to experimental verifications of Libor's original theoretical predictions.

Libor has co-authored 12 papers, in most cases as the leading author or leading theory author, including 2 articles in Physical Review Letters, 2 in Nature Physics, an article in Nature Communications and in Science Advances. His Ph.D thesis contains the original results published in these papers, as well as a number of additional details providing the overview of topological antiferromagnetic band theory and first-principles theory of relativistic antiferromagnets. The text goes well beyond standard thesis as it provides a self-contained

comprehensive entry point for students and senior scientists alike into the new field of topological antiferromagnets.

Finally, I'd like to point out that during his Ph.D years, Libor turned from a tutee into a tutor of his nominally senior supervisors and advisors and that other Ph.D students and postdocs from his home institutions and around the world have greatly benefited from interactions with Libor.

Sincerely,

Tomas Jungwirth, Prague, Apr 2, 2020