Erratum: Large anomalous Nernst and spin Nernst effects in the noncollinear antiferromagnets Mn_3X ($X = \text{Sn, Ge, Ga}$) [Phys. Rev. B **96, 224415 (2017)]**

Guang-Yu Guo and Tzu-Cheng Wang

(Received 20 October 2019; published 31 October 2019)

 DOI: [10.1103/PhysRevB.100.169907](https://doi.org/10.1103/PhysRevB.100.169907)

In the original paper, due to an inadvertent bug in the computer program used, all the values of the anomalous Nernst conductivity (ANC) (α_{xy}^A) and spin Nernst conductivity (SNC) (α_{xy}^z) should be scaled by a factor of $100/V_c$ where V_c is the unit-cell volume in units of a_B^3 with a_B being the Bohr radius. The unit-cell volumes for Mn_3Sn , Mn_3Ge , Mn_3Ga , bcc Fe, and fcc Pt are 848.12, 718.27, 726.37, 101.62, and $79.77a_B^3$, respectively. Consequently, the values of α_{xy}^A and α_{xy}^z for Mn_3Sn , Mn_3Ge , and Mn_3Ga reported in our paper are too large by factors of 8.481, 7.183, and 7.264, respectively, whereas α_{xy}^z for bcc Fe is slightly too small by a factor of 0.798. The correct α_{xy}^A and α_{xy}^z are now listed here in Table I which should replace Table II in the original paper and displayed in Fig. 1 here which should replace Fig. 6 in the original paper. Also, the ANC and SNC curves displayed in Figs. 3(c), 4(c), and 5(c) in our paper should be multiplied by 0.1179 (Mn_3Sn), 0.1392 (Mn_3Ge), and 0.1377 (Mn_3Ga), respectively, although their shapes are correct.

In connection with this mistake, following minor revisions in the text in the original paper are needed. In the abstract, in the second paragraph of Sec. III B and in the Conclusions, “being 10–40 times larger than that of iron” should be read as “being up to five times larger than that of iron.” In the abstract, in the first paragraph of the second column of p. 7, and in the Conclusions, “being about five times larger than that of platinum” should be replaced with “being as large as that of platinum.” In the second paragraph of the first column of p. 2, “being more than ten times” and “is larger than that” should be replaced by “being up to five times” and “is as large as that,” respectively. In the first paragraph of the first column of p. 6, “–19” should be read as “–2.24.” In the second paragraph, “being up to ~ 20 A/m K, which is 50 times larger than that of bcc Fe,” should be read as “being up to $2.65 \text{ A m}^{-1} \text{ K}^{-1}$ which is about five times larger than of bcc Fe.” Also in this paragraph, “(e.g., $\sim 10 \text{ A/m} - \text{K}$ at $T = 400 \text{ K}$)” should be replaced with “(e.g., $\sim 1.5 \text{ A m}^{-1} \text{ K}^{-1}$ at $T = 400 \text{ K}$),” and “the ANC of Mn_3Ge increases steadily and reaches to A/m-K at 50 K, while that of Mn_3Sn stays around 0.6 A/m-K” should be read as “the ANC of Mn_3Ge increases

TABLE I. Calculated density of states at the Fermi level [$N(E_F)$ (states/eV/spin/f.u.), AHC; σ_H^A (σ_{yz}^A , σ_{zx}^A) and ANC; α_N^A (α_{yz}^A , α_{zx}^A) as well as SHC (σ_{xy}^z) and SNC (α_{xy}^z) of Mn_3X ($X = \text{Sn, Ge, Ga}$). For comparison, the calculated related properties of bcc Fe (σ_{xy}^A , α_{xy}^A) and fcc Pt (σ_{xy}^z , α_{xy}^z) are also listed. Note that ANC and SNC listed here were calculated at a temperature of $T = 300 \text{ K}$. The ANCs for Mn_3Sn in brackets were calculated at $T = 210 \text{ K}$ and the SNCs for fcc Pt in brackets were calculated at $T = 255 \text{ K}$. For comparison, the results of the magnetic moment direction-constrained calculation for Mn_3Ga in configuration A (denoted A*) and the ferromagnetic calculation for Mn_3Ga with the magnetic moments in the $\hat{x}$ direction (denoted FM) are given as well. Some previous experimental results are also listed for comparison.

		$N(E_F)$	σ_H^A (S/cm)	$\sigma_H^A(\mu')$ (S cm $^{-1}$ eV $^{-1}$)	α_N^A (A m $^{-1}$ K $^{-1}$)	σ_{xy}^z ($\hbar/e$) (S/cm)	$\sigma_{xy}^z(\mu')$ ($\hbar/e$) (S cm $^{-1}$ eV $^{-1}$)	α_{xy}^z ($\hbar/e$) (A m $^{-1}$ K $^{-1}$)
Mn_3Sn	A	1.96	–132, –68 ^a , –90 ^b	–456	–0.54(–0.14), –0.39 ^b , –0.28 ^c	72	–845	0.91
	B	1.96	–132, –126 ^a , –80 ^b	–444	–0.55(–0.14), –0.32 ^b	74	–834	0.88
Mn_3Ge	A	2.37	–298, 310 ^d , 150 ^e	–9020	–0.89	56	691	0.14
	B	2.38	–298, 380 ^d , 500 ^e	–8289	–0.89	63	1000	0.09
Mn_3Ga	A	5.99	–104	–3722	2.41	–219	–5323	1.01
	A*	5.99	–106	–3697	2.38	–219	–5134	1.17
	B	5.99	–103	–3953	2.34	–241	–3561	0.91
	FM	6.82	181	–12836	–1.94	–678	–10601	0.44
bcc Fe		1.11	708, 1200 ^e	–230	0.50, 1.8 ^f			
fcc Pt		1.75				2139	1214	–1.09(–0.91), –1.57 ^g

^aReference [1] (experiment at 50 K).

^bReference [2] (experiment at 210 K).

^cReference [3] (experiment at 200 K).

^dReference [4] (experiment at 10 K).

^eReference [5] (experiment at 2 K).

^fReference [2] (experiment at 300 K).

^gExtracted from the experiment at 255 K [6].

FIG. 1. (a) ANC (α^A) and (b) SNC (α_{xy}^z) as a function of temperature. The solid symbols denote the values of the ANC and SNC at 100 K calculated using the Mott relations [Eqs. (5) and (7) in our paper] and the energy derivatives of anomalous Hall conductivity (AHC) and spin Hall conductivity (SHC) listed in Table I here, respectively.

steadily and reaches $0.72 \text{ A m}^{-1} \text{ K}^{-1}$ at 50 K, whereas that of Mn_3Sn stays around $0.07 \text{ A m}^{-1} \text{ K}^{-1}$.” In the second paragraph of the first column of p. 7, “although the measured ANC (0.39 and $0.28 \text{ A m}^{-1} \text{ K}^{-1}$) for configuration A is a few times smaller than the calculated ANC ($1.6 \text{ A m}^{-1} \text{ K}^{-1}$)” should be read as “although the measured ANC (0.39 and $0.28 \text{ A m}^{-1} \text{ K}^{-1}$) for configuration A is about two times larger than the calculated ANC ($0.14 \text{ A m}^{-1} \text{ K}^{-1}$).” In the third paragraph of the second column of p. 7, “about $9 (\hbar/e) \text{ A/m-K}$ ” should be read as “about $1.1 (\hbar/e) \text{ A m}^{-1} \text{ K}^{-1}$,” and “being as large as $14 (\hbar/e) \text{ A/m-K}$ at 300 K ” should be replaced with “being as large as $1.9 (\hbar/e) \text{ A m}^{-1} \text{ K}^{-1}$ at 300 K .” In the first paragraph of the first column of p. 8, “ $\sim 10 (\hbar/e) \text{ A/m-K}$ at 400 K ” should be replaced with “ $\sim 1.2 (\hbar/e) \text{ A m}^{-1} \text{ K}^{-1}$ at 400 K ,” “ $\sim 4.4 (\hbar/e) \text{ A/m-K}$ at 400 K ” should be read as “ $\sim 0.61 (\hbar/e) \text{ A m}^{-1} \text{ K}^{-1}$ at 400 K ,” “ $\sim 10 (\hbar/e) \text{ A/m-K}$ at 175 K ” should be replaced with “ $\sim 1.34 (\hbar/e) \text{ A m}^{-1} \text{ K}^{-1}$ at 175 K ,” and “ $\sim 1.9 (\hbar/e) \text{ A/m-K}$ at 400 K ” should be read as “ $\sim 0.26 (\hbar/e) \text{ A m}^{-1} \text{ K}^{-1}$ at 400 K .” In the second paragraph of the first column of p. 8, “For Mn_3Ga (Mn_3Ge), the SNC value from Eq. (7) is 2.5 (five) times smaller than that from Eq. (4). For Mn_3Sn , the SNC values from Eqs. (7) and Eq. (4) differ by one order of magnitude [Fig. 6(b)].” should be read as “For all three Mn compounds Mn_3X , the SNC values estimated using the Mott relation [Eq. (7)] agree rather well with that calculated directly using Eq. (4) [Fig. 6(b)].” A revised version of our paper with the corrected ANC and SNC values and new Table II as well as new Figs. 3–6 is available in Ref. [7]. Finally, since the unit-cell volume for fcc Pd (Pt) is 99.31 (101.62) a_B^3 , the values of the ANC for fcc Pd (Pt) reported in Ref. [8] are more or less unaffected by the bug in the computer program.

-
- [1] S. Nakatsuji, N. Kiyohara, and T. Higo, *Nature (London)* **527**, 212 (2015).
 [2] X. Li, L. Xu, L. Ding, J. Wang, M. Shen, X. Lu, Z. Zhu, and K. Behnia, *Phys. Rev. Lett.* **119**, 056601 (2017).
 [3] M. Ikhlas, T. Tomita, T. Koretsune, M.-T. Suzuki, D. Nishio-Hamane, R. Arita, Y. Otani, and S. Nakatsuji, *Nat. Phys.* **13**, 1085 (2017).
 [4] N. Kiyohara, T. Tomita, and S. Nakatsuji, *Phys. Rev. Appl.* **5**, 064009 (2016).
 [5] A. K. Nayak, J. E. Fischer, Y. Sun, B. Yan, J. Karel, A. C. Komarek, C. Shekhar, N. Kumar, W. Schnelle, J. Kübler, C. Felser, and S. S. P. Parkin, *Sci. Adv.* **2**, e1501870 (2016).
 [6] S. Meyer, Y.-T. Chen, S. Wimmer, M. Althammer, T. Wimmer, R. Schlitz, S. Geprägs, H. Huebl, D. Ködderitzsch, H. Ebert, G. E. W. Bauer, R. Gross, and S. T. B. Goennenwein, *Nature Mater.* **16**, 977 (2017).
 [7] G. Y. Guo and T.-C. Wang, *arXiv:1708.05933v3*.
 [8] G. Y. Guo, Q. Niu, and N. Nagaosa, *Phys. Rev. B* **89**, 214406 (2014).