Spin Hall and spin Nernst effects: temperature dependence ANNA
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cow Warszawy 6, 35-959 Rzeszw, Poland — We have considered temperature de-
pendence of spin Hall and spin Nernst effect in two-dimensional electron gas with
spin-orbit interaction of Rashba type [arXiv:1510.03080]. In our considerations we
have employed the approach based on the Matsubara Green functions. The formal-
ism used in the case of electric field as a driving force was subsequently adopted to
the situation of a spin current driven by a temperature gradient. To achieve this,
we have used the concept of an auxiliary vector field. Such a description gives the
possibility to consider all mechanisms leading to the spin Hall and spin Nernst effect
on equal footing and also their behavior at finite temperatures. Both spin Hall and
spin Nernst conductivities were calculated in the approximation including the vertex
correction. The total spin Hall conductivity, including vertex correction, has been
shown to vanish exactly in the whole temperature range. Thus, our results extend
the earlier ones to an arbitrary temperatures. In turn, the total spin Nernst conduc-
tivity remains finite when the vertex corrections are included. Using the Ioffe-Regel
localization criterion, we have also estimated the range of parameters where the
calculated results for the spin Hall and spin Nernst conductivities are applicable.

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