model. With account of magnetic properties, the relative difference between the predictions of the Drude and plasma model approaches at $T = 280\,\mathrm{K}$ is approximately equal to –6.2% for the Casimir free energy and –7% for the Casimir pressure. Thus, the magnetic phase transition provides additional opportunities for the investigation of the impact of magnetic properties on the Casimir force and for the selection between different theoretical approaches to the thermal Casimir force.

VII. CONCLUSIONS AND DISCUSSION

In the foregoing we have investigated the possible impact of magnetic properties of real materials on the thermal Casimir force in the configuration of two parallel plates. This was done in the framework of the Lifshitz theory of dispersion forces generalized for magnetodielectric media described by the frequency-dependent dielectric permittivity and magnetic permeability. The dielectric permittivity of metals was described in the framework of both the Drude and the plasma model approaches suggested in the literature for the calculation of the Casimir force at nonzero temperature.

It was concluded that magnetic properties of all diamagnetic materials and of paramagnetic materials in the broad sense with the single exception of ferromagnets do not influence on Casimir force. As to ferromagnets, the influence of their magnetic properties on the Casimir force is performed solely through the contribution of the zero-frequency term in the Lifshitz formula. Detailed calculations of the thermal Casimir force have been performed for the following configurations: two ferromagnetic metal plates; one plate made of ferromagnetic metal and the other plate made of nonmagnetic metal; two plates made of ferromagnetic dielectric; one plate made of ferromagnetic dielectric and the other plate made of nonmagnetic metal. In some cases the relative differences due to account of magnetic properties were shown to achieve several tens and even hundreds of percent. It was shown also that the impact of magnetic properties on the Casimir force may be quite different (or even absent) depending on whether the Drude or the plasma model description of the dielectric permittivity of metals is used.

The possible influence of magnetic properties of ferromagnets on the Casimir force may be considered somewhat analogous to the proposed influence of real drift current of conduction electrons. If it is assumed that the fluctuating electromagnetic field can initiate