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Analytical modeling for the heat transfer in sheared flows of nanofluids

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We developed a model for the enhancement of the heat flux by spherical and elongated nano- particles in sheared laminar flows of nano-fluids. Besides the heat flux carried by the nanoparticles the model accounts for the contribution of their rotation to the heat flux inside and outside the particles. The rotation of the nanoparticles has a twofold effect, it induces a fluid advection around the particle and it strongly influences the statistical distribution of particle orientations. These dynamical effects, which were not included in existing thermal models, are responsible for changing the thermal properties of flowing fluids as compared to quiescent fluids. The proposed model is strongly supported by extensive numerical simulations, demonstrating a potential increase of the heat flux far beyond the Maxwell-Garnet limit for the spherical nanoparticles. The road ahead which should lead towards robust predictive models of heat flux enhancement is discussed.

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