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Combined Lorentz force and ultrasound Doppler velocimetry in a vertical convection liquid metal flow[1] TILL ZÜRNER, Technische Universität Ilmenau, TOBIAS VOGT, Helmholtz-Zentrum Dresden-Rossendorf, CHRISTIAN RESAGK, Technische Universität Ilmenau, SVEN ECKERT, Helmholtz-Zentrum Dresden-Rossendorf, JÖRG SCHUMACHER, Technische Universität Ilmenau — We report experimental studies on turbulent vertical convection flow in the liquid metal alloy gallium-indium-tin. Flow measurements were conducted by a combined use of local Lorentz force velocimetry (LLFV) and ultrasound Doppler velocimetry (UDV). It is known that the forced convection flow in a duct generates a force on the LLFV magnet system, that grows proportional to the flow velocity. We show that for the slower flow of natural convection LLFV retains this linear dependence in the range of micronewtons. Furthermore experimental results on the scaling of heat and momentum transport with the thermal driving are presented. The results cover a range of Rayleigh numbers $3 \times 10^5 < Ra < 3 \times 10^7$ at a Prandtl number $Pr \sim 0.032$. The Nusselt number Nu is found to scale as $Nu \propto Ra^{0.31}$. A Reynolds number Re_z based on the vertical velocities close the heated and cooled side walls scales with $Re_z \propto Ra^{0.45}$. Additionally a Reynolds number based on the horizontal flow component is scaling as $Re_x \propto Ra^{0.67}$. These results agree well with numerical simulations and theoretical predictions.

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