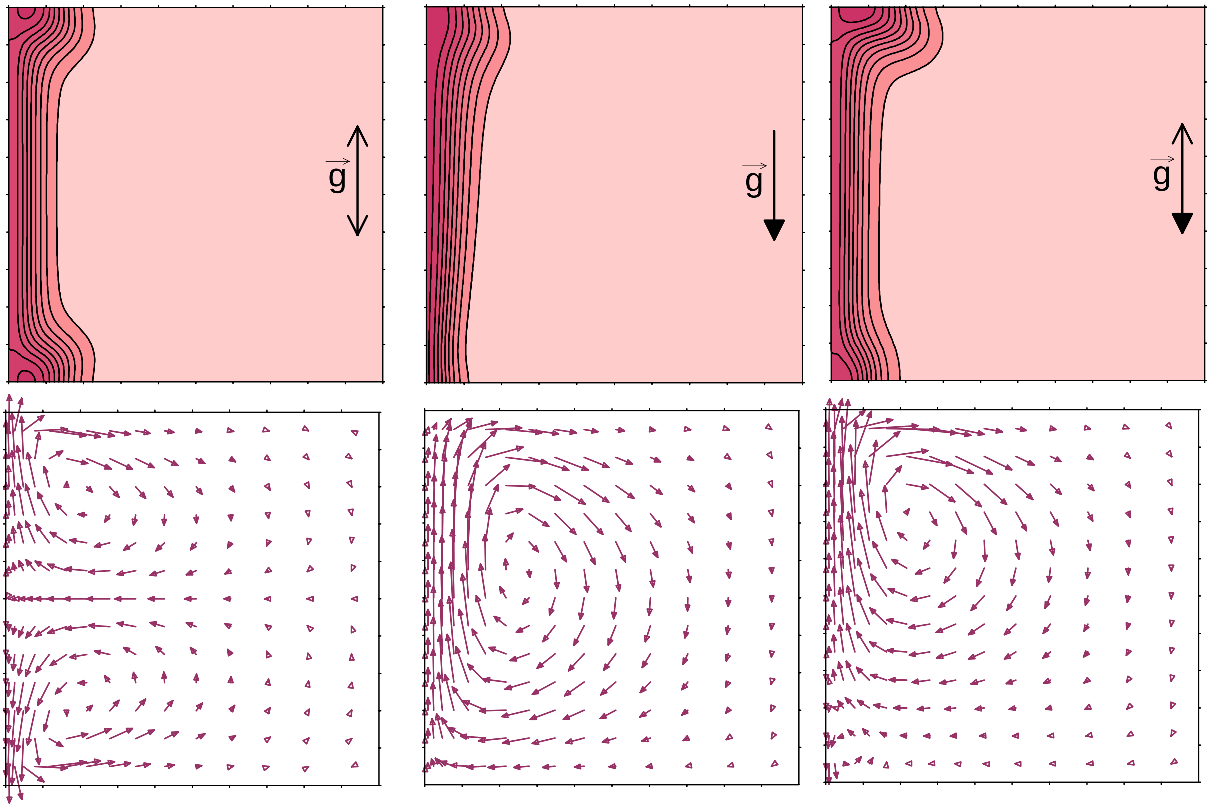
Thermal gravity-driven and vibrational convection

The left boundary of a square cavity with initially isothermal near-critical fluid (its temperature is over the critical one on $0{,}5K$) is fast heated on $0{,}1K$ then heating is stopped. Other boundaries are thermally isolated. A cavity oscillates with high frequency (5 Hz) and short amplitude (1 mm) along the vertical axis in the field of uniform body force pointed down. Owing to vibrations the average large-scale convective motion is induced and interacts with thermal gravity-driven convection under the uniform body force. Microgravity conditions are considered: $\vec{g} = (0, -3 \cdot 10^{-4})$. The other parameters are follows:
$Ra = 406$, $Rv = 2{,}22$, $\Pr = 2{,}27$, $\mathrm{Re} = 3{,}85 \cdot 10^4$, $\varepsilon = 1{,}65 \cdot 10^{-2}$, $\Theta = 3{,}3 \cdot 10^{-4}$,
$\gamma_0 = 1{,}4$, $\Lambda = 0{,}75$, $\psi = 0{,}5$
To obtain characteristics of average motion the variables are calculated from the full governing equations, then they are averaged over the period of oscillations.



The average temperature (isotherms) and velocity fields at the instant $t' = 60\,c$ under vibrational body force (left), constant body force (center) and they superposition (right). In spite of very small values $Ra = 406$, $Rv = 2{,}22$ the near-critical dynamics and heat transfer are actually determined by the "real" parameters $Ra_r = 1{,}46 \cdot 10^6$, $Rv_r = 3.24 \cdot 10^6$ calculated from the calibration laws. The large values of Ra_r and Rv_r ensure the development of vibrational and thermo-gravitational convective motions.

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