Heat transfer in a square cavity with side heating
(one side is isothermal)

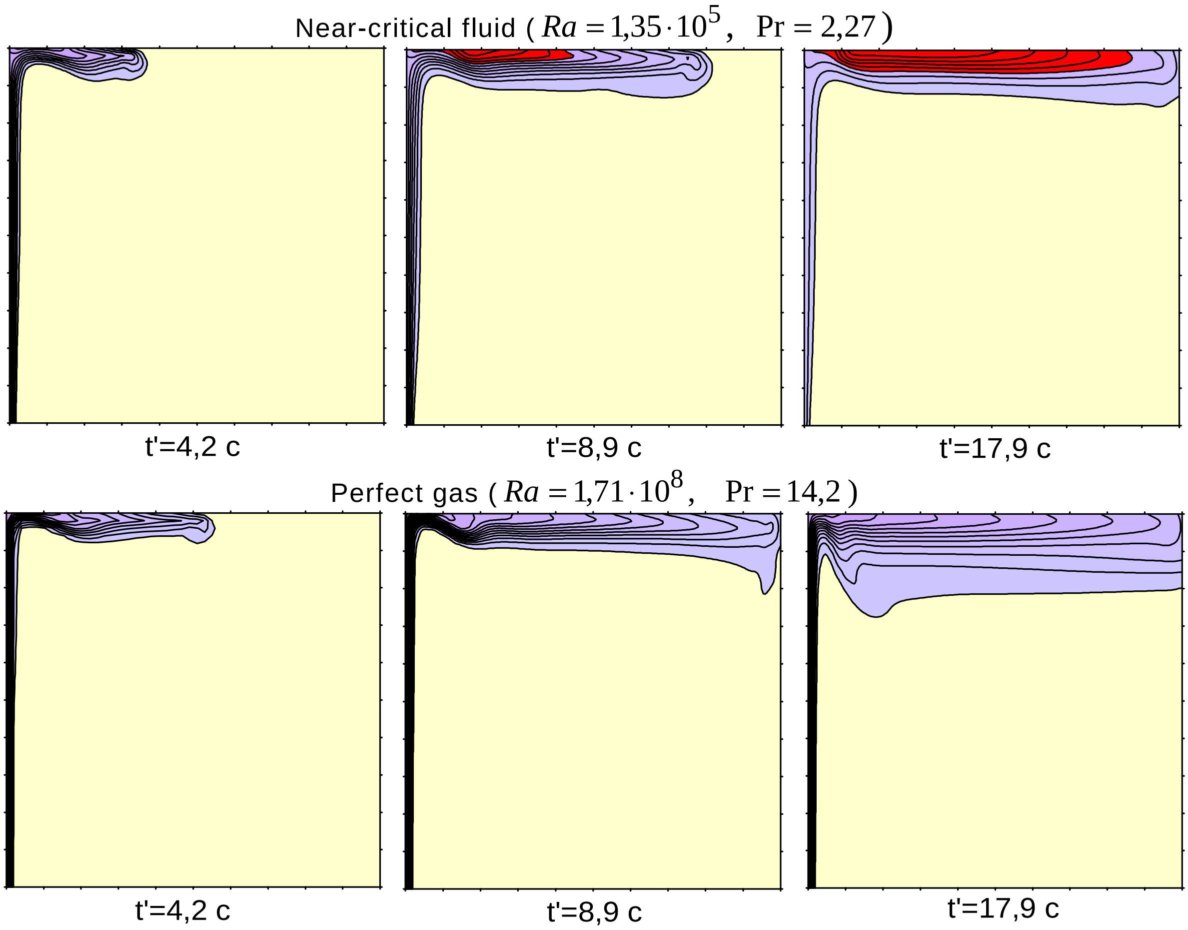
A square cavity is filled with a near-critical fluid under ground-based conditions (the acceleration of gravity force is vertical and pointed down). The temperature on the left side is increased quickly on $0{,}01\ K$ and then it is fixed. Other sides are adiabatic. Owing to heating the steady state is disturbed giving rise to dynamic processes. The following parameters are used:

$Ra = 1{,}35 \cdot 10^5,\ \ \Pr = 2{,}27,\ \ \mathrm{Re} = 3{,}85 \cdot 10^4,\ \ M = 10^{-3},\ \ \varepsilon = 3{,}3 \cdot 10^{-3},\ \ \Theta = 3{,}3 \cdot 10^{-5},\ \ \gamma_0 = 1{,}4,$
$\vec{g} = (0, -1),\ \Lambda = 0{,}75,\ \ \psi = 0{,}5$

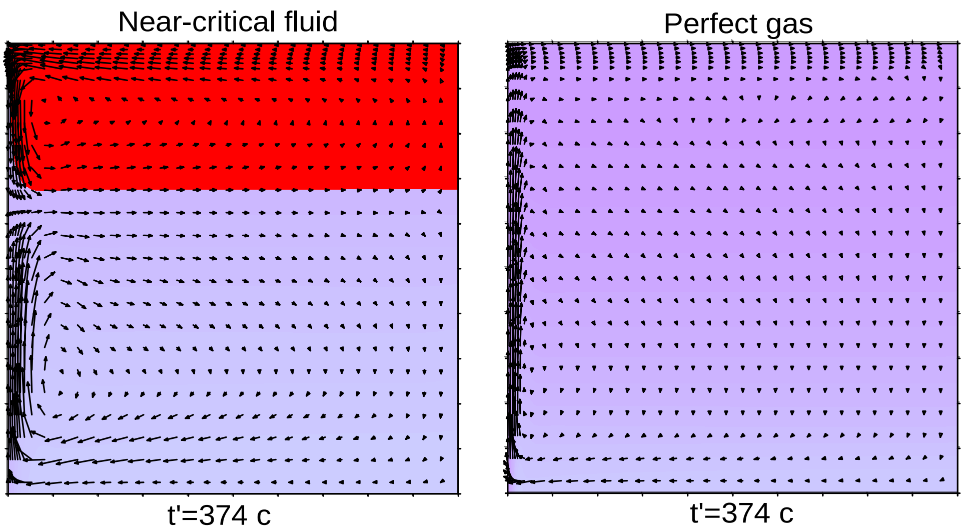
A near-critical fluid is compared with a perfect gas characterized by criteria of similarity

$Ra = 1{,}71 \cdot 10^8,\ \ \ \Pr = 14{,}2$

which defined with the help of [the calibration laws].



Temperature fields (isotherms) represent the stream-type motions in a near-critical fluid (upper) and in a perfect gas (lower) at the different instants. Red color indicates the region of overheating (the temperature in this region is higher than the temperature at the left heated side). The temperature distance between isotherms in a near-critical fluid is essentially less than in a perfect gas because of the Piston-effect leading to the fast bulk heating.



At the long time, there is the two-vortex structure in a near-critical fluid. The stream has turned back in the region of overheating (red color).

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