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Natural Convection in a Fluid Layer Subject to Periodic Heating

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— Natural convection in a horizontal layer exposed to periodic heating is considered. The primary response leads to stationary convection in the form of rolls orthogonal to the heating wave vector. For large α a uniform conductive layer emerges at the upper section of the fluid layer. Secondary convection gives rise either to the longitudinal rolls, or to the transverse rolls or to the oblique rolls depending on α. Three mechanisms of instability have been identified. In the case of small and moderate α the parametric resonance leads to the pattern of instability that is locked-in with the pattern of the heating as $\delta_{cr} = \alpha/2$, where δ_{cr} denotes component of the disturbance wave vector. The second mechanism is associated with the formation of patterns of vertical temperature gradients and the primary convection currents, operates approximately in the same range of α and provides direct modulation with structure dictated by α. The third mechanism operates for large α where the instability is driven by the uniform mean vertical temperature gradient created by the primary convection with the critical disturbance wave vector $\delta_{cr} \to 1.56$. Competition between the first and second effects gives rise to the appearance of soliton lattices.

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