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Propagating fronts through convective flow fields with cooperative and antagonistic feedback[1] SAIKAT MUKHERJEE, MARK PAUL, Virginia Tech — We numerically explore propagating fronts generated by an exothermic and autocatalytic reaction where the products and reactants can vary in density. We study fronts traveling horizontally in a long, shallow, and two-dimensional layer of fluid undergoing thermal convection. In the absence of heat generation by the reaction, any variation in density between the products and reactants results in a single solutally-driven convection roll that propagates with the front. In the presence of heat release by the reaction, a hotspot at the front is generated which leads to the formation of a pair of counter-rotating convection rolls that travel with the front. When the products are less dense than the reactants, the thermal and the solutal effects are cooperative. When the products are more dense than the reactants, the thermal and solutal effects are antagonistic. We study fronts with cooperative and antagonistic feedback that travel through counter-rotating convection rolls generated by Rayleigh-Bénard convection. In the presence of convection, the front and fluid dynamics exhibit oscillatory dynamics. We quantify the fluid dynamics, front velocity, and reaction length scale over a wide range of solutal and thermal driving.

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