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An unconditionally stable splitting scheme for a class of nonlinear parabolic equations.

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A numerical scheme for a class of advection-dominated advection-diffusion-reaction equations is introduced. The developed scheme is essentially based on operator splitting combined with a front tracking method for conservation laws with track and evolving a piecewise constant solution with a discontinuity path defined by a varying velocity field.

The proposed numerical scheme can be made unconditionally stable by choosing appropriate methods for the diffusion and reaction steps. Nevertheless, it is observed that when the time step is notable larger than the diffusion scale, then the scheme can become too diffusive. This can be inferred by the fact that the entropy condition forces the hyperbolic solver to throw away information regarding the structure of steep fronts without a loss of entropy.

It is demonstrated that the disregarded information can be identified as a residual flux term. Moreover, if this residual flux is taken into account via, for example, a separate correction step, steep fronts can give the correct amount of self-sharpening. Four numerical examples are also presented.

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MSC:

65M06	Finite difference methods for initial value and initial-boundary value problems involving PDEs
65M12	Stability and convergence of numerical methods for initial value and initial-boundary value problems involving PDEs
35K57	Reaction-diffusion equations

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