1014-65-873 **Donald Estep*** (estep@math.colostate.edu), 1874 Campus Delivery, Department of Mathematics, Colorado State University, Fort Collins, CO 80523, and **Travis King**, **David Ropp** and **John Shadid**. *Detecting and countering instability in operator splitting methods for reaction-diffusion equations.*

Operator splitting methods are attractive for multiphysics, multiscale problems because they allow the use of accurate, stable, and efficient numerics for the individual components. However, the splitting itself can substantially affect the accuracy and stability of the overall numerical solution, even when the solution of the individual components is accurate. We consider this issue for reaction-diffusion equations, where operator splitting can exhibit a subtle but dangerous form of instability. The continuous balance between the reaction and diffusion in the original problem is "discretized" by operator splitting, which can lead to instabilities such as nonphysical chaotic behavior and blowup. It is generally impossible to detect this instability using standard error estimators. We describe a new *a posteriori* technique for estimating the effects of operator- splitting, in which the effects are explicitly represented by an *a posteriori* expression involving changes in the adjoint problem. We also describe a "local" version of the analysis that are easily implemented and new step selection mechanisms for reducing this instability that are based on stability, rather than accuracy, considerations. (Received September 26, 2005)