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Md Masud Rana* (md-masud.rana@ttu.edu), Texas Tech University, Box 1042, Lubbock, TX 79409, and **Victoria E. Howle, Katharine Long, Ashley Meek** and **William Milestone**. *A New Block Preconditioner for Implicit Runge–Kutta Methods for Parabolic PDE.*

Implicit Runge–Kutta (IRK) methods offer an appealing combination of stability and high order; however, these methods are not widely used for PDE because they lead to large, strongly coupled linear systems. An s -stage IRK system has s -times as many degrees of freedom as the systems resulting from backward Euler or implicit trapezoidal rule discretization applied to the same equation set. Here, we introduce a new block preconditioner for IRK methods, based on a block LDU factorization with algebraic multigrid subsolves for scalability. We demonstrate the effectiveness of this preconditioner on the heat equation as a simple test problem, and compare in condition number and eigenvalue distribution, and in numerical experiments with other preconditioners currently in the literature. Experiments are run with IRK stages up to $s = 7$, and it is found that the new preconditioner outperforms the others, with the improvement becoming more pronounced as spatial discretization is refined and as temporal order is increased. (Received August 29, 2020)