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**The Fast Adaptive Composite-grid Method for a
3-temperature Radiation Diffusion System with Adaptive
Mesh Refinement**

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We describe the fast adaptive composite-grid (FAC) preconditioner applied to a non-equilibrium 3-temperature radiation diffusion problem on dynamic adaptively refined grids. Multiple temporal and spatial scales make the associated initial value problems strongly stiff and very challenging to solve. In this talk we address these challenges by using fully implicit time integration and adaptive mesh refinement for spatial discretization. Furthermore, at every time step, a large scale nonlinear system is solved by the Jacobian-free Newton Krylov approach preconditioned by the FAC method. We will demonstrate the performance of the proposed method with temporal and spatial accuracy, efficiency and scalability results.