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A Spectral Multi-Domain Penalty Method for Elliptic Problems Arising From a Time-Splitting Algorithm For the Incompressible Navier-Stokes Equations THEODORE DIAMANTOPOLOUS, KRISTOPHER ROWE, PETER DIAMESSIS, Cornell University — The Collocation Penalty Method (CPM) solves a PDE on the interior of a domain, while weakly enforcing boundary conditions at domain edges via penalty terms, and naturally lends itself to high-order and multi-domain discretization. Such spectral multi-domain penalty methods (SMPM) have been used to solve the Navier-Stokes equations. Bounds for penalty coefficients are typically derived using the energy method to guarantee stability for time-dependent problems. The choice of collocation points and penalty parameter can greatly affect the conditioning and accuracy of a solution. Effort has been made in recent years to relate various high-order methods on multiple elements or domains under the umbrella of the Correction Procedure via Reconstruction (CPR). Most applications of CPR have focused on solving the compressible Navier-Stokes equations using explicit time-stepping procedures. A particularly important aspect which is still missing in the context of the SMPM is a study of the Helmholtz equation arising in many popular time-splitting schemes for the incompressible Navier-Stokes equations. Stability and convergence results for the SMPM for the Helmholtz equation will be presented. Emphasis will be placed on the efficiency and accuracy of high-order methods.

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