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There has been substantial work on the development of structure-preserving discretisations of differential equations, where the numerical approximation reflects key conservation laws observed of the continuum solution. While such discretisations are unquestionable valuable, their practical utility can be limited by the fact that standard iterative methods for solution of the resulting linear and nonlinear systems only resolve the underlying conserved quantities when solved to near-machine precision. In this talk, we present a generalisation of the (preconditioned) flexible GMRES algorithm that can preserve arbitrarily many such conserved quantities exactly at (nearly) any stopping tolerance, with a small additional cost. Numerical results are presented for several structure-preserving finite-element discretisations of linear parabolic and hyperbolic model problems.

Joint work with Scott MacLachlan (Memorial University of Newfoundland, Canada).