# Modified trigonometric integrators

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Geometric integration of highly oscillatory Hamiltonian systems is difficult, due to the simultaneous presence of fast and slow time scales. Classic methods (such as Störmer/Verlet) are inefficient, since they must take extremely small time steps in order to remain stable. Trigonometric integrators represent a major advance – but even for these methods, there is a fundamental trade-off between stability and consistency with respect to certain multiscale dynamical features (slow energy exchange, near-preservation of adiabatic invariants, etc.). In this talk, we show that modified trigonometric integrators, i.e., trigonometric integrators with modified frequency, are able to sidestep this tradeoff, achieving both stability and consistency. Specifically, we prove that an implicit-explicit (IMEX) method is the unique modified trigonometric integrator which is both stable and multiscale structure-preserving, and we illustrate its performance through numerical experiments on the Fermi-Pasta-Ulam problem.