1046-34-949 **C. David Pruett*** (pruettcd@jmu.edu), Department of Mathematics and Statistics, MSC 1911 James Madison University, Harrisonburg, VA 22807, and **William H. Ingham** (inghamwh@jmu.edu), Department of Physics and Astronomy, MSC 4502 James Madison University, Harrisonburg, VA 22807. *The Ultimate N-Body Algorithm: Parameter-Free, Adaptive, and Parallel.*

Picard iteration, normally considered a theoretical rather than a computational tool, is customarily used to establish existence and uniqueness of solutions to systems of first-order ordinary differential equations (ODEs) of initial-value type. However, about a decade ago, Parker and Sochacki [*Neural, Parallel, and Sci. Comput.* 4, 1996] adopted Picard iteration to develop a practical numerical scheme of arbitrarily high order and suitable for a wide class of initial-value ODEs termed "projectively polynomial;" that is, whose generators can be cast as polynomials in the unknowns. The N-body problem, of both historical and practical interest, falls into this class. The scheme was subsequently adapted to the N-body problem and rendered adaptive in time and order by Pruett, Rudmin, and Lacy [*J. Comput. Phys.* 187, 2003]. In the current paper, the N-body algorithm is further enhanced to exploit data parallelism. The resulting algorithm, developed from first principles in the talk, has several attractive attributes: it is parameter-free, it minimizes computational effort by being simultaneously adaptive in time and order, and it enjoys linear speedup on distributed parallel processors. (Received September 12, 2008)