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B-spline Galerkin methods for the Dirac equation CHARLOTTE FROESE FISCHER, National Institute of Standards and Technology, Gaithersburg, MD 20899, OLEG ZATSARINNY, Department of Physics and Astronomy, Drake University, Des Moines, IA 50311 — The B-spline Galerkin method was first applied successfully to relativistic many-body theory by W. R. Johnson and J. Sapirstein in 1986. Essentially, the diagonalization of a Dirac matrix equation yielded an effectively complete but finite and orthonormal basis for bound and continuum states. Though the low-energy bound states were good approximations to solutions of the Dirac equation, no physical interpretation was important for other states. However, spurious states perturbed the spectrum and slowed the convergence properties of quantum electrodynamic (QED) calculations. Problems have also occurred with the application to relativistic R-matrix methods. In this poster we report on an investigation of Galerkin methods for eigenvalue problems represented by a pair of first-order differential equations. By selecting a simple problem, closely related to the Dirac equation, different methods are analyzed and a stable method identified. In particular, it is shown that expansions in terms of bases (B , B') are equivalent to the B-spline expansions investigated by Igarashi when the difference in order is unity and are similar, though simpler, than the kinetic balance bases that have been proposed. Some differences between solutions of a matrix eigenvalue problem and the the differential equation will be mentioned. Results of the application of the method to the Dirac equation will be presented.

Charlotte Froese Fischer
National Institute of Standards and Technology, Gaithersburg, MD 20899

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