Abstract Submitted
for the APR05 Meeting of
The American Physical Society

The Electromagnetic Current in Nuclear Many-Body Physics[1]
CARRIE E. HALKYARD, BRIAN D. SEROT, Indiana University — The electromagnetic current is studied in a recently proposed effective field theory of the nuclear many-body problem.[2] The Lorentz-invariant lagrangian contains nucleons, pions, isoscalar scalar (σ) and vector (ω) fields, and isovector vector (ρ) fields. The theory exhibits nonlinear $SU(2)_L \times SU(2)_R$ chiral symmetry and has three desirable features: it uses the same degrees of freedom to describe the nuclear currents and strong-interaction dynamics, it satisfies the symmetries of the underlying theory of QCD, and its parameters can be calibrated using strong-interaction phenomena. The low-energy structure of the nucleon is described using vector-meson dominance, so that external form factors are not needed. For normal nuclear systems, it is possible to expand systematically the effective lagrangian in powers of the fields (and their derivatives) and to truncate the expansion reliably after the first few orders. The fully U(1)-gauge-invariant lagrangian is derived for the first few orders of the field expansion, including terms that are both linear and quadratic in the electromagnetic charge, and the electromagnetic current is exhibited to all orders in the pion field. Explicit expressions are derived for the Lorentz-covariant amplitudes of the one- and two-nucleon electromagnetic currents.

[1]Supported in part by the US Department of Energy
[2]R. J. Furnstahl, B. D. Serot, H.-B. Tang, Nucl. Phys. **A615**, 441 (1997).

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Date submitted: 12 Jan 2005 Electronic form version 1.4