The s-wave repulsion in pionic atoms

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Unexpected large s-wave repulsion is obtained from phenomenological analyses of strong interaction effects in pionic atoms.This has been known for a long time [1] but a satisfactory explanation has not been found. Very recently it was suggested by Weise [2] that partial restoration of chiral symmetry in dense matter leads to a density-dependence of the isospin-odd in-medium pion-nucleon amplitude. This could explain the anomalous repulsion. Subsequently the idea was tested by Friedman [3] on a large set of data and found to indeed remove most of the anomaly.

In the present work we extend significantly the analysis of ref.[3] by increasing the number of data points from 60 to 106 and including several series of isotopes. We also use four different sets of nucleon densities and allow more flexibility in the χ^2 fits to the data and in the corrections due to relativistic impulse approximation. The conclusions regarding the s-wave repulsion remain essentially as in ref.[3], namely, that both the Weise prescription [2] and the relativistic correction [1,3] remove large part of the anomaly, and that combining the two removes the anomaly completely. Some implications for elastic scattering of low energy pions by medium weight and heavy nuclei will be discussed.

References

[1] For a recent review see C.J. Batty, E. Friedman, A. Gal, Phys. Rep. **287** (1997) 385.
[2]W. Weise, Nucl. Phys. A **690** (2001) 98.
[3]E. Friedman, Phys. Lett. B **524** (2002) 87.