Kostelecky and Nieto Respond: We disagree with Rau's adverse conclusions about our work.

(1) *Understanding our goals.*—The objections seem to show a misconception about our goals. We are asking if there is any evidence for a broken supersymmetry (SUSY) in the physical properties of atoms.[1] If so, we might obtain a new physical insight into atomic systems. Looking for evidence of a symmetry and performing full many-body calculations are two different but complementary approaches. Our method is similar to one in nuclear physics.[2]

The first step in looking for a symmetry is to ignore symmetry-breaking effects. This we explicitly did.[1] The next step is to include symmetry-breaking effects. This we have since done; see (6) below.

We emphasize that we were *not* trying to obtain better predictions for atomic quantities than one can with, for example, detailed many-body calculations. However, we believe that our results suggest that there is a physical insight to be obtained from SUSY in atomic physics.

(2) *SUSY gives the correct sign for the effective core potential.*—To understand this, compare the hydrogenic picture with the SUSY model for the system that Rau considers, hydrogen versus Li. Focus on the effective principal quantum number n^* in the quantum-defect parametrization $E \sim -1/(n^*)^2$.

With a unit central charge $(3p^+, 2e^-)$, the hydrogenic picture predicts a Li ground state with $n_0 = 1$. It is only by putting in the Pauli principle by hand that $n_0 = 1$ is excluded. In contrast, the ground state of the SUSY Li atom has $n_0 = 2$, which is closer to the physical $n_0^* = 1.6$ of Li than the mathematical $n_0 = 1$ of the hydrogenic picture. SUSY automatically mocks effects of the Pauli principle by adding a *repulsive* potential to the hydrogenic one. Granted, it overcompensates, taking n_0 past 1.6 to 2, but it has the correct sign.

Thus, in a single-particle potential, if one starts from $n_0 = 2$ one needs an attractive effective potential to get to $n_0^* = 1.6$. However, if one instead starts at $n_0 = 1$, as both the bosonic supersymmetric and the hydrogenic potentials do, one needs a repulsive effective potential to get to $n_0^* = 1.6$. One must not confuse the bosonic and fermionic potentials.

(3) *The SUSY states are complete whereas the hydrogenic states are not.*—For the valence electron of Li in one-body Schrödinger theory, one has an interesting matter of principle. The R_{n0}, $n \geq 2$, do *not* form a complete set for the hydrogenic potential. The excluded ground state is needed. In contrast, the SUSY eigenstates R_{n1}, $n \geq 2$, do form a complete set.

(4) *Different predictions of the SUSY and the hydrogenic viewpoints.*—Since the effective potentials and the wave functions are different, physical quantities such as transition probabilities may be different. We have given[3] $s \rightarrow p$ and $p \rightarrow s$ transition probabilities of Li for the hydrogenic picture, the SUSY model, and accepted values. Our points are (a) SUSY gives results consistently superior to those of the hydrogenic picture, and (b) the results are different; i.e., SUSY is more than a rewriting of the hydrogenic picture.

(5) *Properties of the SUSY wave functions.*—The structure of the wave function for the valence electron really has not been settled.[4,5] Most physicists simply assume a hydrogenic behavior. But detailed studies[5] show that this is not necessarily the case at large distances. A related conclusion holds in nuclear physics for the radiative fusion of ^{4}He and ^{3}H to form Li. Here, the asymptotic part of the wave functions is most important in obtaining an accurate transition rate.[6]

Therefore, if anything, the SUSY wave functions are more appropriate for transition probabilities because they yield better results. Also, the different "r" behavior (including $r \rightarrow 0$) and different nodal structures exhibited by the SUSY picture are not, *per se*, deficiencies of SUSY. Rather, they are aspects of our new phenomenology that merit investigation.[3,7]

(6) *Quantum defect theory.*—We have extended this project to quantum defect theory.[7] We observed that analytical solutions to the Schrödinger equation can be obtained if not only $n^* = n - \delta(l)$ but also, in the effective potential, $l \rightarrow l^* = l - \delta(l)$. This yields transition probabilities for Li and Na that in general agree with the accepted values to within the accepted errors. Thus, we have a simple model to predict what detailed calculations may obtain. Our results are parametrized by the quantum defect and by a SUSY-like integer. For phenomenological reasons the two parameters cannot be disentangled. However, the results provide further evidence for the validity of our approach.

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