

Comment on “ M_F -Dependent Lifetimes Due to Hyperfine Induced Interference Effects”

Yao *et al.* [1] recently presented a study of the effects of hyperfine mixing on radiative decay rates of the first excited $3d^9 4s\ ^3D_3$ state of nickel-like Xe^{26+} . In the absence of hyperfine mixing, the 3D_3 state decays to the ground $3d^{10}\ ^1S$ state via an $M3$ transition. Recent measurements of this decay channel by Trabert *et al.* [2] found shorter lifetimes than previously predicted. Yao *et al.* showed that hyperfine mixing with the nearby 3D_2 state adds an $E2$ amplitude to the decay of certain hyperfine levels of the 3D_3 state, thereby shortening the predicted lifetimes. They also proposed that an interference between the $E2$ and $M3$ amplitudes makes a nonzero contribution to the decay rate, which thus becomes dependent on the magnetic quantum number M_F of the initial state. This interference violates rotational invariance.

The decay rate of an atomic state cannot depend on M_F ; were it so, a rotation of the coordinate system would change the observed decay rate.

Interferences between different multipoles can alter the angular distribution of emitted light from oriented atoms but do not contribute to total decay rates. For example, the Hermitian product of $E2$ and $M3$ amplitudes in the $E2$ - $M3$ interference can be rewritten as a sum of terms of angular

momenta $K = 1 \dots 5$. On rotation, these terms transform as $\mathcal{D}^{(K)}$, and their angular average is zero. In general, the decay rate of any atomic state through multiple multipole channels is an incoherent sum of the decay rates of the individual channels [3]. Equation (4) of Ref. [1] violates this direct consequence of rotational invariance.

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Thad G. Walker and Charles J. Goebel
Department of Physics
University of Wisconsin-Madison
Madison, Wisconsin 53706, USA

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