Erratum: Elastic resonant and nonresonant differential scattering of quasifree electrons from $B^{4+}(1s)$ and $B^{3+}(1s^2)$ ions [Phys. Rev. A 69, 052718 (2004)]

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In an earlier publication [1], we included an appendix that derived the ratio of direct electron capture of a $2p$ electron onto a $1s2s(^3S)$ ion ending up in the three possible states $1s[2s2p(^3P)](^4P)$, $1s[2s2p(^3P)](^2P)$, and $1s[2s2p(^1P)](^2P)$ as being 8:1:3. While this result still holds, the appendix contained five typographical errors and also erroneously used incorrect reasoning at one step of the derivation ("The averaged, uncoupled, captured state $1s2s(^3S)2p\ldots$".). Here we correct all 5 typographical errors and use correct reasoning to deduce the probabilities of each of the initially captured states in the amended Appendix.

APPENDIX

In this appendix, we show how the capture of a $2p$ electron to a $1s2s(^3S)$ ion results in a 8:1:3 ratio of probabilities to the states, respectively. We first have a $1s$ electron, with spin and magnetic quantum numbers $s_1=1/2$ and m_1, coupled to a $2s$ electron, with spin and magnetic quantum numbers $s_2=1/2$ and m_2, to yield a coupled $1s2s(^3S)$ state with quantum numbers $s_{12}=1$ and m_{12}, denoted as the ket vector

$$|s_{12},m_{12}\rangle = \sum_{m_1+m_2=m_{12}} C^{s_1 s_2 s_{12}}_{m_1 m_2 m_{12}} |s_1,m_1\rangle |s_2,m_2\rangle. \tag{A1}$$

The uncoupled captured states $1s2s(^3S)2p$ can be denoted as

$$|[1s2s(^3S)]2p\rangle = |s_{12},m_{12}\rangle|s_3,m_3\rangle = \sum_s C^{s_{12}s_3 s}_{m_{12}m_3 m}|s,m\rangle \tag{A2}$$

with $s_3=1/2$, $s=1/2,3/2$, and $m=m_{12}+m_3$. The probability of ending up in a state with final spin s is therefore given as the average of the probabilities that each of the possible $(2s_{12}+1)(2s_3+1)$ uncoupled captured states $|s_{12},m_{12}\rangle|s_3,m_3\rangle$ has spin s and any magnetic quantum number $-s\leqslant m\leqslant s$:

$$P(s) = \frac{1}{(2s_{12}+1)(2s_3+1)}\sum_{m_{12},m_3}\sum_{m=-s}^{m=s}(C^{s_{12}s_3 s}_{m_{12}m_3 m})^2 = \frac{1}{(2s_{12}+1)(2s_3+1)}\sum_{m=-s}^{m=s}1 = \frac{2s+1}{6} = \begin{cases} 4/6 \text{ for the } [1s2s(^3S)]2p(^4P) \text{ state} \\ 2/6 \text{ for the } [1s2s(^3S)]2p(^2P) \text{ state,} \end{cases} \tag{A3}$$

i.e., it breaks down according to spin statistics [2]. The orthogonal property of the Clebsch-Gordon coefficients is used in the first step.

The captured doublet state $[1s2s(^3S)]2p(^2P)$ is not pure, but can be recoupled from a $\{[(s_1,s_2)s_{12}],s_3\}s$ coupling scheme to a $\{s_1,[(s_2,s_3)s_{23}]\}s$ one, where $s_{23}=1$ for the $1s[2s2p(^3P)](^2P)$ state and $s_{23}=0$ for the $1s[2s2p(^1P)](^2P)$ state. These latter states are essentially pure due to the dominance of the correlation between the $n=2$ electrons. The initially captured $[1s2s(^3S)]2p(^2P)$ state can thus be written as

$$|\{[(s_1,s_2)s_{12}],s_3\}s\rangle = \sum_{s_{23}}(-1)^{s_1+s_2+s_3+s}\sqrt{(2s_{12}+1)(2s_{23}+1)}\begin{Bmatrix} s_1 & s_2 & s_{12} \\ s_3 & s & s_{23}\end{Bmatrix}|\{s_1,[(s_2,s_3)s_{23}]\}s\rangle, \tag{A4}$$

and the probability of populating the state with spin s_{23} is thus

$$P(s_{23}) = (2s_{12}+1)(2s_{23}+1)\begin{Bmatrix} s_1 & s_2 & s_{12} \\ s_3 & s & s_{23}\end{Bmatrix}^2 = 3(2s_{23}+1)\begin{Bmatrix} 1/2 & 1/2 & 1 \\ 1/2 & 1/2 & s_{23}\end{Bmatrix}^2 = \begin{cases} 1/4 \text{ for the } 1s[2s2p(^3P)](^2P) \text{ state} \\ 3/4 \text{ for the } 1s[2s2p(^1P)](^2P) \text{ state,} \end{cases} \tag{A5}$$

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which does *not* follow from spin statistics. This gives a final breakdown of 8:1:3 between the energy-ordered states.

[1] E. P. Benis, T. J. M. Zouros, T. W. Gorczyca, A. D. González, and P. Richard, Phys. Rev. A **69**, 052718 (2004).
[2] This same result can be obtained by using a density matrix formalism (T. Kirchner, private communication).