Master equation theory applied to the redistribution of polarized radiation in the weak radiation field limit

V. The two-term atom
(Corrigendum)

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A sign factor was lacking in the expressions of the redistribution matrix in the case of incomplete Paschen-Back effect, Eqs. (A.1) and (A.6) of Bommier (2017). This sign factor is unity in the absence of incomplete Paschen-Back effect. A \((2I + 1)\) denominator was also missing in Eqs. (A6) and (40), and some typos occurred in Eq. (A.6). The correct formulæ are provided below.

The corrected Eq. (A.1) is:

\[
\mathcal{R}_{ij}(v, v_1, \Omega, \Omega_1; B) = \sum_{J_u,J_f,M_u,M_f,J_{u}^*,J_{f}^*,M_{u}^*,M_{f}^*} \int f(v) d^3v \ (-1)^{J_u - M_u} \left\langle j, \Omega \left| T^K_Q \left( j, \Omega \right) \right| T^K_Q \left( i, \Omega \right) \right\rangle \\
\times \frac{2L_u + 1}{25 + 1} \sqrt{(2K + 1)(2K' + 1)} \left( (-1)^{J_u + M_u} (-1)^{J_f + M_f} (-1)^{J_{u}^* + M_{u}^*} (-1)^{J_{f}^* + M_{f}^*} \right) \\
\times \sqrt{(2J_u + 1)(2J_f + 1)(2J_{u}^* + 1)(2J_{f}^* + 1)(2J_1 + 1)(2J_1 + 1)(2J'_{1} + 1)(2J'_{1} + 1)} \\
\times C^{J_u,M_u}_{J_u,M_u}(B) C^{J_f,M_f}_{J_f,M_f}(B) C^{J_{u}^*,M_{u}^*}_{J_{u}^*,M_{u}^*}(B) C^{J_{f}^*,M_{f}^*}_{J_{f}^*,M_{f}^*}(B) C^{J_{1}^*,M_{1}^*}_{J_{1}^*,M_{1}^*}(B) C^{J_{1}^*,M_{1}^*}_{J_{1}^*,M_{1}^*}(B) \\
\times \left\{ J_u \ J_f \ \frac{1}{L_u} \ \frac{1}{L_f} \right\} \left\{ J_u^* \ J_f^* \ \frac{1}{L_u^*} \ \frac{1}{L_f^*} \right\} \left\{ J_{u}^* \ J_{f}^* \ \frac{1}{L_{u}^*} \ \frac{1}{L_{f}^*} \right\} \left\{ J_{u}^* \ J_{f}^* \ \frac{1}{L_{u}^*} \ \frac{1}{L_{f}^*} \right\} \left\{ J_{1}^* \ J_{1}^* \ \frac{1}{L_{1}^*} \ \frac{1}{L_{1}^*} \right\} \left\{ J_{1}^* \ J_{1}^* \ \frac{1}{L_{1}^*} \ \frac{1}{L_{1}^*} \right\} \\
\times \left\{ 1 \ -p \ -p' \ -p'' \ \frac{1}{Q} \right\} \left\{ 1 \ -p \ -p' \ -p'' \ \frac{1}{Q} \right\} \\
\times \left[ \frac{\Gamma_R}{\Gamma_R + \Gamma_I + \Gamma_E + \frac{i \Delta E_{M_u,M_f}}{\hbar}} \right] \delta (\tilde{v} - \tilde{v}_1 - \nu_{M_u,M_f}) \left[ \frac{1}{2} \Phi_{ba} (\nu_{M_u,M_f} - \tilde{v}_1) + \frac{1}{2} \Phi^*_{ba} (\nu_{M_u,M_f} - \tilde{v}_1) \right] \\
+ \left[ \frac{\Gamma_R}{\Gamma_R + \Gamma_I + \frac{i \Delta E_{M_u,M_f}}{\hbar}} \right] \frac{\Gamma_R}{\Gamma_R + \Gamma_I + \Gamma_E + \frac{i \Delta E_{M_u,M_f}}{\hbar}} \left[ \frac{1}{2} \Phi_{ba} (\nu_{M_u,M_f} - \tilde{v}_1) + \frac{1}{2} \Phi^*_{ba} (\nu_{M_u,M_f} - \tilde{v}_1) \right] \left[ \frac{1}{2} \Phi_{ba} (\nu_{M_u,M_f} - \tilde{v}_1) + \frac{1}{2} \Phi^*_{ba} (\nu_{M_u,M_f} - \tilde{v}_1) \right].
\]
The corrected Eq. (A.6) is:

\[
\mathcal{R}_j'(v, \nu_1, \Omega, \Omega_1; B) = \sum_{J,J',F,F',M,J,F,J',F',M,J,F,J',F',M,J,F,J',F',M} \frac{2L_u + 1}{(2J + 1)(2F + 1)} \sqrt{(2J + 1)(2J' + 1)} (\nu_1 - \nu_J) \delta(v - \nu_J - \nu_M) \right]
\]

This equation is in excellent agreement as for the Racah algebra with Eq. (30) of Casini et al. (2014). The product of two coefficients \( C^J_{F,M,J,F,M} \) and \( C^F_J_{F,M,J,F,M} \) is equal to the coefficient \( C^J_F \) of Casini et al. (2014), because these coefficients all result from matrix diagonalization, performed in one step (FS + HFS) in Casini et al. (2014) and in two steps (FS and HFS) in our case. A similar coefficient is visible in Eq. (3.58) of Landi Degl’Innocenti & Landolfi (2004).
The following equation replaces Eq. (40) of Bommier (2017), by introducing the \((2I + 1)\) denominator
\[
\mathcal{R}_I(a,ν; J, J', L, S; L_u, S_u; B = 0) = \sum_{J_u, J_{\ell}, F_u, F_{\ell}, L_u, S_u, L_u, S_u} \int f(\nu) d\nu \left[ \frac{-1}{2\nu^2} \nu T_{\Omega} \nu F_{\Omega} (\nu, J, \Omega, J') T_{\Omega} (\nu, J') \right] 
\times \left[ \frac{2L_u + 1}{(2I + 1)(2S + 1)} \nu (2J_u + 1)(2J_{\ell} + 1)(2F_u + 1)(2F_{\ell} + 1)(2F_u' + 1)(2F_{\ell} + 1)(2F_u'' + 1)(2F_{\ell} + 1)(-1)^{F_u - F_{\ell}} \right] 
\times \left\{ \begin{array}{c} J_u \ 1 \ J_{\ell} \\
L_u \ S \ L_u \\
\end{array} \right\} \left\{ \begin{array}{c} J_u' \ 1 \ J_{\ell}' \\
L_u' \ S \ L_u' \\
\end{array} \right\} \left\{ \begin{array}{c} J_u \ 1 \ J_{\ell} \\
L_u \ S \ L_u \\
\end{array} \right\} \left\{ \begin{array}{c} J_u' \ 1 \ J_{\ell}' \\
L_u' \ S \ L_u' \\
\end{array} \right\} 
\times \left\{ \begin{array}{c} J_u \ 1 \ J_{\ell} \\
J_u' \ 1 \ J_{\ell}' \\
\end{array} \right\} \left\{ \begin{array}{c} F_u \ 1 \ F_{\ell} \\
J_u \ 1 \ J_u' \\
\end{array} \right\} \left\{ \begin{array}{c} F_u' \ 1 \ F_{\ell}' \\
J_u' \ 1 \ J_u' \\
\end{array} \right\} 
\times \left\{ \begin{array}{c} K \ F_u \ F_u' \\
F_{\ell} \ 1 \ 1 \\
\end{array} \right\} \left\{ \begin{array}{c} K \ F_u \ F_u' \\
F_{\ell} \ 1 \ 1 \\
\end{array} \right\}, \quad (40)
\]

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