Erratum: Analysis of the temporal and spectral output properties of a mode-locked and Q-switched laser oscillator with a nonlinear mirror based on stimulated Brillouin scattering [Phys. Rev. A 74, 013809 (2006)]

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We presented the experimental and numerical investigation of the emission dynamics of a mode-locked SBS-laser oscillator. In the development and in the presentation of the numerical models flaws have occurred.

In the spontaneous emission terms in both models the stimulated emission cross section σ has to be substituted by the fraction s of spontaneous emission into the laser mode. In the frequency domain model the fraction of spontaneous emission s_n into the nth mode contains the emission profile S_n and the total number p of resonant modes possible in the laser resonator volume V_R:

$$s_n = \frac{S_n}{p} \quad \text{with} \quad p = 8\pi\nu^2 \frac{\Delta\nu_g V_R}{c^3} \quad \text{and} \quad S_n = \frac{(\Delta\nu_g/2)^2}{(f_n - f_0)^2 + (\Delta\nu_g/2)^2}.$$

$\Delta\nu_g$ is the bandwidth of the gain medium and f_n and f_0 are the frequency of the considered mode and the frequency at line center, respectively.

In the time domain picture the spontaneous emission is considered to be a continuous wave, which is equivalent to spontaneous emission in just one mode. The fraction s of spontaneous emission into the laser mode therefore is $1/p$, the inverse of the total number of resonator modes.

This effects Eqs. (1), (5), (10), and (13). The error has occurred when transferring the formulas from the programming to the editing. Therefore, the numerical results are not questioned since the calculations were carried out with the correct equations.

Another mistype has occurred in Eq. (1). The stimulated emission term (third term on the right side) has to be multiplied by the velocity of light c. The corrected Eq. (1) thus reads

$$\frac{d\phi_n}{dt} = -\frac{\phi_n(t)}{\tau_R} + \frac{l}{L}\frac{n_2(t)s_n}{\tau_{sp}} + \frac{l}{L}n_2(t)\sigma_n\phi_n(t)c + [-2\phi_n(t) + \phi_{n+1}(t) + \phi_{n-1}(t)]m\frac{c}{2L}. \tag{1}$$

In the calculations on the basis of the time-domain model two actual errors have occurred: First, the contribution of the spontaneous emission [last terms in Eqs. (10) and (13)] has to scale linearly with the length of the laser active material. Second, the factor $1/2$ in Eqs. (11) and (14) is wrong. The corrected Eqs. (10) and (11) are therefore

$$I_1 = I_0(t-T)\exp[n_2(t)\sigma l] + n_2\frac{s}{\tau_2}l, \tag{10}$$

$$n_2' = n_2(t) - n_2(t)\sigma I_0(t-T)\Delta t. \tag{11}$$

Due to these errors we have repeated the calculations for all presented results that were gained on the basis of the time-domain model. For the numerical results the neglect of the length of the laser active material leads to an overestimation of the contribution of the spontaneous emission by a factor of 10 (since $l=0.1$ m). This leads to a delay time (interval of time from beginning of the pumping to onset of the Q-switch pulse) which is shorter compared to the results from the corrected equations, but the error is smaller than 1%. Neither the pulse durations nor the pulse shape are influenced noticeably by this error.

The factor $1/2$ in Eqs. (10) and (13) results in a slower depletion of the gain which leads to an overstating of the photon densities by a factor of 2. This applies for the right graph in Fig. 8 and for Fig. 11. Still, the pulse shape and pulse durations are not influenced noticeably by this error.

Please also note that the intensities calculated by the time domain model are normalized to the photon energy, and are thus of the dimension of a particle current density ($1/\mathrm{m}^2\mathrm{s}$).

To conclude, the errors in the time domain model as stated above only marginally influence the numerical results and do not affect the conclusions of the paper at all.

