the relaxation time constant does not follow Eq. (11) and is surprisingly longer. In addition, the relaxation is accompanied by coherent oscillations which stem from the complex gain/loss spectral profile.

When considering the impact of intra-cavity dispersion on the cavity lifetime of these lasers, which is a necessary parameter for determining the STL, some caution in needed. While the dynamics of the subluminal laser is similar to that of a conventional laser, which may indicate that its STL is indeed reduced by the large group index, the dynamics found for the superluminal case is more complex. Particularly, the perturbation relaxation time constant of a superluminal laser is surprisingly larger than that of a conventional one (even when gain saturation effects are considered), which implies that the cavity lifetime in the superluminal case is longer. This inference is counterintuitive, as one might expect the lifetime of a superluminal cavity to be shorter than that of a conventional one. In addition, the impact of the oscillations on the spectral shape of the lasing line is not obvious as it may indicate a non-Lorentzian lineshape. Nevertheless, the fact that the relaxation time constant in superluminal lasers is not smaller than that of equivalent conventional lasers may indicate that the quantum-noise limited linewidth of such lasers is not broadened by the superluminal group velocity, thus rendering them attractive and feasible candidates for the realization of ultra-sensitive sensors and for measuring ultra-weak phenomena.

Acknowledgments