Re: A definition please − relaxation oscillations

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> > >*Maybe we can get his attention to post a simple explanation.*
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I'm around −− though not sure I want to attempt much of an explanation on line. Newsgroup format is a bit restrictive.

General comments:

1) Pumping pushes atomic inversion and gain up; presence of an oscillation signal "burns up" excited atoms and pulls gain down (aka "saturation"). Steady−state oscillation requires signal level to be exactly at the value where gain is saturated down to exactly equal total cavity loss (including outcoupling), for given value of pumping.

2) Suppose oscillator is perturbed by small amount away from steady state conditions: gain momentarily too high or low, and/or signal level too high or low.

If gain is momentarily too high (greater than loss), signal level starts to grow above s−s value (rapidly in some kinds of lasers); v.v., if gain is momentarily too low (compared to loss), signal level drops.

But also, if signal is too high, it pushes gain down (rather slowly, in solid state lasers); and again v.v. if signal is to low.

3) Ergo, two coupled quantities that act in general to damp each other out. If however the time constants of the responses of each to the other are quite different, the damping out will take the form of a damped but oscillatory (quasi sinusoidal) response, aka "relaxation oscillations". This tends to be the case with solid−state and diode lasers, not the case with gas lasers (where the two time constants are similar, and any perturbations tend to damp out in a single highly damped period).

4) Lasers with weakly damped relaxation oscillations (lots of ringing in the die−out) also tend to show strong "spikes" in their initial

turn−on, especially if the pump is rapidly turned on. Initial large−amplitude spiking in this case damps down eventually to small−amplitude decaying quasi sinusoidal relaxation oscillation. Both of these were immediately seen in earliest ruby lasers, hence got a lot of attention.

5) Essentially the same phenomena also occur, however, in lots of other kinds of oscillators as well −− e.g., in the very first hp audio oscillators (interesting story).

Other questions?