Turn-On Dynamics of 2D Random Scatterer Lasers
– linear pump ramp –

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This draft is an addendum to pamphlet [1], where the laser had been turned on suddenly. But the experimental pump pulse is smooth. Does a smooth pump pulse cause relaxation oscillations, too? Michael Höfner couldn't detect them so far in experiment. Here I present an exemplaric simulation.

I consider a stripe laser with 50 randomly distributed scatterers. Lengths $L = 2$ mm, width $w = 0.1$ mm. Other parameters as in [1]. The pump increases linearly from zero to 10 times threshold within 10 ns and back within the next 10 ns. Fig.1 summarizes the results in same manner as in [1].

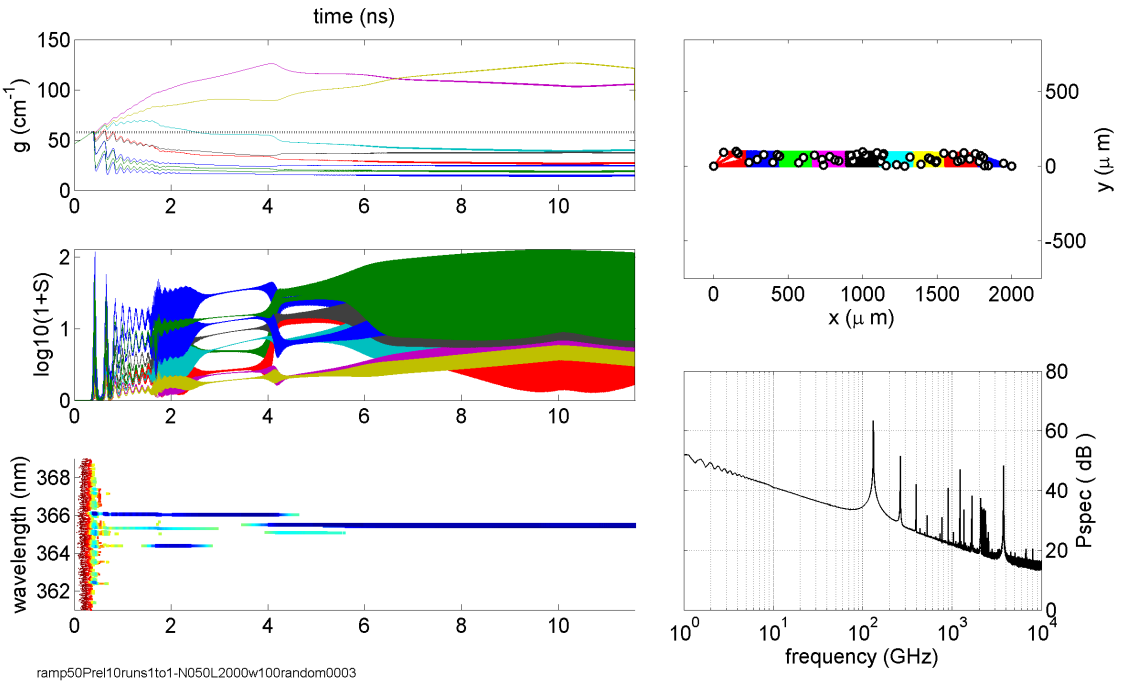

Figure 1: *Turn-on under a linear pump ramp (see text). Left panels: evolution of gain g (top) and mean intensity S (middle) in each domain as well as positions of spectral peaks (bottom). Spectra are calculated with a shifting window of length* $2^9 dt \approx 20$ *ps. For each window, the positions of spectral peaks are plotted at the centrum of the window. Logarithms of the spectral peak heights are color coded from dark blue = highest peak in the actual window to red = 40 dB below. Lower peaks are disregarded. Right top: Positions of scatterers (circels) and grid points (dots with colors distinguishing between domains). Right bottom: power spectrum.*

Gain and intensity clearly show RO within the first two ns. They are expanded in Fig.3. Conclusion: the experimentalist should look to the first ns after turn-on. However, present model disregards possible nonlinear gain saturation, which might considerable increase the damping of the RO in the real samples (this is a standard effect in semiconductor lasers, see textbooks).

References

[1] HJW, "Turn-On Dynamics of 2D Random Scatterer Lasers – First Simulation Results", draft July 3rd, 2012

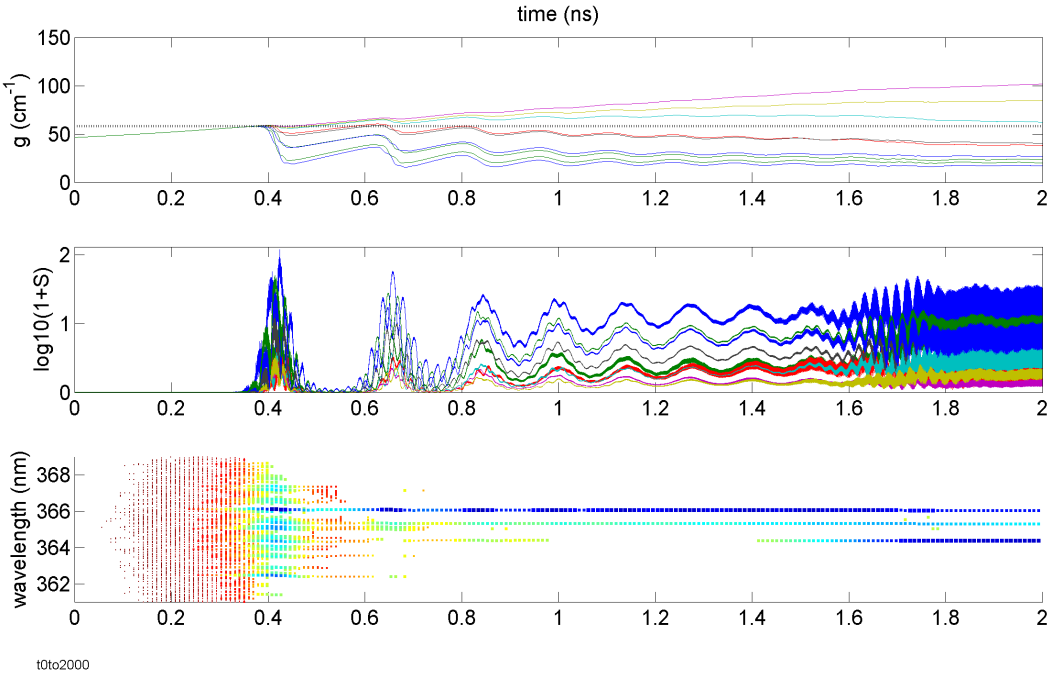

Figure 2: *Expanded RO. Notions as in the left panels of Fig.1*

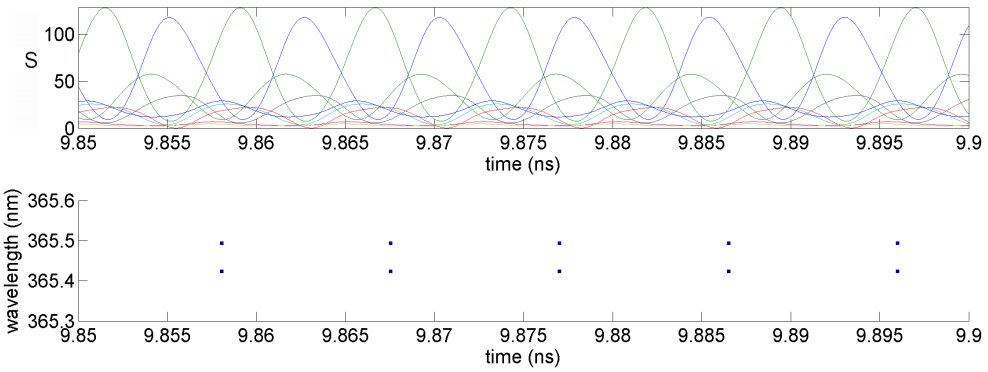

Figure 3: *Top: Expanded mode beating oscillations. Note: the intensities S are plotted in linear scale, here, in order to demonstrate their sinosoidal character. Bottom: The spectral positions of the two beating modes, which were not resolved in Fig.1.*