Umeå University	Växelverkan
Department of Physics	Quantum Optics
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Assignment 1

To be submitted on April 19, 2010

Consider a two-level atom. Find the general solution to the optical Bloch equations as the irradiation time goes to infinity (i.e., assume that the density matrix becomes constant). In the general case, the excited-state poulation depends on: detuning, irradiance and the rate of spontaneous emission. Use your solution to answer these questions:

- (a) What is the spectral shape (as function of frequency) for the excited state population for small irradiance?
- (b) What happens to the spectral shape and the FWHM as the irradiance is increased?
- (c) For a typical atomic transition with $A = 10^8 \text{ s}^{-1}$ and $\lambda = 500 \text{ nm}$, which irradiance is required to get a 10% increase to the FWHM?

The solution should be submitted to Emil Lundh (lundh@tp.umu.se) no later than April 19, 15:00. If the solution is submitted electronically, I will only accept platform independent formats (pdf strongly recommended!). Answers on paper are of course also accepted.