Coherent Light Transmition by Atoms in the Dense Regime: Implementation of a Fabry-Perot Cavityion of a Fabry-Perot Cavity

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In the context of light-matter interaction, a sample of ^{88}Sr is cooled to temperatures on the order of μK and trapped in small regions of space, reaching the dense regime. So, looking at the main transitions of the ^{88}Sr atom (as you can see in 1), one at 461 nm with linewidth of 30.5 MHz (between the $[5s^2]^1S_0$ and $[5s5p]^1P_1$ states), and another at 689 nm with linewidth of 7.6 kHz (this, between the $[5s^2]^1S_0$ and $[5s^2]^3P_1$ states) the cooling process is made by the radiation pressure exercised by a blue laser of wavelenght 461 nm.

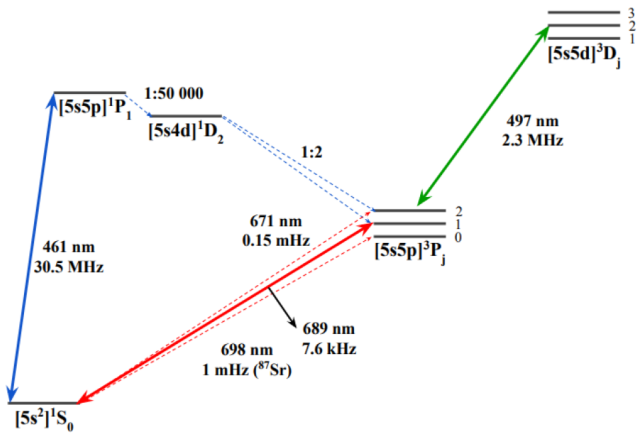

Figure 1: Diagram of the main transitions of the Strontium-88 atom

However, it may occur that the ^{88}Sr atoms, when excited to the $[5s5p]^1P_1$ state, do not decay to the ground state, instead, to the $[5s4d]^1D_2$, and then to the $[5s5p]^3P_2$ state, which is a problem, because with the atoms in this state the cooling process would cease. To get around this problem, we use a 497 nm laser, so that the sample atoms that are in the $[5s5p]^3P_2$ state, will be excited to the $[5s5d]^3D_2$ state, decay to the $[5s5p]^3P_1$ and subsequently decay to the ground state and thus the cooling process is resumed. The process described above is called 'repump' of the atomic cloud.

Therefore, the Fabry-Perot cavity will be used to lock the frequency of the green laser used in the 'repumping' process. For that, the cavity will have its lenght stabilized in relation to the blue laser, which has a stabilized frequency. The green laser will have, then, its frequency stebilized in relation to the cavity's lenght. Finally, as a main goal of this project, the ambition is to carry out the lock-in process of green laser through the use of a FPGA system, called RedPitaya STEMlab 125-14.