Hot Atoms for Temperature Measurements and Lasing without Inversion in the UV

Daniel Koestel[1], Daniel Preissler[1] and Thomas Walther[1]

[1] Inst. for Applied Physics, TU Darmstadt, Germany

In our laboratory, hot atoms play a significant role in two of our endeavors: the measurement of the temperature profile in the mixing layer of the ocean based on a Brillouin lidar and a four-level lasing without inversion (LWI) experiment based on Hg.

In the first experiment, we use an ESFADOF as an edge filter in order to detect the temperature of the water by analysis of the time-resolved (and hence depth resolved) temperature dependent frequency shift of the back-scattered Brillouin components. The ESFADOF consists of a Rb cell placed in a strong static, homogenous magnetic field. The Rb gas is heated to approximately 235 °C and is pumped into the 5 $P_{3/2}$ excited state [1].

The basic idea behind our LWI approach is a four-level scheme in neutral mercury designed to demonstrate LWI in the UV range [2]. The short term experimental goal is amplification without inversion (AWI); however, for the goal of LWI the gain must be maximized to overcome losses. After a short summary of the experimental limitations of our current setup we will discuss the lessons learned from our recent simulations. In order to identify the most promising parameters for maximizing the gain, we performed extensive simulations based on our earlier theoretical model [3].

In our contribution, we give a brief status update on both projects and give an outlook into the next steps.

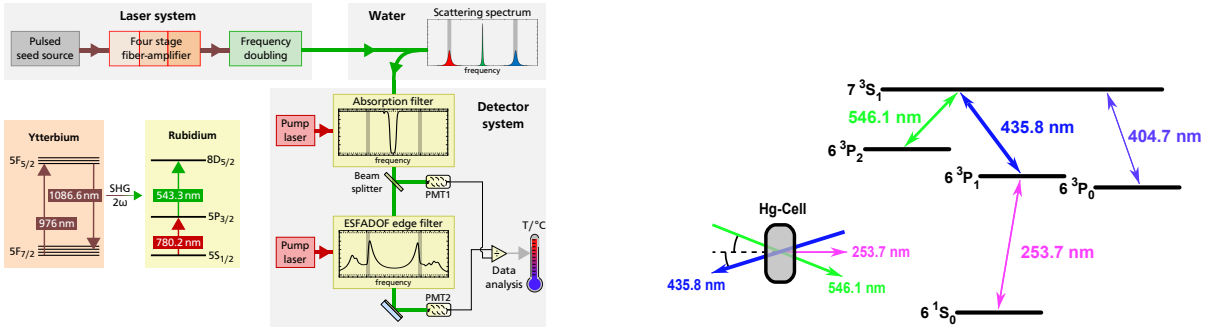

Figure 1. (left) Principle of our Brillouin lidar consisting of the laser source and the receiver. (right) Levels of the UV-LWI scheme in Hg. The UV lasing will occur at 253.7 nm. The inset shows the special laser arrangement to cancel the Doppler effect.

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[2] E.S. Fry, M.D. Lukin, Th. Walther, and G.R. Welch, Four-level atomic coherence and cw VUV lasers, Opt. Comm., **179** 499 (2000).

[3] M. R. Sturm, B. Rein, Th. Walther and R. Walser, Feasibility of UV lasing without inversion in mercury vapor, J. Opt. Soc. Am. B **31** 1964 (2014).