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### Frequency Stabilized Laser Diode with Hollow Core Fiber Gas Cell

#### Project Summary

A visible laser diode (around 633 nm) was stabilized on an absorption line of iodine vapor. The absorption cell is actually composed of a hollow-core fiber filled with iodine gas. The hollow-core fiber is spliced at each end with standard single-mode fibers (monomode at 633 nm), using a filament fusion splicing system. The hollow-core fiber was filled with iodine by drilling the side of the fiber in order to access the hollow core. The solution has the advantage to provide an all-fiber system. The drilling was performed by means of a UV femtosecond laser.

The laser frequency stabilization technique is based on the "side-of-line" technique, i.e. the laser is stabilized at the maximal slope of the absorption line. The laser frequency is therefore slightly decentered with respect to the center of the line. Stabilities better than 0.02 ppm have been obtained on a glass absorption cell.

The feasibility of the concept has been proven in the framework of this project, although the filling process is not yet optimized. Absorption lines have been observed at the end of the fiber. The absorption coefficient is however lower than expected.

Future works will deal with the filling process improvement, as well as the improvement of the process robustness and miniaturization of the fiber ferules at the location of the fiber side holes.

#### Valorisation

Since only one paper relates the filling of hollow-core fibers with iodine vapor, and since the published technique involved a free-space coupling in the fiber through a vacuum vessel, we believe that the developed technique here is worth to be published. Indeed, it has the advantage to provide an all-fiber system, and can be easily miniaturized. A publication is foreseen in 2015.

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