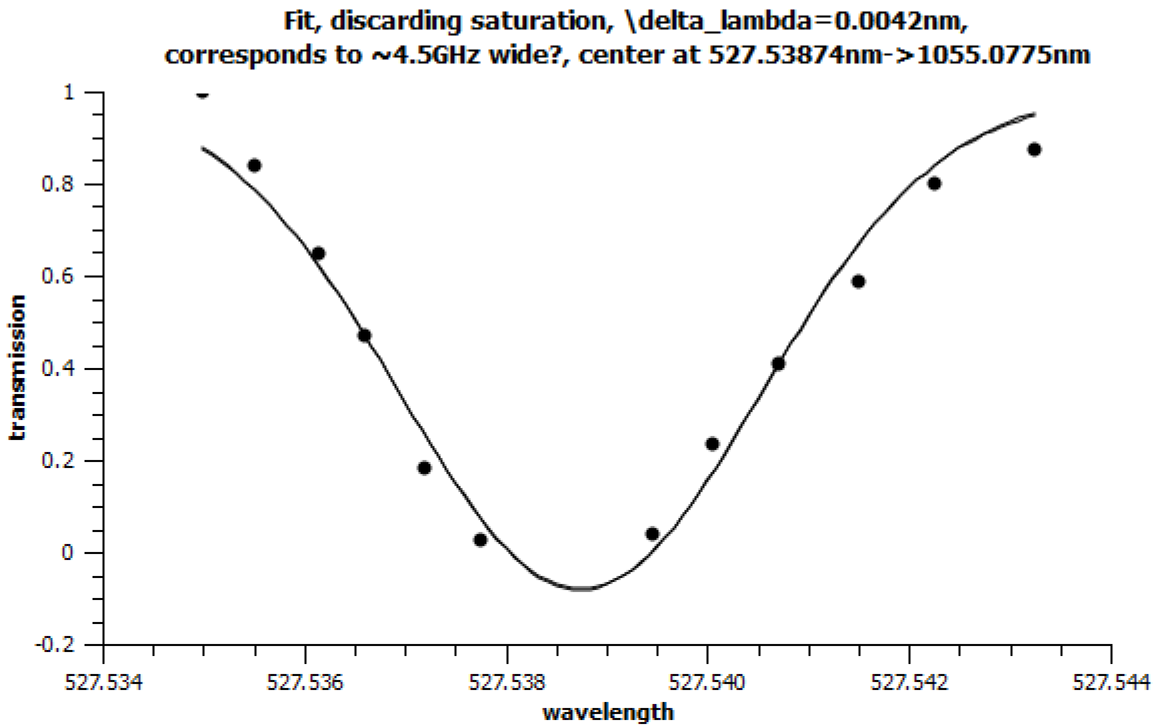
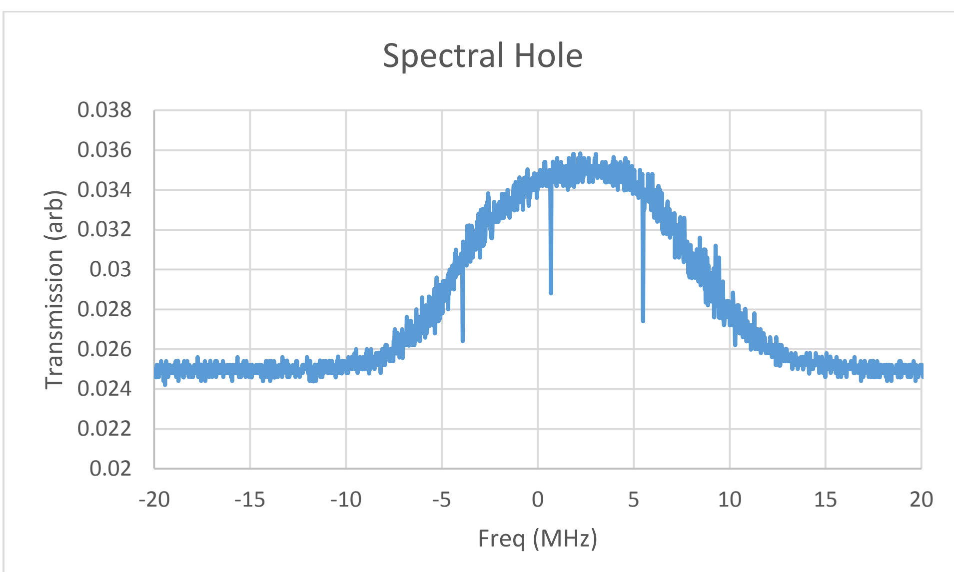
Week of 2-2-2015 Spectral Hole-Burning Scope Shots and Observations

We were able to map out the overall inhomogeneous line by manually scanning the laser; this is tough as the mode-hop -free tuning range of the laser is a similar width to what we're trying to look at, and we also need twice the width as our laser is frequency doubled:

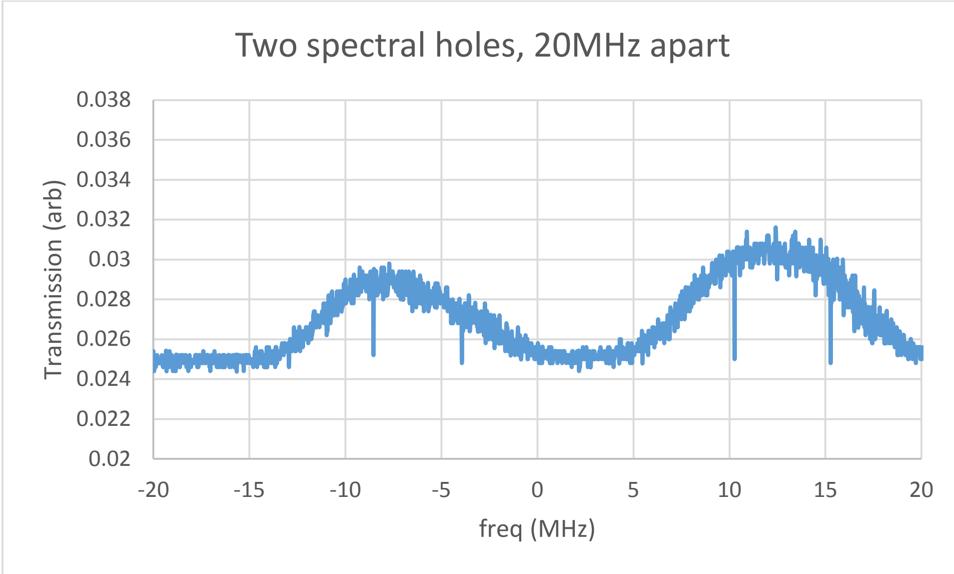


We were also able to burn features into the overall absorption feature. For example, parking the laser in one spot, we see a transmission hole. Note: this was parking the laser in the vicinity of 1055.077nm. Note the thing were interested in is this whole bump, the sharp dips are a frequency source glitch.

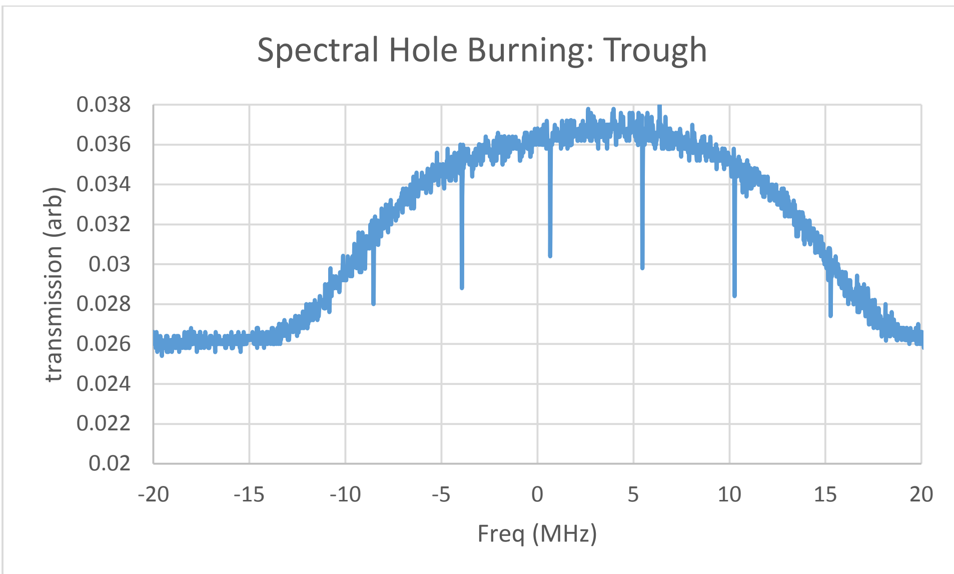


Parking the laser in one spot gives a single transmission feature, we've seen as narrow as about 5-10MHz, although this example looks wider.

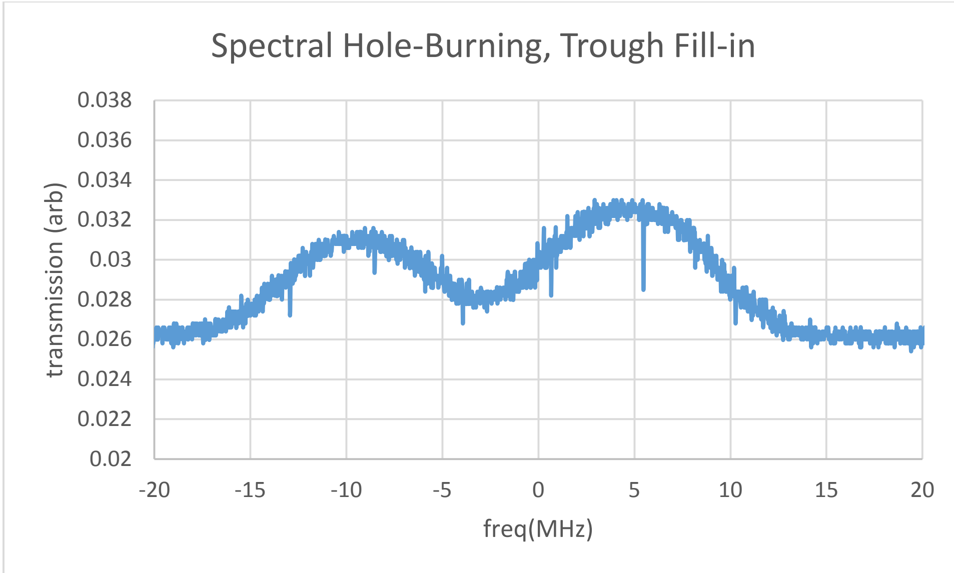
We are also able to burn two adjacent holes:



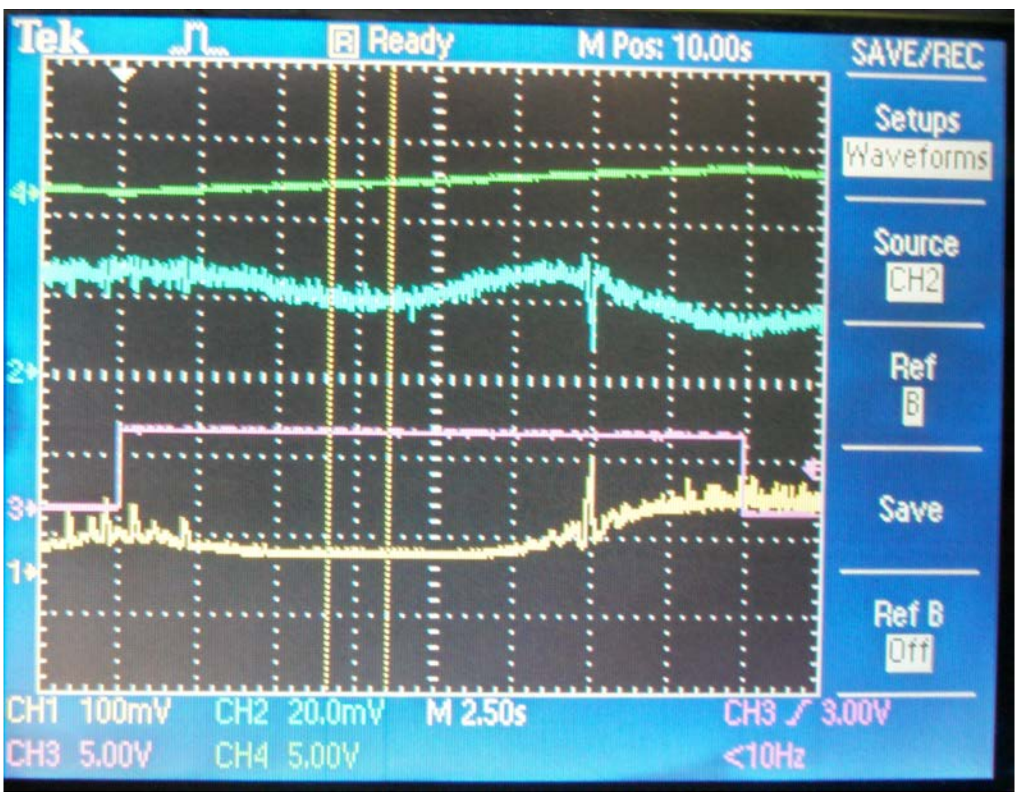
We can also burn a swath, here is a burn 20MHz wide, accomplished by sweeping the rf frequency source driving the AOM:



We have also been able to put population back into a hole by turning on the control beam that is appropriately spaced by the hyperfine ground state splitting. i.e. this is one of the two states the probe would pump to so turning this control beam on pumps population back.

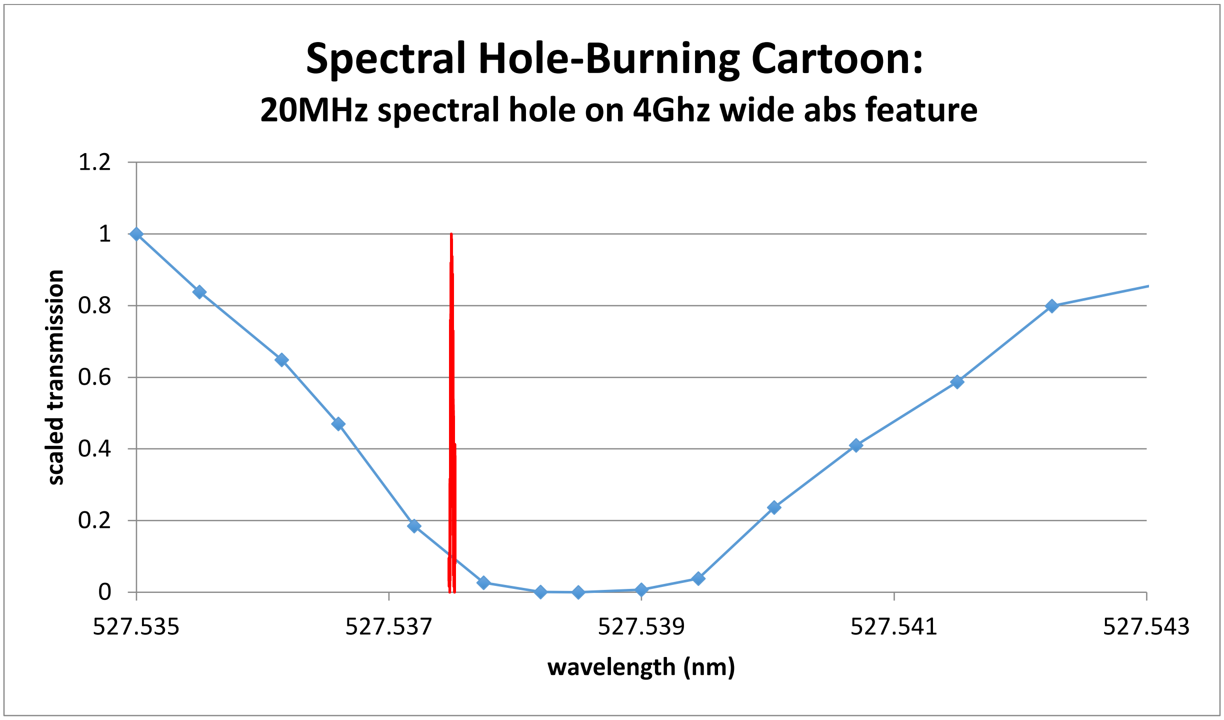


One interesting feature between the spectrally burned features and the inhomogeneous absorption feature is the very different frequency scale. They're different enough that it's difficult to see them at the same time. We can, however, if we slowly ramp the laser piezo to scan the laser. We're working on getting the laser to perform better over a larger freq range right now. Here's a (crappy photo) of a 40MHz wide trough in about 4GHz of sweep across the inhomogeneous absorption feature:



The scan corresponds to when the the pink trace is high. The yellow trace is the crystal transmission; there isn't enough power and so the laser is being absorbed and so flat in the middle of the scan. The blue is the fluorescence. The small dip in the fluorescence and excess in the transmission is the 40MHz spectral hole burned part way through the inhomogeneous line.

Alternatively here's a cartoon depicting our 20MHz wide trough on top of our abs feature:



These very different frequency scales is related to interest in these material as a sort of optical memory. The presence or absence of spectral holes could be used to store information.