**04-02-2012**

We observe that RF switches (ZASWA-2-50DR+) add (depending on the power) **enormous side bands to the RF, perfect higher harmonics**.

* This explains our problems with the spectra. In the old configuration of switches we did not reach the power levels that are “needed” to see the enormous side bands.

We furthermore observed that **we must not have any DC offset** on the Agilents because then the problem of higher harmonics is even much stronger….

In any case, it should help to put an appropriate low pass filter (e.g. 48 MHz) after the chain of switches to suppress the higher harmonics.

(Important side note: The switches can be used in regular or reversed arrangement (i.e. from one input to two outputs or form two ))

Order of RF-Switches

Amplifier

Last switch: Agilent 2

Next: RF 1

Next: Agilent

Next: RF pulse

Next: Rhode-Schwartz

Note: the output power difference between Agilent2 and RS is 5dB

Maximum power one should apply on Agilent2 is 3dBm and RS is 8dBm

**Test 1:** 35 MHz, 13dBm, after Switch chain, without amplifier, observed with Agilent Spectrum Analyzer.

We also noticed 60KHz, 120KHz, 180kHz noise from the 30W RF amplifier. Power level is around -28dBm.

(i) If going through one switch (Agilent 2): First higher harmonic suppressed by 40dB

(ii) If going through five switches (R & S): ): First higher harmonic suppressed by 28dB. With 1Volt DC offset: ONLY 10dB suppression of first harmonic!!!

**Test 2:** 35 MHz, 13dBm, after switch chain, **with** amplifier, observed with Agilent Spectrum Analyzer.

* The higher harmonics seem to be slightly suppressed compared to test 1, by additional 2dB or so. Probably the RF amp is more efficient for lower freq. So, no additional badness through the amp ☺

NOTE: The line width of the RF is not visibly increasing after the switch chain or the amplifier. Using the spectrum analyzer it appears to be clearly below 100Hz. So, no risk that a broadening of the frequency covers the molecule binding energy.

**Lessons learned:** Let’s make sure the most important RF pulse (now: molecule association) is going through ONLY ONE RF switch in order to minimize the side effects!

**04-04-2012**

Locating the molecule association frequency: 35.088 MHz (center, sweep with 6kHz)

* We are trying out the “short pulse idea” for molecule association. However, we see a clearly smaller molecule signal already at for pulse durations of 1ms at the (maximum possible, see above) amplitude of 3dBm.
* Thinking about it, this is actually no surprise: When we measured molecule conversion versus pulse duration (e.g. March 18th) we saw that the conversion efficiency kind of saturates at about 2ms pulse length. For shorter pulses conversion is worse. We would have to crank up the atom-molecule Rabi coupling by increasing the RF power, but this doesn’t work due to the RF switch issues and saturation of the RF amplifier.

So, we stick with the 2ms association, 6 kHz wide association sweep for the molecules.

Now, we check if the short pulse works for dissociation. Probably the molecule-free atoms Rabi coupling is much better, and a short pulse might work…

1. We map out the dissociation spectrum using 2 ms, 0dBm pulses. We get the maximal transfer of the 33.35 MHz.

Dissociation



Atomic transfer

1. To figure out the shortest workable pulse, we park the frequency at 33.35 MHz and vary the pulse length.



Minimum

Maximal transfer we already see after 400us, so we don’t need to apply longer dissociation pulses or a sweep anymore. That is likely to make the lifetime measurements cleaner!

Let’s check with more stable Na number, if we actually see molecule-atom-molecule oscillations here…

BTW: This time the time scale does NOT match to the sinc-lobes that move through the atomic features (spaced by 100 kHz) as a function of time (compare data on Feb 28th). So this dip might actually be real!!! To be checked further…

**04-05-2012**

Trying the transfer of Na to the (1,0) state. We use the RIGOL to do a 1 ms sweep at central frequency of

84.950 MHz, sweep width of 80kHz.

The transfer works very efficiently. However, we don’t see any improvement of the molecule lifetime, compared to not doing the sweep to (1,0). It seems to be as good to just leave the sodium in the (1,1) state…

We actually also applied a “blast” pulse that is resonant with (1,0) sodium atoms. However, we realized that it must be quite long to be efficient, i.e. 300us and the molecules are also blown away, because the light is also affecting sodium atoms in (1,1). The later cannot be avoided, possibly due to the high field imaging, where we don’t address cycling transitions…

So, maybe we should just measure the lifetime curves with the “sodium drop” technique that has already proven to work ☺ (see March 28th).