

March 2019 78 GHz Arizona Operating Event

By Bill Schwantes W7QQ and Mark Lewis N0IO

Winter resident Barry VE4MA organized a 78 GHz operating event during the second weekend of March 2019 in the Phoenix Arizona vicinity. This account describes the activities from my perspective during operations at 3 sites; Shaw Butte in the Phoenix metro area, White Tanks Mountains immediately west of Phoenix and Harquahala Mountain about 60 miles west of Phoenix. The main objective was to verify 78 GHz capability at longer paths beyond 100 kilometers. The southern Arizona terrain and low humidity present unique opportunities for DX on the 78 GHz and other microwave bands. The weather timing was critical due to an approaching Pacific storm. Weather-wise our operations fit tightly into a 3 day window which ended just one day after our testing was completed. A secondary objective was to feel some warmer weather after a long (and continuing) winter pattern in Colorado and New Mexico, and probably other places as well.

The 78 GHz event was a success in many ways. We had not planned on setting a new record, and didn't. Based on what we learned we're very optimistic that a new record beyond 300 km is possible in the inter-mountain west, given a low humidity and a Line of Sight (LOS) path.

Mark N0IO brought two 78 GHz stations; one with a 12" cassegrain dish and the other, a 47/78 rig with horn antennas. My contribution was to provide 10 GHz coordination and a pointing reference. The EIRP limit on 78 is 55 dBm, and Mark's dish rig does that with antenna gain. The horn rig does that with an expensive power amp and a receive preamp. Some others do that with both the PA power and dish gain but that's another story. Both N0IO rigs are legal.

DAY ONE

We started on Friday, March 8th, on Shaw Butte, a short drive from Kevin AD7OI and Tammy KI7GVT's QTH in a west Phoenix suburb. The Shaw Butte access road is a gated and Kevin had the keys. The narrow 4x4 access road is also used by hikers, and several visited us on the summit. There we completed short 60 km contacts with Barry VE4MA/W7, Al W5LUA, and Tony K8ZR who were located at San Tan, another southeast Phoenix suburb. Tony is the CQ Magazine VHF+ editor and had driven all the way from Cleveland, OH to be part of this experiment. The objective of Day One was to check radios on all bands, assess VHF repeater operation and cell phone coverage for future coordination. We completed the Friday event by making strong contacts on 10, 24, 47 and 78 GHz, all on USB. The day was completed over dinner with the crowd at a nice Mexican restaurant in Tempe near the Arizona State University campus. It was great to meet Tony Emanuel from Ohio and Al Ward from Texas who had traveled so far to be part of this effort. They made the rest of us feel like locals even though I had traveled from New Mexico and Mark from Colorado.

DAY TWO

Saturday, March 9th, Kevin AD7OI took us to White Tank Mountains to a 4,000 ft RF site where a 10 GHz beacon, an ATV link and a large array of commercial and government gear were located west of Phoenix. The other group of Al, Barry and Tony plus Ron K7RJ and Steve KJ7OG went to Mt Lemmon near Tucson. That distance was indicated as 208 Km.

The trip to the top was an adventure. There were four gates controlling access and Kevin had keys to each gate. It was beautiful, steep and rough with un-nerving exposure. Mark's Toyota FJ Cruiser performed the boulder hopping admirably in 4 wheel low. Kevin, who had been up that road many times led the way in his Chev 4x4 diesel pickup. When we arrived at the top, Kevin turned off everything that interfered with our millimeter wavelength ops. Despite the other emitters we had nice quiet conditions.

Al, Barry, Tony, Ron and Steve traveled to Mt. Lemmon near Tucson. We were told that wind gusts at Mt Lemmon had reached 115 mph during the night but luckily the wind had died by Saturday afternoon. Temperature was just above freezing and the humidity was reported to be relatively low on the Mt Lemmon end.

After an initial 10 GHz contact with the folks on Mt Lemmon, Mark quickly found Barry VE4MA on 78 GHz and made an S9 SSB contact. Al W5LUA followed at S9 and Tony K8ZG was much weaker but easy copy. Mark worked Al and Barry on 47 GHz and I worked them both on 24 GHz. We were excited! The 78 phone contacts sounded like we were on a repeater; crystal clear and loud with good frequency matching and no drift. That made us all think about what we had to do to stretch the distance to record length at about 300 Km. .

After we had worked everyone I suggested that Mark N0IO try his 47/78 horn rig since the signals had been so strong. He said "you call Barry (VE4MA)". I fiddled with it for a bit and heard Barry weakly on 78 but he was so weak that it was hard to tune his voice pitch on phone. Assuming we might be able to work on CW I fetched the key from my 10/24 rig and was in the process of plugging it in to the FT-817 IF rig when both Mark and I heard Barry's booming voice briefly in the speaker. Mark quickly found an intermittent IF cable and replaced it. I worked Barry VE4MA and Al W5LUA on 78 USB and we all thought transmit and receive signal strength was as good as the dish rig. Barry couldn't believe we were on the horn rig! We verified that the horn antenna was easier to point effectively.

We tried a 47 GHz contact with the 47/78 horn rig and found it much more difficult to complete than on 78 GHz. The signal strength was much weaker. We joked that we needed to use the 78 GHz dish rig to coordinate and point the 47 GHz rig. We weren't able to explain that but we were so happy with the 78 results it hardly mattered. The horn rig could have been driven a bit harder for 6 dBm more signal on 78 GHz but we joked that we were trying to stay with FCC rules to use only as much power as needed to make the contact. Everyone on White Tank was pretty happy. AD7OI Kevin had taken some great pictures of our op site with still camera, video and a drone. We packed up, restored the RF site's operation and departed down the steep hill.

DAY THREE

On Sunday things had changed. We drove out to Harquahala Mountain where Kevin AD7OI and Tammy KI7GVT led us off the blacktop about 1.5 hours west of Phoenix.. The path from 5900 foot Harquahala to Mt. Lemmon is indicated at 282 Km just a few kilometers short of the existing 78 GHz DX record. There was some doubt whether the path was partly blocked. Some thought it wasn't blocked, others felt it wouldn't matter. The path had been worked several times on 10 GHz. Still others felt it was the best we could do in Arizona without better planning and more time. Path performance on 78 GHz was new territory for all of us, but everybody was optimistic.

The Harquahala Mountain Road is public and un-gated. The map and other public info say the road is 10.5 miles to the top. We thought it would be better maintained than the White Tanks road but we were wrong. It was pretty much the same but longer. I squeezed the door handle until there was no juice left in it! Mark was experienced with unimproved roads and encouraged me with little white lies about the top being "just around the next switchback". It took about 2 hours from blacktop to the top. When we did reach the top the view was amazing! There was a small solar powered RF site, a helipad, a preserved 1920's Smithsonian observatory and some picnic sites at the top.

As soon as I got out of the FJ I noticed there was moisture in the air and it was much cooler than on Saturday. The cloud deck was lower and thicker than on day two. I put on a jacket and wool hat and we set up our equipment in a light breeze. Kevin configured the UHF repeater so we could communicate with Mt. Lemmon but comms required Kevin to use the radio in his truck parked 75 feet away for transmit. First reports from Mt. Lemmon were that it was below freezing, windy and the clouds were whizzing by just above the team there. We were a little unsure of the correct bearing. My two magnetic compasses indicated 25 degrees apart. We could see the White Tank Mountain RF site where we were the day before and chose a bearing that seemed to make sense.

Mark was confident in 78 GHz and began calling the Mt Lemmon crew and beaconing with a CW keyer. Nothing..... The Mt Lemmon crew suggested we listen on 47 GHz..... nothing. I fired up the 10/24 rig and called on 10 GHz phone. There was a weak S3 response that allowed both ends to peak the signal and refine the pointing using CW beacon mode. We were all surprised how weak the 10 GHz signal was. The pointing was very close to the bearing used just prior to peaking, so it appeared we guessed correctly. We learned later that it required 3 people on Mt Lemmon to operate on 10 GHz; two to hold the 30 cm dish in the wind and an operator..... very tough weather on Mt Lemmon. We had it easy on Harquahala Mountain.

Mark N0IO called, listened and beaconed on CW on 78 and 47 GHz for over an hour using each of his three rigs. Nothing was heard on either end. Everybody was cold and uncomfortable but nobody wanted to give up. There were no signals heard: Not a quiver in the background noise and nothing to work with. We concluded that the path was, in fact blocked by terrain and that the effects of water vapor signal absorption may have been underestimated.

We packed up the radio gear and bailed off Mt. Harquahala a little disappointed, but optimistic about future efforts.

The experiments were a great collaborative effort by several of the most active microwave experimenters in the country. I was privileged to be part of that. I want to thank a number of Phoenix area hams who supported this gathering. Without them this could not have happened.

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Video here: https://www.youtube.com/watch?v=_w1QfZ-tfpg