

78 GHz Fun in the Arizona Sun.

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Whether it is on 160 meters, 241 GHz or any band in between most of us try to achieve the best possible DX on our favorite band(s). While attending MUD 2018 in Dayton Barry Malowanchuk, VE4MA, Al Ward, W5LUA, and I discussed the idea of taking a spring time mm-wave DXpedition to Arizona to try to best the current 75 GHz North American DX record of 289km held by AD6IW, KF6KVG and K6GZA.

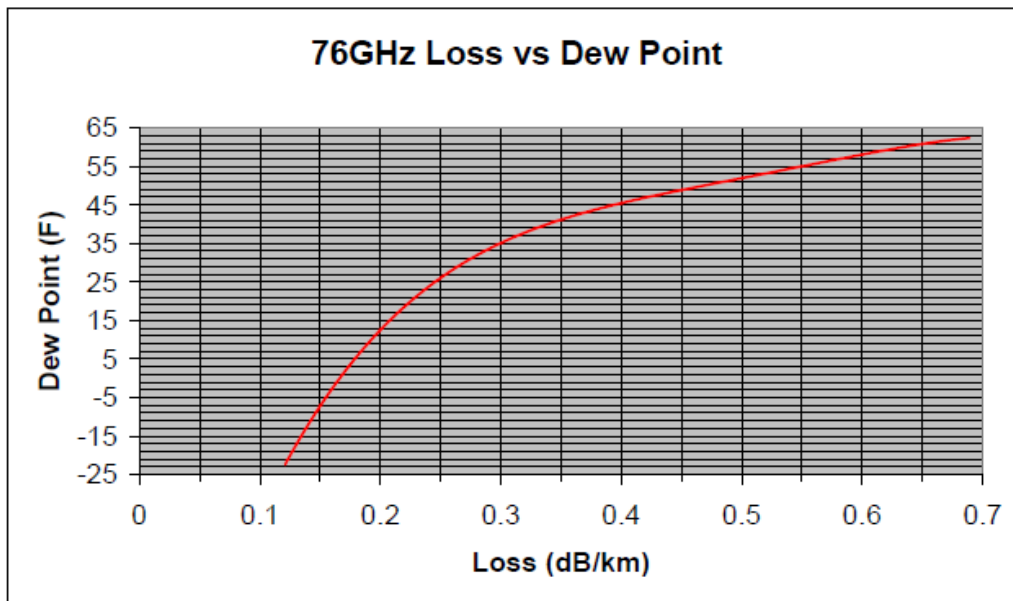
75 GHz			
LOS	289	AD6IW (CN90fl) - KF6KVG (CM97av)	23-Jun-14
LOS	289	AD6IW (CN90fl) - K6GZA (CM97av)	23-Jun-14
LOS	205	N1JEZ/1 (FN44ig) - WA1MBA/1 (FN42bl)	19-Sep-14
LOS	177	AD6FP/6 (CM88qp) - KF6KVG/6 (CM97ad)	1-Mar-02
LOS	177	W0EOM/6 (CM88qp) - KF6KVG/6 (CM97ad)	1-Mar-02
LOS	110	K2AD (EM96ur) - W2SZ (FM07fm)	20-May-99

ARRL VHF DX records. See <http://www.arrl.org/distance-records>

Each band has its own set of challenges and the 76 to 81 GHz band (4 mm-wave) is no exception. In July 2017 the FCC made a significant change reducing the maximum permissible power to 55 dBm peak effective isotropic radiated power (316 W EIRP). The rationale for the power reduction is to prevent possible interference to vehicular radar located at 77 GHz. Curiously enough Canadian and German amateurs do not have the same power restriction despite the fact that automobiles in the both countries are equipped with radar at 77 GHz. To put the power limitation in perspective 10 milliwatts (10 dBm) at 76 GHz into a 1 foot dish, assuming 55% efficiency and 45 dBi gain, will result in 55dBm EIRP – the new maximum power limit.

An added challenge at 76 GHz is path loss due to attenuation/absorption beyond the free space loss. With a dew point of 50F the additional path loss is ~0.5db per km at sea level.

Path Loss Charts. This path loss is ONLY the part due to atmospheric attenuation/absorption. Based on Lieb formulations
Prepared by Brian Justin WA1ZMS. Calculated for Sea Level (standard pressure).



Credit: Brian Justin, WA1ZMS.

Over a 100km path that amounts to 50dB additional loss just due to absorption/attenuation! However with a dew point of ~-5F the additional path loss is a much more manageable 0.15dB/km or 15dB over the same 100km path. Clearly the dry Arizona winter air would have a positive impact on any attempts to break the record.

Any record breaking attempts would be over line-of-sight (LOS) paths implying that high elevation end points were necessary due to the curvature of the earth. As a bonus the path loss due to absorption/attenuation decreases with elevation - a benefit, small to be sure, but every fraction of a dB/km gained could make the difference between success and failure.

VE4MA winters in the Phoenix area and over the winter engaged several local amateurs with knowledge and access to possible operating sites. With their help he determined several paths that looked promising. It must be acknowledge that without the help of Kevin Jacobson, AD7OI, and his wife Tammy, KI7GVT, at the western end and Steve Bell, KJ7OG, his wife Clare White and Ron Jones, K7RJ, at the eastern end of the paths it would not have been possible to challenge the existing 4 mm-wave North American DX record.

Over the winter several other operators with 76 GHz capability were recruited by VE4MA including Mark Lewis, N0IO, from Grand Junction, CO; Jim Hermanek, K0KFC, who winters in Arizona and Bill Schwantes, W7QQ, from Santa Fe, NM. By early February a plan had coalesced: N0IO and W7QQ would operate at the western end of the paths at two or possibly three locations while VE4MA, W5LUA, K0KFC and K8ZR would operate at the eastern terminus on Mt. Lemmon, AZ with a tentative target date of either the first or second weekend of March. Unfortunately K0KFC had a family emergency and could not participate.

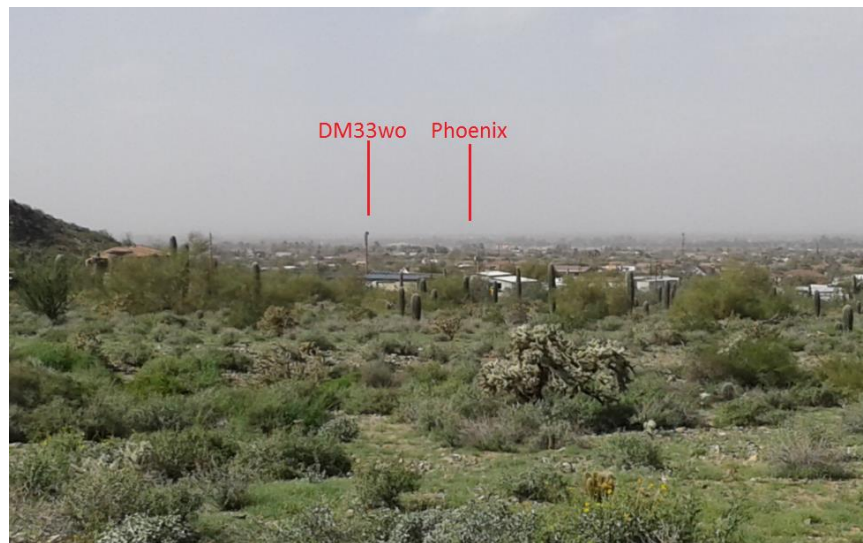
The southeastern Arizona weather had been unusually rainy the weeks before the agreed upon weekend of March 9th. There had been some discussion of postponing the attempts until fall but the weather forecast showed promise the first of the month and on March 3rd all agreed to be in Phoenix by Thursday the 7th. K8ZR left Ohio carrying 10, 24, 47 and 76 GHz gear on the 5th, met W5LUA at his QTH on the 6th and the pair arrived in Arizona Thursday afternoon. In addition to 76 GHz, W5LUA also packed his 47 GHz transverter. N0IO and W7QQ also arrived in Phoenix on Thursday.

Friday morning K8ZR and W5LUA met at VE4MA's QTH for 76 GHz equipment check out. W5LUA had yet to make a 76 GHz contact and VE4MA quickly obliged. During the equipment checkout K8ZR learned that N0IO could only operate on 78,192 MHz and not 76,032 MHz the portion of the band that the 4 mm-wave ops in Michigan and Ohio had been using. Fortunately it was an easy matter of reprogramming the PLL to 9,756 MHz².

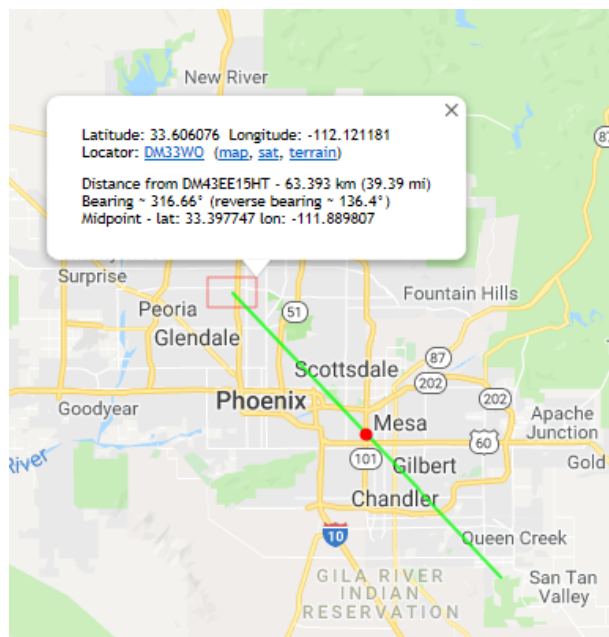


L. to R.: 78 GHz W5LUA and K8ZR at VE4MA's winter home.
Photo: K8ZR

After lunch N0IO and W7QQ traveled to Shaw Butte DM33wo and VE4MA, W5LUA and K8ZR traveled across town to San Tan Mountain Regional Park to a site located in DM43ee15ht. A path check on 10 GHz revealed extremely strong signals over the 63.3km (39.4 mile) path and so everyone QSYed immediately to 47 GHz quickly working with 5x9+ signals from all. 78 GHz proved to be just as easy and again both teams easily worked each other on SSB with 5x9 signals. That evening the two teams met in Phoenix for dinner and to finalize plans for Saturday.



DM43ee15ht looking towards DM33wo. Photo: K8ZR



DM43ee15ht to DM33wo. See <http://k7fry.com/grid/>



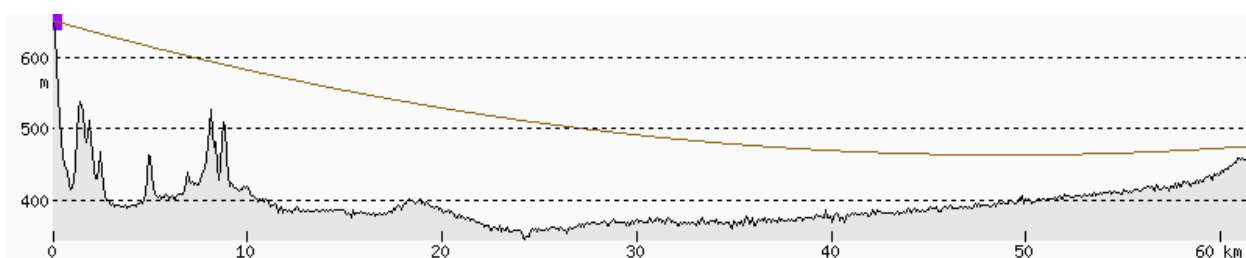
W5LUA ready on 47 & 78 GHz in DM43ee15ht looking towards DM33wo.
Photo: K8ZR



K8ZR DM43ee15ht looking towards DM33wo. Photo: W5LUA



Barry VE4MA 10 GHz liaison @ DM43ee15ht.
Photo: K8ZR.



Shaw Butte DM33wo to San Tan Mountain Park DM43ee15ht. Courtesy VE4MA

Mt Lemmon, AZ DM42ok56ig Saturday & Sunday March 9th & 10th.

From VE4MA's winter home to the summit of Mt. Lemmon, AZ in DM42ok56ig is almost a three hour drive with the last hour or so traveling up the well paved mountain road to the summit at 9,159 feet. VE4MA, W5LUA and K8ZR met their east end hosts Steve Bell, KJ7OG, his wife Clare White and Ron Jones, K7RJ, for lunch. Steve is associated with the University of Arizona which maintains an

astronomy observatory at the summit. Leaving the restaurant the air temperature was in the low 60's F and at the summit it was 29F with a dew point of ~ 0F at 1PM local.



Setting up on Mt. Lemmon DM42ok56ig. L. to R. KJ7OG (10 GHz), K7RJ & VE4MA.
Photo: K8ZR.



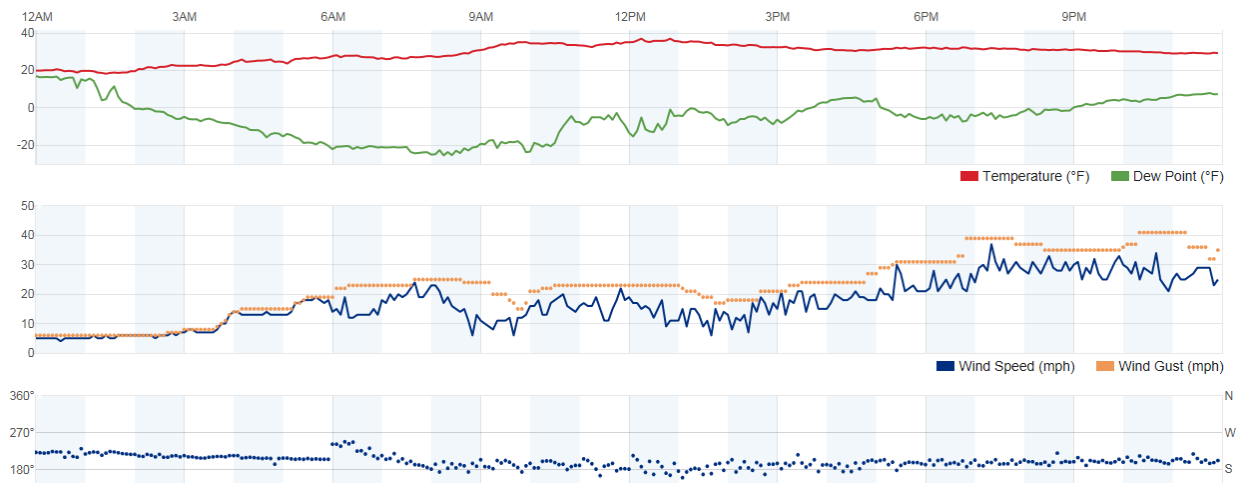
L: An ecstatic Barry VE4MA after 207km 78 GHz QSO with N0IO.
R: K8ZR ready to go on 78 GHz @ DM42ok56ig.



W5LUA: 47 GHz (upper) & 78 GHz @ DM42ok56ig
Photo: K8ZR.

A weather station is located below the observatory on Radio Ridge and weather data is conveniently accessible via a website³.

Weather History Graph March 9, 2019



Mt. Lemmon, AZ DM42ok56ig Dew Point ~-5F @2PM local.

The west end host Kevin Jacobson, AD7OI, along with N0IO and W7QQ made their way to White Tanks Mountain Regional Park to a location at ~4,000 feet in DM33rn26sp. Unlike the paved road to Mt. Lemmon their journey to the operating site was more of an off-road experience on a dirt, at times steep, boulder strewn road. Conditions on White Tanks were a bit more comfortable as can be seen by the photographs.



L. to R. AD7OI, W7QQ & N0IO DM33rn26sp.
Photo: AD7OI drone.



L. to R. Mark N0IO, 78 GHz and 47 GHz White Tanks, AZ DM33rn26sp.
Photo: AD7OI.

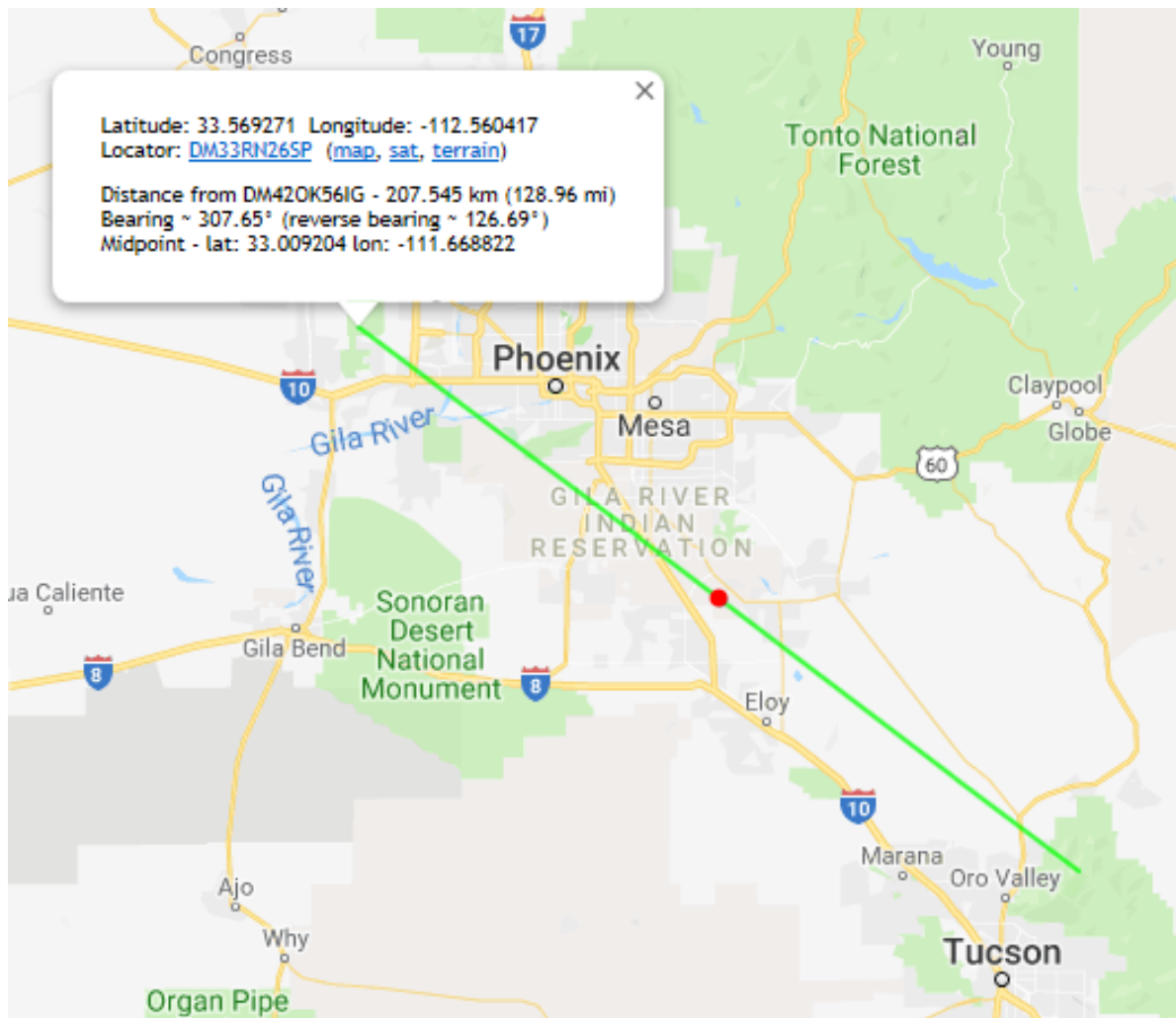


Bill W7QQ with N0IO's backup 78 GHz system with horn antennas.
 Bill easily worked VE4MA & W5LUA @ 207km
 Photo: AD7OI



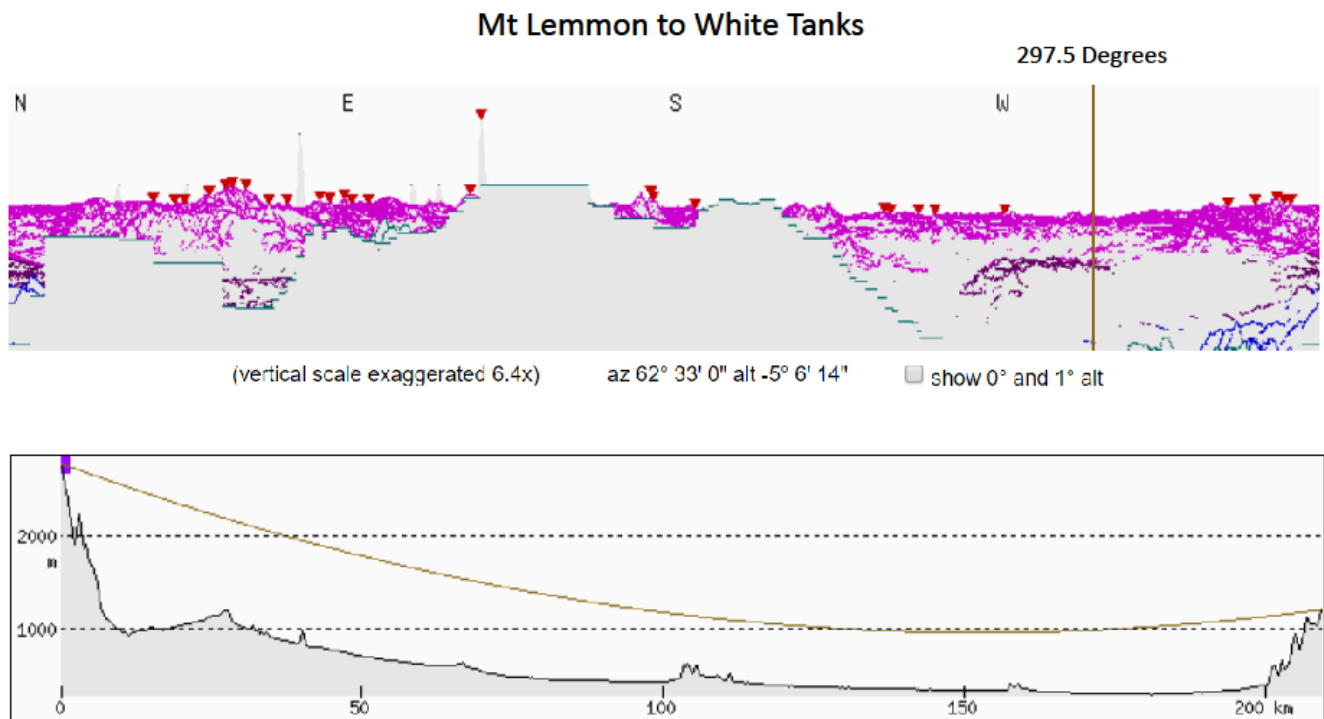
L. to R.: N0IO 47 GHz, N0IO 78 GHz with horn antenna and N0IO 78 GHz.
 Photo: AD7OI.

The 10 GHz beacon on White Tanks was used for initial antenna alignment. With antennas aligned on 10 GHz the beacon was turned off and 10 GHz became the liaison frequency for the 78 GHz attempts. Before too long VE4MA was hearing N0IO; they easily worked on SSB over the 207km path with excellent signals. W5LUA easily worked N0IO while K8ZR running less power had to resort to CW with signals at 579. W7QQ using N0IO's 78 GHz "QRP" rig with a horn antenna easily worked VE4MA and W5LUA on SSB.



DM42ok56ig to DM33rn26sp @ 207.5km

Courtesy <http://k7fry.com/grid/>

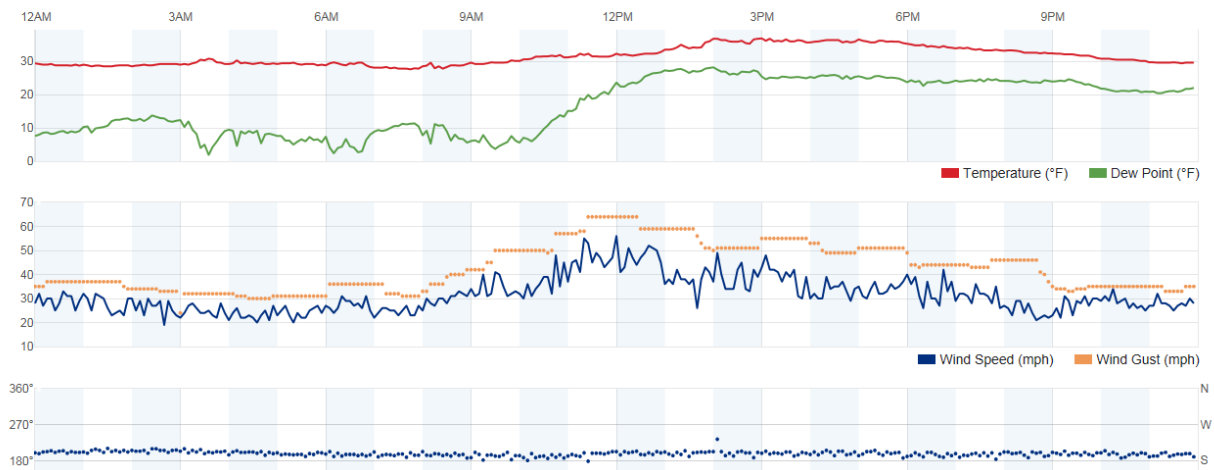


Courtesy VE4MA

Though not a record all were extremely pleased with the results. Buoyed by their success the group QSYed to 47 GHz and all easily worked on SSB. A video taken by AD7OI while at White Tanks and later posted to YouTube can be found by searching on "78 GHz" or 78 GHz W7QQ - VE4MA 207 KM 128.8 Mile QSO DM33rn to DM42ok. See: <https://www.youtube.com/watch?v=w1QfZ-tfpg> YouTube video courtesy of Kevin Jacobson, AD7OI.

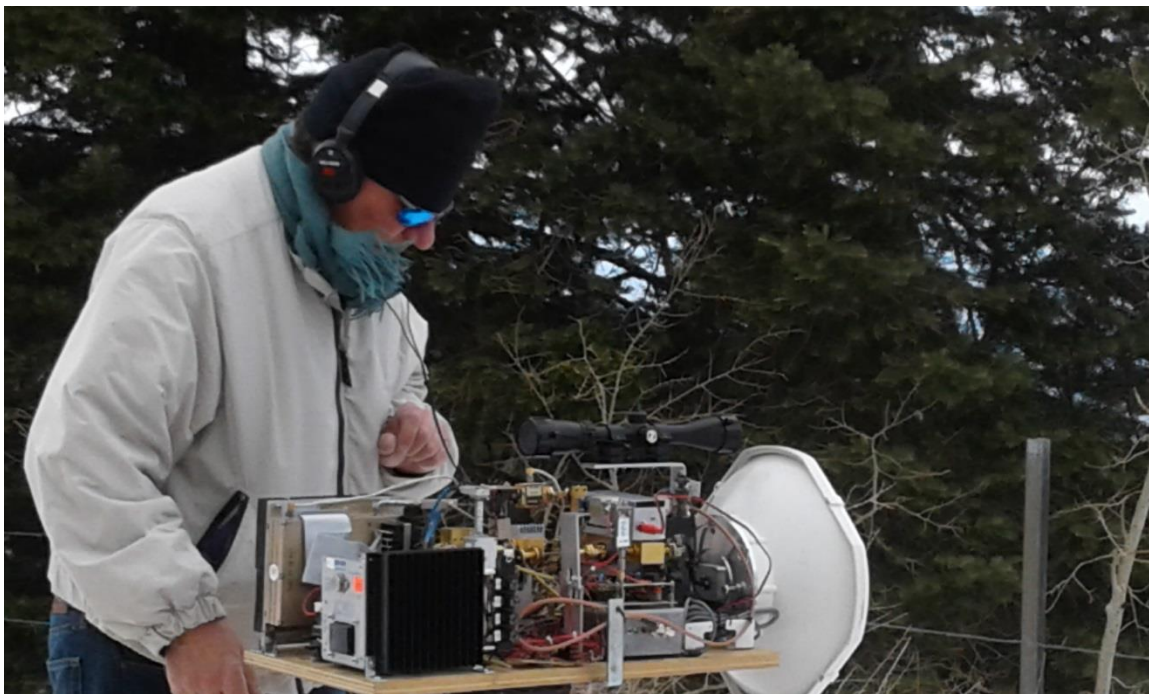
The plan for Sunday was for N0IO, W7QQ under the guidance of AD7OI to travel to the Harquahala Mountains in southwestern Arizona to a location at ~5,900 feet with the eastern team making their way back to Mt. Lemmon. The distance between the two operating sites is 285km just short of the record but over an obstructed path. At Mt. Lemmon Sunday afternoon the weather had taken a turn for the worst with gusts to over 60 mph and notably the dew point had climbed to 27F almost a 50 degree swing from the day before.

Weather History Graph
March 10, 2019

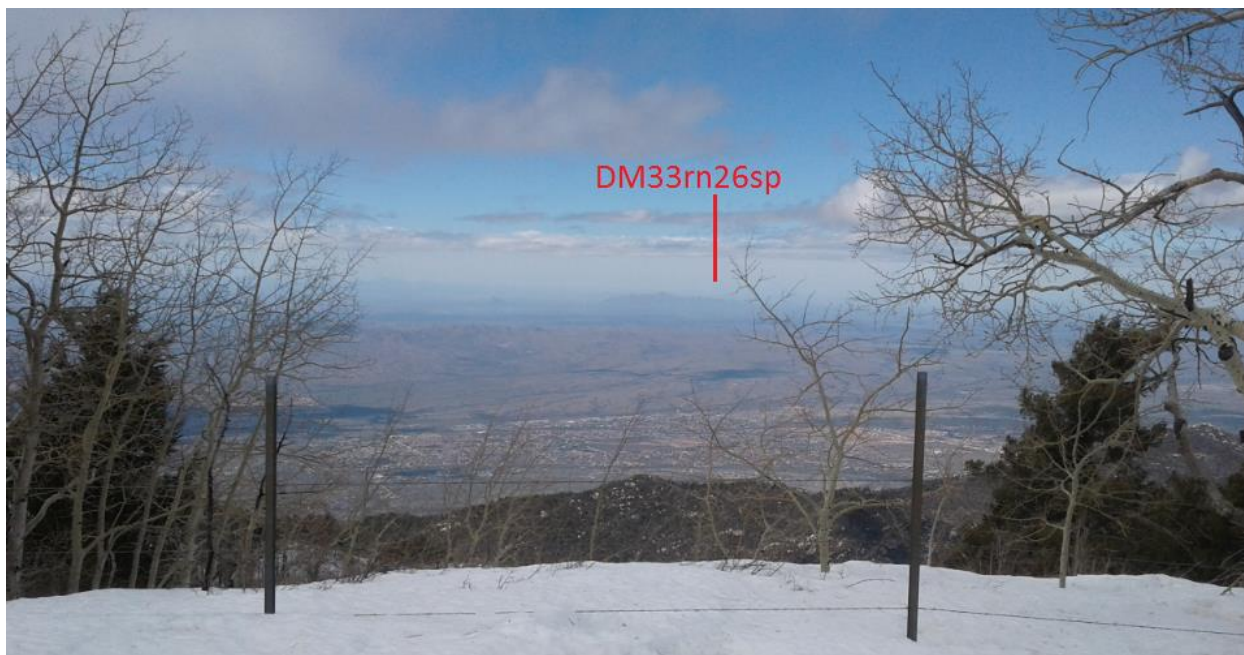


Mt. Lemmon, AZ DM42ok56ig Dew Point ~+25F @ 2PM local.

Despite the winds 10 GHz was set up to check the path. It took three people to mount the dish and two people required at all times to keep the dish from becoming airborne. Signals on 10 GHz were notably weaker than the day before – not a good sign. Multiple attempts on both 47 GHz and 78 GHz were not successful.



VE4MA @ DM42ok56ig unsuccessful attempt with N0IO @ 285km.
Wind gusts > 60 mph. Photo: K8ZR.



Mt. Lemmon AZ DM42ok56ig towards White Tanks AZ DM33rn26sp @207km.
Photo: K8ZR

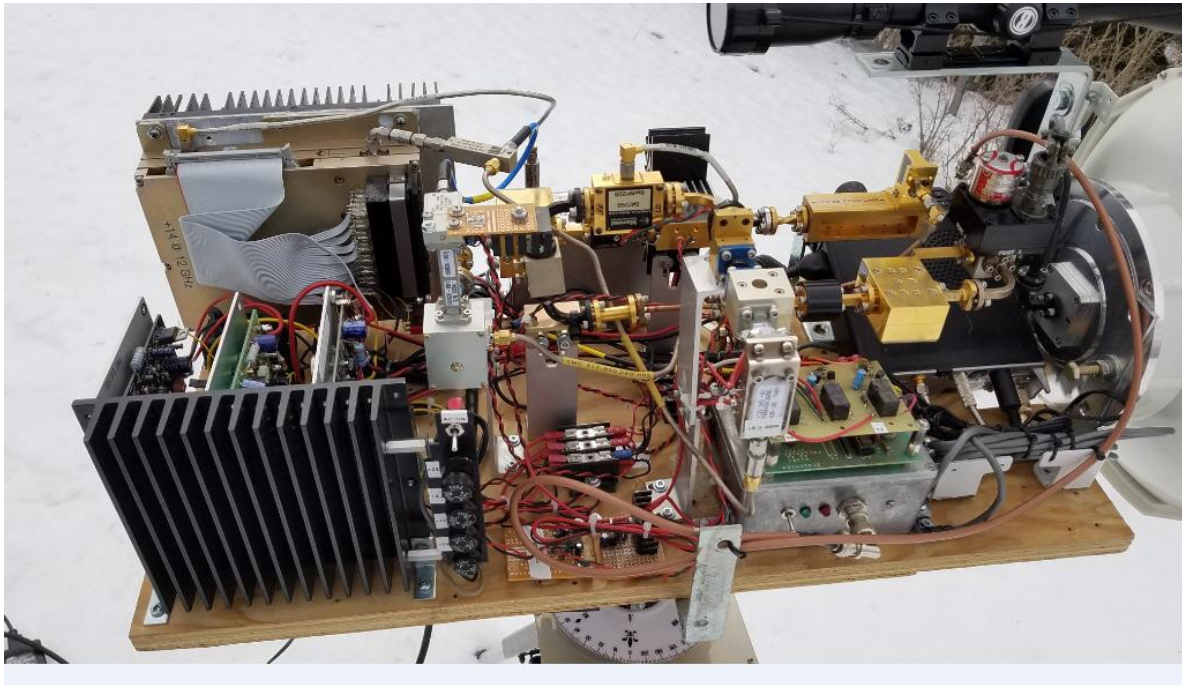
The group plans to return to Arizona in the late fall to take advantage what is historically the lowest dew points of the year in their attempt at making a 300+km QSO on the 4 mm-wave band. Several of the group should be QRV on 122 GHz by then and attempts will be made on that band over shorter paths.

¹ Ex: WA8RJF

² The Kuhne Electronics 76 GHz transverter is capable of operating on 78 GHz. See W5LUA's presentation regarding its performance at <https://www.ntms.org/> 78,912 MHz – 144 MHz IF= 78,048 MHz. The transverter requires an LO 1/8 in frequency or 9,756 MHz. The Kuhne PLL can be easily programmed for 9,756 MHz - thankfully.

³ Radio Ridge weather website: <https://www.wunderground.com/personal-weather-station/dashboard?ID=KAZMOUNT7> Weather Underground

Additional Photos:



Barry's VE4MA 78 GHz transverter on Mt. Lemmon, AZ DM42ok56ig
Photo: K8ZR



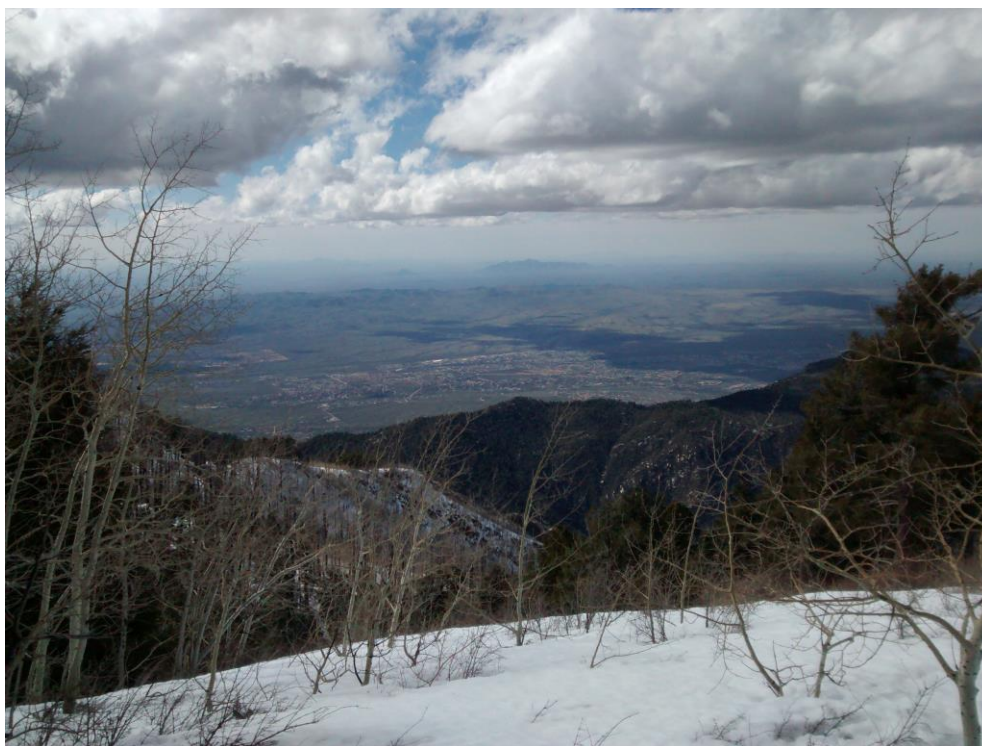
VE4MA in high winds – gusts > 60 mph. Photo: K8ZR



VE4MA DM42ok56ig Mt. Lemmon looking towards White Tanks DM33rn26sp
Photo: K8ZR



VE4MA DM42ok56ig Mt. Lemmon, AZ Photo: K8ZR



Mt. Lemmon, AZ DM42ok56ig looking west towards White Tanks DM33rn26sp.
Photo: K8ZR



L. to R. W5LUA & K8ZR setting up in high winds – gusts > 60 mph. Photo: KJ7OG



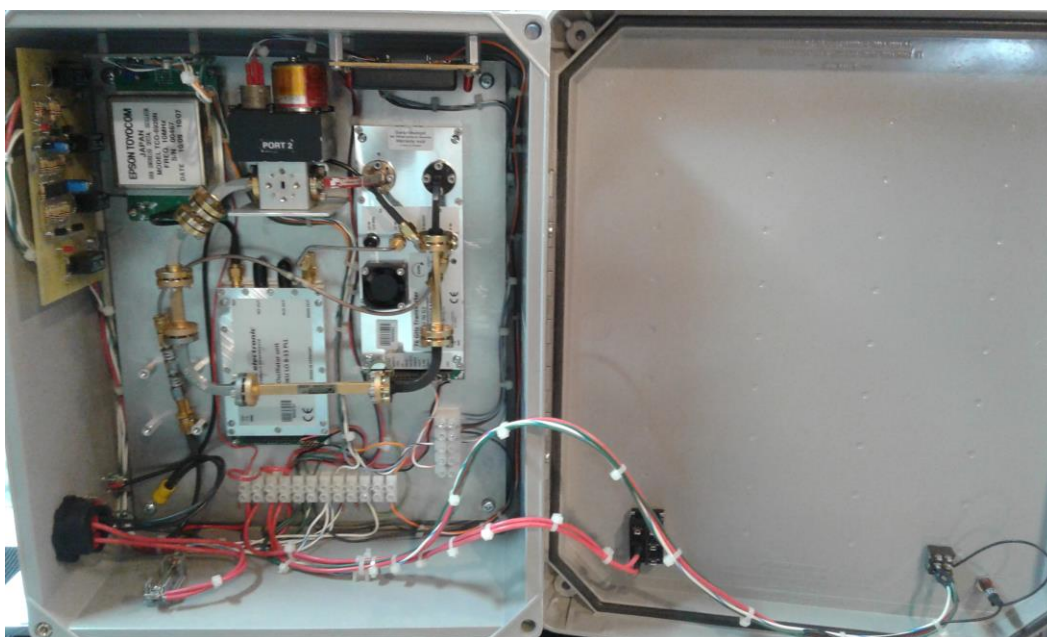
W5LUA: 47 GHz (upper) and 78 GHz. Photo: K8ZR.



L. to R. K8ZR setting up 78 GHz & Clare White XYL of Steve KJ7OG. Photo: KJ7OG.



K8ZR: 78 GHz ready for the 285km attempt. Photo: K8ZR



K8ZR 76/78 GHz transverter. Photo: K8ZR



Mt. Lemmon hosts - without their help the 78 GHz DXpedition would not have been possible. L. to R.: Ron Jones K7RJ, Steve Bell KJ7OG and his wife Clare White.
Photo: K8ZR



University of Arizona Observatory. Photo: K8ZR