Haswel Trip Report for November 1, 2021

Trip Objective:

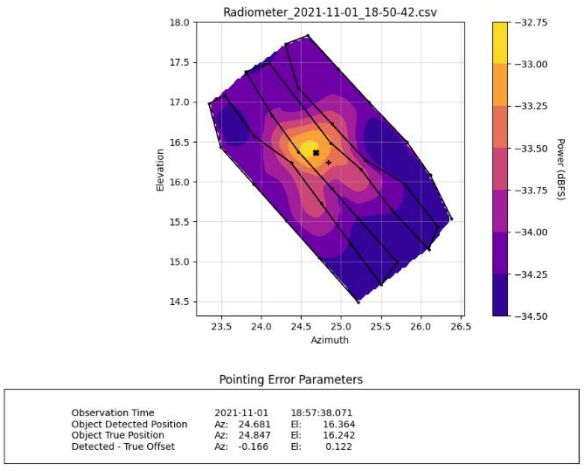
1) Assess prototype antenna pointing calibration on the 1296 MHz antenna feed
2) Assess capability to point at and track moon
3) Detect Belgium 1296 MHz beacon bounced off the moon

Team:

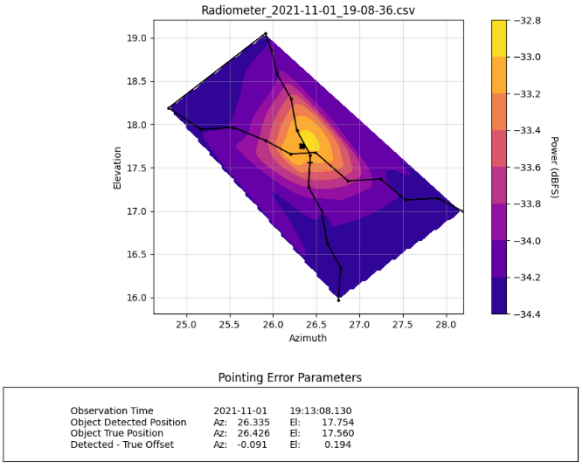
1) Glenn Davis
2) Lewis Putnam

Summary:

1) Initial Antenna Pointing assessment – Ray's beacon was set to 1296 MHz and placed along the 0° azimuth pointing angle on the ground about a mile from the antenna. The antenna elevation was set to 1° and the antenna was pointed at Azimuth positions from about 357° to 2° in 1° increments. Eyeballing the SDR receiver spectrograph to asses beacon signal level versus azimuth angle, the strongest signal level seemed to occur close to 0° but possibly a few tenths higher than 0°. Antenna appeared to be pointing fairly well.
2) Cas A Cal Scan # 1 – Executed a coarse spacing (.6°) serpentine scan pattern on Cas A calibration object to get an approximate estimate of the Az/El pointing offsets. The measured offsets were relatively small – between 1 and 2 encoder counts. Results indicated that current encoder zero points are close enough to proceed with a fine spacing "X" scan pattern to obtain final offsets.
   a) Object: Cas A
   b) Scan Parms: 3° x 3° serpentine scan at .6° spacing resulting in 36 FOVs
   c) Offsets measured by calibration: Az: -0.166°, El: 0.122°

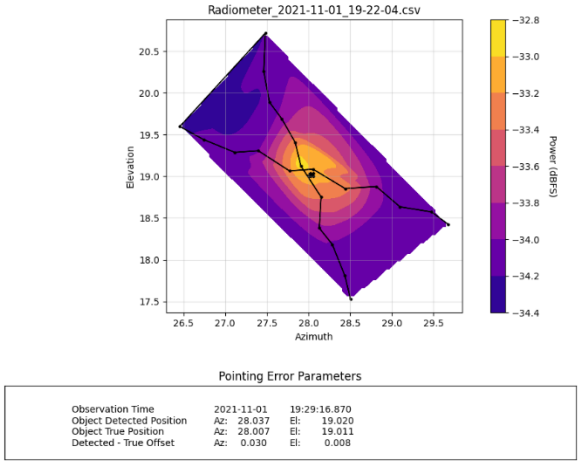


3) Cas A Cal Scan # 2 – Executed a fine spacing (.3°) “X” scan pattern on Cas A calibration object to get fine estimate of the Az/El pointing offsets. The measured offsets were consistent with offsets from Cal Scan #1 and assessed to be a good basis for updating the encoder zero points.
   a) Object: Cas A
   b) Scan Parms: 3° x 3° “X” scan pattern at .3° spacing resulting in 16 FOVs
   c) Offsets measured by calibration: Az: -0.091°, El: 0.194°

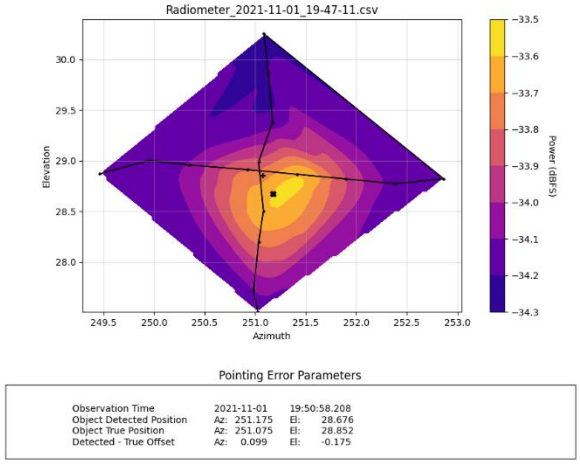


4) Updated Az / El axis encoder zero points based on offsets from Cas A Cal Scan #2
   a) Az encoder zero point of 1958 updated to 1959
   b) El encoder zero point of 3584 updated to 3582
5) Cas A Cal Scan #3 – Re-executed same scan pattern as Cal Scan #2 after update of encoder zero points to assess effects of encoder zero points update. Measured offsets were less than 1 encoder count and assessed to be “good to go”.
   a) Object: Cas A
   b) Scan Parms: 3° x 3° “X” scan pattern at .3 deg spacing resulting in 16 scan positions

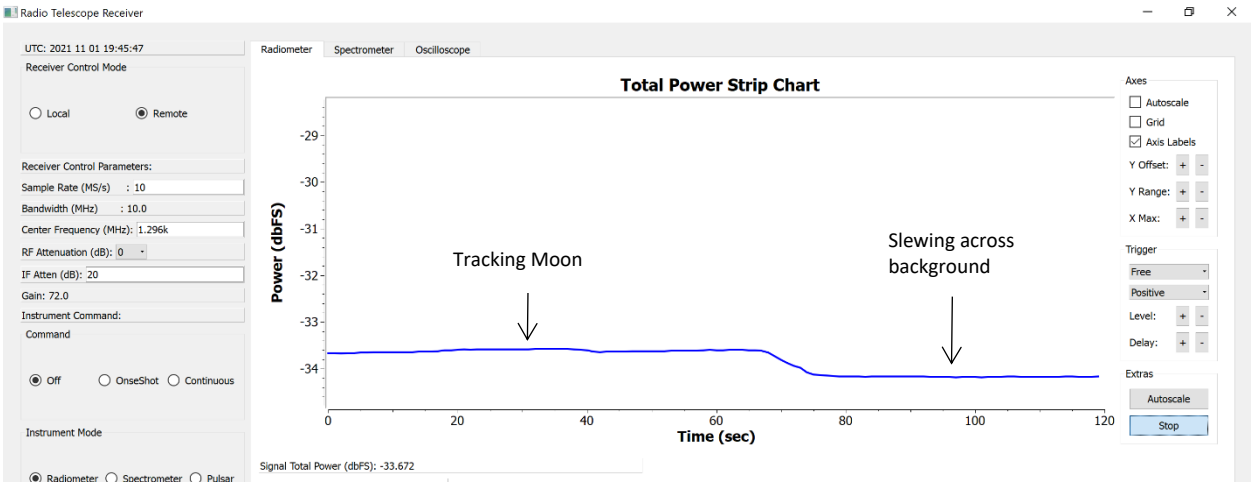
c) Offsets measured by calibration: Az: 0.030°, El: 0.008°



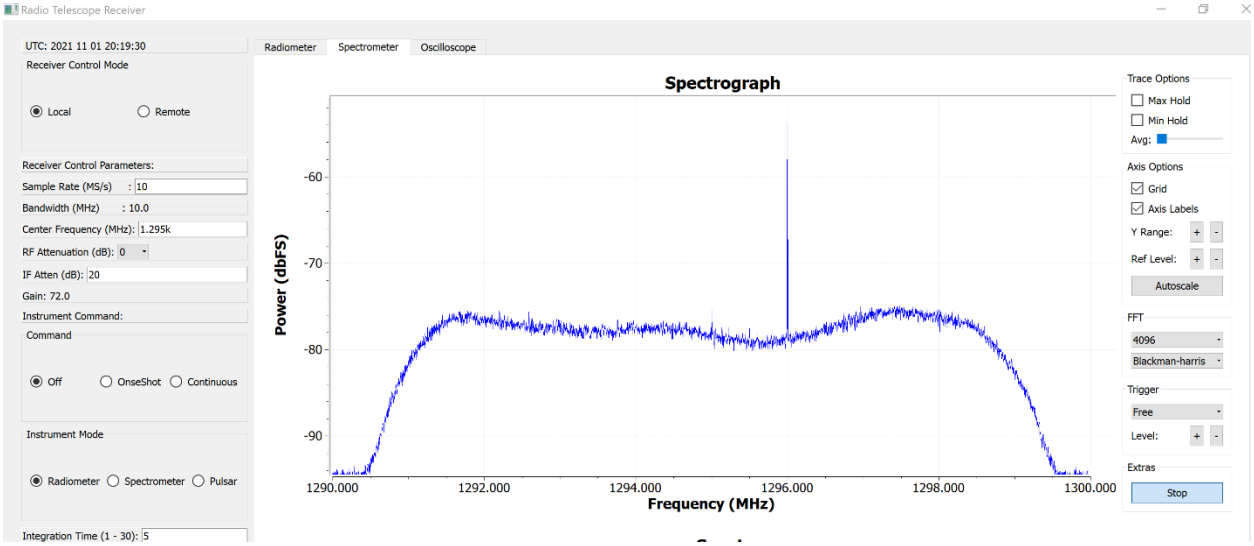
6) Moon Detection – The moon has a signal power level at 1296 MHz that is significantly higher than sky background signal level and thus the moon should be detectable in a scan about the moon. Based on this, a scan about the moon was performed to assess if the moon could be detected and the moon position be determined accurately. The moon was clearly seen in the scan and the Az/El offsets computed from the scan were within an encoder count or two of the calibration scans on Cas A.
   a) Object: Moon
   b) Scan Parms: 2° x 2° “X” scan pattern at .3 deg spacing resulting in 16 scan positions.
   c) Offsets measured by calibration: Az: 0.099°, El: -0.175°



7) Moon Track Test – The previous test demonstrated that the moon could be detected at 1296 MHz. The ability to detect the moon was then used to assess if the antenna can be accurately tracked on the moon. In this test, the antenna was slewed to point at and track the moon using the system 1 operator console moon tracking capability. The SDR receiver radiometer strip chart capability was used to determine and monitor "Total Signal" power at 1296 MHz / 10 MHz bandwidth during the slew to and tracking of the moon. During the test, the radiometer total power reading was relatively constant during slew across sky background to moon and then ramped up to a higher level when the antenna was pointing at the moon (see following figure). The radiometer power reading remained fairly constant at the higher-level during tracking of the moon. This test indicates that antenna can be pointed at and track the moon is quite well.



8) 1296 Beacon Bounced off of Moon - We looked for the 1296 beacon while tracking the moon per Dan/Ray's suggestion. We did have a narrow spike at 1296 well above noise level while tracking moon. However, we also saw this spike while antenna was not pointing at the moon. Thinking this might be a DC offset spike, we shifted the SDR center frequency slightly off of 1296 MHz to several different frequencies within a few MHz of 1296 to determine if this spike was a DC spike. The spike moved from the center of the spectrograph when the center frequency was shifted indicating that the spike was not a DC offset but an actual signal. See Figure below. At this point, it is not clear what the 1296 spike is.


Radio Telescope Receiver
UTC: 2021 11 01 20:19:30
Receiver Control Mode
Local
Remote
Receiver Control Parameters:
Sample Rate (MS/s) : 10
Bandwidth (MHz) : 10.0
Center Frequency (MHz): 1.295k
RF Attenuation (dB): 0
IF Atten (dB): 20
Gain: 72.0
Instrument Command:
Command
Off
OnseShot
Continuous
Instrument Mode
Radiometer
Spectrometer
Pulsar
Integration Time (1 - 30): 5
Radiometer
Spectrometer
Oscilloscope
Spectrograph
Power (dbFS)
-60
-70
-80
-90
1290.000
1292.000
1294.000
1296.000
1298.000
1300.000
Frequency (MHz)
Trace Options
Max Hold
Min Hold
Avg:
Axis Options
Grid
Axis Labels
Y Range:
Ref Level:
Autoscale
FFT
4096
Blackman-harris
Trigger
Free
Level:
Extras
Stop