



Working Together to Improve EMECalc

The latest improvements in VK3UM's EMECalc software

- Better Spillover estimation giving more accurate G/T value.
- More accurate Moon temperature estimate.

Components of Tsys

Losses ahead of the LNA

LNA Noise Figure and second stage contribution

Spillover Ts

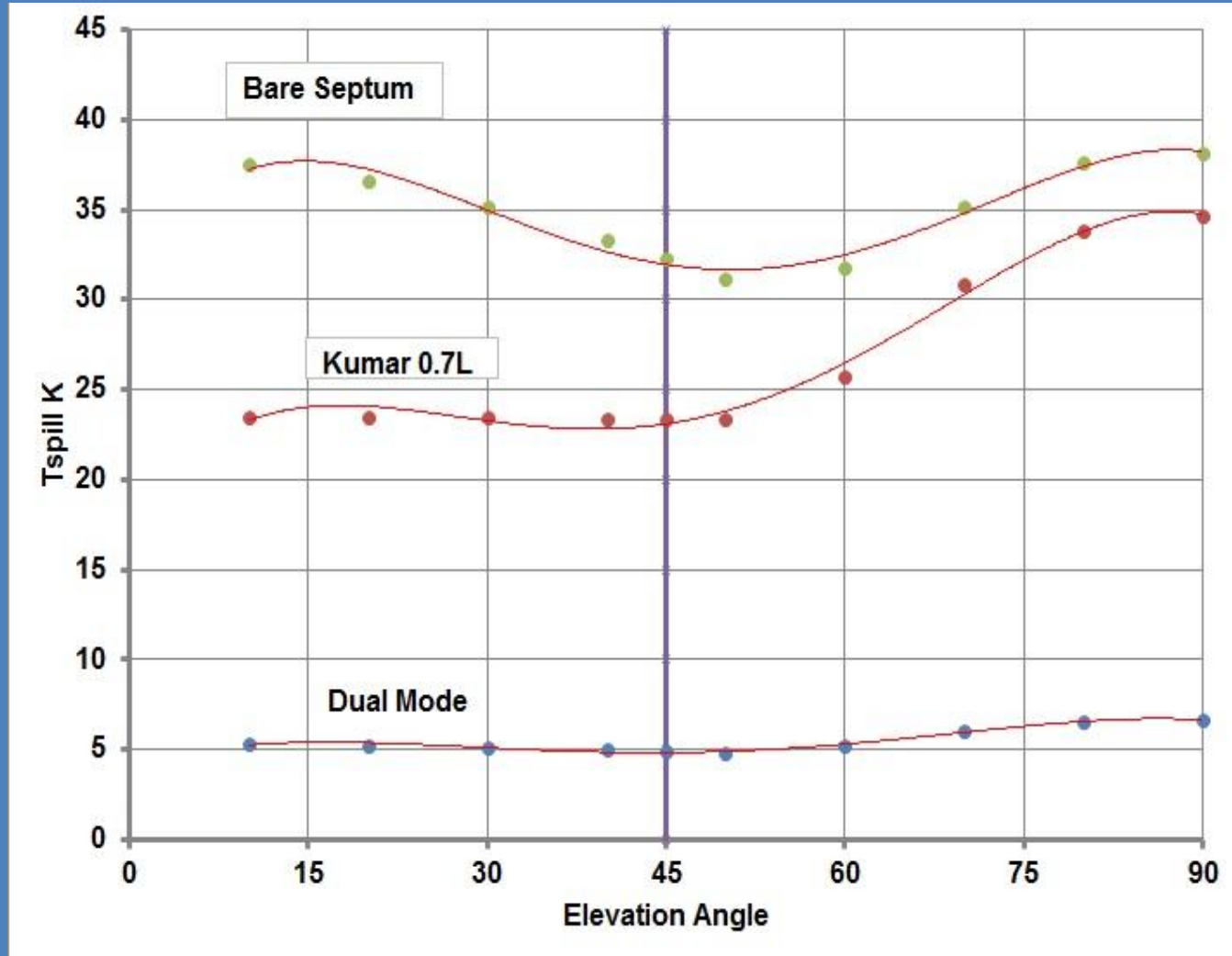
Mesh Feedthrough

The screenshot shows a software interface for a radio station, titled "Two Station EME". The main display area is divided into several sections:

- Station Info:** Tx A (Home Station), G3LTF_2320_2
- Frequency and Path Loss:** 2304 MHz, 275.51 dB
- Antenna and Spacing:** Rx BW: 5 K, 120 Hz; Diam: 1.00 mm; Mesh: 6.00 mm; Spacing H-V: 6.00 mm
- System Sensitivity and Echo S/N:** -159.0 dBm, 17.44 dB
- Effective ground:** 255 K, 6.31 dB
- Frequency and Path Loss (Detailed):** 178 MHz, 0.10 dB, 0.33 dB, 42.0 dB, 5.0 dB, 1.5 dB, 36 K, 5 K, 21.81 dB
- Losses and Power:** 10.7cm, LNA Loss, LNA Nf, LNA Gain, Coax Loss, Rx Nf, Spillover, Feedthrough, Sun Y, Moon Y
- Power and Temperature:** Tx A Output Power: 250 Watts, 23.98 dBW; Transmission Loss: 0.5 dB; Power at Feed: 223 Watts, 23.48 dBW; 2,354,474 W EIRP
- System Noise Temperature (Tsys):** 76.2 K = 1.01 dB (System Noise Temperature)
- Receiver Noise Temperature:** RxTK 30.2 K = 0.43 dB (Receiver Noise Temperature)
- Ground Temperature:** 290 K, 17 °C

Spillover contribution varies with Elevation

Examples at 0.4 f/D, 290K



Using W1GHZ's on-line Antenna Book modelling.....

- Until Version 10, the spillover temperature at 45 deg elevation was derived for each f/D as:

$$T_s = 290 * \text{spillover\%} * 0.75$$

- The 0.75 was a guestimate of the amount of spillover “seeing” the ground, temperature 290K

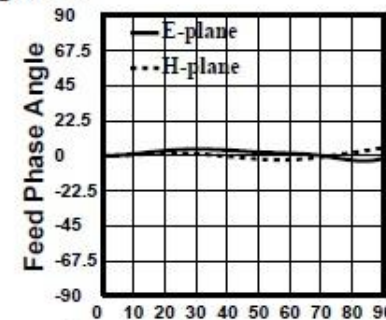
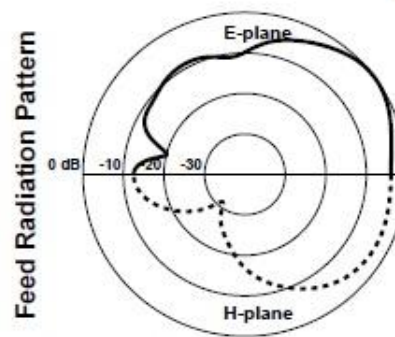
The 0.75 is called factor Y

- Paul's EME2014 paper “Feedhorn analysis for parabolic dish G/T” inspired an improved method

- Dmitry, RA3AQ's paper provided the same analysis

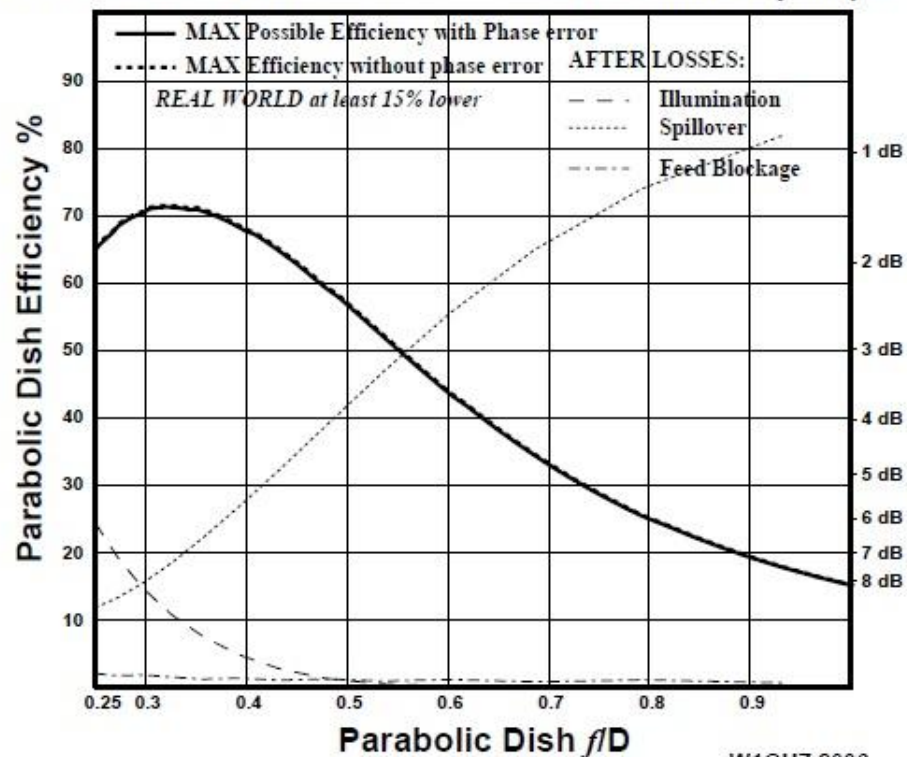
Original VE4MA Feed 0.77λ horn diameter
Ring 0.50λ wide x 0.50λ deep, 0.15λ behind rim

Figure 3



Dish diameter = 20λ Feed diameter = 1.7λ

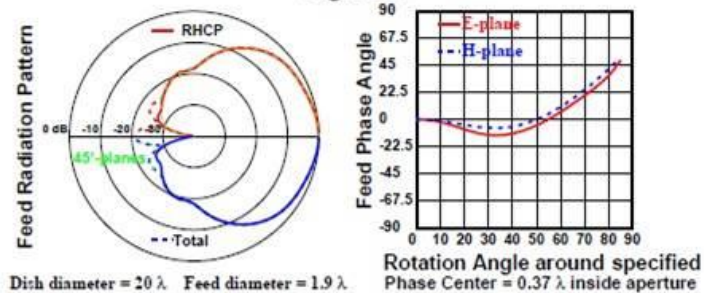
Rotation Angle around specified Phase Center = 0.014λ beyond aperture



Curves in the W1GHZ EME2014 paper are for specific dish sizes and Trx but we can obtain a value for factor **Y** for the range of f/D ratios

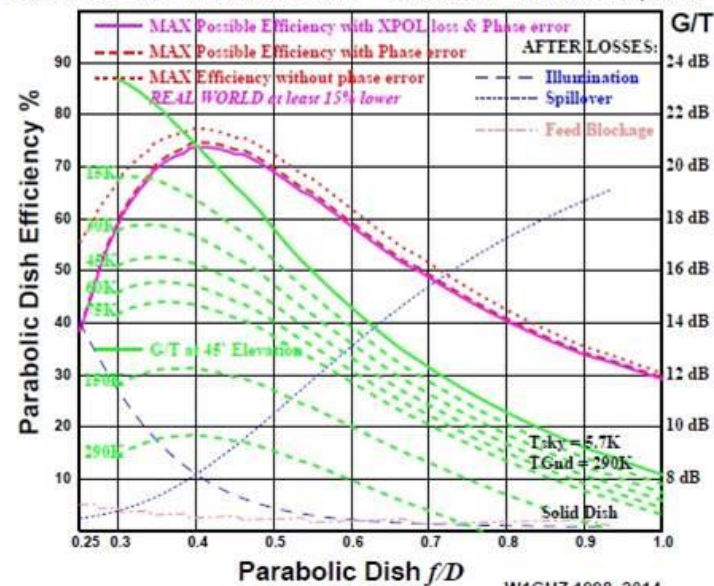
Super VE4MA, choke 0.6λ wide \times 0.45λ deep, back 0.05λ
 Receiver Noise Temp Comparison - 15,30,45,60,75,150 & 290K

Figure 15

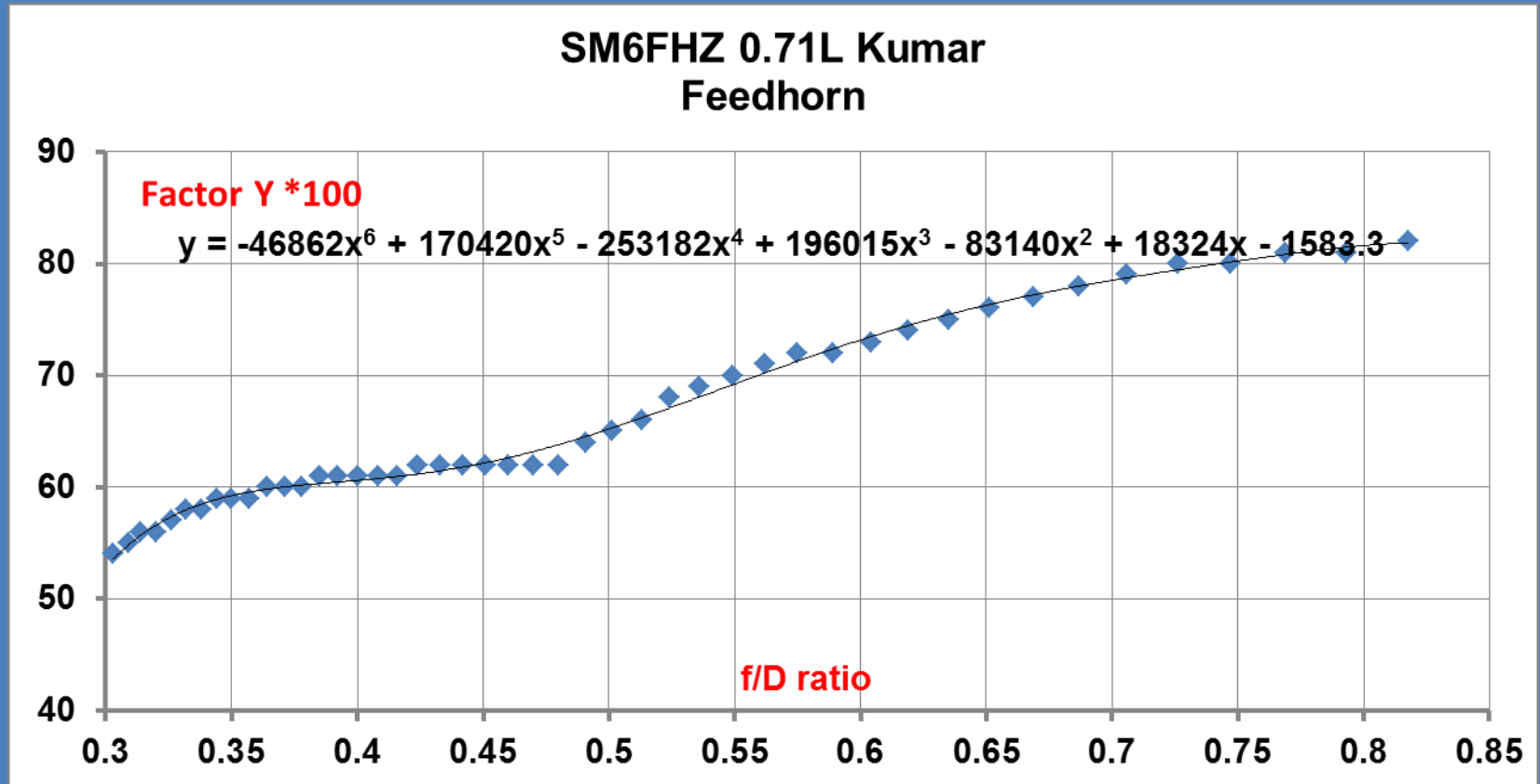


Dish diameter = 20λ Feed diameter = 1.9λ

Rotation Angle around specified Phase Center = 0.37λ inside aperture



A typical result for **factor Y** versus f/D at 45 deg elevation. Using this (in place of “0.75”) has greatly improved the accuracy of G/T estimates



How EMECalc V10 calculates Tspill

Spillover temperature contribution T_s is calculated for each feed and f/D as :

$$T_s = T_g * \text{spillover\%} * (6^{\text{th}} \text{ order polynomial of } Y)$$

T_g is ground temperature taken from the slider selected value

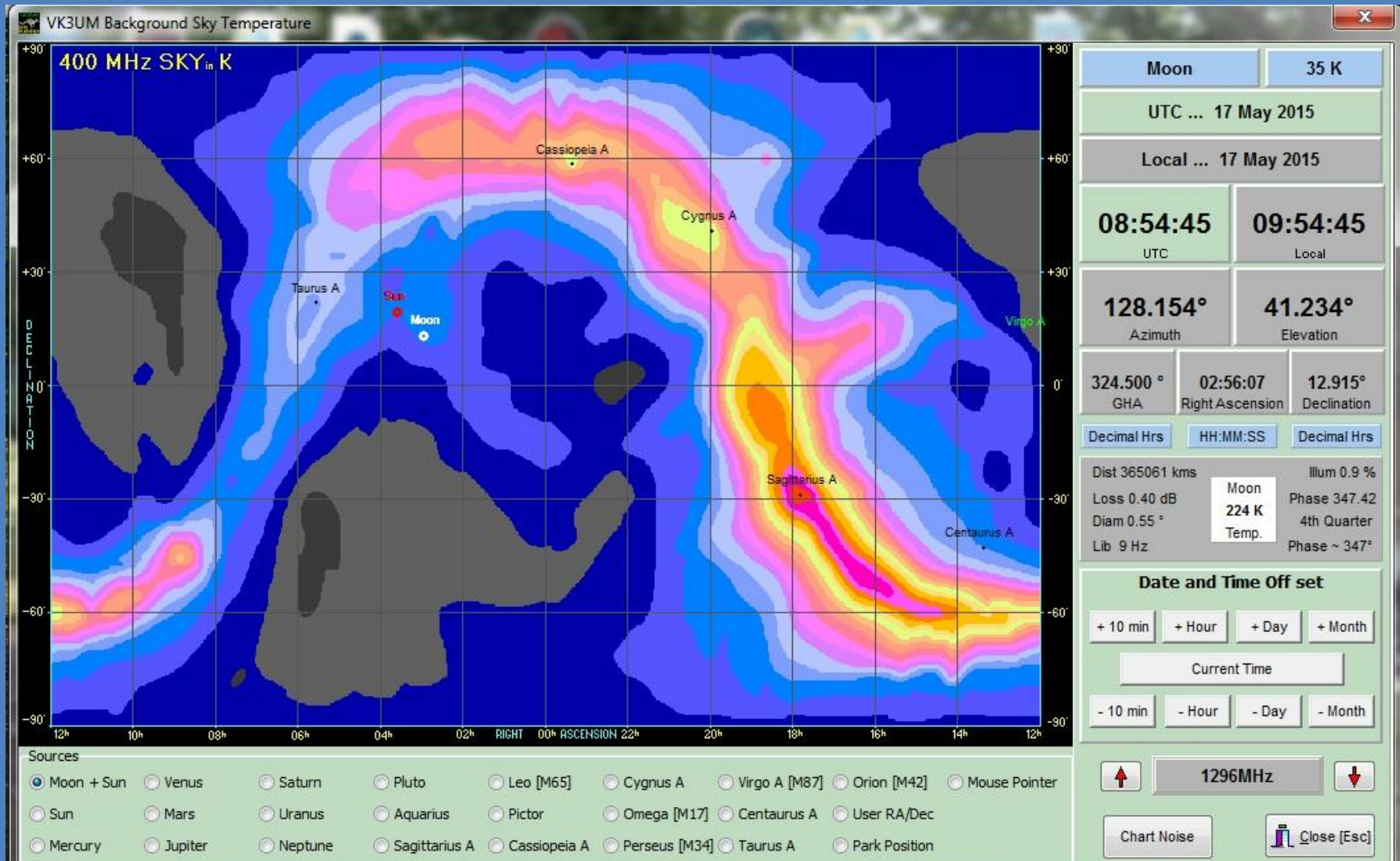
A more accurate Moon Temperature Estimate in EMECalc



Measuring G/T with Moon Noise

- To measure G/T we need two temperature reference points, one cold, one hot.
- Cold sky is relatively easy.....

VK3UM - Sky noise display



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- **Hot sources –**

Ground - House wall, Tree in full leaf –must fill the near field

Sun – unpredictable flux vs frequency

Radio stars - predictable flux but weak

Moon – higher flux but variable with distance and phase

Moon noise characteristics

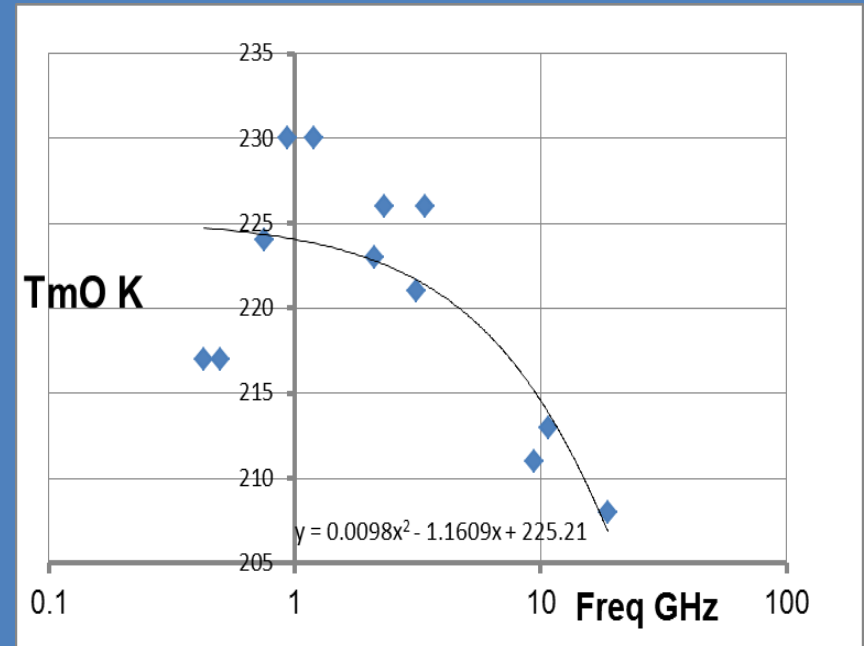
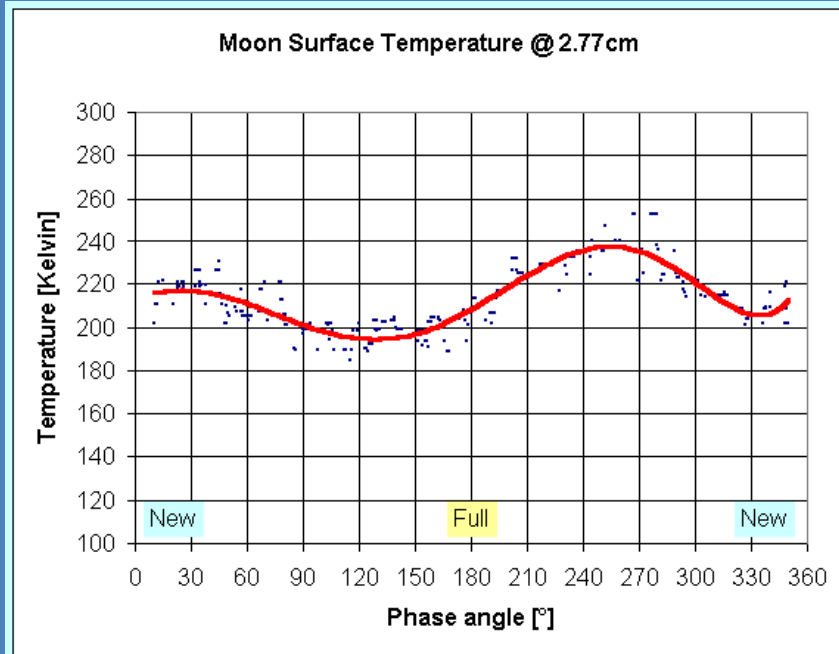
- The level of moon noise received varies with frequency, moon phase and distance
-
- At 2320MHz with 6m dish and $T_{\text{sys}} = 73\text{K}$
moon noise variation **0.98 to 0.76dB**
- At 3400MHz with 6m dish and $T_{\text{sys}} = 95\text{K}$
moon noise variation **1.45 to 1.12dB**
- So we need to state the conditions of our measurements.

Moon Temperature vs phase and frequency

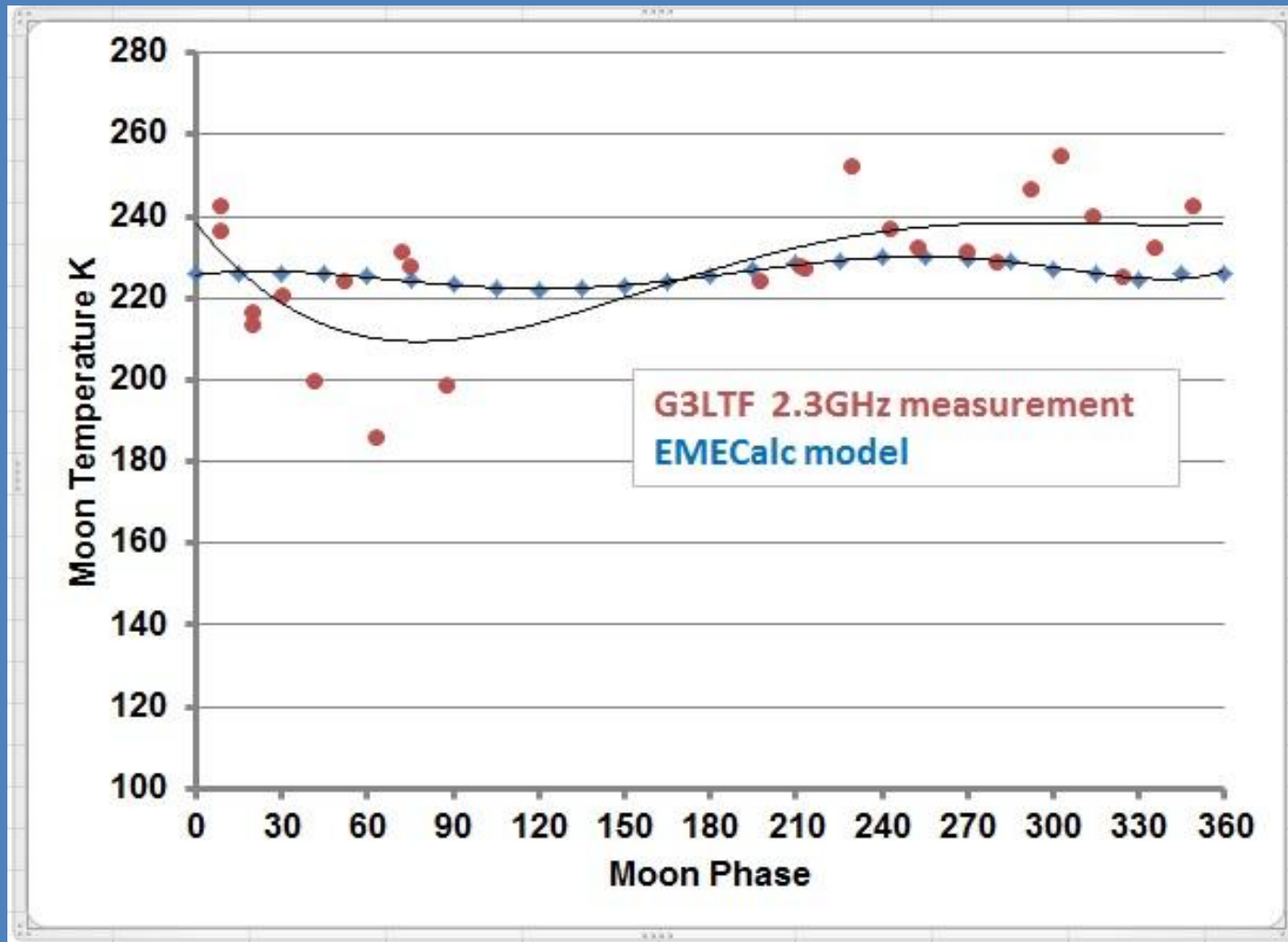
C.Monstein, Zurich 2001

Moon temperature vs Phase

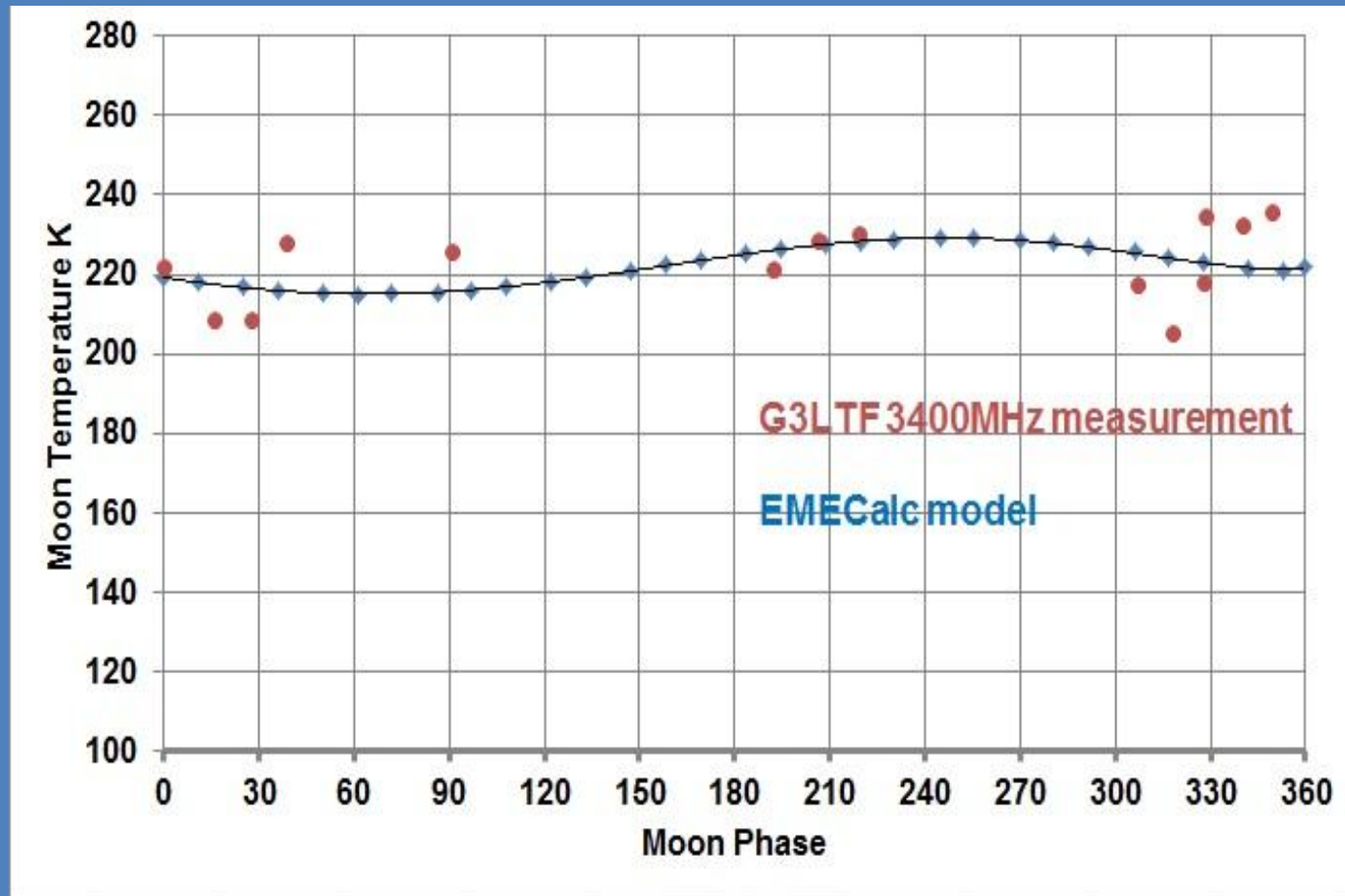
Mean temperature vs Frequency (several sources)



2.3GHz measurement referenced to Cygnus: Mean value 226K



3.4GHz measurement referenced to Taurus: Mean value 223K

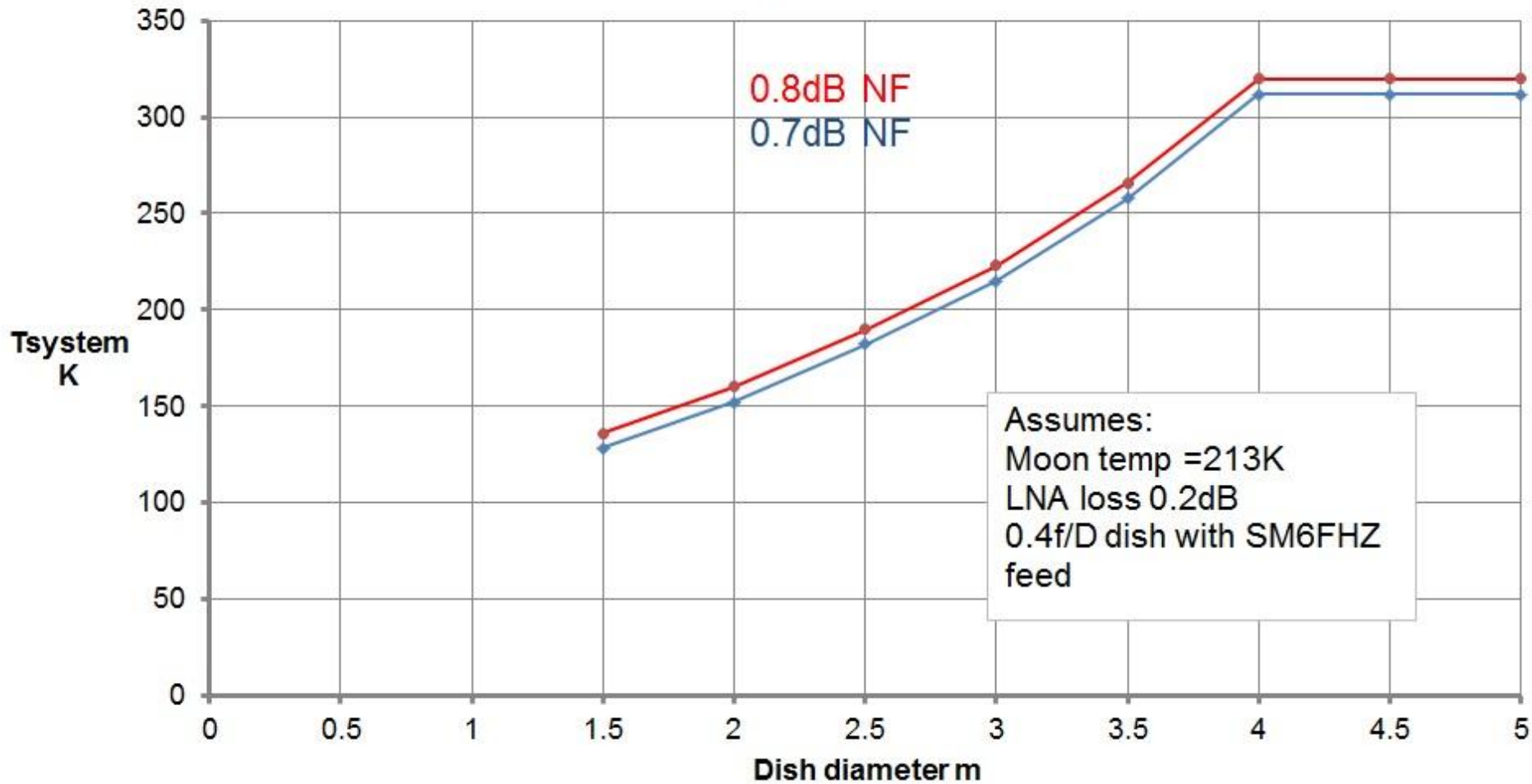


Moon Data in EMECalc is now better, but still work in progress.

The screenshot displays the EMECalc software interface with several data fields and controls. A red hand-drawn box highlights the Moon Data section on the right and the Moon Flux and Sv values in the bottom center.

Effective Aperture		Beam Width Ratio		Set Current Moon		Moon Data	
TxA	19.05 M ²	0.5249		S/F	Update Moon	Phase 0.01	
TxB	3.51 M ²	0.2178				Illum 0.2 %	
Moon Beam Fill Factor		Sun Beam Fill Factor		G/T Ratio		4th Quarter	
TxA	1.0985	0.4081dB	1.0976	0.4044dB	324.27	25.11dB	P Angle 3°
TxB	1.0165	0.0712dB	1.0164	0.0706dB	62.93	17.99dB	
Moon Radar Equ.		Current Moon Distance		Moon Angular Diam		Moon Temp	
52.56 dB		368,819 kms		0.540° 32'24.0"		221 K	
Moon return Loss		Moon Flux 10° -22		Moon Declination		Corrected sfu	
278.85 dB		Sv = 0.5482		Dec. 15.57 °		178	
Engineering Panel						3400 MHz	

Moon noise dominates T_{sys} as Dish size increases



Acknowledgements

Doug, VK3UM

Paul, W1GHZ

Ingolf, SM6FHZ