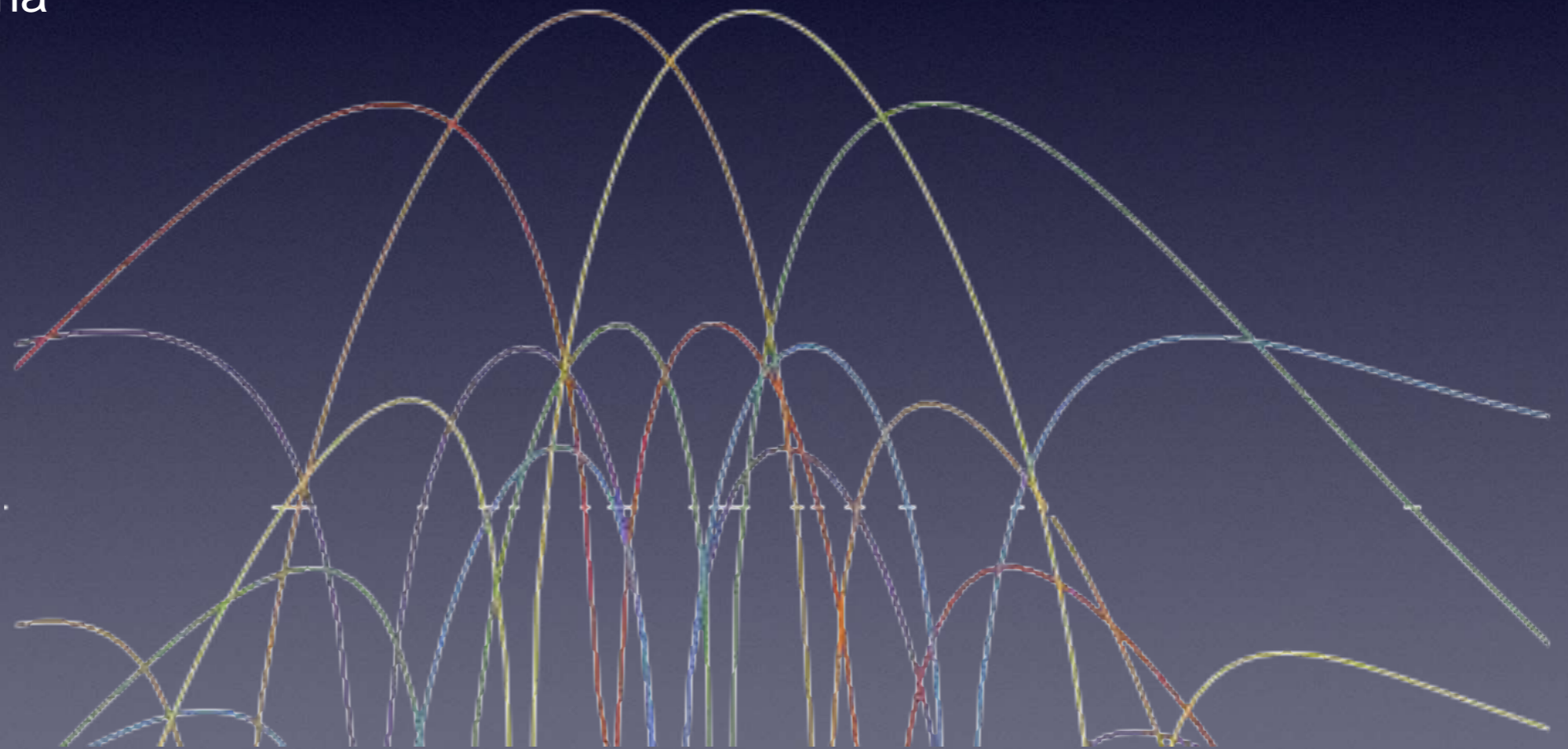
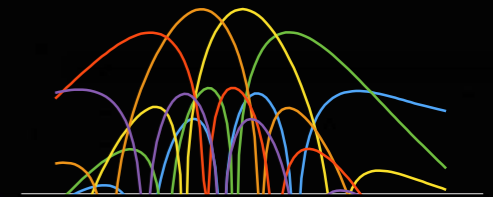


Modeling and Simulating Static Arrays

Juan Guadiana
Rigil Corp.

January 20, 2017





Moore's law

The observation that the number of transistors in a dense integrated circuit doubles approximately every two years.

–Wikipedia



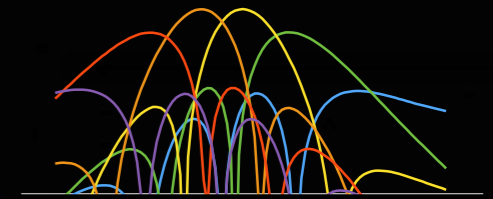
Spectrum Analyzer -
SignalHound.com

Table 1

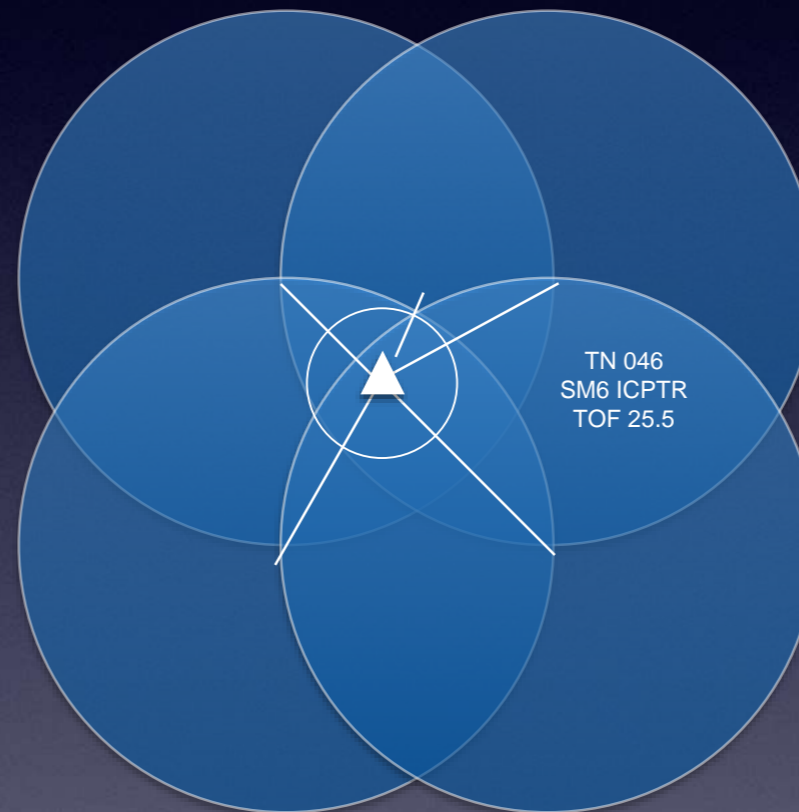
ARRAY	x	y	z	AZ Offset
Dart 1	132000.0000	60000.0000	2240.0000	90
Dart 2	120000.0000	90000.0000	2240.0000	90
Dart 3	115000.0000	120000.0000	2240.0000	90
Dart 4	115000.0000	150000.0000	2240.0000	90
Dart 5	115000.0000	180000.0000	2240.0000	90
Dart 6	168000.0000	75000.0000	2240.0000	270
Dart 7	168000.0000	105000.0000	2240.0000	270
Dart 8	168000.0000	135000.0000	2240.0000	270
Dart 9	168000.0000	165000.0000	2240.0000	270
Dart 10	168000.0000	195000.0000	2240.0000	270

Numbers Spread Sheet -
Apple.com

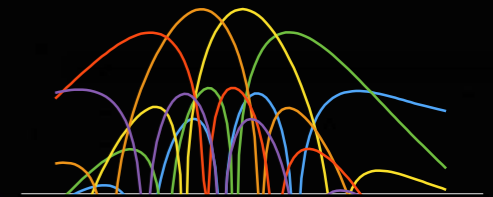
Why Staring Arrays?



- Unmanned operation
- Network Data Transport
- Space Diversity
- TSPI capability
- Can be Cost competitive

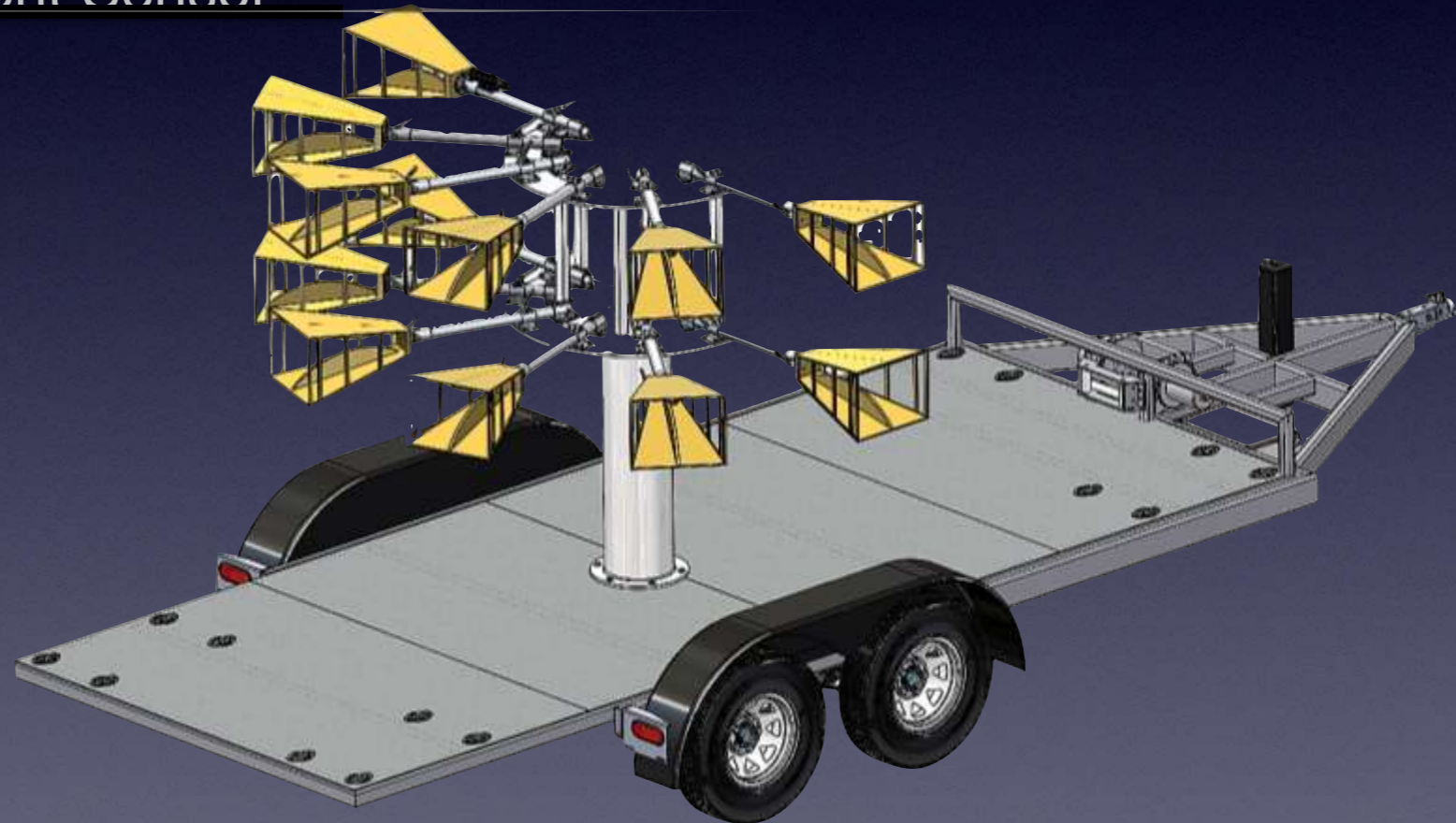


Distributed Array Remote Telemetry System



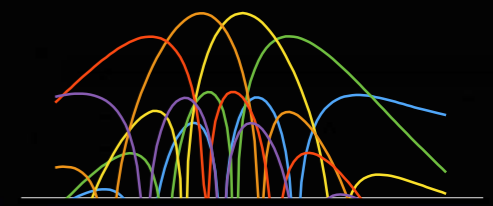
Model 6 Element Sensor

Simulate 12 Element Sensor

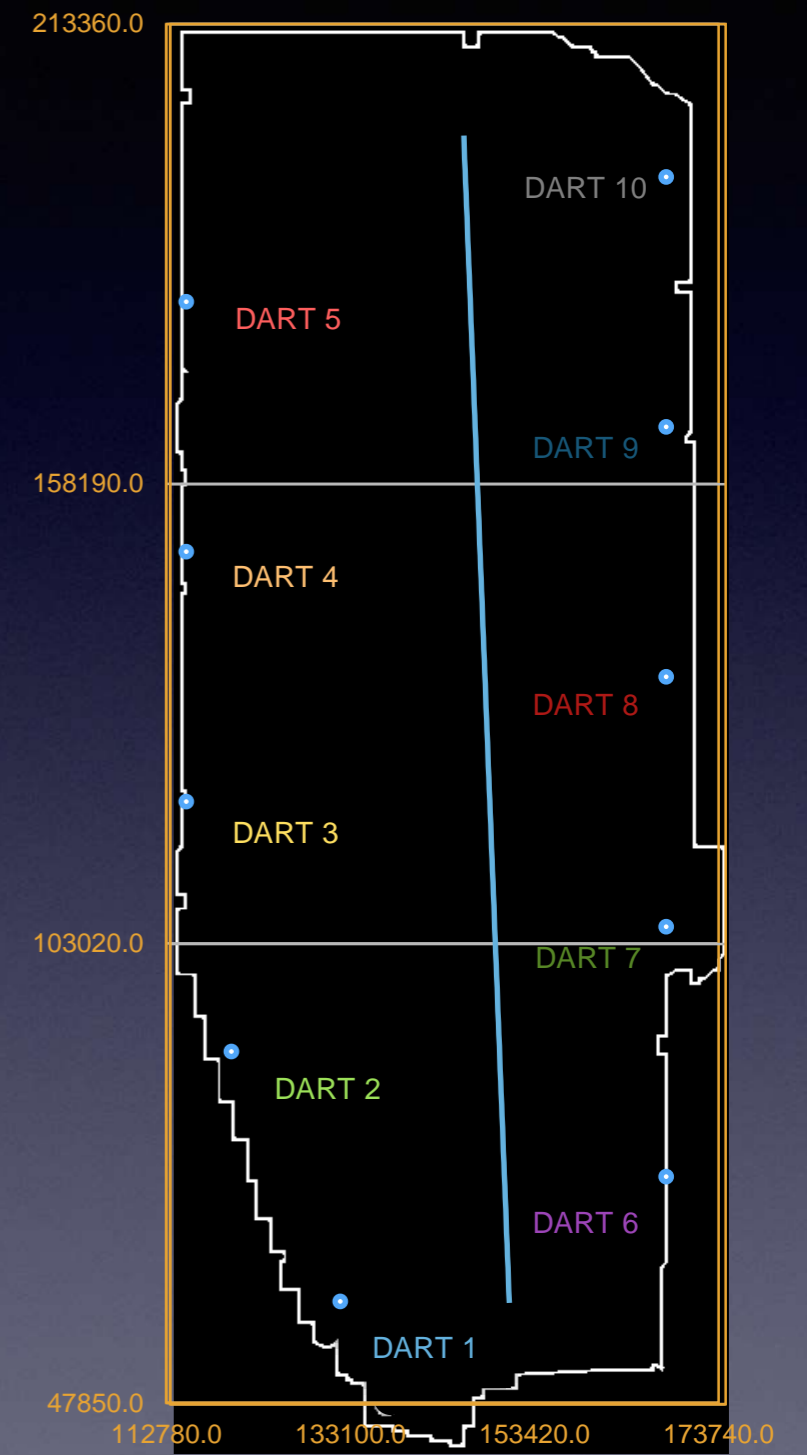
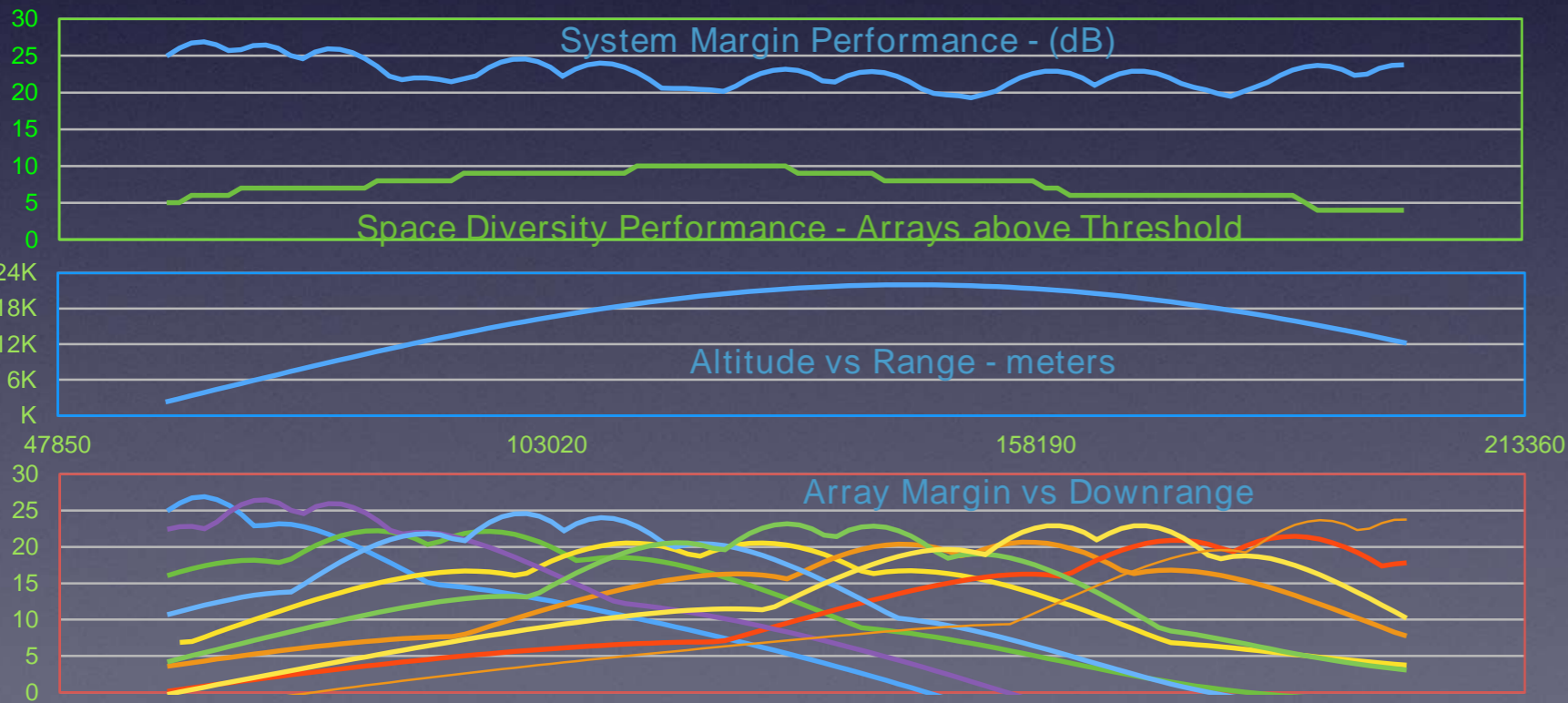


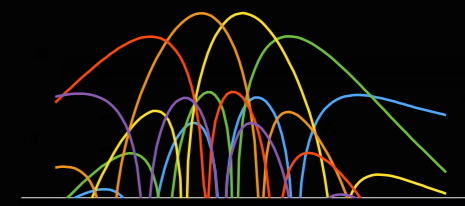
Courtesy Mannatech Inc.

DARTS - 6 Element Math Model



ARRAY	x	y	z	AZ Offset	Elevation Control 1 Opt, 2 Median, 3 Designated	Designated Elevation	Elevation	Trajectory Control	SINE	ft	meters
Dart 1	132000.0000	60000.0000	2240.0000	90	1	10		1		570000	173736
Dart 2	120000.0000	90000.0000	2240.0000	90	1	10		UTM Meters			
Dart 3	115000.0000	120000.0000	2240.0000	90	1	10		Sine/Flat	x	y	z
Dart 4	115000.0000	150000.0000	2240.0000	90	1	10		Start	150000	60000	2240
Dart 5	115000.0000	180000.0000	2240.0000	90	1	10		End	145000	200000	12192
Dart 6	168000.0000	75000.0000	2240.0000	270	1	10		Apogee			22000
Dart 7	168000.0000	105000.0000	2240.0000	270	1	10		Radial	x	y	z
Dart 8	168000.0000	135000.0000	2240.0000	270	1	10		Origin	143260.0000	130605.0000	12240.0000
Dart 9	168000.0000	165000.0000	2240.0000	270	1	10		R - Start/End meters	10000	10000	
Dart 10	168000.0000	195000.0000	2240.0000	270	1	10					
Antenna BeamWidth (deg)	33.8	Gain (dB)	15.0					TX Ant BeamWidth (Deg)	40	Gain (dB)	0
Noise F	2	Misc Losses	1		Margin Threshold (dB)	5		TX Freq(GHz), Data Rate (Mbps), ERP (dBm)	5.15	10.00	37.00

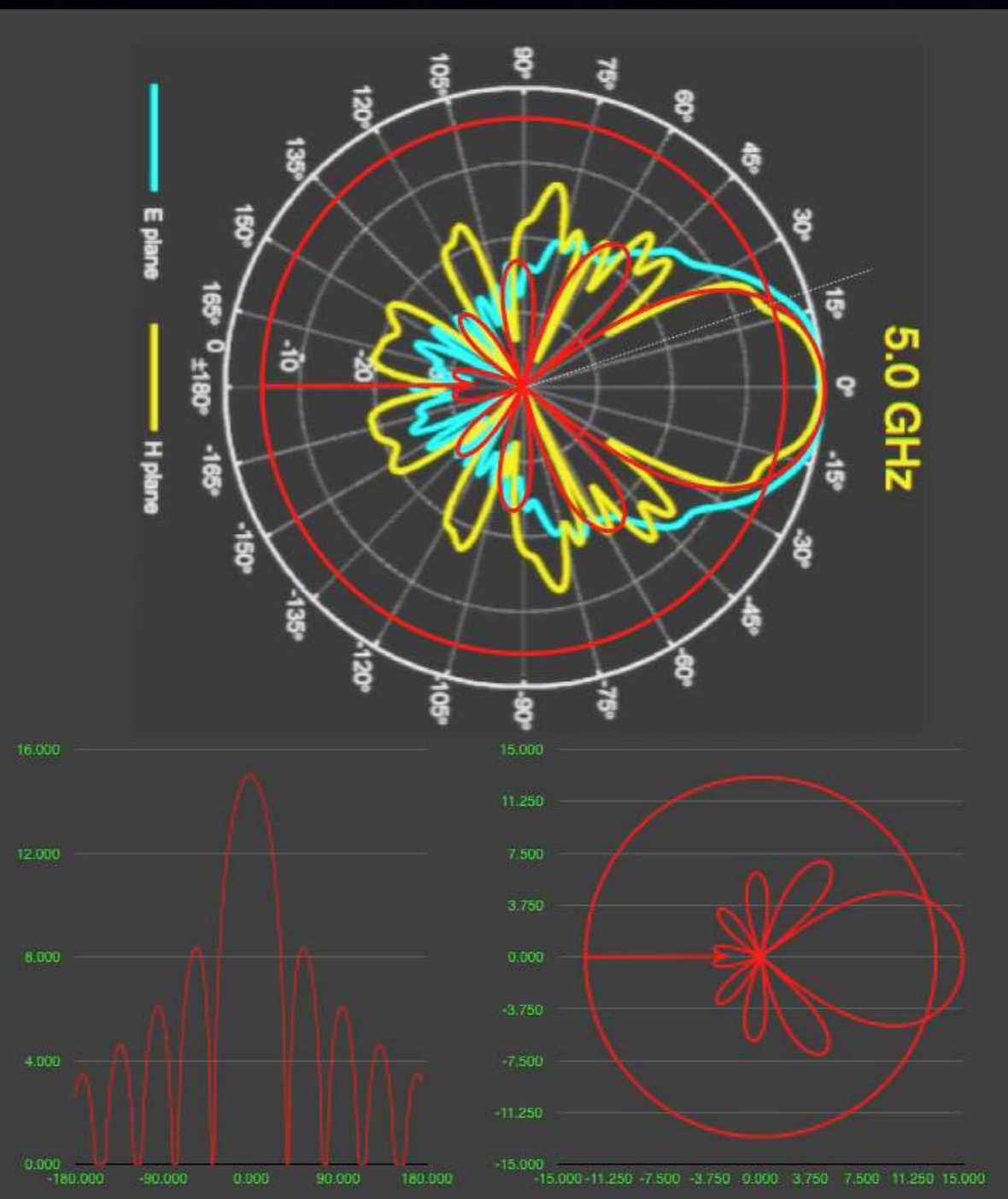




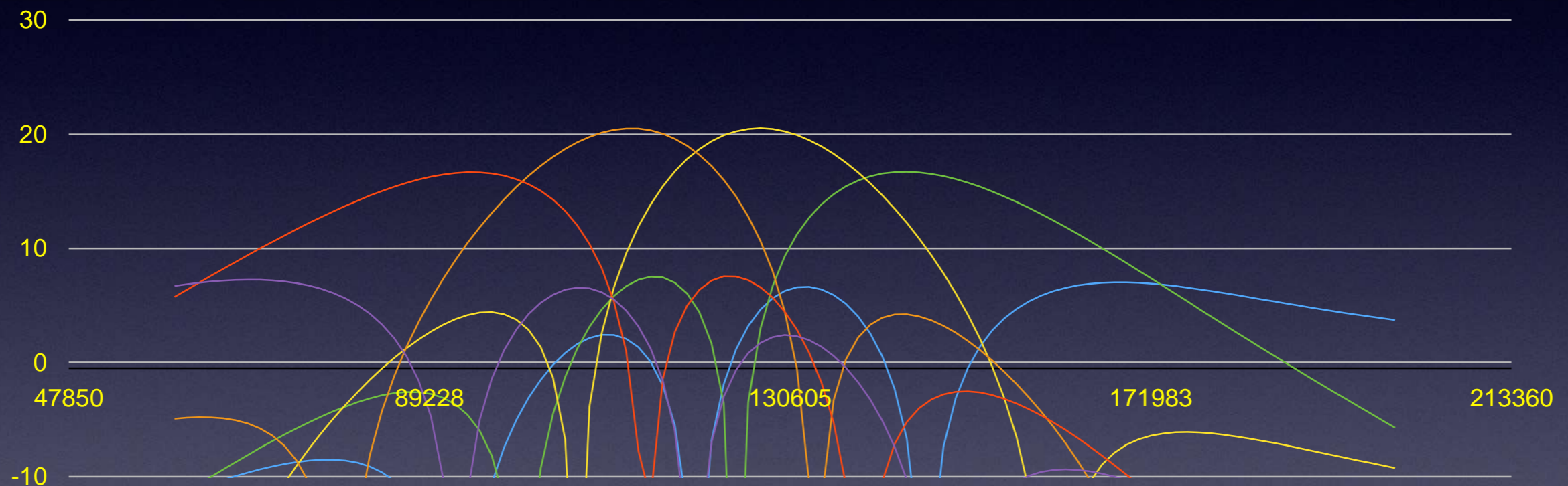
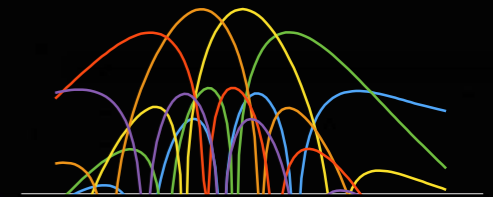
13.000 Course Fine Coefficient a Ratio
 4.000 0.7 4.700 0.709

$\text{SIN}(4.700 X)$
 $4.700 X$

ax in Radians	sin(ax)/ax	non negative	x, r cos theta	y, r sin theta
0	-14.765	0.055	2.649	-2.649
0	-14.683	0.058	2.870	-2.870
0	-14.601	0.061	3.055	-3.053
0	-14.519	0.064	3.206	-3.202
0	-14.437	0.066	3.326	-3.318
0	-14.355	0.068	3.414	-3.401
0	-14.273	0.069	3.473	-3.454
0	-14.191	0.070	3.503	-3.477
0	-14.109	0.071	3.504	-3.470
0	-14.027	0.071	3.475	-3.432
0	-13.945	0.070	3.416	-3.364
0	-13.863	0.069	3.326	-3.265
0	-13.781	0.068	3.202	-3.132
0	-13.699	0.066	3.043	-2.965
0	-13.617	0.064	2.845	-2.761
0	-13.535	0.061	2.605	-2.516
0	-13.453	0.058	2.315	-2.225
0	-13.371	0.054	1.969	-1.883
0	-13.289	0.050	1.556	-1.480
0	-13.207	0.045	1.061	-1.003
0	-13.125	0.040	0.461	-0.433
0	-13.043	0.035	-0.280	0.000
0	-12.961	0.030	-1.222	0.000
0	-12.879	0.024	-2.485	0.000
0	-12.797	0.018	-4.346	0.000
0	-12.715	0.012	-7.802	0.000
0	-12.633	0.005	-14.026	0.000
0	-12.551	-0.001	-6.064	0.000
0	-12.469	-0.008	-3.406	0.000
0	-12.387	-0.014	-1.771	0.000
0	-12.305	-0.021	-0.594	0.000



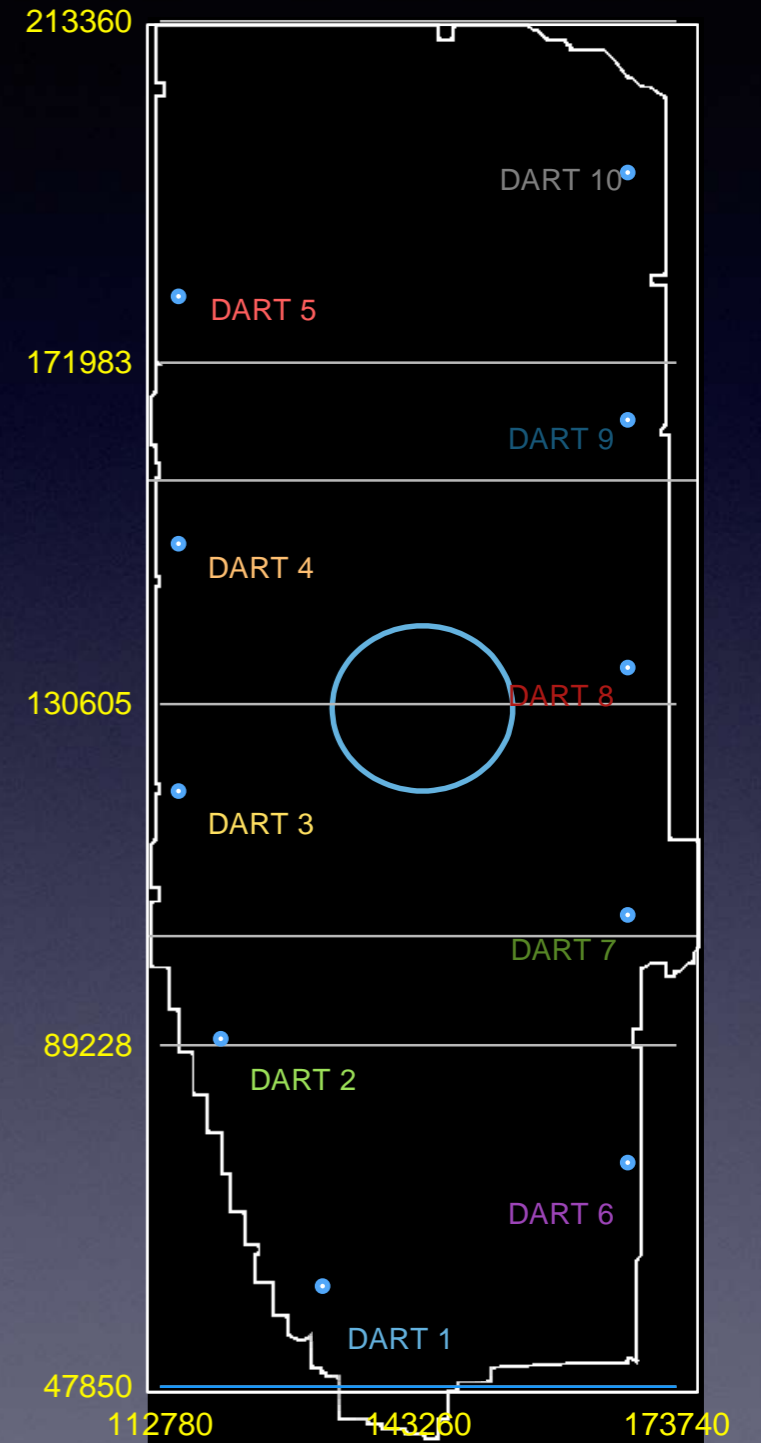
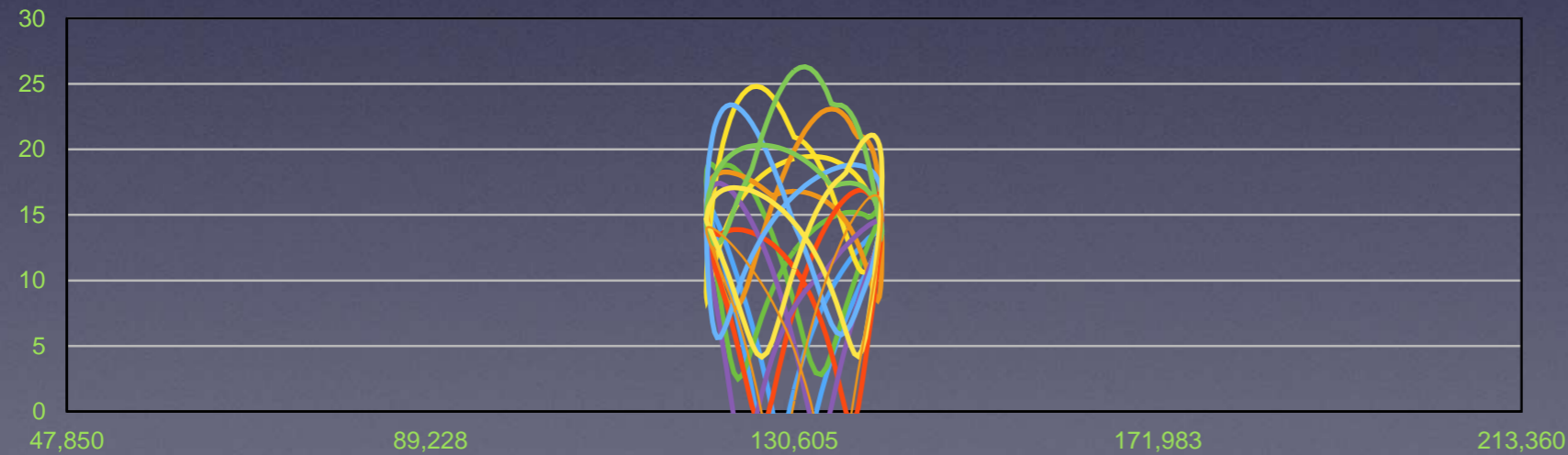
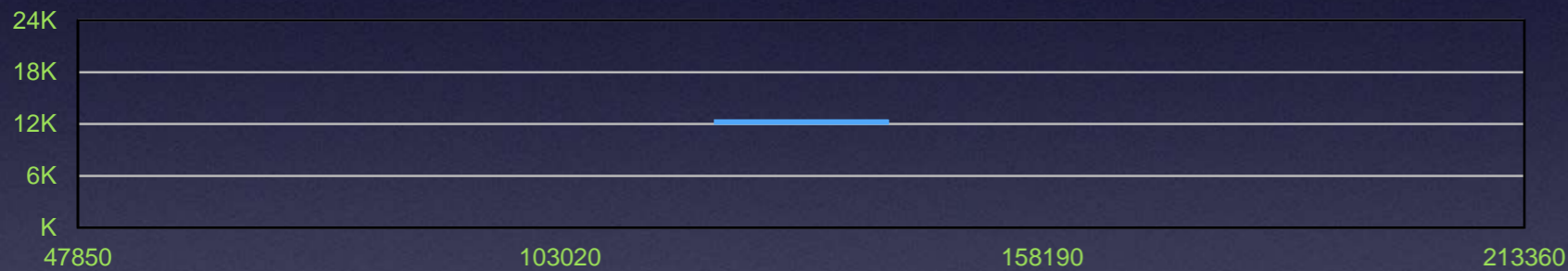
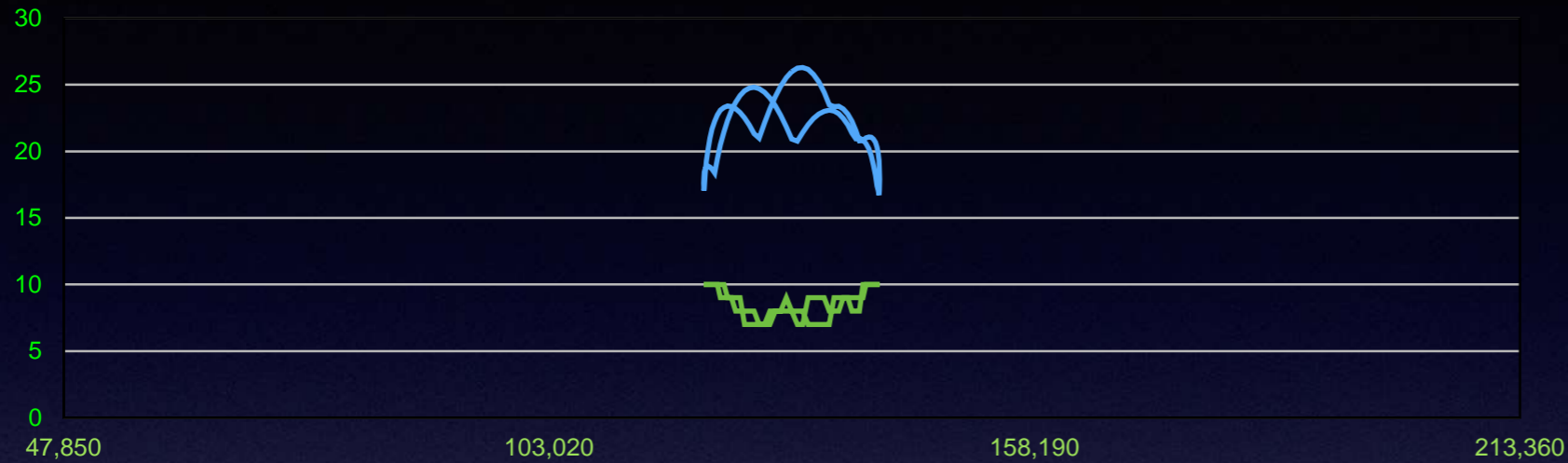
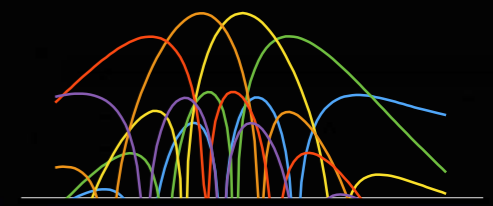
DART 3 Link Margin Performance



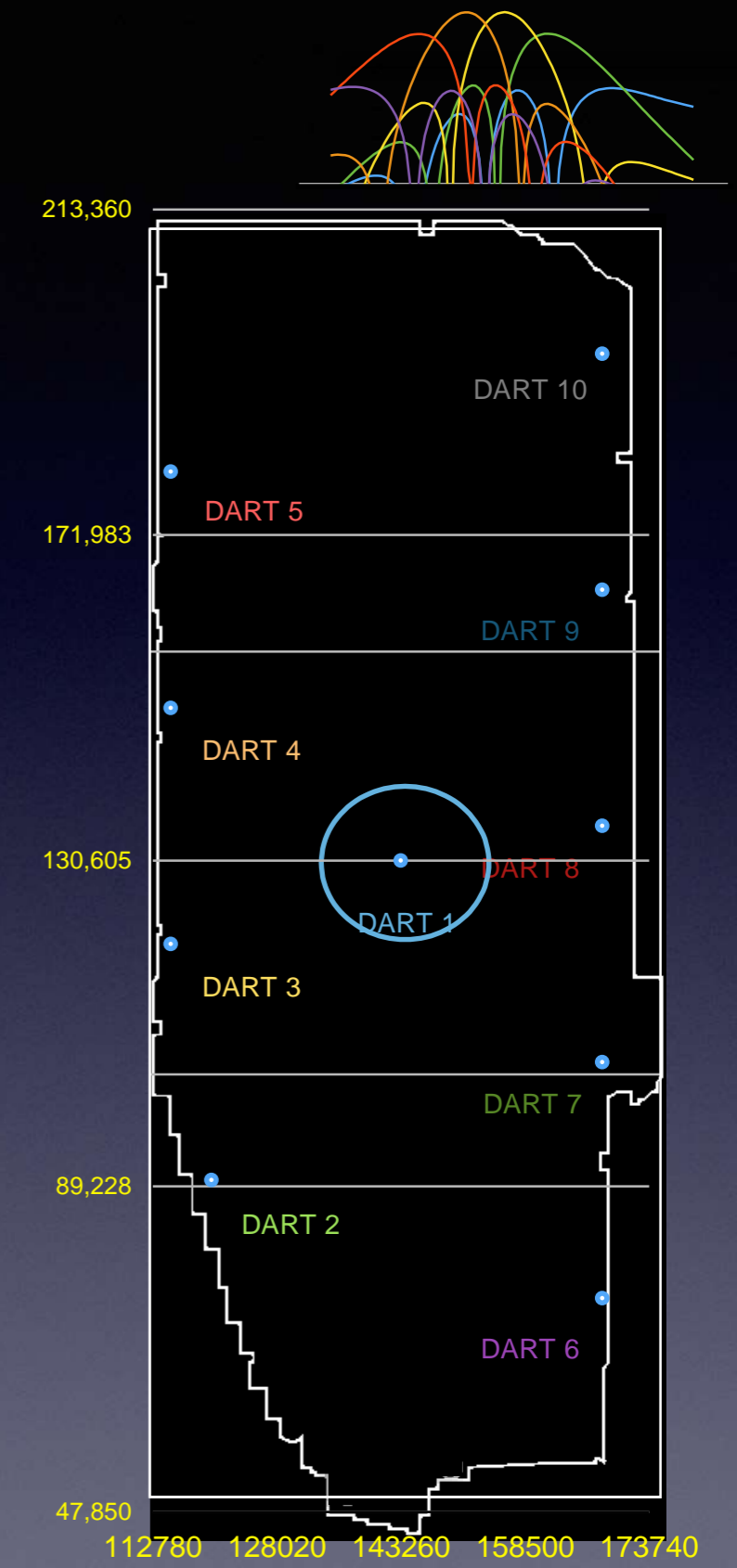
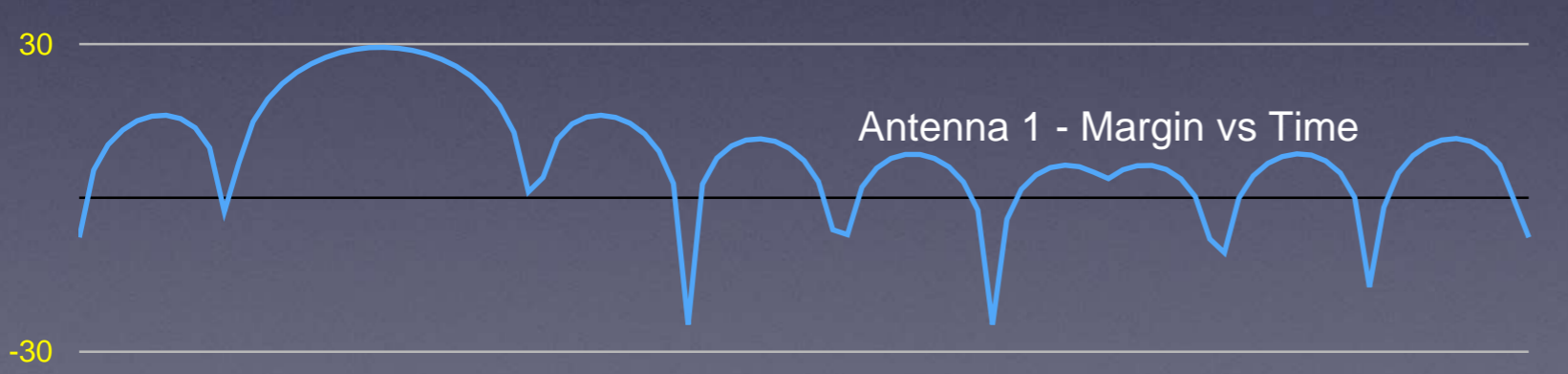
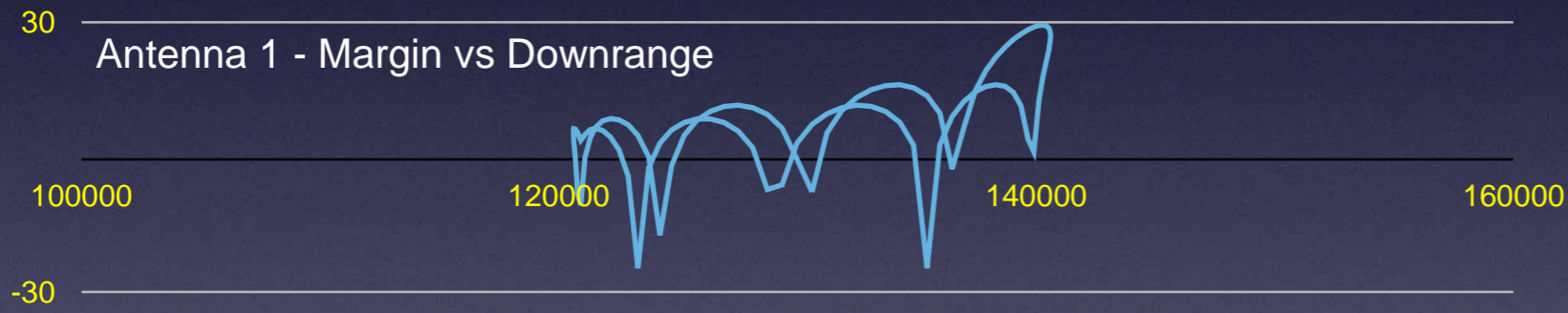
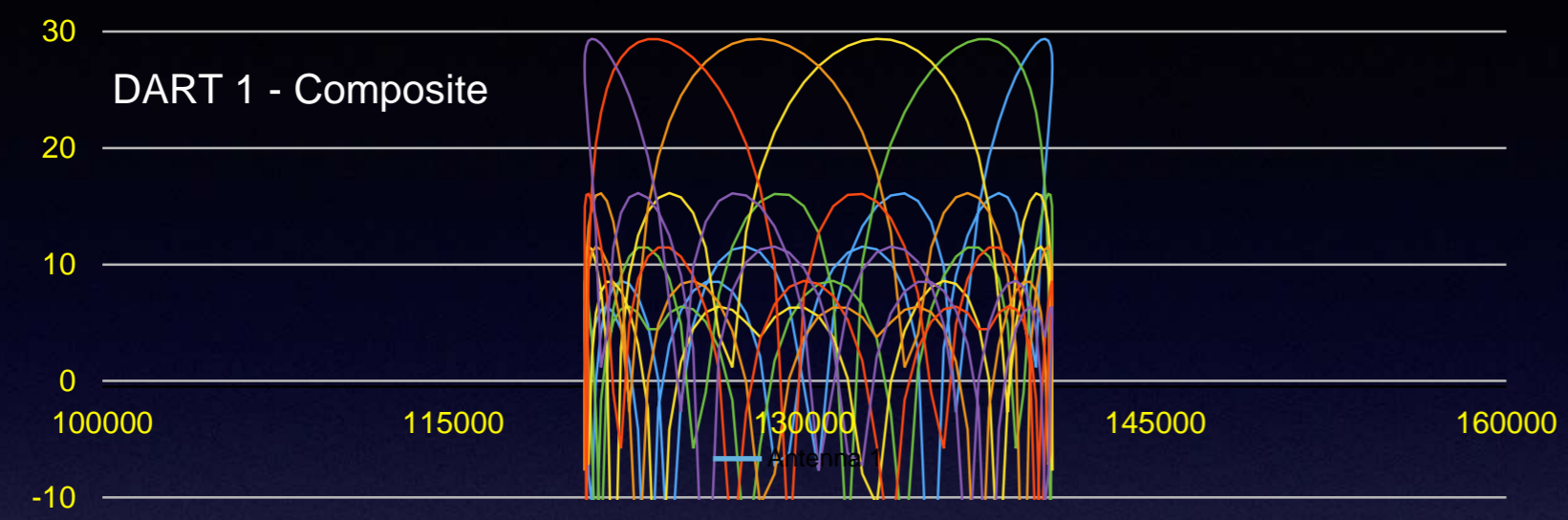
DART 3 ARRAY Azimuth - 90° True

Antenna 1-15°, Antenna 2 - 45°, Antenna 3 - 75°, Antenna 4 -105°, Antenna 5 -135°, Antenna 6 -165°

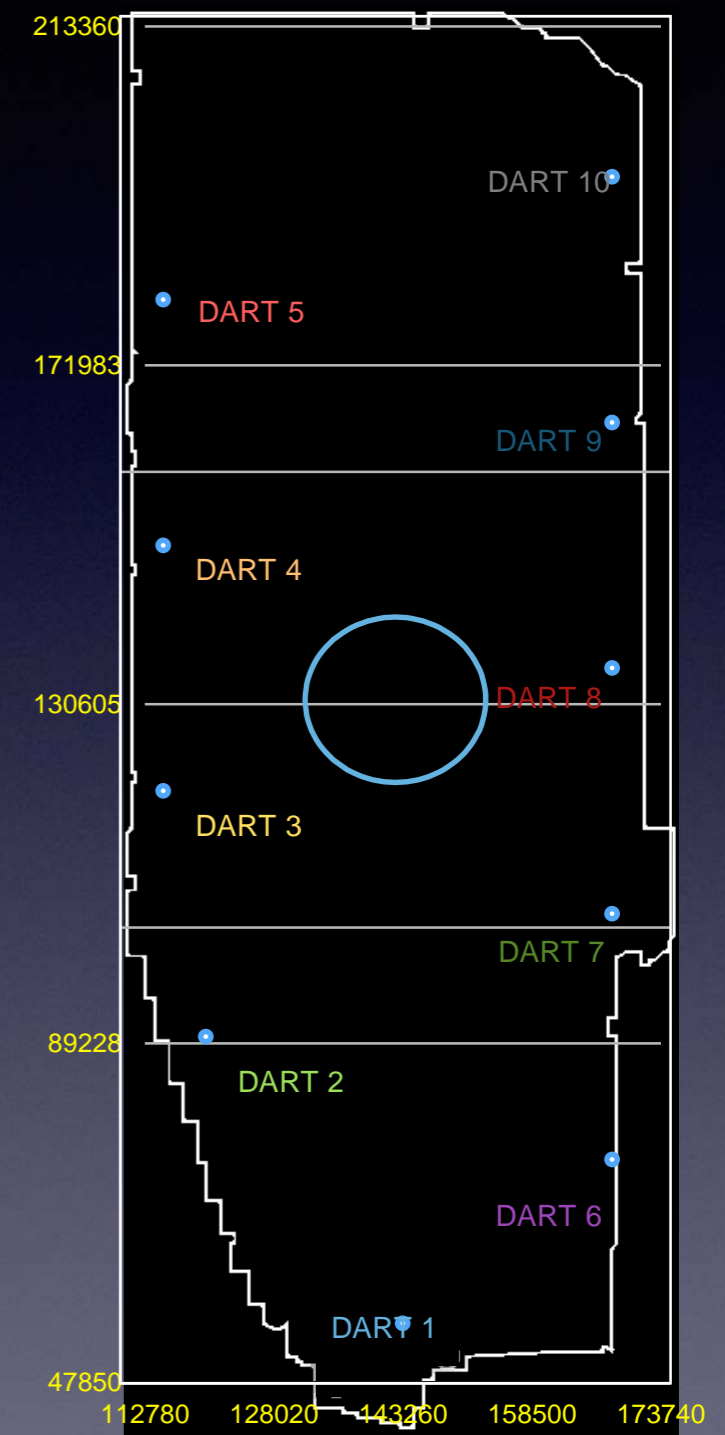
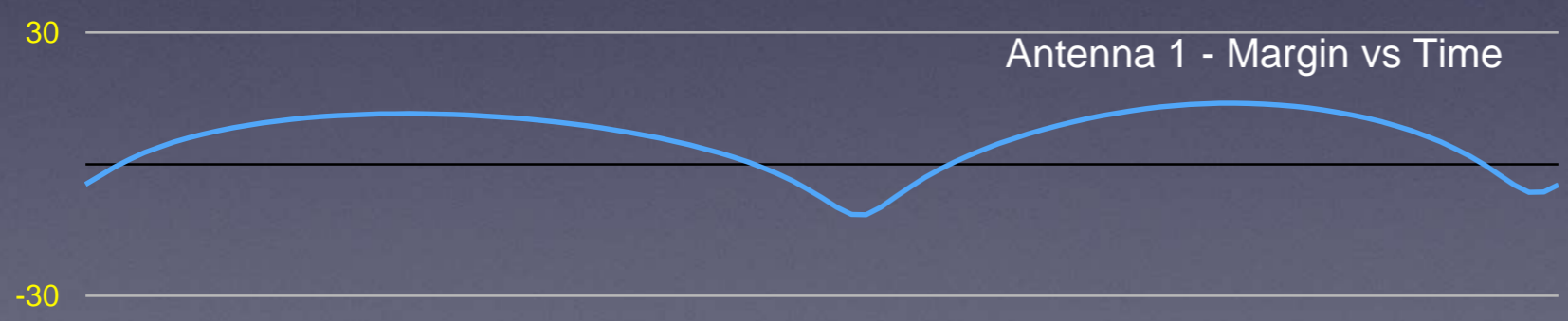
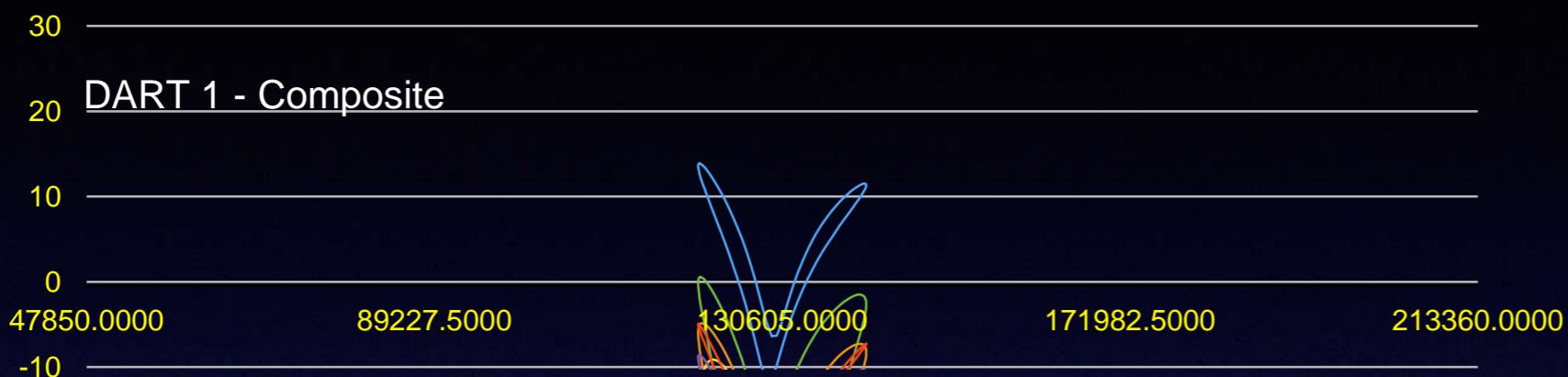
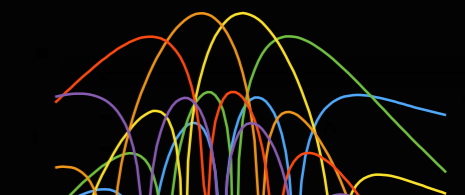
Radial Orbit Simulation



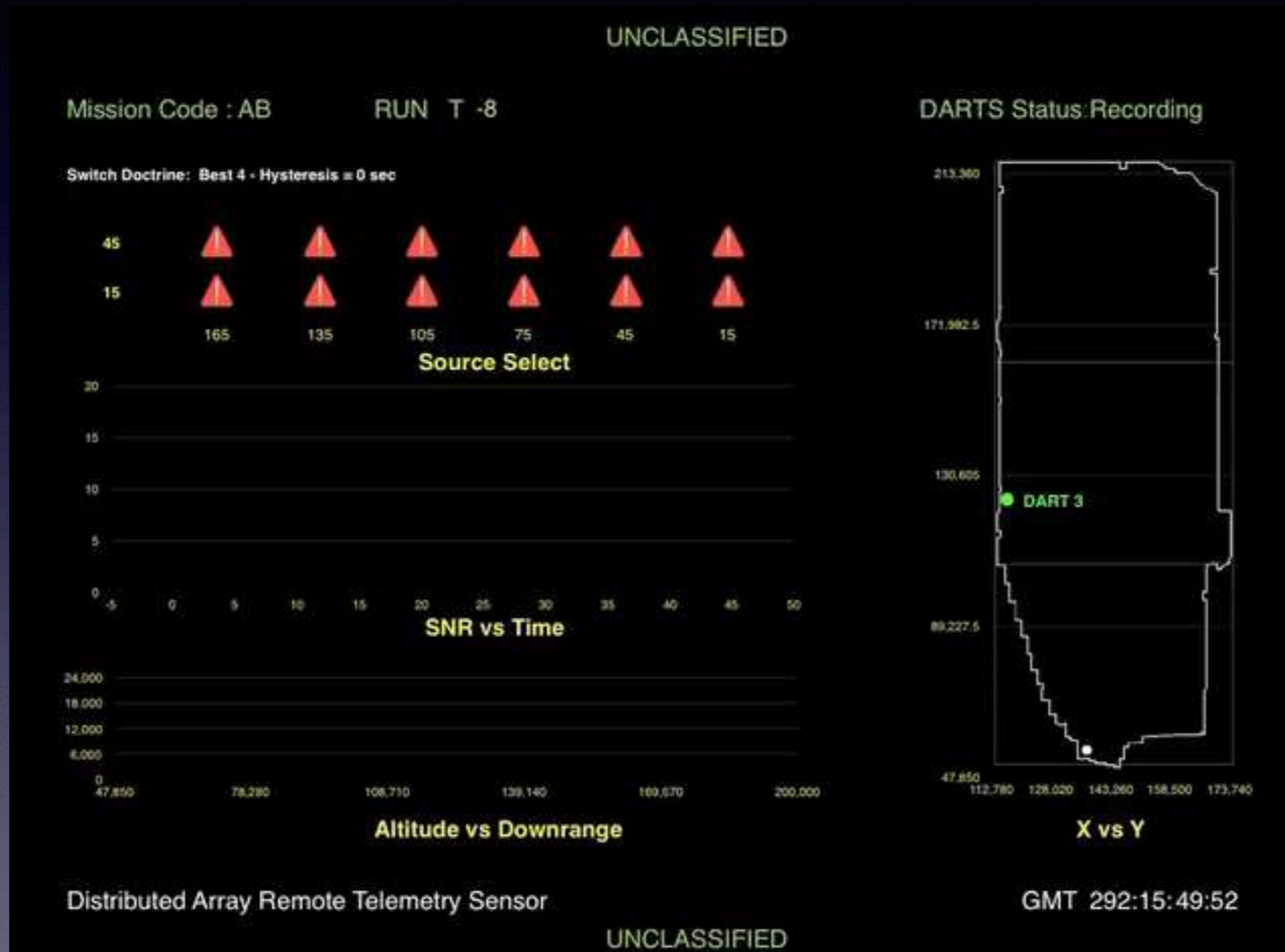
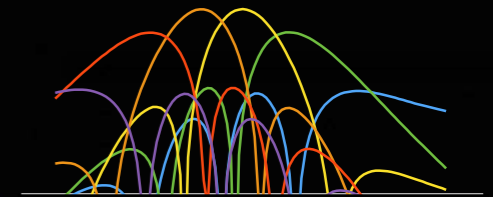
DART 1 Array - Orbit Origin Co-located

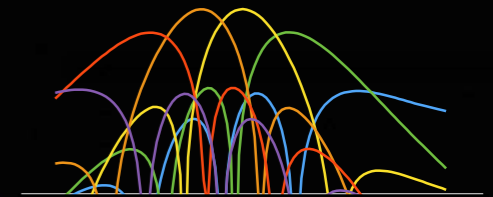


DART 1 Array - Stand off Orbit



DARTS 12 Element Simulation





References

A Brave New C Band Architecture
A Smarter Antenna
Look Ma No Hardware

Juan Guadiana
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Juan Guadiana

ITC Proceedings 2015
ITC Proceedings 2011
ITC Proceedings 2009

Acknowledgements

Rigil Corporation (Rigil.com)
Mannatek Solutions, Inc.
Scientific Value LLC
Our friends at NAS Patuxent River, MD.

Let's make life better
The little company that could
Optimizing scientific value, smart and systematic