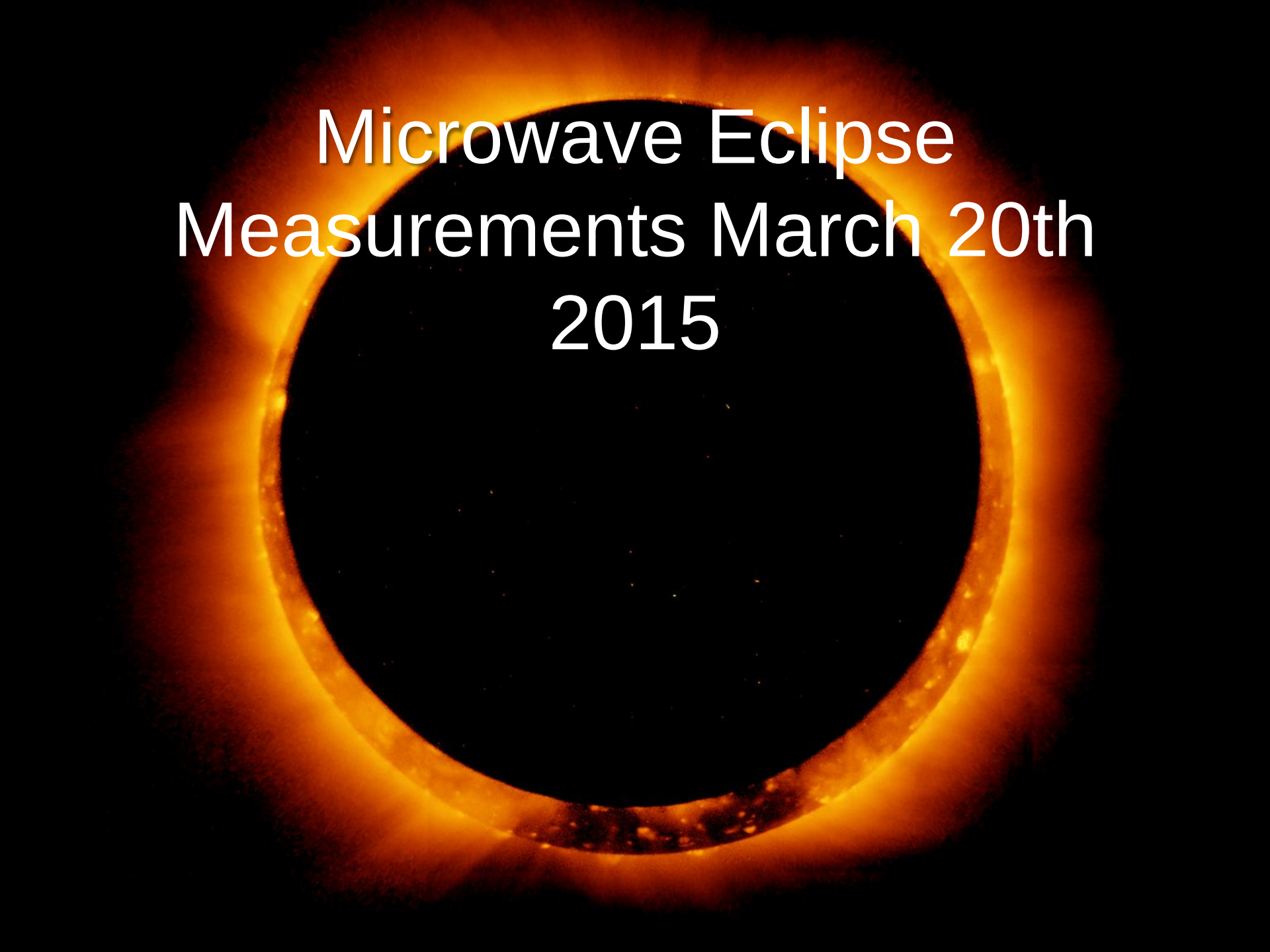


Microwave Eclipse Measurements March 20th 2015

March 20th 2015..08:00...Are we ready?

- Great participation in this unique event
- Over 20 stations across Europe made measurements
- Several really useful data sets obtained
- Please note … I am not the expert in this field
- The real experts are

  Joachim, DF3GJ /DL0SHF

  Jean-Jacques, F1EHN

They have been so helpful and generous.

Microwave Observations across Europe

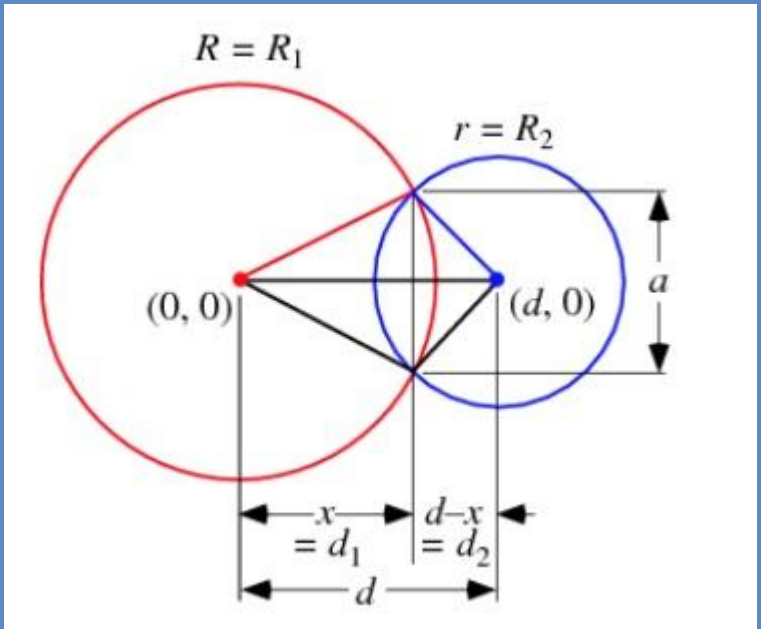
The data has been collected …. 144MHz to 24GHz

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	NOTES	Callsign	freq	Normal	dB drop	Antenna	Beamwidt	Lat	Long	QRA	% obscured		START	MAX	END	Graph		PCA			Separation	%	Moon	Flux
2				level			Deg				max	corr drop				data	az moon	el moon	az sun	el sun	min arc	obscured	Impact	Fraction
3		G3LTF	2320	19.4	4.8	6m dish	1.5	51 15 9	1 25 16 W	IO91GG	85	4.9	08:22.5	09:28.4	10:38.4	Y	131.704	27.921	131.689	27.839	5.00	85	0.33	0.32
4	See Sht 3	G3LTF	3400	18.6	1.8	6m dish	1	"	"	IO91GG	36.2	1.83	08:22.5	09:28.4	10:38.4	Y	131.704	27.921	131.689	27.839	5.00		0.33	
5		G4NNS	1410	16.2	6	3.7m dish	4	51 14 53	1 34 16 W	IO91FF	85.1	6.33	08:22.5	09:28.4	10:38.4	Y	131.587	27.885	131.574	27.804	4.92	85.1	0.33	0.23
6		OK1DFC	1296	21.2	6	10mdish	1.62	49.94	14.54	JN79GW	68.6	6.1	08:36	09:45	10:57	N	153.356	36.835	153.314	36.686	9.29	68.6	0.62	0.25
7		ES5PC	1296	15.5	3	4.5m dish	3.6	58.39097	26.62874	KO38HJ	72.87	3.13	09:00	10:09	11:17	Y	176.528	31.468	176.465	31.348	8.13	72.87	0.54	0.49
8		G4BAO	2320	8	1.5	1.9m dish	4.76	52.26	0.196	JO02CG	85.4	1.85	08:26	09:32	10:42	Y	134.769	28.417	134.757	28.338	4.79	85.4	0.32	0.65
9	see sh 3	LX1DB	10368	16.5	4	3m dish	0.675	49.6	6.2	JN39CO	75.83	4.15	08:27	09:35	10:46	Y	140.823	33.285	140.814	33.165	7.22	75.83	0.48	0.38
10	see sht 3	LX1DB	3400	16	3.8	10mdish	0.62	49.6	6.2	JN39CO	75.83	3.96	08:27	09:35	10:46	N	140.823	33.285	140.814	33.165	7.22	75.83	0.48	0.4
11		I1NDP	1296	23.7	3.2	10m dish	1.62	45 27 45	8E	JN45AL	66	3.22	08:23	09:31	10:43	Y	139.882	36.856	139.881	36.695	9.66	66	0.64	0.48
12	estimate	F2CT	5760	20	5.2	13m dish	0.28	48.785	3.5175W	IN88FS	82.5	5.3	08:18	09:23	10:33	Y tbd	127.378	27.848	127.382	27.756	5.53	82.5	0.37	0.3
13	estimate	F2CT	4150	20	5.2	13m dish	0.39	48.785	3.5175W	IN88FS	82.5	5.3	08:18	09:23	10:33	Y tbd	127.378	27.848	127.382	27.756	5.53	82.5	0.37	0.3
14		OE5JFL	1296	23.2	3.5	7.3m offse	2.2			JN68MG	66.5	3.53	08:32	09:41	10:43	N	149.768	37.538	149.735	37.380	9.68	66.5	0.65	0.44
15		OK1CA	24,000	13.8	3.3	4.2m dish	0.25	50.53	14.56	JO70GM	69.4	3.52	08:37	09:46	10:57	Y	153.840	36.390	153.800	36.245	9.02	69.4	0.6	0.44
16	estimate	SM7GVF	144	4	2.2	4 x 8ele		57	14.52E	JO77GA	81	4.69	08:46	09:54	11:04	Y	157.929	30.891	157.896	30.798	5.92	81	0.39	0.34
17		IW1DTU	1410	10.75	2.3	2.4m dish	6.2	45 19	7 34	JN35TC	65.8	2.59	08:22	09:30	10:41	Y	138.964	36.840	138.967	36.677	9.78	65.8	0.65	0.55
18	estimate	F1GQB	1440	15	2.3	3.2m dish	4.7	45 07 40	0 24 07	IN95TC	73.3	2.4	08:14	09:20	10:31	N	128.061	31.428	128.075	31.298	7.85	73.3	0.52	0.58
19	estimate	F5SE	1296	20	3.6	10.5m dis	1.54	49 18 11	3 55 47	JN19XG	77.3	3.66	08:25	09:32	10:43	Y	137.451	32.257	137.448	32.143	6.84	77.3	0.46	0.43
20	estimate	F1EHN	1410	15	4	3.3m dish	4.4	48.78	2.17	JN18CS	77.9	4.22	08:22	09:29	10:40	Y	134.617	31.475	134.615	31.364	6.66	77.9	0.44	0.38
21		DL9KR	432	19.5	5	16X 8.5L		50.16	8.32	JO40DE	74.8	5.11	08:30	09:38	10:49	N	144.182	33.929	144.164	33.805	7.52	74.8	0.5	0.31
22	see sht 3	SM3JQU	1296	7.6	3.1	2.45m dis	5.2	62.51	17.34	JP82QM	87.4	4.17	08:56	10:02	11:10	Y	164.344	26.452	164.311	26.387	4.37	87.4	0.29	0.38
23		DJ8FR	1296	18	5	4.93m dis	3.3	54.27	9.87	JO44WG	80	5.15	08:38	09:46	10:56	N	149.635	31.695	149.615	31.597	6.00	80	0.4	0.31
24	SEE	DL0SHF	1296	30	4.19	9m dish	1.8	54.31	10.28	JO54CG	80.3	4.2	08:38	09:46	10:57	Y	150.019	31.796	149.995	31.697	6.11	80.3	0.41	0.38
25	NOTES	DL0SHF	2320	30	4.19	6m dish	1.5	54.31	10.28	JO54CG	80.3	4.2	08:38	09:46	10:57	Y	150.019	31.796	149.995	31.697	6.11	80.3	0.41	0.38
26	SHT 3	DL0SHF	10368	18	7.83	7.2m dish	0.28	54.31	10.28	JO54CG	80.3	8.2	08:38	09:46	10:57	Y	150.019	31.796	149.995	31.697	6.11	80.3	0.41	0.15
27		DC9UP	1296	13.5	3.7	3m dish	4.4	49.58	7.4	JN39QN	74.6	3.98	08:28	09:36	10:48	N	142.362	33.886	142.348	33.762	7.49	74.6	0.5	0.4
28		OK1KIR	10368	17.9	5.23	4.5m dish	0.45	50.11	14.46	JN79DW	68.7	5.4	08:37	09:46	10:57	Y	153.344	36.836	153.314	36.687	9.12	68.7	0.61	0.29
29		G4SWX	144	5.5	2	4x10JXX16		52.1	1.27	JO02RF	84.3	3.13	08:27	09:33	10:43	N	136.302	29.091	136.288	29.008	5.05	84.3	0.34	0.49
30		3peaks	1420			3.3m dish	4	54.148	2.296W	IO84UD	90.3		08:28	09:33	10:42	Y	133.169	26.119	133.160	26.059	3.64	90.300	0.24	

We have results, now we need a model

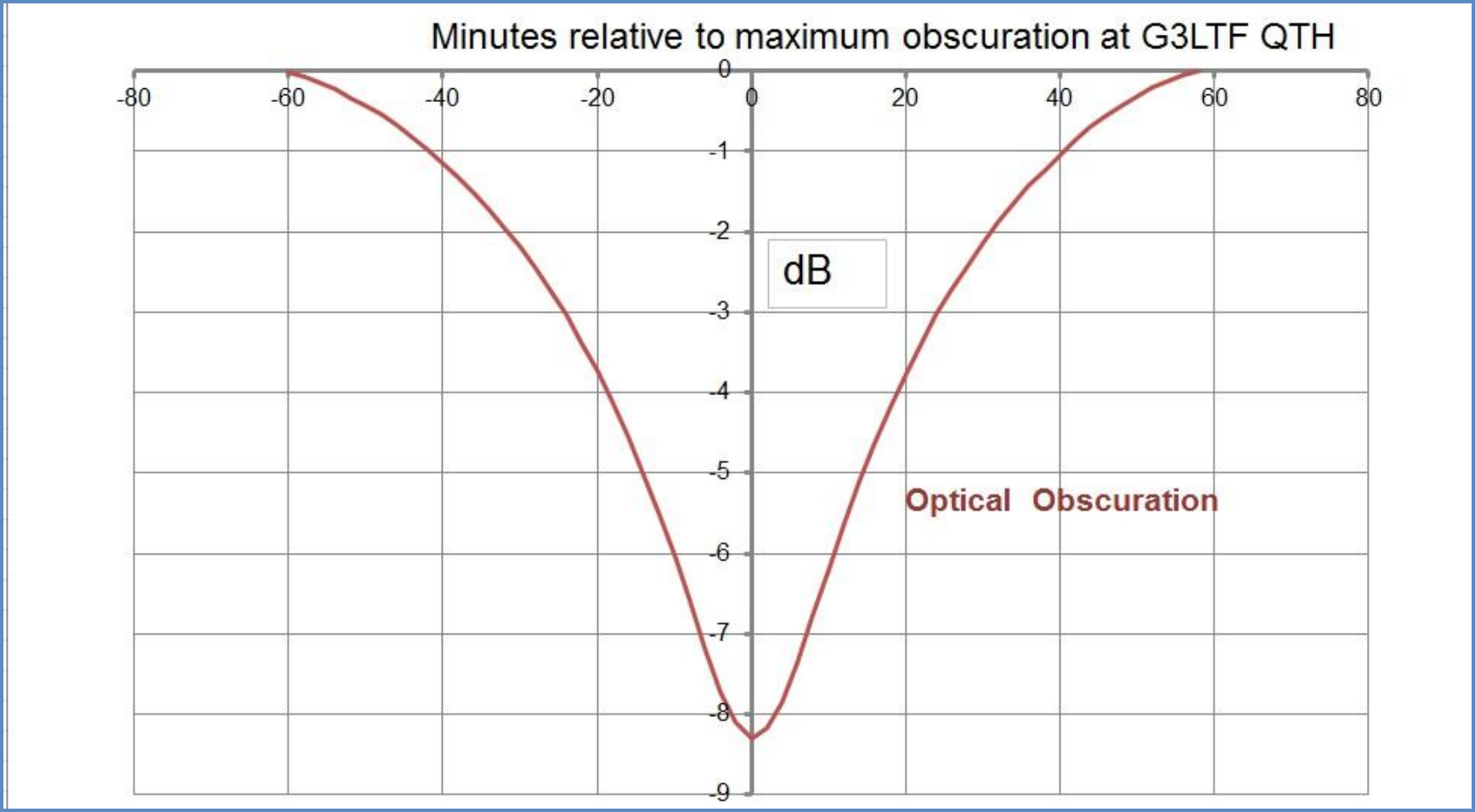
Thank goodness for….

http://mathworld.wolfram.com/Circle-CircleIntersection.html

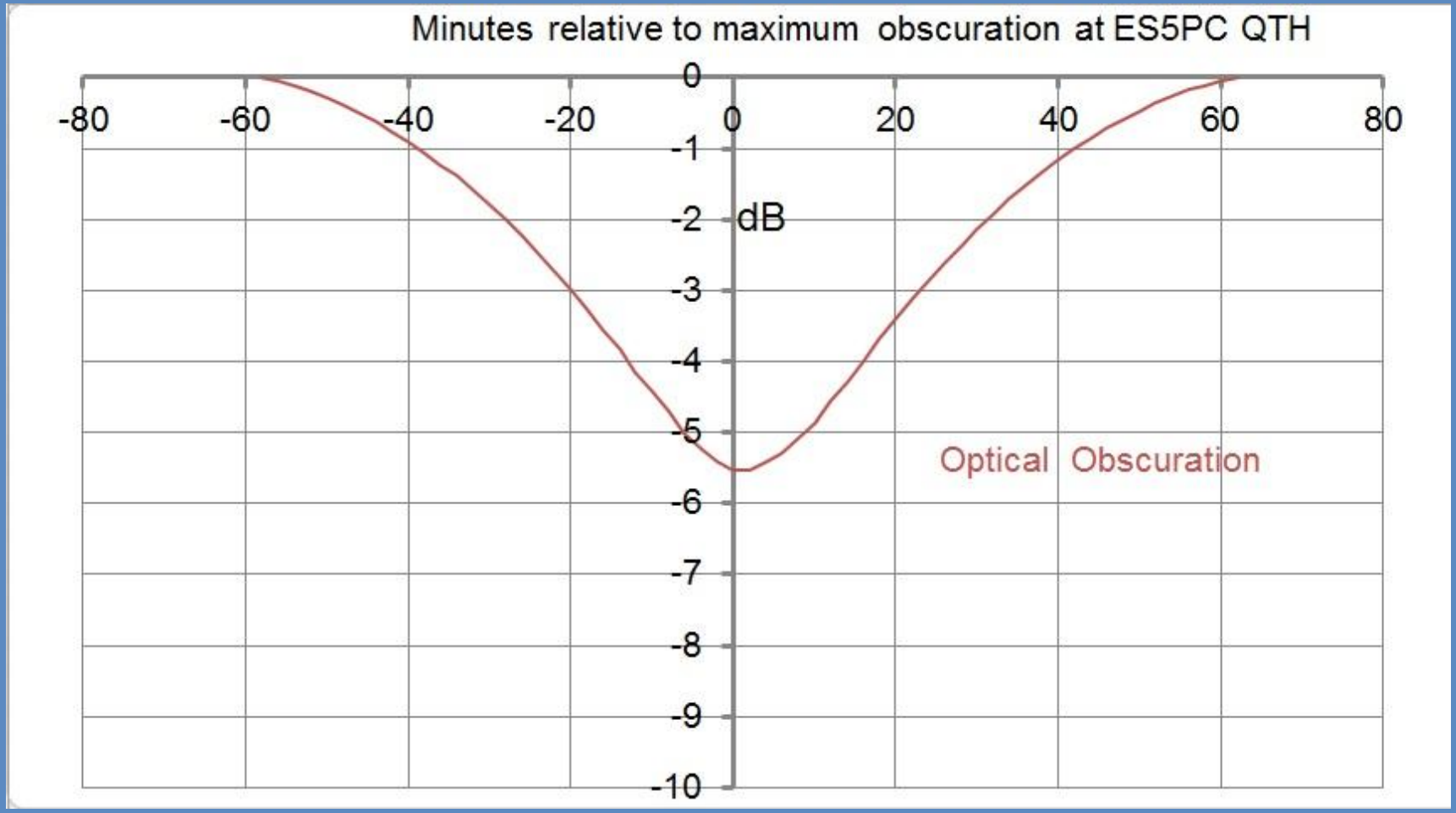


$$A = A(R, d_1) + A(r, d_2)$$
$$= r^2 \cos^{-1}\left(\frac{d^2 + r^2 - R^2}{2dr}\right) + R^2 \cos^{-1}\left(\frac{d^2 + R^2 - r^2}{2dR}\right) -$$
$$\frac{1}{2}\sqrt{(-d + r + R)(d + r - R)(d - r + R)(d + r + R)}.$$

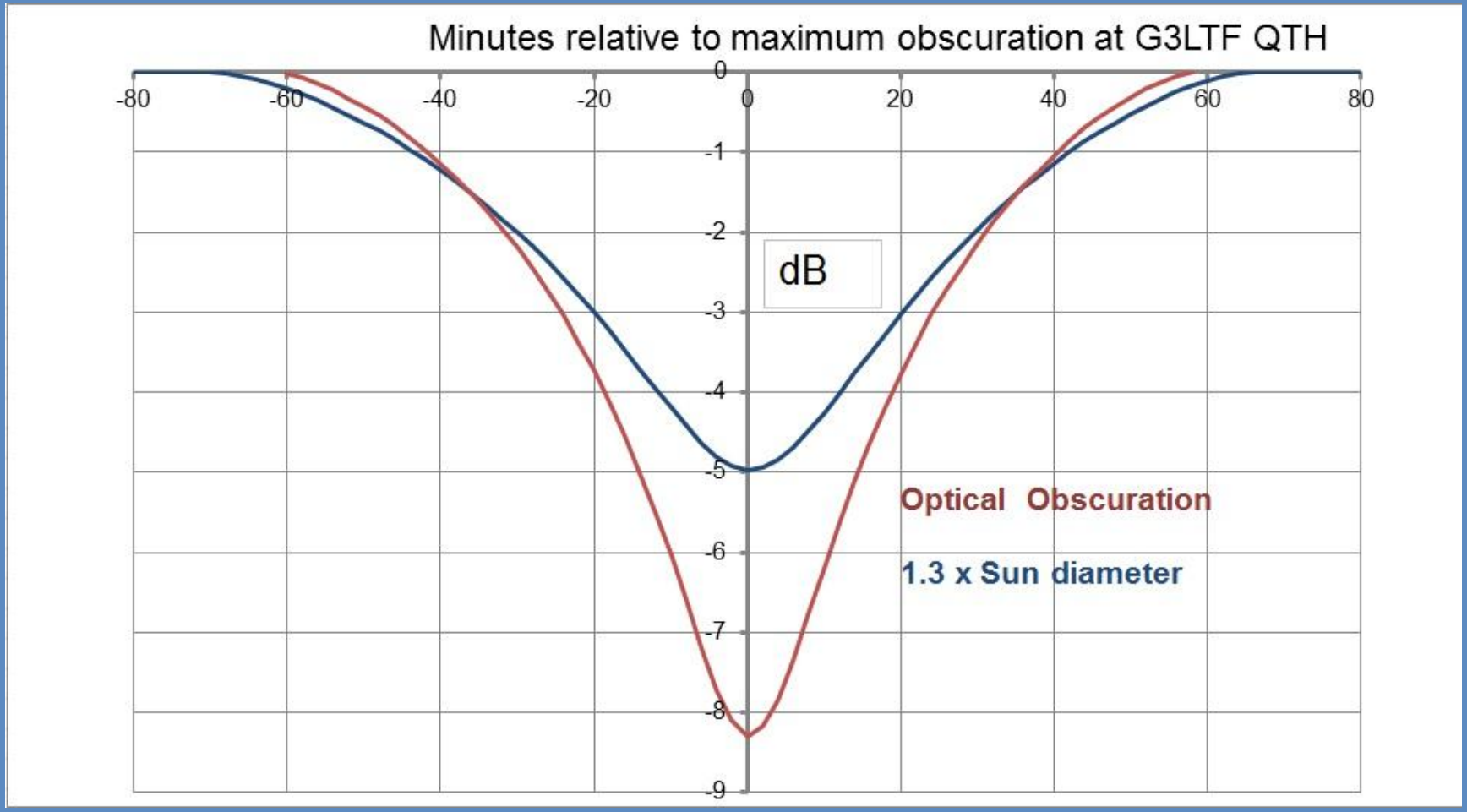
Microwave Eclipse – The basics



Microwave Eclipse – The basics

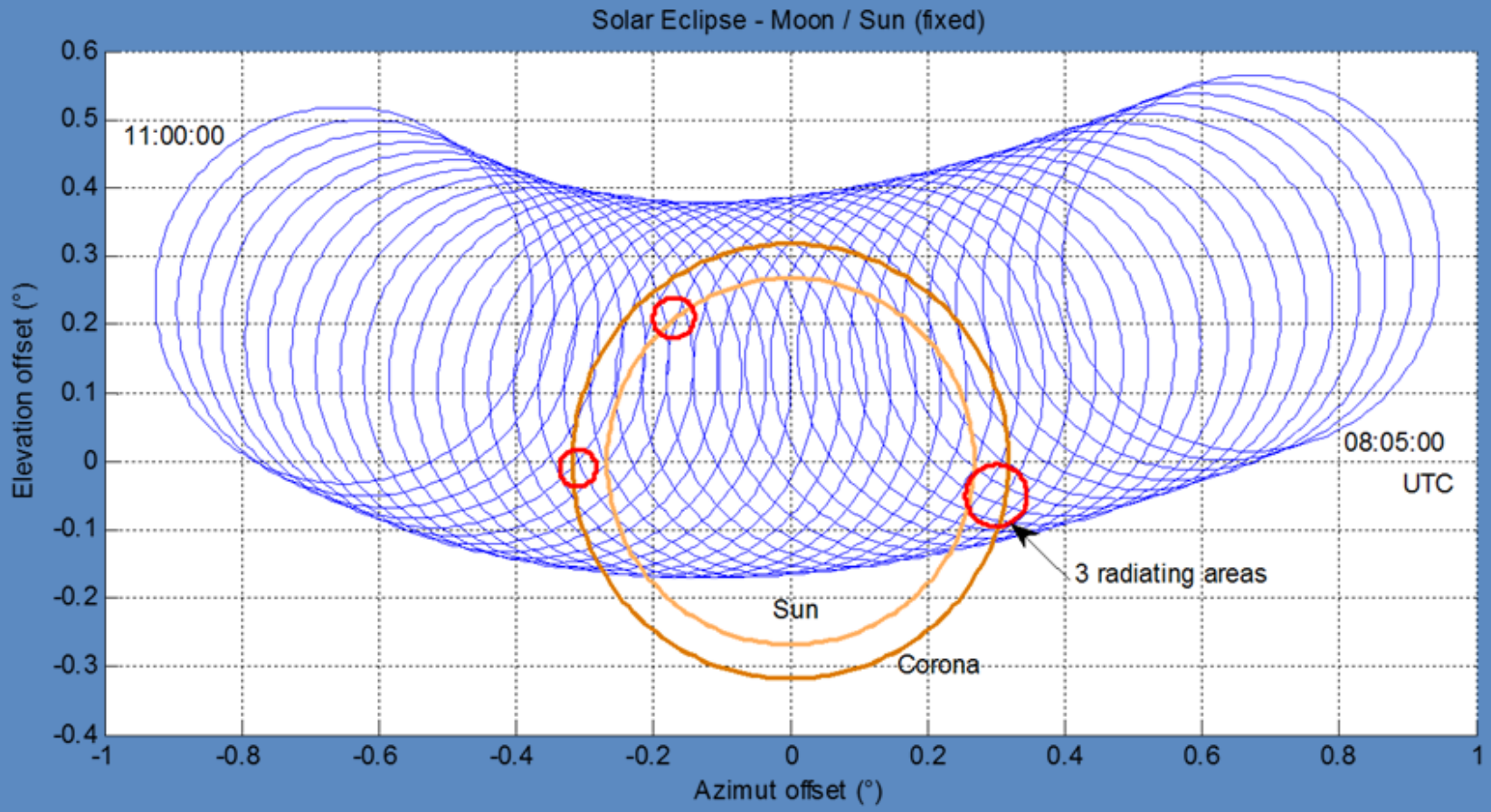


Microwave Eclipse – The basics

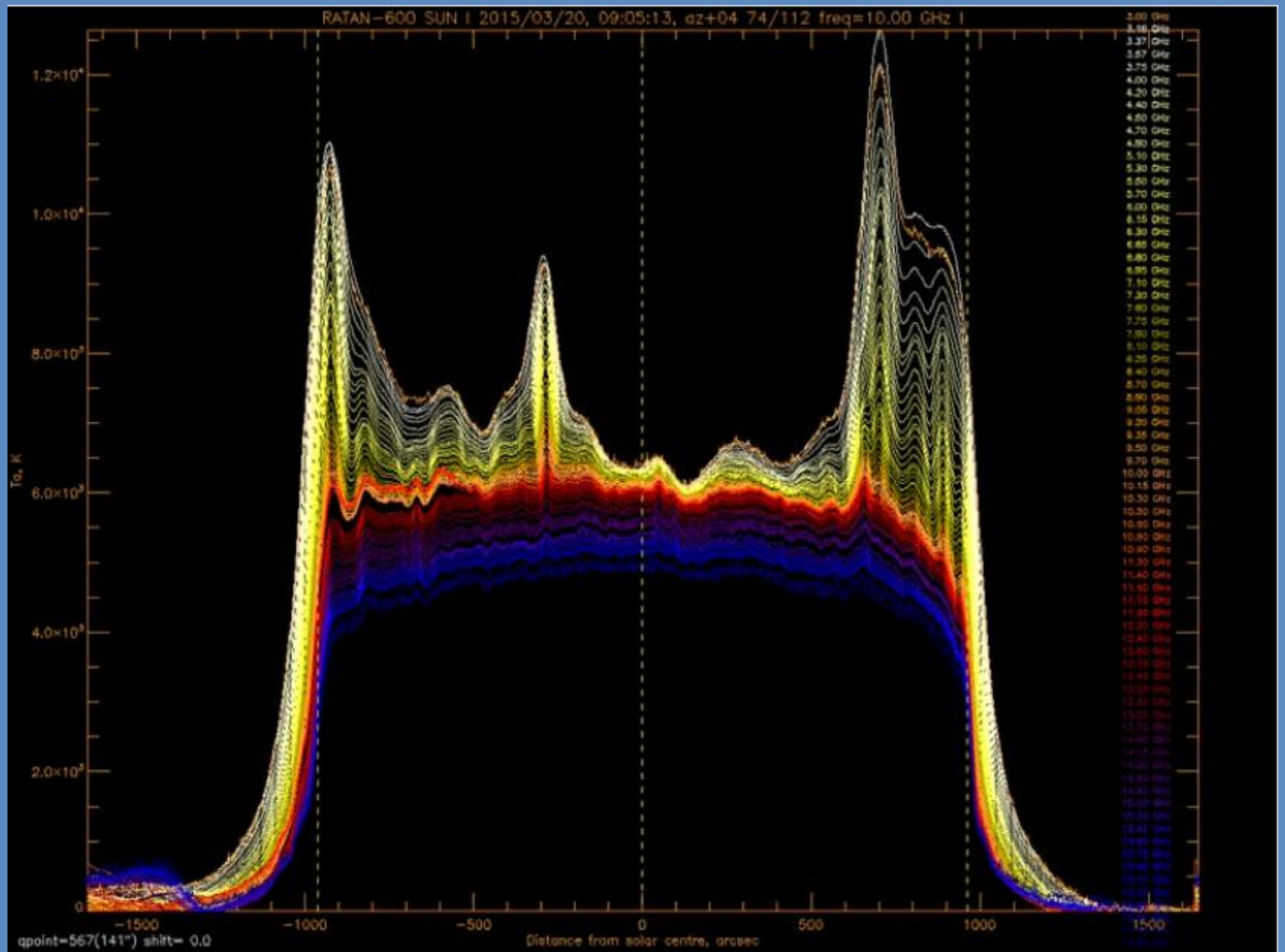


But it is a bit more complex…..

F1EHN slide

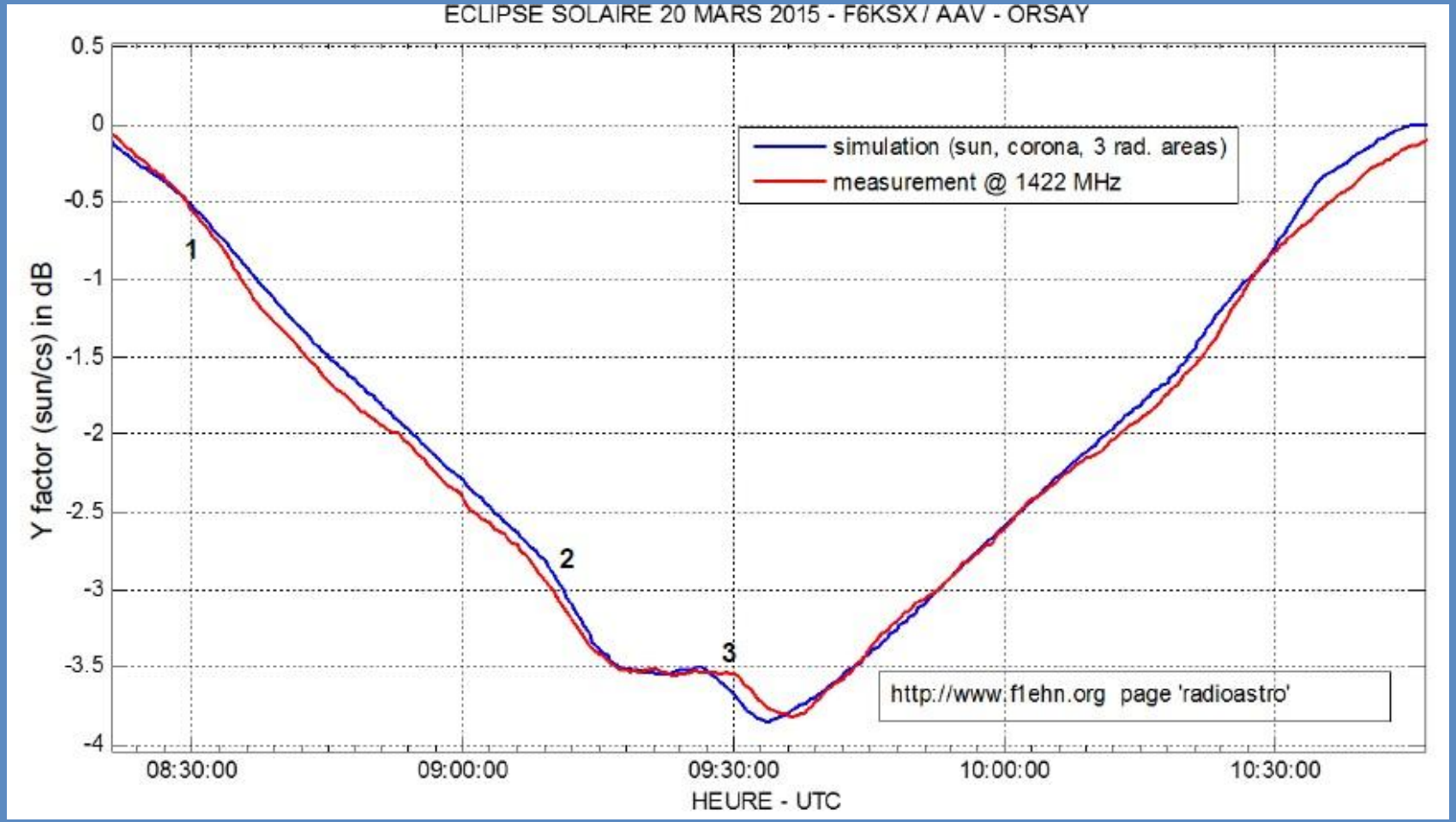


The RATAN-600 radio telescope shows this solar activity in a time-lapse sequence.

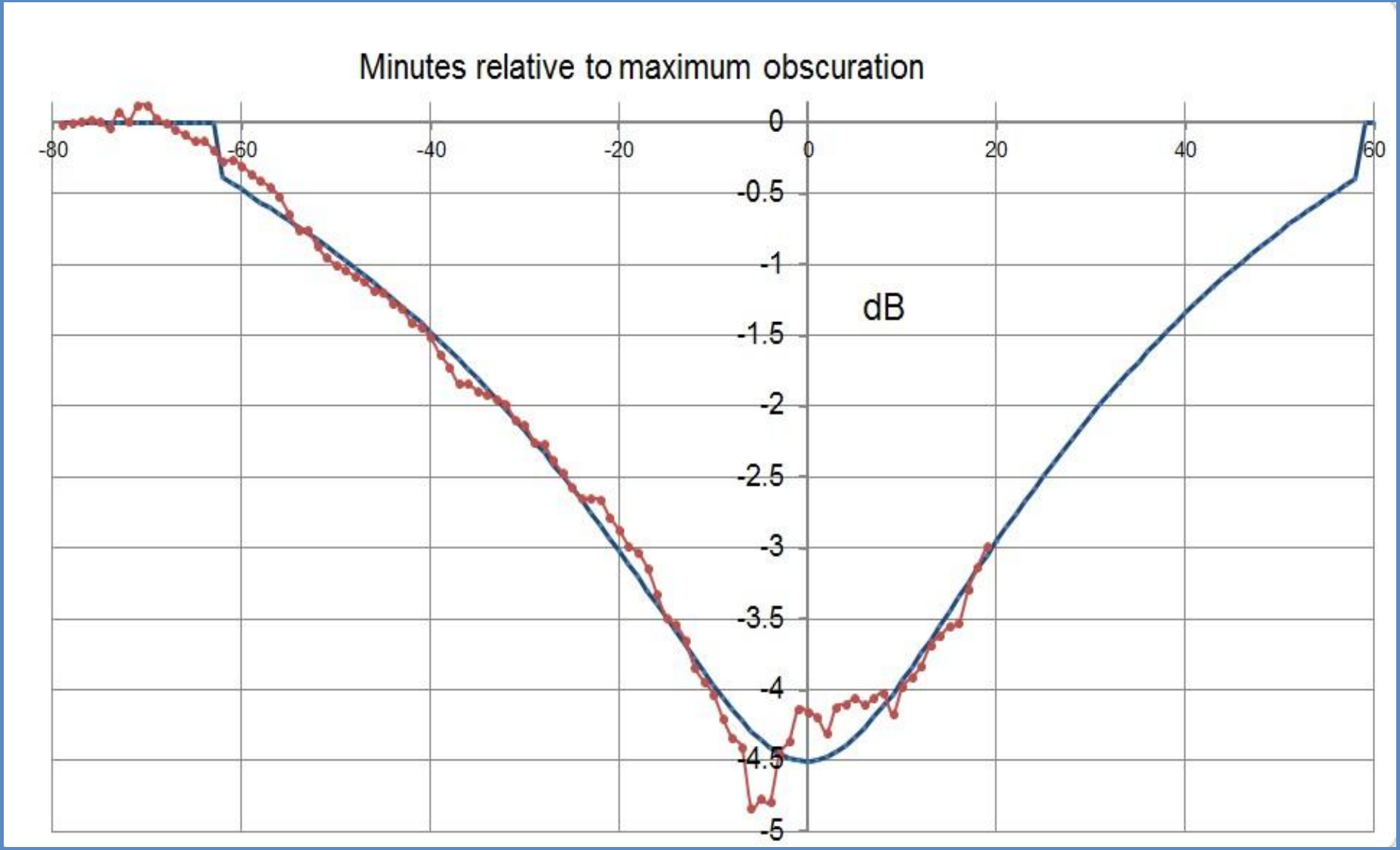


F1EHN result and simulation 1.4GHz

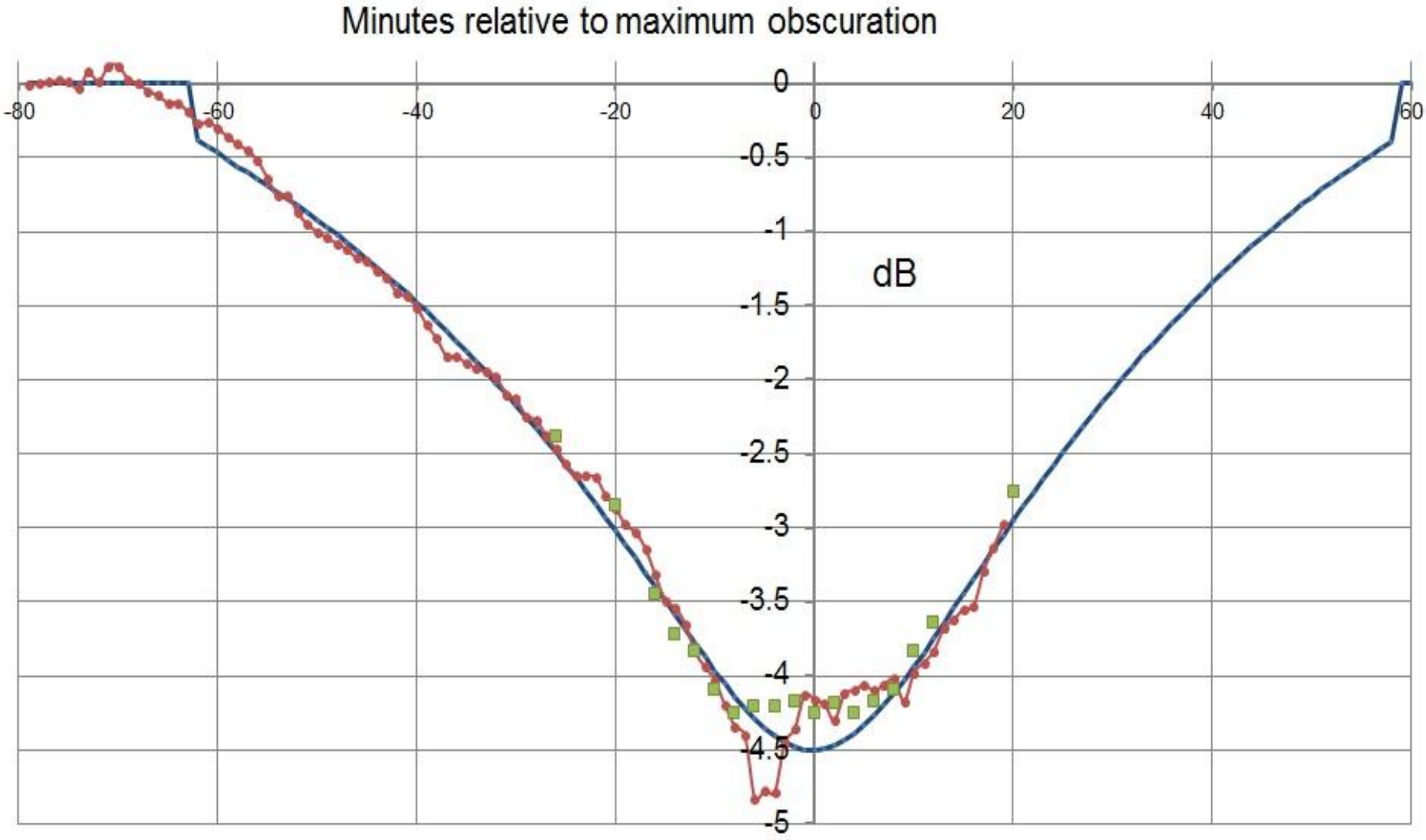
Outer radius 1.2x Inner 0.97x



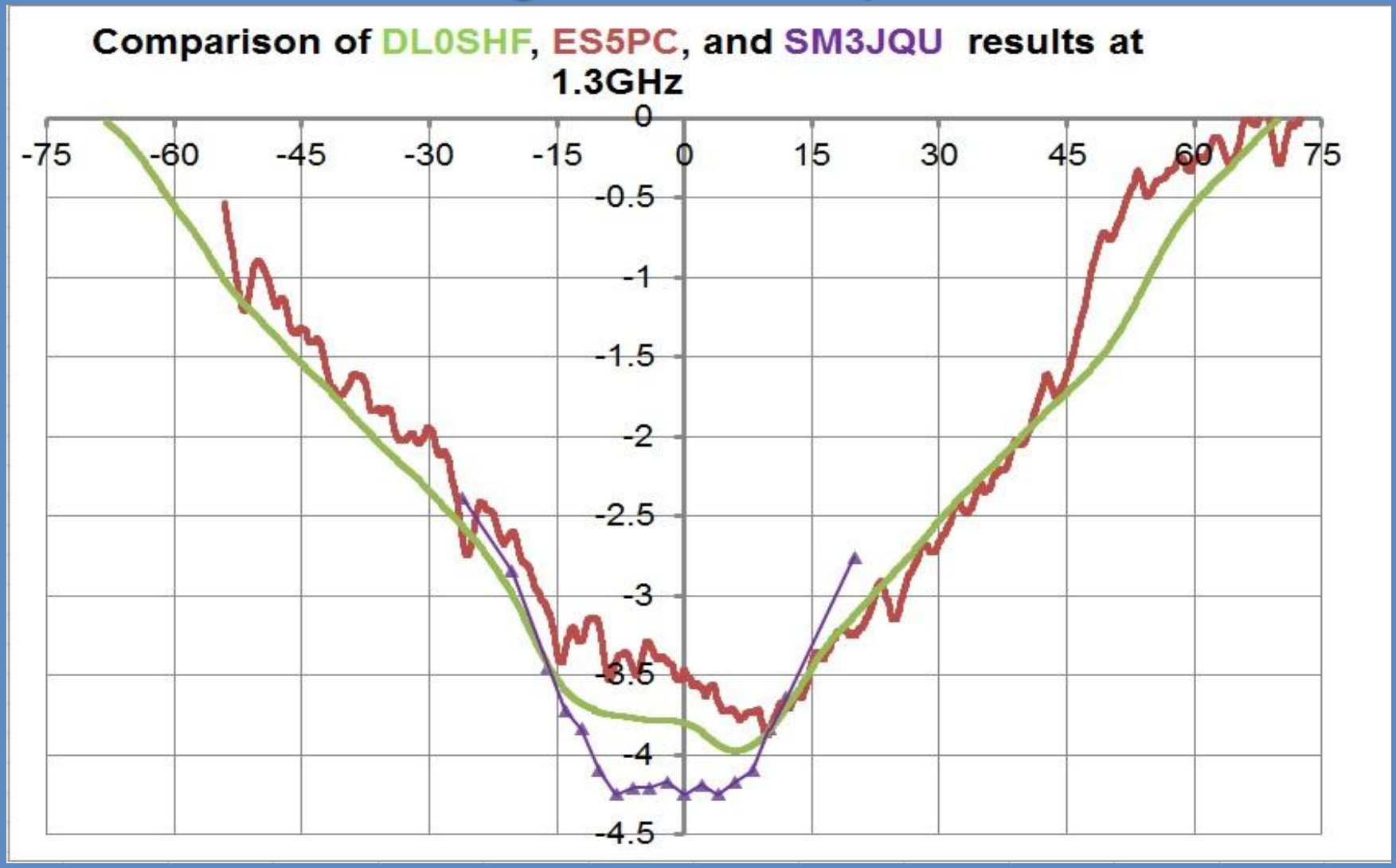
G3LTF result and simulation 2.3GHz. Outer radius 1.2x inner 0.97x



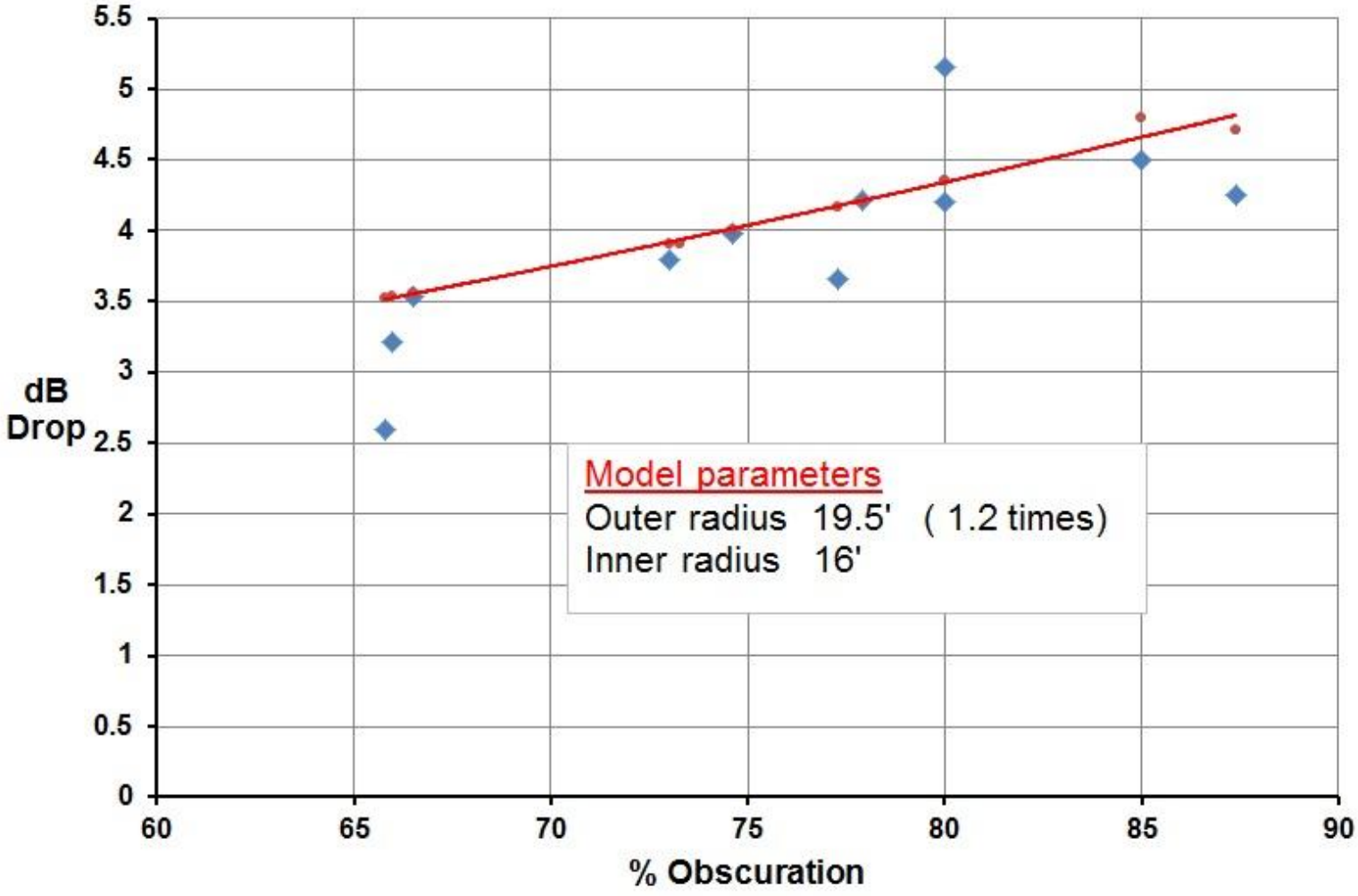
G3LTF result and simulation 2.3GHz. Outer rad. 1.2x inner 0.97x +SM3JQU



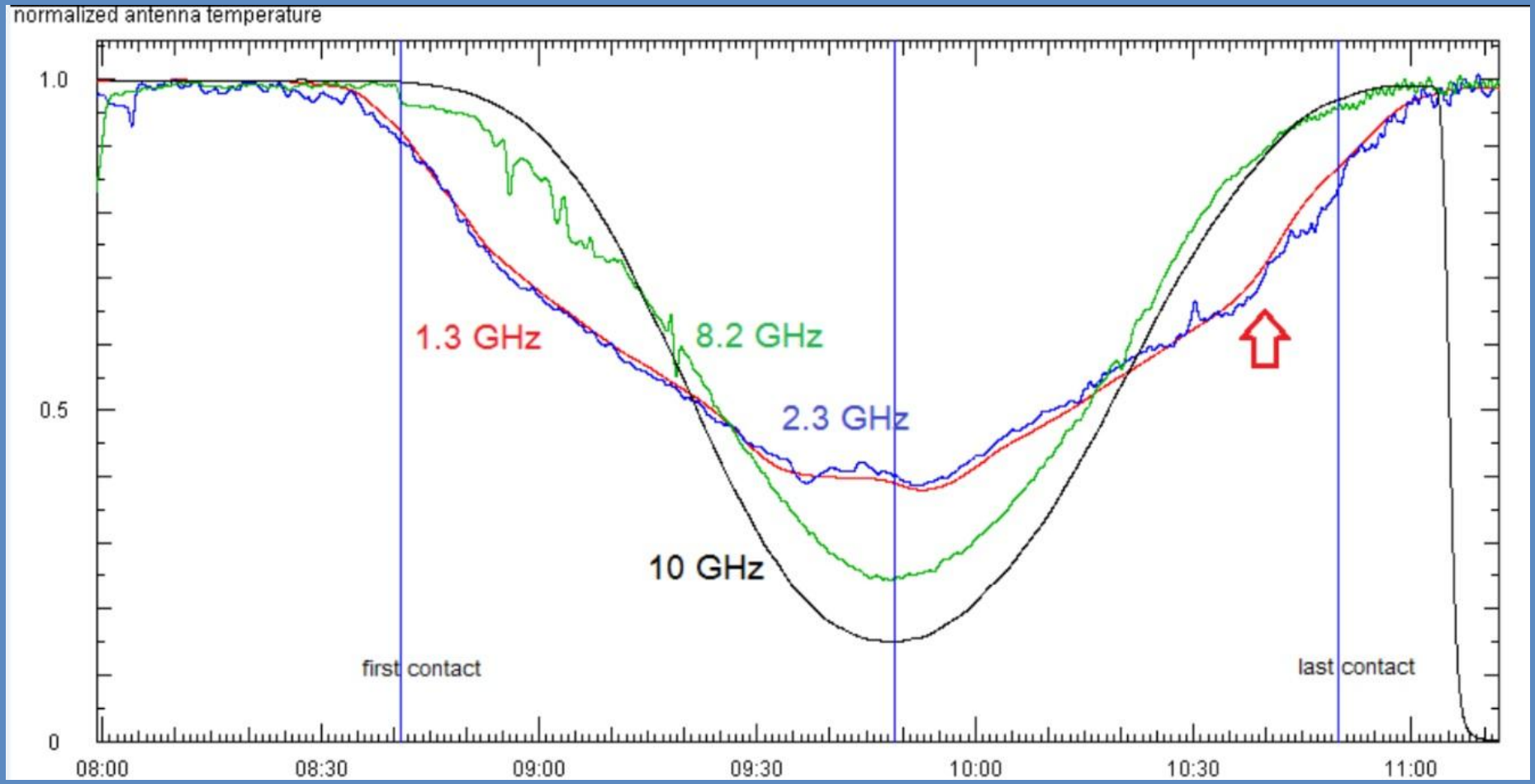
Stations closer to the area of totality measure a bigger dip but all have the same general shape



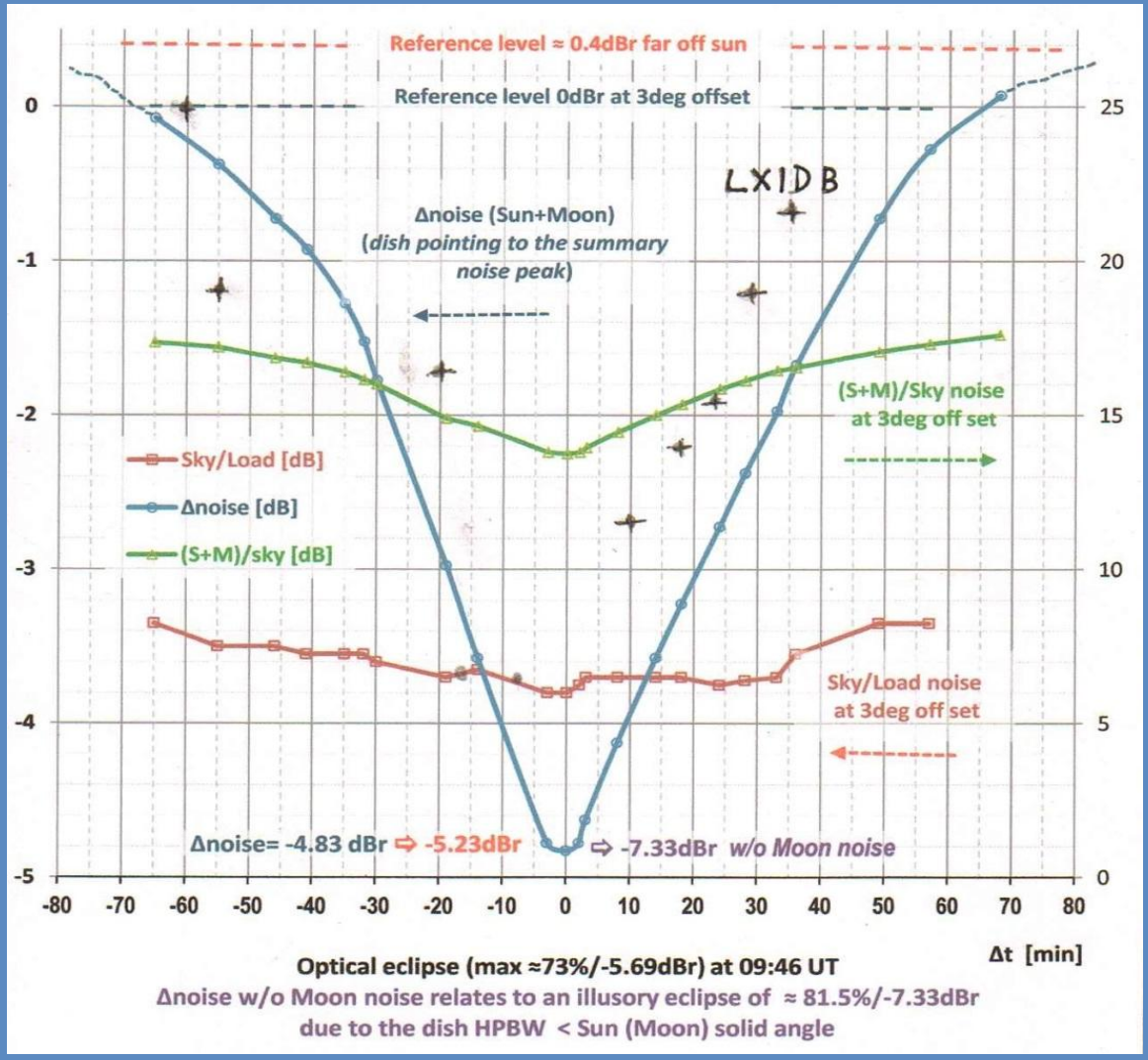
Results from 13 stations of dB drop vs the model show reasonable agreement. (1.3 and 2.3GHz)



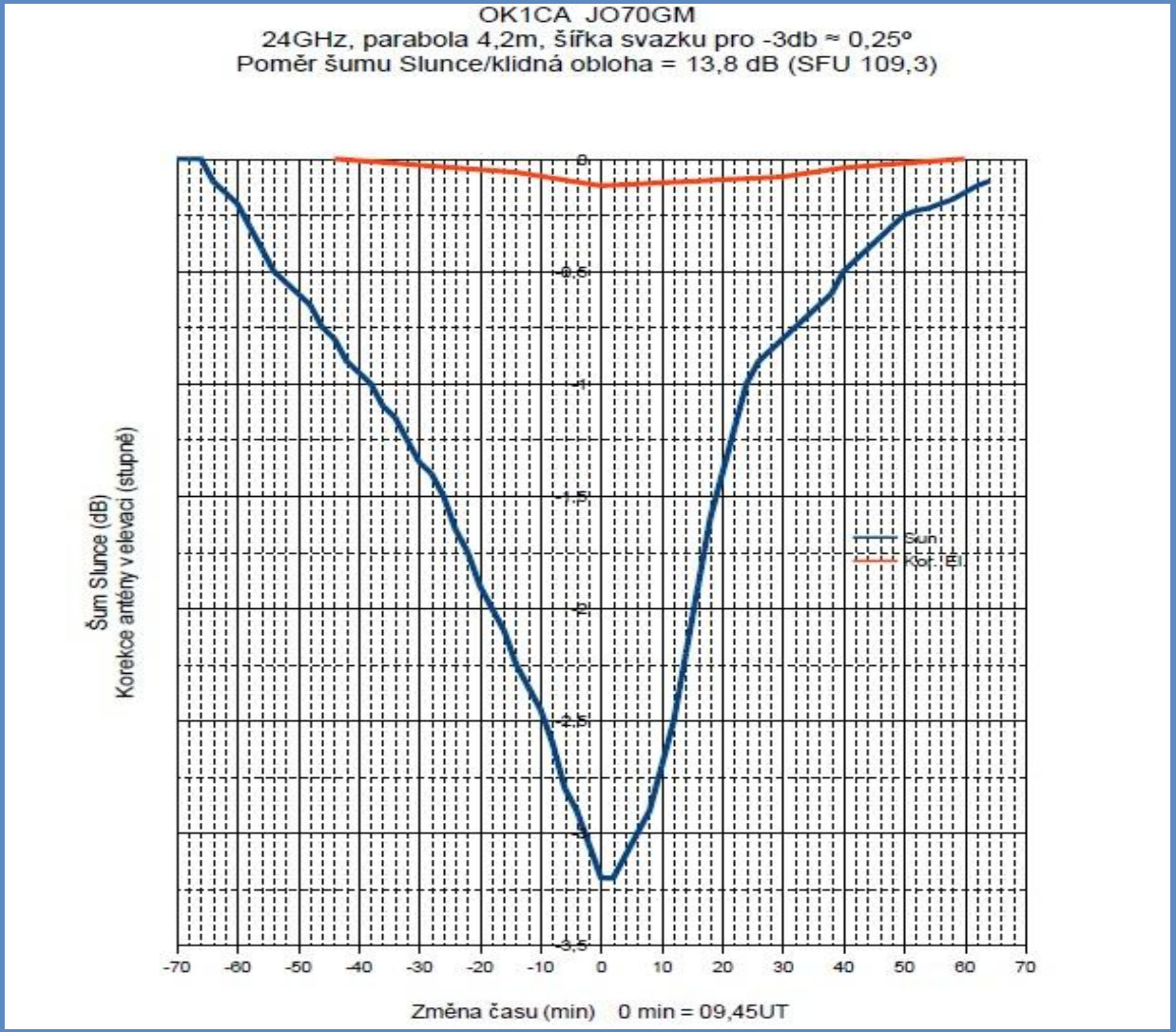
DL0SHF mutiband measurements show optical similarity at shorter wavelengths



OK1KIR 10.4GHz 0.45deg. BW



OK1CA 24GHz measurement, 0.25 deg. beamwidth.



Some conclusions

- It looked like a simple measurement
- The active sun complicated the results
- Simple models provide an explanation
- More complex models show excellent agreement
- We should take sun diameter as 1.2x at 1.3 and 2.3GHz

Thanks to all for the measurements and to DF3GJ and F1EHN for their help and guidance, and to VK3UM for modifying the EME Planner.

DL0SHF http://sat-sh.lernnetz.de/indexEE.html

F1EHN http://www.f1ehn.org/

DF3GJ Applet http://sat-sh.lernnetz.de/applets/RadioEclipse/index.html

RATAN-600 http://www.sao.ru/Doc-en/SciNews/2015/eclipse2015/