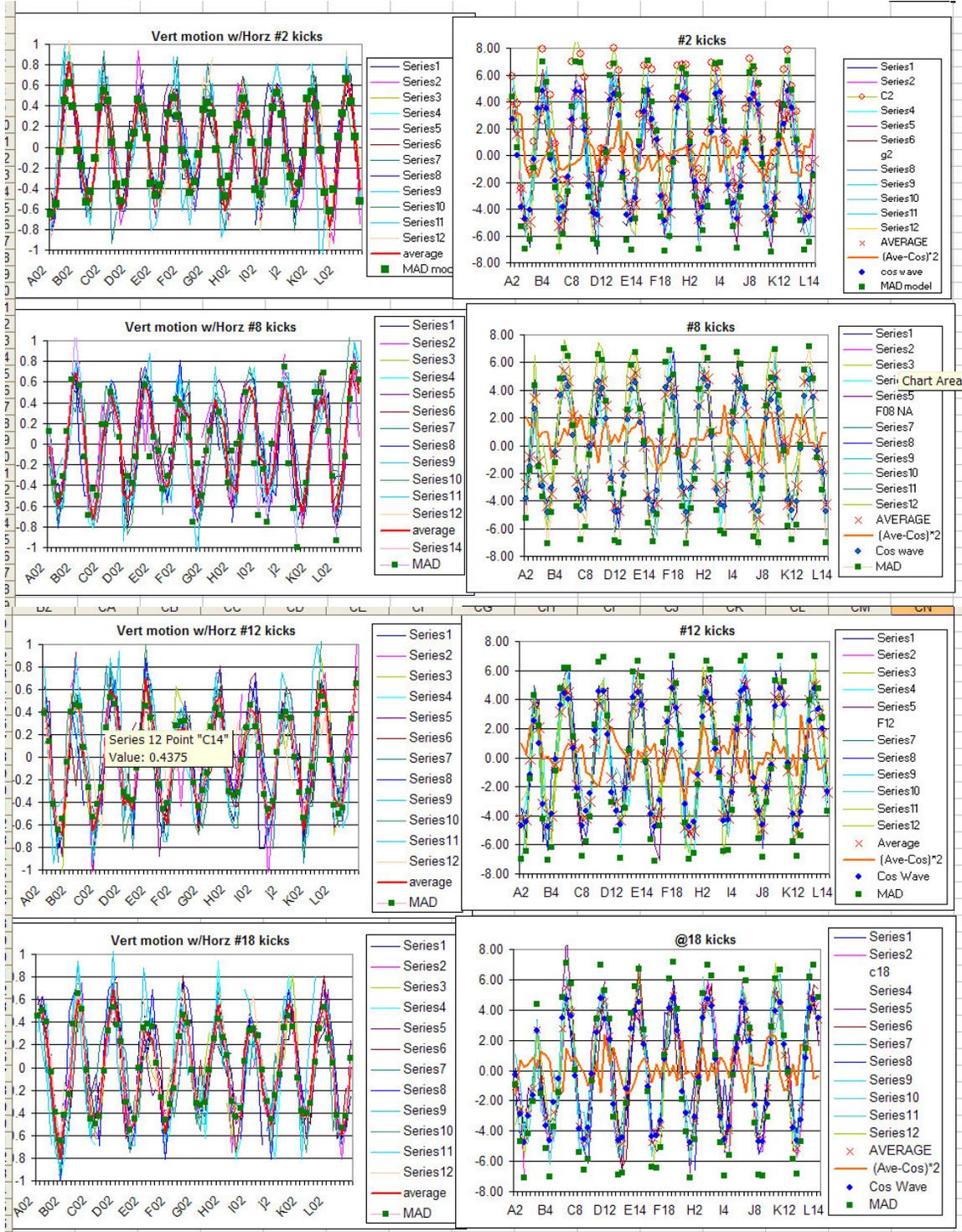


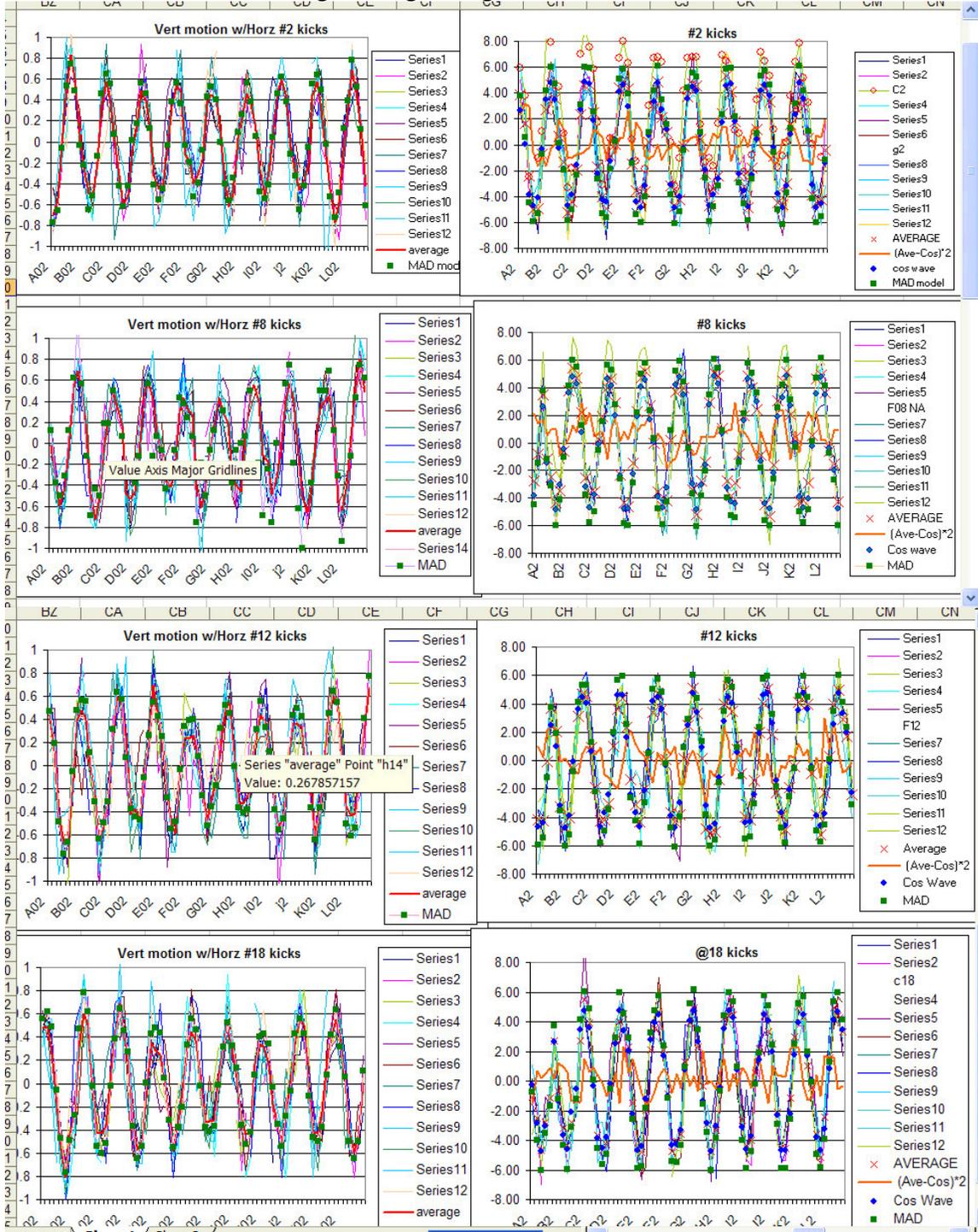
Comparing coupled data with MAD model

The startling result that the coupling in the AGS seemed to be super period symmetric, precipitated an effort to test a conjecture that coupling in the 'bare' AGS is caused by roll of the dipoles. This roll was observed on a couple of magnets some years ago and is caused by a sagging of the magnets in the center; when they are leveled, they are rolled to raise the middle leveling pad. The first half of the super period they are rolled clockwise and, as the backlegs are on the outside in the second half of the super period, they are rolled counter-clockwise.

The first model was built with all the long magnets rolled 0.6 milli-radians and the short ones $\frac{3}{4}$ of this as they should slump less. The coupling was weak so the roll was increased by a factor of ten.

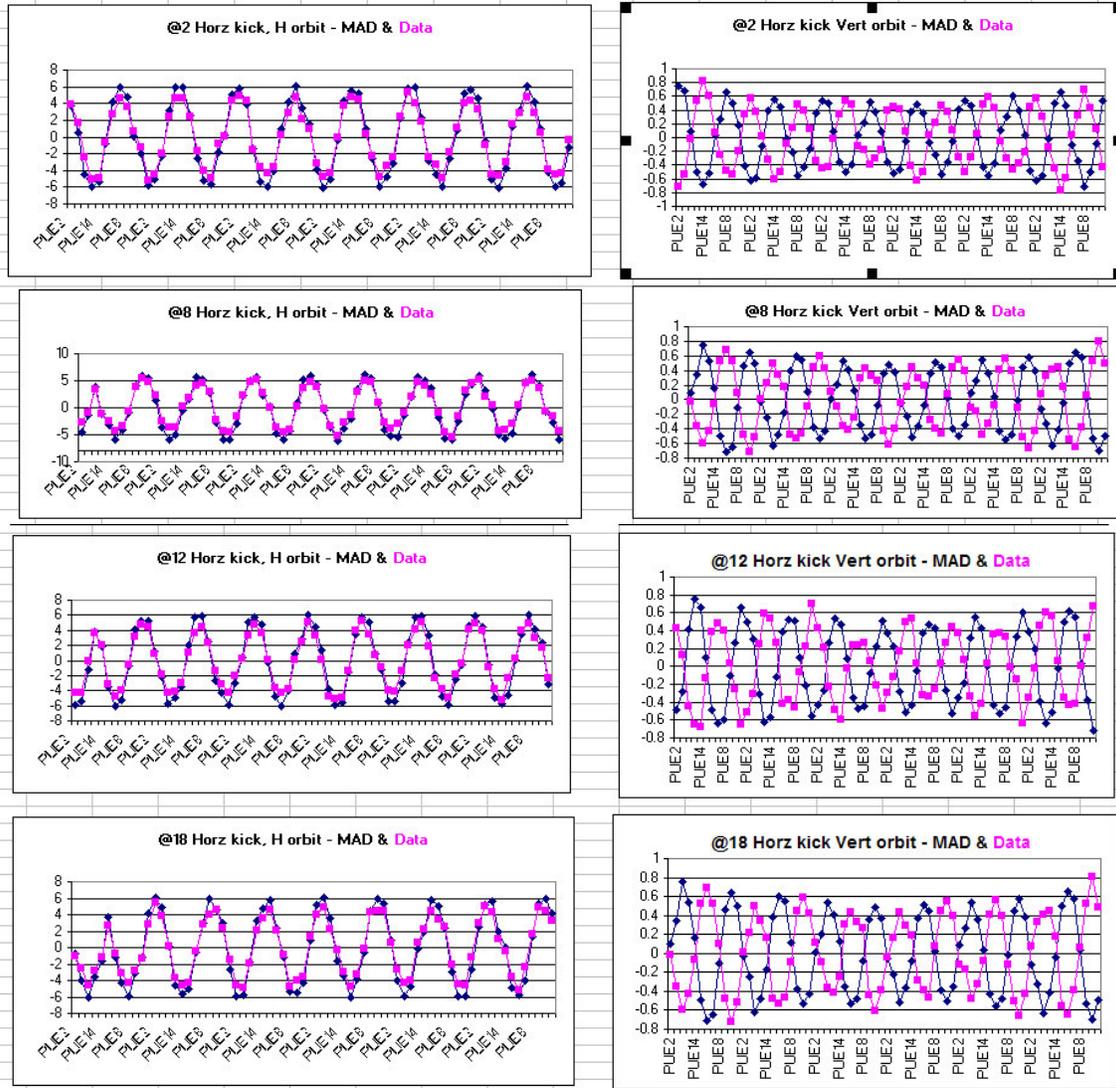


The amplitude of the kicks and the coupling was then tweaked to 0.6 m-rad kick and 5.4 & 6.9 m-rad of roll short/long. This gave a good match between model and data.



Though the match is good, the required rolls are excessive, implying the center of the magnets have sagged some 100 millsto have the 'levelin' process put this mutc roll in.

The next attempt was only roll the long magnets, speculating that sticktion between laminates on short magnets would greatly reduce the slump on them compared to the long magnets with their increased weight and longer span between jacks. The amount of roll was also reduced to 2 mr as the alteration of gradients 'to first order' cancel.



The match is remarkably good – save for the sign – with the waist on amplitude on the opposite side of the AGS from the kick and some of its details. A sign error is plausible as the AGS is rotates in a counterclockwise direction but to keep signs of X and dispersion 'rational' it is modeled in a clockwise direction.

	H	D	C	D	E	F	G	H	I	J
18										
19	#2									
20	1	0	AGSR	-5.9245	-5.9245	0		-0.1888	-0.1888	0
21	2	0	PUE2	-4.4649	-4.4649	0		0.0965	0.0965	0
22	3	0	PUE4	-1.4767	-1.4767	0		0.3405	0.3405	0
23	4	0	PUE8	3.7579	3.7579	0		0.7508	0.7508	0
24	5	0	PUE1	-1.2175	-1.2175	0		0.5343	0.5343	0
25	6	0	PUE1	-3.1341	-3.1341	0		0.1605	0.1605	0
26	7	0	PUE1	-6.0044	-6.0044	0		-0.4942	-0.4942	0
27	8	0	PUE2	-4.1255	-4.1255	0		-0.7135	-0.7135	0
28	9	0	PUE4	-0.9949	-0.9949	0		-0.6474	-0.6474	0
29	10	0	PUE8	4.127	4.127	0		-0.1106	-0.1106	0
30	11	0	PUE1	6.001	6.001	0		0.4597	0.4597	0
31	12	0	PUE1	5.5188	5.5188	0		0.6412	0.6412	0
32	13	0	PUE1	1.2714	1.2714	0		0.4971	0.4971	0
33	14	0	PUE2	-3.744	-3.744	0		-0.0256	-0.0256	0
34	15	0	PUE4	-5.803	-5.803	0		-0.2501	-0.2501	0
35	16	0	PUE8	-4.9721	-4.9721	0		-0.6237	-0.6237	0
36	17	0	PUE1	-0.5369	-0.5369	0		-0.4819	-0.4819	0
37	18	0	PUE1	1.5267	1.5267	0		-0.1754	-0.1754	0
38	19	0	PUE1	5.6411	5.6411	0		0.3373	0.3373	0
39	20	0	PUE2	5.2316	5.2316	0		0.5966	0.5966	0
40	21	0	PUE4	2.769	2.769	0		0.5527	0.5527	0
41	22	0	PUE8	-2.6159	-2.6159	0		0.1083	0.1083	0
42	23	0	PUE1	-5.8281	-5.8281	0		-0.3779	-0.3779	0
43	24	0	PUE1	-5.9606	-5.9606	0		-0.5346	-0.5346	0
44	25	0	PUE1	-2.9301	-2.9301	0		-0.4329	-0.4329	0
45	26	0	PUE2	2.2041	2.2041	0		0.0109	0.0109	0
46	27	0	PUE4	5.0084	5.0084	0		0.2056	0.2056	0
47	28	0	PUE8	5.7881	5.7881	0		0.5356	0.5356	0
48	29	0	PUE1	2.3203	2.3203	0		0.4079	0.4079	0
49	30	0	PUE1	0.2942	0.2942	0		0.131	0.131	0
50	31	0	PUE1	-4.7632	-4.7632	0		-0.3535	-0.3535	0
51	32	0	PUE2	-5.9232	-5.9232	0		-0.5277	-0.5277	0
52	33	0	PUE4	-4.2393	-4.2393	0		-0.4837	-0.4837	0
53	34	0	PUE8	0.9222	0.9222	0		-0.0786	-0.0786	0
54	35	0	PUE1	5.1647	5.1647	0		0.354	0.354	0
55	36	0	PUE1	5.902	5.902	0		0.4821	0.4821	0
56	37	0	PUE1	4.3995	4.3995	0		0.37	0.37	0
57	38	0	PUE2	-0.3978	-0.3978	0		-0.0484	-0.0484	0
58	39	0	PUE1	-3.7142	-3.7142	0		-0.2253	-0.2253	0
59	40	0	PUE8	-6.0421	-6.0421	0		-0.5115	-0.5115	0
60	41	0	PUE1	-3.8291	-3.8291	0		-0.3626	-0.3626	0
61	42	0	PUE1	-2.0191	-2.0191	0		-0.0816	-0.0816	0
62	43	0	PUE1	3.4854	3.4854	0		0.3691	0.3691	0
63	44	0	PUE2	6.066	6.066	0		0.5074	0.5074	0
64	45	0	PUE4	5.3783	5.3783	0		0.4514	0.4514	0
65	46	0	PUE8	0.9208	0.9208	0		0.0285	0.0285	0
66	47	0	PUE1	-3.9908	-3.9908	0		-0.3919	-0.3919	0
67	48	0	PUE1	-5.272	-5.272	0		-0.5017	-0.5017	0
68	49	0	PUE1	-5.4019	-5.4019	0		-0.3542	-0.3542	0
69	50	0	PUE2	-1.3784	-1.3784	0		0.0878	0.0878	0
70	51	0	PUE4	2.1376	2.1376	0		0.2673	0.2673	0
71	52	0	PUE8	5.7877	5.7877	0		0.5434	0.5434	0
72	53	0	PUE1	5.0513	5.0513	0		0.3531	0.3531	0
73	54	0	PUE1	3.6298	3.6298	0		0.0349	0.0349	0
74	55	0	PUE1	-1.8314	-1.8314	0		-0.4319	-0.4319	0
75	56	0	PUE2	-5.6255	-5.6255	0		-0.5544	-0.5544	0
76	57	0	PUE4	-5.9887	-5.9887	0		-0.4844	-0.4844	0
77	58	0	PUE8	-2.413	-2.413	0		-0.0109	-0.0109	0
78	59	0	PUE1	2.5117	2.5117	0		0.4521	0.4521	0
79	60	0	PUE1	4.2123	4.2123	0		0.5737	0.5737	0
80	61	0	PUE1	5.9672	5.9672	0		0.3878	0.3878	0
81	62	0	PUE2	3.0915	3.0915	0		-0.1207	-0.1207	0
82	63	0	PUE4	-0.3097	-0.3097	0		-0.3229	-0.3229	0
83	64	0	PUE8	-4.9746	-4.9746	0		-0.6334	-0.6334	0
84	65	0	PUE1	-5.7673	-5.7673	0		-0.413	-0.413	0
85	66	0	PUE1	-4.8509	-4.8509	0		-0.0437	-0.0437	0
86	67	0	PUE1	0.0855	0.0855	0		0.4962	0.4962	0
87	68	0	PUE2	4.7198	4.7198	0		0.6517	0.6517	0
88	69	0	PUE4	6.0935	6.0935	0		0.5746	0.5746	0
89	70	0	PUE8	4.1271	4.1271	0		0.0306	0.0306	0
90	71	0	PUE1	-0.7463	-0.7463	0		-0.5247	-0.5247	0
91	72	0	PUE1	-2.7203	-2.7203	0		-0.6928	-0.6928	0
92	73	0	PUE1	-5.9567	-5.9567	0		-0.4949	-0.4949	0
93	74	0	AGSR	-5.9245	-5.9245	0		-0.1888	-0.1888	0
94										

printNoCouplMadWnoCcomp.xls															
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	diff between coup & not coup - nothing in orbits														
2	some difference in tunes, disp etc														
3															
4	leng	th =	807.09	1278	Q1	=	8.70039	7	Q2	=	8.775413				
5	(s)	=	-0.92	7875	mm										
6		=	0.13	9.80E+02	betax(max)	x) =	23.03098	9	betay(max)	=	22.83763				
7	(tr)	=	8.45	7695	Dx(max)	) =	2.7005	3	Dy(max)	=	0.077092				
8					Dx(r.m.s)	) =	1.83653	1	Dy(r.m.s)	=	0.03203				
9					xco(max)	) =	7.31547	0	yco(max)	=	0.872786				
10					xco(r.m.s)	) =	4.30279	2	yco(r.m.s)	=	0.429904				
11															
12	length	=	807.09	1278	Qx	=	8	0.712172	Qy	=	8.76	3669			
13	(s)	=	-0.92	4645	mm	Qx	=	-20	0.952275	Qy'	=	1.69	9013		
14		=	0.13	9.80E+02	betax(max)	x) =	22	0.96396	betay(max)	x) =	22.89	5078			
15	(tr)	=	8.45	7641	Dx	(max)	=	2	0.698301	Dy(max)	x) =	0.07	6878		
16					Dx	(r.m.s)	=	1	0.834479	Dy(r.m.s)	=	0.03	1988		
17					xc	o(max)	=	7	0.283536	yco(max)	=	0.86	9581		
18					xc	o(r.m.s)	=	4	0.284915	yco(r.m.s)	=	0.42	8606		
19															
20															
21			#2	H											

Though probably stiffer I then modeled only rolling the short magnets. It turns out they need only be rolled a milli-radian to give an excellent match, with the right sign of coupling with the sign convention I **think** is correct.

