

# Chapter 29

## HRMA Off-Axis Focal Positions

*William Podgorski*

For off-axis angles the optimum focal surface of the HRMA is closer to the HRMA than that for on-axis. This displacement depends on both off-axis angle and shell. A raytrace simulation of the offset of the best off-axis focus from the best on-axis focus was made using SAO's XRCF HRMA model (model `xrcf_SAO1G+HDOS_HDOS-scat-old.02`, which does not implement the XRCF-determined decenter). This data is presented in Table 29.1.

Table 29.1: Offset from on-axis focus (mm), + towards HRMA

Angle [°]	System	Shell 1	Shell 3	Shell 4	Shell 6
0	0.0000	0.0000	0.0000	0.0000	0.0000
5	1.4384	1.0905	1.5921	2.0559	3.6470
10	5.6211	4.0979	6.2833	8.0436	14.0232
15	12.1095	9.0284	13.6771	17.4109	30.3917
20	20.6847	15.5253	23.6882	30.2079	54.1046
25	31.1065	23.6816	36.0489	46.4008	85.0136
30	44.7368	34.0254	51.7845	66.5531	122.6774

A series of tests was run on 1/30/97 and 1/31/97 to measure the best focus using the HSI and the quad shutter focus procedure. The starting point (in PrimeX) for each measurement was the on-axis best focus, as determined by the quad shutter focus procedure using the FPC. The FPC facility optical axis (FOA) in place during this test series is listed in Table 29.2.

Since Table 29.2 is determined for the HXDS FPC's, the PrimeX offset between the HSI and `fpc_x2` ( $20\ \mu\text{m}$  aperture) must be added to the PrimeX values in the table to obtain the initial

Table 29.2: HXDS FOA Values During Off-Axis Tests

IRIG	Shell	Prime X	Prime Y	PCAZ
030102900000	all	-32679	-307153	10543
030102901000	1	-32912	-307153	10543
030102901000	3	-32561	-307153	10543
030102902000	4	-32292	-307153	10543
030102903000	6	-32664	-307153	10543

PrimeX values for the HSI. At the time of these tests the PrimeX value carried for the  $20\ \mu\text{m}$  aperture for `fpc_x2` was  $-43500\ \mu\text{m}$ . The PrimeX value carried for the HSI was  $-46475\ \mu\text{m}$ , so  $2975\ \mu\text{m}$  must be subtracted from the PrimeX values in Table 29.2 to yield the on-axis best focus values for the HSI. These values are listed in Table 29.3.

Table 29.3: HSI PrimeX Values for Best On-Axis Focus

Shell	PrimeX <sub>00</sub> [mm]
HRMA	-35.6540
1	-35.8870
3	-35.5360
4	-35.2670
6	-35.6390

The measured data from the 20 tests (some with 2 iterations) are listed in Table 29.4. The data given are:

TRW ID	Test ID
RunID	One of 4 RunID's from the Quad shutter test
$\theta$	Off-axis angle
$\phi$	Clocking of the off-axis angle relative to XRCF-Y (see Figure B.1).
Shell	HRMA shell number
PrimeX	Initial PrimeX stage position during test
$\Delta X$	Change in PrimeX for best focus from HSI measurement and shutter focus calculation
$\delta F_{\text{meas}}$	$\text{PrimeX}/1000 - \Delta X/1000 - \text{PrimeX}_{00}$
$\delta F_{\text{sim}}$	Simulated shift in focal position from the on-axis focal position
$\Delta F$	$\delta F_{\text{meas}} - \delta F_{\text{sim}}$

$\delta F_{\text{meas}}$  and  $\delta F_{\text{sim}}$  are plotted in Figure 29.1.

Table 29.4: Off-Axis Focus Test Data

TRW ID	RunID	$\theta$ [ $^\circ$ ]	$\phi$ [ $^\circ$ ]	Shell	PrimeX [ $\mu\text{m}$ ]	$\Delta X$ [ $\mu\text{m}$ ]	$\delta F_{\text{meas}}$ [mm]	$\delta F_{\text{sim}}$ [mm]	$\Delta F$ [mm]
E-IXH-SF-15.001	110553	5	135	All	-34215.08	-613	2.0519	1.4384	0.6135
E-IXH-SF-15.001	110560	5	135	All	-33603.14	49	2.0019	1.4384	0.5635
E-IXH-SF-15.002	110561	5	135	1	-34860.02	-450	1.4770	1.0905	0.3865
E-IXH-SF-15.002	110568	5	135	1	-34408.06	-9	1.4879	1.0905	0.3974
E-IXH-SF-15.003	110569	5	135	3	-33942.11	-412	2.0059	1.5921	0.4138
E-IXH-SF-15.003	110577	5	135	3	-33528.65	10	1.9973	1.5921	0.4052
E-IXH-SF-15.004	110578	5	135	4	-33209.18	-384	2.4418	2.0559	0.3859
E-IXH-SF-15.004	110585	5	135	4	-32823.22	-4	2.4478	2.0559	0.3919
E-IXH-SF-15.005	110586	5	135	6	-31990.30	-407	4.0557	3.6470	0.4087
E-IXH-SF-15.005	110593	5	135	6	-31579.34	788	3.2717	3.6470	-0.3753
E-IXH-SF-15.006	110595	10	0	All	-30030.50	-35	5.6585	5.6211	0.0374
E-IXH-SF-15.006	110603	10	0	All	-29995.50	-7	5.6655	5.6211	0.0444
E-IXH-SF-15.007	110607	10	0	1	-31786.82	186	3.9142	4.0979	-0.1837
E-IXH-SF-15.007	110611	10	0	1	-31972.80	50	3.8642	4.0979	-0.2337
E-IXH-SF-15.008	110618	10	0	3	-29252.07	487	5.7969	6.2833	-0.4864
E-IXH-SF-15.008	110619	10	0	3	-29739.53	44	5.7525	6.2833	-0.5308
E-IXH-SF-15.009	110623	10	0	4	-27221.28	726	7.3197	8.0436	-0.7239
E-IXH-SF-15.009	110630	10	0	4	-27949.21	-59	7.3768	8.0436	-0.6668
E-IXH-SF-15.010	110631	10	0	6	-21614.34	1160	12.8647	14.0232	-1.1585
E-IXH-SF-15.010	110638	10	0	6	-22775.72	-195	13.0583	14.0232	-0.9649
E-IXH-SF-15.011	110640	15	135	All	-23542.15	315	11.7968	12.1095	-0.3127
E-IXH-SF-15.011	110647	15	135	All	-23858.61	38	11.7574	12.1095	-0.3521
E-IXH-SF-15.012	110648	15	135	1	-26923.31	845	8.1187	9.0284	-0.9097
E-IXH-SF-15.012	110655	15	135	1	-27770.22	-34	8.1508	9.0284	-0.8776
E-IXH-SF-15.013	110656	15	135	3	-21857.31	898	12.7807	13.6771	-0.8964
E-IXH-SF-15.014	110660	15	135	4	-17854.21	791	16.6218	17.4109	-0.7891
E-IXH-SF-15.015	110664	15	135	6	-5245.48	-329	30.7225	30.3917	0.3308
E-IXH-SF-15.016	110670	25	135	All	-4546.05	-1058	32.1660	31.1065	1.0595
E-IXH-SF-15.016	110677	25	135	All	-3487.15	-32	32.1988	31.1065	1.0923
E-IXH-SF-15.017	110678	25	135	1	-12202.78	-1143	24.8272	23.6816	1.1456
E-IXH-SF-15.018	110682	25	135	3	514.45	578	35.4725	36.0489	-0.5765
E-IXH-SF-15.019	110688	25	135	4	11135.89	1060	45.3429	46.4008	-1.0579
E-IXH-SF-15.020	110692	25	135	6	49377.06	587	84.4291	85.0136	-0.5845

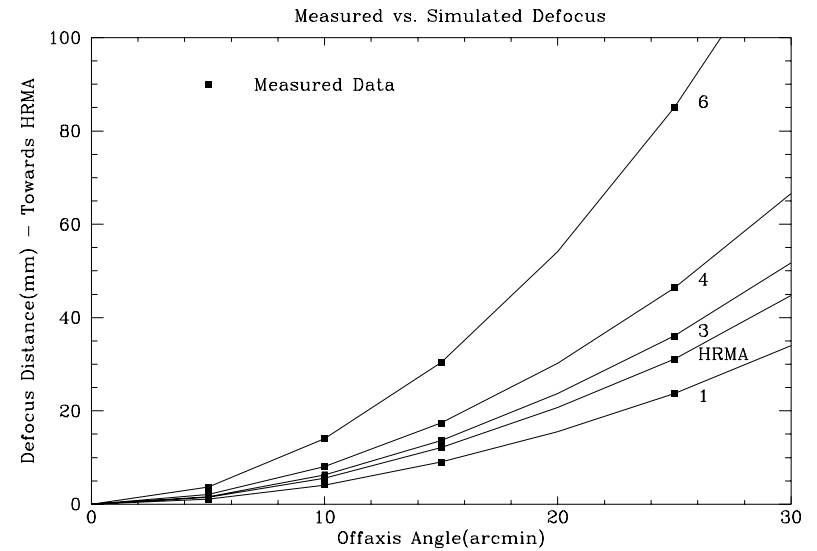


Figure 29.1: Measured vs. Simulated Off-Axis Focus Data