

RxPD and TxPD Calibration Trends

| GENERATED FOR LHO_EndY

Report Generated on December 17, 2019

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1 About

This document contains the Pcal PD (TxPD and RxPD) Calibration trends. The first six sections contain the six ratios measured at the end-station labeled as m1, m2m6. The section that follows contains the relevant information calculated from these measurements which include Optical Efficiency, Power Imbalance, TX/WS and RX/WS ratio.

Understanding Each Section

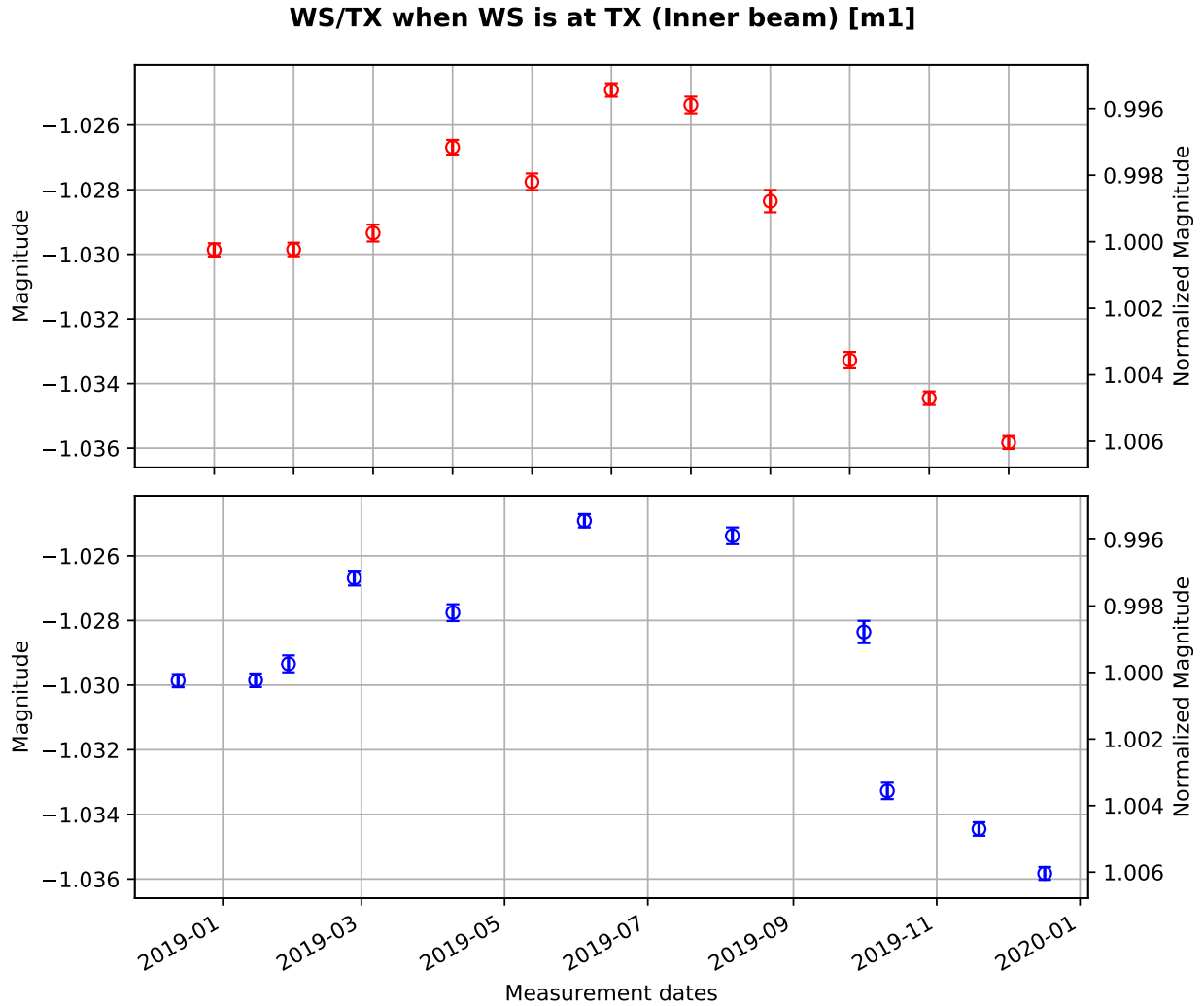
Each section contains a list of measurements with Magnitude, Standard Error (Std Err) and Relative Error (Rel Err) for each measurement. The list is followed by two plot figures with Magnitude on the first plot and the the Normalized Magnitude on the second. Each section ends with a summary that contains the weighted mean of all the measurement along with their Standard Deviation (Std Dev), Std Err and Rel Err where each of these terms are defined as:

```
Mean = sum(x(i)*w(i))/sum(w(i))  
Std Dev = sqrt(sum(w(i)*(x(i)-x_mean)^2)/((n-1)/n*sum(w(i))))  
Std Err = Std Dev/sqrt(n)  
Rel Err = Std Err/Mean
```

2 WS/TX Ratio when WS is at TX (Inner Beam)

List of Measurements

Date	m1 $\pm$ SE_m1	Normalized
D20181213	-1.029863 $\pm$ 0.000204	(1 $\pm$ 0.000198)
D20190115	-1.029851 $\pm$ 0.000210	(1 $\pm$ 0.000204)
D20190129	-1.029342 $\pm$ 0.000262	(1 $\pm$ 0.000254)
D20190226	-1.026687 $\pm$ 0.000228	(1 $\pm$ 0.000223)
D20190409	-1.027757 $\pm$ 0.000260	(1 $\pm$ 0.000253)
D20190604	-1.024913 $\pm$ 0.000208	(1 $\pm$ 0.000203)
D20190806	-1.025378 $\pm$ 0.000258	(1 $\pm$ 0.000252)
D20191001	-1.028355 $\pm$ 0.000346	(1 $\pm$ 0.000336)
D20191011	-1.033275 $\pm$ 0.000253	(1 $\pm$ 0.000245)
D20191119	-1.034452 $\pm$ 0.000209	(1 $\pm$ 0.000202)
D20191217	-1.035826 $\pm$ 0.000200	(1 $\pm$ 0.000193)

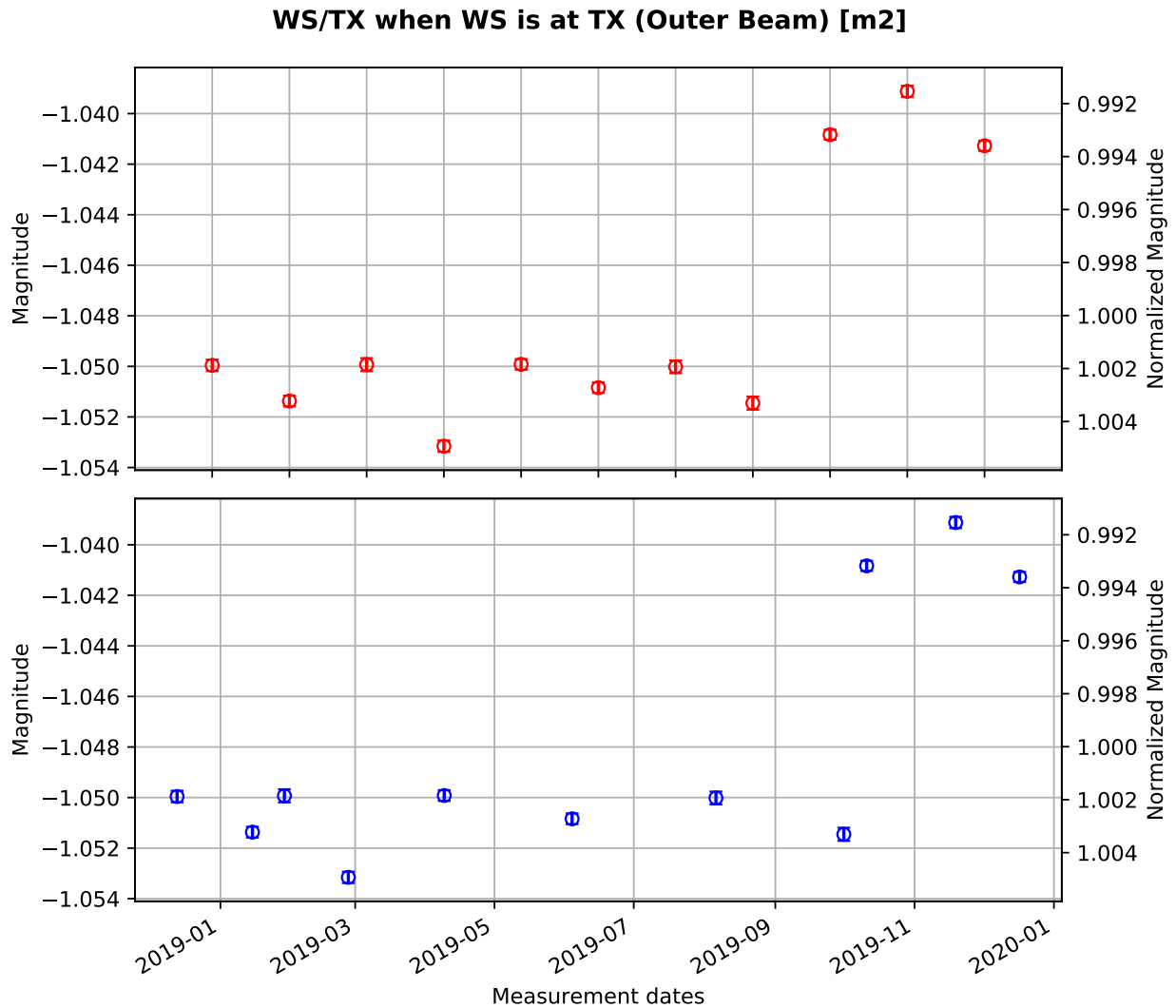


Summary of WS/TX when WS is at TX (Inner beam) [m1]	
Mean value:	-1.029609
Standard deviation:	0.003595
Standard error:	0.001135
Relative Standard error:	0.001103

3 WS/TX Ratio when WS is at TX (Outer Beam)

List of Measurements

Date	m2 $\pm$ SE_m2	Normalized
D20181213	-1.049960 $\pm$ 0.000226	(1 $\pm$ 0.000215)
D20190115	-1.051369 $\pm$ 0.000212	(1 $\pm$ 0.000202)
D20190129	-1.049931 $\pm$ 0.000258	(1 $\pm$ 0.000245)
D20190226	-1.053157 $\pm$ 0.000223	(1 $\pm$ 0.000212)
D20190409	-1.049920 $\pm$ 0.000210	(1 $\pm$ 0.000200)
D20190604	-1.050841 $\pm$ 0.000210	(1 $\pm$ 0.000200)
D20190806	-1.050017 $\pm$ 0.000251	(1 $\pm$ 0.000239)
D20191001	-1.051453 $\pm$ 0.000259	(1 $\pm$ 0.000246)
D20191011	-1.040834 $\pm$ 0.000198	(1 $\pm$ 0.000190)
D20191119	-1.039120 $\pm$ 0.000222	(1 $\pm$ 0.000214)
D20191217	-1.041274 $\pm$ 0.000198	(1 $\pm$ 0.000190)

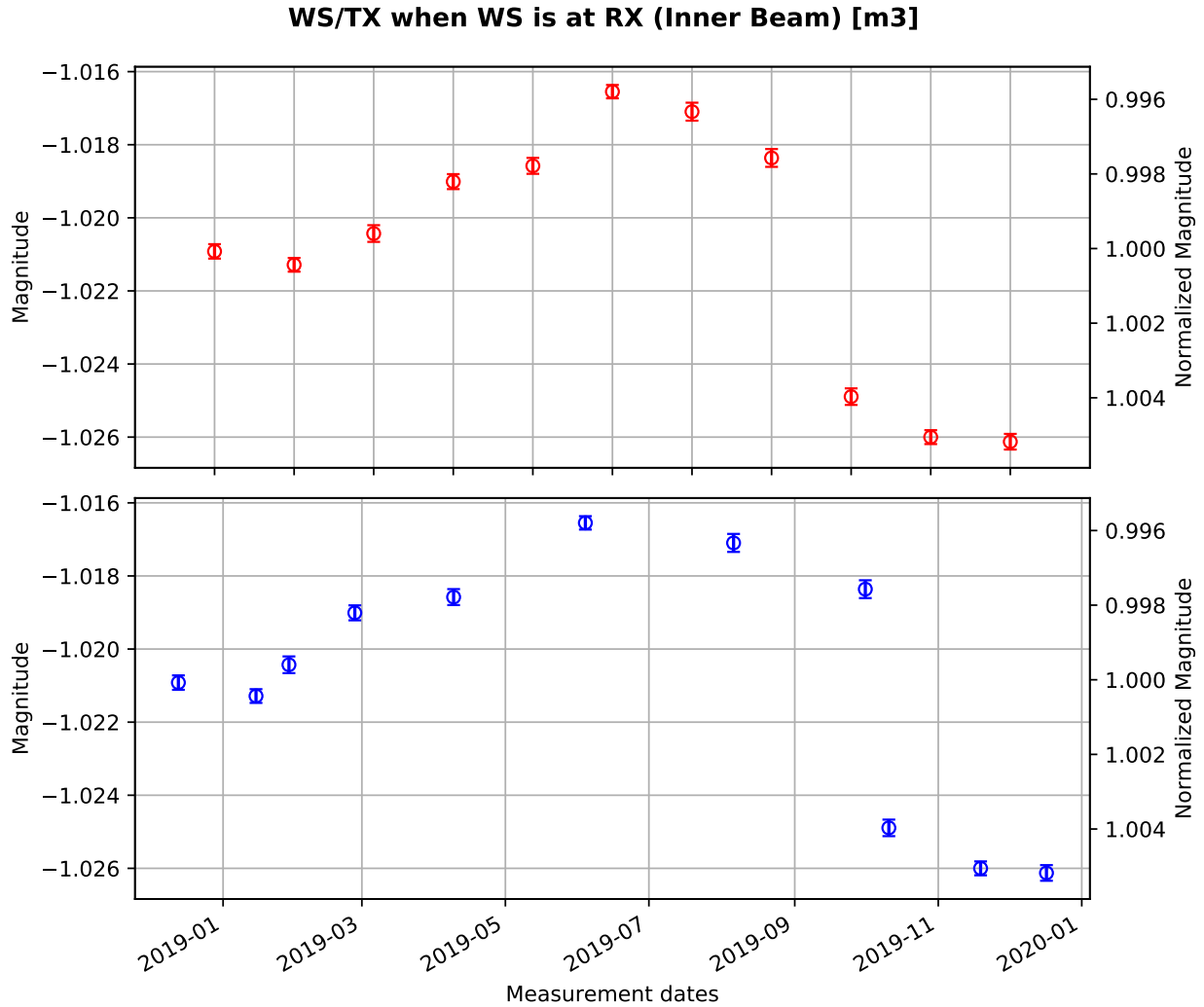


Summary of WS/TX when WS is at TX (Outer Beam) [m2]	
Mean value:	-1.047989
Standard deviation:	0.004987
Standard error:	0.001575
Relative Standard error:	0.001503

4 WS/TX Ratio when WS is at RX (Inner Beam)

List of Measurements

Date	m3 $\pm$ SE_m3	Normalized
D20181213	-1.020918 $\pm$ 0.000198	(1 $\pm$ 0.000194)
D20190115	-1.021286 $\pm$ 0.000188	(1 $\pm$ 0.000184)
D20190129	-1.020430 $\pm$ 0.000228	(1 $\pm$ 0.000224)
D20190226	-1.019010 $\pm$ 0.000205	(1 $\pm$ 0.000201)
D20190409	-1.018578 $\pm$ 0.000218	(1 $\pm$ 0.000214)
D20190604	-1.016548 $\pm$ 0.000183	(1 $\pm$ 0.000180)
D20190806	-1.017096 $\pm$ 0.000246	(1 $\pm$ 0.000242)
D20191001	-1.018362 $\pm$ 0.000244	(1 $\pm$ 0.000239)
D20191011	-1.024893 $\pm$ 0.000226	(1 $\pm$ 0.000221)
D20191119	-1.026000 $\pm$ 0.000190	(1 $\pm$ 0.000185)
D20191217	-1.026126 $\pm$ 0.000214	(1 $\pm$ 0.000209)

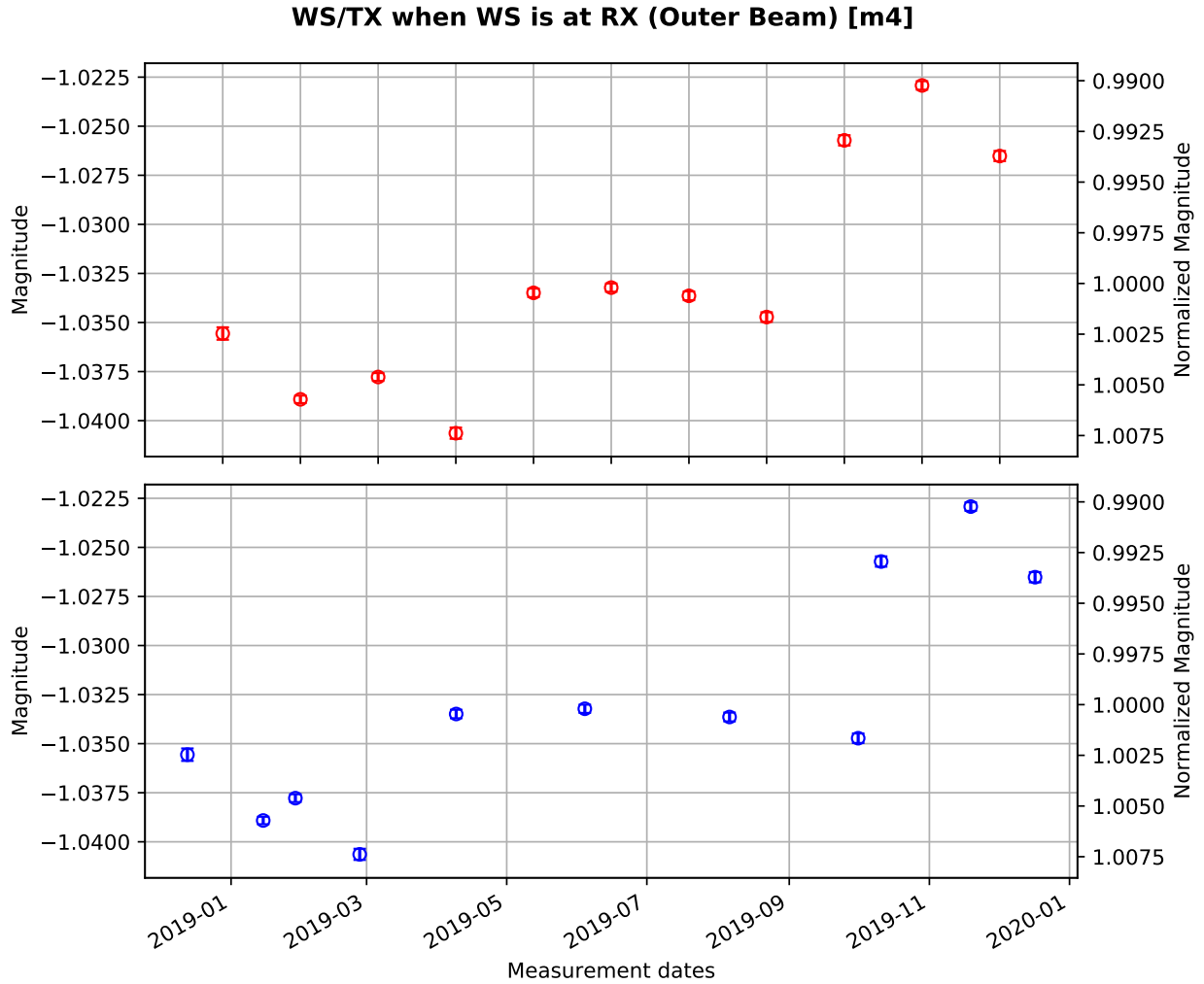


Summary of WS/TX when WS is at RX (Inner Beam) [m3]	
Mean value:	-1.020841
Standard deviation:	0.003441
Standard error:	0.001087
Relative Standard error:	0.001065

5 WS/TX Ratio when WS is at RX (Inner Beam)

List of Measurements

Date	m4 $\pm$ SE_m4	Normalized
D20181213	-1.035561 $\pm$ 0.000318	(1 $\pm$ 0.000307)
D20190115	-1.038914 $\pm$ 0.000191	(1 $\pm$ 0.000184)
D20190129	-1.037777 $\pm$ 0.000199	(1 $\pm$ 0.000192)
D20190226	-1.040640 $\pm$ 0.000285	(1 $\pm$ 0.000274)
D20190409	-1.033489 $\pm$ 0.000217	(1 $\pm$ 0.000210)
D20190604	-1.033223 $\pm$ 0.000211	(1 $\pm$ 0.000204)
D20190806	-1.033641 $\pm$ 0.000224	(1 $\pm$ 0.000216)
D20191001	-1.034722 $\pm$ 0.000242	(1 $\pm$ 0.000234)
D20191011	-1.025720 $\pm$ 0.000263	(1 $\pm$ 0.000256)
D20191119	-1.022923 $\pm$ 0.000216	(1 $\pm$ 0.000212)
D20191217	-1.026520 $\pm$ 0.000261	(1 $\pm$ 0.000254)

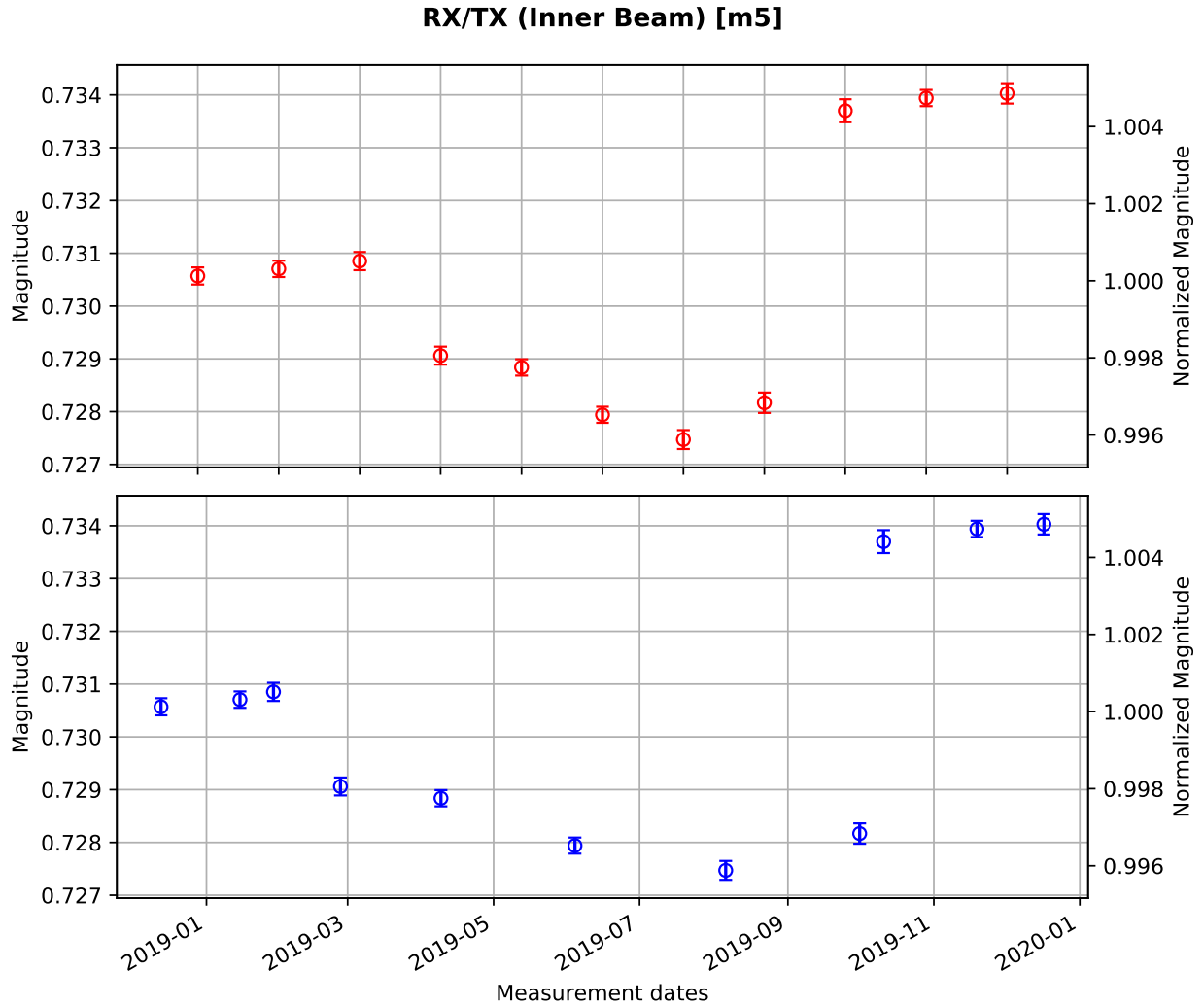


Summary of WS/TX when WS is at RX (Outer Beam) [m4]		
Mean value:	-1.033012	
Standard deviation:	0.005683	
Standard error:	0.001795	
Relative Standard error:	0.001738	

6 RX/TX Ratio (Inner Beam)

List of Measurements

Date	m5 $\pm$ SE_m5	Normalized
D20181213	0.730570 $\pm$ 0.000162	(1 $\pm$ 0.000222)
D20190115	0.730706 $\pm$ 0.000155	(1 $\pm$ 0.000212)
D20190129	0.730852 $\pm$ 0.000172	(1 $\pm$ 0.000235)
D20190226	0.729060 $\pm$ 0.000170	(1 $\pm$ 0.000233)
D20190409	0.728837 $\pm$ 0.000154	(1 $\pm$ 0.000212)
D20190604	0.727940 $\pm$ 0.000152	(1 $\pm$ 0.000209)
D20190806	0.727470 $\pm$ 0.000180	(1 $\pm$ 0.000247)
D20191001	0.728168 $\pm$ 0.000193	(1 $\pm$ 0.000265)
D20191011	0.733700 $\pm$ 0.000217	(1 $\pm$ 0.000296)
D20191119	0.733941 $\pm$ 0.000154	(1 $\pm$ 0.000210)
D20191217	0.734029 $\pm$ 0.000193	(1 $\pm$ 0.000263)

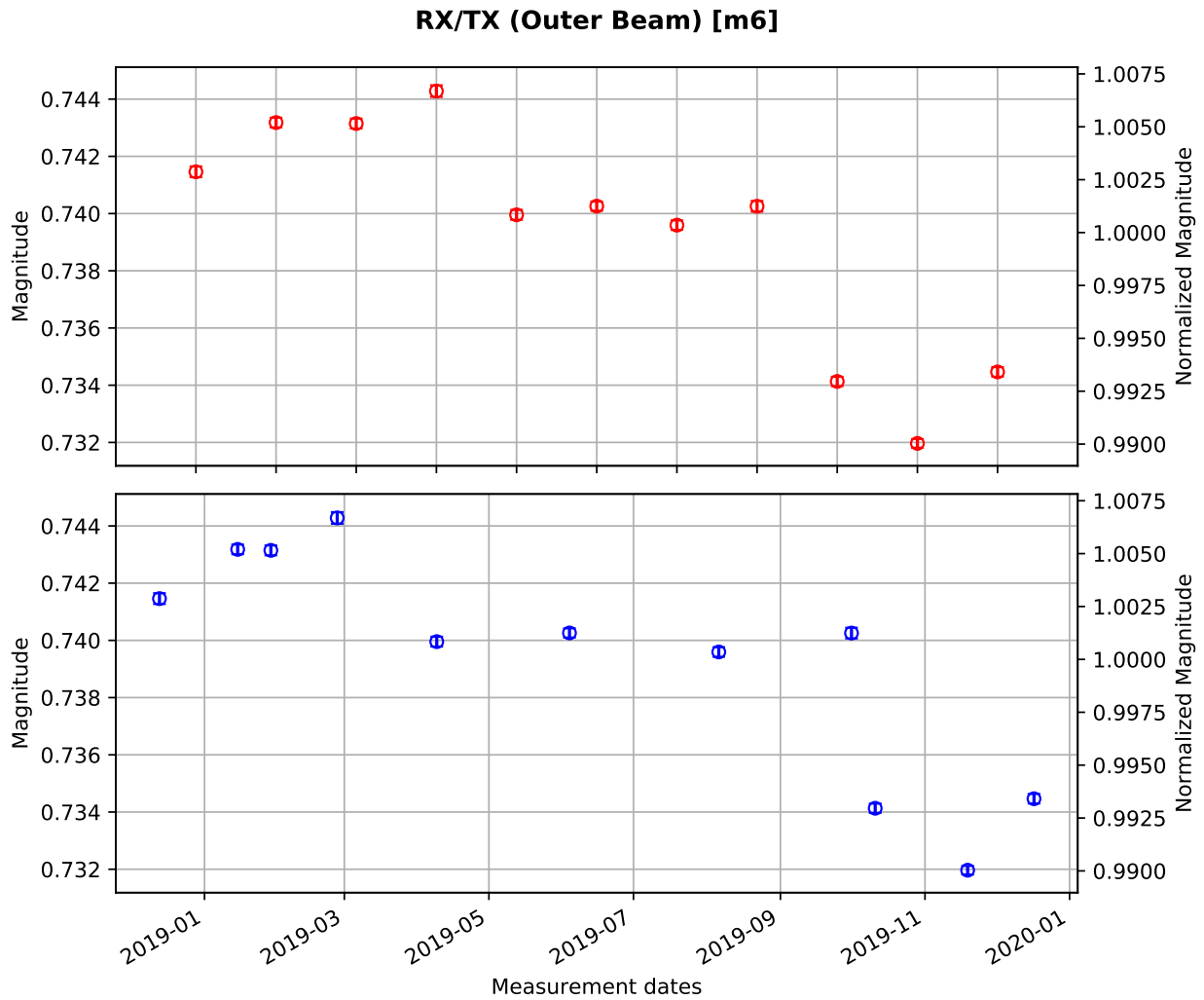


Summary of RX/TX (Inner Beam) [m5]		
Mean value:	0.730480	
Standard deviation:	0.002464	
Standard error:	0.000778	
Relative Standard error:	0.001065	

7 RX/TX Ratio (Outer Beam)

List of Measurements

Date	m6 $\pm$ SE_m6	Normalized
D20181213	0.741459 $\pm$ 0.000189	(1 $\pm$ 0.000255)
D20190115	0.743180 $\pm$ 0.000170	(1 $\pm$ 0.000228)
D20190129	0.743147 $\pm$ 0.000173	(1 $\pm$ 0.000233)
D20190226	0.744280 $\pm$ 0.000203	(1 $\pm$ 0.000273)
D20190409	0.739956 $\pm$ 0.000172	(1 $\pm$ 0.000232)
D20190604	0.740259 $\pm$ 0.000161	(1 $\pm$ 0.000217)
D20190806	0.739595 $\pm$ 0.000165	(1 $\pm$ 0.000223)
D20191001	0.740255 $\pm$ 0.000187	(1 $\pm$ 0.000252)
D20191011	0.734131 $\pm$ 0.000164	(1 $\pm$ 0.000223)
D20191119	0.731966 $\pm$ 0.000150	(1 $\pm$ 0.000205)
D20191217	0.734465 $\pm$ 0.000165	(1 $\pm$ 0.000225)

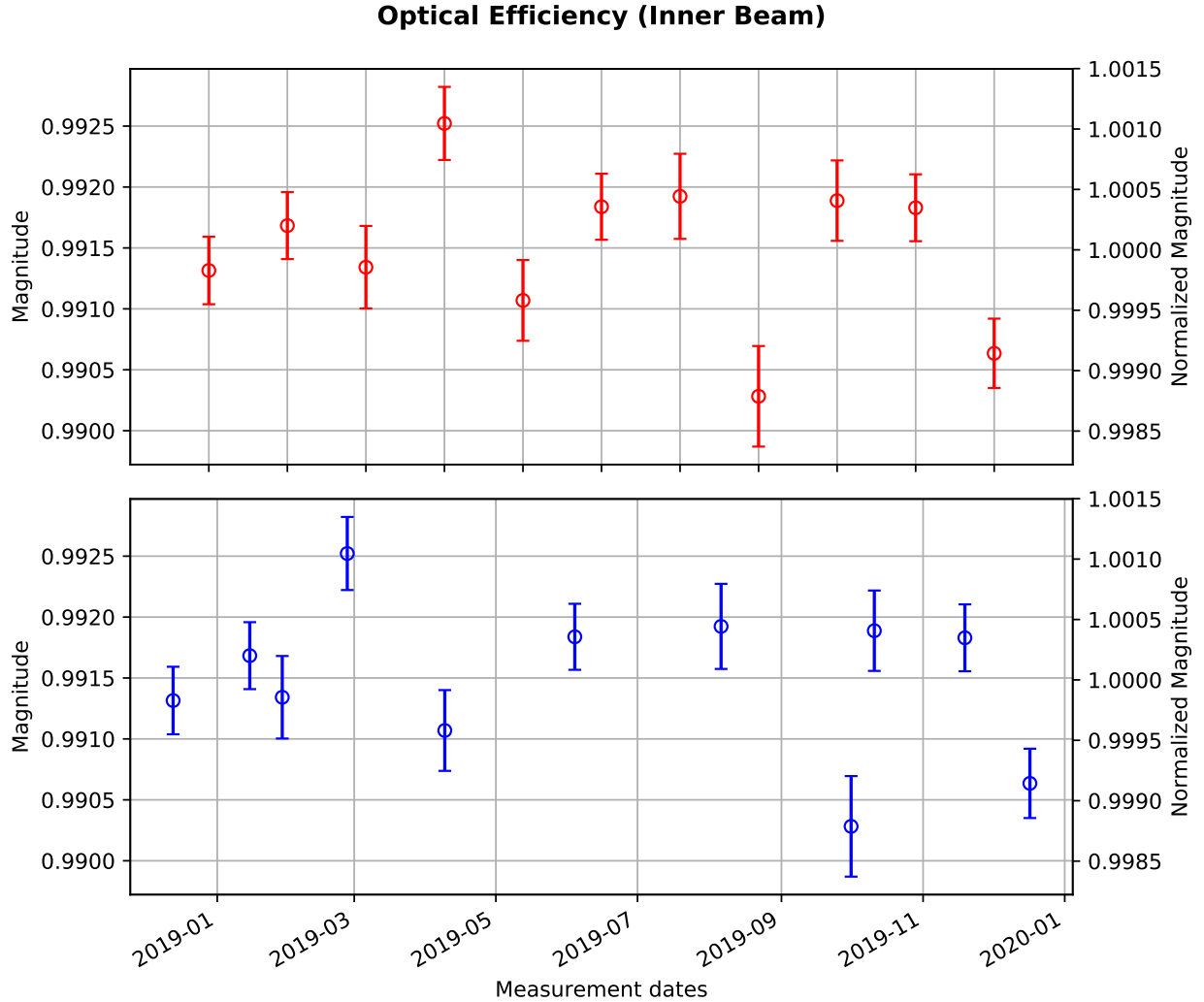


Summary of RX/TX (Outer Beam) [m6]			
	Mean value:	0.739336	
	Standard deviation:	0.004069	
	Standard error:	0.001285	
	Relative Standard error:	0.001738	

8 Optical Efficiency of Inner Beam

List of Measurements

Date	$e_i \pm SE_{e_i}$	Normalized
D20181213	0.991315 ± 0.000277	(1 ± 0.000280)
D20190115	0.991683 ± 0.000275	(1 ± 0.000277)
D20190129	0.991342 ± 0.000339	(1 ± 0.000342)
D20190226	0.992522 ± 0.000300	(1 ± 0.000302)
D20190409	0.991069 ± 0.000331	(1 ± 0.000334)
D20190604	0.991838 ± 0.000271	(1 ± 0.000273)
D20190806	0.991923 ± 0.000349	(1 ± 0.000352)
D20191001	0.990282 ± 0.000413	(1 ± 0.000417)
D20191011	0.991888 ± 0.000330	(1 ± 0.000333)
D20191119	0.991830 ± 0.000274	(1 ± 0.000277)
D20191217	0.990635 ± 0.000285	(1 ± 0.000287)

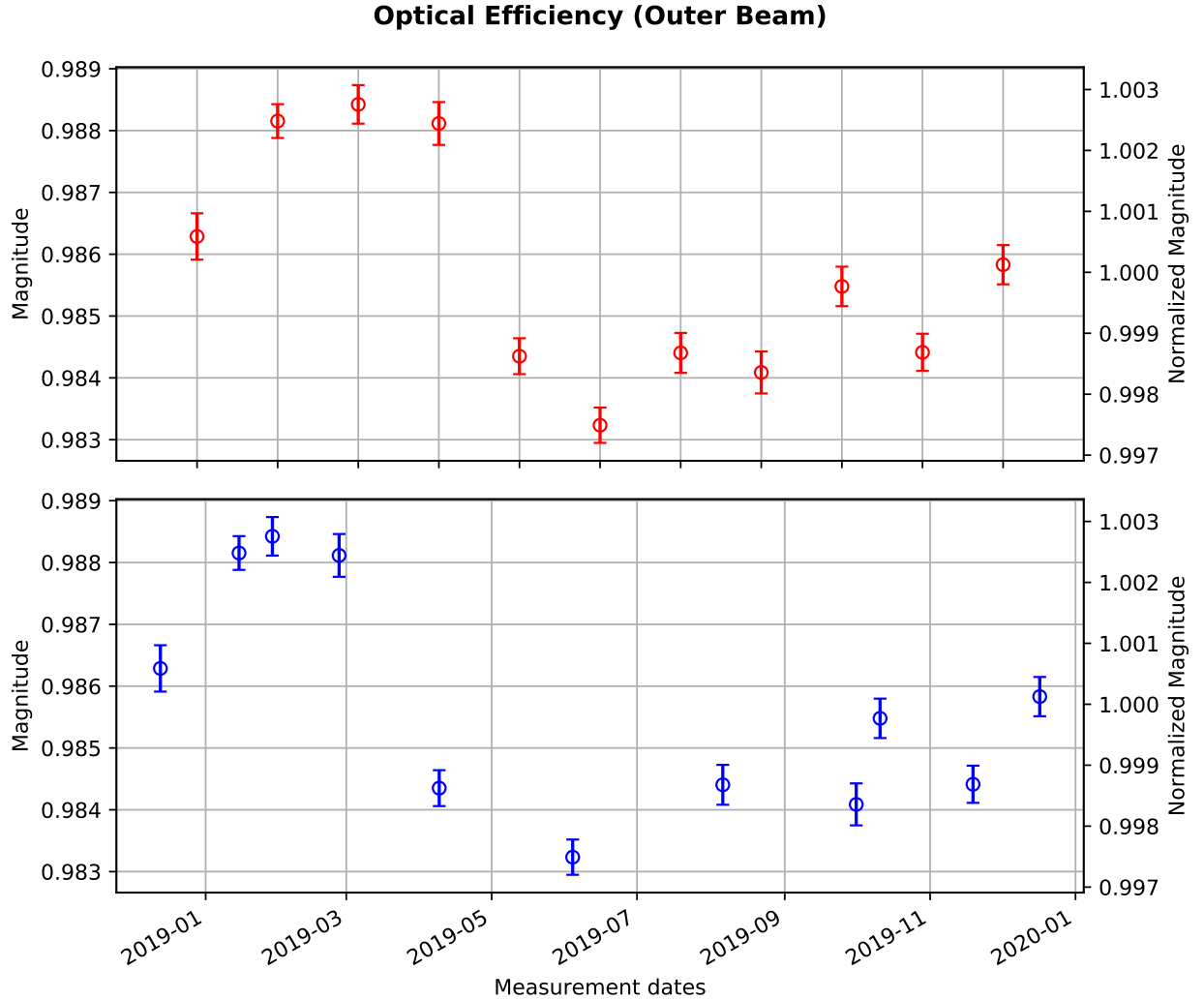


Summary of Optical Efficiency (Inner Beam)		
Mean value:	0.991484	
Standard deviation:	0.000641	
Standard error:	0.000202	
Relative Standard error:	0.000204	

9 Optical Efficiency of Outer Beam

List of Measurements

Date	$e_o \pm SE_{e_o}$	Normalized
D20181213	0.986287 ± 0.000375	(1 ± 0.000380)
D20190115	0.988154 ± 0.000273	(1 ± 0.000277)
D20190129	0.988424 ± 0.000312	(1 ± 0.000315)
D20190226	0.988115 ± 0.000346	(1 ± 0.000350)
D20190409	0.984351 ± 0.000290	(1 ± 0.000295)
D20190604	0.983234 ± 0.000286	(1 ± 0.000290)
D20190806	0.984404 ± 0.000323	(1 ± 0.000328)
D20191001	0.984088 ± 0.000340	(1 ± 0.000345)
D20191011	0.985479 ± 0.000319	(1 ± 0.000324)
D20191119	0.984413 ± 0.000301	(1 ± 0.000305)
D20191217	0.985831 ± 0.000317	(1 ± 0.000322)

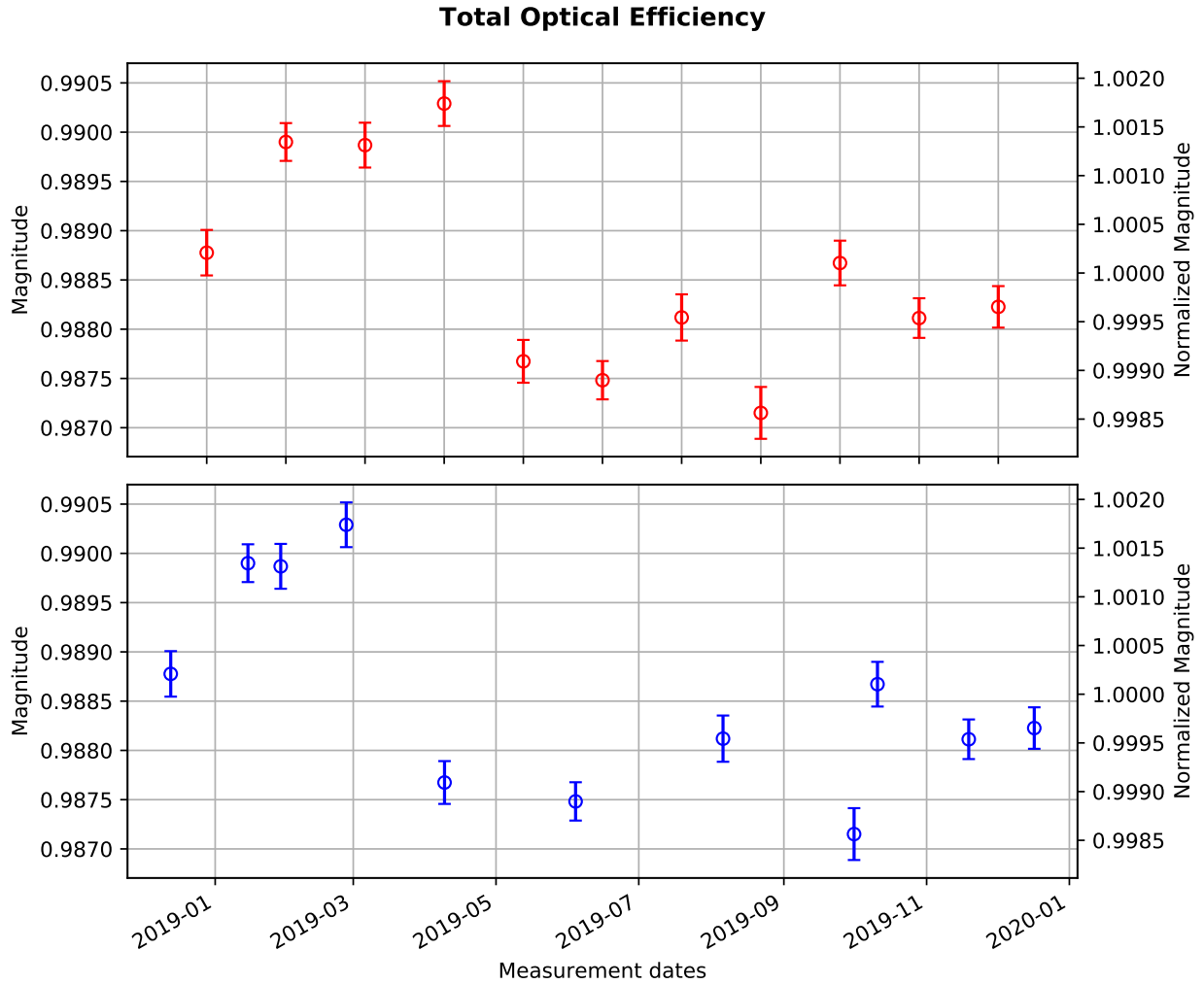


Summary of Optical Efficiency (Outer Beam)		
Mean value:	0.985707	
Standard deviation:	0.001831	
Standard error:	0.000578	
Relative Standard error:	0.000587	

10 Total Optical Efficiency

List of Measurements

Date	$e \pm SE_e$	Normalized
D20181213	0.988777 ± 0.000231	(1 ± 0.000234)
D20190115	0.989900 ± 0.000192	(1 ± 0.000194)
D20190129	0.989868 ± 0.000228	(1 ± 0.000230)
D20190226	0.990290 ± 0.000227	(1 ± 0.000229)
D20190409	0.987674 ± 0.000217	(1 ± 0.000220)
D20190604	0.987482 ± 0.000194	(1 ± 0.000197)
D20190806	0.988119 ± 0.000235	(1 ± 0.000238)
D20191001	0.987151 ± 0.000263	(1 ± 0.000267)
D20191011	0.988672 ± 0.000227	(1 ± 0.000229)
D20191119	0.988113 ± 0.000201	(1 ± 0.000204)
D20191217	0.988227 ± 0.000211	(1 ± 0.000213)



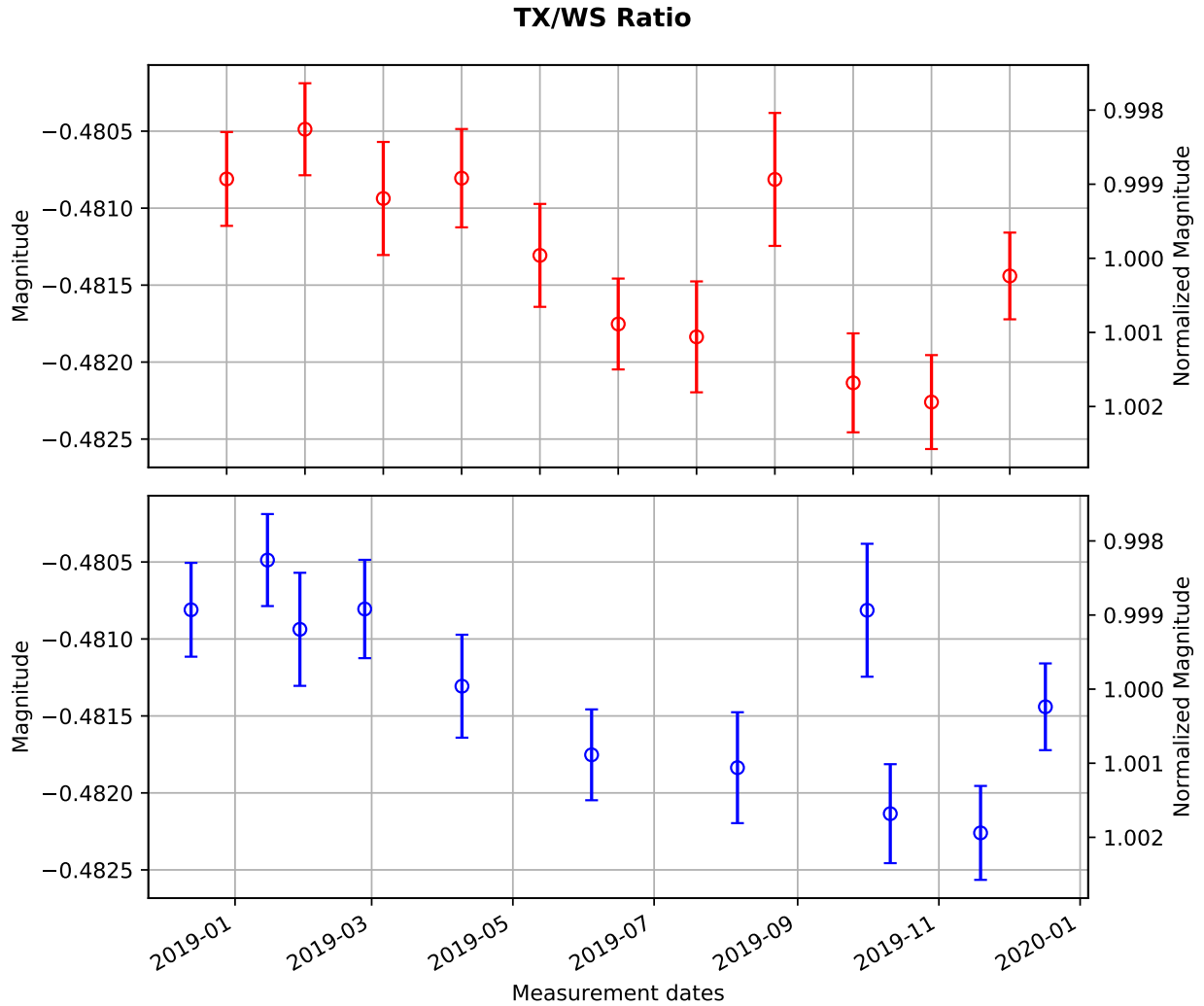
Summary of Total Optical Efficiency

Mean value:	0.988570
Standard deviation:	0.001049
Standard error:	0.000331
Relative Standard error:	0.000335

11 TX/WS Ratio

List of Measurements

Date	TW $\pm$ SE_TW	Normalized
D20181213	-0.480810 $\pm$ 0.000305	(1 $\pm$ 0.000634)
D20190115	-0.480488 $\pm$ 0.000299	(1 $\pm$ 0.000622)
D20190129	-0.480937 $\pm$ 0.000367	(1 $\pm$ 0.000764)
D20190226	-0.480805 $\pm$ 0.000319	(1 $\pm$ 0.000664)
D20190409	-0.481307 $\pm$ 0.000334	(1 $\pm$ 0.000695)
D20190604	-0.481753 $\pm$ 0.000295	(1 $\pm$ 0.000613)
D20190806	-0.481836 $\pm$ 0.000360	(1 $\pm$ 0.000748)
D20191001	-0.480813 $\pm$ 0.000432	(1 $\pm$ 0.000898)
D20191011	-0.482135 $\pm$ 0.000321	(1 $\pm$ 0.000667)
D20191119	-0.482260 $\pm$ 0.000305	(1 $\pm$ 0.000633)
D20191217	-0.481440 $\pm$ 0.000282	(1 $\pm$ 0.000585)



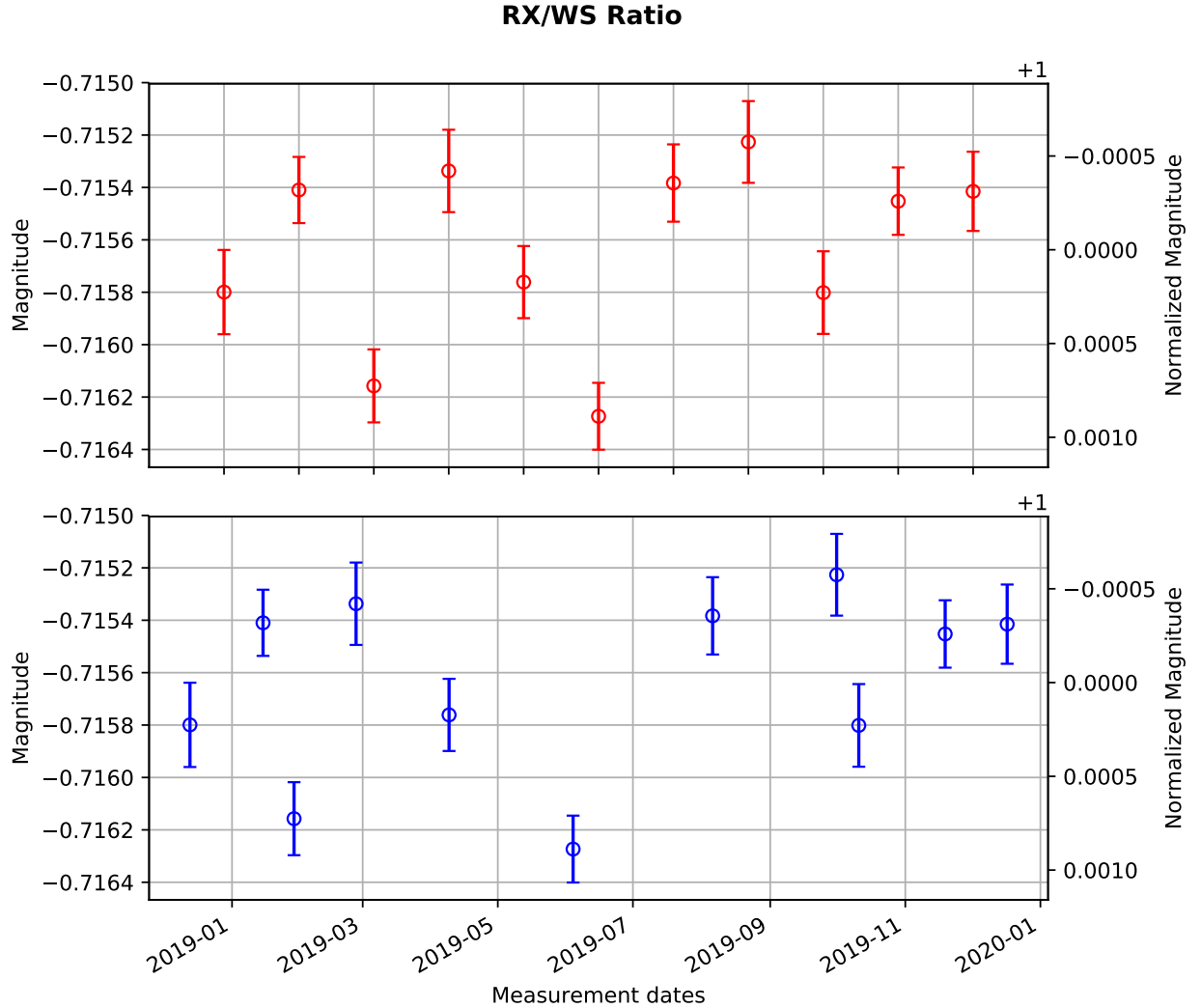
Summary of TX/WS Ratio

Mean value:	-0.481326
Standard deviation:	0.000603
Standard error:	0.000190
Relative Standard error:	0.000396

12 RX/WS Ratio

List of Measurements

Date	RW $\pm$ SE_RW	Normalized
D20181213	-0.715799 $\pm$ 0.000161	(1 $\pm$ 0.000225)
D20190115	-0.715410 $\pm$ 0.000126	(1 $\pm$ 0.000177)
D20190129	-0.716157 $\pm$ 0.000139	(1 $\pm$ 0.000194)
D20190226	-0.715337 $\pm$ 0.000157	(1 $\pm$ 0.000220)
D20190409	-0.715761 $\pm$ 0.000138	(1 $\pm$ 0.000192)
D20190604	-0.716273 $\pm$ 0.000128	(1 $\pm$ 0.000178)
D20190806	-0.715383 $\pm$ 0.000148	(1 $\pm$ 0.000206)
D20191001	-0.715226 $\pm$ 0.000156	(1 $\pm$ 0.000218)
D20191011	-0.715801 $\pm$ 0.000158	(1 $\pm$ 0.000220)
D20191119	-0.715452 $\pm$ 0.000129	(1 $\pm$ 0.000180)
D20191217	-0.715415 $\pm$ 0.000151	(1 $\pm$ 0.000211)



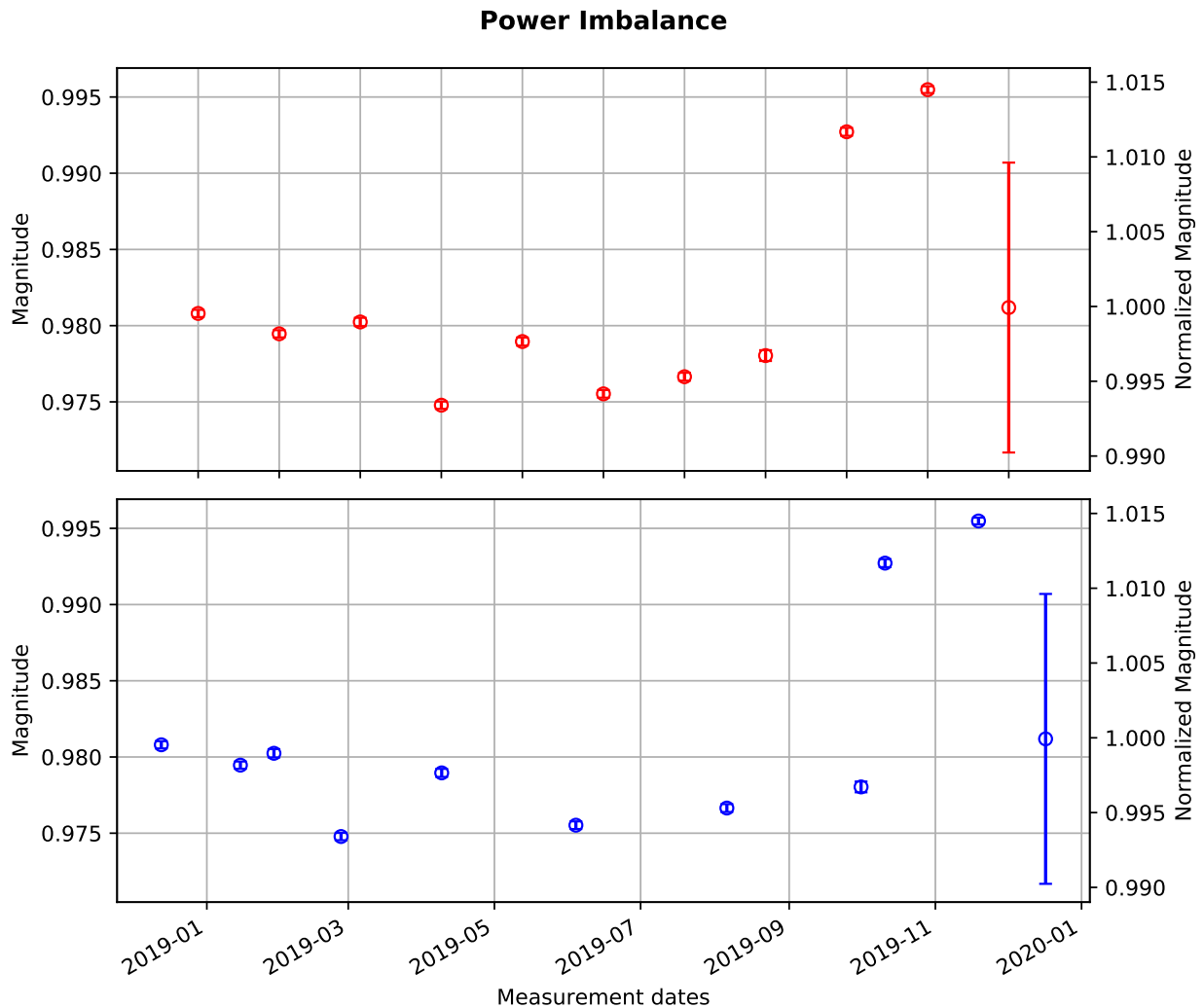
Summary of RX/WS Ratio

Mean value:	-0.715638
Standard deviation:	0.000347
Standard error:	0.000110
Relative Standard error:	0.000153

13 Power Imbalance

List of Measurements

Date	PI $\pm$ SE_PI	Normalized
D20181213	0.980800 $\pm$ 0.000238	(1 $\pm$ 0.000243)
D20190115	0.979465 $\pm$ 0.000238	(1 $\pm$ 0.000243)
D20190129	0.980242 $\pm$ 0.000274	(1 $\pm$ 0.000279)
D20190226	0.974782 $\pm$ 0.000242	(1 $\pm$ 0.000249)
D20190409	0.978957 $\pm$ 0.000265	(1 $\pm$ 0.000270)
D20190604	0.975524 $\pm$ 0.000250	(1 $\pm$ 0.000256)
D20190806	0.976649 $\pm$ 0.000259	(1 $\pm$ 0.000265)
D20191001	0.978036 $\pm$ 0.000354	(1 $\pm$ 0.000362)
D20191011	0.992718 $\pm$ 0.000262	(1 $\pm$ 0.000264)
D20191119	0.995482 $\pm$ 0.000222	(1 $\pm$ 0.000223)
D20191217	0.981187 $\pm$ 0.009509	(1 $\pm$ 0.009692)



Summary of Power Imbalance

Mean value:	0.981258
Standard deviation:	0.006707
Standard error:	0.002118
Relative Standard error:	0.002159