

RxPD and TxPD Calibration Trends

| GENERATED FOR LHO_EndX

Report Generated on September 27, 2022

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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:

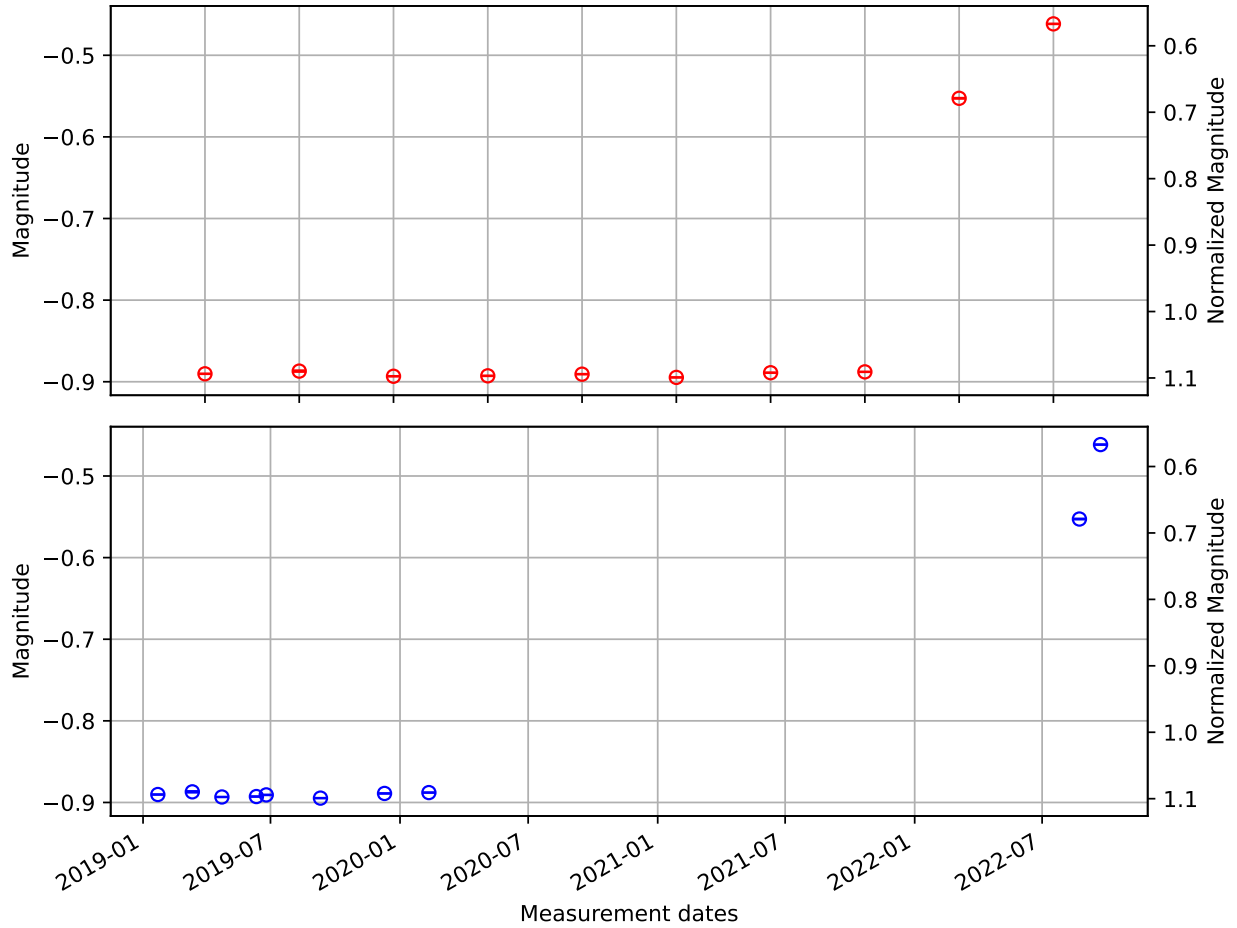
```
Mean = sum(x(i)*w(i))/sum(w(i))  
Std Dev = sqrt(sum(w(i)*(x(i)-x_mean)^2)/((n-1)/n*sum(w(i))))  
Std Err = Std Dev/sqrt(n)  
Rel Err = Std Err/Mean
```

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

List of Measurements

Date	m1 $\pm$ SE_m1	Normalized
D20190122	-0.890272 $\pm$ 0.000242	(1 $\pm$ 0.000271)
D20190312	-0.886971 $\pm$ 0.000843	(1 $\pm$ 0.000951)
D20190423	-0.893277 $\pm$ 0.000214	(1 $\pm$ 0.000239)
D20190611	-0.892752 $\pm$ 0.000282	(1 $\pm$ 0.000315)
D20190625	-0.890721 $\pm$ 0.000267	(1 $\pm$ 0.000300)
D20190910	-0.894681 $\pm$ 0.000205	(1 $\pm$ 0.000229)
D20191210	-0.888945 $\pm$ 0.000256	(1 $\pm$ 0.000288)
D20200211	-0.887892 $\pm$ 0.000210	(1 $\pm$ 0.000236)
D20220823	-0.552728 $\pm$ 0.000462	(1 $\pm$ 0.000836)
D20220922	-0.461525 $\pm$ 0.000269	(1 $\pm$ 0.000583)

WS/TX when WS is at TX (Inner beam) [m1]



Summary of WS/TX when WS is at TX (Inner beam) [m1]

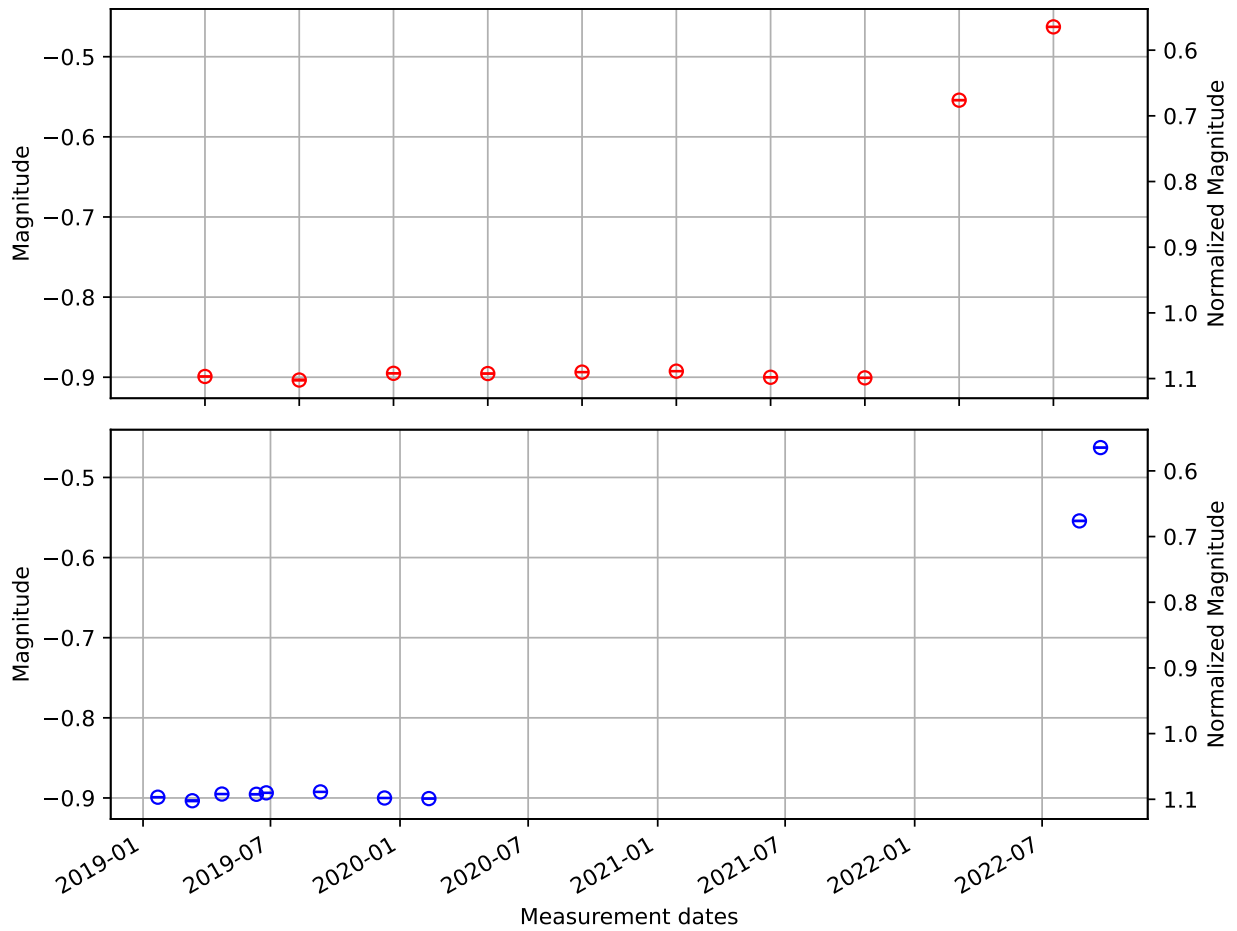
Mean value:	-0.813976
Standard deviation:	0.163164
Standard error:	0.054309
Relative Standard error:	0.066721

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

List of Measurements

Date	m2 $\pm$ SE_m2	Normalized
D20190122	-0.899052 $\pm$ 0.000248	(1 $\pm$ 0.000275)
D20190312	-0.903477 $\pm$ 0.000682	(1 $\pm$ 0.000755)
D20190423	-0.895117 $\pm$ 0.000254	(1 $\pm$ 0.000284)
D20190611	-0.895410 $\pm$ 0.000331	(1 $\pm$ 0.000370)
D20190625	-0.893618 $\pm$ 0.000204	(1 $\pm$ 0.000228)
D20190910	-0.892423 $\pm$ 0.000206	(1 $\pm$ 0.000230)
D20191210	-0.900036 $\pm$ 0.000230	(1 $\pm$ 0.000255)
D20200211	-0.900777 $\pm$ 0.000190	(1 $\pm$ 0.000211)
D20220823	-0.554245 $\pm$ 0.000350	(1 $\pm$ 0.000631)
D20220922	-0.462744 $\pm$ 0.000271	(1 $\pm$ 0.000586)

WS/TX when WS is at TX (Outer Beam) [m2]



Summary of WS/TX when WS is at TX (Outer Beam) [m2]

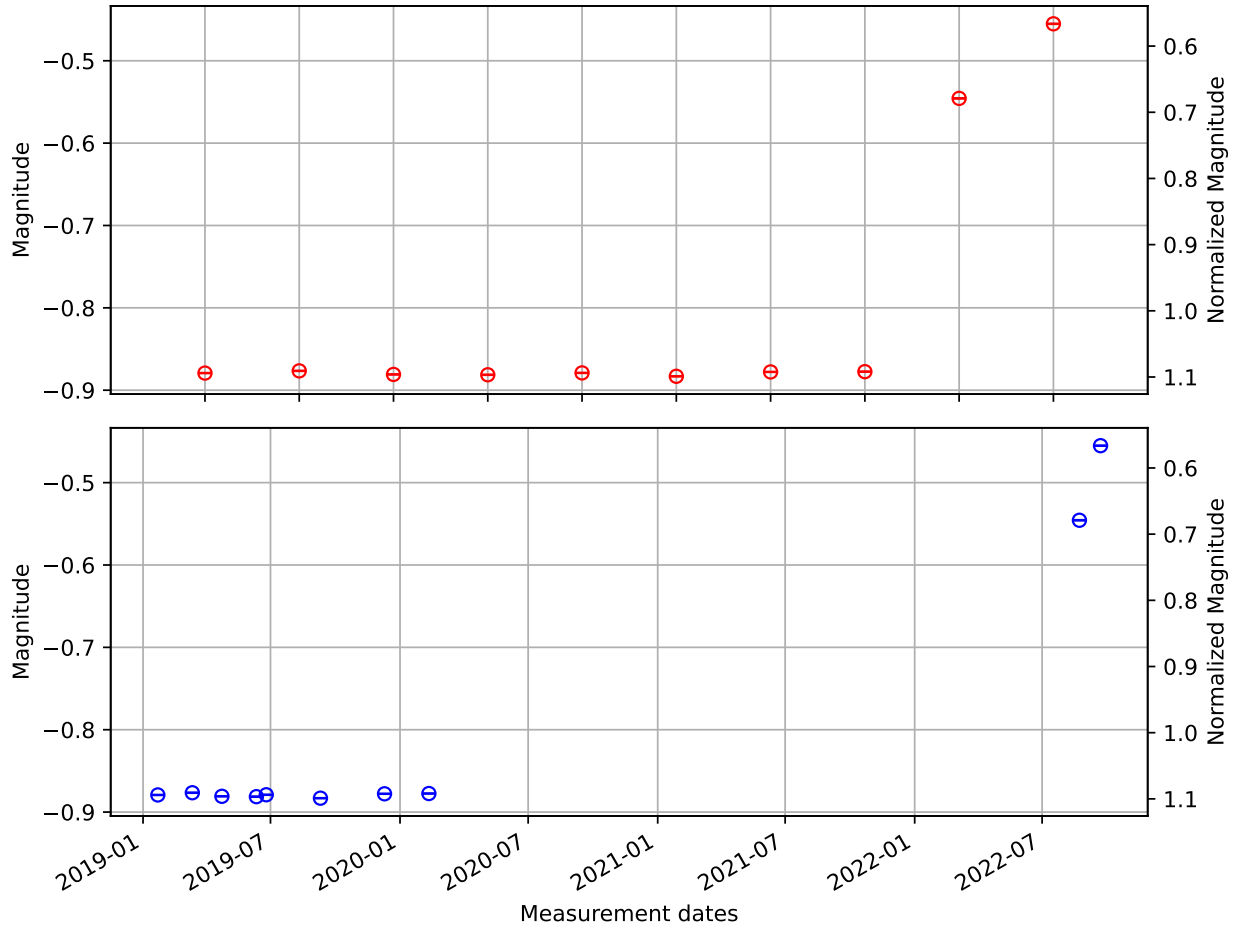
Mean value: -0.819690
 Standard deviation: 0.165462
 Standard error: 0.055074
 Relative Standard error: 0.067189

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

List of Measurements

Date	m3 $\pm$ SE_m3	Normalized
D20190122	-0.879214 $\pm$ 0.000247	(1 $\pm$ 0.000281)
D20190312	-0.876532 $\pm$ 0.000269	(1 $\pm$ 0.000307)
D20190423	-0.880851 $\pm$ 0.000224	(1 $\pm$ 0.000255)
D20190611	-0.881291 $\pm$ 0.000271	(1 $\pm$ 0.000307)
D20190625	-0.878999 $\pm$ 0.000229	(1 $\pm$ 0.000260)
D20190910	-0.883128 $\pm$ 0.000204	(1 $\pm$ 0.000231)
D20191210	-0.877819 $\pm$ 0.000182	(1 $\pm$ 0.000207)
D20200211	-0.877488 $\pm$ 0.000199	(1 $\pm$ 0.000227)
D20220823	-0.545669 $\pm$ 0.000308	(1 $\pm$ 0.000564)
D20220922	-0.455127 $\pm$ 0.000264	(1 $\pm$ 0.000579)

WS/TX when WS is at RX (Inner Beam) [m3]



Summary of WS/TX when WS is at RX (Inner Beam) [m3]

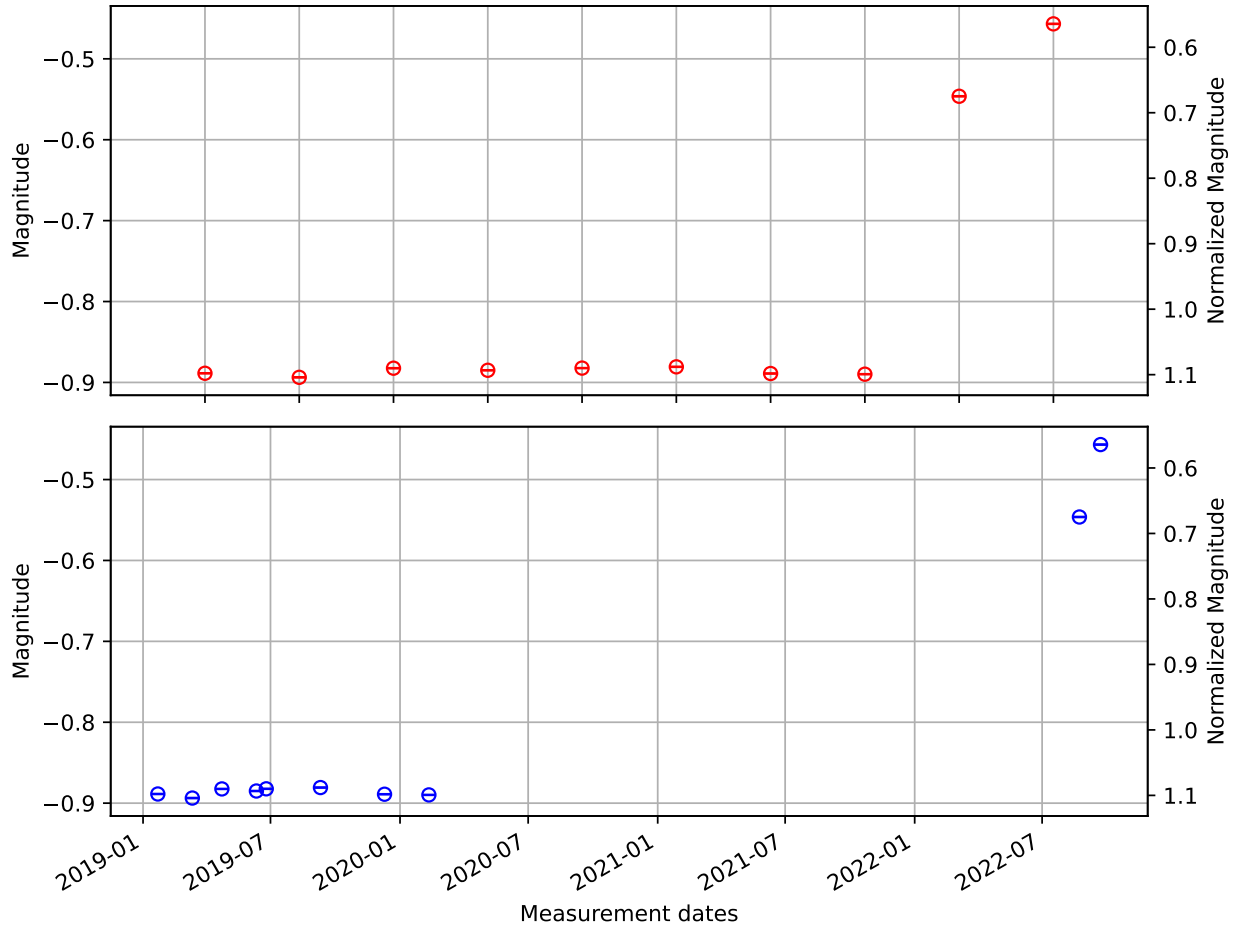
Mean value:	-0.803612
Standard deviation:	0.161238
Standard error:	0.053668
Relative Standard error:	0.066784

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

List of Measurements

Date	m4 $\pm$ SE_m4	Normalized
D20190122	-0.888682 $\pm$ 0.000240	(1 $\pm$ 0.000270)
D20190312	-0.893703 $\pm$ 0.000294	(1 $\pm$ 0.000328)
D20190423	-0.882418 $\pm$ 0.000223	(1 $\pm$ 0.000252)
D20190611	-0.884988 $\pm$ 0.000245	(1 $\pm$ 0.000277)
D20190625	-0.882293 $\pm$ 0.000206	(1 $\pm$ 0.000233)
D20190910	-0.880733 $\pm$ 0.000224	(1 $\pm$ 0.000255)
D20191210	-0.888975 $\pm$ 0.000210	(1 $\pm$ 0.000237)
D20200211	-0.889809 $\pm$ 0.000215	(1 $\pm$ 0.000242)
D20220823	-0.546278 $\pm$ 0.000280	(1 $\pm$ 0.000512)
D20220922	-0.456768 $\pm$ 0.000256	(1 $\pm$ 0.000560)

WS/TX when WS is at RX (Outer Beam) [m4]



Summary of WS/TX when WS is at RX (Outer Beam) [m4]

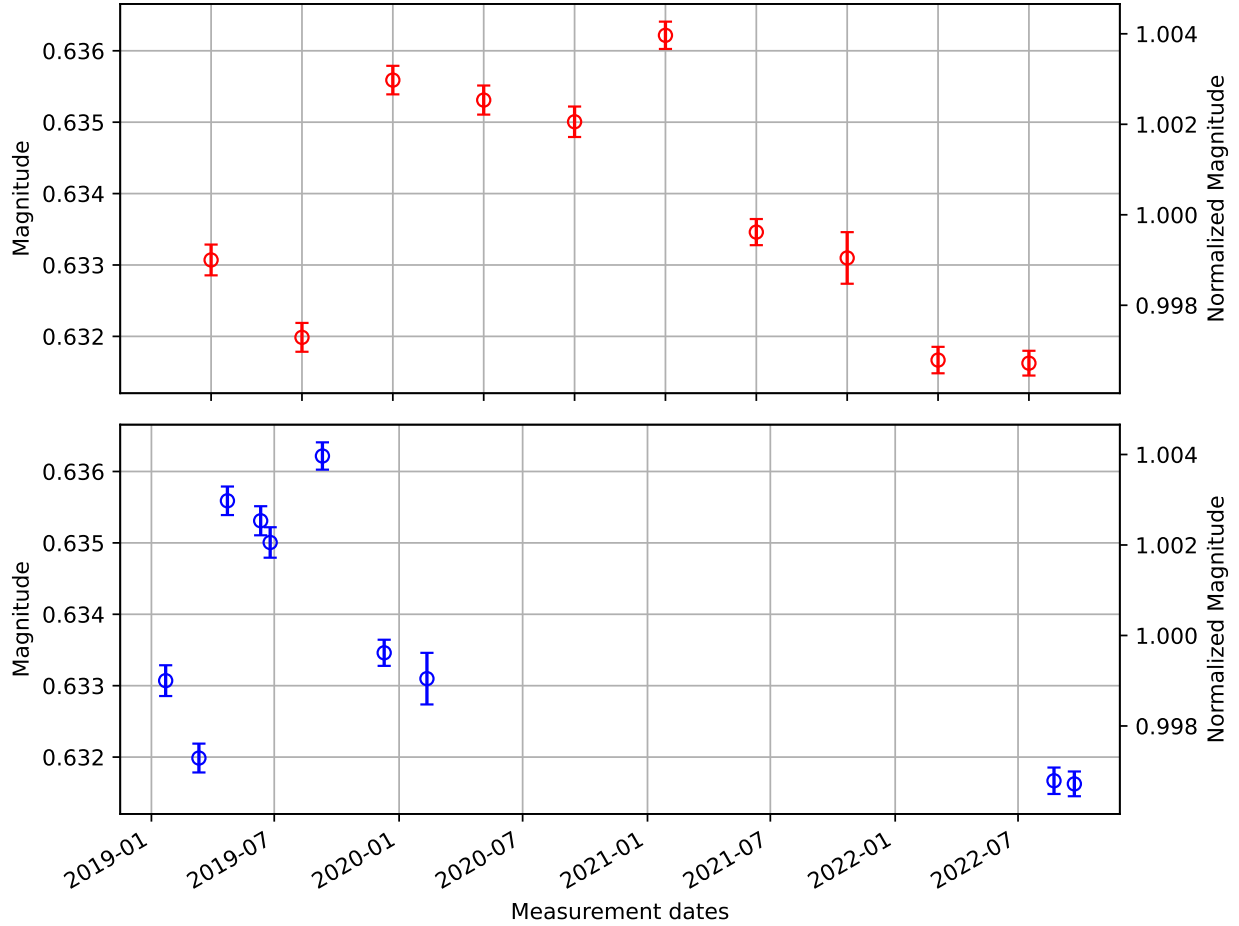
Mean value:	-0.809465
Standard deviation:	0.163714
Standard error:	0.054492
Relative Standard error:	0.067319

6 RX/TX Ratio (Inner Beam)

List of Measurements

Date	m5 $\pm$ SE_m5	Normalized
D20190122	0.633071 $\pm$ 0.000216	(1 $\pm$ 0.000341)
D20190312	0.631987 $\pm$ 0.000202	(1 $\pm$ 0.000320)
D20190423	0.635590 $\pm$ 0.000200	(1 $\pm$ 0.000314)
D20190611	0.635310 $\pm$ 0.000204	(1 $\pm$ 0.000321)
D20190625	0.635006 $\pm$ 0.000213	(1 $\pm$ 0.000336)
D20190910	0.636217 $\pm$ 0.000191	(1 $\pm$ 0.000301)
D20191210	0.633461 $\pm$ 0.000183	(1 $\pm$ 0.000289)
D20200211	0.633099 $\pm$ 0.000361	(1 $\pm$ 0.000571)
D20220823	0.631668 $\pm$ 0.000185	(1 $\pm$ 0.000293)
D20220922	0.631625 $\pm$ 0.000173	(1 $\pm$ 0.000275)

RX/TX (Inner Beam) [m5]



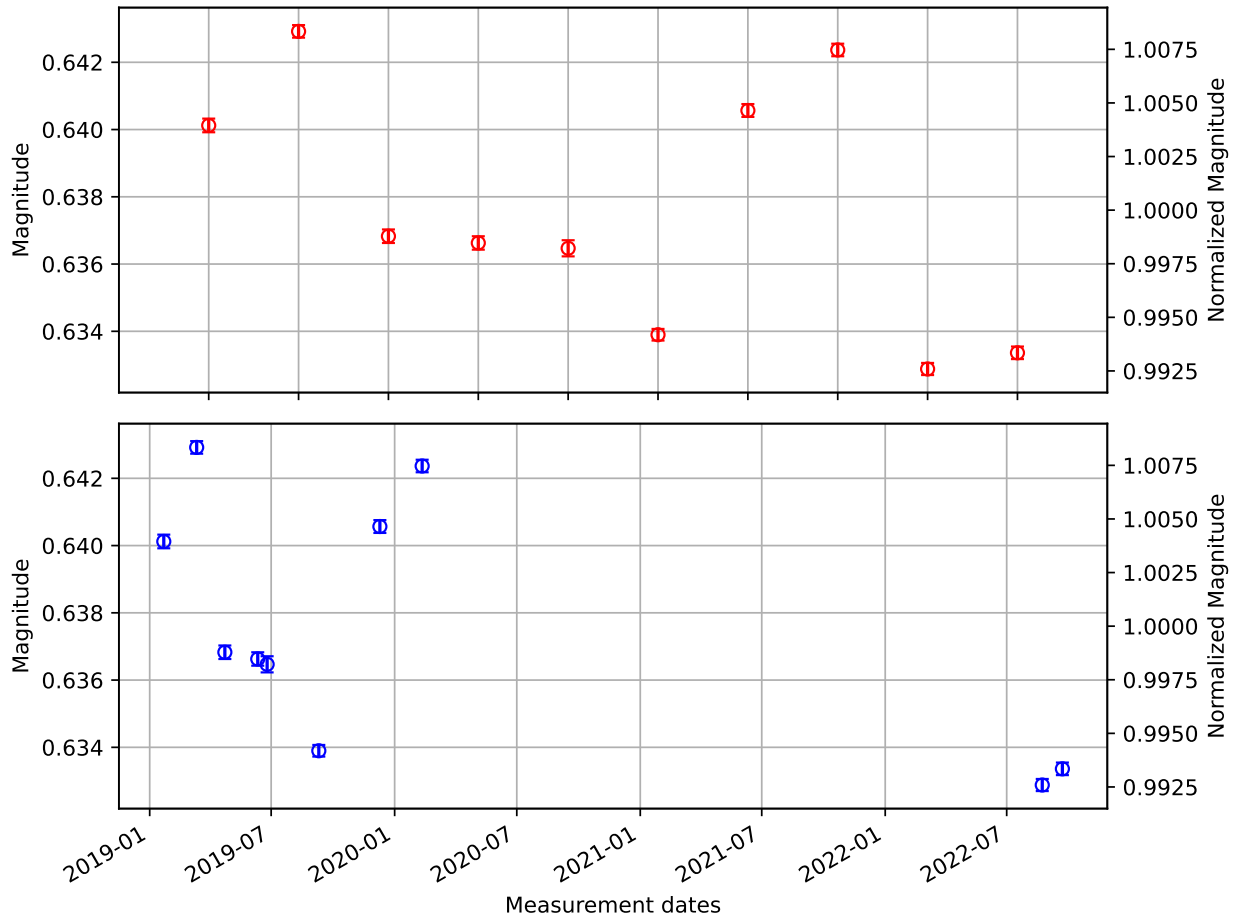
Summary of RX/TX (Inner Beam) [m5]		
Mean value:	0.633703	
Standard deviation:	0.001712	
Standard error:	0.000570	
Relative Standard error:	0.000899	

7 RX/TX Ratio (Outer Beam)

List of Measurements

Date	m6 $\pm$ SE_m6	Normalized
D20190122	0.640122 $\pm$ 0.000203	(1 $\pm$ 0.000317)
D20190312	0.642919 $\pm$ 0.000187	(1 $\pm$ 0.000291)
D20190423	0.636828 $\pm$ 0.000201	(1 $\pm$ 0.000316)
D20190611	0.636627 $\pm$ 0.000200	(1 $\pm$ 0.000313)
D20190625	0.636468 $\pm$ 0.000240	(1 $\pm$ 0.000377)
D20190910	0.633898 $\pm$ 0.000173	(1 $\pm$ 0.000273)
D20191210	0.640567 $\pm$ 0.000191	(1 $\pm$ 0.000298)
D20200211	0.642366 $\pm$ 0.000187	(1 $\pm$ 0.000291)
D20220823	0.632879 $\pm$ 0.000180	(1 $\pm$ 0.000285)
D20220922	0.633360 $\pm$ 0.000187	(1 $\pm$ 0.000295)

RX/TX (Outer Beam) [m6]



Summary of RX/TX (Outer Beam) [m6]

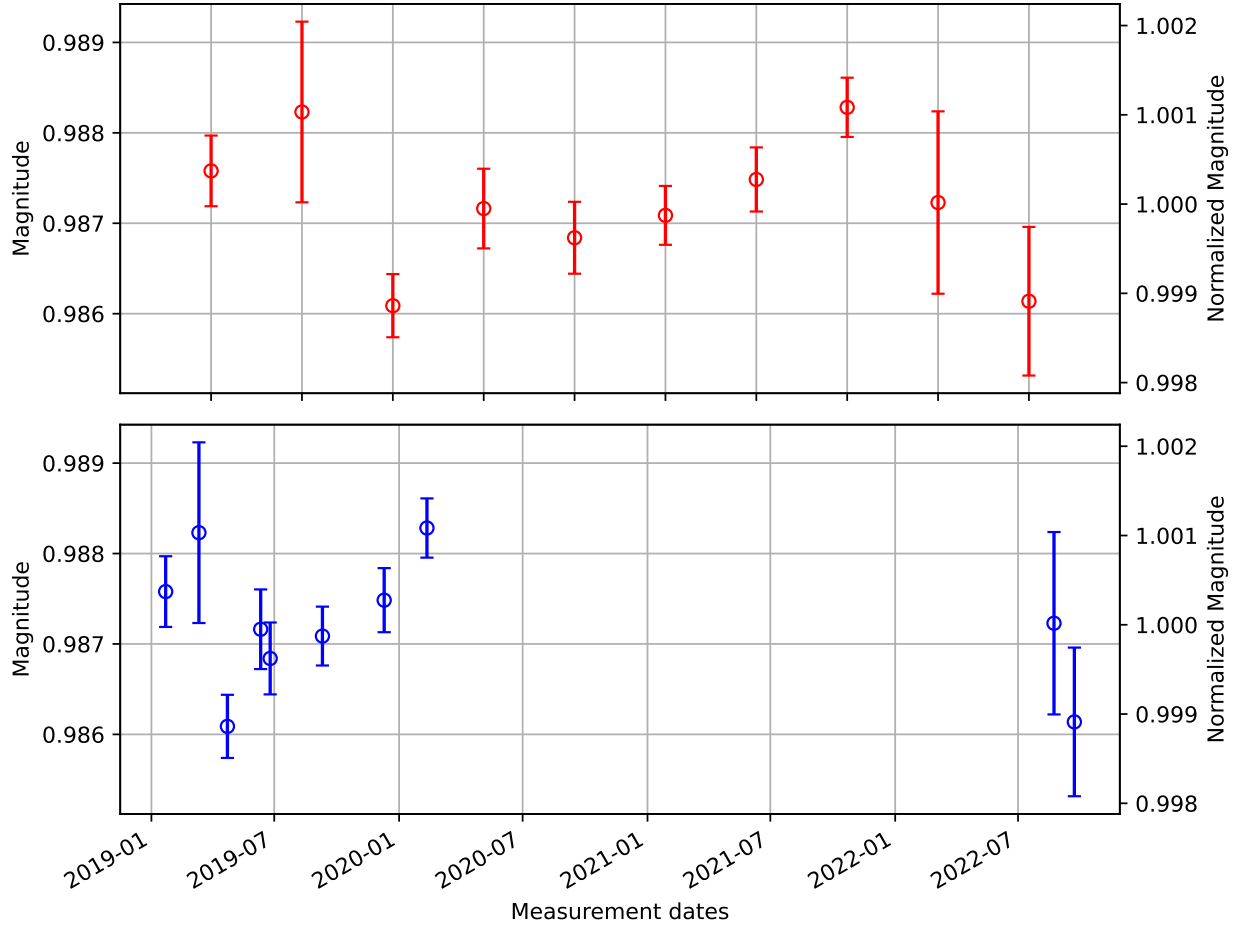
Mean value:	0.637603
Standard deviation:	0.003696
Standard error:	0.001230
Relative Standard error:	0.001930

8 Optical Efficiency of Inner Beam

List of Measurements

Date	$e_i \pm SE_{e_i}$	Normalized
D20190122	0.987579 ± 0.000391	(1 ± 0.000396)
D20190312	0.988231 ± 0.000999	(1 ± 0.001011)
D20190423	0.986089 ± 0.000349	(1 ± 0.000354)
D20190611	0.987163 ± 0.000440	(1 ± 0.000446)
D20190625	0.986840 ± 0.000398	(1 ± 0.000403)
D20190910	0.987087 ± 0.000326	(1 ± 0.000330)
D20191210	0.987484 ± 0.000354	(1 ± 0.000359)
D20200211	0.988282 ± 0.000328	(1 ± 0.000331)
D20220823	0.987229 ± 0.001008	(1 ± 0.001022)
D20220922	0.986138 ± 0.000822	(1 ± 0.000834)

Optical Efficiency (Inner Beam)



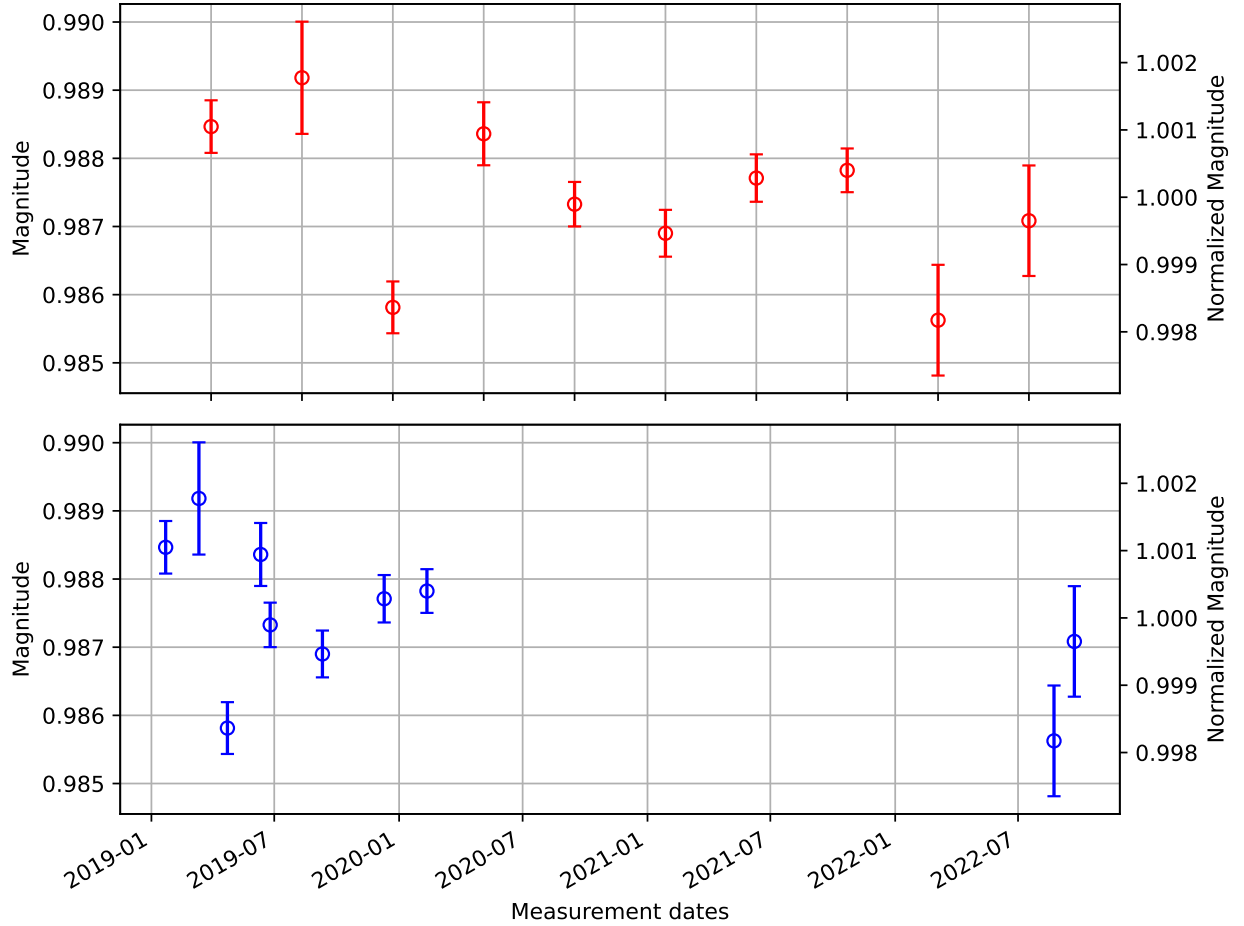
Summary of Optical Efficiency (Inner Beam)		
Mean value:	0.987212	
Standard deviation:	0.000743	
Standard error:	0.000247	
Relative Standard error:	0.000250	

9 Optical Efficiency of Outer Beam

List of Measurements

Date	$e_o \pm SE_{e_o}$	Normalized
D20190122	0.988466 ± 0.000386	(1 ± 0.000390)
D20190312	0.989182 ± 0.000823	(1 ± 0.000832)
D20190423	0.985814 ± 0.000380	(1 ± 0.000386)
D20190611	0.988360 ± 0.000462	(1 ± 0.000468)
D20190625	0.987327 ± 0.000326	(1 ± 0.000331)
D20190910	0.986901 ± 0.000343	(1 ± 0.000348)
D20191210	0.987711 ± 0.000348	(1 ± 0.000352)
D20200211	0.987824 ± 0.000321	(1 ± 0.000325)
D20220823	0.985626 ± 0.000812	(1 ± 0.000824)
D20220922	0.987085 ± 0.000811	(1 ± 0.000821)

Optical Efficiency (Outer Beam)



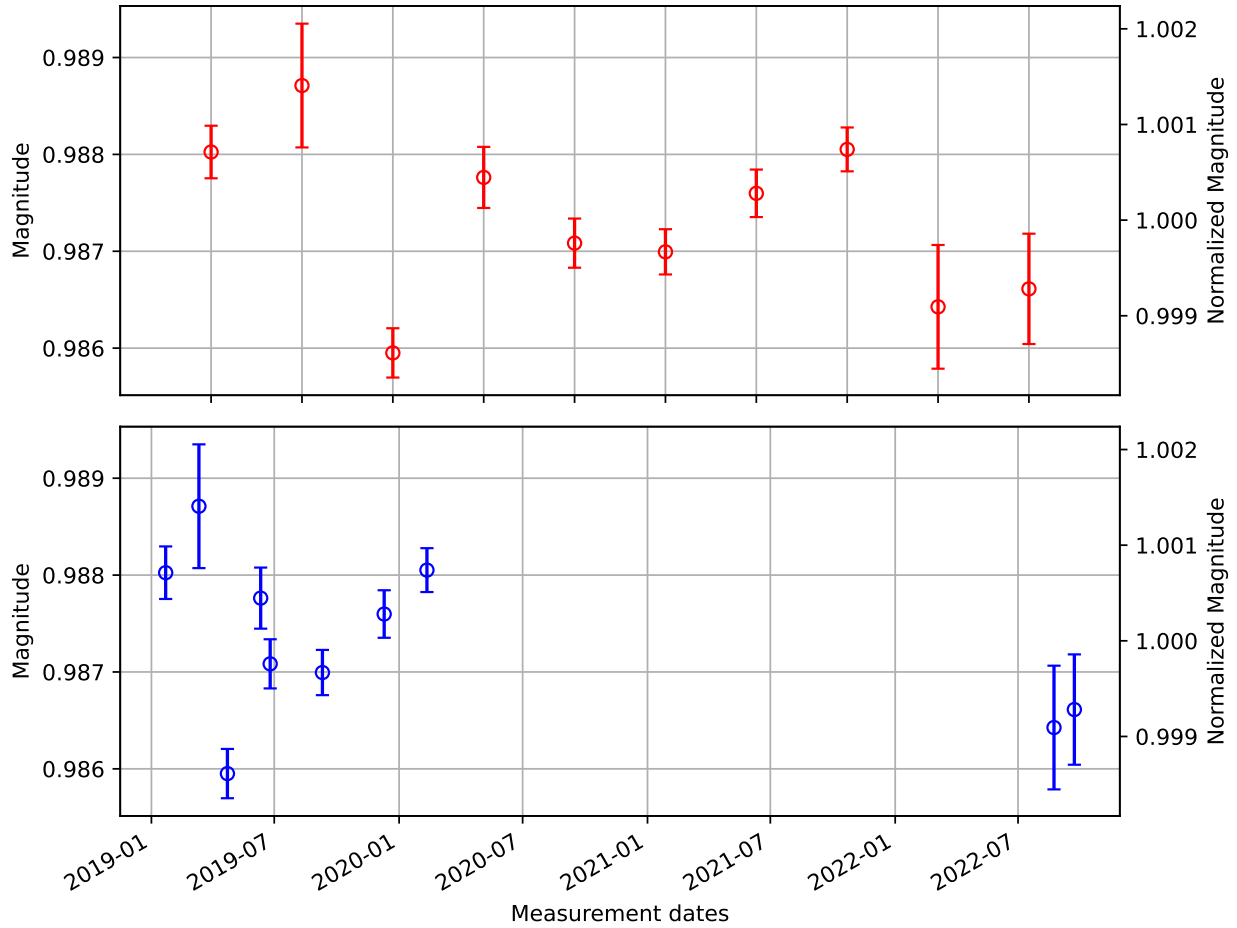
Summary of Optical Efficiency (Outer Beam)		
Mean value:	0.987429	
Standard deviation:	0.001131	
Standard error:	0.000377	
Relative Standard error:	0.000381	

10 Total Optical Efficiency

List of Measurements

Date	e $\pm$ SE_e	Normalized
D20190122	0.988025 $\pm$ 0.000271	(1 $\pm$ 0.000275)
D20190312	0.988711 $\pm$ 0.000639	(1 $\pm$ 0.000646)
D20190423	0.985951 $\pm$ 0.000254	(1 $\pm$ 0.000258)
D20190611	0.987762 $\pm$ 0.000315	(1 $\pm$ 0.000319)
D20190625	0.987084 $\pm$ 0.000254	(1 $\pm$ 0.000257)
D20190910	0.986994 $\pm$ 0.000234	(1 $\pm$ 0.000237)
D20191210	0.987598 $\pm$ 0.000245	(1 $\pm$ 0.000248)
D20200211	0.988051 $\pm$ 0.000226	(1 $\pm$ 0.000229)
D20220823	0.986426 $\pm$ 0.000638	(1 $\pm$ 0.000647)
D20220922	0.986612 $\pm$ 0.000570	(1 $\pm$ 0.000577)

Total Optical Efficiency



Summary of Total Optical Efficiency

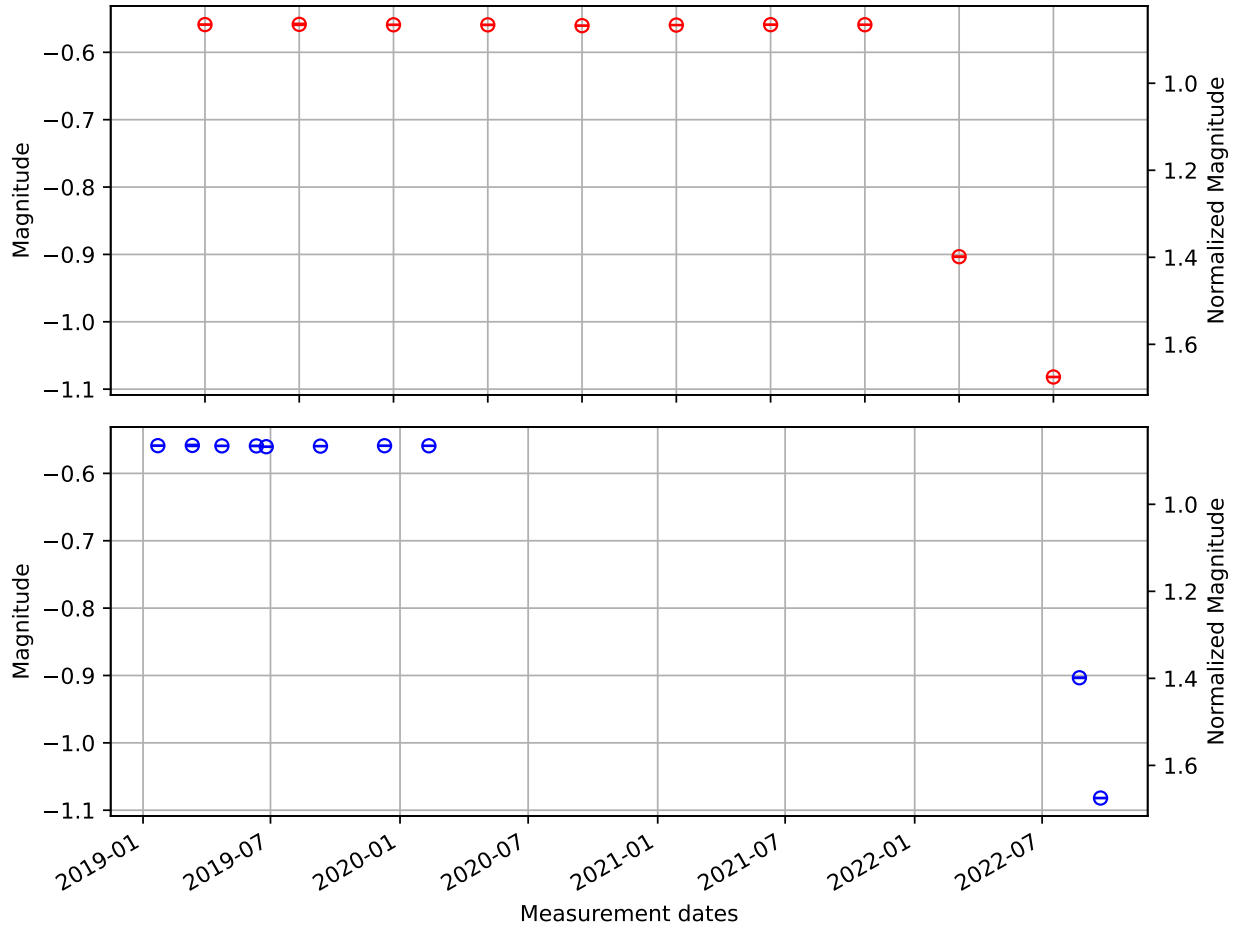
Mean value:	0.987321
Standard deviation:	0.000855
Standard error:	0.000284
Relative Standard error:	0.000288

11 TX/WS Ratio

List of Measurements

Date	TW $\pm$ SE_TW	Normalized
D20190122	-0.558870 $\pm$ 0.000346	(1 $\pm$ 0.000619)
D20190312	-0.558519 $\pm$ 0.001085	(1 $\pm$ 0.001942)
D20190423	-0.559161 $\pm$ 0.000332	(1 $\pm$ 0.000594)
D20190611	-0.559233 $\pm$ 0.000435	(1 $\pm$ 0.000778)
D20190625	-0.560432 $\pm$ 0.000336	(1 $\pm$ 0.000600)
D20190910	-0.559565 $\pm$ 0.000290	(1 $\pm$ 0.000519)
D20191210	-0.558977 $\pm$ 0.000344	(1 $\pm$ 0.000615)
D20200211	-0.559075 $\pm$ 0.000283	(1 $\pm$ 0.000506)
D20220823	-0.903365 $\pm$ 0.000579	(1 $\pm$ 0.000641)
D20220922	-1.081936 $\pm$ 0.000382	(1 $\pm$ 0.000353)

TX/WS Ratio



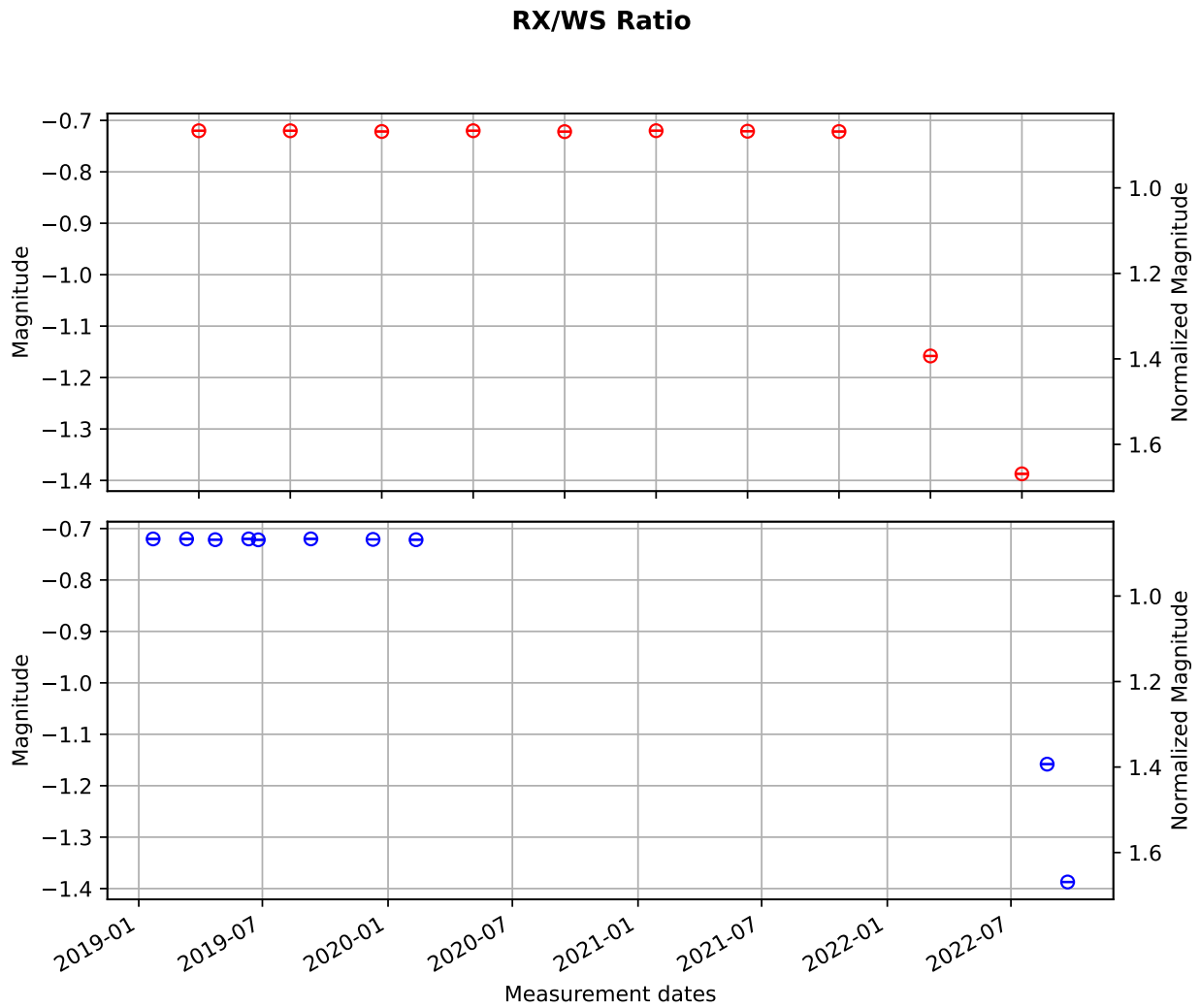
Summary of TX/WS Ratio

Mean value:	-0.645913
Standard deviation:	0.187531
Standard error:	0.062420
Relative Standard error:	0.096638

12 RX/WS Ratio

List of Measurements

Date	RW $\pm$ SE_RW	Normalized
D20190122	-0.720173 $\pm$ 0.000164	(1 $\pm$ 0.000227)
D20190312	-0.720198 $\pm$ 0.000174	(1 $\pm$ 0.000242)
D20190423	-0.721624 $\pm$ 0.000153	(1 $\pm$ 0.000212)
D20190611	-0.720124 $\pm$ 0.000167	(1 $\pm$ 0.000232)
D20190625	-0.721900 $\pm$ 0.000161	(1 $\pm$ 0.000222)
D20190910	-0.720076 $\pm$ 0.000143	(1 $\pm$ 0.000199)
D20191210	-0.721099 $\pm$ 0.000138	(1 $\pm$ 0.000192)
D20200211	-0.721702 $\pm$ 0.000181	(1 $\pm$ 0.000251)
D20220823	-1.158066 $\pm$ 0.000283	(1 $\pm$ 0.000245)
D20220922	-1.387206 $\pm$ 0.000310	(1 $\pm$ 0.000224)



Summary of RX/WS Ratio

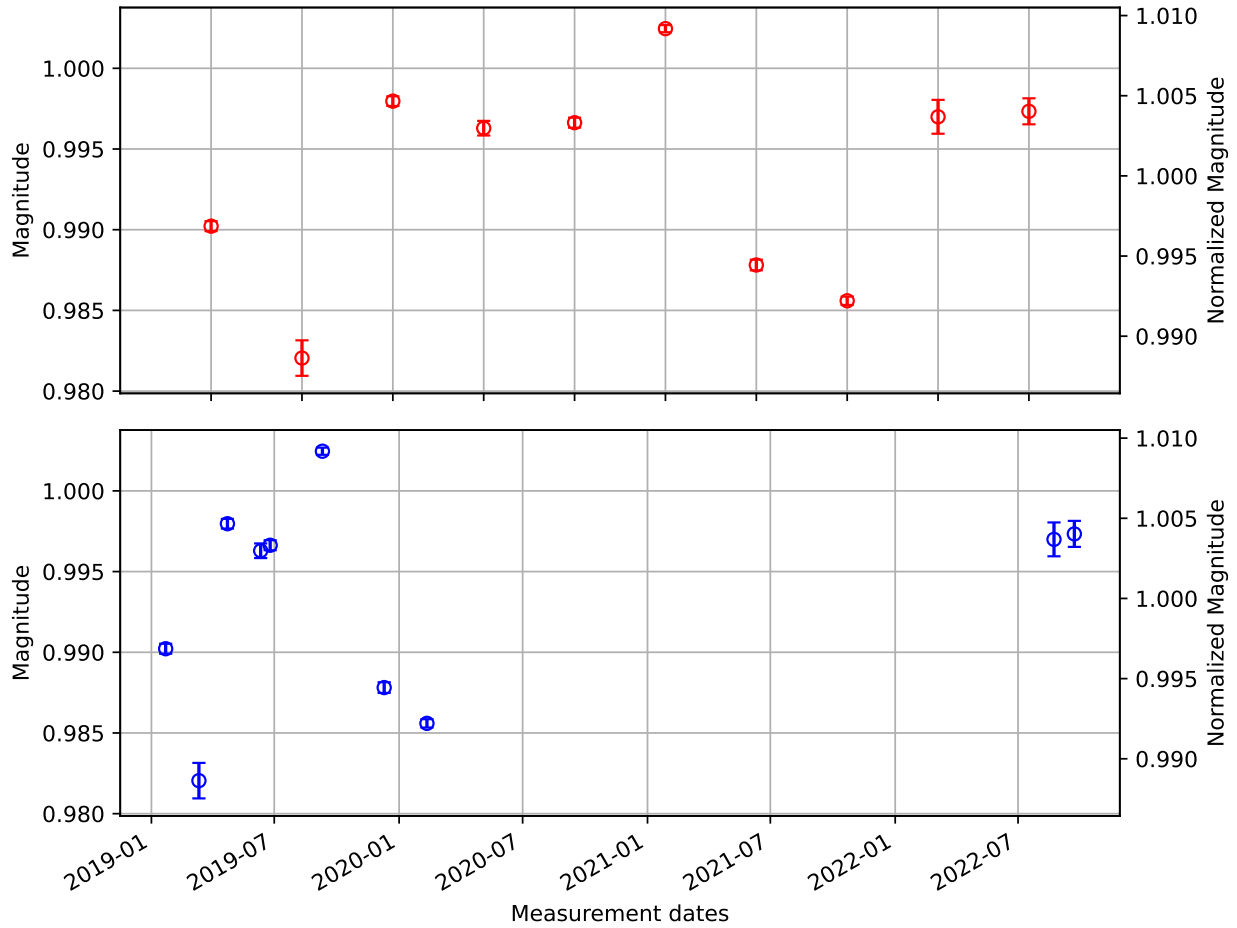
Mean value:	-0.831217
Standard deviation:	0.238836
Standard error:	0.079497
Relative Standard error:	0.095639

13 Power Imbalance

List of Measurements

Date	PI $\pm$ SE_PI	Normalized
D20190122	0.990220 $\pm$ 0.000309	(1 $\pm$ 0.000312)
D20190312	0.982046 $\pm$ 0.001100	(1 $\pm$ 0.001120)
D20190423	0.997965 $\pm$ 0.000299	(1 $\pm$ 0.000299)
D20190611	0.996290 $\pm$ 0.000454	(1 $\pm$ 0.000456)
D20190625	0.996631 $\pm$ 0.000309	(1 $\pm$ 0.000310)
D20190910	1.002457 $\pm$ 0.000223	(1 $\pm$ 0.000222)
D20191210	0.987813 $\pm$ 0.000331	(1 $\pm$ 0.000335)
D20200211	0.985596 $\pm$ 0.000259	(1 $\pm$ 0.000263)
D20220823	0.996996 $\pm$ 0.001049	(1 $\pm$ 0.001052)
D20220922	0.997336 $\pm$ 0.000806	(1 $\pm$ 0.000808)

Power Imbalance



Summary of Power Imbalance

Mean value:	0.993335
Standard deviation:	0.006508
Standard error:	0.002166
Relative Standard error:	0.002181