
LHOY-End RxPD and TxPD Calibration Trends

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About

This document contains the Pcal PD (TxPD and RxPD) Calibration trends. The first six section contains the six ratio measured at 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 and Relative Error for each measurement. The list is followed by two plot figure 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 Err and Rel Err where each of these terms are defined as:

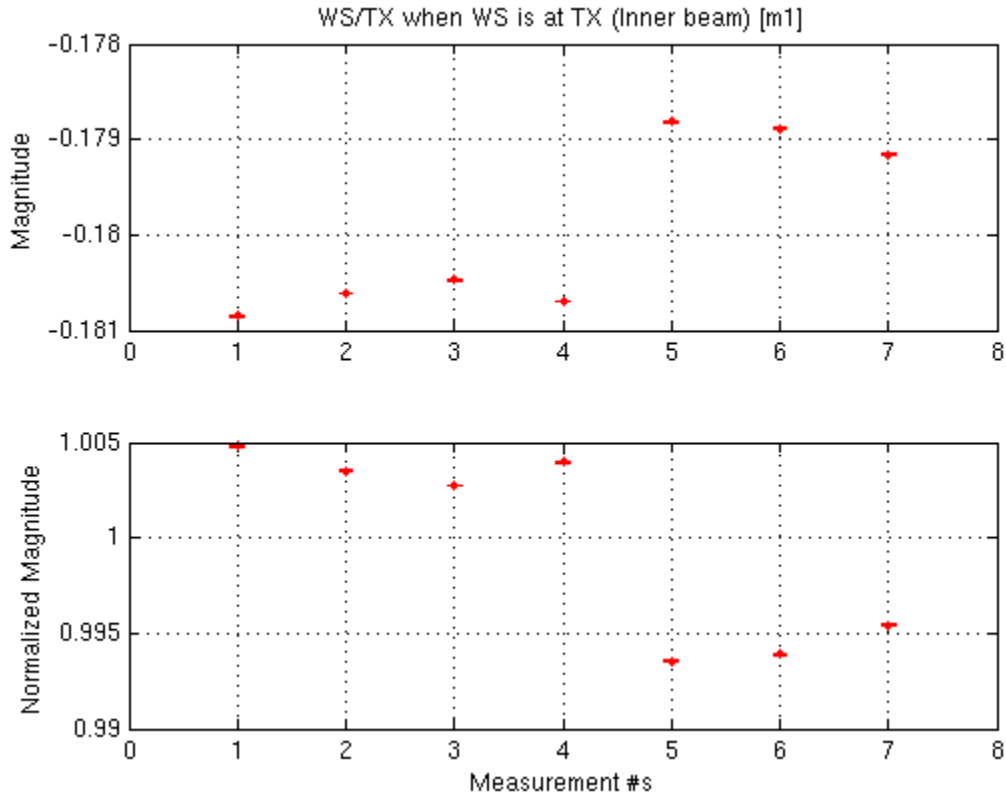
$$\begin{aligned} \text{Mean} &= \text{sum}(x(i)*w(i))/\text{sum}(w(i)) \\ \text{Std Dev} &= \text{sqrt}(\text{sum}(w(i)*(x(i)-x_mean)^2)/((n-1)/n*\text{sum}(w(i)))) \\ \text{Std Err} &= \text{Std Dev}/\text{sqrt}(n) \\ \text{Rel Err} &= \text{Std Err}/\text{Mean} \end{aligned}$$

Report created on 27-Sep-2016

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

List of Measurements

<i>Date</i>	<i>$m1 \pm SE_{\{m1\}}$</i>	<i>Normalized</i>
<i>D20150811</i>	<i>-0.180846 ± 0.000008</i>	<i>(1 ± 0.000044)</i>
<i>D20150827</i>	<i>-0.180614 ± 0.000007</i>	<i>(1 ± 0.000037)</i>
<i>D20151013</i>	<i>-0.180474 ± 0.000006</i>	<i>(1 ± 0.000034)</i>
<i>D20151222</i>	<i>-0.180696 ± 0.000008</i>	<i>(1 ± 0.000044)</i>
<i>D20160505</i>	<i>-0.178817 ± 0.000008</i>	<i>(1 ± 0.000043)</i>
<i>D20160628</i>	<i>-0.178884 ± 0.000007</i>	<i>(1 ± 0.000041)</i>
<i>D20160927</i>	<i>-0.179158 ± 0.000008</i>	<i>(1 ± 0.000046)</i>



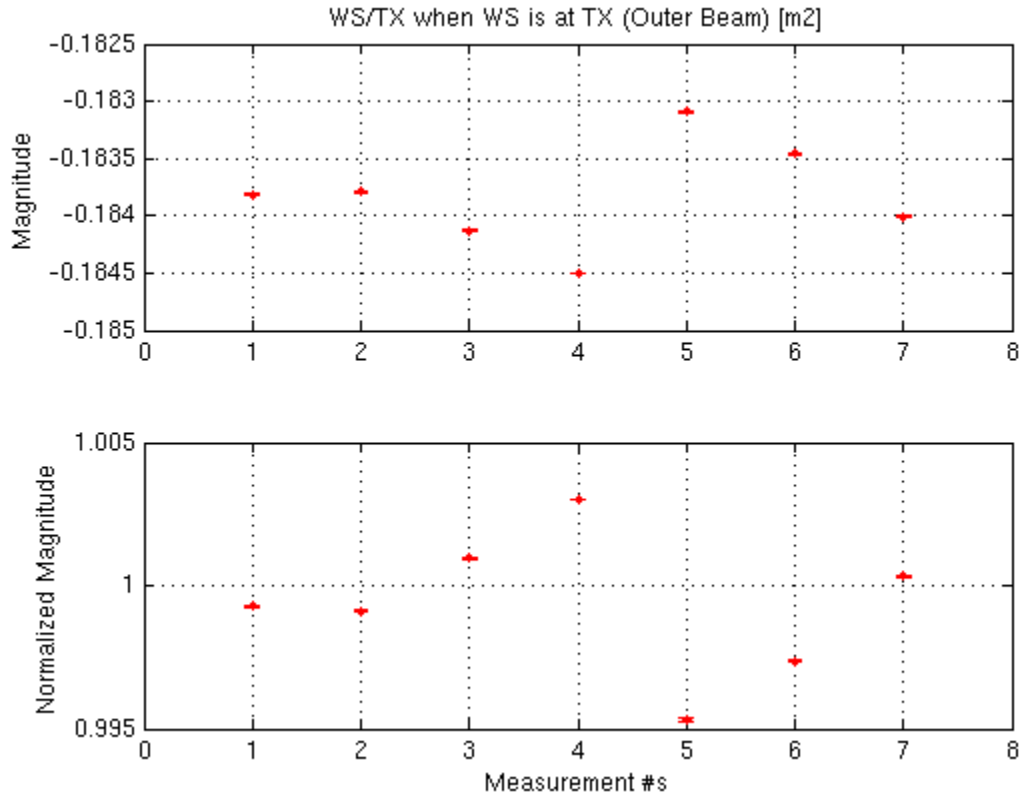
Summary of WS/TX when WS is at TX (Inner beam) [m1]:

Mean value: -0.179979
Standard deviation: 0.000899
Standard Error: 0.000366
Relative Standard Error: 0.002033

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

List of Measurements

<i>Date</i>	<i>m2 ± SE_{m2}</i>	<i>Normalized</i>
<i>D20150811</i>	<i>-0.183815 ± 0.000007</i>	<i>(1 ± 0.000039)</i>
<i>D20150827</i>	<i>-0.183788 ± 0.000006</i>	<i>(1 ± 0.000035)</i>
<i>D20151013</i>	<i>-0.184127 ± 0.000007</i>	<i>(1 ± 0.000036)</i>
<i>D20151222</i>	<i>-0.184502 ± 0.000005</i>	<i>(1 ± 0.000027)</i>
<i>D20160505</i>	<i>-0.183087 ± 0.000008</i>	<i>(1 ± 0.000044)</i>
<i>D20160628</i>	<i>-0.183461 ± 0.000008</i>	<i>(1 ± 0.000042)</i>
<i>D20160927</i>	<i>-0.184007 ± 0.000008</i>	<i>(1 ± 0.000044)</i>



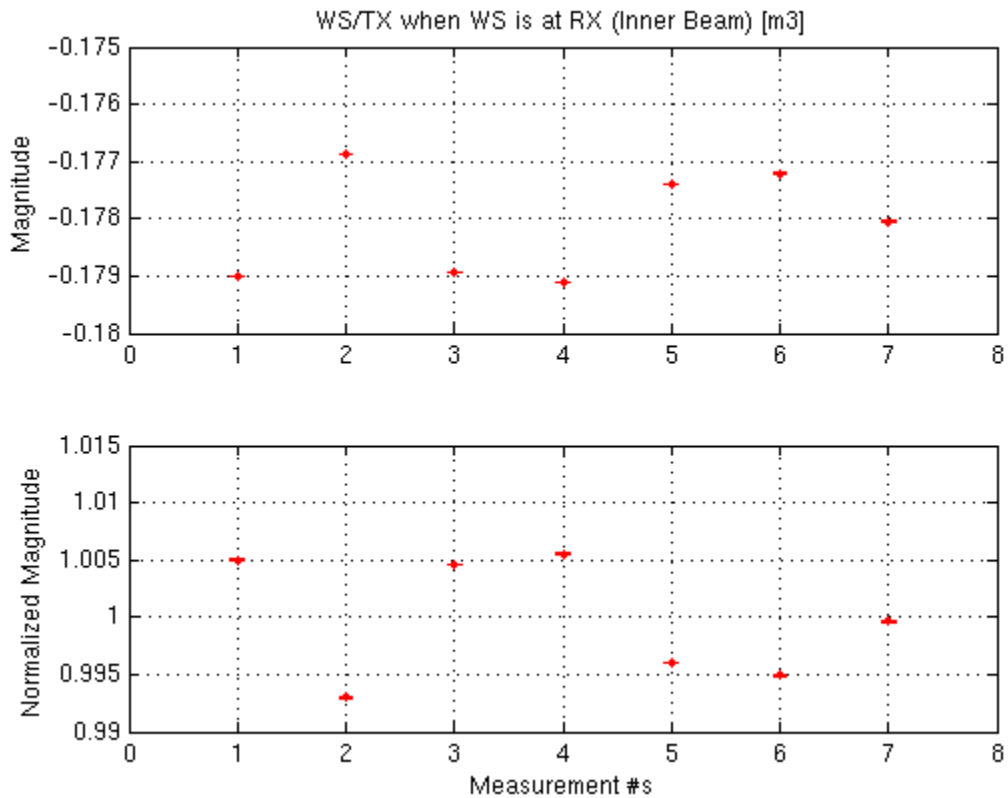
Summary of WS/TX when WS is at TX (Outer Beam) [m2]:
Mean value: -0.183949
Standard deviation: 0.000472

Standard Error: 0.000192
Relative Standard Error: 0.001045

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

List of Measurements

Date	$m3 \pm SE_{\{m3\}}$	Normalized
D20150811	-0.179002 ± 0.000008	(1 ± 0.000043)
D20150827	-0.176861 ± 0.000006	(1 ± 0.000036)
D20151013	-0.178931 ± 0.000006	(1 ± 0.000035)
D20151222	-0.179098 ± 0.000007	(1 ± 0.000037)
D20160505	-0.177402 ± 0.000008	(1 ± 0.000043)
D20160628	-0.177210 ± 0.000008	(1 ± 0.000043)
D20160927	-0.178050 ± 0.000008	(1 ± 0.000046)



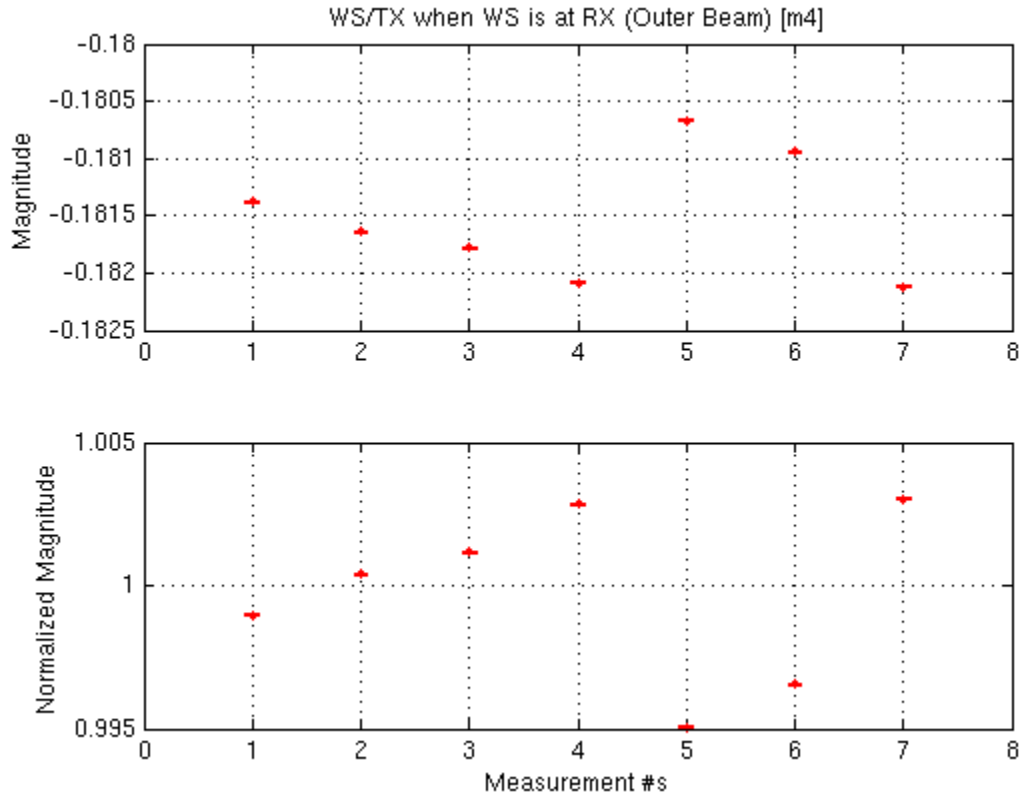
Summary of WS/TX when WS is at RX (Inner Beam) [m3]:

Mean value: -0.178113
Standard deviation: 0.000975
Standard Error: 0.000397
Relative Standard Error: 0.002227

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

List of Measurements

Date	$m4 \pm SE_{\{m4\}}$	Normalized
D20150811	-0.181381 $\pm$ 0.000008	(1 $\pm$ 0.000046)
D20150827	-0.181640 $\pm$ 0.000006	(1 $\pm$ 0.000031)
D20151013	-0.181781 $\pm$ 0.000006	(1 $\pm$ 0.000034)
D20151222	-0.182083 $\pm$ 0.000006	(1 $\pm$ 0.000031)
D20160505	-0.180668 $\pm$ 0.000007	(1 $\pm$ 0.000040)
D20160628	-0.180940 $\pm$ 0.000007	(1 $\pm$ 0.000040)
D20160927	-0.182118 $\pm$ 0.000009	(1 $\pm$ 0.000048)



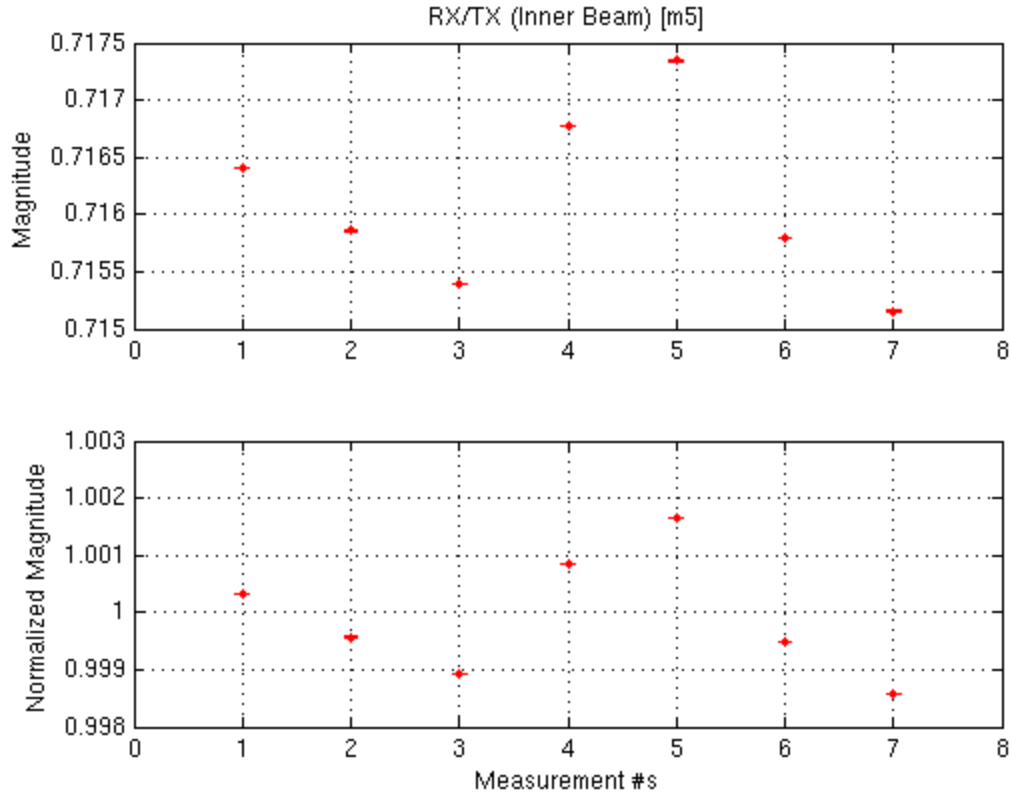
Summary of WS/TX when WS is at RX (Outer Beam) [m4]:

Mean value: -0.181566
Standard deviation: 0.000527
Standard Error: 0.000215
Relative Standard Error: 0.001182

RX/TX Ratio (Inner Beam)

List of Measurements

<i>Date</i>	<i>m5 ± SE_{m5}</i>	<i>Normalized</i>
<i>D20150811</i>	<i>0.716408 ± 0.000003</i>	<i>(1 ± 0.000005)</i>
<i>D20150827</i>	<i>0.715858 ± 0.000003</i>	<i>(1 ± 0.000004)</i>
<i>D20151013</i>	<i>0.715399 ± 0.000002</i>	<i>(1 ± 0.000003)</i>
<i>D20151222</i>	<i>0.716771 ± 0.000002</i>	<i>(1 ± 0.000003)</i>
<i>D20160505</i>	<i>0.717343 ± 0.000002</i>	<i>(1 ± 0.000003)</i>
<i>D20160628</i>	<i>0.715799 ± 0.000002</i>	<i>(1 ± 0.000003)</i>
<i>D20160927</i>	<i>0.715156 ± 0.000003</i>	<i>(1 ± 0.000004)</i>



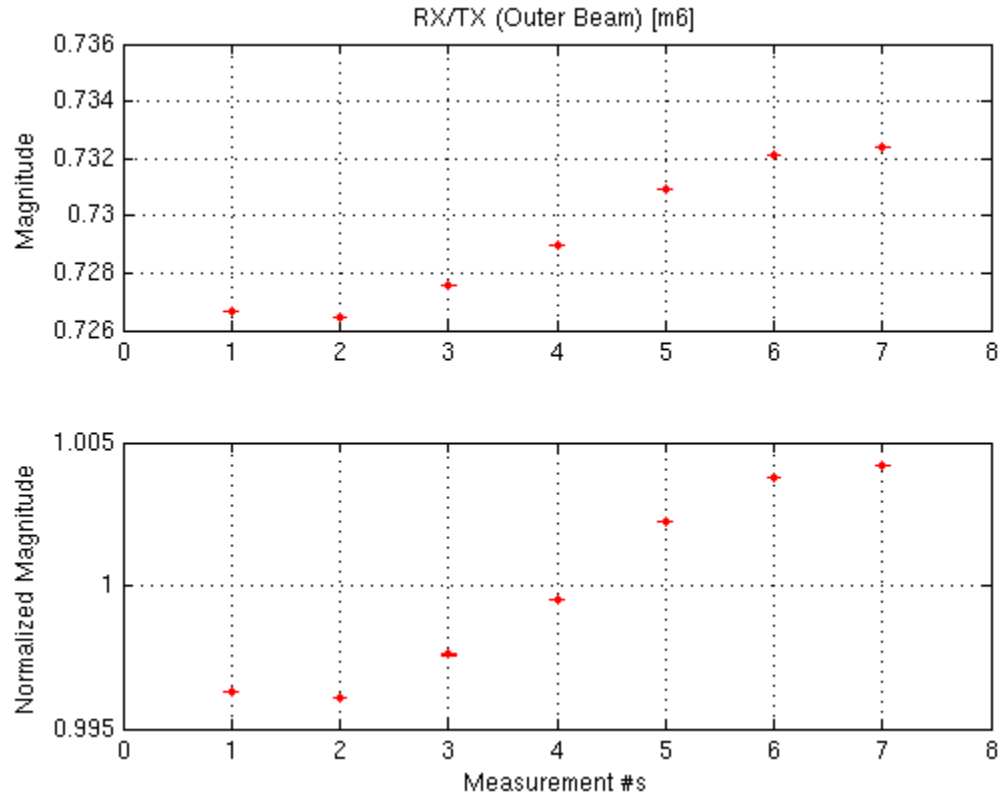
Summary of RX/TX (Inner Beam) [m5]:

Mean value: 0.716166
Standard deviation: 0.000810
Standard Error: 0.000330
Relative Standard Error: 0.000460

RX/TX Ratio (Outer Beam)

List of Measurements

Date	$m6 \pm SE_{\{m6\}}$	Normalized
D20150811	0.726657 ± 0.000003	(1 ± 0.000004)
D20150827	0.726468 ± 0.000002	(1 ± 0.000003)
D20151013	0.727582 ± 0.000002	(1 ± 0.000003)
D20151222	0.728972 ± 0.000002	(1 ± 0.000003)
D20160505	0.730960 ± 0.000002	(1 ± 0.000003)
D20160628	0.732089 ± 0.000003	(1 ± 0.000004)
D20160927	0.732393 ± 0.000002	(1 ± 0.000003)



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

Mean value: 0.729339
Standard deviation: 0.002394
Standard Error: 0.000974
Relative Standard Error: 0.001336

Optical Efficiency of Inner Beam

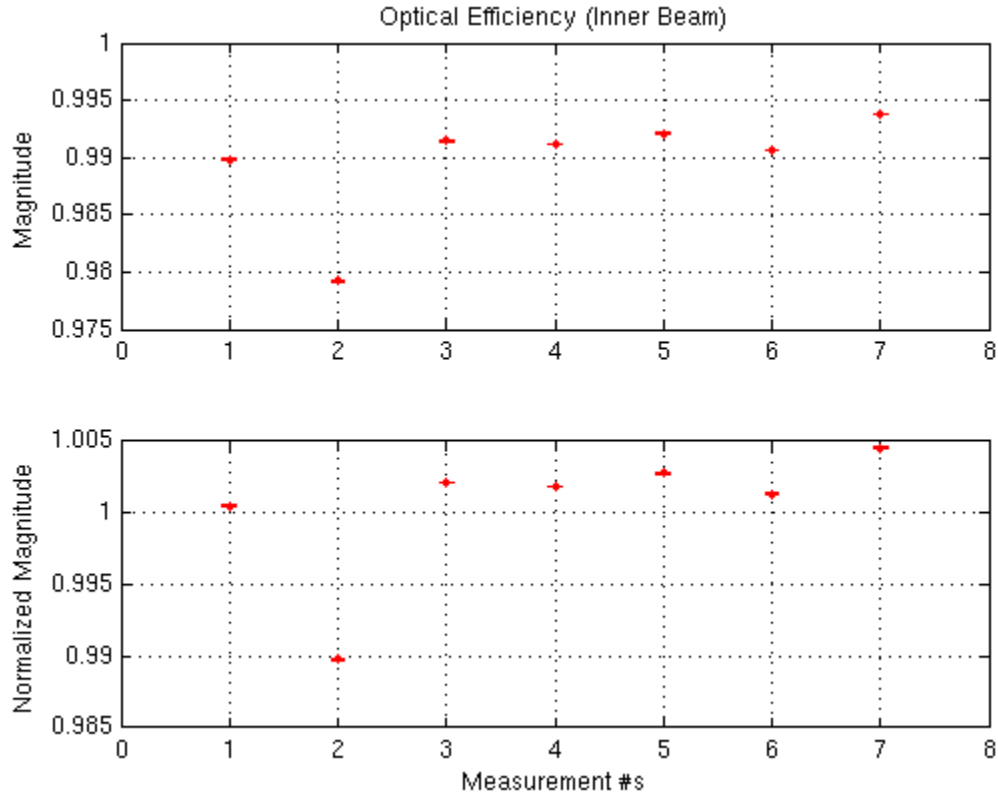
List of Measurements

Date	$e_i \pm SE_{\{e_i\}}$	Normalized
D20150811	0.989808 ± 0.000062	(1 ± 0.000062)
D20150827	0.979224 ± 0.000052	(1 ± 0.000053)
D20151013	0.991448 ± 0.000049	(1 ± 0.000049)
D20151222	0.991154 ± 0.000057	(1 ± 0.000058)
D20160505	0.992086 ± 0.000061	(1 ± 0.000061)
D20160628	0.990643 ± 0.000059	(1 ± 0.000060)

D20160927

0.993815 ± 0.000065

(1 ± 0.000065)



Summary of Optical Efficiency (Inner Beam):

Mean value: 0.989328
Standard deviation: 0.005117
Standard Error: 0.002082
Relative Standard Error: 0.002105

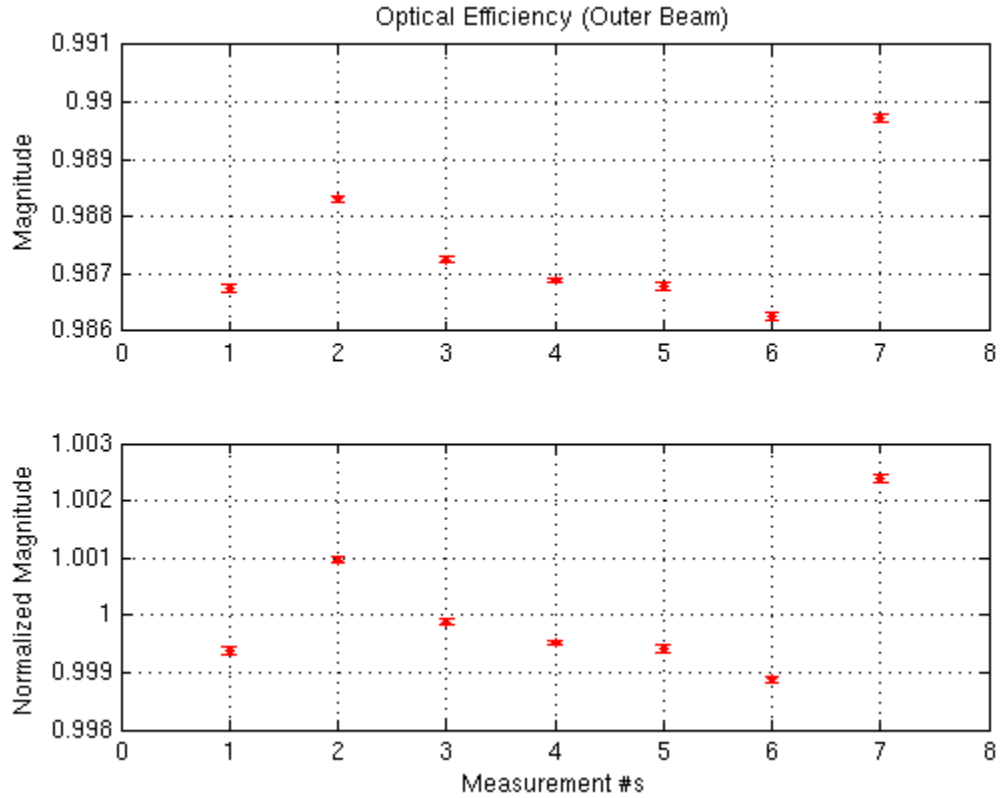
Optical Efficiency of Outer Beam

List of Measurements

<i>Date</i>	<i>$e_o \pm SE_{\{e_o\}}$</i>	<i>Normalized</i>
D20150811	0.986759 ± 0.000061	(1 ± 0.000062)
D20150827	0.988317 ± 0.000047	(1 ± 0.000047)
D20151013	0.987256 ± 0.000049	(1 ± 0.000050)
D20151222	0.986890 ± 0.000041	(1 ± 0.000041)
D20160505	0.986788 ± 0.000060	(1 ± 0.000061)

D20160628 0.986257 ± 0.000058 (1 ± 0.000059)

D20160927 0.989731 ± 0.000065 (1 ± 0.000066)



Summary of Optical Efficiency (Outer Beam):

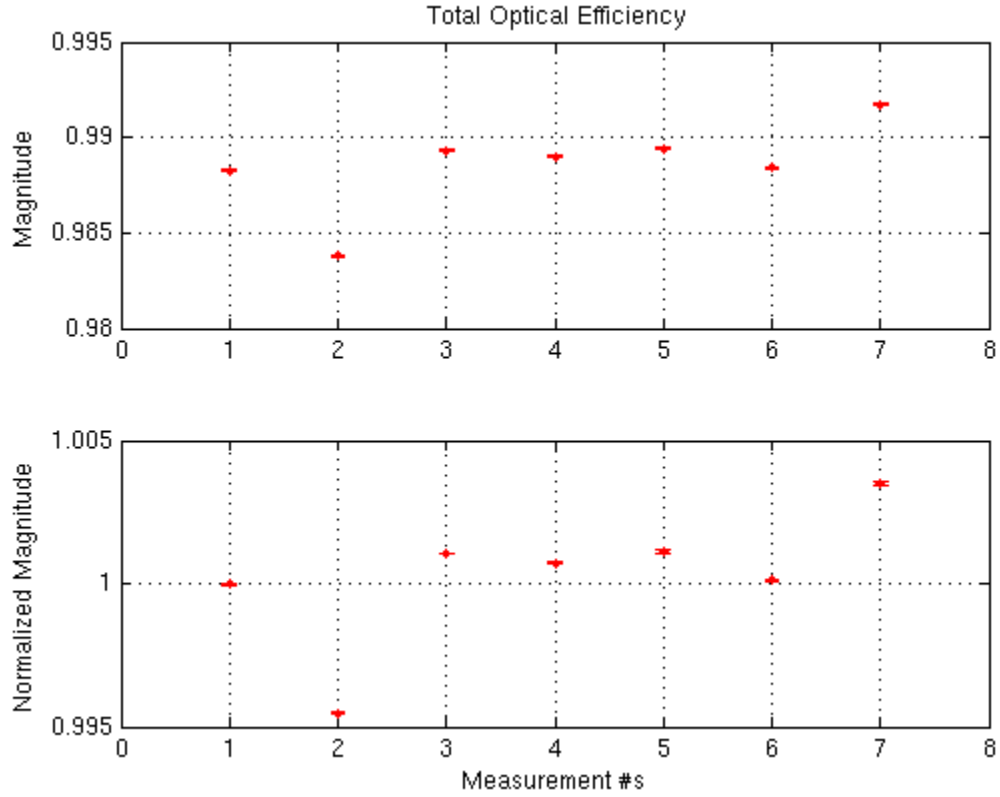
Mean value: 0.987367
Standard deviation: 0.001052
Standard Error: 0.000428
Relative Standard Error: 0.000434

Total Optical Efficiency

List of Measurements

<i>Date</i>	<i>e ± SE_{e}</i>	<i>Normalized</i>
<i>D20150811</i>	0.988271 ± 0.000043	(1 ± 0.000043)
<i>D20150827</i>	0.983810 ± 0.000034	(1 ± 0.000035)
<i>D20151013</i>	0.989331 ± 0.000034	(1 ± 0.000035)
<i>D20151222</i>	0.989000 ± 0.000035	(1 ± 0.000035)

<i>D20160505</i>	<i>0.989405 ± 0.000042</i>	<i>(1 ± 0.000043)</i>
<i>D20160628</i>	<i>0.988423 ± 0.000041</i>	<i>(1 ± 0.000041)</i>
<i>D20160927</i>	<i>0.991746 ± 0.000046</i>	<i>(1 ± 0.000046)</i>



Summary of Total Optical Efficiency:

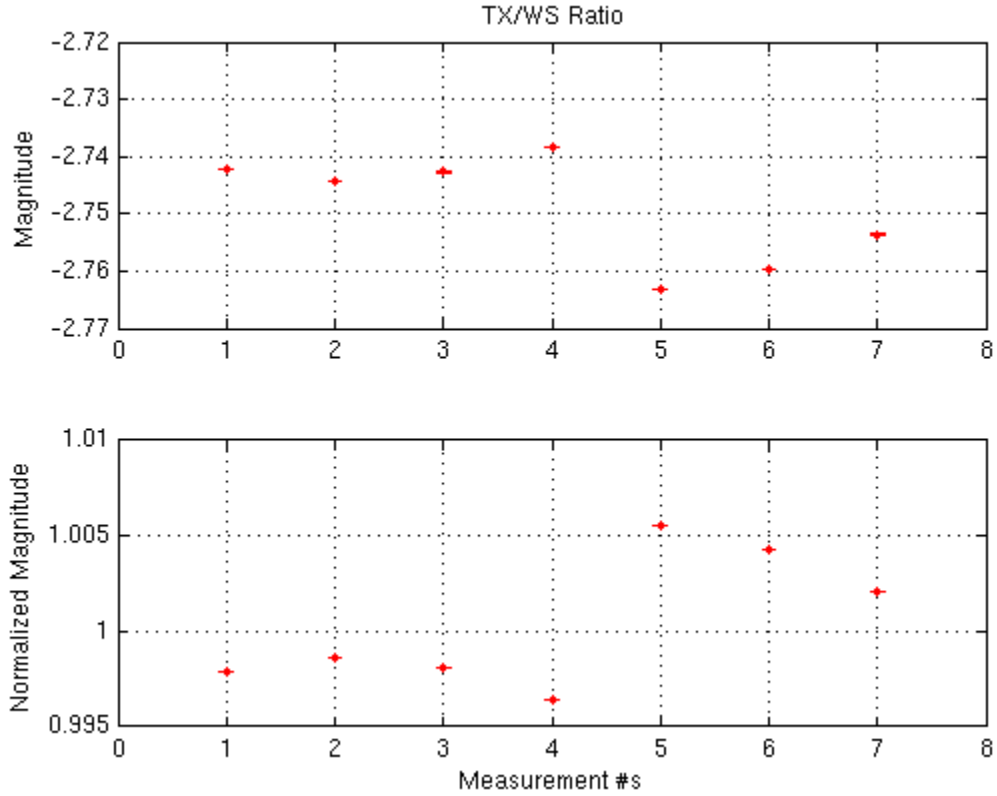
<i>Mean value:</i>	<i>0.988295</i>
<i>Standard deviation:</i>	<i>0.002480</i>
<i>Standard Error:</i>	<i>0.001009</i>
<i>Relative Standard Error:</i>	<i>0.001021</i>

TX/WS Ratio

List of Measurements

<i>Date</i>	<i>R_TW ± SE_{R_TW}</i>	<i>Normalized</i>
<i>D20150811</i>	<i>-2.742279 ± 0.000011</i>	<i>(1 ± 0.000004)</i>
<i>D20150827</i>	<i>-2.744228 ± 0.000009</i>	<i>(1 ± 0.000003)</i>
<i>D20151013</i>	<i>-2.742723 ± 0.000009</i>	<i>(1 ± 0.000003)</i>

<i>D20151222</i>	-2.738239 ± 0.000009	(1 ± 0.000003)
<i>D20160505</i>	-2.763161 ± 0.000011	(1 ± 0.000004)
<i>D20160628</i>	-2.759803 ± 0.000011	(1 ± 0.000004)
<i>D20160927</i>	-2.753569 ± 0.000011	(1 ± 0.000004)



Summary of TX/WS Ratio:

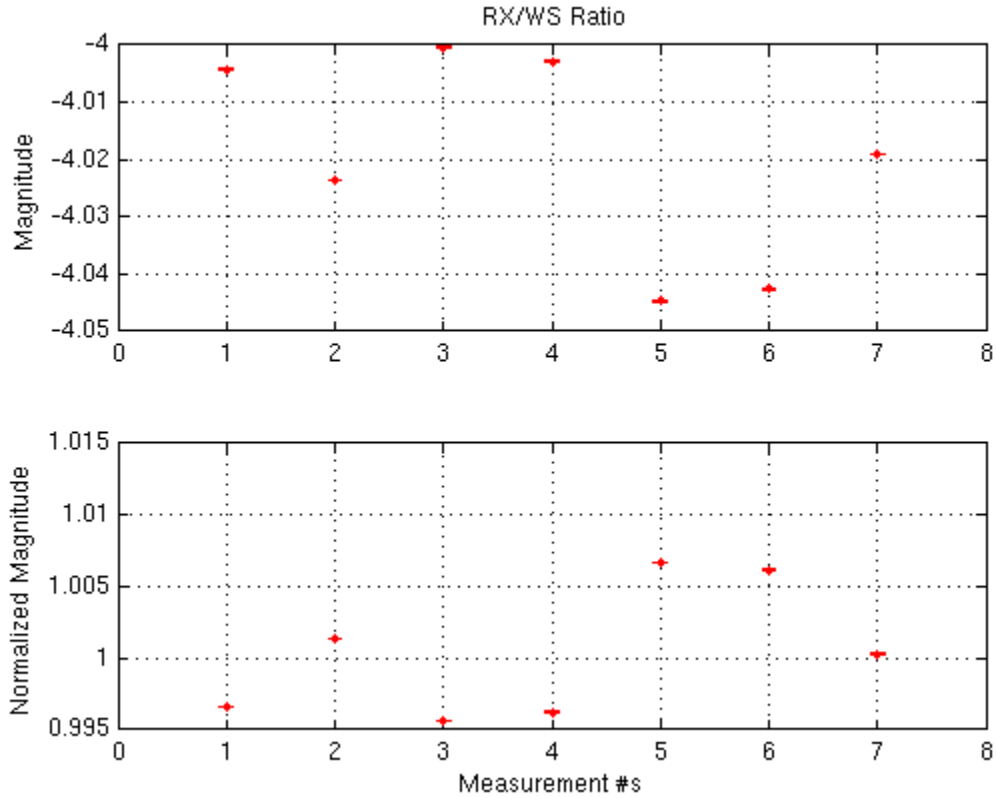
Mean value:	-2.747978
Standard deviation:	0.009404
Standard Error:	0.003827
Relative Standard Error:	0.001393

RX/WS Ratio

List of Measurements

<i>Date</i>	$R_{RW} \pm SE_{\{R_{RW}\}}$	<i>Normalized</i>
<i>D20150811</i>	-4.004239 ± 0.000126	(1 ± 0.000032)
<i>D20150827</i>	-4.023526 ± 0.000096	(1 ± 0.000024)

<i>D20151013</i>	<i>-4.000359 ± 0.000097</i>	<i>(1 ± 0.000024)</i>
<i>D20151222</i>	<i>-4.002816 ± 0.000096</i>	<i>(1 ± 0.000024)</i>
<i>D20160505</i>	<i>-4.044736 ± 0.000119</i>	<i>(1 ± 0.000029)</i>
<i>D20160628</i>	<i>-4.042655 ± 0.000118</i>	<i>(1 ± 0.000029)</i>
<i>D20160927</i>	<i>-4.019073 ± 0.000135</i>	<i>(1 ± 0.000033)</i>



Summary of RX/WS Ratio:

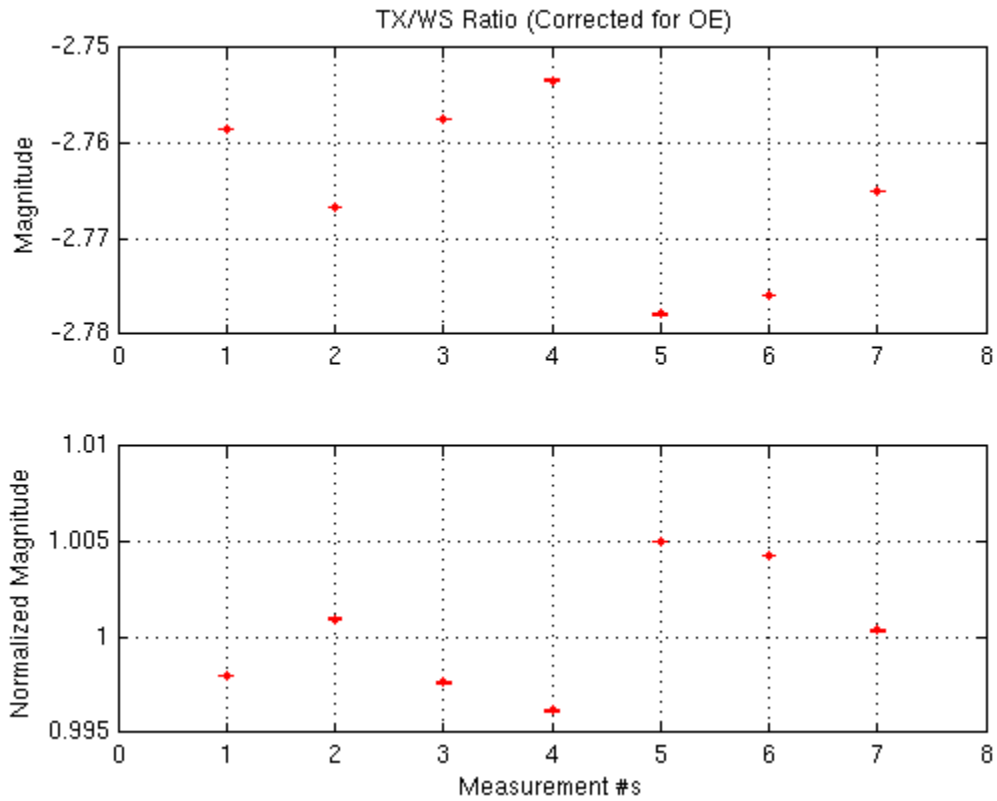
Mean value:	-4.017863
Standard deviation:	0.018302
Standard Error:	0.007448
Relative Standard Error:	0.001854

TX/WS Ratio (Corrected for OE)

List of Measurements

<i>Date</i>	<i>R_Twc ± SE_{R_Twc}</i>	<i>Normalized</i>
<i>D20150811</i>	<i>-2.758456 ± 0.000060</i>	<i>(1 ± 0.000022)</i>

D20150827	-2.766624 ± 0.000048	(1 ± 0.000017)
D20151013	-2.757433 ± 0.000048	(1 ± 0.000017)
D20151222	-2.753383 ± 0.000048	(1 ± 0.000018)
D20160505	-2.777877 ± 0.000059	(1 ± 0.000021)
D20160628	-2.775872 ± 0.000058	(1 ± 0.000021)
D20160927	-2.764980 ± 0.000064	(1 ± 0.000023)



Summary of TX/WS Ratio (Corrected for OE):

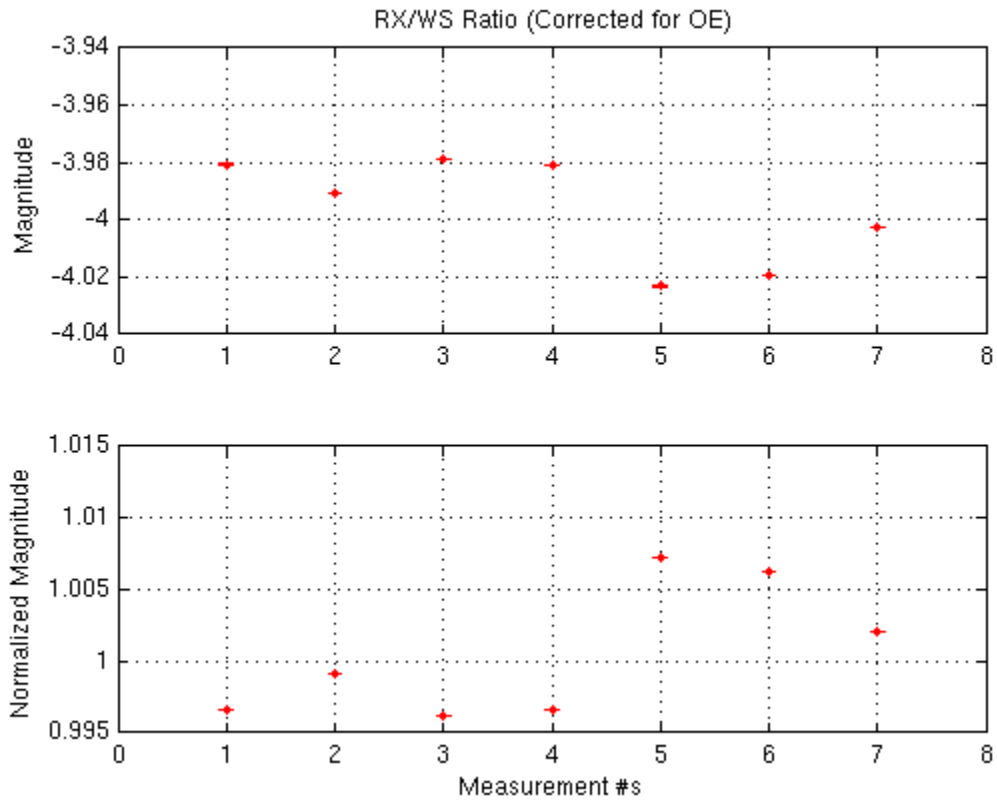
Mean value:	-2.763965
Standard deviation:	0.009236
Standard Error:	0.003759
Relative Standard Error:	0.001360

RX/WS Ratio (Corrected for OE)

List of Measurements

Date	$R_{Rwc} \pm SE_{\{R_{Rwc}\}}$	Normalized
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D20150811	-3.980617 ± 0.000087	(1 ± 0.000022)
D20150827	-3.990691 ± 0.000070	(1 ± 0.000018)
D20151013	-3.978905 ± 0.000069	(1 ± 0.000017)
D20151222	-3.980678 ± 0.000070	(1 ± 0.000018)
D20160505	-4.023196 ± 0.000086	(1 ± 0.000021)
D20160628	-4.019117 ± 0.000084	(1 ± 0.000021)
D20160927	-4.002417 ± 0.000092	(1 ± 0.000023)



Summary of RX/WS Ratio (Corrected for OE):

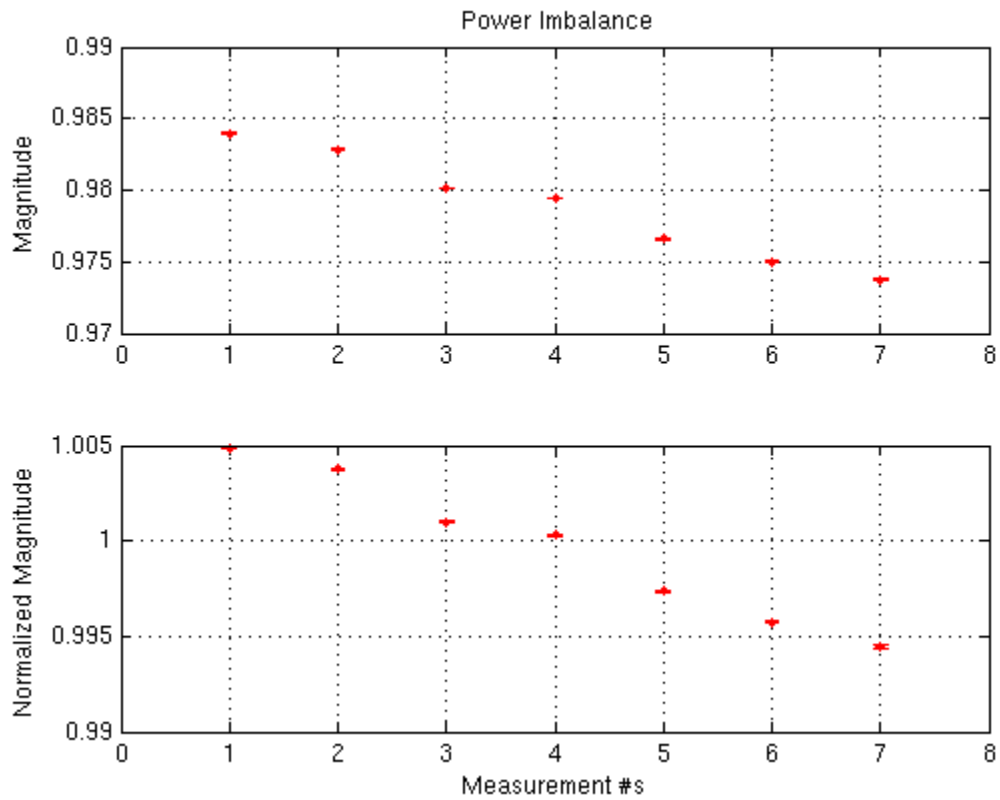
Mean value:	-3.994188
Standard deviation:	0.018164
Standard Error:	0.007392
Relative Standard Error:	0.001851

Power Imbalance

List of Measurements

LHOY-End RxPD and Tx-
PD Calibration Trends

D20150811	0.983938 ± 0.000059	(1 ± 0.000059)
D20150827	0.982844 ± 0.000050	(1 ± 0.000051)
D20151013	0.980135 ± 0.000048	(1 ± 0.000049)
D20151222	0.979459 ± 0.000051	(1 ± 0.000052)
D20160505	0.976585 ± 0.000060	(1 ± 0.000062)
D20160628	0.974999 ± 0.000057	(1 ± 0.000059)
D20160927	0.973728 ± 0.000061	(1 ± 0.000063)



Summary of Power Imbalance:

Mean value:	0.979162
Standard deviation:	0.003689
Standard Error:	0.001501
Relative Standard Error:	0.001533

Summary

Description	Value	Std Dev	Std Err	Rel Err:
OE (e)	0.9883	0.0025	0.0010	0.0010

LHOY-End RxPD and Tx-
PD Calibration Trends

<i>TX/WS (a1a2)</i>	<i>-2.7640</i>	<i>0.0092</i>	<i>0.0038</i>	<i>0.0014</i>
<i>RX/WS (b1b2)</i>	<i>-3.9942</i>	<i>0.0182</i>	<i>0.0074</i>	<i>0.0019</i>
<i>W (a5)</i>	<i>1.0000</i>	<i>----</i>	<i>----</i>	<i>0.0034</i>

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