March 28, 2018

ILRS Quality Control Board (QCB)
Telecon
March 28 2018

Next meeting: Wednesday, April 25 at 13:00 UTC, 09:00 EDT, 14:00 in UK; 15:00 in Central Europe; 22:00 in Japan.

Participants: Frank Lemoine, Carey Noll, Toshi Otsubo, Erricos Pavlis, Mike Pearlman, Matt Wilkinson, Tom Varghese, Alexandre Belli

SLR Data Residuals (Horst)

The features in the residual plots (shown in last month's report) appear to be solely due to Ajisai, and are probably a result of the array pattern. This may be of interest to those using this satellite for their research, but do not appear to have influence on the reference frame of the POD on active satellites.

Mt. Stromlo Data Bias Issues

On November 8, Mt. Stromlo corrected a software bug of about a cm. in their current (manual) data processing system. They believe that this system is now working properly, but any correction of back data awaits validation by the SSEM PP that the current data is now bias free.

In parallel they are developing an automated system which is being tested on-site. When it is ready it will be tested in quarantine through the SSEM PP to assure its quality, and then used operationally and as a means of correcting the back log. We probably will not know the full story until the history of biases (first for the legacy systems and then for the automated systems) is revealed by the System Bias Pilot Project Analysis.

Discussions have been underway on the difference in performance in ranging to the two LAGEOS satellites shown in last month's report; this may be the result of the different inclinations. Any other thoughts?

Station Systematic Error Monitoring Pilot Project-- SSEM PP (Erricos)

ASI, BKG, GFZ, JCET, and NSGF have submitted their SSEM PP series for 1993 to present; still awaiting submissions from DGFI and ESA; arrangements were made to store these test results at EDC; the combination process will start momentarily at ASI so results can be discussed at the ASC in Vienna; the delinquent ACs can be added later; the combination process will lead to the bias model which will be the benchmark representation to be used in the reanalysis process for the next ITRF.

Jose is working on the revised CoM corrections for the spherical satellites, but they will not be ready until sometime this summer. Current modeling errors in the satellites will be recovered as part of the biases from the solutions; the final reanalysis for the ITRF will have to wait until after the fall. The new process will then become an operational tool for monitoring station performance and extending the SSEM model.

Web Based Station Performance Tool (Erricos)

The tool is fully operational since last summer (http://geodesy.jcet.umbc.edu/QC/). The ITRF 2014 updated data set from the Russians with proper span of ITRF 2014 (going back to June 2016) is not available, but it does run back now for nearly a year, so their values on the web are

consistent with those from the other ACs. Erricos is adding capability to the website to display series from multiple ACs at the same time. Erricos expects this tool to evolve as inter-comparisons are made among the results from the different AC and that it will eventually be converted to a web-based too.

Data Issues

Matt has made the routines for analyzing calibration data available to the Russians; this should allow them to correct the missing calibration information in their CRD data format. A link is available to access these routines through the ILRS website

Current and back data (to early January 2018) is now flowing from the Russian stations.

Site Logs

Christian is finishing up his software for the editing process and the transfer of current site log information into the new format. Some new fields having to do with the start circuit

are being added to site log format. Randy will manage the implementation with the field stations and work with Carey and Christian to update the related ILRS webpages.

We have agreed to give the stations 90 days (from completion of set up) to update their site logs. We should specify the expected reporting time for site log updates.

The update of the site logs from the NASA stations awaits past survey information that seems to require the attention of Jim Long; the questions here are: Is this something that can get done in the short term? and Have these site logs been brought up to date in every other respect?

Range Dependent Errors

This topic will wait for the new center of mass corrections and will be left to the systems bias activity. No center of mass values has been generated for the Wettzell SOS system.

Full-Rate Data and NP Testing

A summary chart on the current status of the FR data submission is shown in Attachment 1. Some of the Russian stations have begun sending FR data; some other stations are not sending FR for all satellites.

ACTION Mike: remind station that are not fully compliant that we need all of their FR data.

Matt is working on the NP software to make it more easily transferable; he will then do the NP studies with first priority on the spherical geodetic satellites.

It appears that the satellite center-of-mass corrections generated by Graham for the network stations take consideration of the n-sigma data filtering criteria used for each station, but not the number of iterations allowed. This may be too complicated. This will require some more discussion. Are Graham and Jose using the criteria?

Low Elevation Data Modeling

Stefan Riepl is examining the impact of different ways of calculating NPs. He and Horst are planning to submit an article for the JoG Special Issue on SLR (JOGSILR).

Satellites Center-of-Mass Parameters on New Satellites

Missions are expected to provide all of the physical information required for the C/M correction models. In some cases, the correction models may be developed from laboratory measurements

or from using already standard arrays (LEO and GNSS). The final correction model will be derived from ranging measurements once in orbit.

We should establish a target signal group to fulfill this roll, including perhaps Dave A., Toshi, Jose, etc.

Data Population on LAGEOS and Other Satellite Passes

Work continues at CDDIS to provide reports in terms of passes. It was suggested that we define a pass for synchronous satellites as all the data taken by a station over 24 hours, starting at 00:00 hours UT. At some point, we may want to make the transition to passes, but at the moment both passes and pass segments may be available.

The Study Group tasked with recommending new criteria for evaluating (and rewarding) station performance (rather than just number of passes) has sent out a list of criteria for feedback and suggestions.

The CB should also issue a document of best practices for tracking operations including pass coverage and time separation of calibrations.

Station Tools

The Forum has been quiet. Don't be shy. Matt has started discussion on this within the Networks and Engineering Standing Committee and on the forum on stations tools and practices that might be useful. Toshi has asked that the forum have a section on satellite missions.

Other Topics

Alexandre Belli was visiting and showed some very interesting charts on the power of accurate timing as determined using T2L2 (i.e., time bias seen by GPS tagged by T2L2). Time bias (microseconds) and timing RMS shows discontinuities and other trends that are seem correlated with changes in stations configuration or events that may have been associated with such change. This is far more sensitive that the current analysis that we are doing with examination of orbital features. This seems to come free in the sense that stations need only range properly to T2L2, which unfortunately in nearing end of life. It looks like changes of a few 10's of nsec can reveal system issues. This looks like a very powerful tool for SLR. (See charts in Attachment 2).

In our 1 mm long-term interest, it probably is a good idea to do a rigorous component-by-component examination of the SLR systems, trying to understand all error sources in measurements. We should discuss this with Ivan Prochazka.

Next Meeting

Wednesday, April 25 at 13:00 UTC, 09:00 EDT, 14:00 in UK; 15:00 in Central Europe; 22:00 in Japan. Telecon info: Passcode: 317382, international phone numbers:

USA (toll free)	1-844-467-4685
Austria (toll free)	0 800 006 089
Austria, Vienna	+43 (0) 1 25301 0163
France (national)	0 811 655 211
France (toll free)	0 800 949 765
France (toll free)	0 805 101 207
France, Paris	+33 (0) 1 70 37 14 61
Germany (national)	0 1801 003 798

Italy (toll free)	0 800 977 597
Italy, Rome	+39 06 452 366 22
Japan (toll free)	0 066 3386 1015
Japan, Osaka	+81 (0) 6 4560 2100
Japan, Tokyo	+81 (0) 3 4560 1264
UK (national)	0 845 355 5040
UK (toll free)	0 800 358 8173
UK (toll free)	0 800 279 4867

Germany (toll free)	0 800 320 2291	UK London	+44 (0) 20 7154 2976
Germany (toll free)	0 800 589 1850		
Germany, Frankfurt	+49 (0)69 66777 5747		
Germany, Munich	+49 (0) 89 7104 24681		

ATTACHMENT 1

SLR Normal Point/Full-Rate Summary
(January 01-March 26, 2018)

as of March 27, 2018

Site Name	Sta.	NPTs					Full-Rate				
		#Sats.	Pass Segs.	Points	Start Date	End Date	#Sats.	Pass Segs	Points	Start Date	End Date
Altay	1879	50	971	4,507	20180101	20180322					
Arequipa	7403	18	108	900	20180102	20180322	18	108	9,884	20180102	20180322
Arkhyz	1886	40	134	746	20180106	20180325					
Badary	1890	28	454	3,978	20180101	20180324	28	468	668,585	20180101	20180324
Baikonur	1887	19	158	653	20180115	20180316					
Beijing	7249	71	952	6,351	20180116	20180325	70	908	3,945,148	20180116	20180325
Borowiec	7811	24	318	4,383	20180105	20180326	24	312	180,346	20180105	20180325
Brasilia	7407	29	42	260	20180109	20180302					
Changchun	7237	76	3,714	29,822	20180101	20180325	76	3,688	35,249,115	20180101	20180325
Grasse	7845	15	164	1,617	20180111	20180326	10	83	224,393	20180111	20180323
Graz	7839	71	974	13,069	20180102	20180323	53	302	9,669,904	20180306	20180323
Greenbelt	7105	49	2,050	31,828	20180102	20180320	49	2,049	2,218,304	20180102	20180320
Haleakala	7119	22	361	5,172	20180101	20180319	22	361	143,599	20180101	20180319
Hartebeesthoek	7501	32	140	1,234	20180118	20180325	32	139	86,624	20180118	20180325
Herstmonceux	7840	72	2,036	18,209	20180101	20180323	72	2,035	17,379,053	20180101	20180323
Irkutsk	1891	47	587	3,975	20180109	20180323	44	495	1,381,958	20180131	20180323
Katzively	1893	27	327	3,171	20180102	20180325	27	324	37,829	20180102	20180325
Kiev	1824	18	100	718	20180105	20180326	18	100	4,971	20180105	20180326
Komsomolsk	1868	50	844	3,947	20180102	20180324					
Kunming	7819	73	1,655	13,449	20180104	20180322	60	291	1,285,449	20180117	20180228
Matera	7941	55	1,360	10,890	20180101	20180321	55	1,360	1,519,292	20180101	20180321
McDonald	7080	17	93	890	20180119	20180302	17	93	40,784	20180119	20180302
Mendeleevo	1874	20	48	714	20180110	20180301	13	22	68,680	20180207	20180213
Monument Peak	7110	49	1,538	18,019	20180102	20180323	49	1,538	1,446,564	20180102	20180323
Mount Stromlo	7825	70	2,852	29,694	20180101	20180325	69	2,747	4,498,928	20180101	20180325
Potsdam	7841	62	1,407	19,782	20180101	20180325	6	73	670,819	20180103	20180321
Riga	1884	24	155	2,301	20180107	20180324	21	115	69,650	20180112	20180324
Sejong	7394	17	37	689	20180124	20180201	17	37	1,543,131	20180124	20180201
Shanghai	7821	74	1,746	12,151	20180101	20180325	72	1,231	21,045,411	20180122	20180325
Simeiz	1873	41	368	3,739	20180103	20180325	40	360	24,550	20180103	20180324
Simosato	7838	17	554	8,621	20180104	20180326	17	544	230,408	20180104	20180323
Tahiti	7124	33	255	3,002	20180111	20180323	33	255	119,513	20180111	20180323
Wettzell SOS	7827	69	1,278	9,374	20180108	20180326					
Wettzell	8834	68	1,106	7,284	20180106	20180320	67	949	563,547	20180106	20180319
Yarragadee	7090	75	11,202	87,912	20180101	20180326	75	11,128	2,882,616	20180101	20180324
Zelenchukskaya	1889	38	113	547	20180102	20180321	38	120	140,054	20180102	20180321
Zimmerwald	7810	63	1,241	14,002	20180101	20180326	61	988	2,272,709	20180101	20180325
Totals:	37		41,442	377,600				33,223	109,621,818		

Sites we should go after in a first round and ask them to submit all (or more) FR data

Sites that submit all or most of their FR data already

Red Pass segments indicate that less FR data are submitted vs. NPs from that site

ATTACHMENT 2

Technology changes in MOBLAS

and recent TB evolution

Seen by T2L2

Quick-Check on-line (T2L2)

www.geoazur.fr/t2l2/en/data/v4

1: ground to space (TB seen by GPS, tagged by T2L2)

2: date (dd/mm/yyyy) & station selection

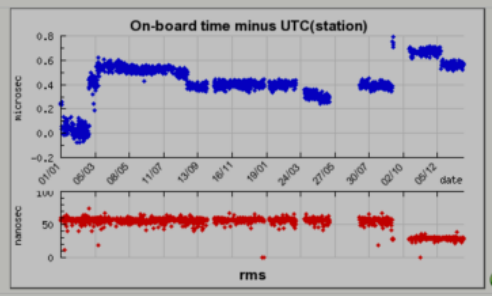
3: plot

4: data table

5: download

Help | Station | Board | Ground to Space | Ground to Ground | DORIS oscillator | Ephemeris | Obs 2016 | Obs 16-08 | Obs 16-09 | Obs 16-10 | Obs 16-11 | Obs 16-12

Start : 01-01-2016
End : 01-03-2018
Station : 7090 Yarragadee
UTC(station)
Get all files for one day by email
Download CrdReader.jar
Data Table
Help



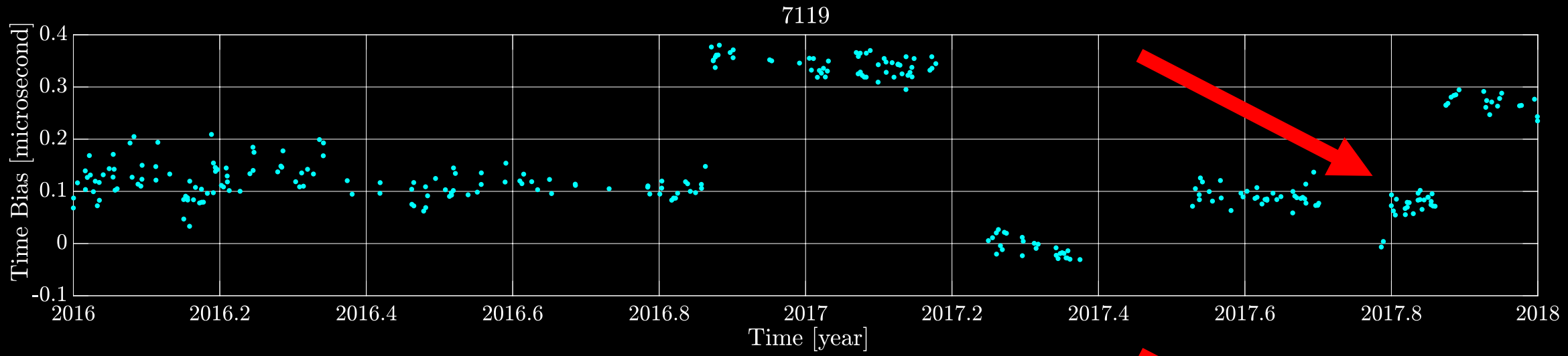
Date		# Passage (click for graph)	Start	End	Shots nb	Triplets nb	Energy Max (μJoul/m²)	Onboard time minus ground time (μs)	rms (ns)
57388	01/01/2016	1	18:12:23	18:20:08	1801	1576	78.671	+0.2366	**56.265**
57389	02/01/2016	1	06:37:52	06:44:43	252	245	38.417	+0.2490	**59.562**
57389	02/01/2016	2	08:30:46	08:41:33	1264	984	122.370	+0.2416	**57.483**
57389	02/01/2016	3	16:33:21	16:42:58	725	721	58.648	+0.2597	**57.843**
57389	02/01/2016	4	18:27:31	18:42:24	3841	3314	155.571	+0.2358	**57.724**
57390	03/01/2016	1	06:58:45	07:10:09	1870	1639	50.440	+0.0547	**55.666**
57390	03/01/2016	2	17:01:26	17:05:21	87	85	37.139	+0.0315	**57.595**
57393	06/01/2016	1	06:12:31	06:20:23	591	572	54.071	+0.1312	**57.025**
57393	06/01/2016	2	08:05:43	08:18:20	1082	980	69.098	-0.0142	**58.396**
57393	06/01/2016	3	18:07:56	18:11:26	84	75	33.565	+0.0040	**61.830**
57394	07/01/2016	1	08:29:34	08:38:51	77	76	26.584	-0.0054	**57.255**
57394	07/01/2016	2	18:30:22	18:30:57	19	19	46.999	+0.0297	56.758
57395	08/01/2016	1	06:54:00	07:06:08	705	611	65.185	+0.0512	**56.934**
57395	08/01/2016	2	08:57:24	09:00:17	7	6	16.900	+0.0309	11.020
57395	08/01/2016	3	15:02:12	15:04:20	30	29	37.249	+0.0983	50.922
57395	08/01/2016	4	16:52:51	17:06:07	2352	2115	101.239	+0.0367	**57.150**
57396	09/01/2016	1	05:23:51	05:31:45	72	72	19.721	+0.0659	**57.343**
57396	09/01/2016	2	07:17:36	07:29:19	254	245	52.778	+0.0123	**57.735**
57396	09/01/2016	3	17:19:31	17:25:34	1229	1050	98.057	+0.0233	**57.605**
57397	10/01/2016	1	05:45:06	05:55:53	240	227	37.558	+0.0771	**55.516**
57397	10/01/2016	2	07:40:30	07:52:02	259	258	27.476	+0.0017	**58.001**
57397	10/01/2016	3	15:41:11	15:54:44	1734	1677	141.705	+0.0563	**56.093**
57397	10/01/2016	4	17:38:45	17:49:28	169	167	77.991	+0.0530	**52.086**
57398	11/01/2016	1	06:07:36	06:19:53	1033	790	125.623	+0.0527	**56.409**
57398	11/01/2016	2	08:05:11	08:11:10	160	159	23.005	-0.0105	**55.361**
57398	11/01/2016	3	14:11:16	14:15:31	36	35	31.000	+0.0916	63.193
57398	11/01/2016	4	16:04:09	16:18:09	2438	2103	141.620	+0.1175	**56.571**
57399	12/01/2016	1	04:40:01	04:42:58	25	24	19.425	+0.1205	63.979
57399	12/01/2016	2	06:30:04	06:42:07	882	785	76.594	+0.0431	**56.476**
57399	12/01/2016	3	16:28:37	16:35:22	73	63	33.540	+0.0860	**46.861**
57400	13/01/2016	1	04:58:38	05:07:56	260	245	61.075	+0.0676	**57.032**

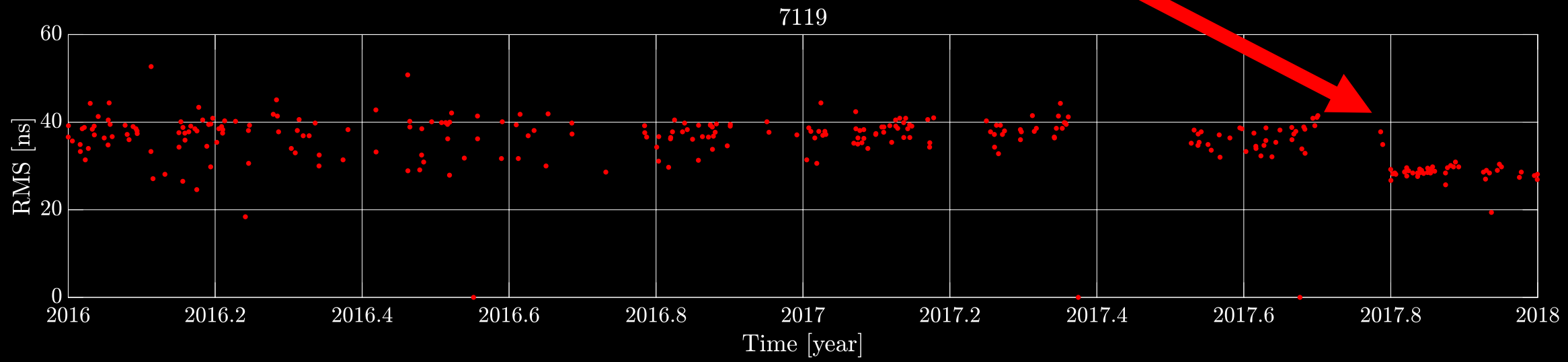
V4.2 15/06/2016 #visits : 2490

Accuracy: PPS GPS
Around +/- 15 ns

TLRS 4 (7119) 10/17/2017

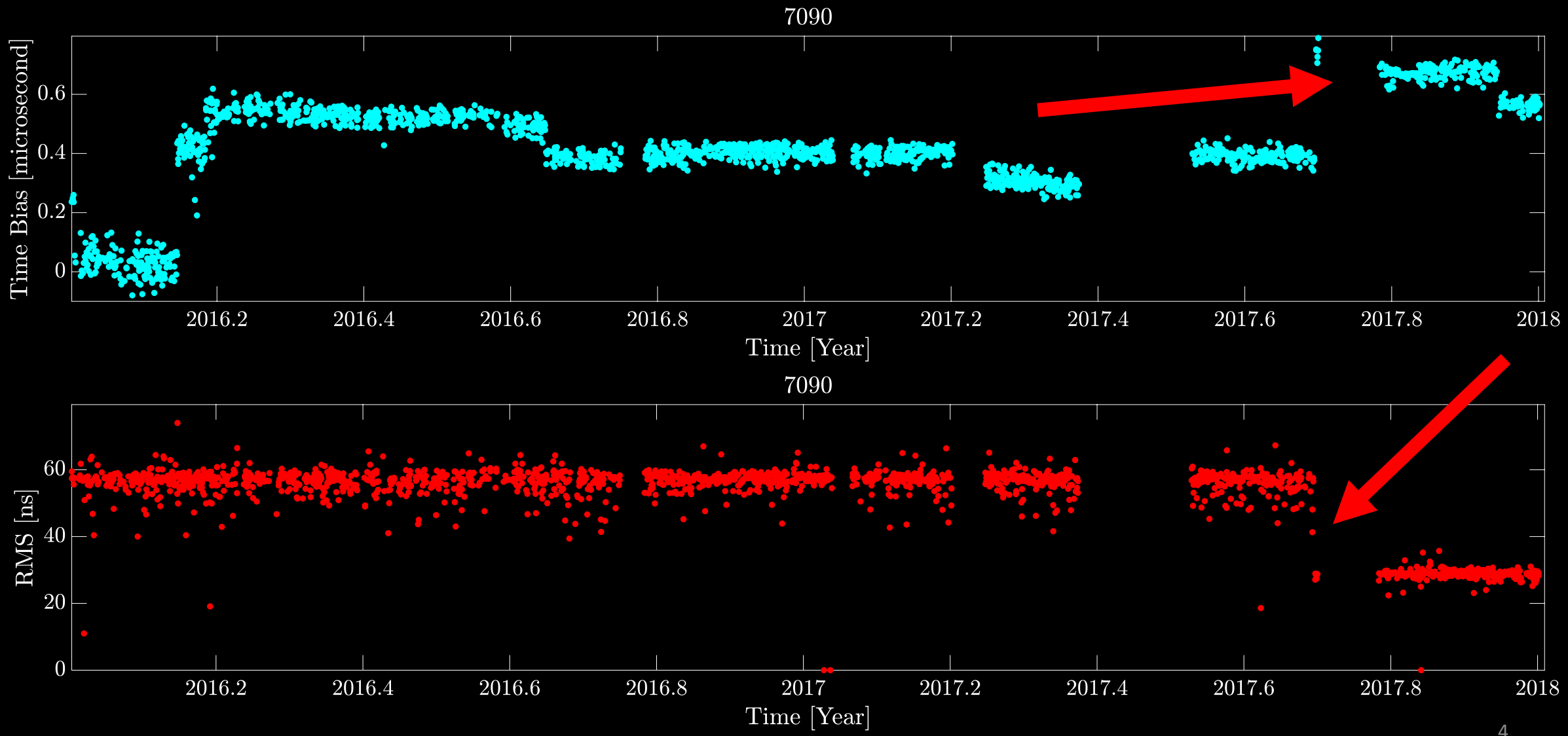
10/16: 0.004 microseconds to 0.07 microseconds the 10/19



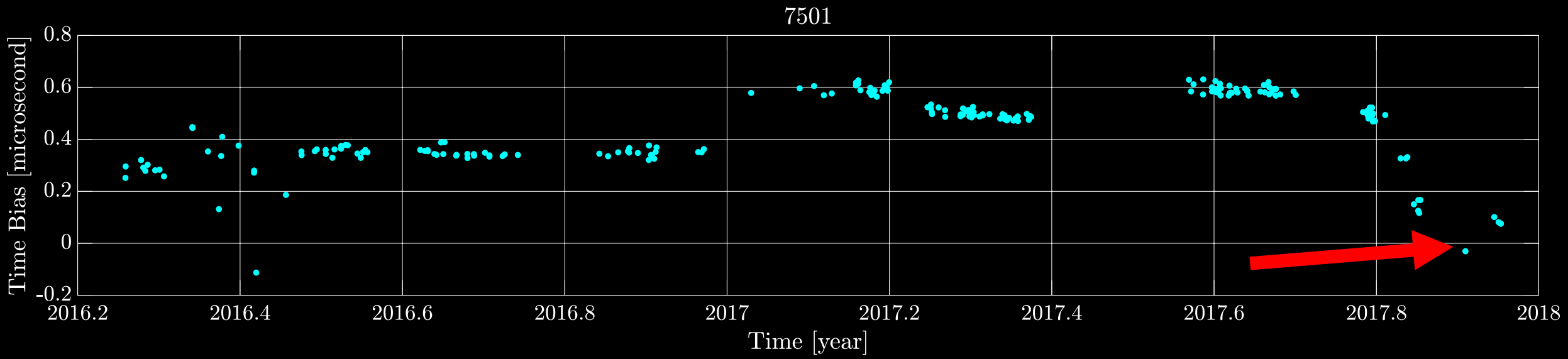


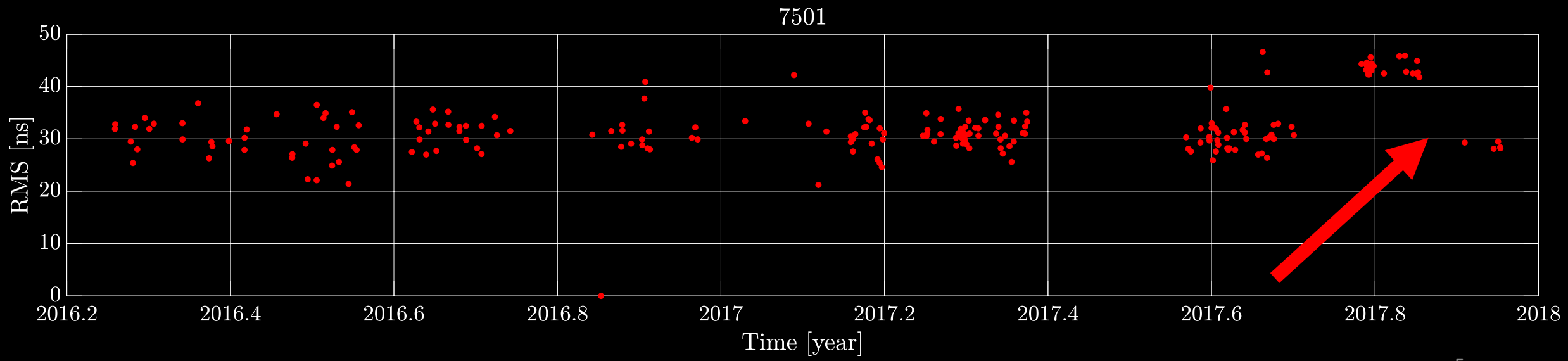
Moblas 5 (7090) 9/11/2017

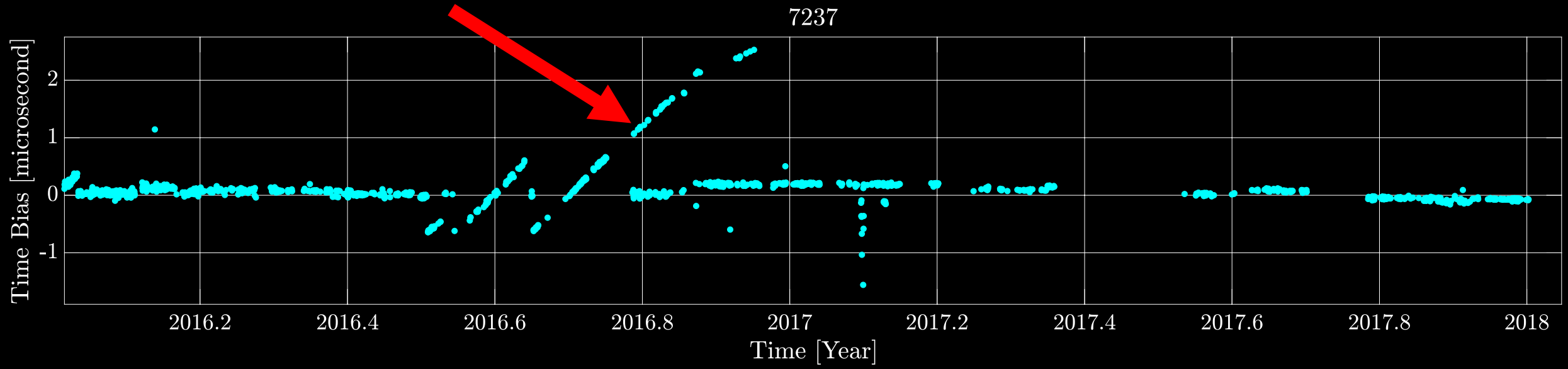
Between the 9/11 and 9/12 +0.37 microseconds !!

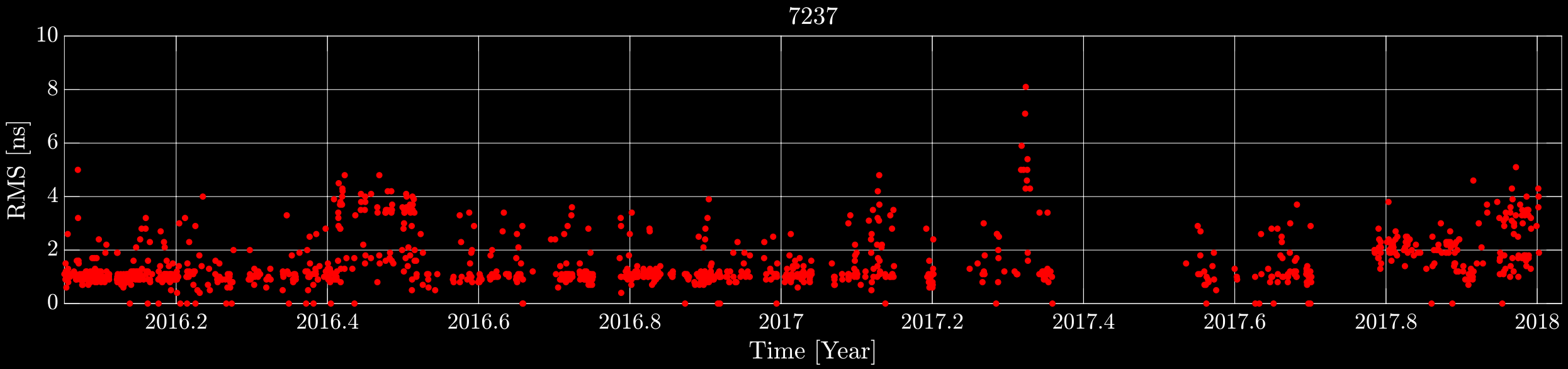


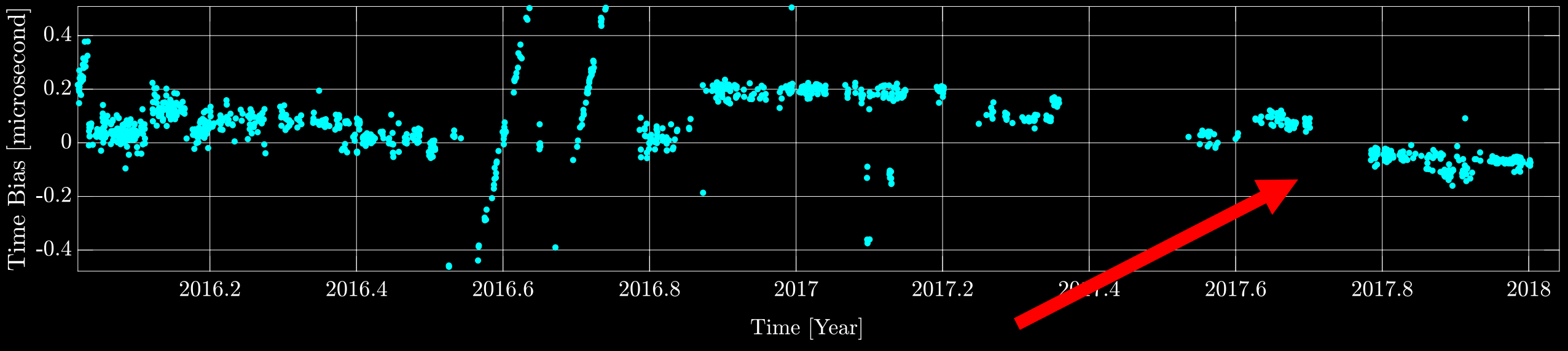
Moblas 6 (7501) 11/29/2017

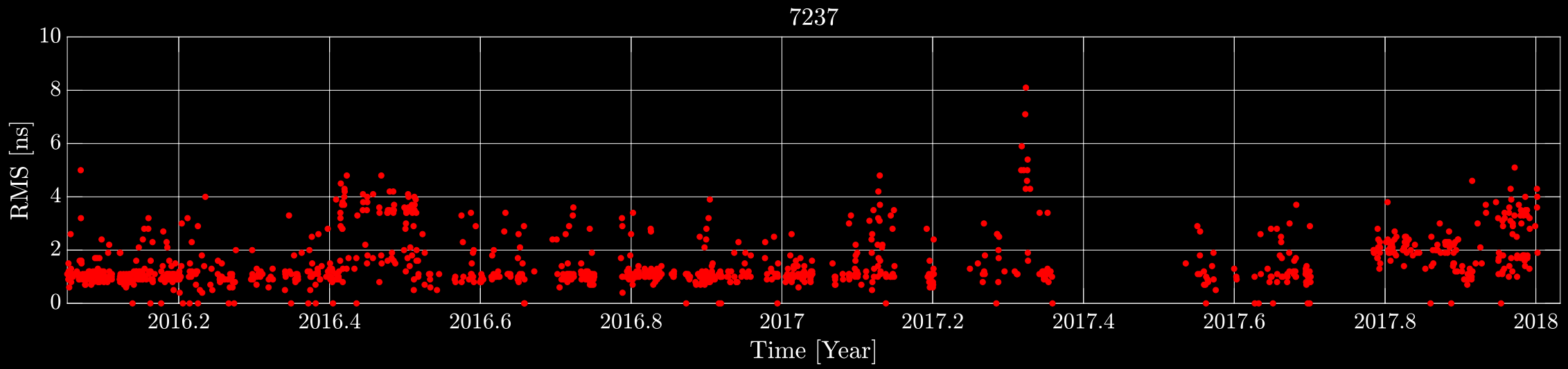





7237
Time Bias [microsecond]
2
1
0
-1
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]

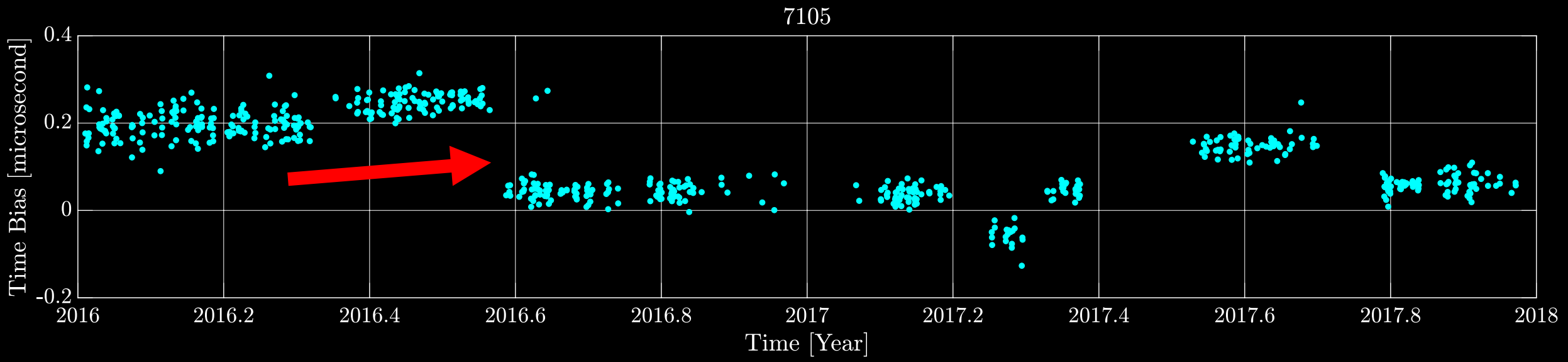

7237
RMS [ns]
10
8
6
4
2
0
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]

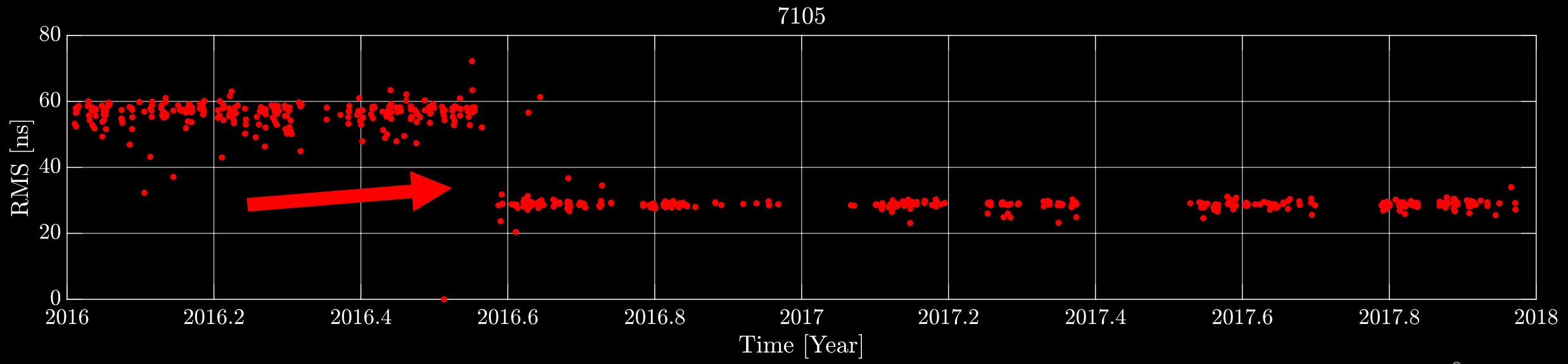

Time Bias [microsecond]
0.4
0.2
0
-0.2
-0.4
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]

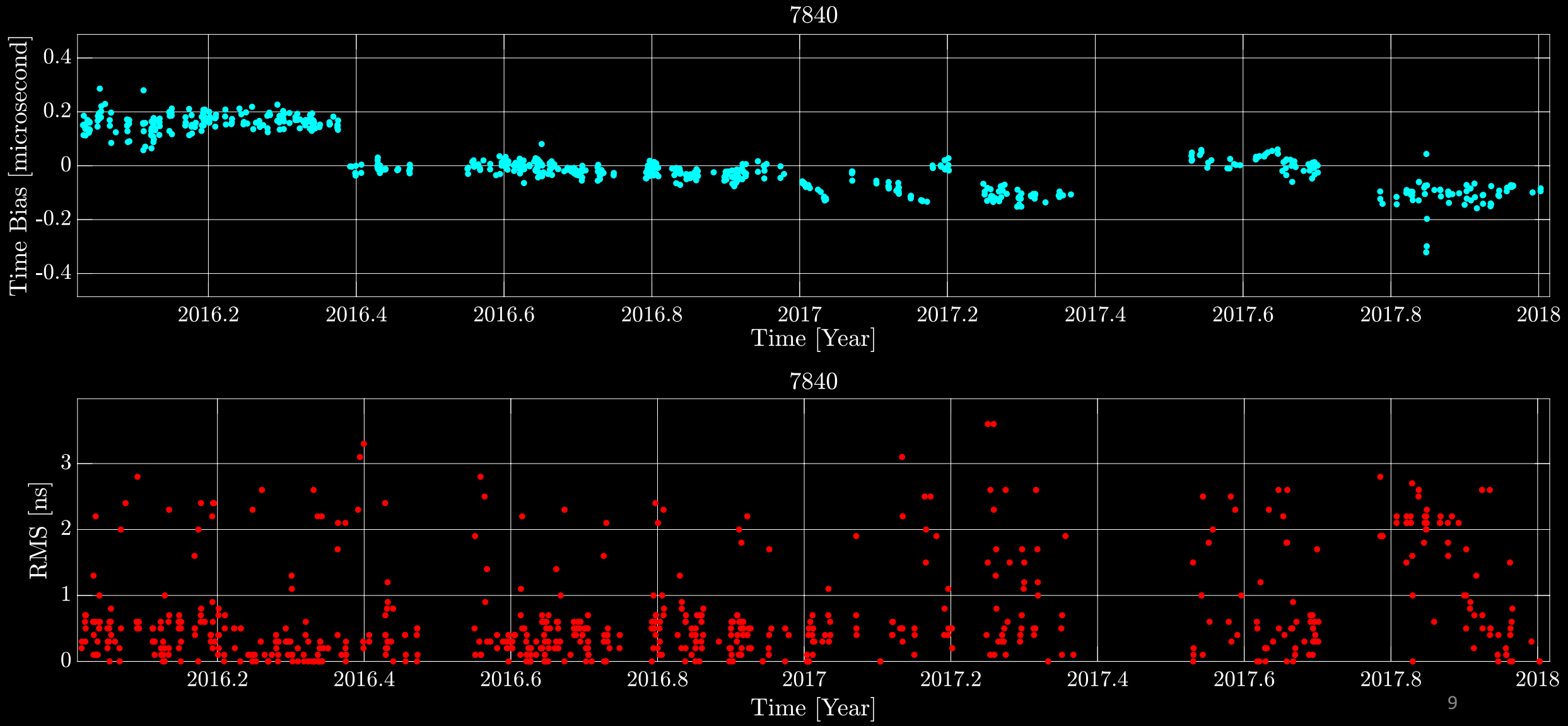

7237
RMS [ns]
10
8
6
4
2
0
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]

Moblas 7 (7105) 7/27/2016

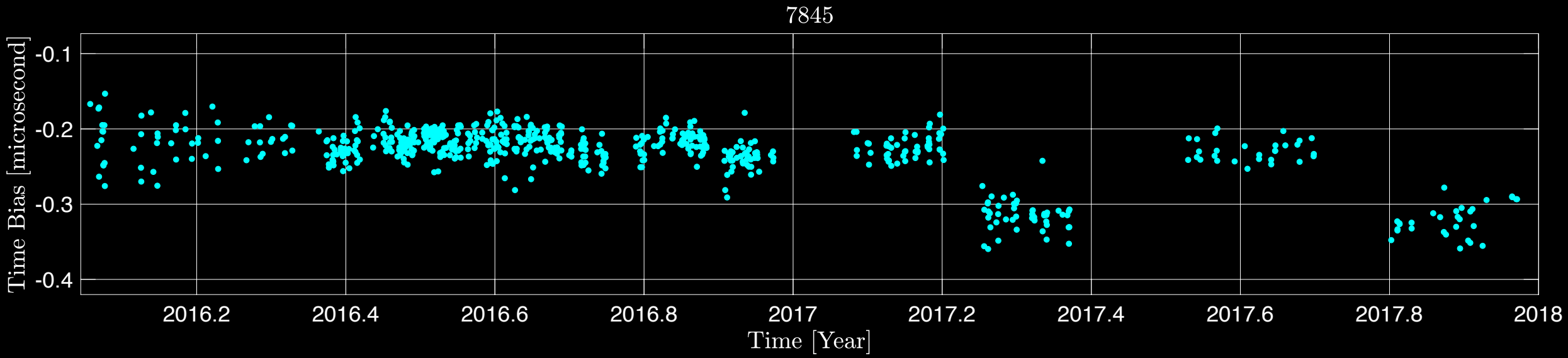
07/25 0.23 micros to around 0.05 micros after

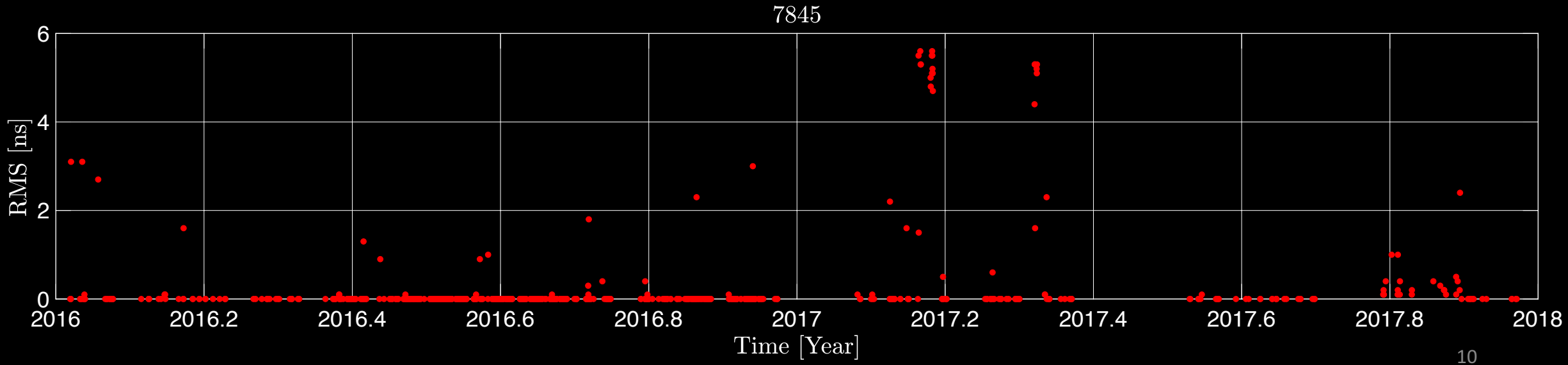


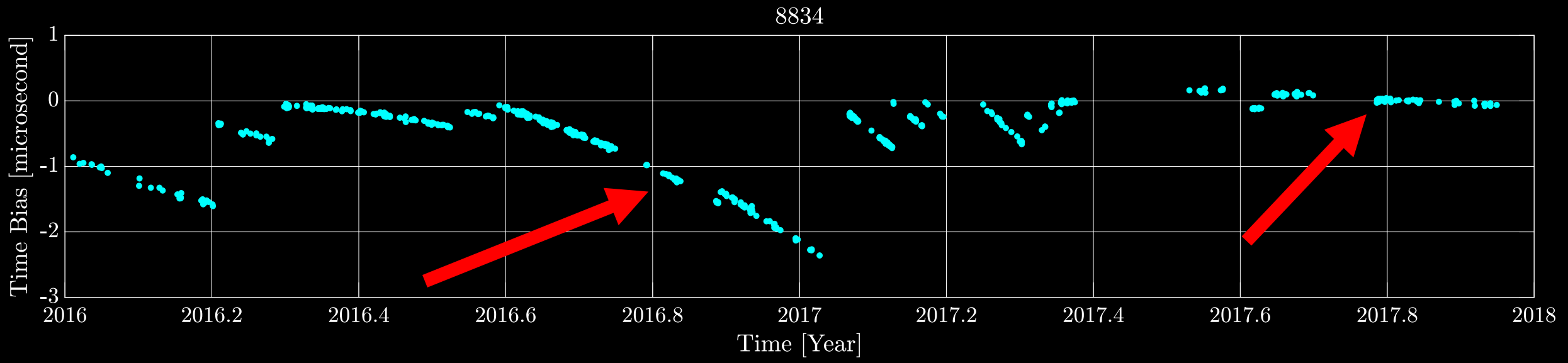


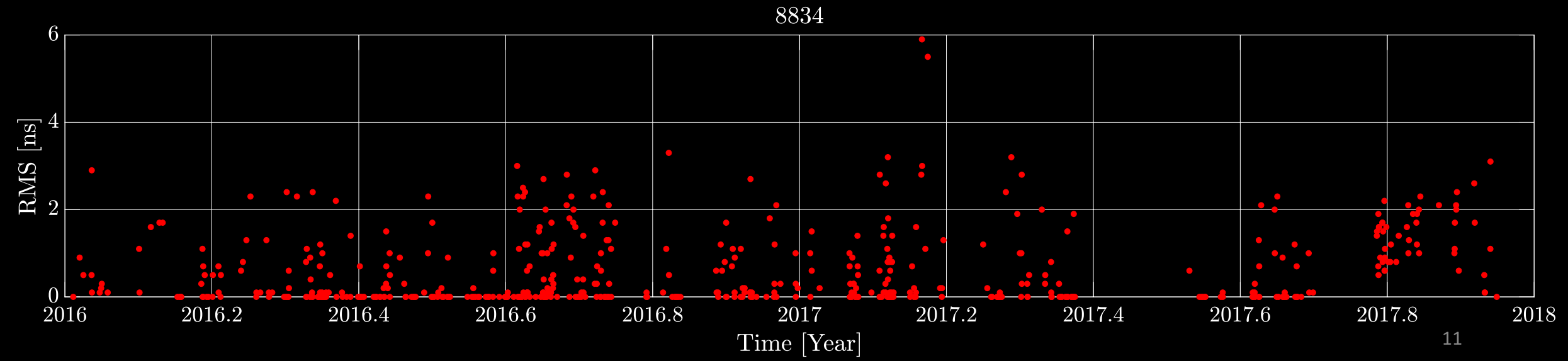

7840
Time Bias [microsecond]
0.4
0.2
0
-0.2
-0.4
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]
7840
RMS [ns]
3
2
1
0
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]

The value of the calibration (around 230 ns) was never included in the data






8834
Time Bias [microsecond]
1
0
-1
-2
-3
2016
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]


8834
RMS [ns]
6
4
2
0
2016
2016.2
2016.4
2016.6
2016.8
2017
2017.2
2017.4
2017.6
2017.8
2018
Time [Year]

Time Biases Origin

- Clock Stability
- Manual operations
- Event Timer
  - Better resolution
- Delays in cables