Report for Calibration of G2 Laboratories NTSC and BIRM by NIM

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The report is divided by seven parts. The first part introduces the calibration briefly. And the second and third parts describe separately the equipments and the operation methods, and the experiment setups during the calibration campaign. Part 4 introduce the data processing of the calibration. Then the fifth part describe the final results by processing. In part 6, it is shown how the calibration uncertainties are evaluated. Climate parameters during the calibration is involved in part 7.

1. Introduction

Time link calibration is the premise of time transfer. Since 2012, BIPM has started to draw up the new guideline for GNSS link calibration and assigned several NMIs including NIM as the group 1 laboratories to implement the possibility of calibration of group 2 laboratories in the local RMO (Regional Metrology Organization) that might give some assist to BIPM.

NIM Cal-001 has been installed and operated at NTSC since the end of December of 2018. NIM Cal-001 was sent to BIRM from NTSC and arrived at BIRM in early March of 2019. Finally, it came back to NIM in the middle of May.

2. Description of the equipments and the operation method

The NIM transportable calibrator NIM Cal-001 is pictured in figure 1 and depicted schematically in figure 2.

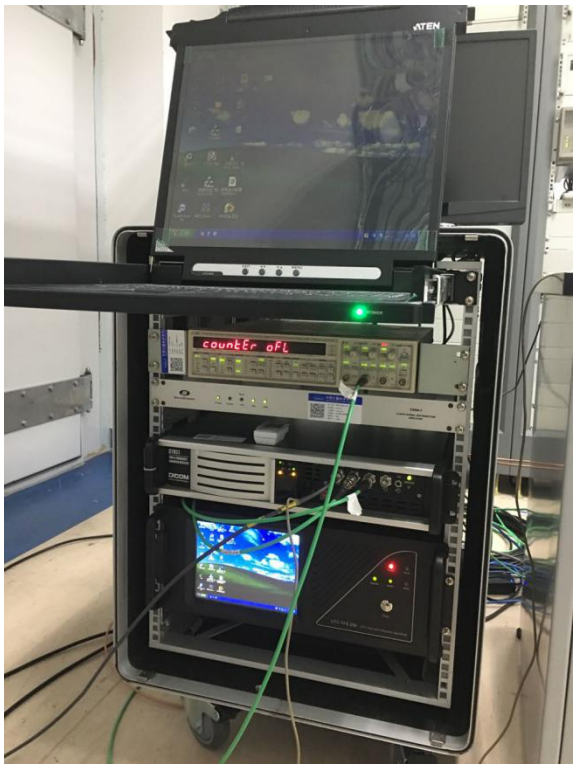

Figure 1. NIM calibrator(NIM Cal-001)

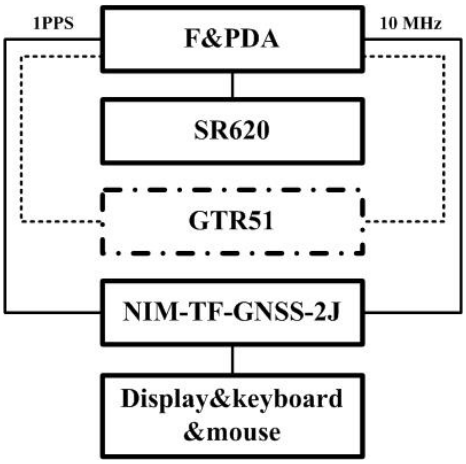

Figure 2. Schematic of NIM Cal-001

Referring to figure 2, the function of each part is as follows.

1. **NIM-TF-GNSS-2J**: GNSS time and frequency transfer travelling receiver developed by NIM
2. SR620:Time interval counter used to measure the reference delay
3. P&FDA: phase and frequency distribution amplifier
4. Display&keyboard&mouse (KVM): Interface between PC and the user, the interface for control of the receiver and logging of GNSS measurement data
5. **GTR51**: Dicom company product
   Physical Size: : 62cm(width)*78cm(height)*89cm(depth) (without the wheels)
   wheel height:12cm
   rough weight: 101 kg
   List of supplied items

Receivers:
IM09(site name for CGGTTS is IM09): NIM-TF-GNSS-2J(with antenna AT1675 AT-200)
IM11(site name for CGGTTS is IM11): GTR51(with antenna NOV703GGG)
Others:
KVM(ATEN)
PDA and FDA(SDI)
SR620(SRS)
cables
Connectors

All information about the equipments for the calibrator and the receivers to be calibrated are list in table 1.

Table 1. Sites used for the calibration

Timing lab	Site name	BIPM code	Model	Role	Notes
NIM	IM06	IM06	Dicom GTR50	Reference receiver	Master
NIM	IM09	IM09	NIM-TF-GNSS-2J	Traveling receiver	Traveling
NIM	IM11	IM11	GTR51	Traveling receiver	Traveling
NTSC	NTP1	NTP1	SEPT POLARX4TR	Receiver to be calibrated	
NTSC	NTP2	NTP2	SEPT POLARX4TR	Receiver to be calibrated	
NTSC	NTP3	NTP3	SEPT POLARX4TR	Receiver to be calibrated	
NTSC	JA01	JA01	SEPT POLARX4TR	Receiver to be calibrated	
BIRM	BI01	BI01	TTS-4	Receiver to be calibrated	
BIRM	BI22	BI22	GTR51	Receiver to be calibrated	
BIRM	BI41	BI41	GTR51	Receiver to be calibrated	

The whole calibration tour includes start CCD before calibration, calibration on site and closure CCD as shown in table 2.

Table 2. Measurements used for the calibration

Time period	Location	Operation	Notes
MJD 58460-MJD 58467	NIM	Start CCD before calibration	
MJD 58548-MJD 58560	BIRM	Calibration on site	
MJD 58483-MJD 58513	NTSC	Calibration on site	
MJD 58620-MJD 58624	NIM	Closure CCD after calibration	

The calibration method, the differential calibration with closure of GPS (Global Positioning System) time and frequency transfer receiver, is used. Its principle

concept is addressed in [1].

3. Experiment setups

In the campaign, the receivers used were as follows in table 1. IMEJ (site name for CGGTTS is IM06) is the master GPS time and frequency transfer receiver of NIM for TAI contribution. The calibrator at NTSC and BIRM was installed and the setups and the sub-delay information for start and closure experiments at NIM and calibration experiments on site at NTSC and BIRM were depicted in figure 4 and 5.

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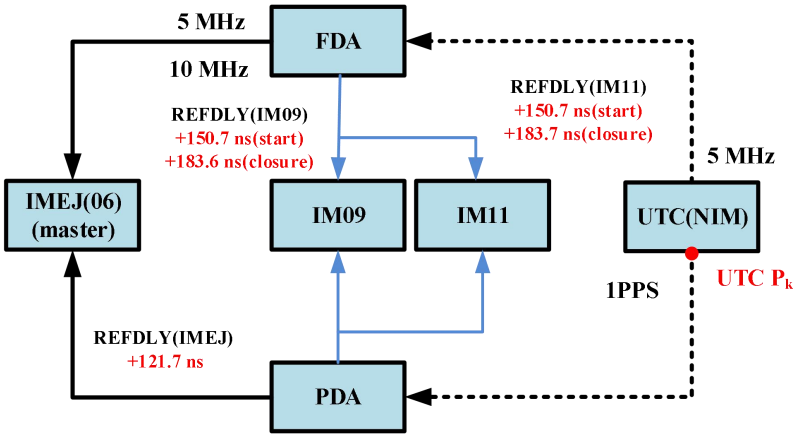
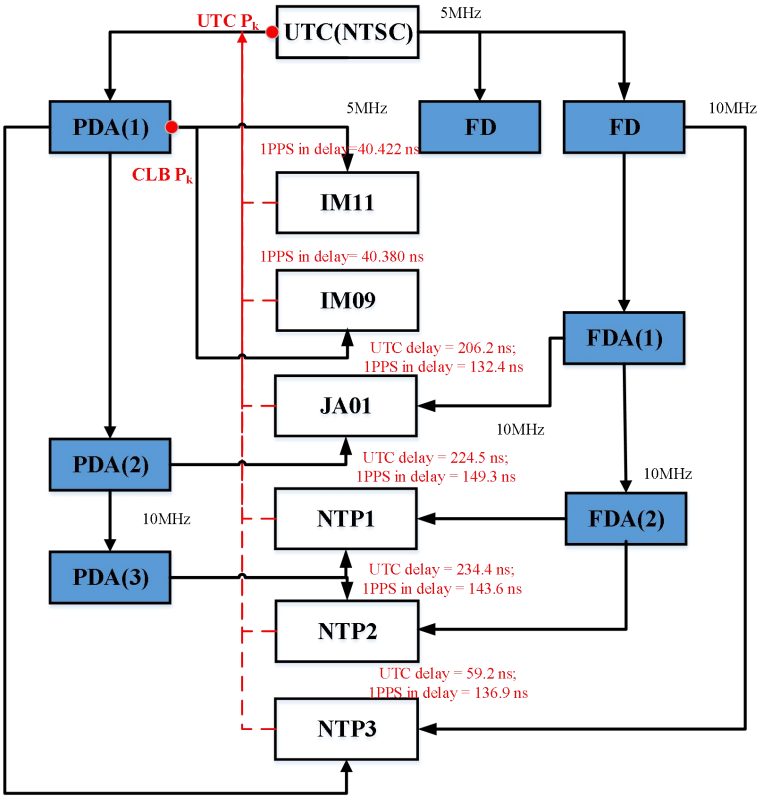


Figure 3. Experiment setup @NIM(for CCD experiments)



$UTC\ P_k$ is the UTC(NTSC) reference point(which is defined in the HROG output point).
$CLB\ P_k$ is the Calibration point.
FD is the frequency doubler. PDA is the pulse distribution amplifier; FDA is the frequency distribution amplifier.

Figure 4. Experiment setup @NTSC (for CCD experiments)

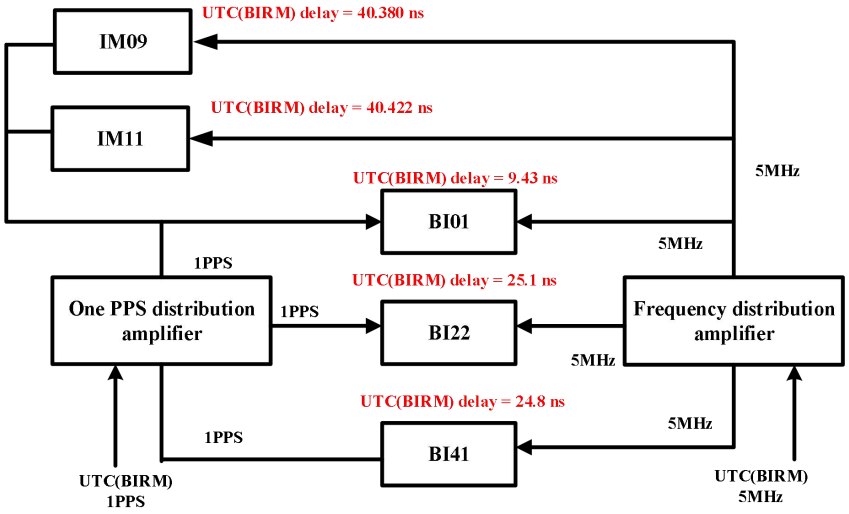


Figure 5. Experiment setup @ BIRM(for CCD experiments)

4. Data processing

The raw differences $RAWDIF(P1/P2)_{A-B}$ between two receivers such as A and B, in the CCD experiments during the calibration, are given by

$$RAWDIF(P1/P2)_{A-B} = \Delta CABDLY_{A-B} + \Delta INTDLY(P1/P2)_{A-B} - \Delta REFDLY_{A-B} \quad (1)$$

where $RAWDIF(P1/P2)_{A-B}$ are the differences of code measurements from Rinex files without compensation of the antenna cable delay(CABDLY), the internal delay(INTDLY), and reference delay(REFDLY) from CGGTTS header. $\Delta CABDLY_{A-B}$, $\Delta REFDLY_{A-B}$ and $\Delta INTDLY_{A-B}$ are the differences of CABDLY, INTDLY, and REFDLY separately, given in table 3. P3 results are calculated by the formula $P3=P1*2.54573-P2*1.54573$.

Table 3. REFDLY and CABDLY differences between stations and traveling receivers

Pair	MJD	△REFDLY(ns)	△CABDLY(ns)
IM09-IM06	58462-58466	29.0	-45.7
IM11-IM06	58462-58466	29.0	-71.6
NTP1-IM09	58483-58487	289.8	6.0
NTP1-IM11	58483-58487	289.8	31.9
NTP2-IM09	58486-58490	294.0	18.0
NTP2-IM11	58486-58490	294.0	43.9
NTP3-IM09	58438-58487	112.1	6.0
NTP3-IM11	58438-58487	112.1	31.9
JA01-IM09	58508-58512	286.5	-203.0
JA01-IM11	58508-58512	286.5	-177.1
BI01-IM09	58548-58559	-34.3	15.9
BI01-IM11	58548-58559	-34.4	41.8
BI22-IM09	58548-58559	-15.3	17.1
BI22-IM11	58548-58559	-15.3	43.1
BI41-IM09	58548-58559	-15.6	17.7
BI41-IM11	58548-58559	-15.6	43.6
IM09-IM06	58620-58625	61.9	-45.7
IM11-IM06	58620-58625	62.0	-71.6

5. Calibration computation and calibration values

Table 4 shows INTDLY for station IM06. Raw P1, P2, P3 and P1-P2 differences calculated between station and traveling receivers are given in table 5. The values for ΔINTDLY between a given pair of receivers are computed using Eq.(1) and given in

table 6. Closure values(the difference between the mean values before calibration and after calibration) are given in table 7. The values of INTDLY for receiver NTP1, NTP2, NTP3, JA01, BI01, BI22 and BI41 are computed using ΔINTDLY between receivers to be calibrated and the traveling receivers and ΔINTDLY between the traveling receivers and IM06 (values from 1001-2018). The values of INTDLY are given in table 8.

CGGTTS file headers

IM11

MJD 58460-58467

INT DLY =-29.2 ns (GPS C1), -35.0 ns (GPS P1),0.0 ns (GPS C2), -37.5 ns (GPS P2),0.0 ns (GPS L5)

CAB DLY =177.1 ns

REF DLY = 150.7 ns

MJD 58620-58624

INT DLY = -29.2 ns (GPS C1), -35.0 ns (GPS P1), 0.0 ns (GPS C2), -37.5 ns (GPS P2), 0.0 ns (GPS L5)

CAB DLY = 177.1 ns

REF DLY = 183.7 ns

IM09

MJD 58460-58467

INT DLY = 0.0 ns (GPS P3), 0.0 ns (GPS C1)

CAB DLY = 203.0 ns

REF DLY = 150.7 ns

MJD 58620-58624

INT DLY = 0.0 ns (GPS C1),0.0 ns (GPS P3)

CAB DLY = 203.0 ns

REF DLY = 183.6 ns

Table 4. INTDLY for station IM06 from 1001-2018

Rcvr	C1(ns)	P1(ns)	P2(ns)	P3(ns)
IM06	-31.0	-31.8	-18.4	-52.5

5.1. Raw differences

Table 5. Raw differences between stations and traveling receivers

Pair	MJD	△C1(ns)	△P1(ns)	△P2(ns)	△P3(ns)	△P1-P2(ns)
IM09-IM06	58462-58466	-61.8	-61.7	-70.0	-48.8	-5.1
IM11-IM06	58462-58466	-106.0	-107.5	-121.2	-86.3	-2.2
NTP1-IM09	58483-58487	\	-211.5	-218.2	-201.1	6.7
NTP1-IM11	58483-58487	\	-165.7	-166.3	-164.5	3.2
NTP2-IM09	58486-58490	\	-203.9	-211.3	-192.5	7.4
NTP2-IM11	58486-58490	\	-158.1	-159.4	-156.0	3.8
NTP3-IM09	58438-58487	\	-36.5	-43.4	-25.8	6.9

NTP3-IM11	58438-58487	\	9.3	8.5	10.9	3.4
JA01-IM09	58508-58512	\	-240.0	-248.7	-226.7	8.6
JA01-IM11	58508-58512	\	-193.7	-196.3	-189.5	5.1
BI01-IM09	58548-58559	28.0	27.0	19.4	38.8	7.6
BI01-IM11	58548-58559	73.1	73.4	71.6	76.2	4.3
BI22-IM09	58548-58559	74.7	74.9	69.5	83.2	-0.7
BI22-IM11	58548-58559	119.7	121.4	121.8	120.8	-4.0
BI41-IM09	58548-58559	75.0	75.0	71.0	81.1	-29.1
BI41-IM11	58548-58559	119.8	121.4	123.2	118.7	-32.4
IM09-IM06	58620-58625	-94.2	-94.2	-102.3	-81.7	-5.3
IM11-IM06	58620-58625	-139.6	-140.6	-154.3	-119.4	-2.2

5.2. Closure CCD after calibration

Table 6. INTDLY differences between stations and traveling receivers

Pair	△INTDLY(C1)(ns)	△INTDLY(P1)(ns)	△INTDLY(P2)(ns)	△INTDLY(P3)(ns)
IM09-IM06$\|_{before}$	12.9	13.0	4.7	25.9
IM11-IM06$\|_{before}$	-5.4	-6.9	-20.6	14.3
NTP1-IM09	\	72.3	65.6	82.7
NTP1-IM11	\	92.2	91.6	93.4
NTP2-IM09	\	72.1	64.7	83.5
NTP2-IM11	\	92.0	90.7	94.1
NTP3-IM09	\	69.6	62.7	80.3
NTP3-IM11	\	89.5	88.7	91.1
JA01-IM09	\	249.5	240.8	262.8
JA01-IM11	\	269.9	267.3	274.1
BI01-IM09	-22.2	-23.2	-30.8	-11.4
BI01-IM11	-3.1	-2.8	-4.6	0
BI22-IM09	42.2	42.4	37.0	50.7
BI22-IM11	61.3	63.0	63.4	62.4
BI41-IM09	41.7	41.7	37.7	47.8
BI41-IM11	60.6	62.2	64.0	59.5
IM09-IM06$\|_{after}$	13.4	13.4	5.3	25.9
IM11-IM06$\|_{after}$	-6.0	-7.0	-20.7	14.2

5.3. Closure values

Table 7. Closure values

Pair	△C1(ns)	△P1(ns)	△P2(ns)	△P3(ns)
IM09-IM06	-0.5	-0.4	-0.6	0
IM11-IM06	0.6	0.1	0.1	0.1

5.4. Calibration values

Table 8. INTDLY for stations NTP1, NTP2, NTP3, JA01, BI01, BI22 and BI41

Rcvr	C1(ns)	P1(ns)	P2(ns)	P3(ns)
NTP1|IM09	\	53.6	51.9	56.1
NTP1|IM11	\	53.5	52.6	55.2
NTP2|IM09	\	53.4	51.0	56.9
NTP2|IM11	\	53.3	51.7	55.9
NTP3|IM09	\	50.9	49.0	53.7
NTP3|IM11	\	50.8	49.7	52.9
JA01|IM09	\	230.7	227.1	236.2
JA01|IM11	\	231.2	228.3	235.9
BI01|IM09	-40.2	-42.0	-44.5	-38.0
BI01|IM11	-39.5	-41.4	-43.5	-38.2
BI22|IM09	24.2	23.7	23.4	24.1
BI22|IM11	24.9	24.3	24.4	24.2
BI41|IM09	23.6	22.9	24.0	21.2
BI41|IM11	24.1	23.5	25.0	21.3
NTP1	\	53.6	52.3	55.7
NTP2	\	53.4	51.4	56.4
NTP3	\	50.9	49.4	53.3
JA01	\	231.0	227.7	236.1
BI01	-39.9	-41.7	-44.0	-38.1
BI22	24.6	24.0	23.9	24.2
BI41	23.9	23.2	24.5	21.3

Note: The software version of BI01 had been upgraded from 2.29 to 2.39 in December 2016 after the 1015-2016 calibration was implemented, which might lead to the change of the calibration values.

6. Uncertainty Evaluation

Here we evaluated the uncertainty from the sources as follows and got the combined uncertainty as 1.5 ns conservatively for C1 and P codes. All the measurements related to the cable and reference delays were done with SR620 on the trigger level 1.0 V. And the uncertainties from position references and multipaths are just referenced to the description of the guideline. The u_a values are from TDEV of the corresponding CCD results shown in the figures in Annex 6.

Table 9. Uncertainty contributions

Unc.	Value P1 (ns)	Value P2 (ns)	Value C1 (ns)	Value P3 (ns)	Description
u_a (T-V)	0.2	0.2	0.2	0.3	RAWDIF (traveling-visited)
u_a (T-R)	0.2	0.2	0.2	0.3	RAWDIF (traveling-reference)
u_a	0.3	0.3	0.3	0.4	

Misclosure					
$u_{b,1}$	0.4	0.6	0.6	0.1	observed mis-closure
Systematic components related to RAWDIF					
$u_{b,11}$	0.05	0.05	0.05	0.05	Position error at reference
$u_{b,12}$	0.05	0.05	0.05	0.05	Position error at visited
$u_{b,13}$	0.3	0.3	0.3	0.3	Multipaths at reference
$u_{b,14}$	0.3	0.3	0.3	0.3	Multipaths at visited
Link of the Traveling system to the local UTC(*k*)					
$u_{b,21}$	0.5	0.5	0.5	0.5	$REFDLY_T$ (at ref lab)
$u_{b,22}$	0.5	0.5	0.5	0.5	$REFDLY_T$ (at visited lab)
$u_{b,TOT}$	1.0	1.1	1.1	0.9	
Link of the Reference system to its local UTC(*k*)					
$u_{b,31}$	0.5	0.5	0.5	0.5	$REFDLY_R$ (at ref lab)
Link of the Visited system to its local UTC(*k*)					
$u_{b,32}$	0.5	0.5	0.5	0.5	$REFDLY_V$ (at visited lab)
$u_{b,SYS}$	1.2	1.3	1.3	1.2	Components of equation (2)
u_{CAL}	1.4	1.5	1.5	1.4	Composed of u_a and $u_{b,SYS}$
Antenna cable delays					
$u_{b,41}$	0.5	0.5	0.5	0.5	$CABDLY_R$
$u_{b,42}$	0.5	0.5	0.5	0.5	$CABDLY_V$
Combined Uncertainty: 1.5 ns					

7. Climate parameters

7.1. Temperature and humidity

23.3°C~24.3°C ±0.5°C
32.1%~42.3% ±3%

7.2. Reference signal

Rise time of the local UTC pulse: 2 ns

References:

[1] BIPM. BIPM guidelines for GNSS calibration(V3.2). 05, 02, 2016.

Annex 1. CCD results for NTSC

1. Start CCD before calibration

IM09-IM06

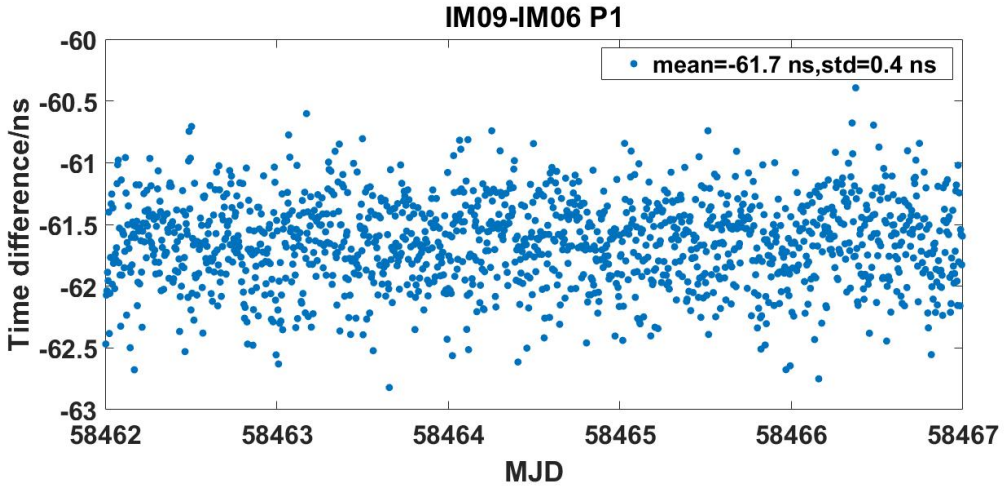


Figure 6. CCD between IM09 and IM06 at NIM(P1)

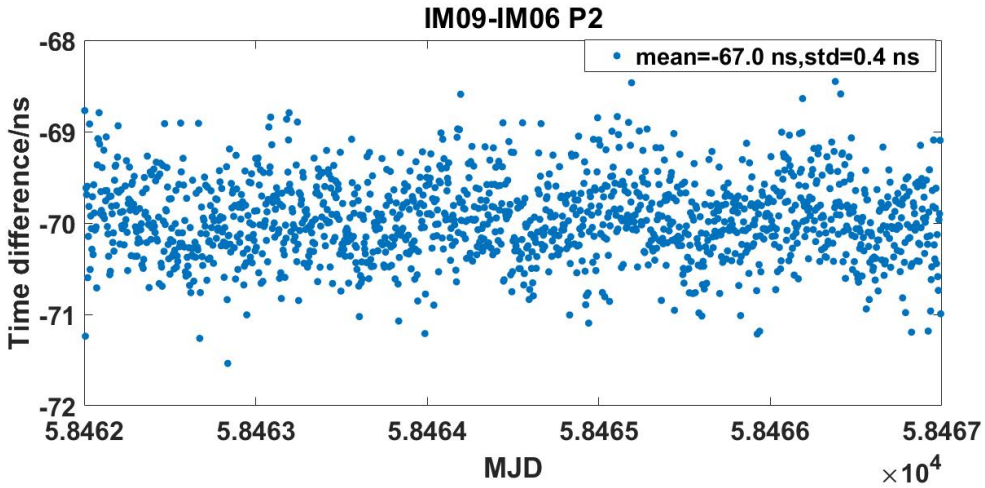


Figure 7. CCD between IM09 and IM06 at NIM(P2)

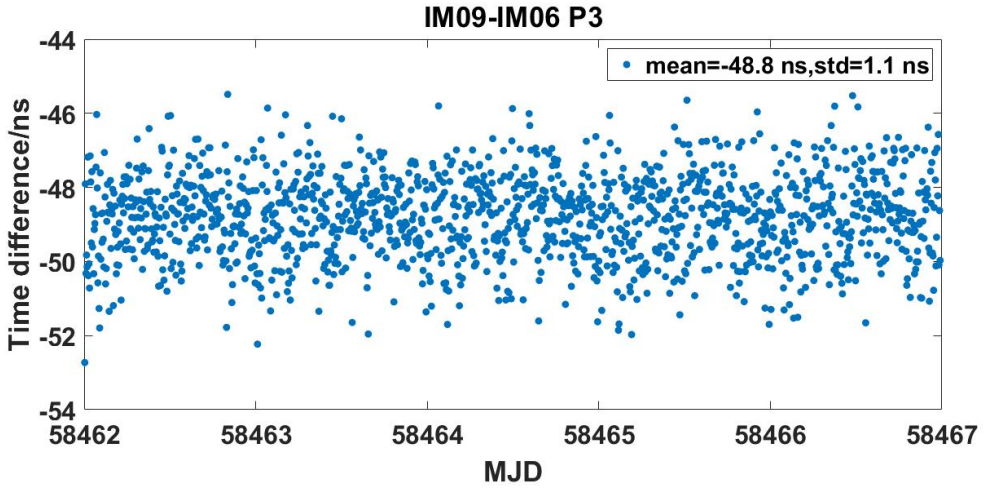


Figure 8. CCD between IM09 and IM06 at NIM(P3)

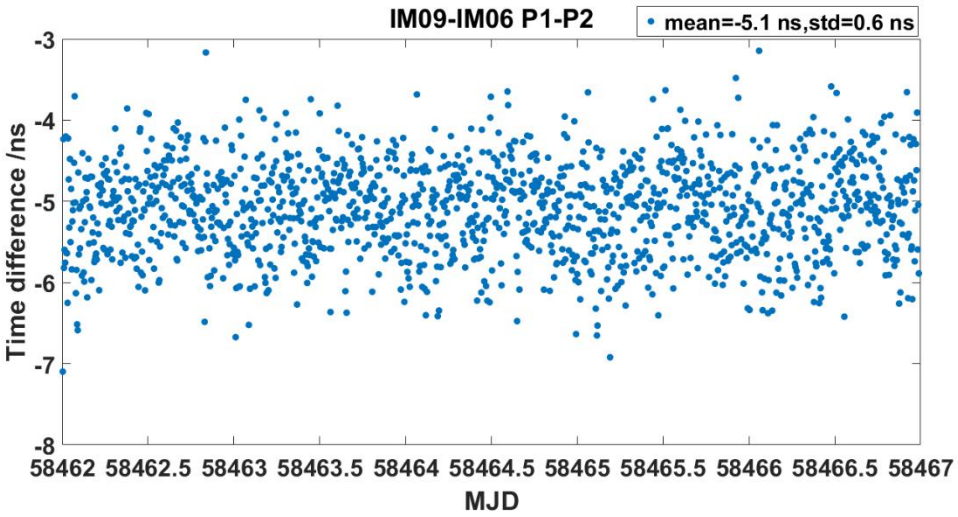


Figure 9. CCD between IM09 and IM06 at NIM(P1-P2)

IM11-IM06

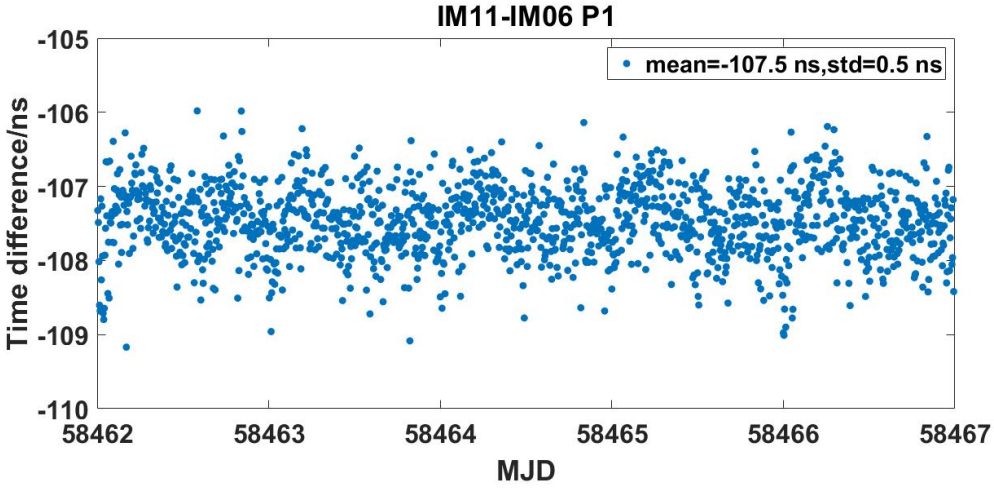


Figure 10. CCD between IM11 and IM06 at NIM(P1)

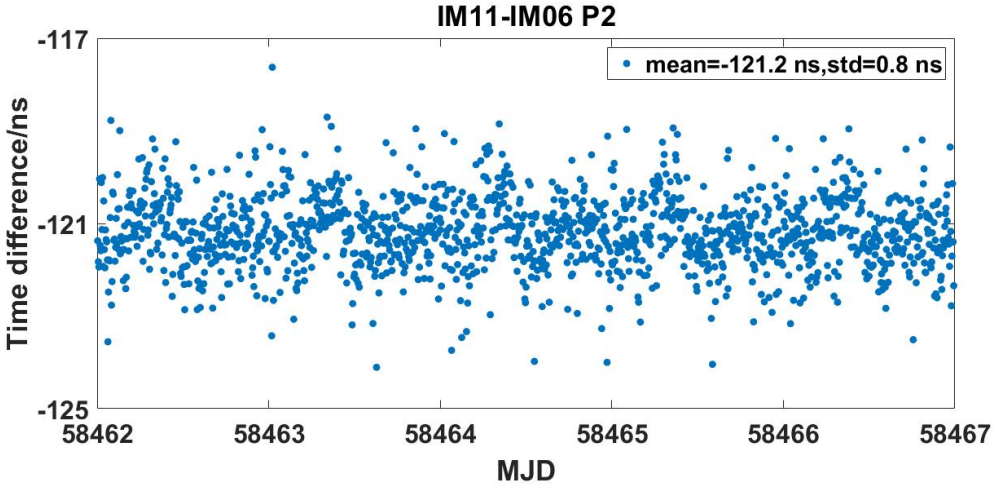


Figure 11. CCD between IM11 and IM06 at NIM(P2)

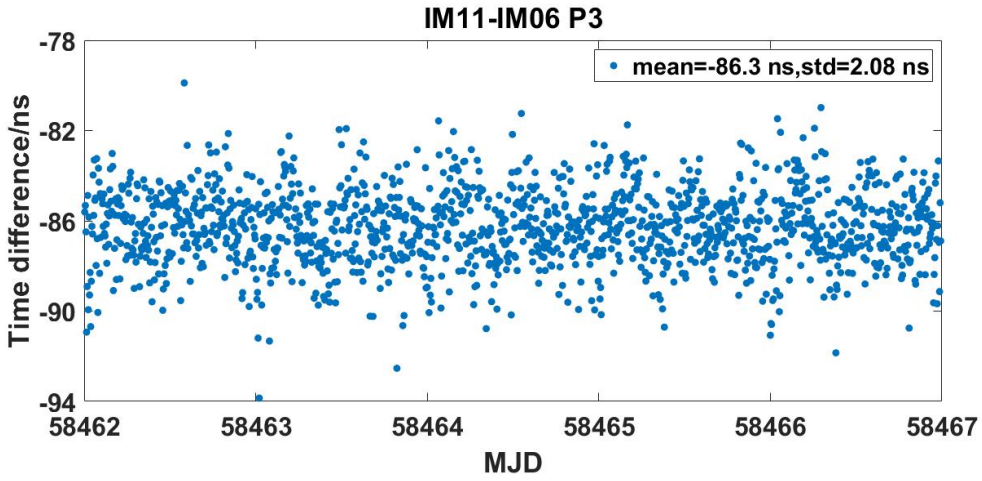


Figure 12. CCD between IM11 and IM06 at NIM(P3)

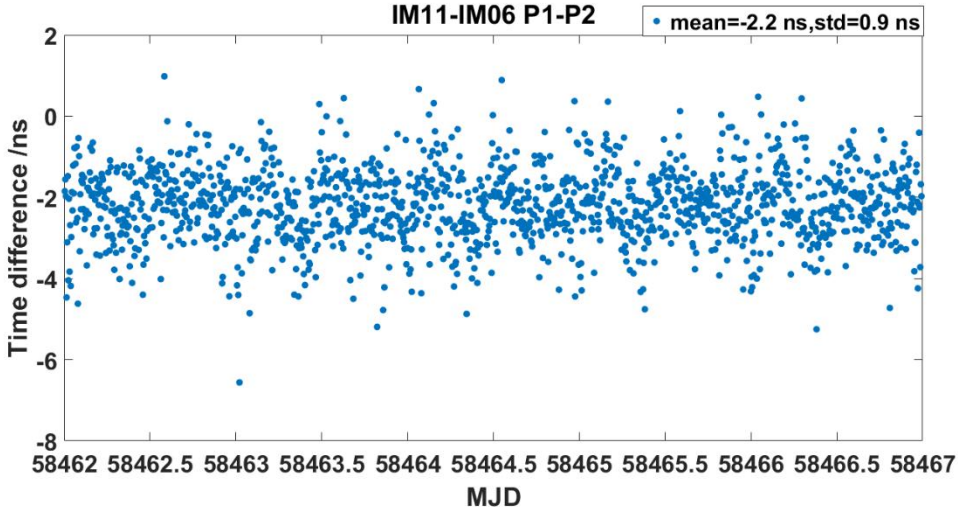


Figure 13. CCD between IM11 and IM06 at NIM(P1-P2)

2. Calibration on site

NTP1 – IM09

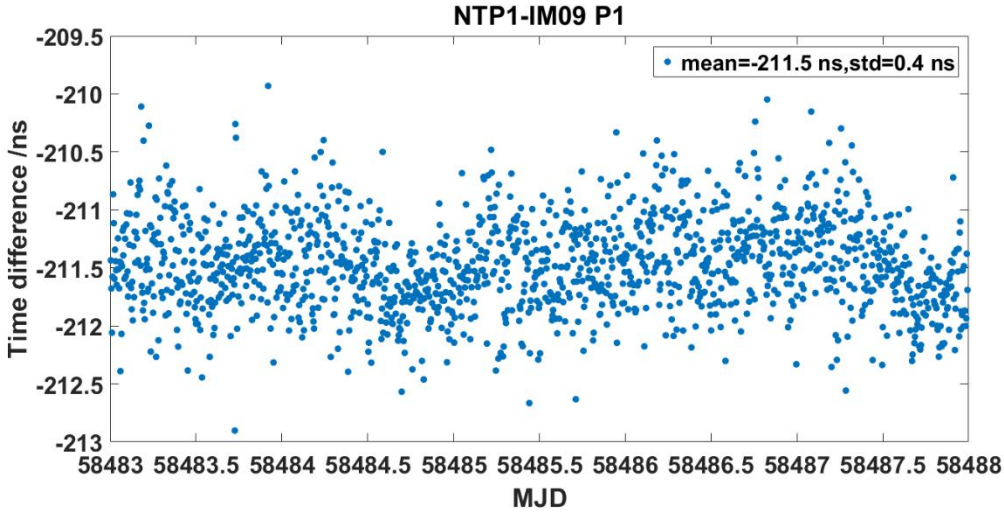


Figure 14. CCD between NTP1 and IM09 at NTSC(P1)

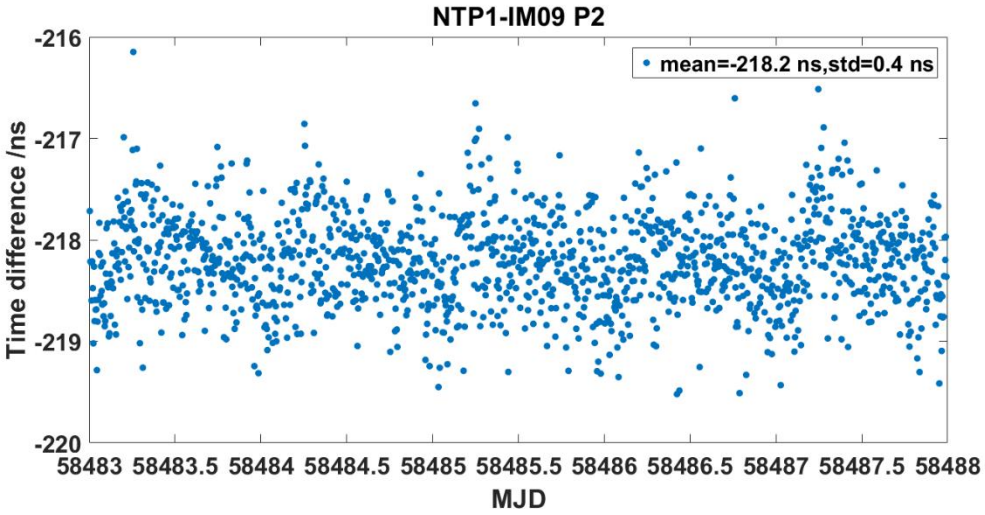


Figure 15. CCD between NTP1 and IM09 at NTSC(P2)

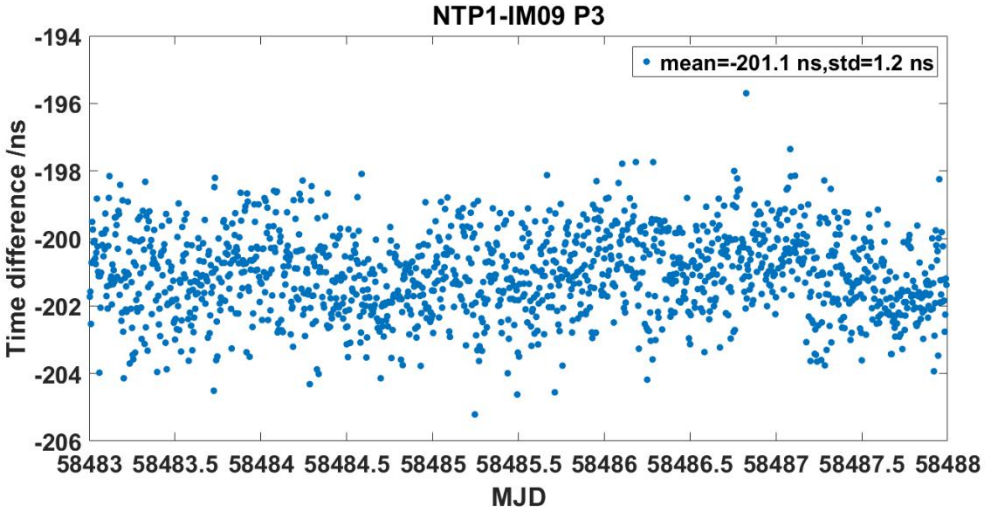


Figure 16. CCD between NTP1 and IM09 at NTSC(P3)

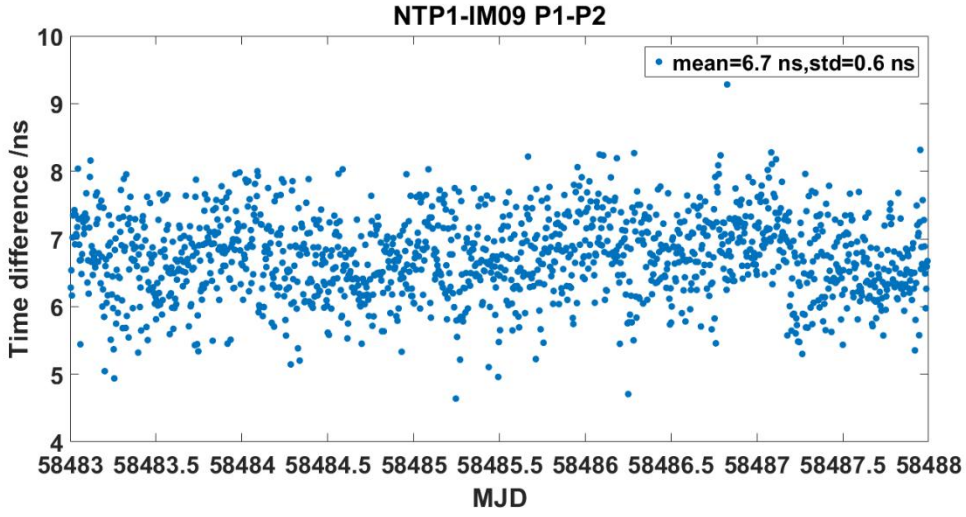


Figure 17. CCD between NTP1 and IM09 at NTSC(P1-P2)

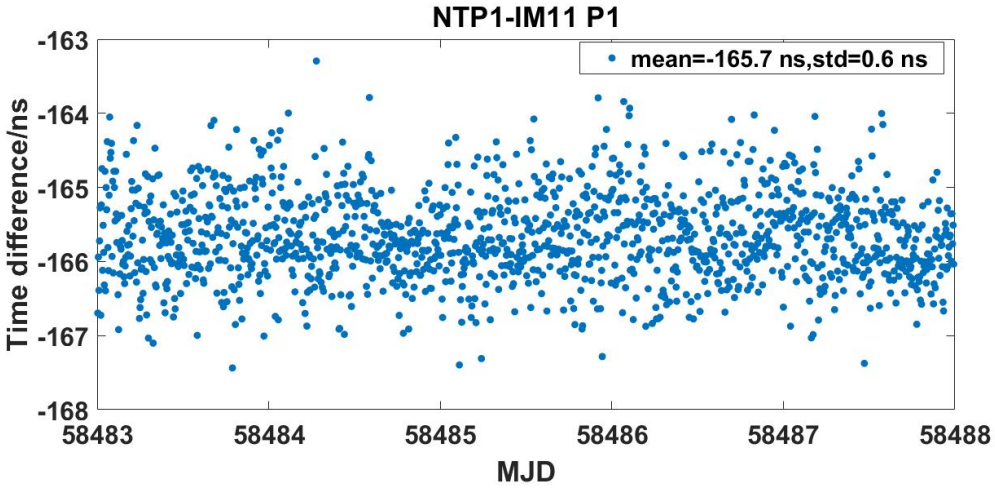


Figure 18. CCD between NTP1 and IM11 at NTSC(P1)

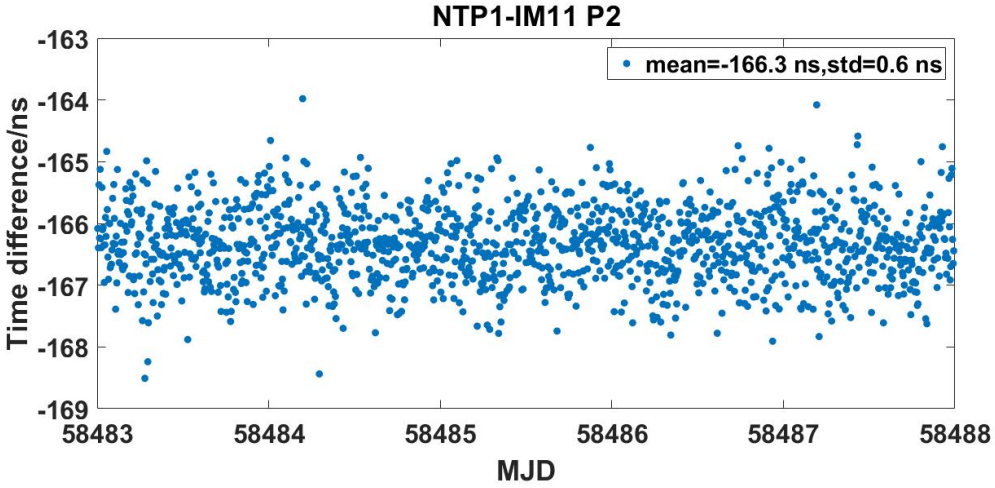


Figure 19. CCD between NTP1 and IM11 at NTSC(P2)

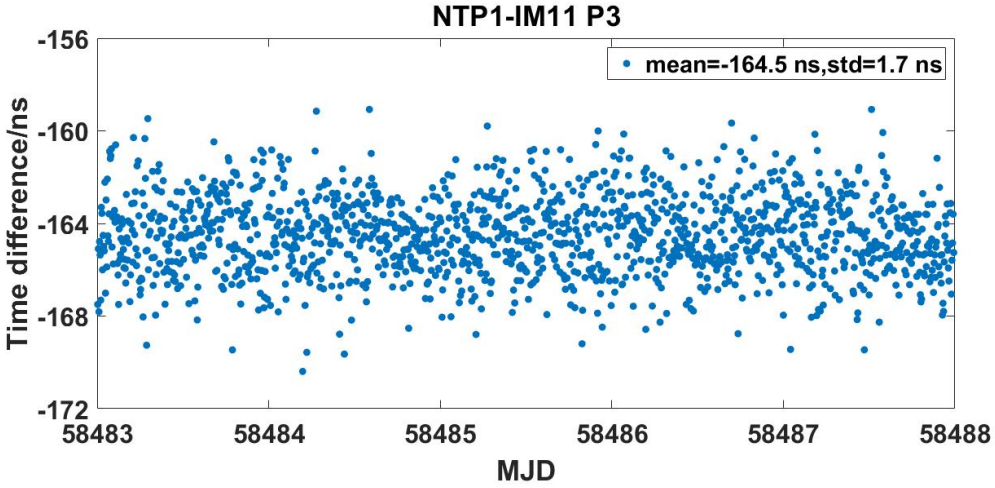


Figure 20. CCD between NTP1 and IM11 at NTSC(P3)

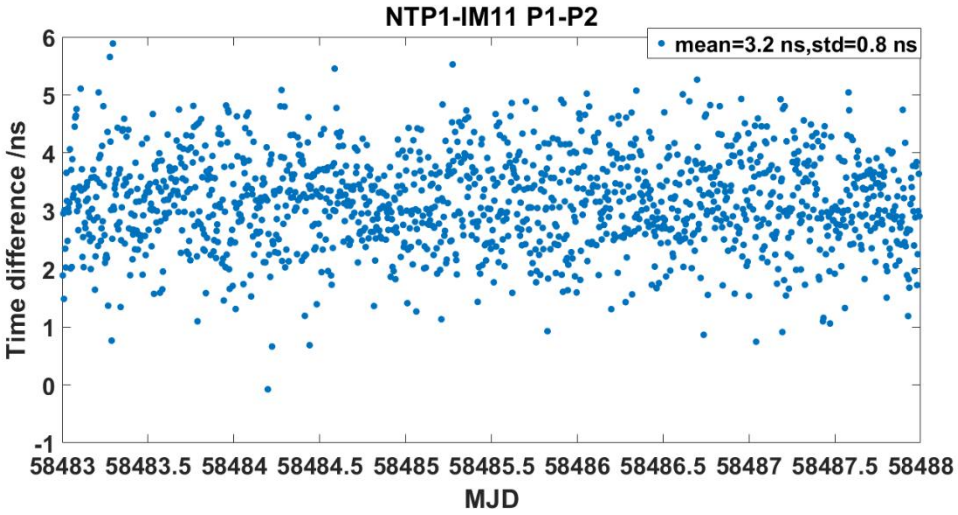


Figure 21. CCD between NTP1 and IM11 at NTSC(P1-P2)

NTP2 - IM09

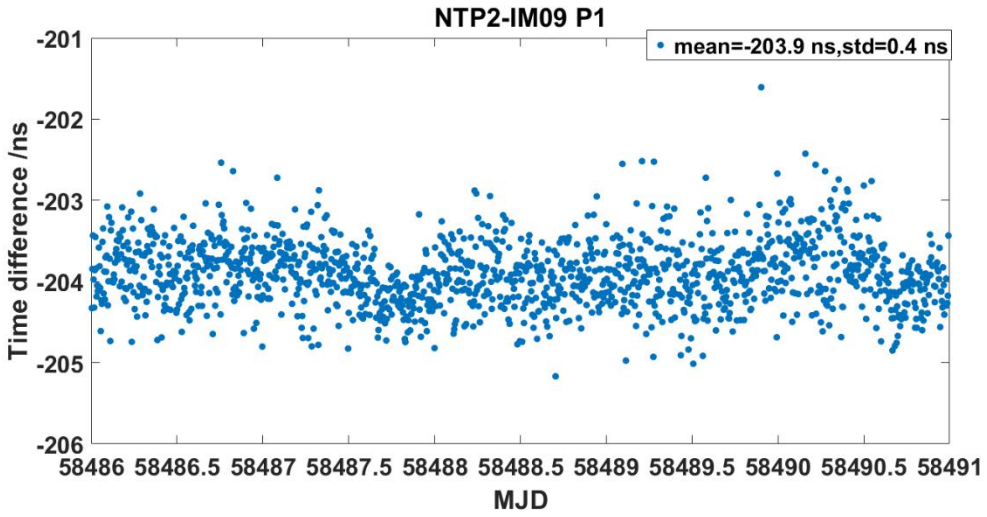


Figure 22. CCD between NTP2 and IM09 at NTSC(P1)

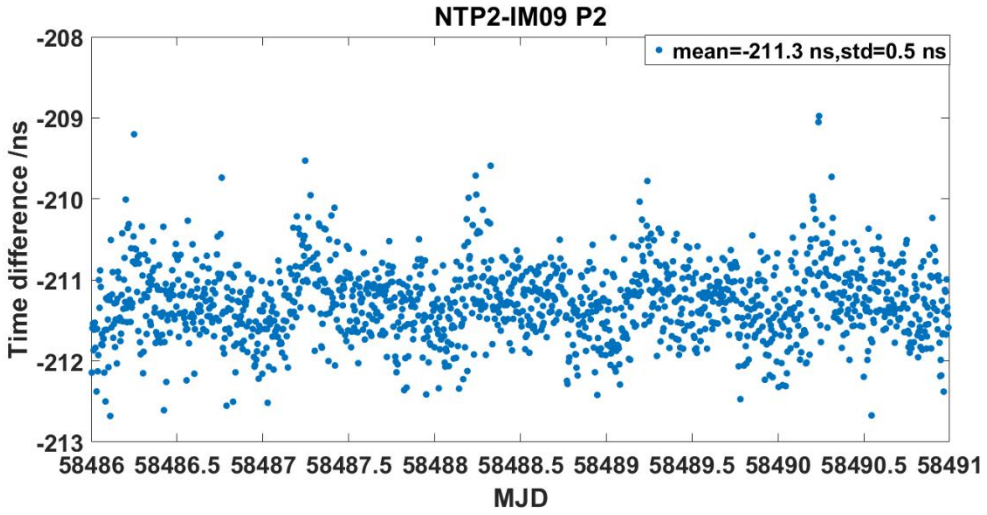


Figure 23. CCD between NTP2 and IM09 at NTSC(P2)

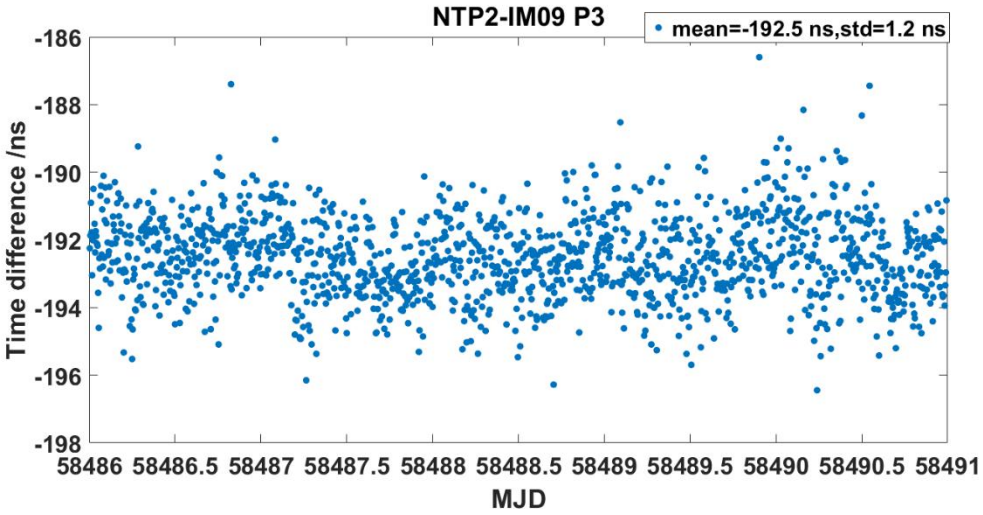


Figure 24. CCD between NTP2 and IM09 at NTSC(P3)

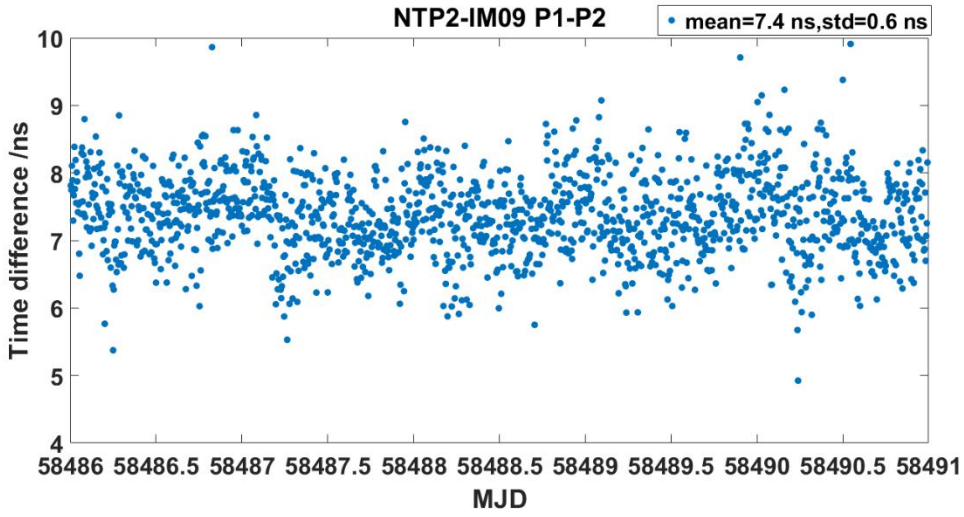


Figure 25. CCD between NTP2 and IM09 at NTSC(P1-P2)

NTP2 - IM11

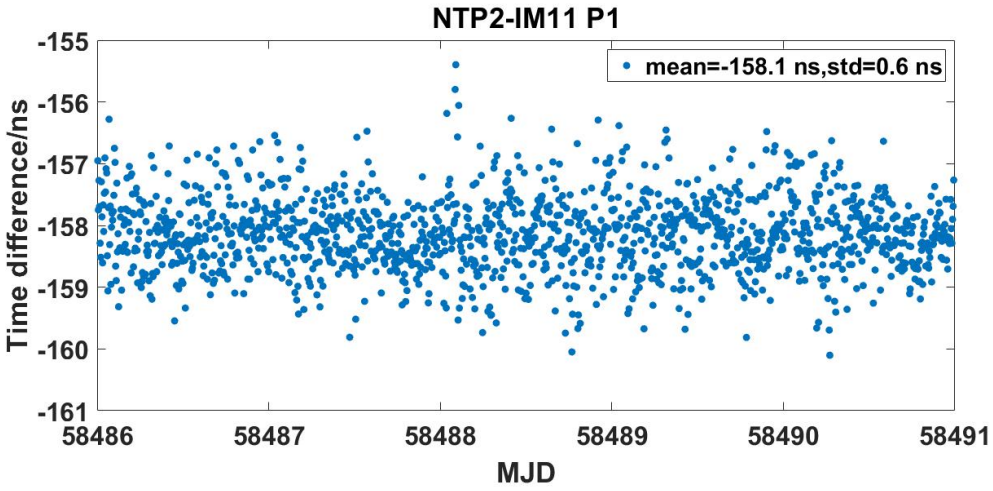


Figure 26. CCD between NTP2 and IM11 at NTSC(P1)

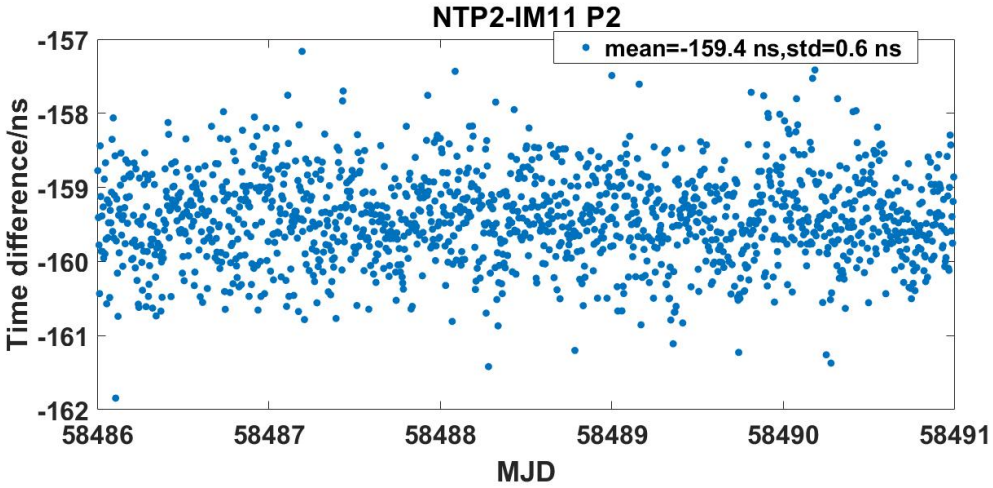


Figure 27. CCD between NTP2 and IM11 at NTSC(P2)

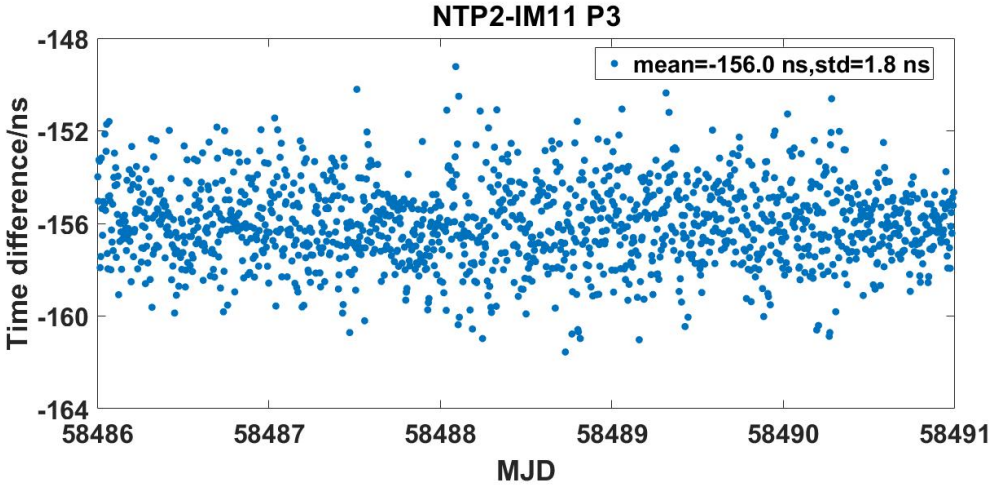


Figure 28. CCD between NTP2 and IM11 at NTSC(P3)

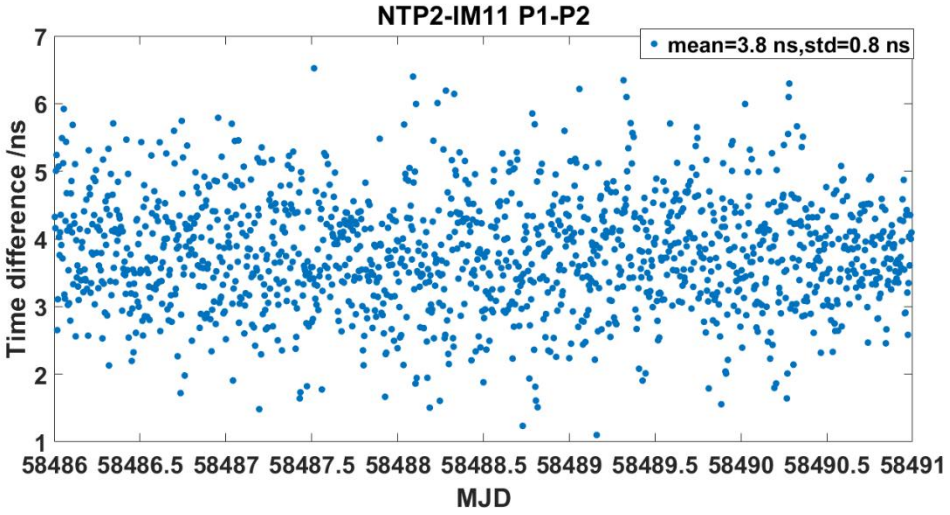


Figure 29. CCD between NTP2 and IM11 at NTSC(P1-P2)

NTP2 - IM09

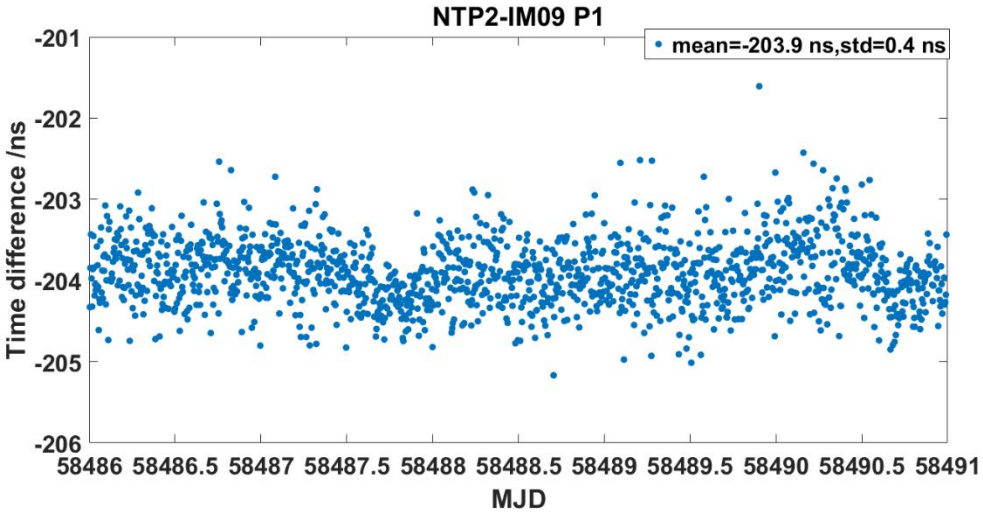


Figure 30. CCD between NTP2 and IM09 at NTSC(P1)

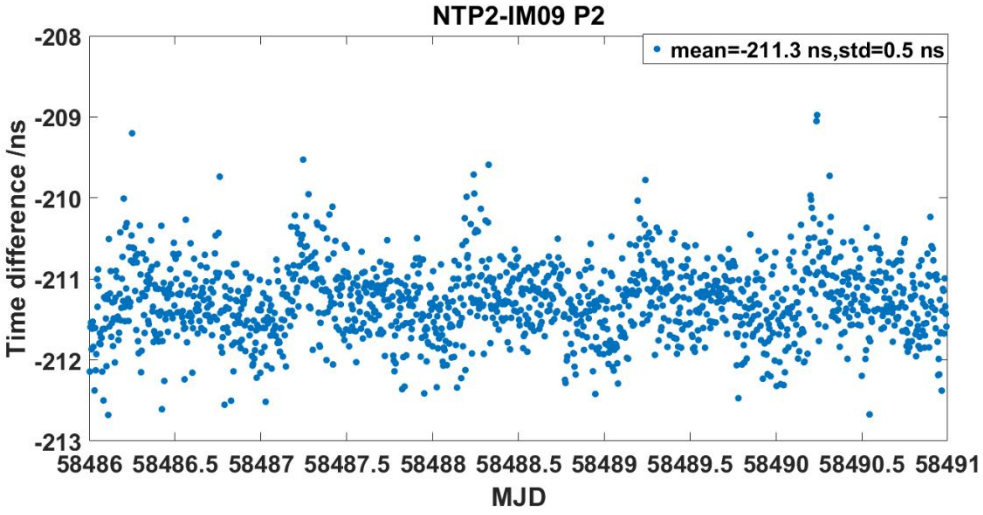


Figure 31. CCD between NTP2 and IM09 at NTSC(P2)

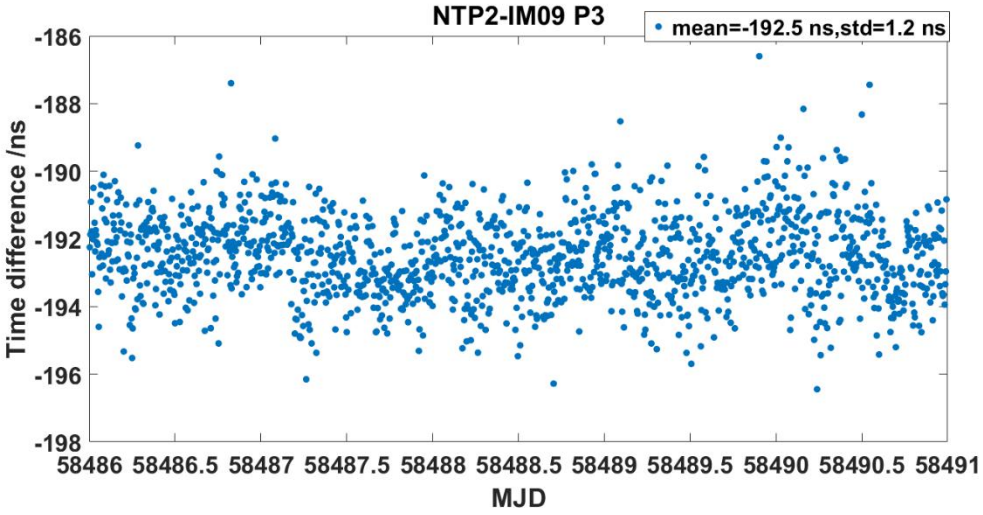


Figure 32. CCD between NTP2 and IM09 at NTSC(P3)

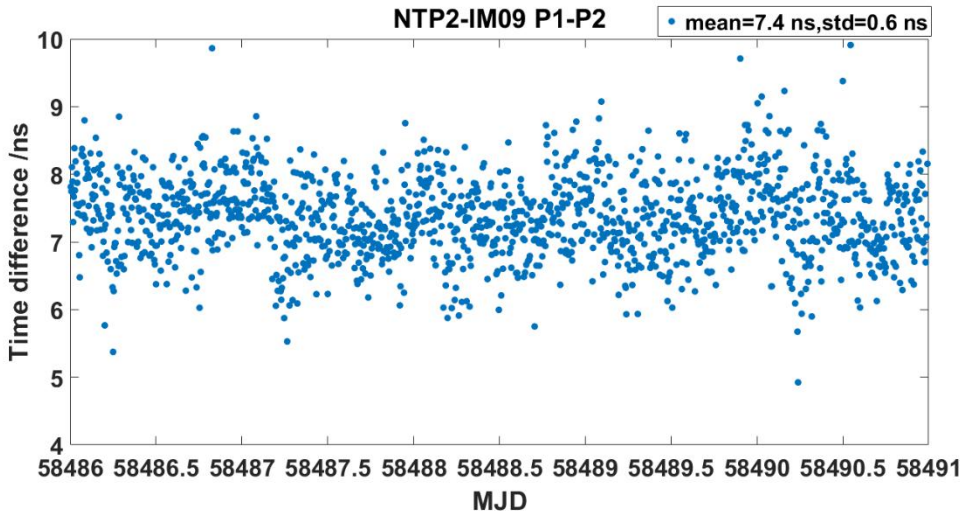


Figure 33. CCD between NTP2 and IM09 at NTSC(P1-P2)

NTP3 - IM09

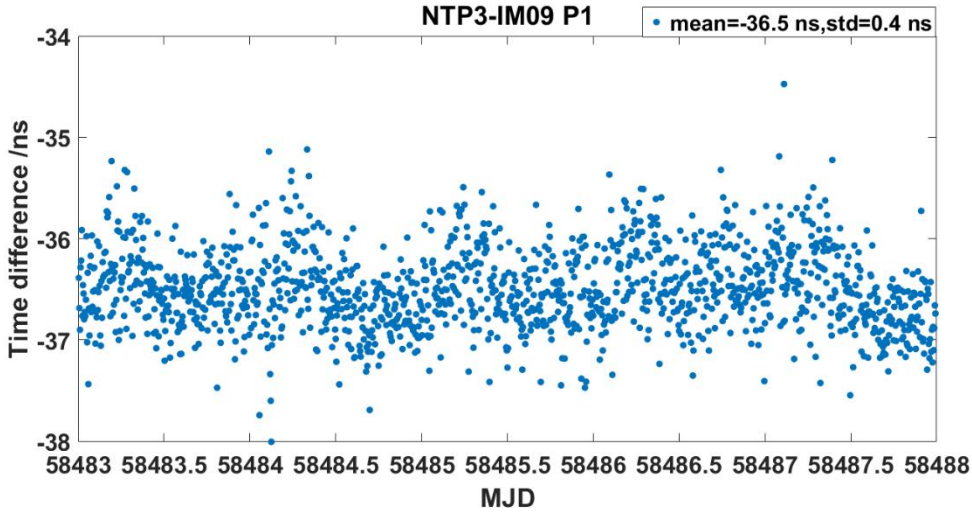


Figure 34. CCD between NTP3 and IM09 at NTSC(P1)

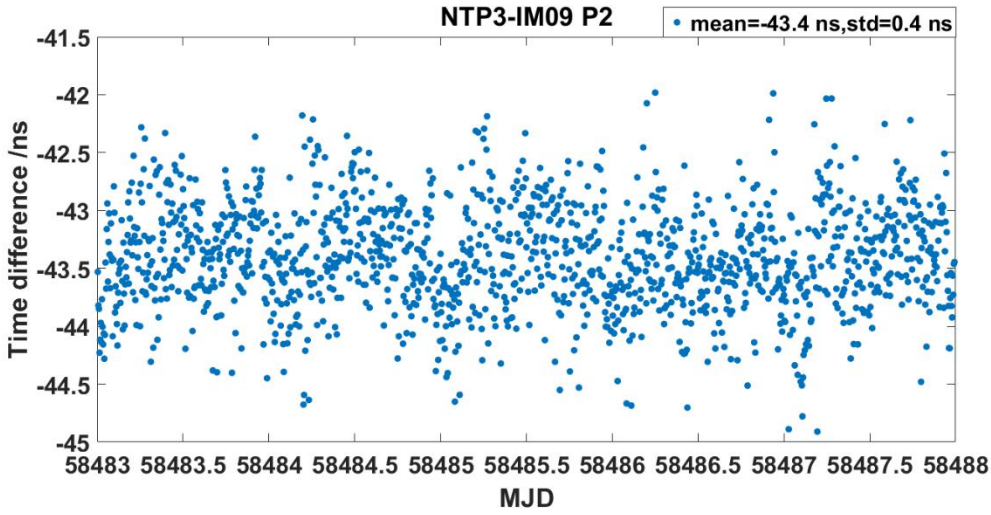


Figure 35. CCD between NTP3 and IM09 at NTSC(P2)

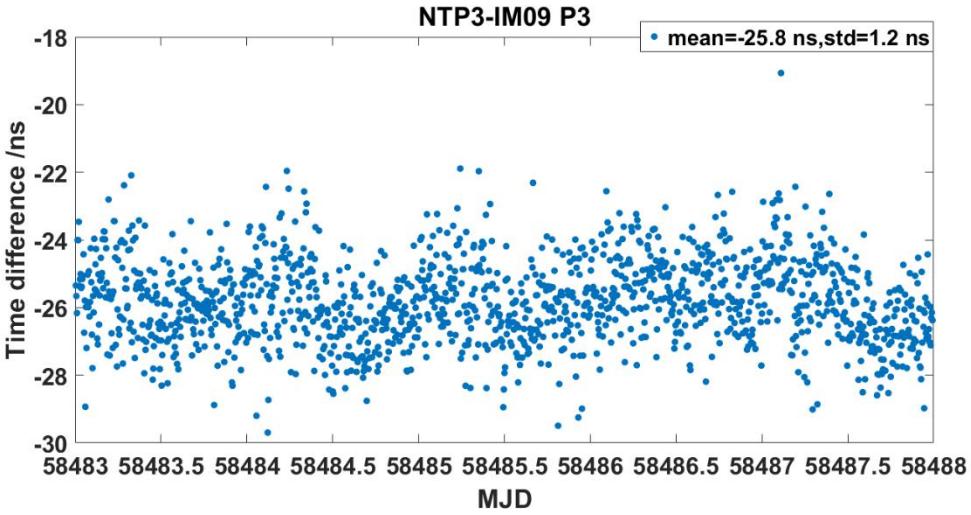


Figure 36. CCD between NTP3 and IM09 at NTSC(P3)

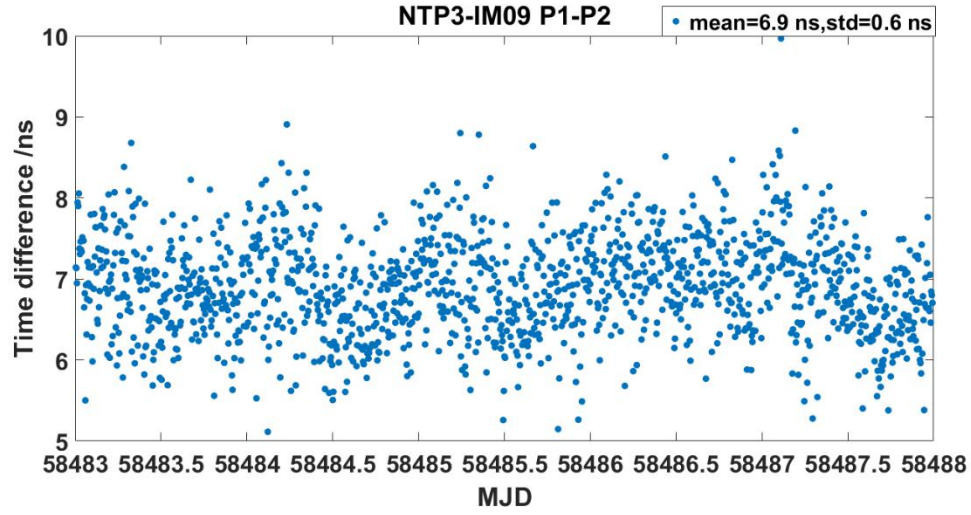


Figure 37. CCD between NTP3 and IM09 at NTSC(P1-P2)

NTP3 - IM11

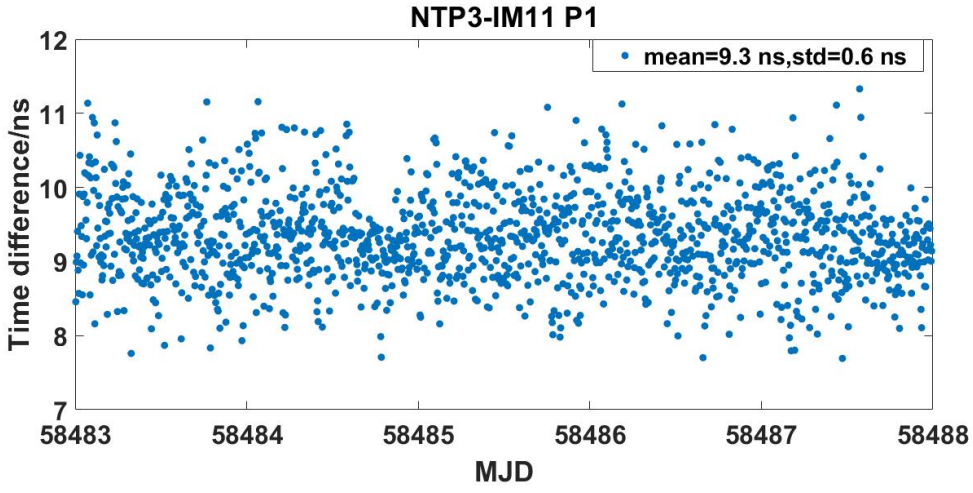


Figure 38. CCD between NTP3 and IM11 at NTSC(P1)

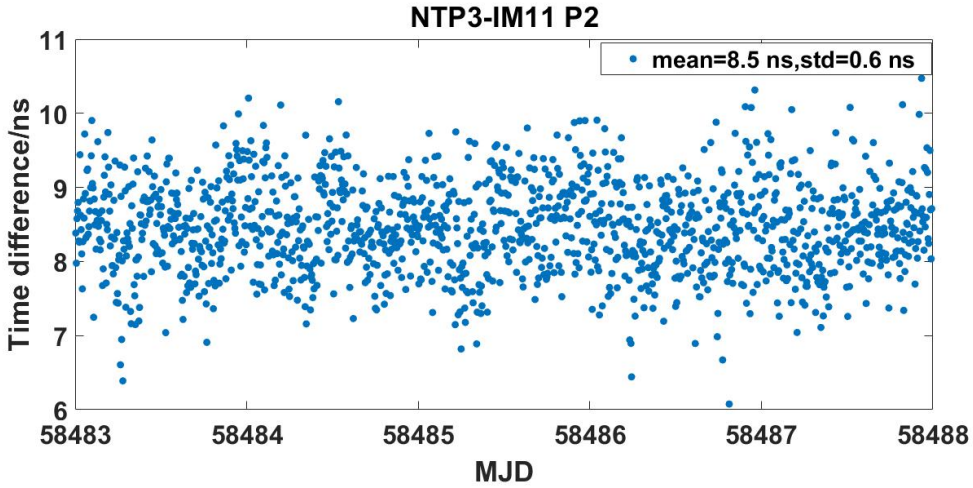


Figure 39. CCD between NTP3 and IM11 at NTSC(P2)

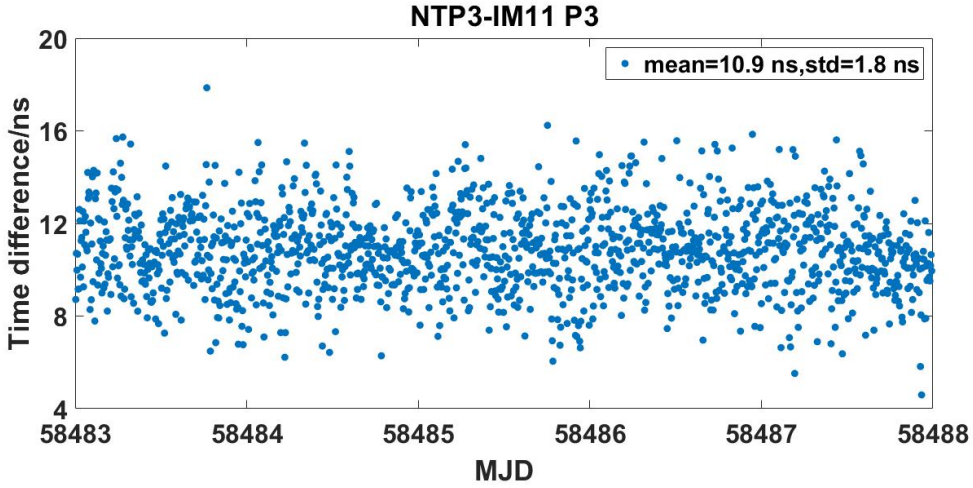


Figure 40. CCD between NTP3 and IM11 at NTSC(P3)

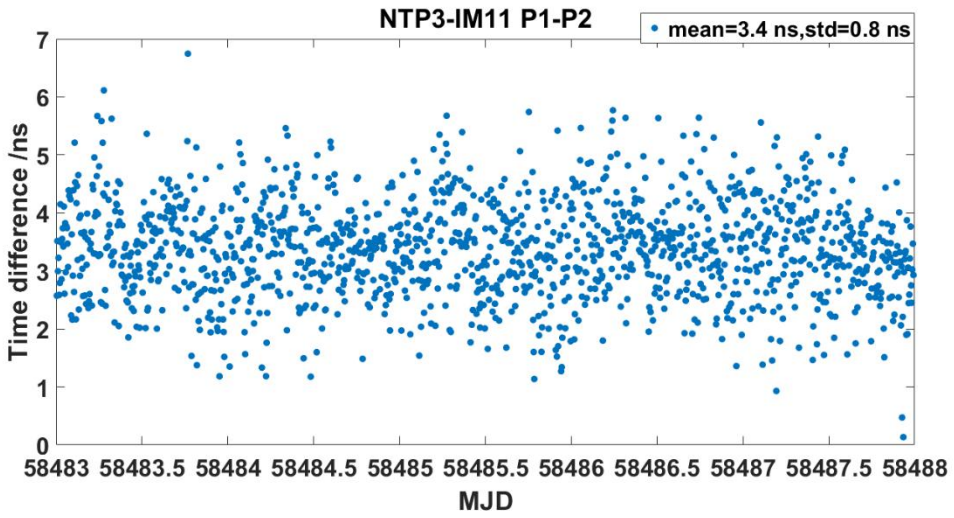


Figure 41. CCD between NTP3 and IM11 at NTSC(P1-P2)

JA01 - IM09

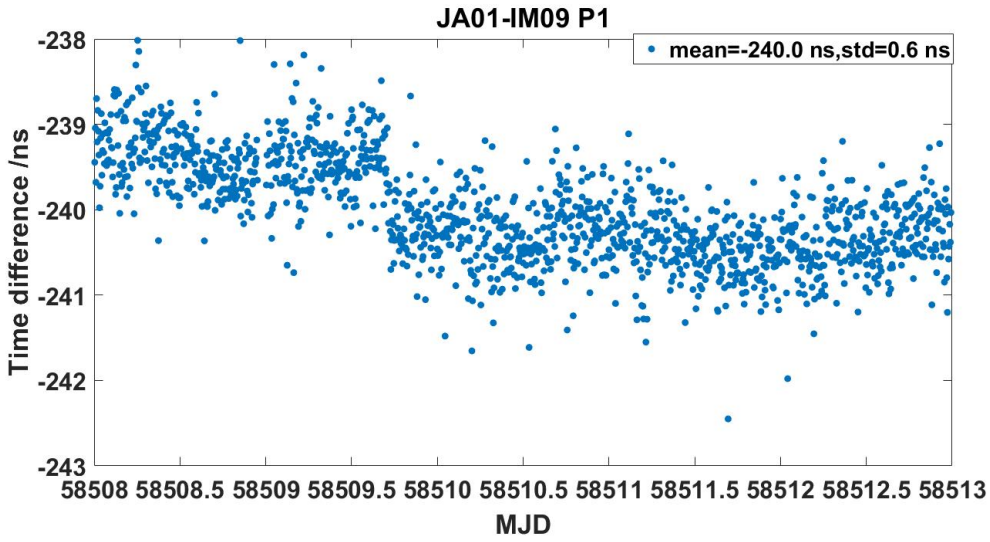


Figure 42. CCD between JA01 and IM09 at NTSC(P1)

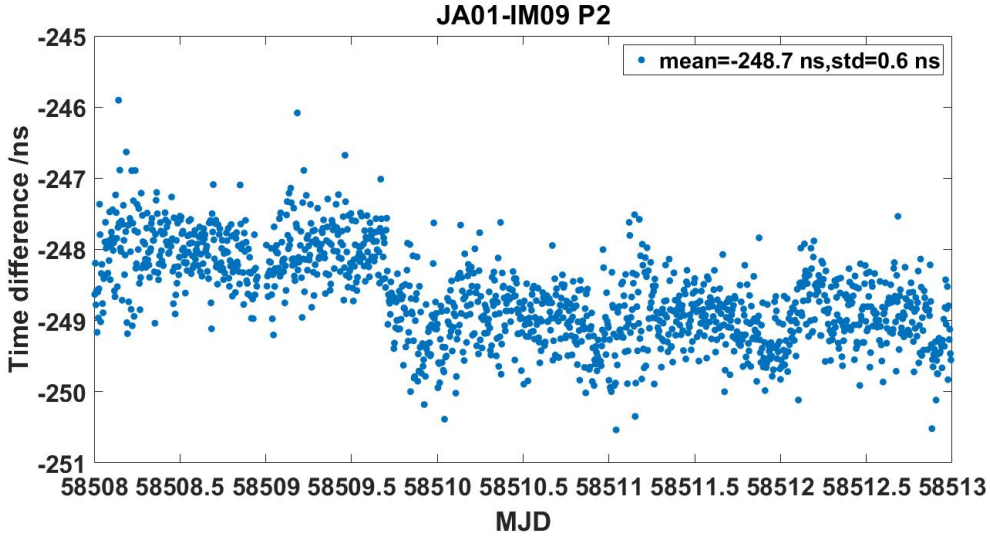


Figure 43. CCD between JA01 and IM09 at NTSC(P2)

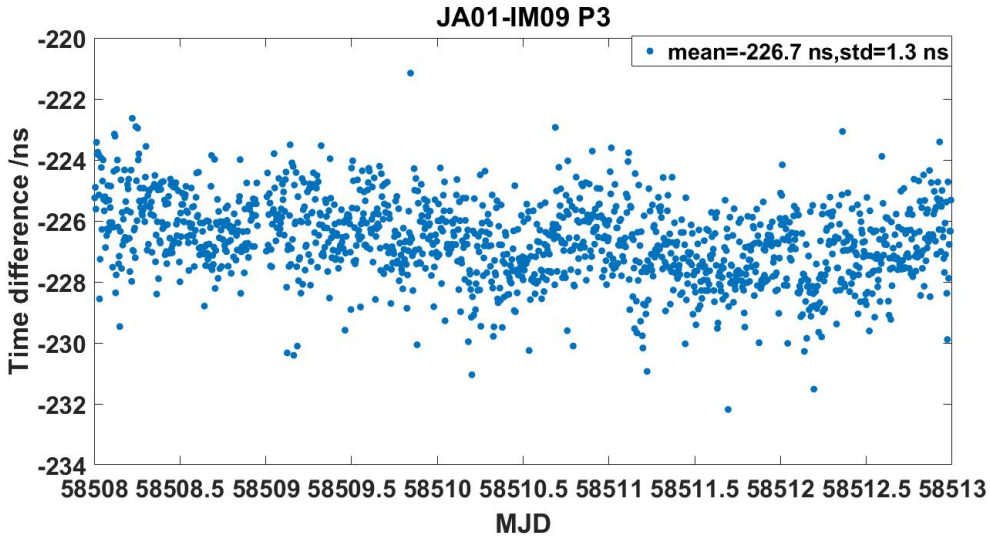


Figure 44. CCD between JA01 and IM09 at NTSC(P3)

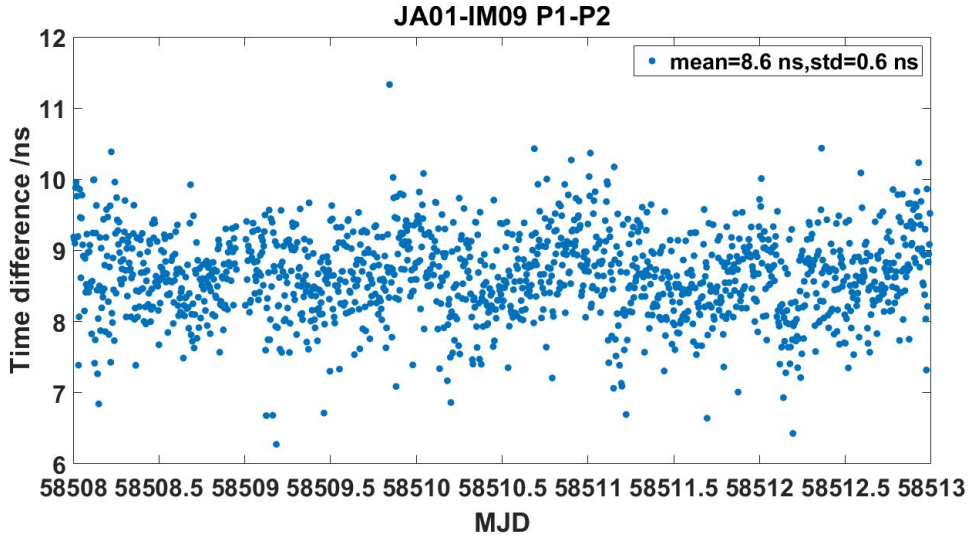


Figure 45. CCD between JA01 and IM09 at NTSC(P1-P2)

JA01 - IM11

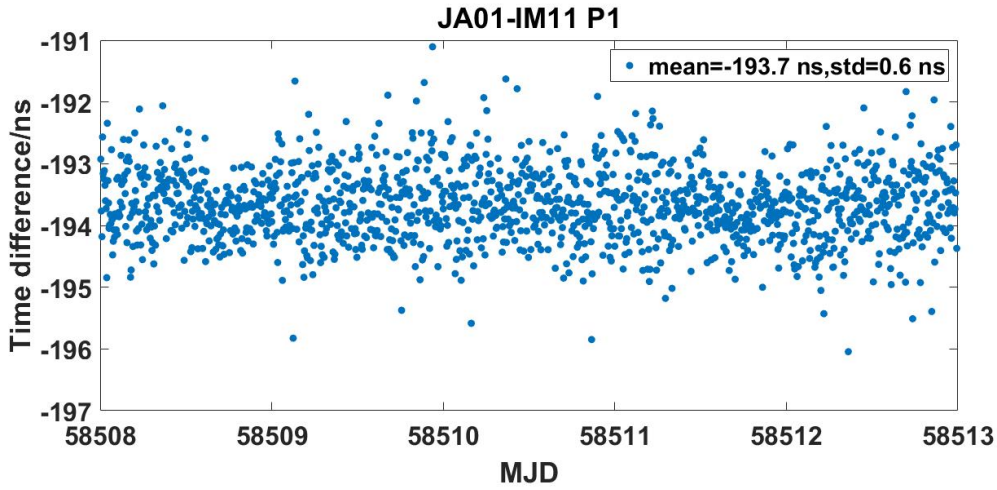


Figure 46. CCD between JA01 and IM11 at NTSC(P1)

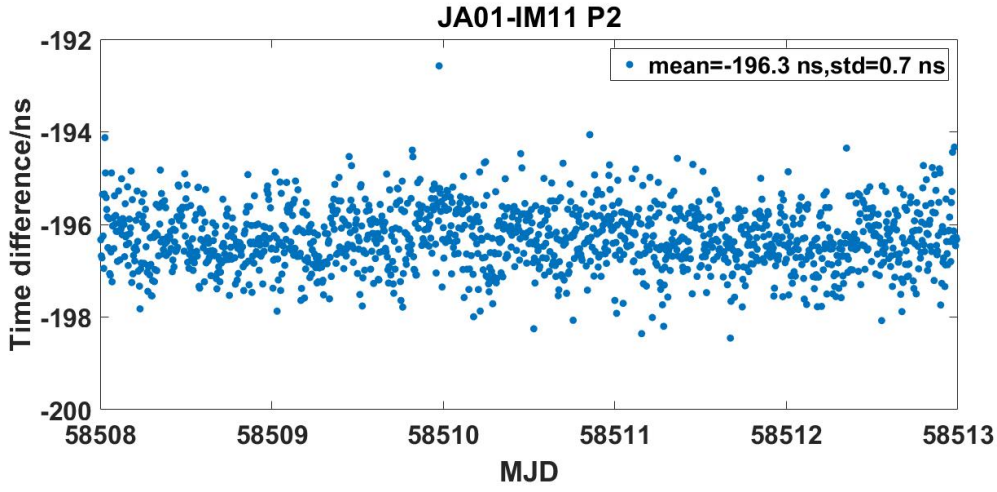


Figure 47. CCD between JA01 and IM11 at NTSC(P2)

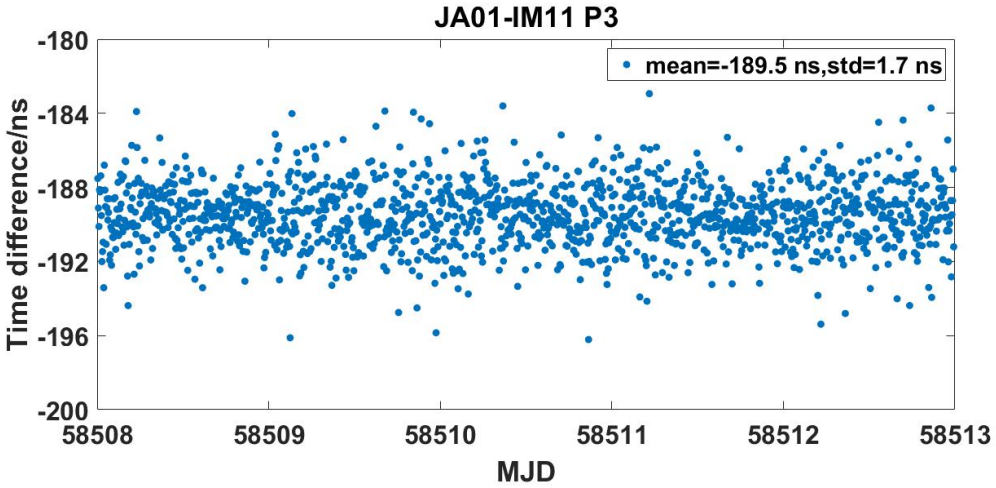


Figure 48. CCD between JA01 and IM11 at NTSC(P3)

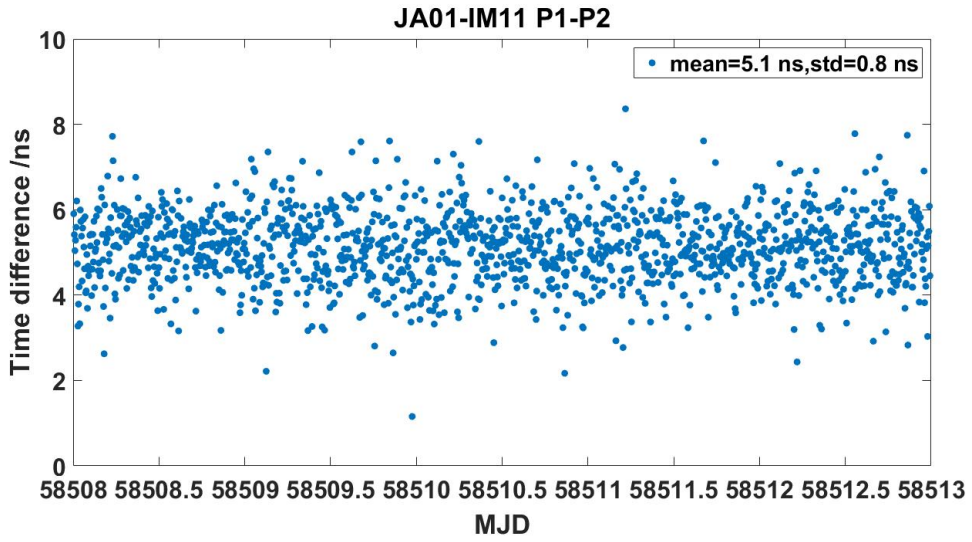


Figure 49. CCD between JA01 and IM11 at NTSC(P1-P2)

3. Closure CCD after calibration

IM09 - IM06

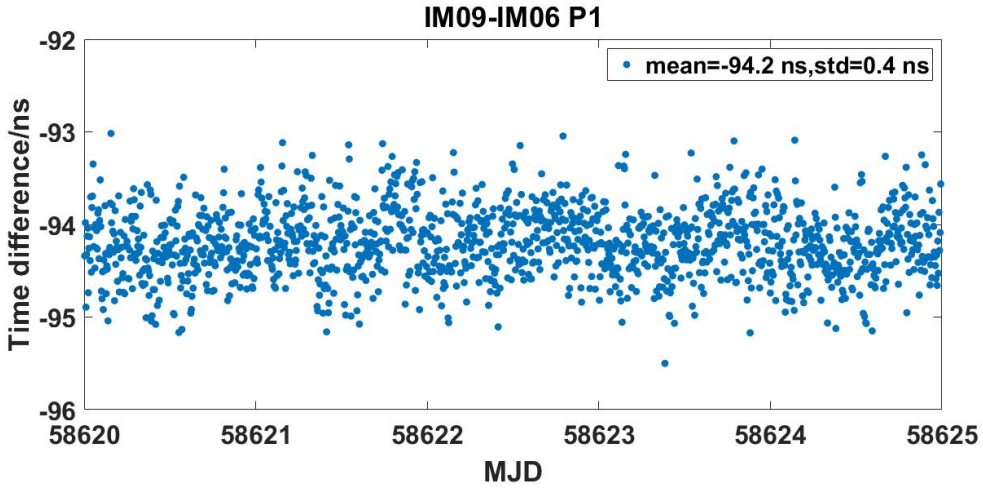


Figure 50. CCD between IM09 and IM06 at NIM(P1)

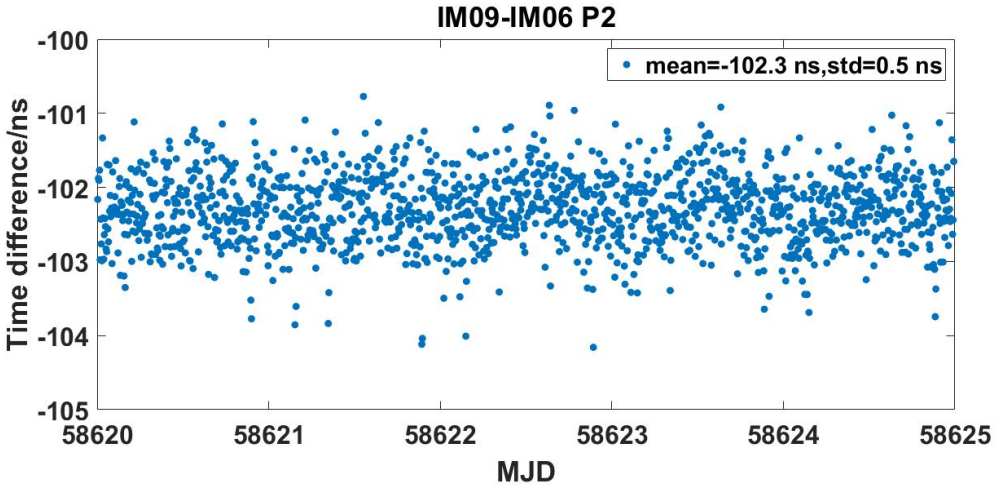


Figure 51. CCD between IM09 and IM06 at NIM(P2)

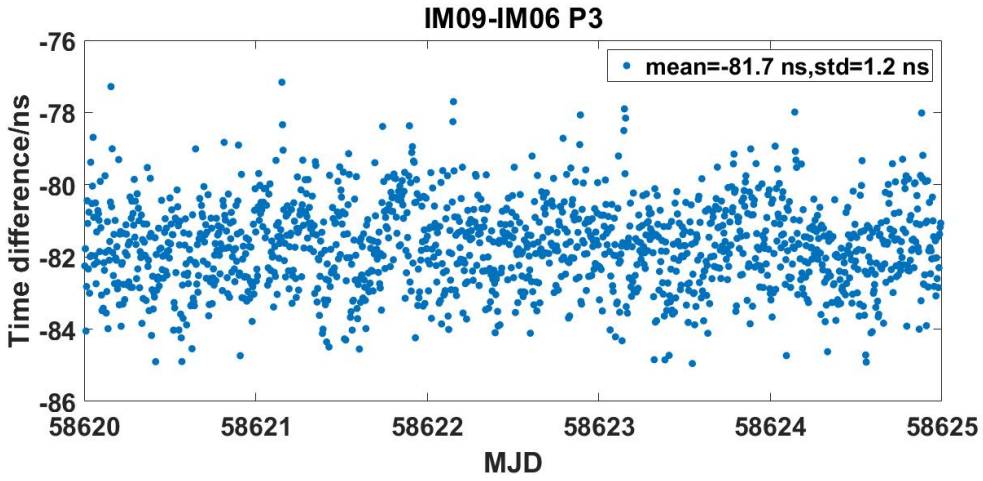


Figure 52. CCD between IM09 and IM06 at NIM(P3)

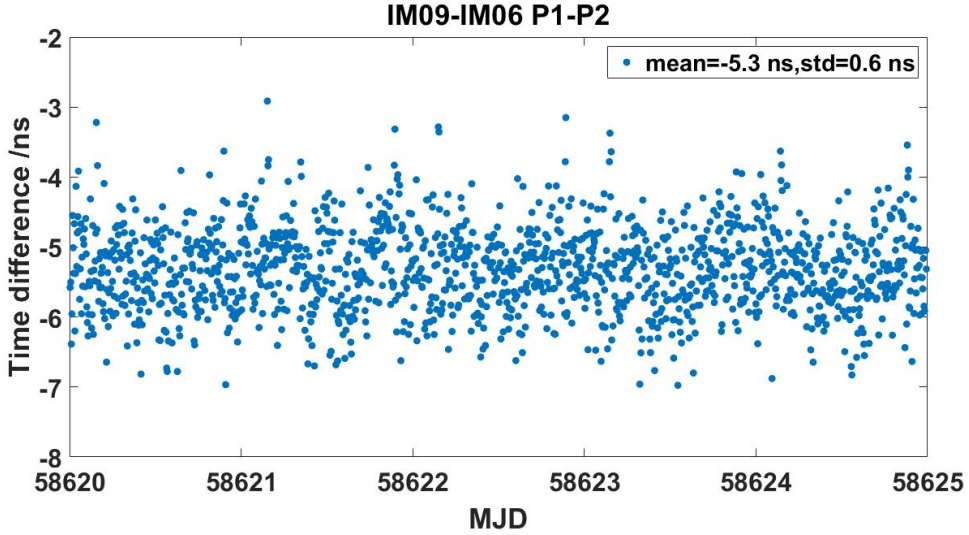


Figure 53. CCD between IM09 and IM06 at NIM(P1-P2)

IM11 - IM06

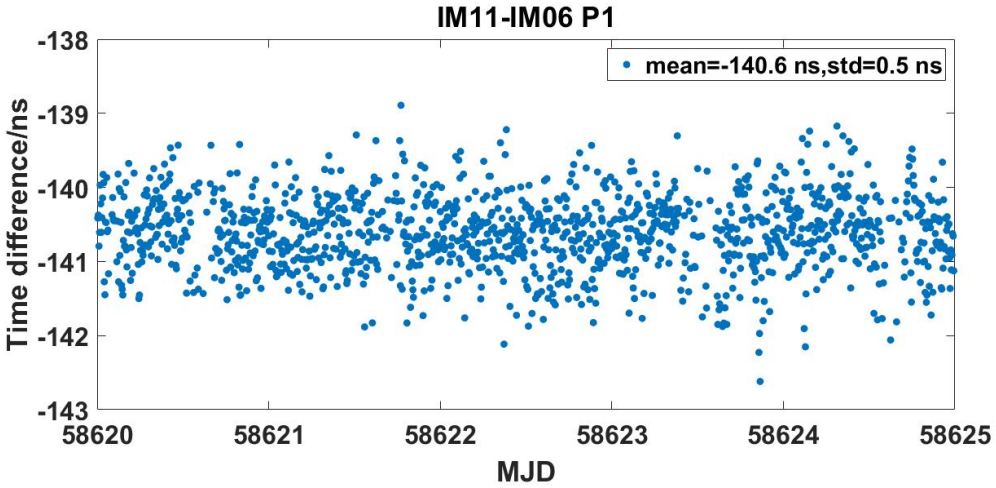


Figure 54. CCD between IM11 and IM06 at NIM(P1)

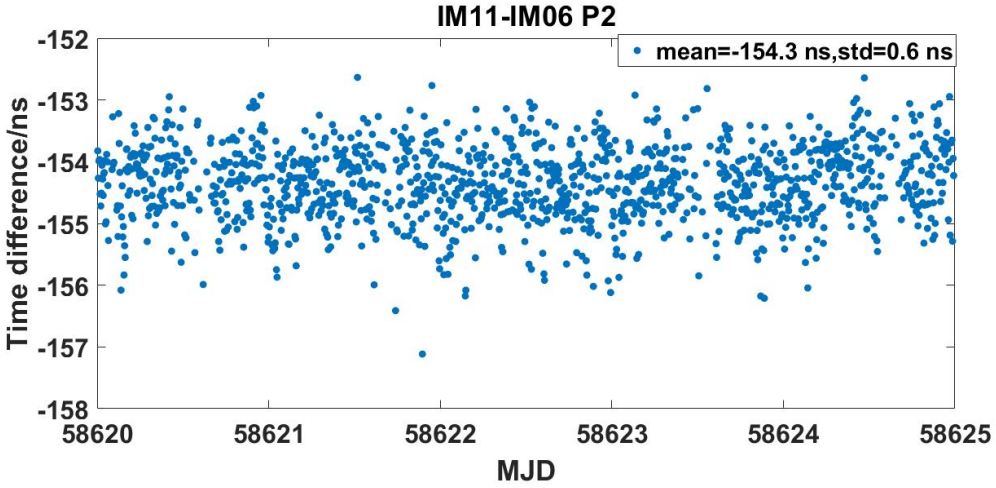


Figure 55. CCD between IM11 and IM06 at NIM(P2)

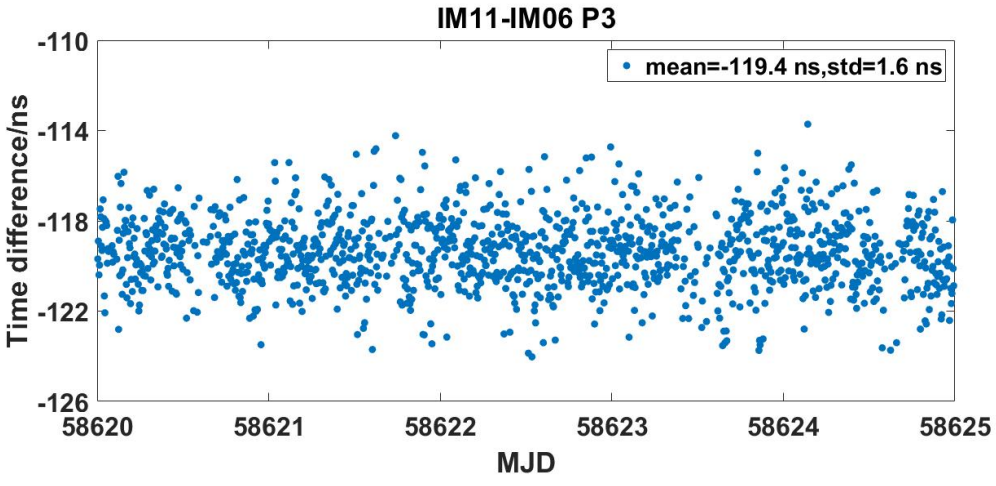


Figure 56. CCD between IM11 and IM06 at NIM(P3)

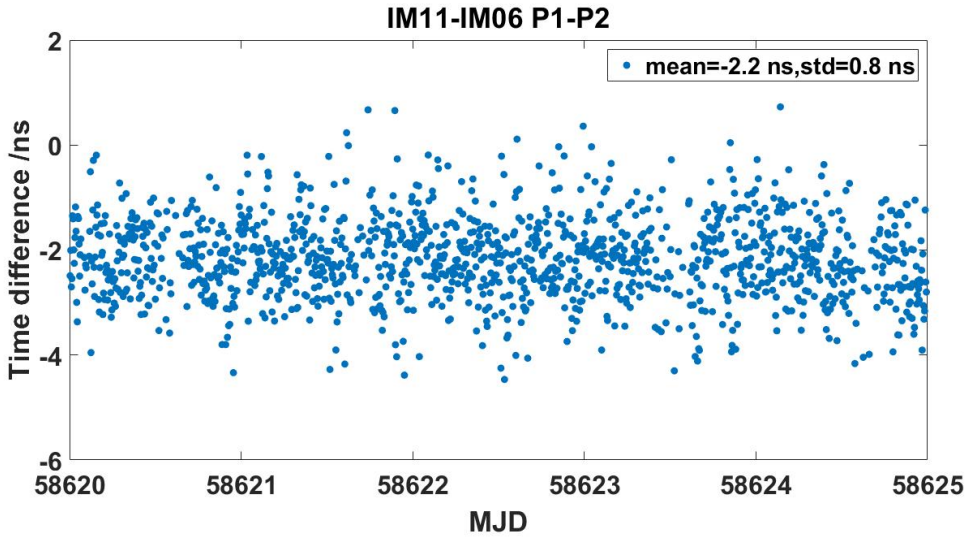


Figure 57. CCD between IM11 and IM06 at NIM(P1-P2)

Annex 2. CCD results for BIRM

1. Start CCD before calibration

IM09-IM06

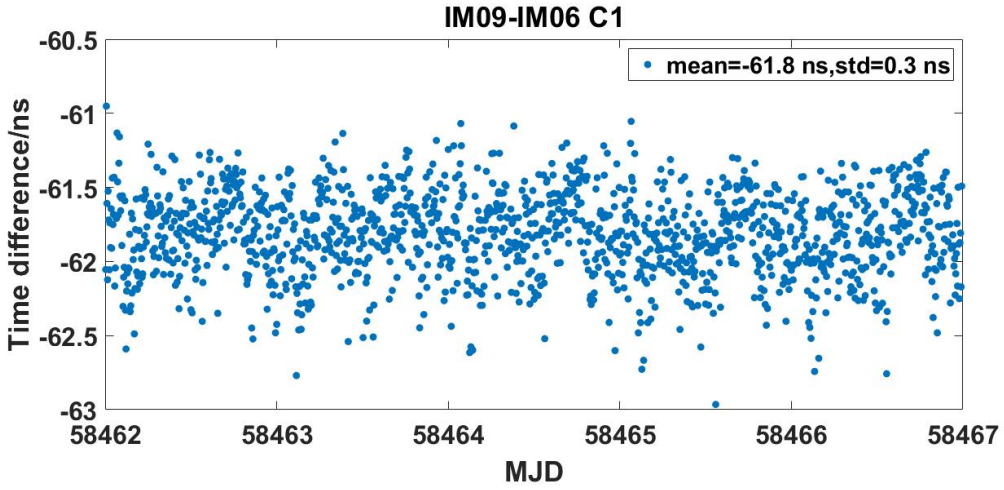


Figure 58. CCD between IM09 and IM06 at NIM(C1)

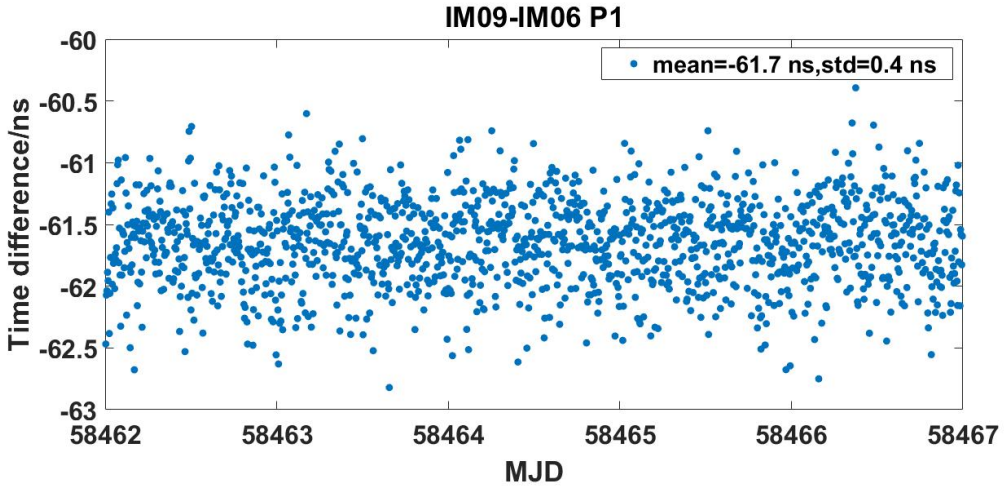


Figure 59. CCD between IM09 and IM06 at NIM(P1)

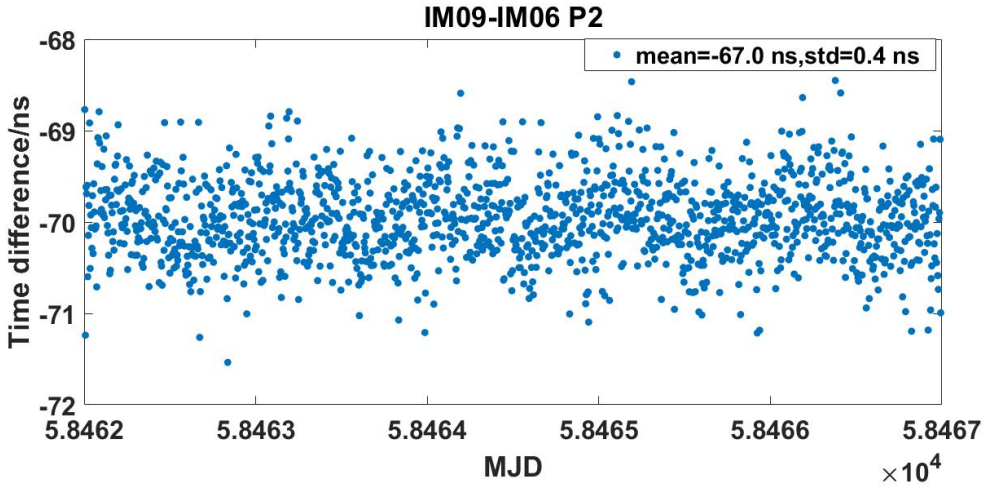


Figure 60. CCD between IM09 and IM06 at NIM(P2)

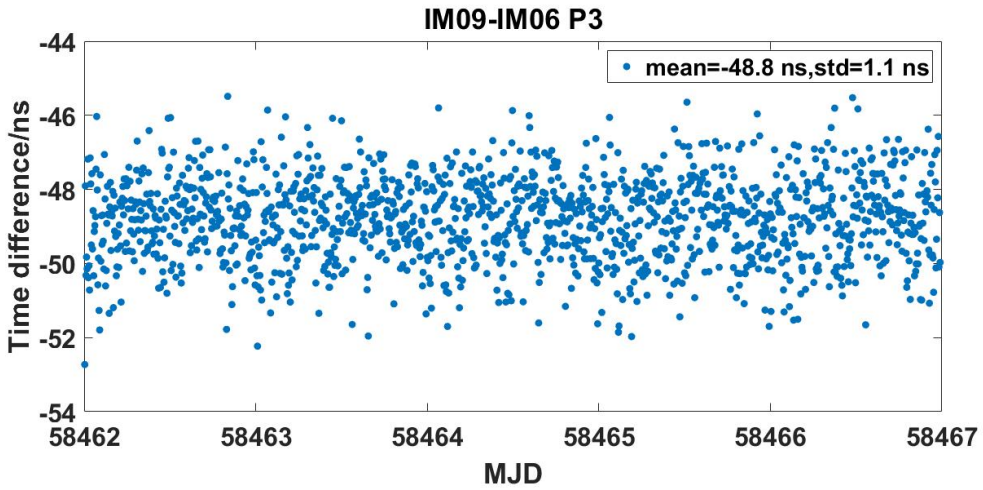


Figure 61. CCD between IM09 and IM06 at NIM(P3)

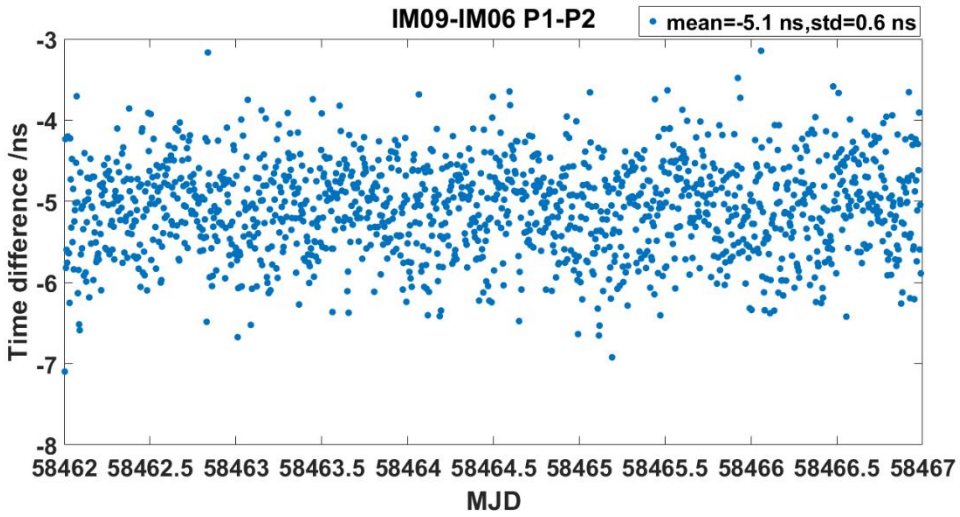


Figure 62. CCD between IM09 and IM06 at NIM(P1-P2)

IM11-IM06

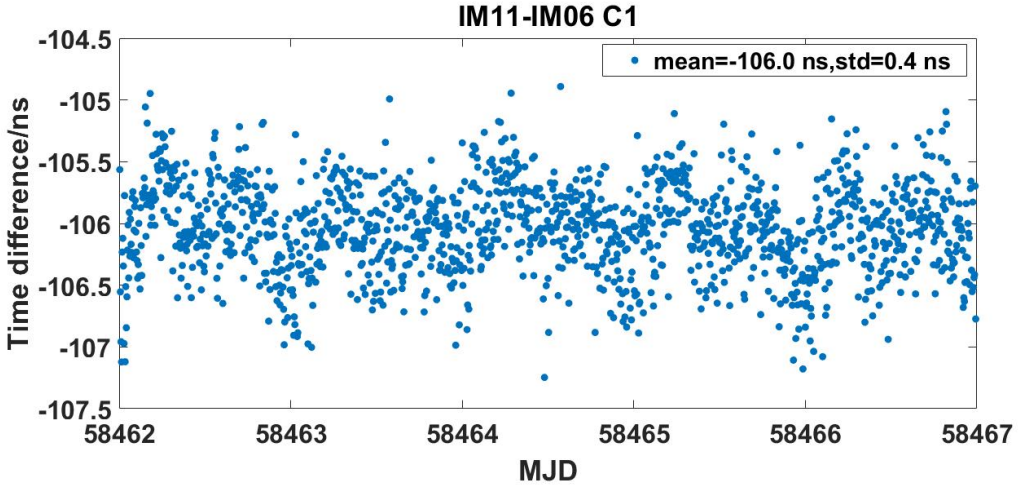


Figure 63. CCD between IM11 and IM06 at NIM(C1)

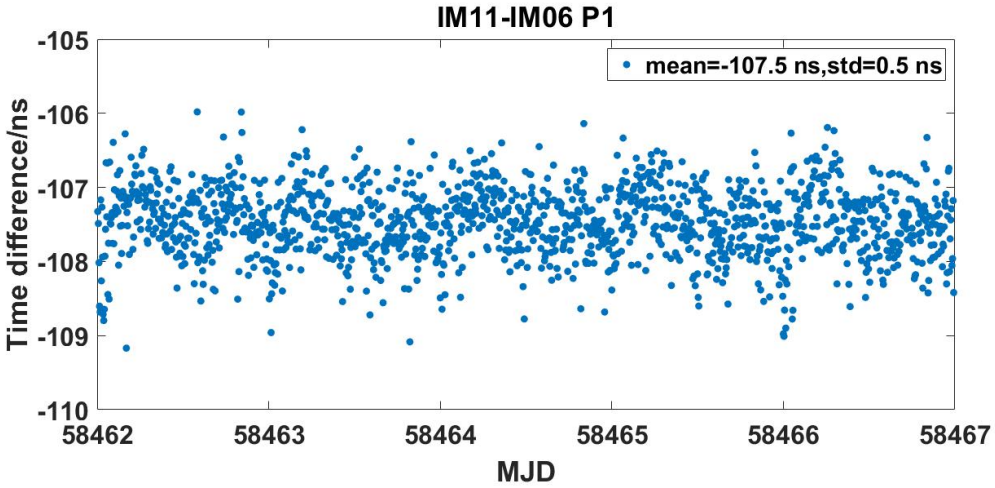


Figure 64. CCD between IM11 and IM06 at NIM(P1)

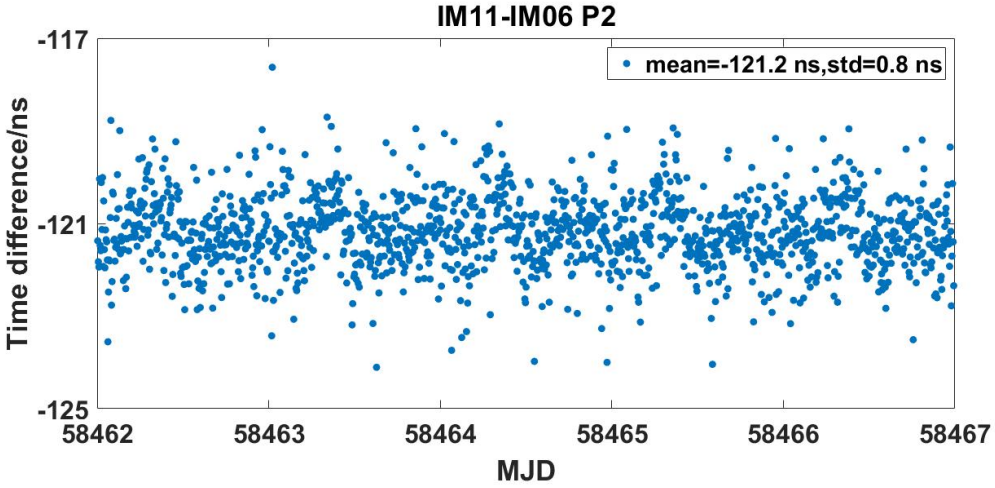


Figure 65. CCD between IM11 and IM06 at NIM(P2)

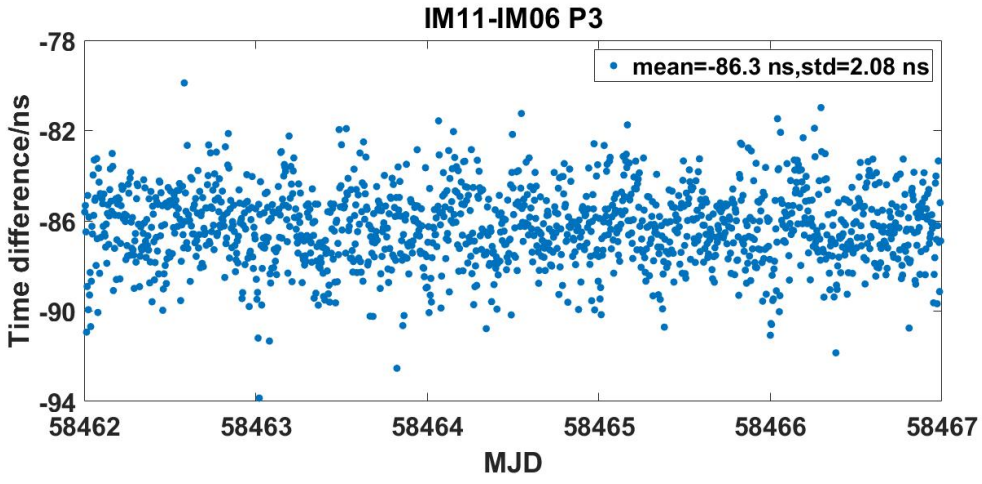


Figure 66. CCD between IM11 and IM06 at NIM(P3)

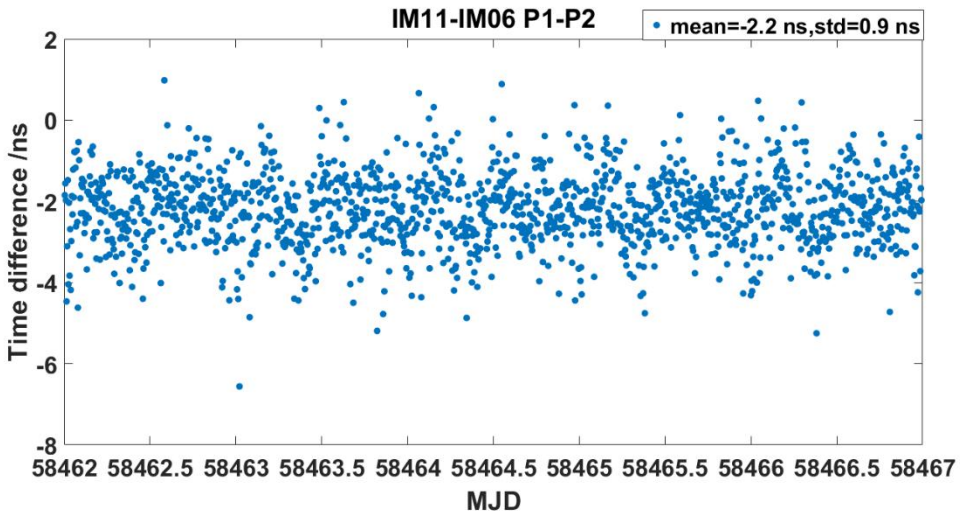


Figure 67. CCD between IM11 and IM06 at NIM(P1-P2)

2. Calibration on site

IM09 – BI01

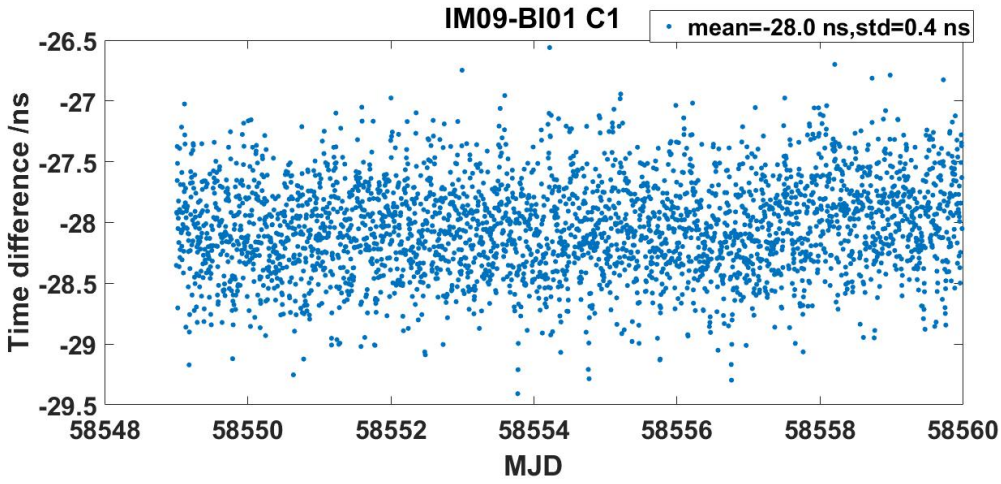


Figure 68. CCD between IM09 and BM01 at BIRM (C1)

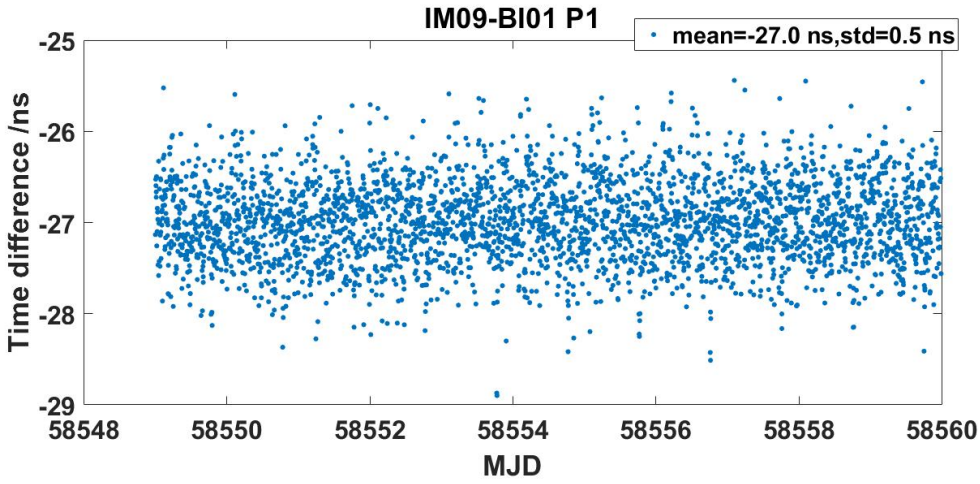


Figure 69. CCD between IM09 and BM01 at BIRM (P1)

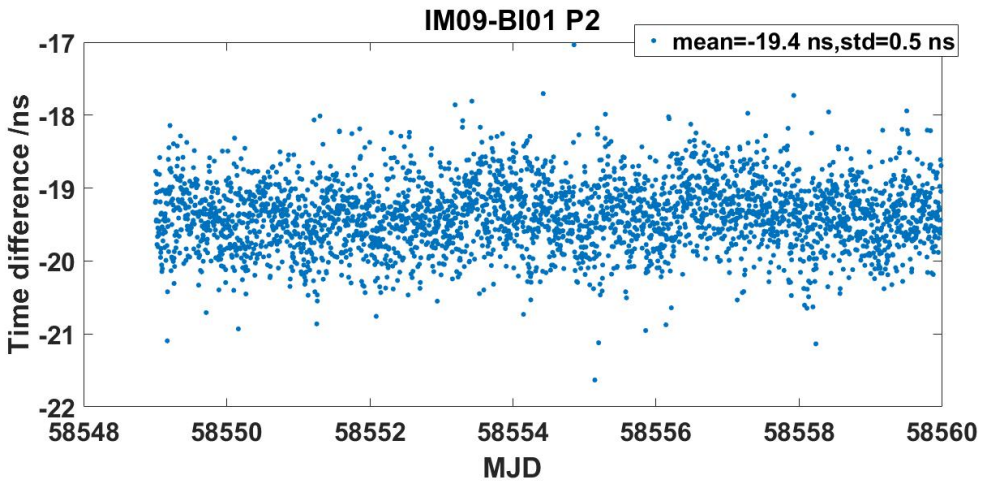


Figure 70. CCD between IM09 and BM01 at BIRM (P2)

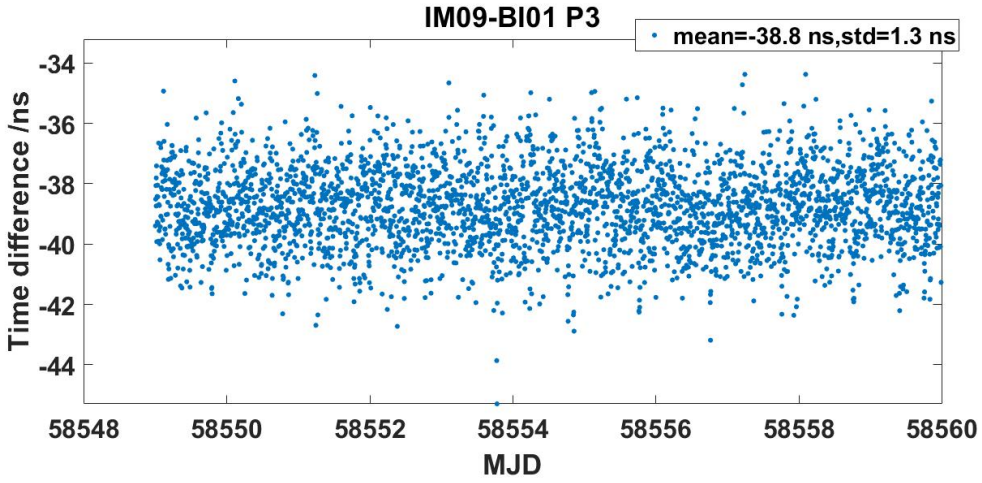


Figure 71. CCD between IM09 and BM01 at BIRM (P3)

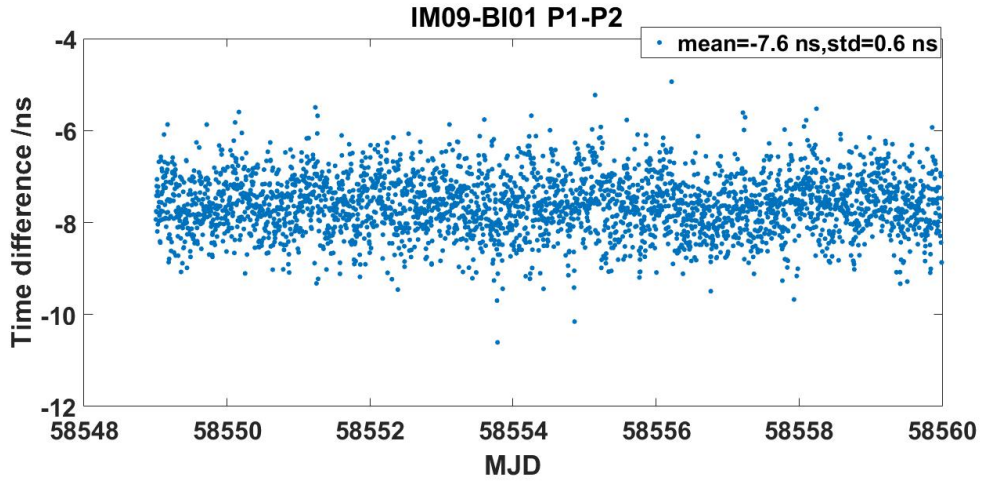


Figure 72. CCD between IM09 and BM01 at BIRM (P1-P2)

IM11 – BI01

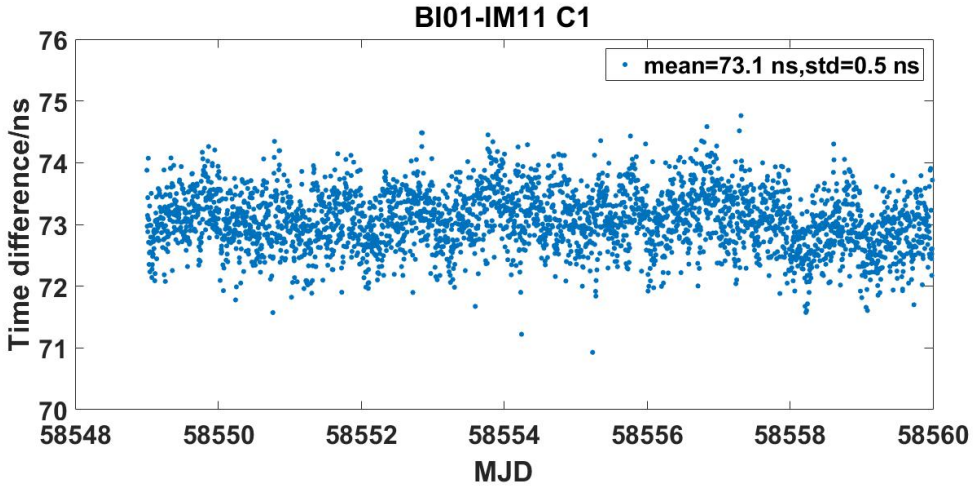


Figure 73. CCD between IM11 and BI01 at BIRM (C1)

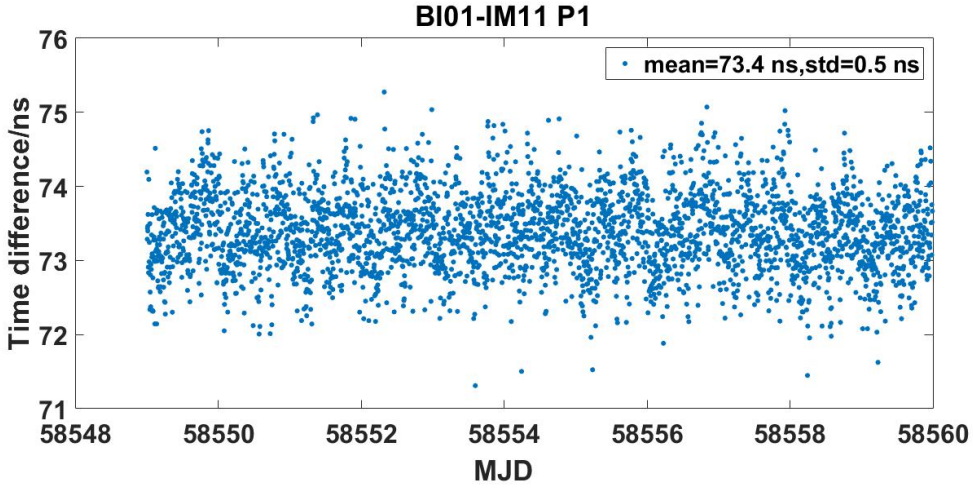


Figure 74. CCD between IM11 and BI01 at BIRM (P1)

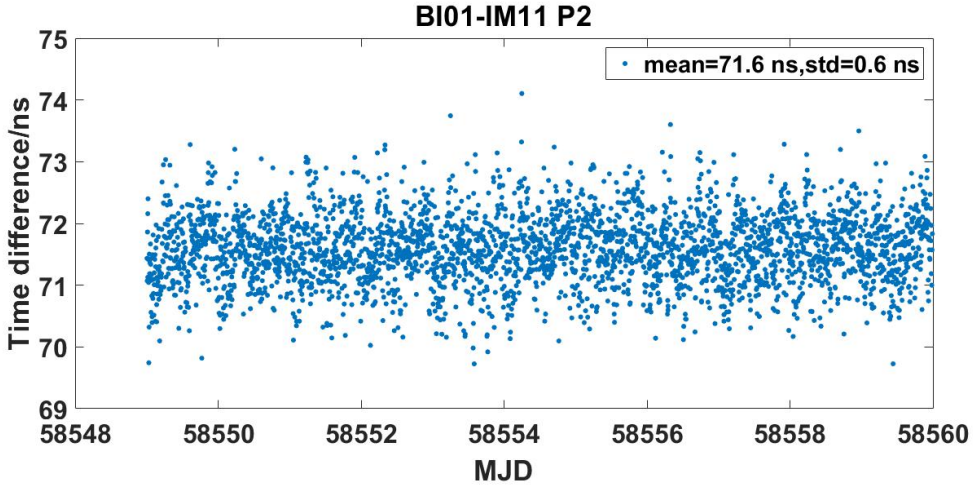


Figure 75. CCD between IM11 and BI01 at BIRM (P2)

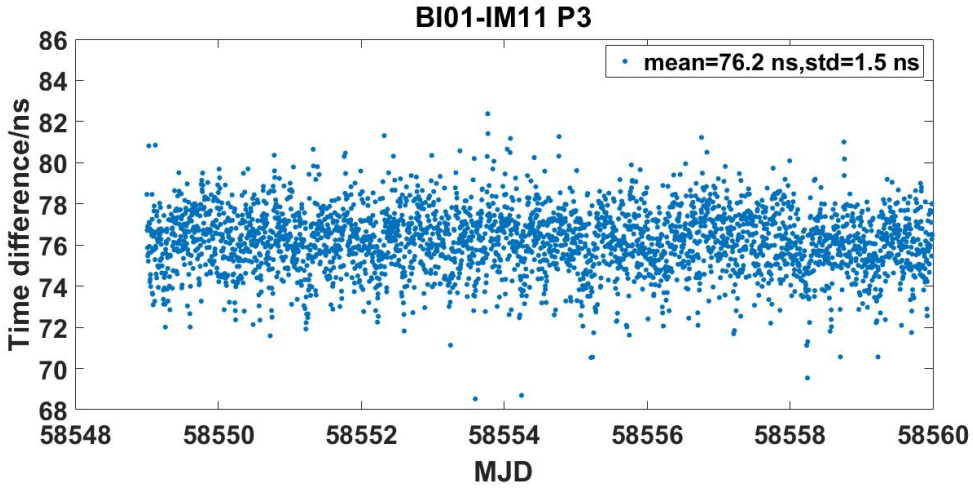


Figure 76. CCD between IM11 and BI01 at BIRM (P3)

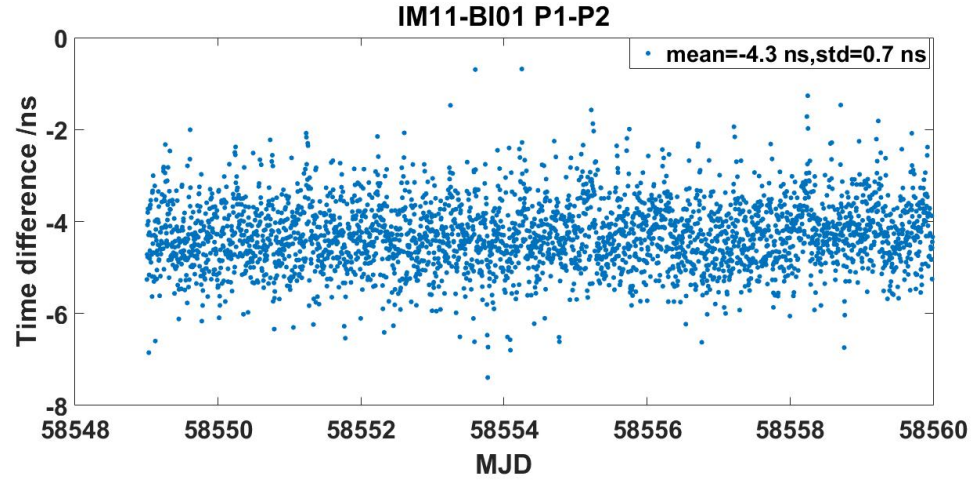


Figure 77. CCD between IM11 and BI01 at BIRM (P1-P2)

IM09-BI22

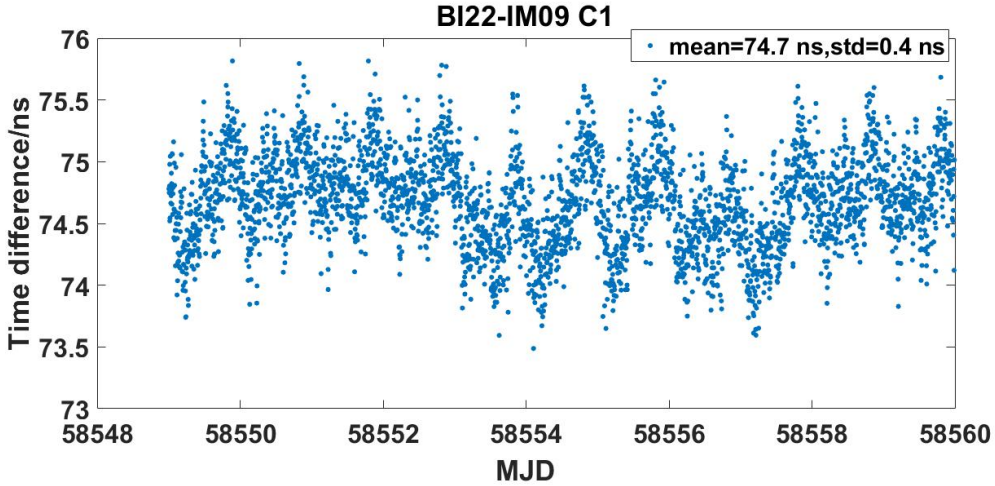


Figure 78. CCD between IM09 and BI22 at BIRM (C1)

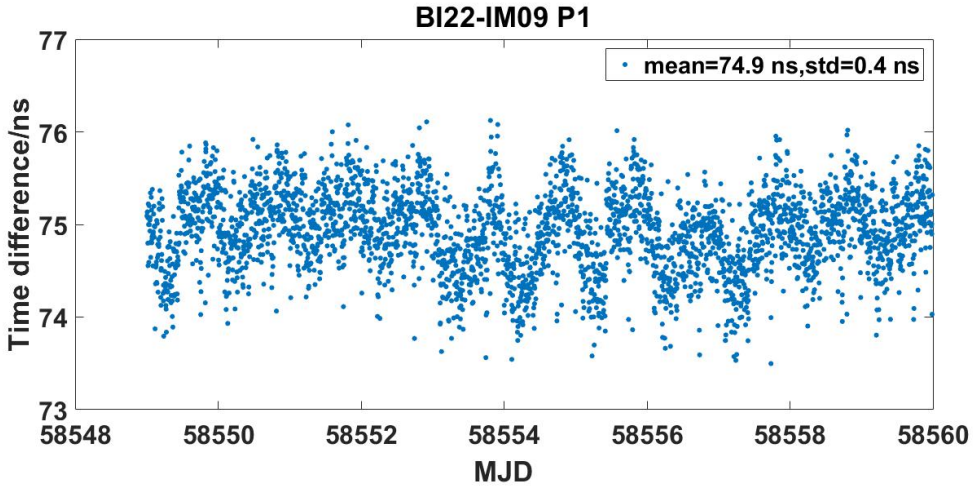


Figure 79. CCD between IM09 and BI22 at BIRM (P1)

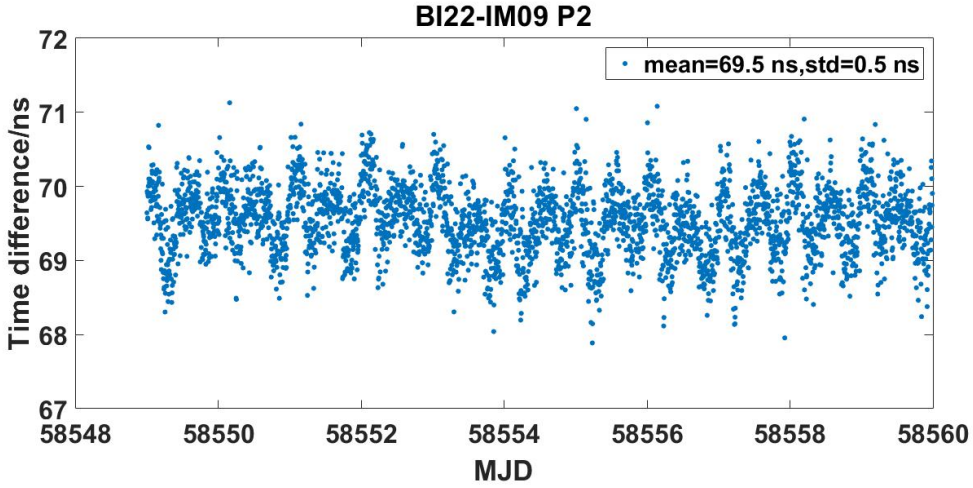


Figure 80. CCD between IM09 and BI22 at BIRM (P2)

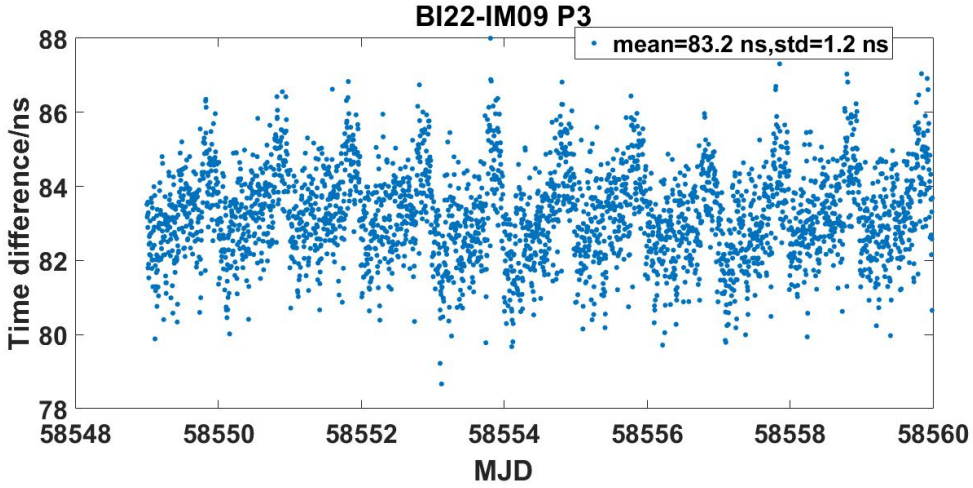


Figure 81. CCD between IM09 and BI22 at BIRM (P3)

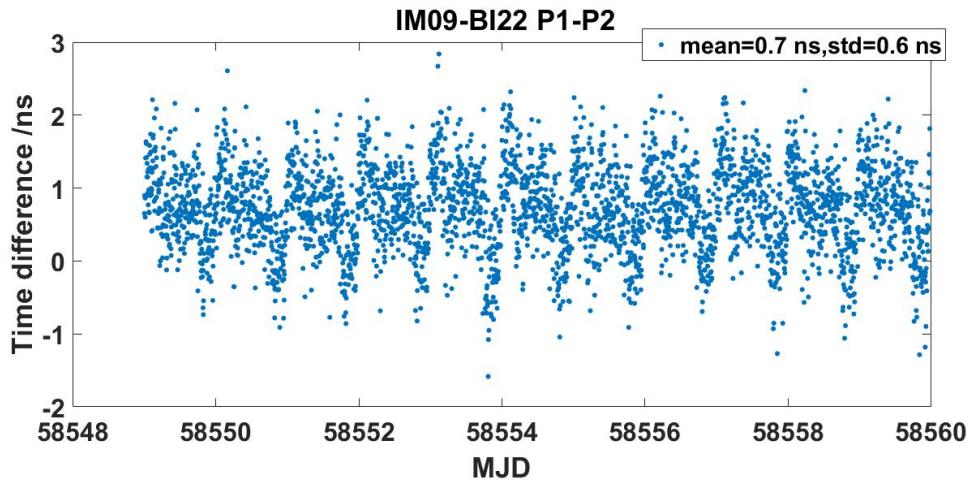


Figure 82. CCD between IM09 and BI22 at BIRM (P1-P2)

IM11-BI22

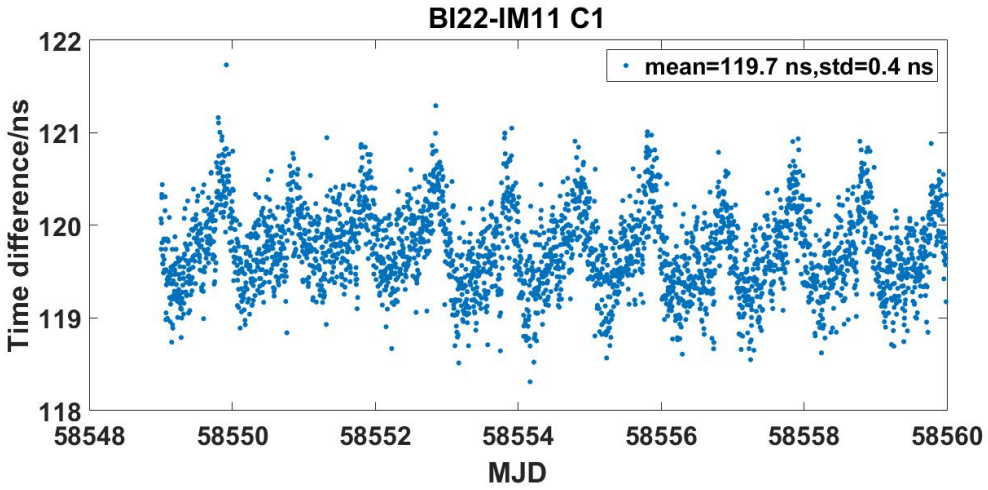


Figure 83. CCD between IM11 and BI22 at BIRM (C1)

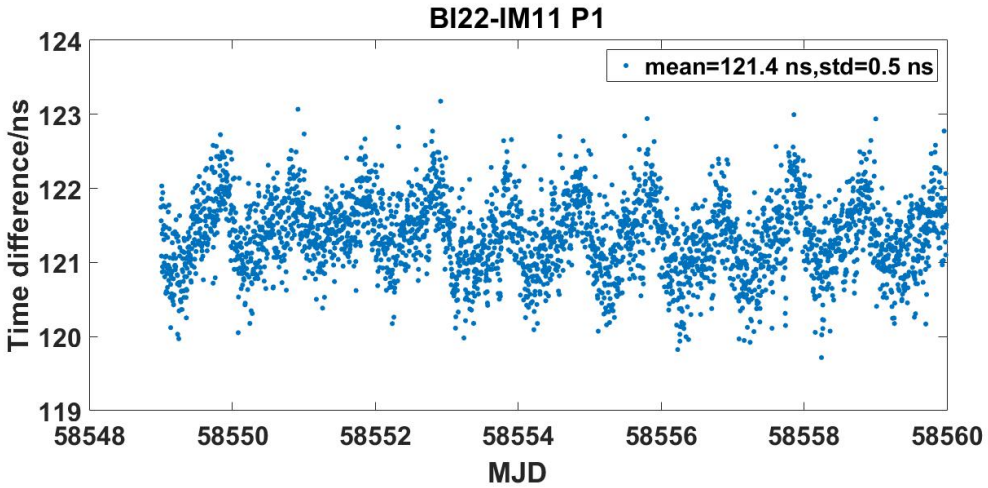


Figure 84. CCD between IM11 and BI22 at BIRM (P1)

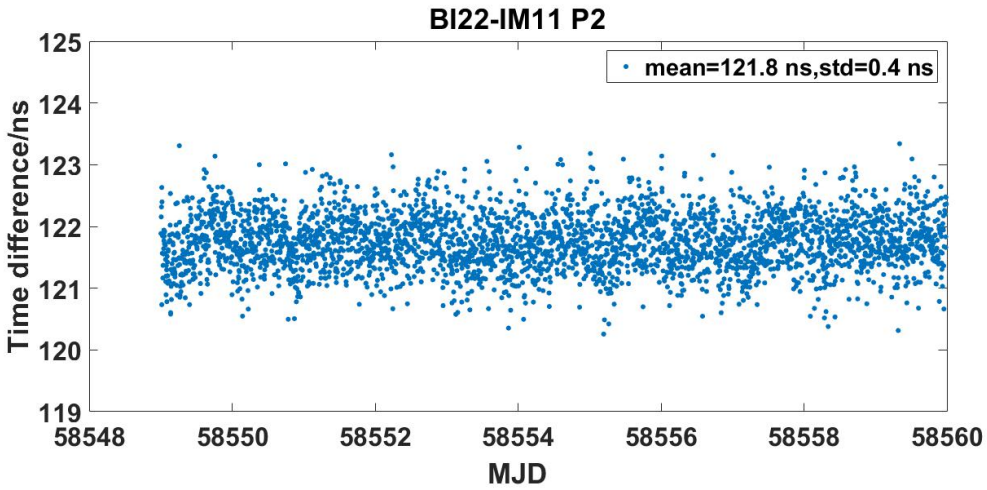


Figure 85. CCD between IM11 and BI22 at BIRM (P2)

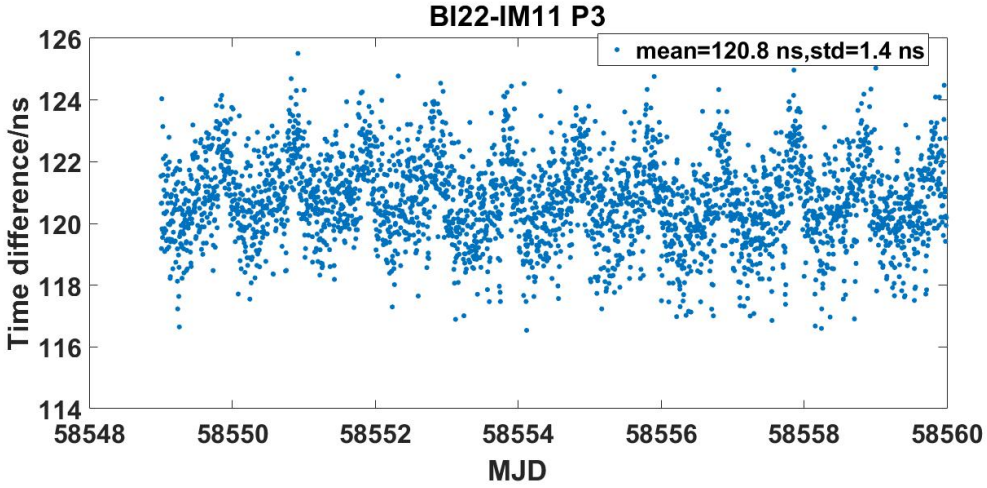


Figure 86. CCD between IM11 and BI22 at BIRM (P3)

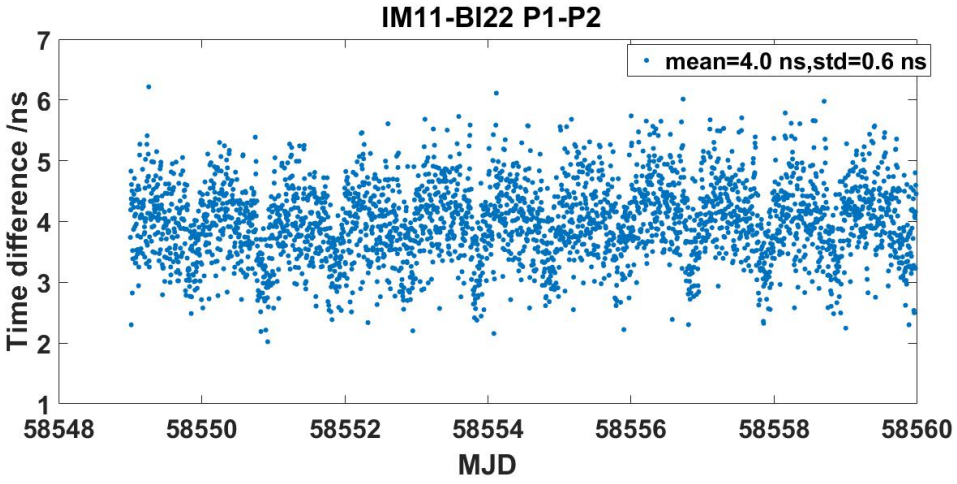


Figure 87. CCD between IM11 and BI22 at BIRM (P1-P2)

IM09-BI41

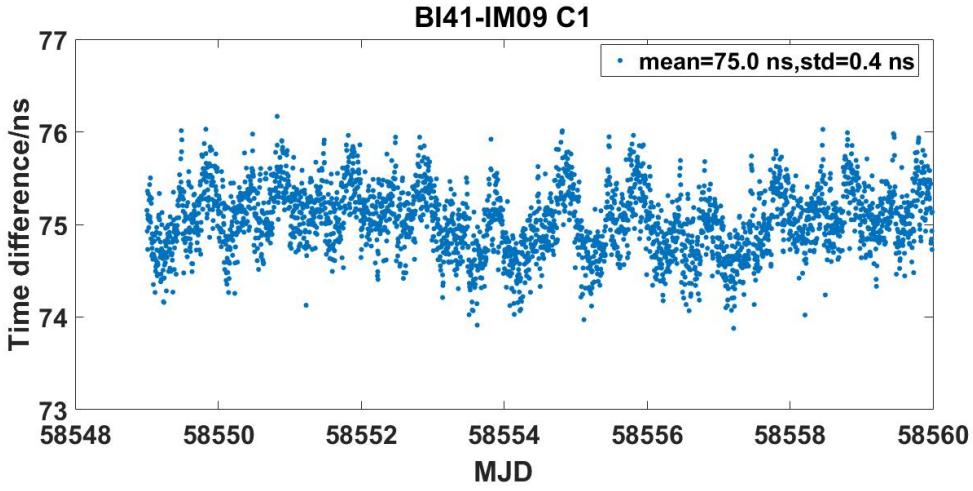


Figure 88. CCD between IM09 and BM41 at BIRM (C1)

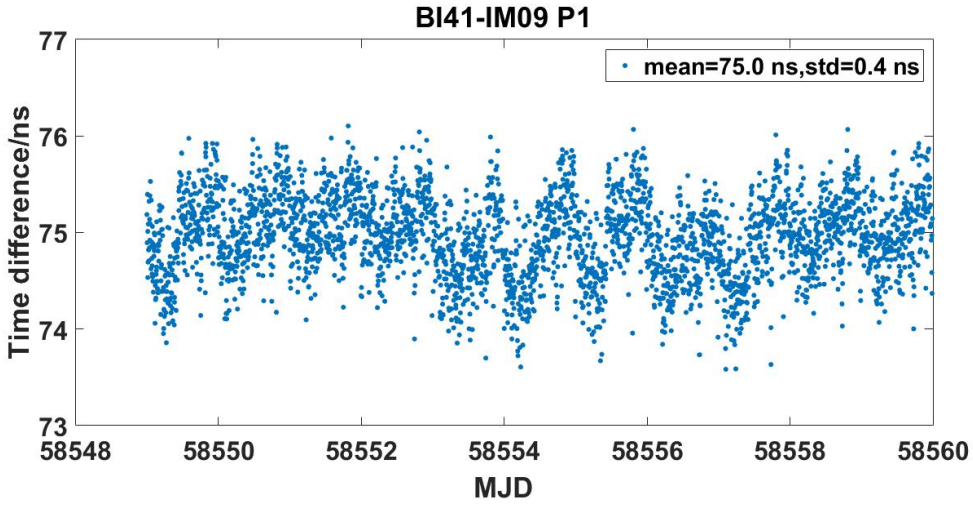


Figure 89. CCD between IM09 and BM41 at BIRM (P1)

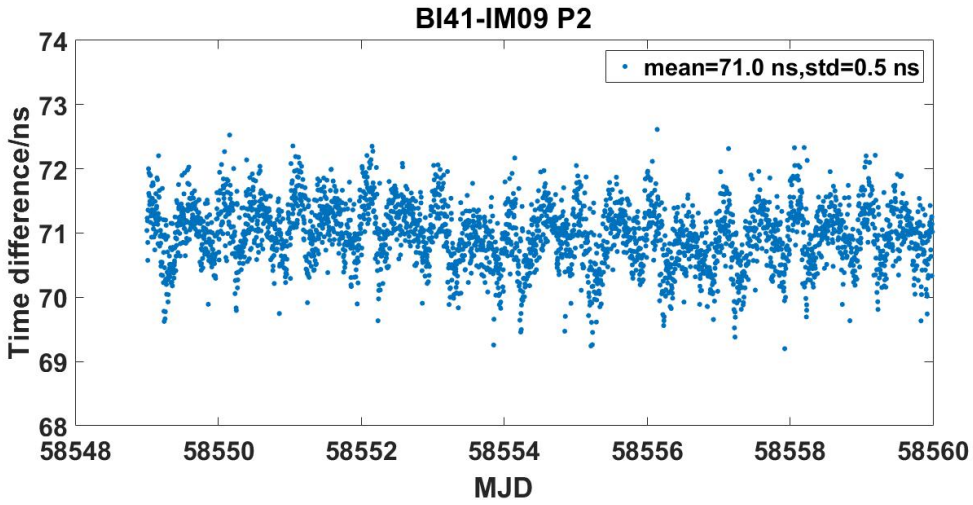


Figure 90. CCD between IM09 and BM41 at BIRM (P2)

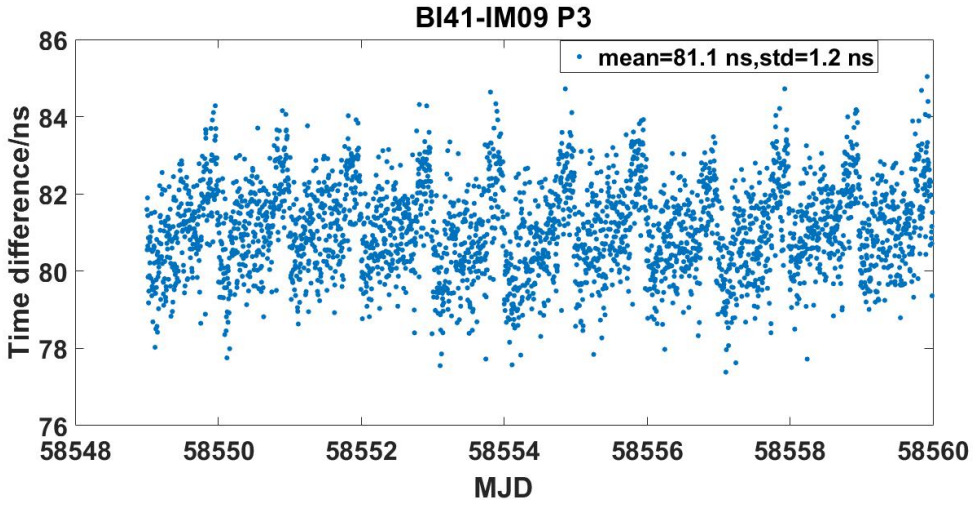


Figure 91. CCD between IM09 and BM41 at BIRM (P3)

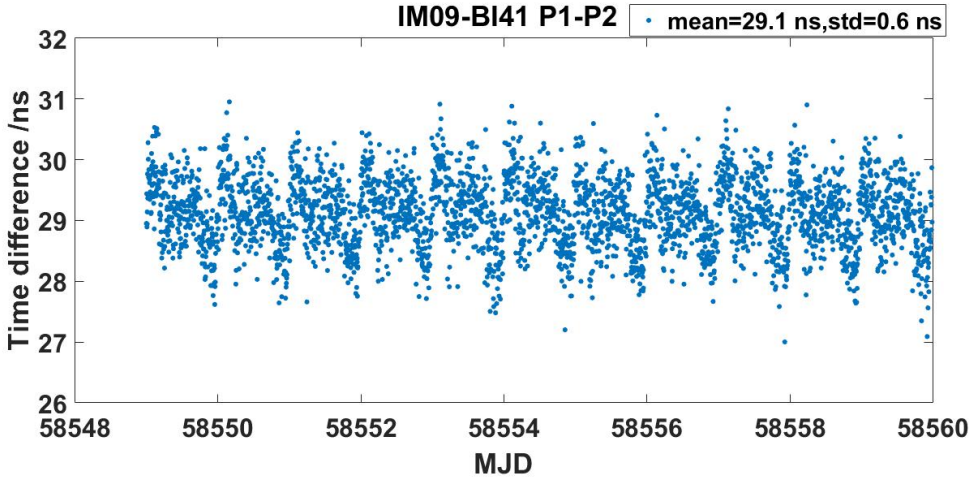


Figure 92. CCD between IM09 and BM41 at BIRM (P1-P2)

IM11-BI41

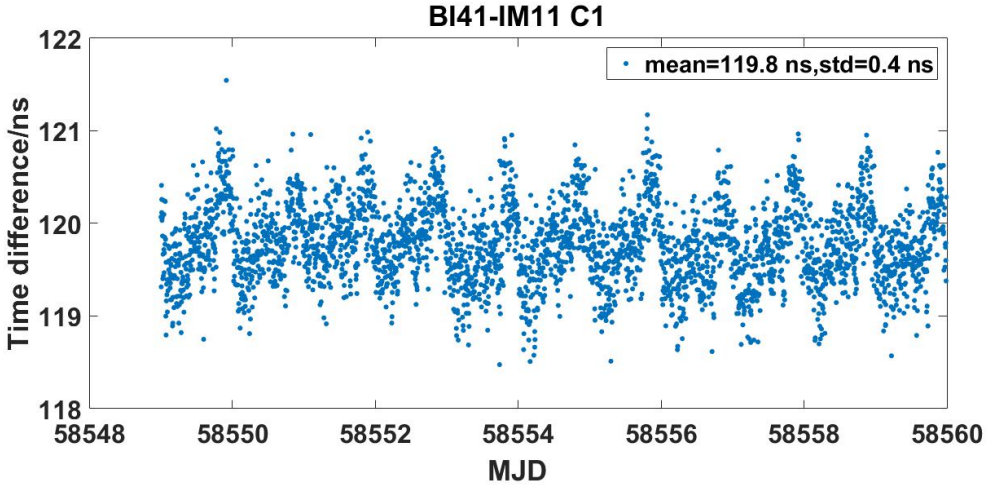


Figure 93. CCD between IM11 and BI41 at BIRM (C1)

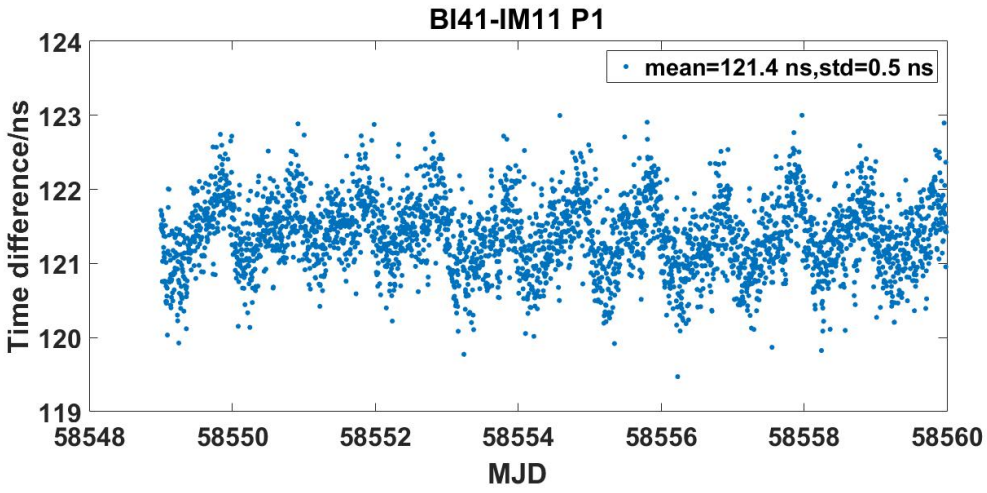


Figure 94. CCD between IM11 and BI41 at BIRM (P1)

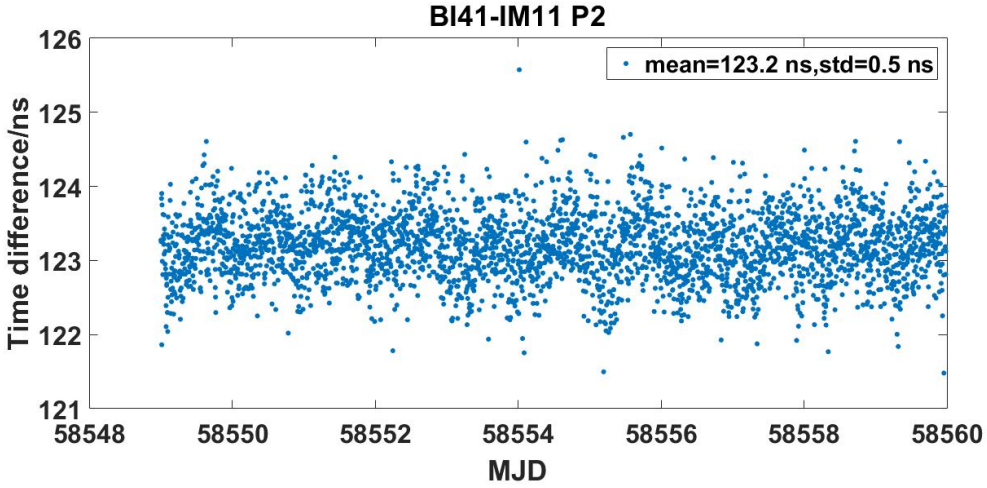


Figure 95. CCD between IM11 and BI41 at BIRM (P2)

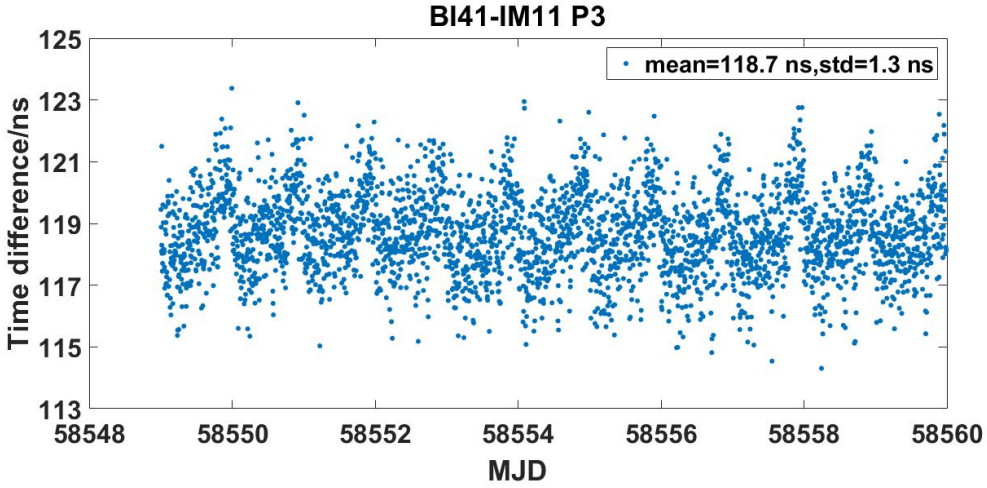


Figure 96. CCD between IM11 and BI41 at BIRM (P3)

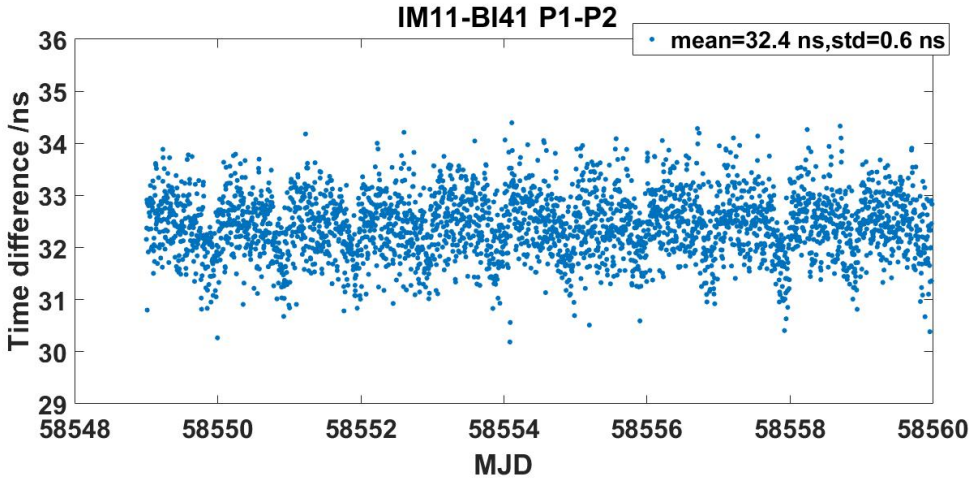


Figure 97. CCD between IM11 and BI41 at BIRM (P1-P2)

3. Closure CCD after calibration

IM09 - IM06

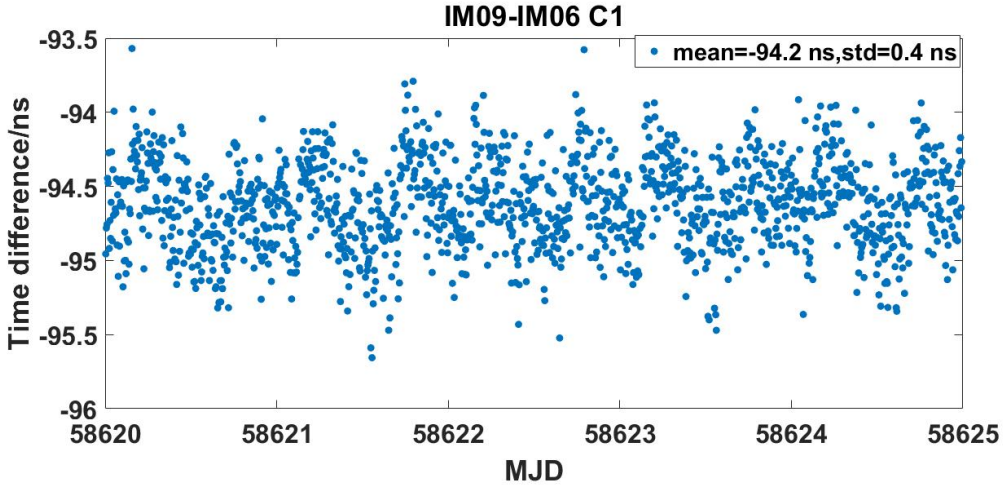


Figure 98. CCD between IM09 and IM06 at NIM(C1)

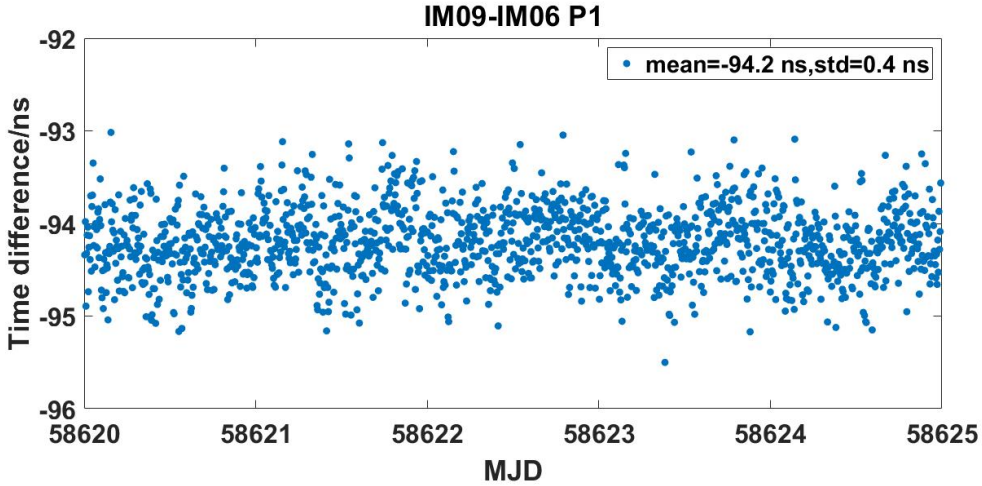


Figure 99. CCD between IM09 and IM06 at NIM(P1)

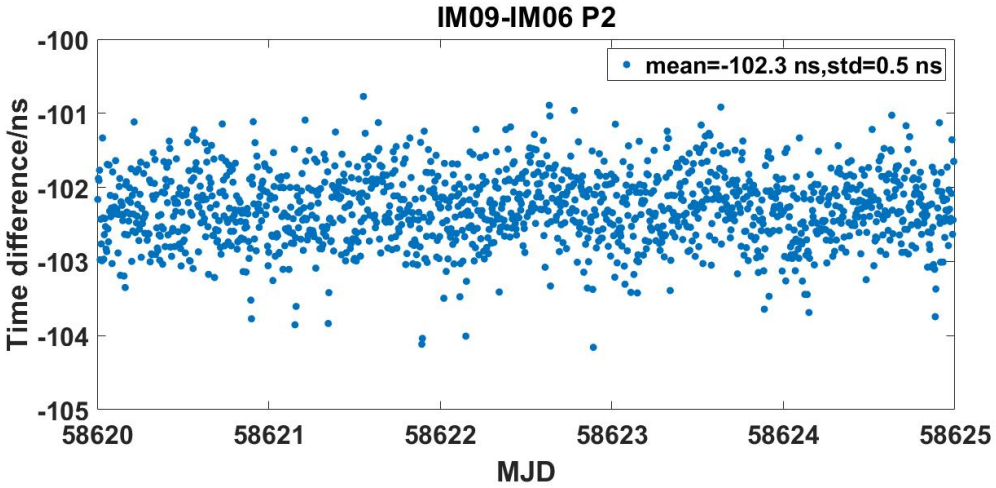


Figure 100. CCD between IM09 and IM06 at NIM(P2)

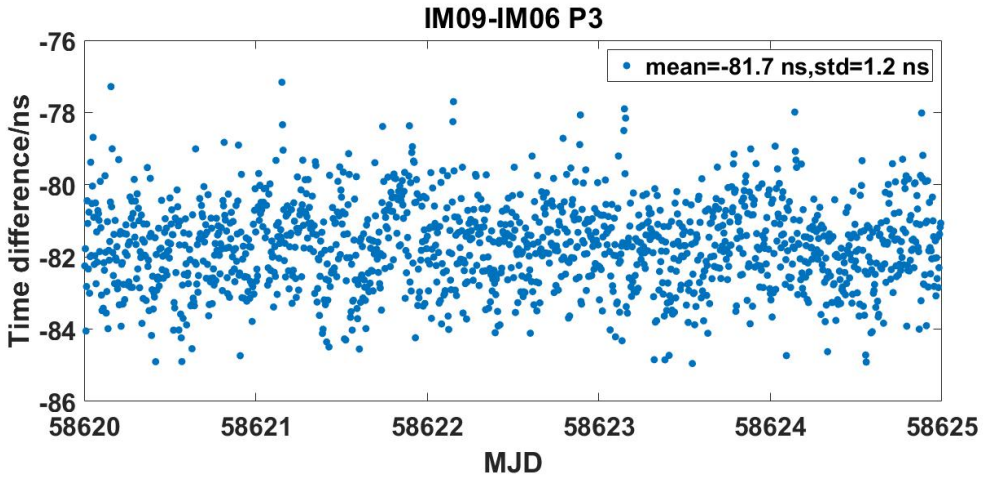


Figure 101. CCD between IM09 and IM06 at NIM(P3)

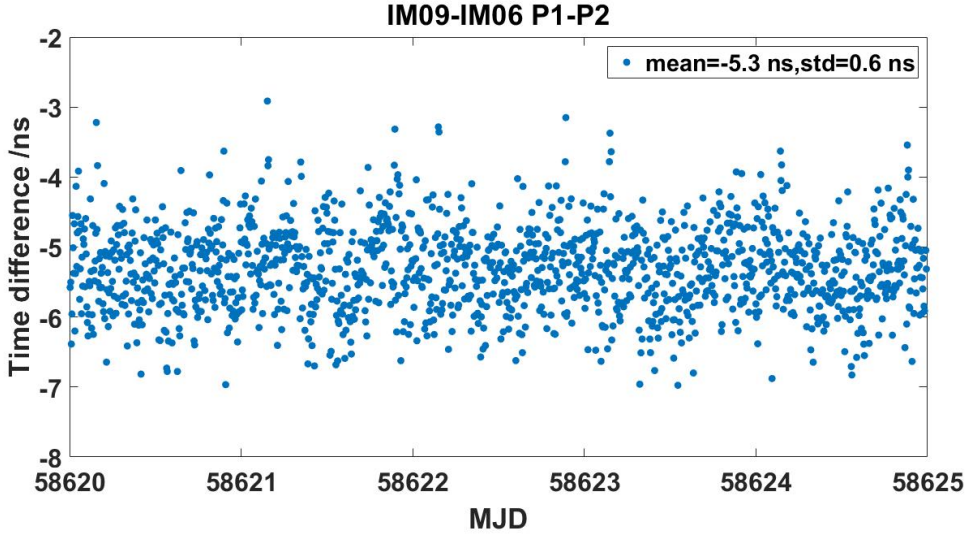


Figure 102. CCD between IM09 and IM06 at NIM(P1-P2)

IM11 - IM06

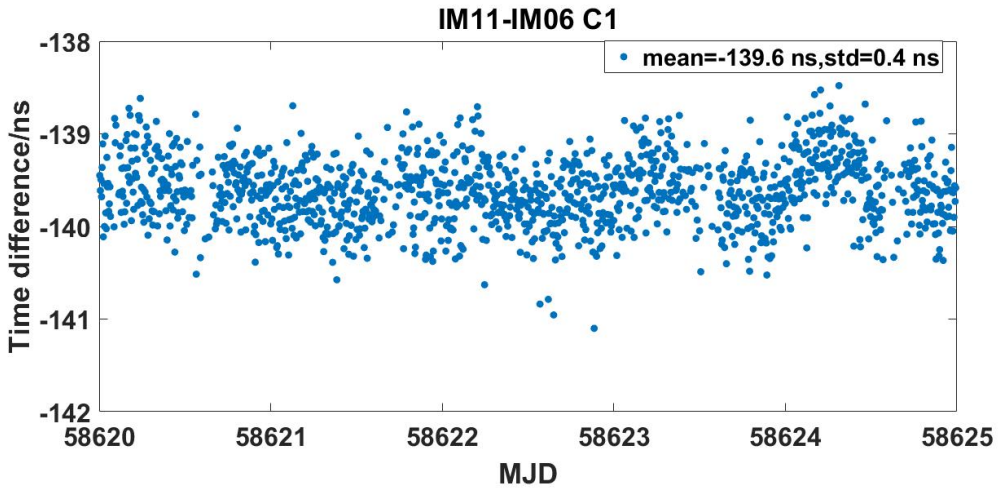


Figure 103. CCD between IM11 and IM06 at NIM(C1)

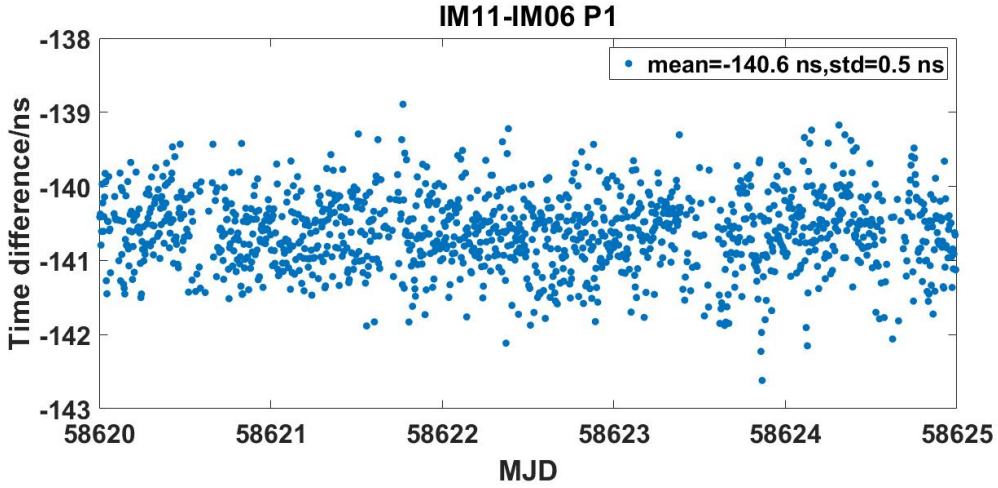


Figure 104. CCD between IM11 and IM06 at NIM(P1)

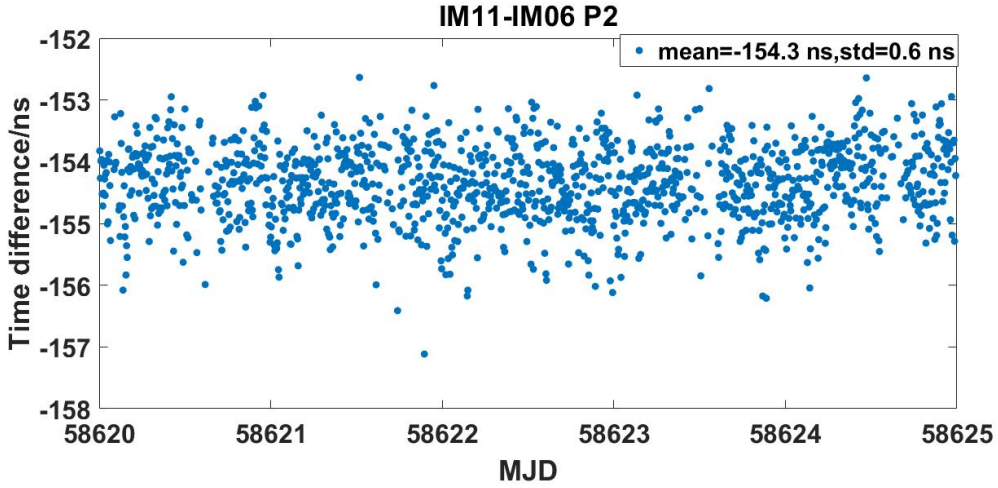


Figure 105. CCD between IM11 and IM06 at NIM(P2)

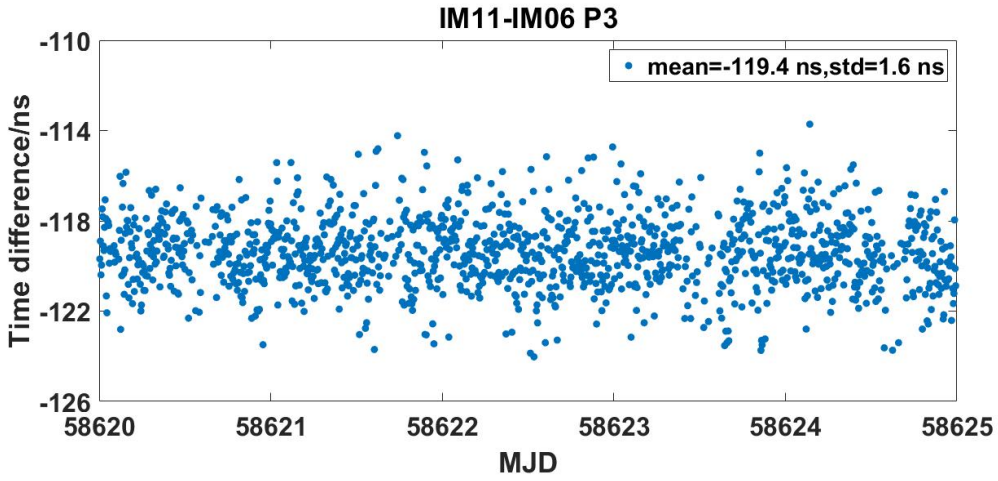


Figure 106. CCD between IM11 and IM06 at NIM(P3)

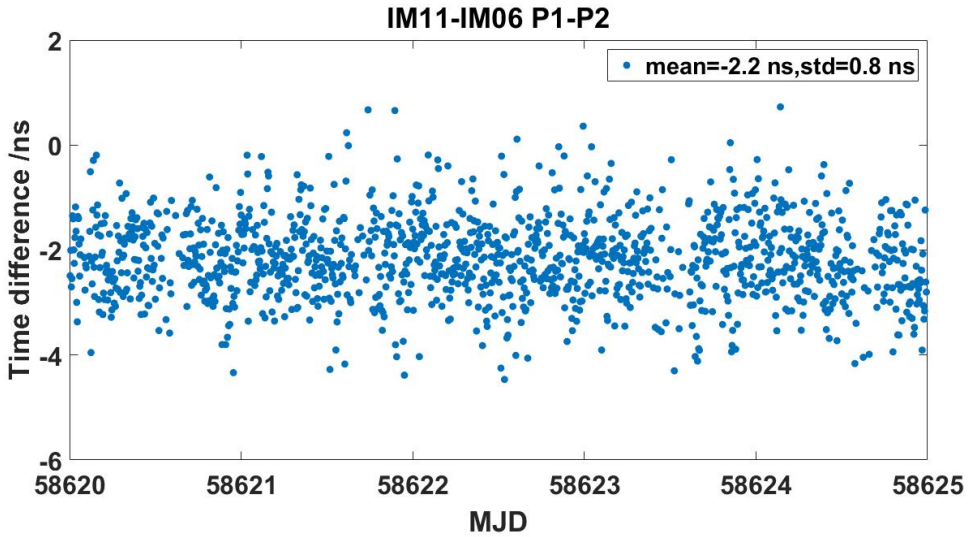


Figure 107. CCD between IM11 and IM06 at NIM(P1-P2)

Annex 3 - Information Sheets

Information Sheet

Laboratory:	NIM
Date and hour of the beginning of measurements:	UTC time: 0:00 am Dec. 8,2018
Date and hour of the end of measurements:	UTC time: 0:00 am Dec.14,2018

Information on the system

	Local:	**Travelling:**
4-character BIPM code	IM06	(1) IM09 (2) IM11
Receiver maker and type: Receiver serial number：	maker:Dicom type: GTR50 serial number:1007011	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	0~2	0~2
Antenna cable maker and type: Phase stabilised cable (Y/N):	maker: type: Phase stabilised cable:N	maker: type: Phase stabilised cable:N
Length outside the building /m:	5.0	5.0
Antenna maker and type: Antenna serial number:	maker:Novatel type: GPS-702-GGG Serial number: NAE10220060	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C		

Measured delays /ns

	Local:	**Travelling:**
Delay from local UTC to receiver 1 PPS-in:	121.7	(1)0 (2)0
Delay from 1 PPS-in to internal Reference (if different):		
Antenna cable delay:	248.7	(1)203.0 (2)177.1
Splitter delay (if any):		

Additional cable delay (if any):		

Data used for the generation of CGGTTS files (IM06)	
INT DLY (GPS) /ns:	-31.8 ns (GPS P1), -18.4 ns (GPS P2), -31.0 ns(GPS C1)
INT DLY (GLONASS) /ns:	0.0
CAB DLY /ns:	248.7
REF DLY /ns:	121.7
Coordinates reference frame:	ITRF
Latitude or X /m:	-2154288.06
Longitude or Y /m:	+4373440.56
Height or Z /m:	+4098884.94

Data used for the generation of CGGTTS files (IM09)	
INT DLY (GPS) /ns:	0
INT DLY (GLONASS) /ns:	0
CAB DLY /ns:	203.0 ns
REF DLY /ns:	150.7 ns
Coordinates reference frame:	ITRF Dx = 0.0 m, Dy = 0.0 m, Dz = 0.0 m, ds = 0.0, Rx = 0.0, Ry = 0.0, Rz = 0.000000
Latitude or X /m:	-2154285.275
Longitude or Y /m:	+4373441.683
Height or Z /m:	+4098885.379

Data used for the generation of CGGTTS files (IM11)	
INT DLY (GPS) /ns:	-29.2 ns (GPS C1), -35.0 ns (GPS P1), 0.0 ns (GPS C2), -37.5 ns (GPS P2), 0.0 ns (GPS L5)
INT DLY (GLONASS) /ns:	0
CAB DLY /ns:	177.1 ns
REF DLY /ns:	150.7 ns
Coordinates reference frame:	ITRF
Latitude or X /m:	-2154286.81
Longitude or Y /m:	+4373440.53
Height or Z /m:	+4098885.50

General information	
Rise time of the local UTC pulse	unknown
Is the laboratory air conditioned	No
Set temperature value and uncertainty:	26.0ºC ±0.2 ºC
Set humidity value and uncertainty:	21% ± 1%

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

(to be repeated for each calibrated system)

Laboratory:	NTSC
Date and hour of the beginning of measurements:	UTC time: Dec. 28,2018
Date and hour of the end of measurements:	

Information on the system

	Local:	Travelling:
4-character BIPM code	NTP1	(1)IM09 (2)IM11
• Receiver maker and type: Receiver serial number:	SEPT POLARX4TR 3002043	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	1	1
• Antenna cable maker and type: Phase stabilised cable (Y/N):	- -	- -
Length outside the building /m:	About 20m	About 20m
• Antenna maker and type: Antenna serial number:	SEPCHOKE_MC 5312	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010

Temperature (if stabilised) /°C	23Temp°C	23Temp°C

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	224.5	(1)83.980 (2)84.022
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	149.3	
• Antenna cable delay:	209.0	(1) 203.0 (2) 177.1
Splitter delay (if any):	-	(1)
Additional cable delay (if any):	-	(1)

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	55.7(P1), 55.1(P2)
• INT DLY (GLONASS) /ns:	-
• CAB DLY /ns:	209.0
• REF DLY /ns:	373.8
• Coordinates reference frame:	ITRF 2008
Latitude or X /m:	-1735233.40
Longitude or Y /m:	+4976844.43
Height or Z /m:	+3580530.51

General information

• Rise time of the local UTC pulse:	3.2ns
• Is the laboratory air conditioned:	yes
Set temperature value and uncertainty:	23Set °C
Set humidity value and uncertainty:	55%et

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Information Sheet

(to be repeated for each calibrated system)

Laboratory:	NTSC
Date and hour of the beginning of measurements:	UTC TIME: DEC. 28,2018
Date and hour of the end of measurements:	

Information on the system

	Local:	Travelling:
4-character BIPM code	NTP2	(1)IM09 (2)IM11
• Receiver maker and type:	SEPT POLARX4TR	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
Receiver serial number:	3002046	
1 PPS trigger level /V:	1	1
• Antenna cable maker and type:	-	-

Phase stabilised cable (Y/N):	-	-
Length outside the building /m:	About 20m	About 20m
• Antenna maker and type: Antenna serial number:	SEPCHOKE_MC 5312	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C	23Temp℃	23Temp℃

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	234.4	(1)83.980 (2)84.022
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	143.6	
• Antenna cable delay:	221.0	(1)203.0 (2)177.1
Splitter delay (if any):		(1)
Additional cable delay (if any):		(1)

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	55.5(P1), 54.2(P2)
• INT DLY (GLONASS) /ns:	-
• CAB DLY /ns:	221.0
• REF DLY /ns:	378.0
• Coordinates reference frame:	ITRF 2008
Latitude or X /m:	-1735233.40
Longitude or Y /m:	+4976844.43
Height or Z /m:	+3580530.51

General information

• Rise time of the local UTC pulse:	3.2ns
• Is the laboratory air conditioned:	yes
Set temperature value and uncertainty:	23Set ℃
Set humidity value and uncertainty:	55%et

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Information Sheet

(to be repeated for each calibrated system)

Laboratory:	NTSC
Date and hour of the beginning of measurements:	UTC TIME: DEC. 28,2018
Date and hour of the end of measurements:	

Information on the system

	Local:	Travelling:
4-character BIPM code	NTP3	(1)IM09 (2)IM11
• Receiver maker and type: Receiver serial number:	SEPT POLARX4TR 3102140	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	1	1
• Antenna cable maker and type: Phase stabilised cable (Y/N):	- -	- -
Length outside the building /m:	About 20m	About 20m
• Antenna maker and type: Antenna serial number:	SEPCHOKE_MC 5392	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C	23Temp℃	23Temp℃

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	Travelling:
• Delay from local UTC to receiver 1 PPS-in:	59.2	(1)83.980 (2)84.022
Delay from 1 PPS-in to internal Reference (if different):	136.9	

(see section 2 for details)		
• Antenna cable delay:	209.0	(1)203.0 (2)177.1
Splitter delay (if any):	-	(1)
Additional cable delay (if any):	-	(1)

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	53.1(P1), 52.2(P2)
• INT DLY (GLONASS) /ns:	-
• CAB DLY /ns:	
• REF DLY /ns:	
• Coordinates reference frame:	ITRF 2008
Latitude or X /m:	-1735229.95
Longitude or Y /m:	+4976843.70
Height or Z /m:	+3580533.43

General information

• Rise time of the local UTC pulse:	3.2ns
• Is the laboratory air conditioned:	yes
Set temperature value and uncertainty:	23Set ℃
Set humidity value and uncertainty:	55%et

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Information Sheet

(to be repeated for each calibrated system)

Laboratory:	JATC
Date and hour of the beginning of measurements:	UTC TIME :23 JAN. 2019
Date and hour of the end of measurements:	

Information on the system

	Local:	Travelling:
4-character BIPM code	JA01	(1)IM09 (2)IM11
• Receiver maker and type: Receiver serial number:	SEPT POLARX4TR 3009580	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	1	1
• Antenna cable maker and type: Phase stabilised cable (Y/N):	- -	- -
Length outside the building /m:	About 20m	About 20m
• Antenna maker and type: Antenna serial number:	SEPCHOKE_MC	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C	23Temp℃	23Temp℃

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	Travelling:
• Delay from local UTC to receiver 1 PPS-in:	206.2	(1)52.080 (2)52.122
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	132.4	
• Antenna cable delay:	-	(1)203.0

		(2)177.1
Splitter delay (if any):	-	(1)
Additional cable delay (if any):	-	(1)

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	237.2(SYS DLY GPS P3)
• INT DLY (GLONASS) /ns:	-
• CAB DLY /ns:	-
• REF DLY /ns:	341.8
• Coordinates reference frame:	ITRF 2008
Latitude or X /m:	-1735234.40
Longitude or Y /m:	+4976845.76
Height or Z /m:	+3580528.39

General information

• Rise time of the local UTC pulse:	3.2ns
• Is the laboratory air conditioned:	yes
Set temperature value and uncertainty:	23Set ℃
Set humidity value and uncertainty:	55%et

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Information Sheet

(to be repeated for each calibrated system)

Laboratory：	BIRM

Date and hour of the beginning of measurements:	UTC time: 0:00 am Mar. 7,2019
Date and hour of the end of measurements:	UTC time: 0:00 am Mar. 17,2019

Information on the system

	Local:	**Travelling:**
4-character BIPM code	BI01	(1)IM09 (2)IM11
Receiver maker and type: Receiver serial number：	maker: PIKTIME type: TTS-4 serial number:140	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	0~2	0~2
Antenna cable maker and type: Phase stabilised cable (Y/N):	maker:JiangXiLianChuang type: 5D-FB Phase stabilised cable:N	maker: type: Phase stabilised cable:N
Length outside the building /m:	4.4	4.4
Antenna maker and type: Antenna serial number:	maker: PIKTIME type: Javad RingAnt-G3T serial number: 00635	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C		

Measured delays /ns

	Local:	**Travelling:**
Delay from local UTC to receiver 1 PPS-in:	9.43	(1)61.980 (2)62.022
Delay from 1 PPS-in to internal Reference (if different):	phase corr:-3.36	
Antenna cable delay:	218.90	(1)IM09：203.0 (2)IM11：177.1
Splitter delay (if any):		

Additional cable delay (if any):		

Data used for the generation of CGGTTS files	
INT DLY (GPS) /ns:	L1C:-54.70,L2C:0.00, L1P:-7.10 ,L2P:8.00, L5P:0.00
INT DLY (GLONASS) /ns:	0
CAB DLY /ns:	218.90
REF DLY /ns:	6.64 (1PPS DLY: 10.00 ns, phase corr: -3.36 ns)
Coordinates reference frame:	WGS84
Latitude or X /m:	-2167479.45
Longitude or Y /m:	4393380.29
Height or Z /m:	4070639.01

General information	
Rise time of the local UTC pulse	2ns
Is the laboratory air conditioned	Yes
Set temperature value and uncertainty:	23.3°C~24.3°C ±0.5°C
Set humidity value and uncertainty:	32.1%~42.3% ±3%

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Information Sheet

(to be repeated for each calibrated system)

Laboratory：	BIRM
Date and hour of the beginning of measurements:	UTC time: 0:00 am Mar. 7,2019
Date and hour of the end of measurements:	UTC time: 0:00 am Mar. 17,2019

Information on the system

	Local:	**Travelling:**
4-character BIPM code	BI22	(1)IM09 (2)IM11
Receiver maker and type: Receiver serial number：	maker: MESIT type: GTR51 serial number:1708726	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	0~2	0~2
Antenna cable maker and type: Phase stabilised cable (Y/N):	maker:BeiJingTianLang type: TL-2TNC(m)FSF500-50m Phase stabilised cable:N	maker: type: Phase stabilised cable:N
Length outside the building /m:	5.0	5.0
Antenna maker and type: Antenna serial number:	maker: WeiXinJie type: ANT-GGB50 serial number: 180408003	(1)maker:AeroAntenna Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C		

Measured delays /ns		
	Local:	**Travelling:**
Delay from local UTC to receiver 1 PPS-in:	25.1	(1)61.980 (2)62.022
Delay from 1 PPS-in to internal Reference (if different):		
Antenna cable delay:	220.2	(1)IM09：203.0 (2)IM11：177.1
Splitter delay (if any):		
Additional cable delay (if any):		

Data used for the generation of CGGTTS files	
INT DLY (GPS) /ns:	L1C:38.10,L2C:0.00, L1P:34.10 ,L2P:28.00, L5P:0.00
INT DLY (GLONASS) /ns:	0
CAB DLY /ns:	220.2
REF DLY /ns:	25.1
Coordinates reference frame:	WGS84
Latitude or X /m:	-2167476.02
Longitude or Y /m:	4393381.57
Height or Z /m:	4070639.62

General information	
Rise time of the local UTC pulse	2ns
Is the laboratory air conditioned	Yes
Set temperature value and uncertainty:	23.3°C~24.3°C ±0.5°C
Set humidity value and uncertainty:	32.1%~42.3% ±3%

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Information Sheet

(to be repeated for each calibrated system)

Laboratory：	BIRM
Date and hour of the beginning of measurements:	UTC time 0:00 am Mar. 7,2019
Date and hour of the end of measurements:	UTC time 0:00 am Mar. 17,2019

Information on the system

	Local:	**Travelling:**
4-character BIPM code	BI41	(1)IM09 (2)IM11
Receiver maker and type: Receiver serial number：	maker: MESIT type: GTR51 serial number:1708725	(1)maker: NIM type: NIM-TF-GNSS-2J serial number:SN201401 (2)maker: DICOM type: GTR51 serial number:1405004
1 PPS trigger level /V:	0~2	0~2
Antenna cable maker and type: Phase stabilised cable (Y/N):	maker:BeiJingTianLangTongXin type: TL-2TNC(m)FSF500-50m Phase stabilised cable:N	maker: type: Phase stabilised cable:N
Length outside the building /m:	5.0	5.0
Antenna maker and type:	maker:COMTECHSyS	(1)maker:AeroAntenna

Antenna serial number:	type: CRG-2D serial number: 160405022	Technology type: AT200-GNSS serial number: 5098 (2)maker: Novatel type: GPS-703-GGG serial number: NEG14100010
Temperature (if stabilised) /°C		

Measured delays /ns

	Local:	**Travelling:**
Delay from local UTC to receiver 1 PPS-in:	24.8	(1)61.980 (2)62.022
Delay from 1 PPS-in to internal Reference (if different):		
Antenna cable delay:	220.7	(1)IM09：203.0 (2)IM11：177.1
Splitter delay (if any):		
Additional cable delay (if any):		

Data used for the generation of CGGTTS files

INT DLY (GPS) /ns:	L1C:37.00,L2C:27.3, L1P:33.10,L2P:0.00, L5P:0.00
INT DLY (GLONASS) /ns:	0
CAB DLY /ns:	220.7
REF DLY /ns:	24.8
Coordinates reference frame:	WGS84
Latitude or X /m:	-2167476.17
Longitude or Y /m:	4393381.88
Height or Z /m:	4070639.22

General information

Rise time of the local UTC pulse	2ns
Is the laboratory air conditioned	Yes
Set temperature value and uncertainty:	23.3°C~24.3°C ±0.5°C
Set humidity value and uncertainty:	32.1%~42.3% ±3%

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up

Please see the report.

Log of Events / Additional Information

Annex 4 – TDEV for CCD results at NTSC

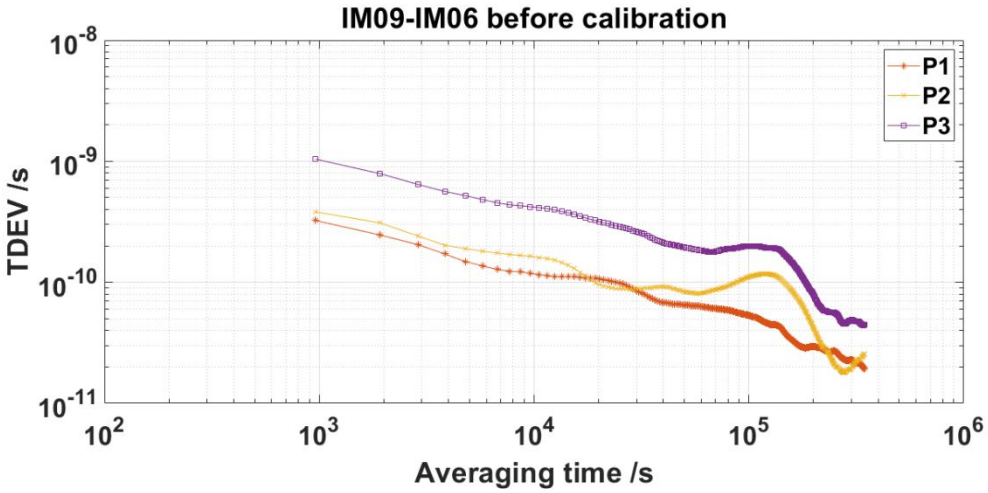


Figure 108. TDEV between IM09 and IM06 receivers at NIM before calibration

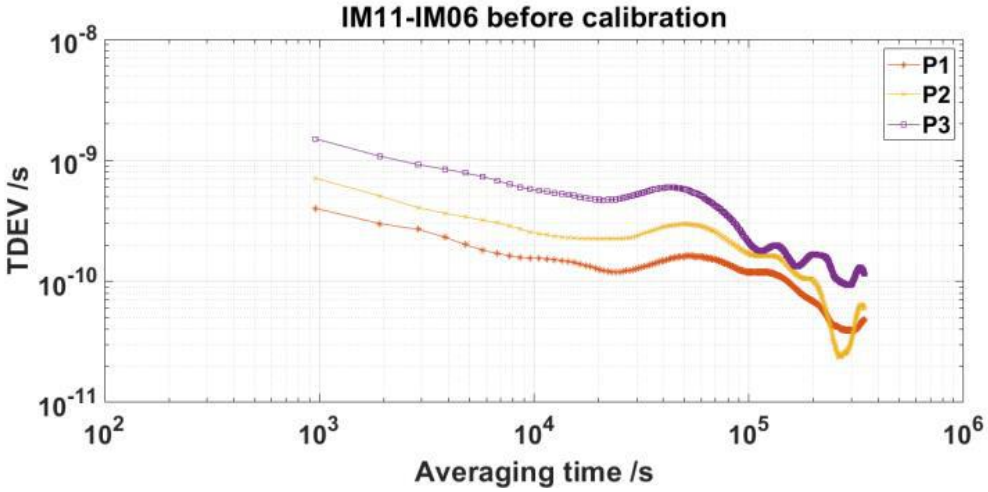


Figure 109. TDEV between IM11 and IM06 receivers at NIM before calibration

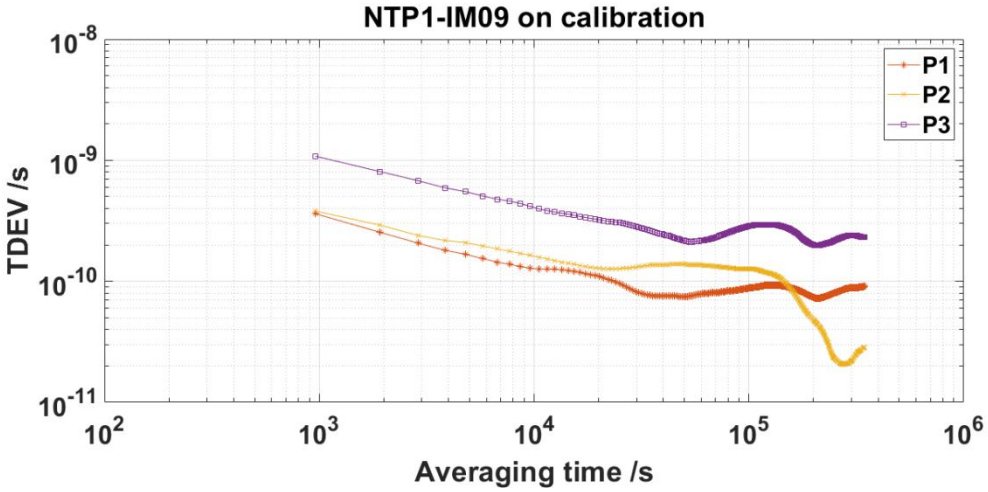


Figure 110. TDEV between NTP1 and IM09 receivers at NTSC during calibration

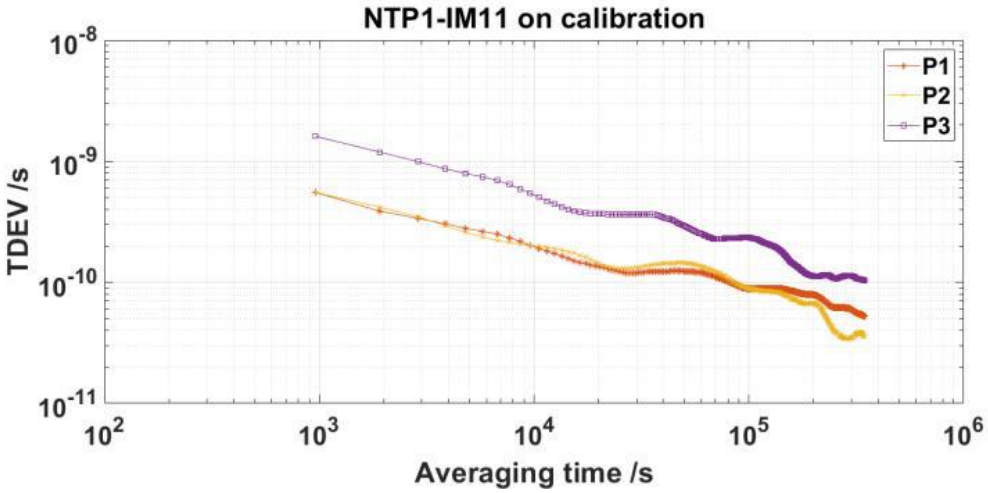


Figure 111. TDEV between NTP1 and IM11 receivers at NTSC during calibration

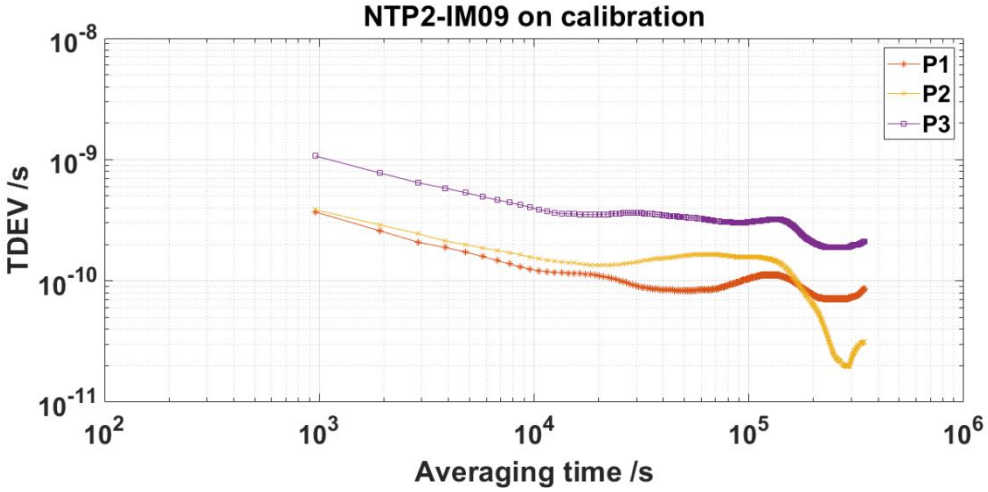


Figure 112. TDEV between NTP2 and IM09 receivers at NTSC during calibration

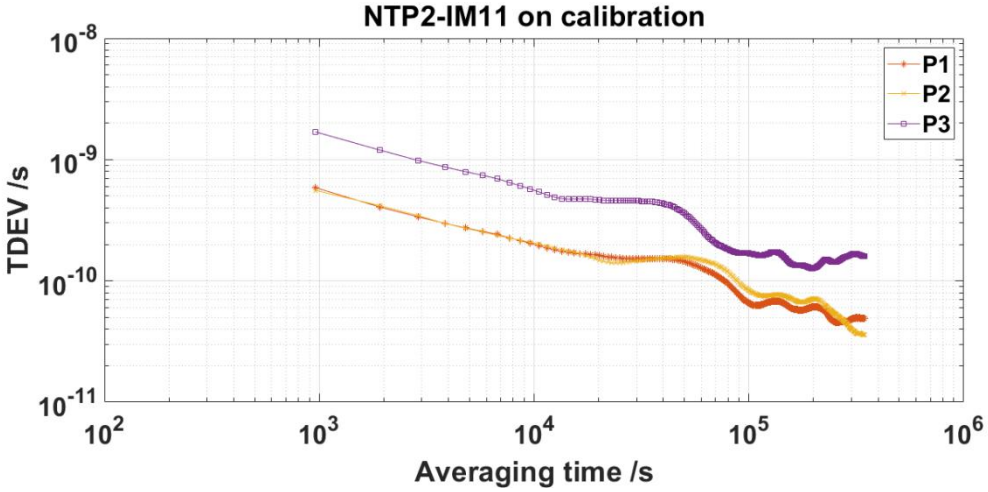


Figure 113. TDEV between NTP2 and IM11 receivers at NTSC during calibration

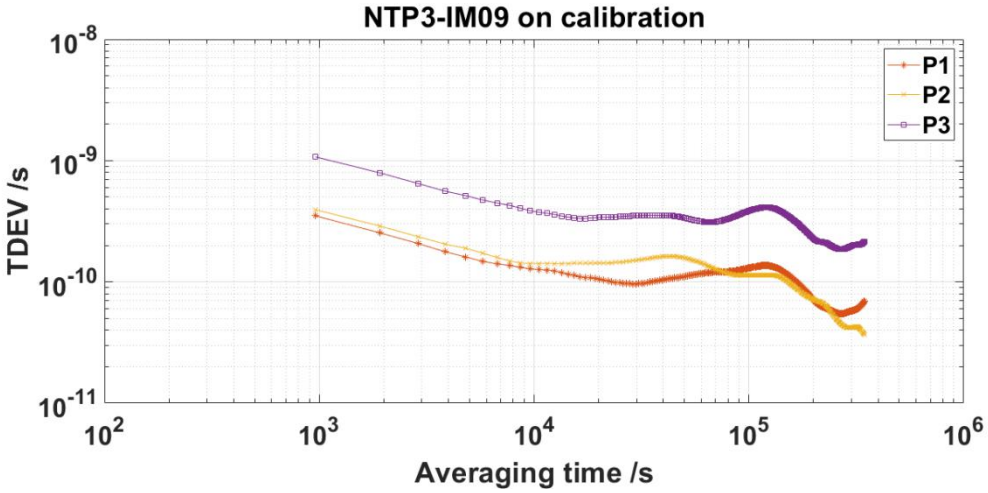


Figure 114. TDEV between NTP3 and IM09 receivers at NTSC during calibration

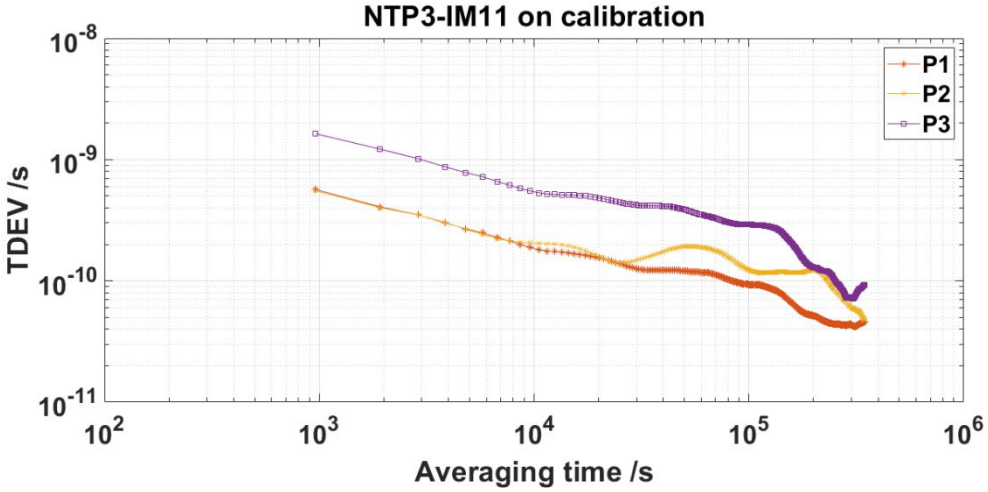


Figure 115. TDEV between NTP3 and IM11 receivers at NTSC during calibration

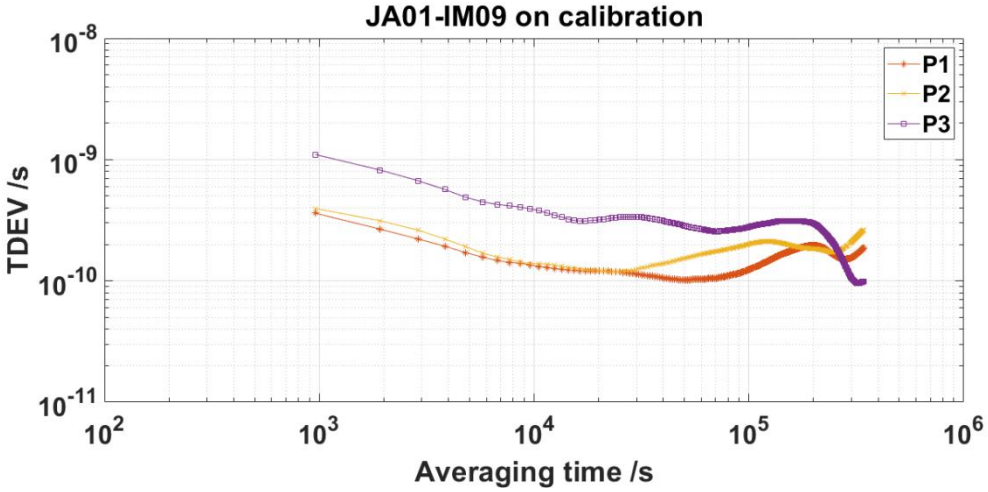


Figure 116. TDEV between JA01 and IM09 receivers at NTSC during calibration

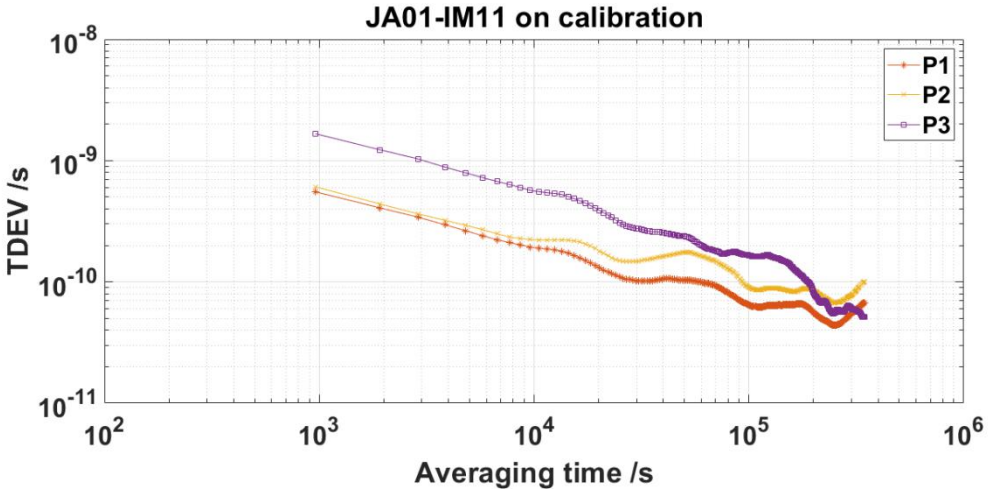


Figure 117. TDEV between JA01 and IM11 receivers at NTSC during calibration

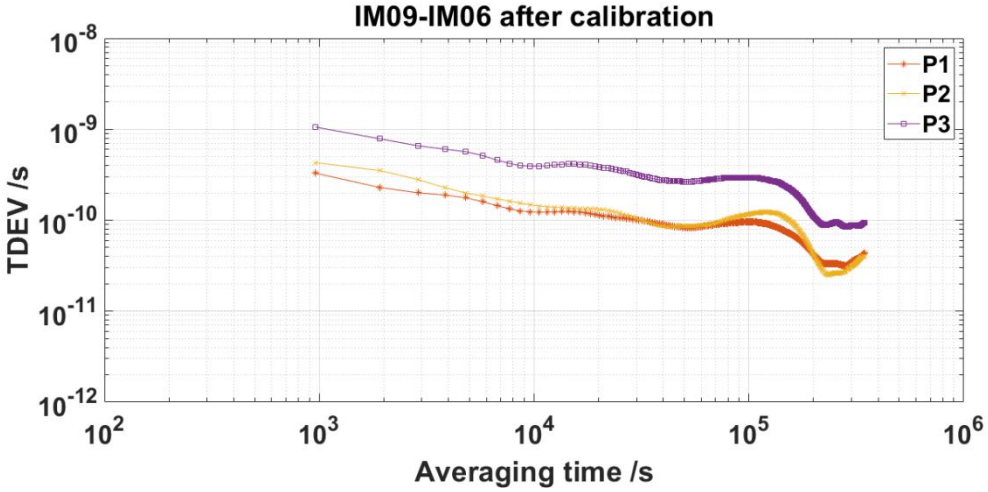


Figure 118. TDEV between IM09 and IM06 receivers at NIM after calibration

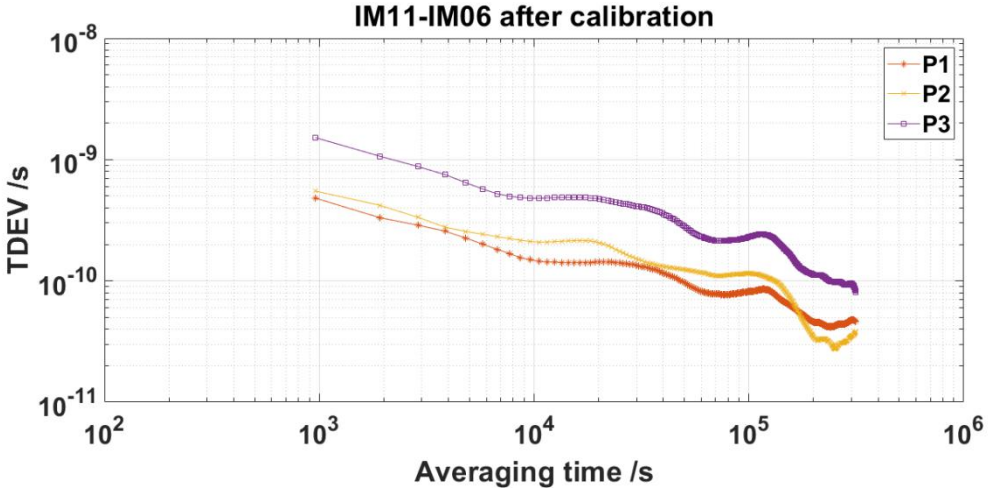


Figure 119. TDEV between IM11 and IM06 receivers at NIM after calibration

Annex 5 – TDEV for CCD results at BIRM

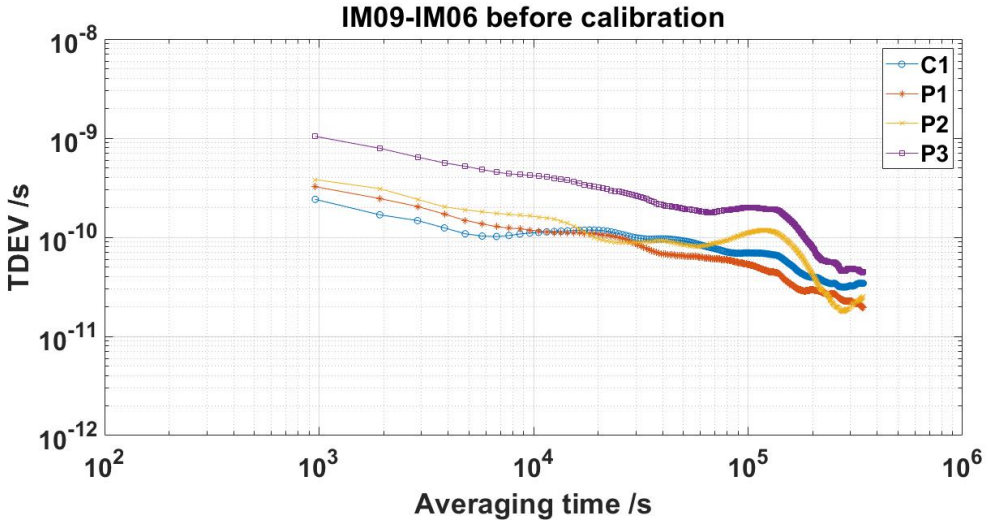


Figure 120. TDEV between IM09 and IM06 receivers at NIM before calibration

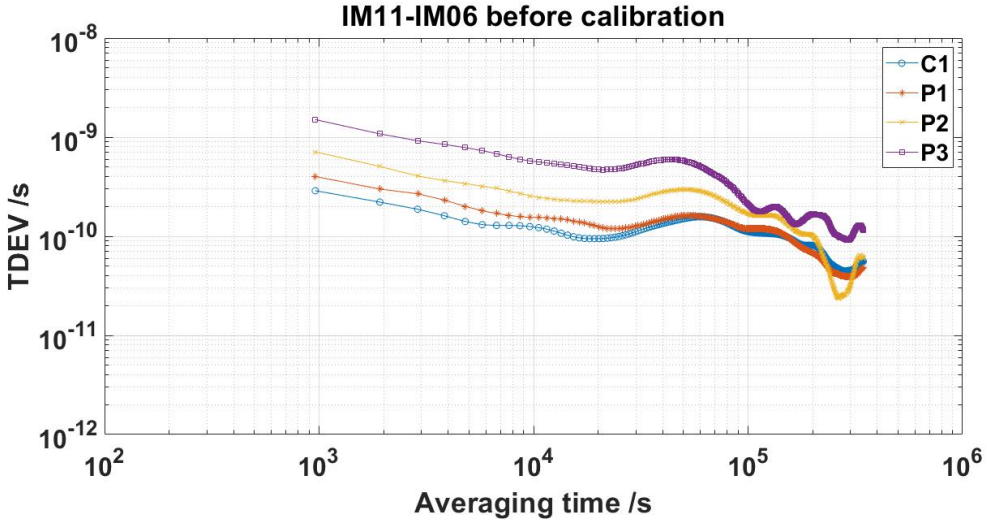


Figure 121. TDEV between IM11 and IM06 receivers at NIM before calibration

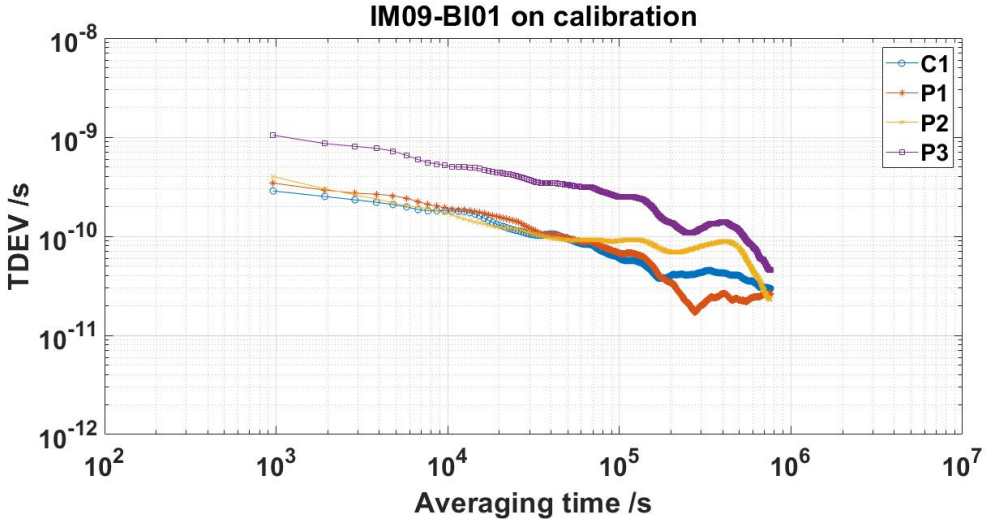


Figure 122. TDEV between IM09 and BI01 receivers at BIRM during calibration

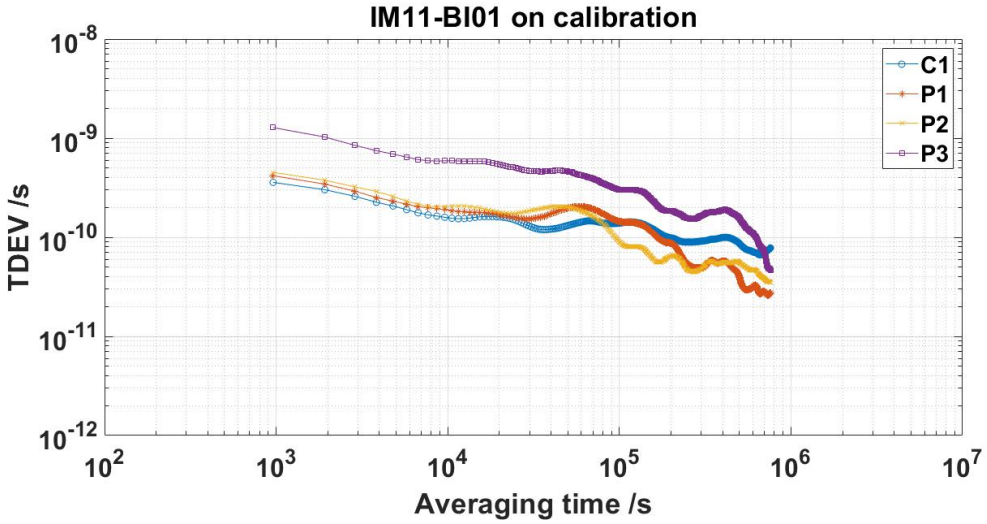


Figure 123. TDEV between IM11 and BI01 receivers at BIRM during calibration

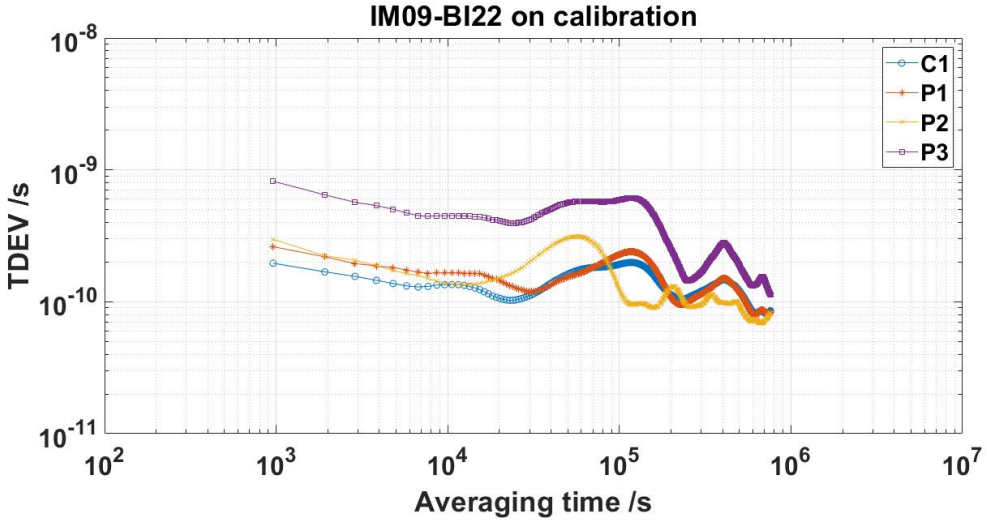


Figure 124. TDEV between IM09 and BI22 receivers at BIRM during calibration

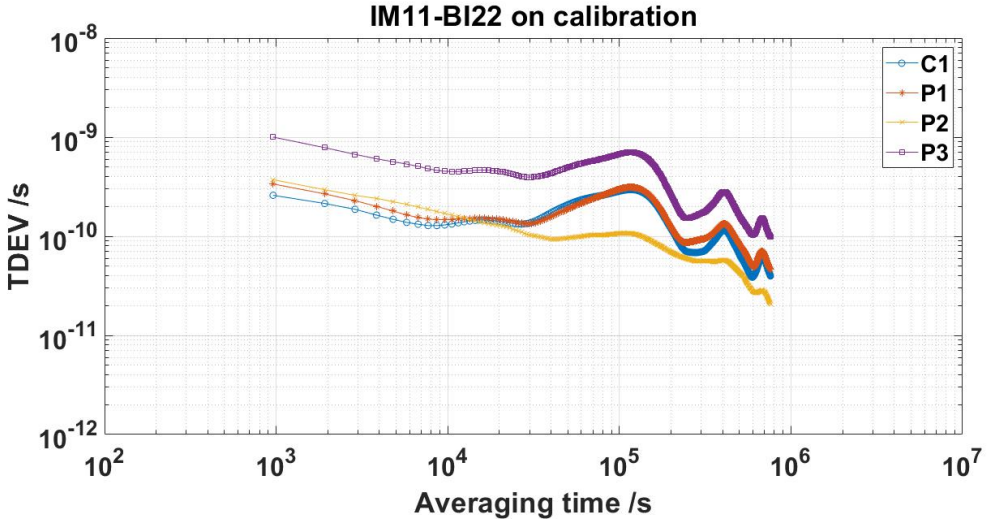


Figure 125. TDEV between IM11 and BI22 receivers at BIRM during calibration

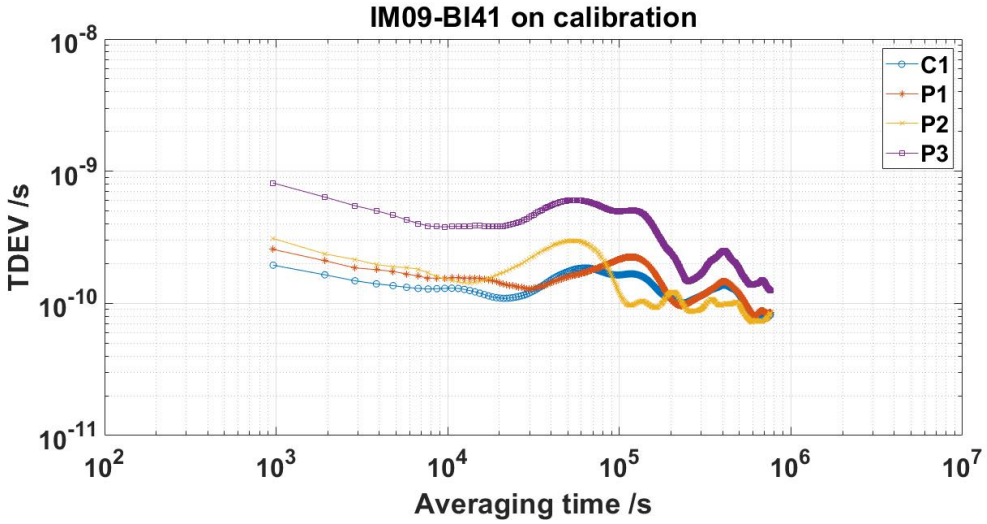


Figure 126. TDEV between IM09 and BI41 receivers at BIRM during calibration

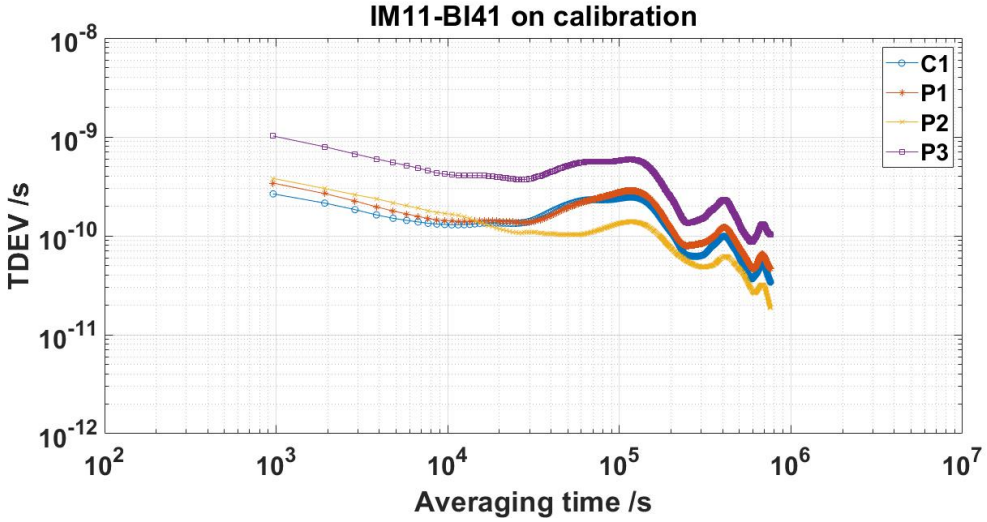


Figure 127. TDEV between IM11 and BI41 receivers at BIRM during calibration

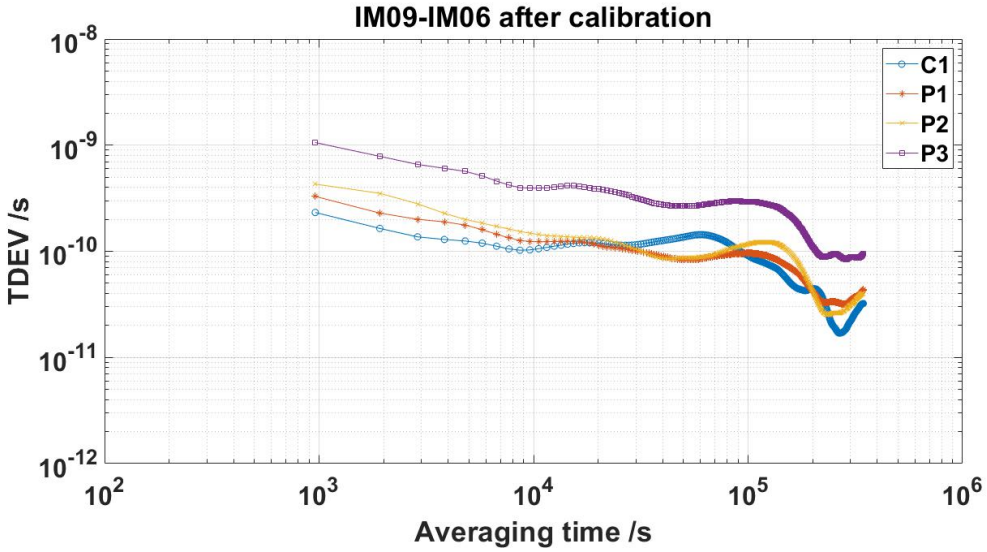


Figure 128. TDEV between IM09 and IM06 receivers at NIM after calibration

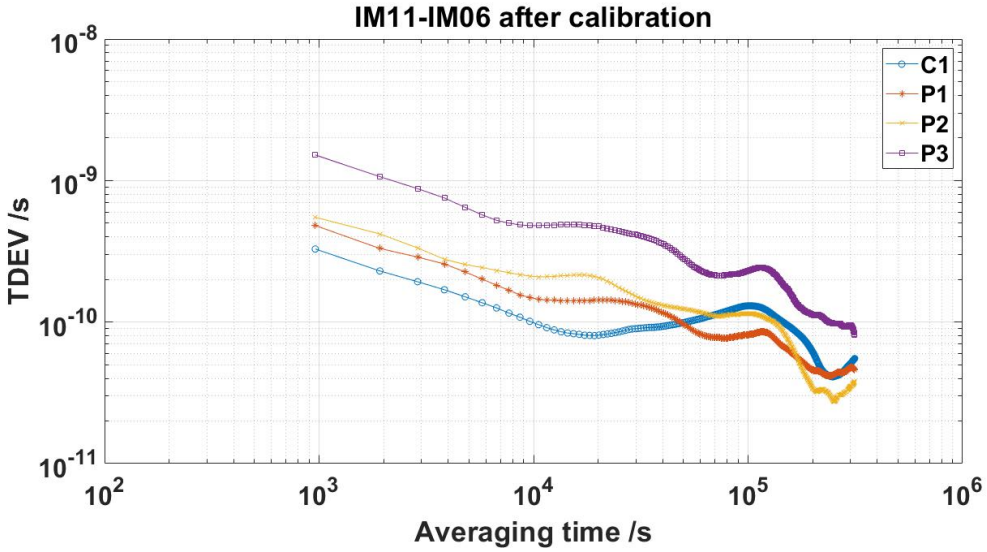


Figure 129. TDEV between IM11 and IM06 receivers at NIM after calibration