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4th BIPM TWSTT Monthly Report

To: TWSTT Participating Stations

Copy:

Prof. J. Kovalevsky, President of the CIPM
Prof. S. Leschiutta, President of the CCTF
Dr T. J. Quinn, Director of the BIPM

Dear Colleagues,

Introduction of TUG/PTB TWSTT link into TAI

We are delighted to inform you that, following a decision of the CCTF in April, the TWSTT link between the TUG and the PTB has been introduced into the computation of TAI from July 1999.

This TWSTT link was calibrated differentially by transportation of a portable TWSTT station in May-June 1998. The GPS link between the TUG and the PTB is also computed as a check and the data kept in reserve; this link also was calibrated differentially, using a portable GPS receiver at the same epoch as the TWSTT calibration. The TUG/PTB TWSTT and GPS links are compared in Table 1 of the Appendix to this report. It is of note that the two techniques, after independent calibration, agree to within the associated uncertainties.

As usual we present some selected TWSTT links which are computed and compared to GPS at the time of preparation of *Circular T* but are not yet used for the construction of TAI. The results of the computation of six such links for July 1999 are given in Tables 2 to 7 of the Appendix. Some remaining minor operational problems are treated on a day-to-day basis in collaboration with the laboratories concerned, and more TWSTT links will be introduced into TAI as soon as their reliability is proved.

The introduction of TWSTT links into TAI is the fruit of many years' commitment of the TWSTT community to this technique, and we congratulate you once again on this success.

We will be pleased to receive your comments on this report.
With our best regards,

Jacques Azoubib and Włodzimierz Lewandowski

Appendix

to 4th BIPM TWSTT Monthly Report

TWSTT links computed at the BIPM

Because the TWSTT data are unevenly spaced by intervals of 2 or 3 days, they are linearly interpolated to give the data for the TAI standard dates at intervals of 5 days.

Table 1. TUG/PTB link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(TUG) – UTC(PTB)*] /ns**		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
1	1 April (51269)	110	132	–22
	6 April (51274)	112	133	–21
	11 April (51279)	112	135	–23
	16 April (51284)	129	148	–19
	21 April (51289)	156	180	–24
	26 April (51294)	177	197	–20
2	1 May (51299)	193	217	–24
	6 May (51304)	196	217	–21
	11 May (51309)	205	231	–26
	16 May (51314)	222	242	–20
	21 May (51319)	236	258	–22
	26 May (51324)	248	271	–23
	31 May (51329)	266	288	–22
3	5 June (51334)	286	307	–21
	10 June (51339)	293	314	–21
	15 June (51344)	308	331	–23
	20 June (51349)	* 322	341	* –19
	25 June (51354)	331	352	–21
	30 June (51359)	342	368	–26

Note 1: The TUG/PTB TWSTT link was calibrated by the transportation of a TWSTT station in May-June 1998. Until 30 June 1999 the *Circular T* GPS data for TUG were calibrated using an outdated value; this is the reason for the offset of about –22 ns between the two techniques.

* This value replaces the incorrect value given in the 3rd Report.

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Table 1. TUG/PTB link (cont.)

Introduction of TUG/PTB TWSTT link into TAI

BIPM Report No.	Date 1999 (MJD)	**[*UTC(TUG) – UTC(PTB)*] /ns**		
		Circular T (TWSTT)	GPS	*Circular T* – GPS
4	5 July (51364)	358	360	−2
	10 July (51369)	370	372	−2
	15 July (51374)	379	379	0
	20 July (51379)	385	388	−3
	25 July (51384)	391	390	1
	30 July (51389)	410	411	−1

Note 2: The TUG/PTB TWSTT link has been included in the computation of TAI from July 1999. This link was calibrated by the transportation of a TWSTT station in May-June 1998.

The GPS link between the TUG and the PTB is also computed as a check and the data kept in reserve; this link was calibrated by the transportation of a GPS receiver in May-June 1998 (4th BIPM GPS calibration trip).

It is of note that, for the TUG/PTB link, the TWSTT and GPS techniques were independently calibrated, and the results agree to within the associated uncertainties.

Table 2. PTB/NIST link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(PTB) – UTC(NIST)*] /ns**		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
1	1 April (51269)	41	41	0
	6 April (51274)	38	37	1
	11 April (51279)	36	36	0
	16 April (51284)	30	33	–3
	21 April (51289)	19	16	3
	26 April (51294)	10	12	–2
2	1 May (51299)	3	3	0
	6 May (51304)	1	3	–2
	11 May (51309)	2	1	1
	16 May (51314)	–3	–4	1
	21 May (51319)	–4	–6	2
	26 May (51324)	–7	–9	2
	31 May (51329)	–10	–11	1
3	5 June (51334)	–9	–9	0
	10 June (51339)	–3	–5	2
	15 June (51344)	–1	–3	2
	20 June (51349)	* 2	2	* 0
	25 June (51354)	4	2	2
	30 June (51359)	8	7	1
4	5 July (51364)	9	16	–7
	10 July (51369)	14	23	–9
	15 July (51374)	16	23	–7
	20 July (51379)	16	24	–8
	25 July (51384)	21	27	–6
	30 July (51389)	23	31	–8

Note: The PTB/NIST TWSTT link was calibrated by *Circular T* prior to July 1999.

Since July 1999 the GPS link between Europe and North America has been corrected by ionospheric delays derived from an IGS map, rather than as previously by direct ionospheric measurements. This is the reason for the step of about 8 ns at the beginning of July 1999 between the TWSTT and GPS values.

* This value replaces incorrect value given in the 3rd Report.

Table 3. NPL/USNO link

BIPM Report No.	Date 1999 (MJD)	[*UTC(NPL) – UTC(USNO)*] /ns		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
2	26 April (51294)	82	–46	128
	1 May (51299)	83	–48	131
	6 May (51304)	81	–48	129
	11 May (51309)	81	–48	129
	16 May (51314)	77	–51	128
	21 May (51319)	75	–52	127
	26 May (51324)	74	–53	127
	31 May (51329)	72	–54	126
3	5 June (51334)	† 61	–58	† 119
	10 June (51339)	† 39	–59	† 98
	15 June (51344)	† 59	–61	† 120
	20 June (51349)	† 27	–61	† 88
	25 June (51354)	† 29	–63	† 92
	30 June (51359)	† 27	–65	† 92
4	5 July (51364)	† 26	–56	† 82
	10 July (51369)	† 25	–57	† 82
	15 July (51374)	† 24	–61	† 85
	20 July (51379)	† 33	–58	† 91
	25 July (51384)	† –96	–59	† –37
	30 July (51389)	† –69	–56	† –13

Note: The NPL/USNO TWSTT link was not calibrated until 21 July 1999. Since 25 July 1999 this link has been calibrated by *Circular T* using the data of June 1999.

See also the note to Table 2 concerning the time step in the GPS values between 30 June 1999 and 5 July 1999

† Hardware and automation problems have rendered USNO TWSTT data since 5 June 1999 unreliable. These data will be checked at the USNO and updated in the next report.

Table 4. USNO/PTB link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(USNO) – UTC(PTB)*] /ns**		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
2	26 April (51294)	–11	–33	22
	1 May (51299)	–7	–28	21
	6 May (51304)	–4	–27	23
	11 May (51309)	–8	–25	17
	16 May (51314)	4	–19	23
	21 May (51319)	8	–16	24
	26 May (51324)	12	–11	23
	31 May (51329)	15	–7	22
3	5 June (51334)	† 25	–6	† 31
	10 June (51339)	† 43	–10	† 53
	15 June (51344)	† 21	–9	† 30
	20 June (51349)	† 49	–12	† 61
	25 June (51354)	† 46	–10	† 56
	30 June (51359)	† 45	–12	† 57
4	5 July (51364)	† 45	–20	† 65
	10 July (51369)	† 41	–26	† 67
	15 July (51374)	† 41	–25	† 66
	20 July (51379)	† 18	–24	† 42
	25 July (51384)	† 11	–27	† 38
	30 July (51389)	†–16	–29	† 13

Note: The USNO/PTB TWSTT link was calibrated using *Circular T* of May 1997. At this time the USNO GPS time-receiving equipment was inaccurate by about 23 ns, which explains the offset between the TWSTT data and the *Circular T* data observed in this table.

See also the note to Table 2 concerning the time step in the GPS values between 30 June 1999 and 5 July 1999

† See note for Table 3.

Table 5. PTB/DTAG link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(PTB) – UTC(DTAG)*] /ns**		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
2	26 April (51294)	22	–2	24
	1 May (51299)	–	–15	–
	6 May (51304)	–	–11	–
	11 May (51309)	–1	–22	21
	16 May (51314)	–8	–22	14
	21 May (51319)	–14	–42	28
	26 May (51324)	–33	–57	24
	31 May (51329)	–39	–61	22
3	5 June (51334)	–49	–67	18
	10 June (51339)	–46	–65	19
	15 June (51344)	–65	–82	17
	20 June (51349)	–82	–104	22
	25 June (51354)	–81	–102	21
	30 June (51359)	–78	–99	21
4	5 July (51364)	–75	–98	23
	10 July (51369)	–64	–83	19
	15 July (51374)	–76	–79	3
	20 July (51379)	–87	–91	4
	25 July (51384)	–99	–100	1
	30 July (51389)	–113	–117	4

Note: The PTB/DTAG TWSTT link was calibrated by the transportation of a TWSTT station. The observed discrepancy between the TWSTT data and the *Circular T* values in this table might be explained by an inaccuracy of the DTAG GPS time-receiving equipment.

Table 6. VSL/PTB link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(VSL) – UTC(PTB)*] /ns**		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
3	6 May (51304)	–66	–67	1
	11 May (51309)	–77	–73	– 4
	16 May (51314)	–79	–78	– 1
	21 May (51319)	–83	–80	– 3
	26 May (51324)	–84	–82	– 2
	31 May (51329)	–83	–80	– 3
	5 June (51334)	–78	–77	– 1
	10 June (51339)	–77	–74	– 3
	15 June (51344)	–85	–84	– 1
	20 June (51349)	–85	–85	0
	25 June (51354)	–86	–81	– 5
	30 June (51359)	–	–67	–
4	5 July (51364)	–	19	–
	10 July (51369)	–	–107	–
	15 July (51374)	–	–97	–
	20 July (51379)	–	–82	–
	25 July (51384)	–	–61	–
	30 July (51389)	–	–35	–

Note: The VSL/PTB TWSTT link was calibrated by *Circular T*.

The transmitted power of the TWSTT signal from VSL has been suffering from an extra attenuation of up to 6 dB since 30 June 1999. The VSL TWSTT data were not available between 9 July 1999 and 2 August 1999.

Table 7. NPL/NIST link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(NPL) – UTC(NIST)*] /ns**		
		TWSTT	*Circular T* (GPS)	TWSTT – *Circular T*
***3**	26 April (51294)	31	–67	98
	1 May (51299)	28	–73	101
	6 May (51304)	27	–72	99
	11 May (51309)	27	–72	99
	16 May (51314)	28	–74	102
	21 May (51319)	28	–74	102
	26 May (51324)	28	–73	101
	31 May (51329)	28	–72	100
	5 June (51334)	29	–73	102
	10 June (51339)	28	–74	102
	15 June (51344)	29	–73	102
	20 June (51349)	28	–71	99
	25 June (51354)	28	–71	99
	30 June (51359)	30	–70	100
4	5 July (51364)	30	–60	90
	10 July (51369)	28	–60	88
	15 July (51374)	31	–63	94
	20 July (51379)	32	–58	90
	25 July (51384)	35	–59	94
	30 July (51389)	38	–54	92

Note: The NPL/NIST TWSTT link is not calibrated.

See also the note to Table 2 concerning the time step in the GPS values between 30 June 1999 and 5 July 1999

* These values take into account the correct Earth rotation correction and replace the values in the previous report.