



State Scientific Center  
of the Russian  
Federation



National Research Institute for  
Physical-Technical and Radio Engineering Measurements

# VNIIFTRI TWSTFT Station Report

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VNIIFTRI

21st TWSTFT Meeting, Taiwan 2013

## Plan:

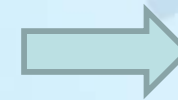
1. New realization strategy of UTC(SU)
2. Calibration results of TWSTFT VNIIFTRI – PTB link in year 2012
3. TimeTech Optic Line testing results vs SU01 and SU02 in VNIIFTRI zero base
4. Current Status of SU01 station
5. Information from Intersputnik about AM-2
6. Information of 7-th International Symposium “Metrology of Time and Space”

# 1. New realization strategy of UTC(SU)

TA(SU) starting MJD 56289 daily calculated on the basis of the frequency difference measurement Cs Fountains and H-Masers



UTC(SU) daily calculated on the basis of TA(SU) and corrected one time in month for providing  $UTC - UTC(SU) \leq 10 \text{ ns}$



1 pps UTC(SU) real-time realization

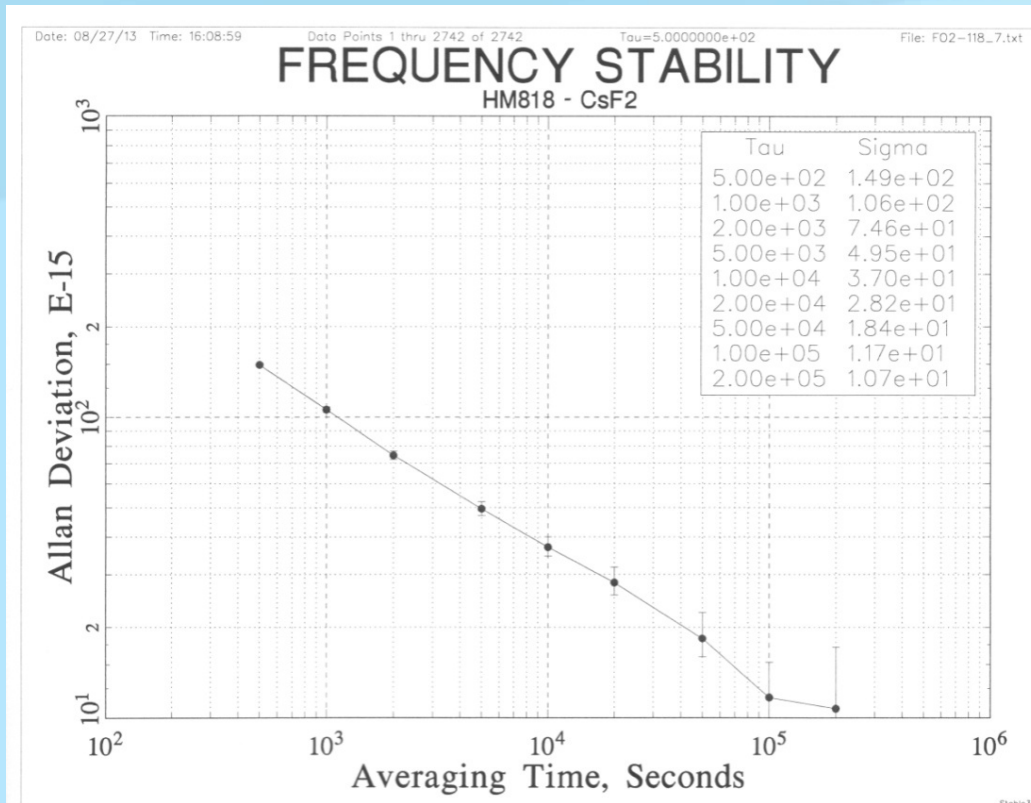


$U_B : \text{CsF1} \leq 2.0 \text{ E-15}$

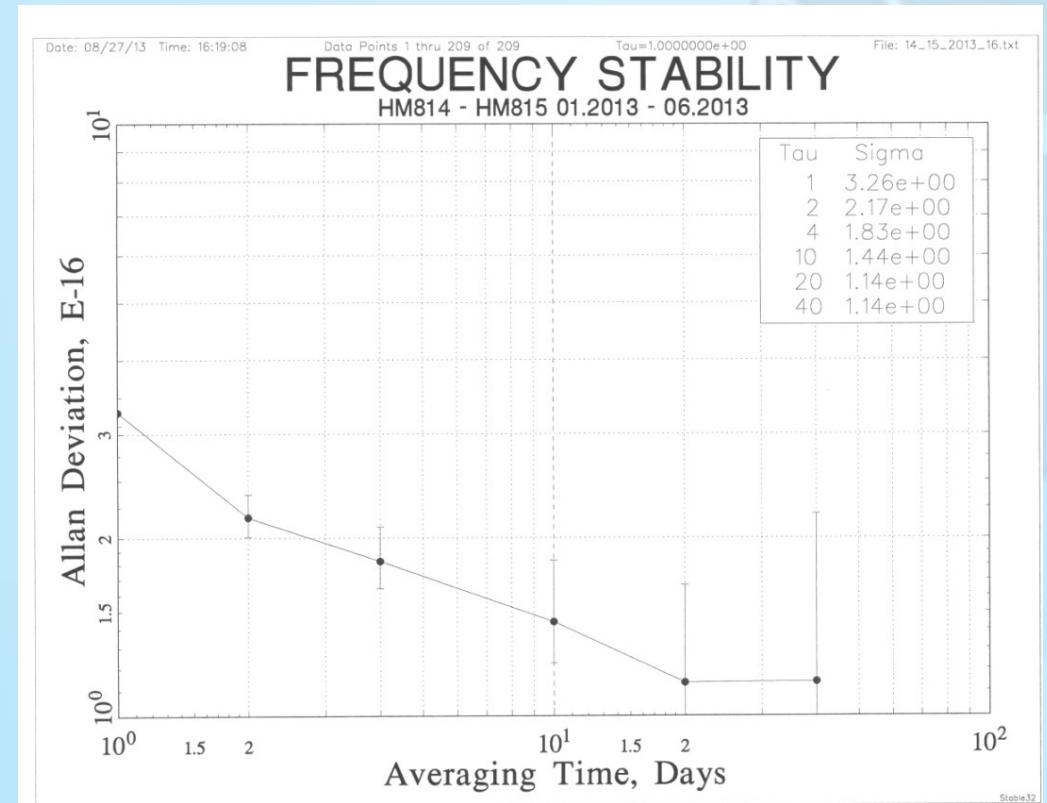
$U_B : \text{CsF2} \leq 5.0 \text{ E-16}$

8 H-Maser CH1-75A to keeping TA(SU)

# Clocks Characteristics



Instability of CsF2 vs HM 818



Instability for HM 814 and HM 815  
(frequency drift removed)

## 2. Calibration results of TWSTFT VNIIFTRI – PTB link in year 2012

Calibration object and transportable calibration equipment



Calibration object –  
fixed TWSTFT SU01 station



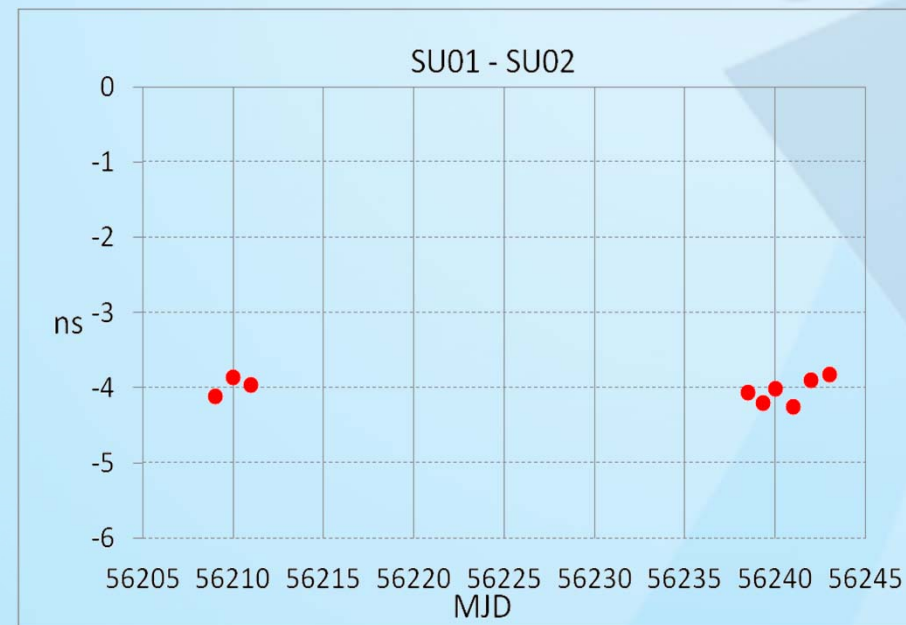
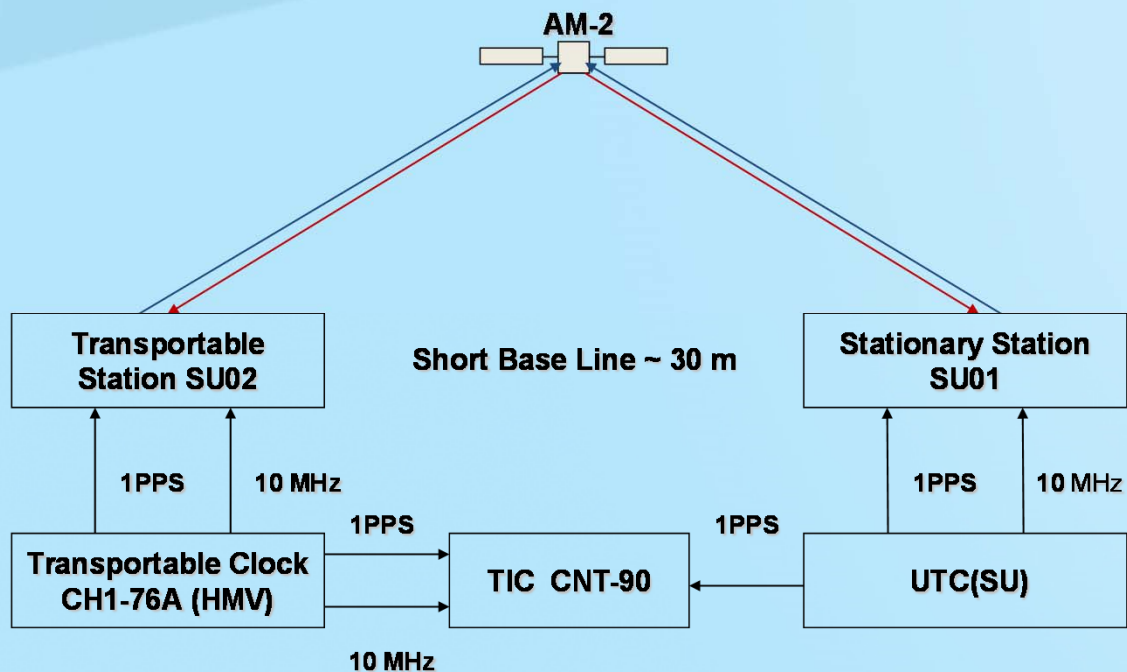
Mobile TWSTFT  
station SU02

Transportable GNSS  
receiver TTS-3

Transportable passive  
H-Maser CH1-76A



# SU01 and SU02 calibration results in VNIIFTRI zero base



SU01 and SU02 stations connection schematic in VNIIFTRI

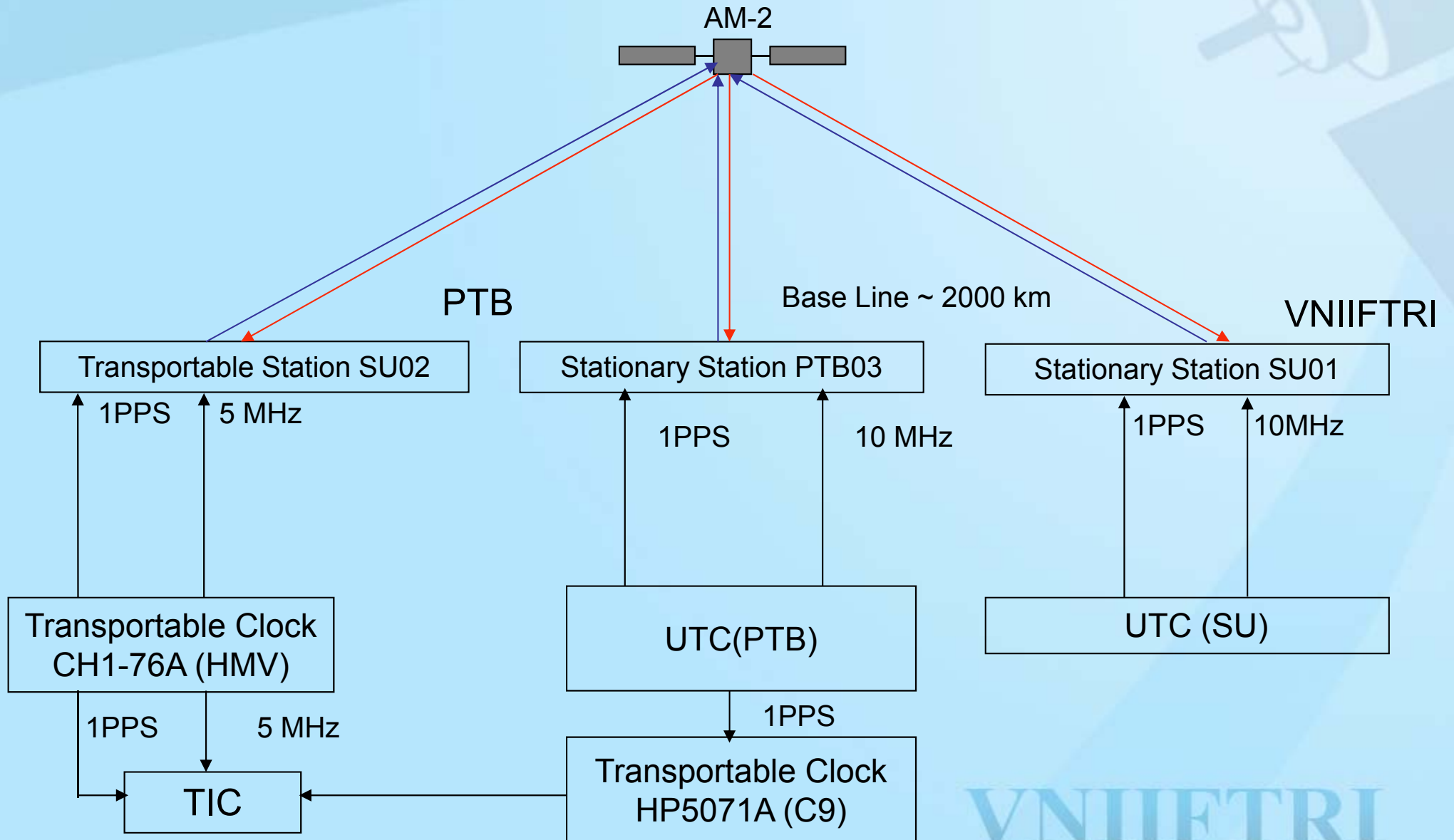
SU02 before and after trip in VNIIFTRI Zero base

SU01 and SU02 mutual calibration results in both cases were identical and  $SU01 - SU02 = -4.0$  ns with uncertainty  $u_B \leq 0.5$  ns

# Route of the trip

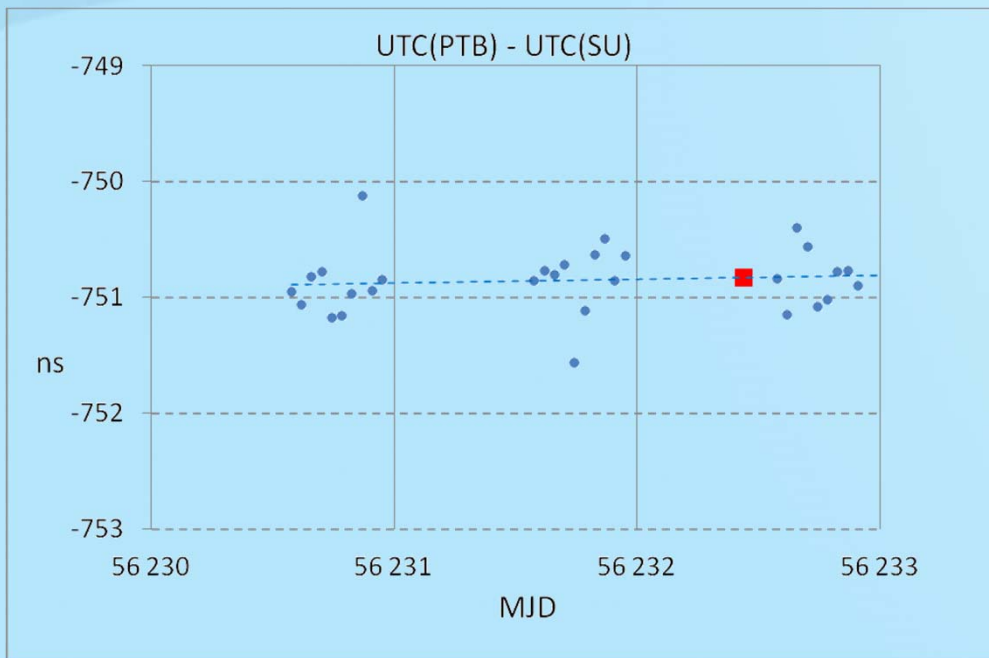


# SU01, SU02, PTB03 connection schematic

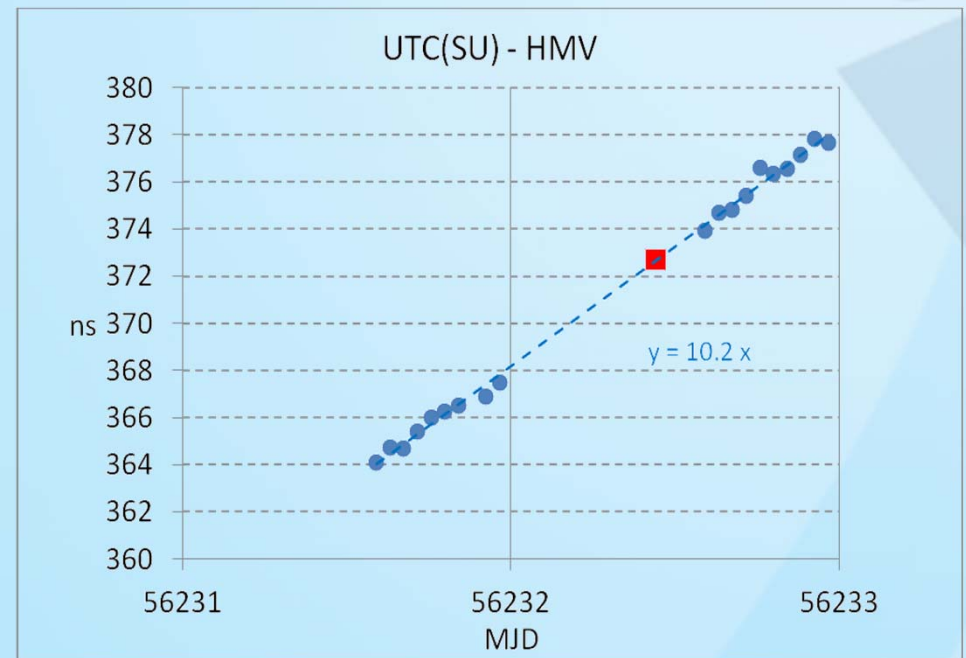




# Comparison results between UTC(PTB) and UTC(SU) stations SU01 and SU02



PTB03 – SU01



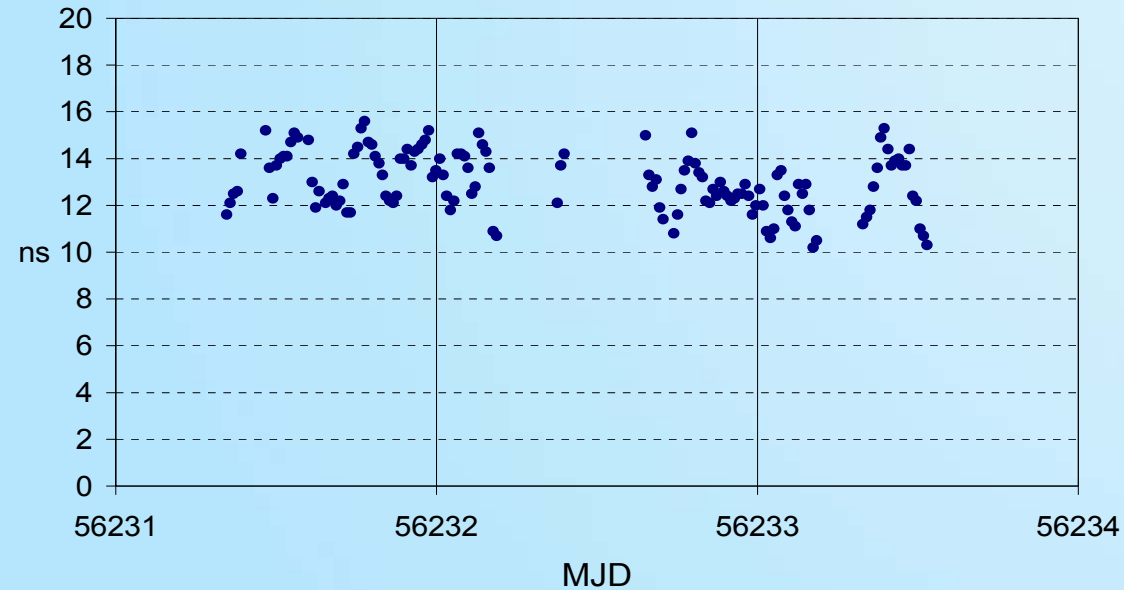
SU01 – SU02 (SU02 in PTB)

■ – values obtained by interpolation on moment of UTC(PTB) and HVM time scales comparisons

Uncertainty of UTC(PTB) and UTC(SU) time scales comparisons:  $U_A \leq 0.3 \text{ ns}$   $U_B \leq 1.0 \text{ ns}$

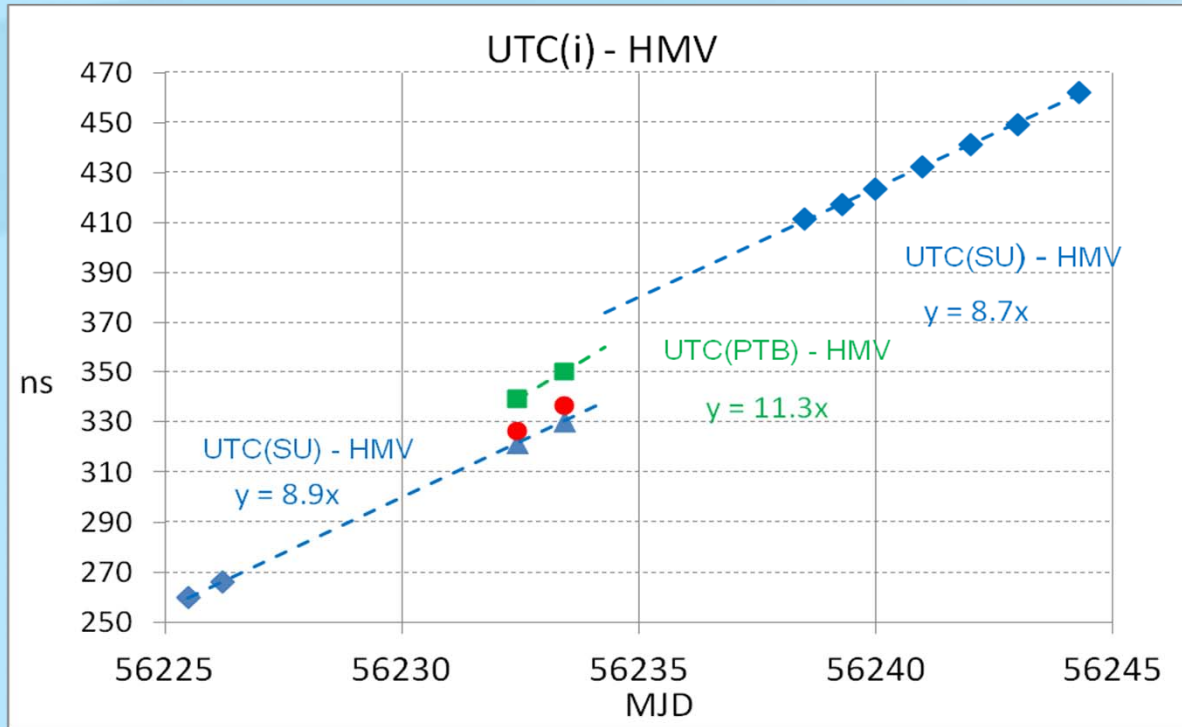
# UTC(PTB) and UTC(SU) time scales comparison results by GPS signals

UTC(PTB) - UTC(SU)  
TTS-3 (SU030) - TTS-3 (SU026)



MJD	UTC(PTB) - UTC(SU) ns	Number of common-views	Standard deviation for 1 day ns	$u_B$ ns	$u$ ns
56231.50	13.5	56	1.3	3.0	3.3
56232.50	12.9	48	1.2	3.0	3.2
56233.50	12.4	41	1.4	3.0	3.3

# Transportable clock

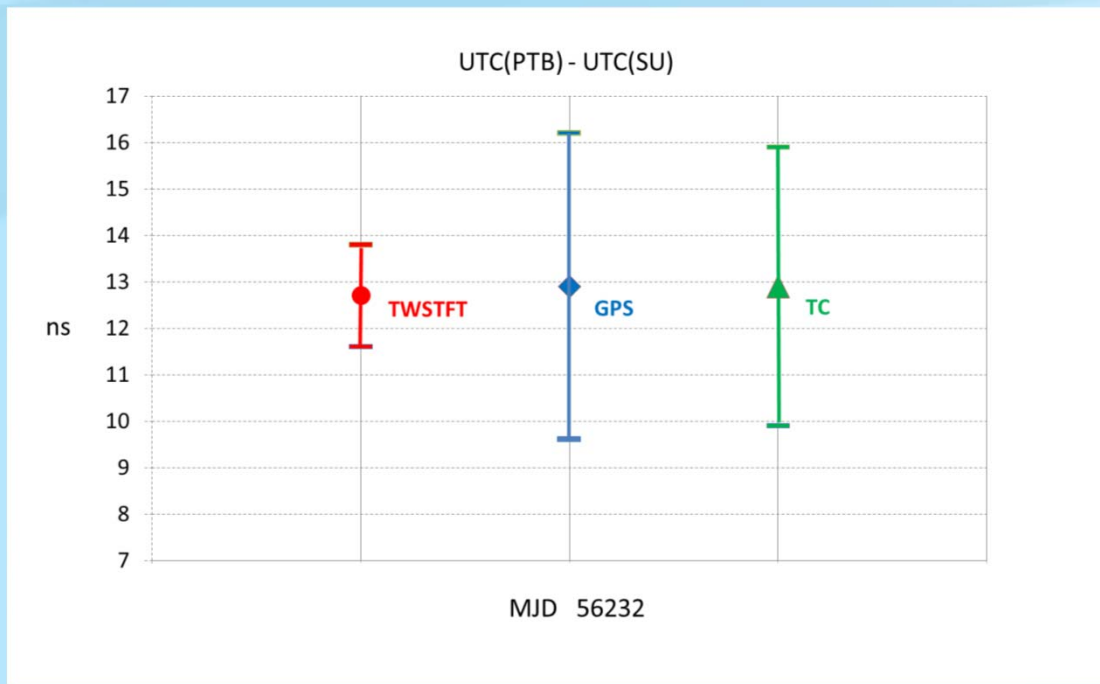


- ◆ - UTC(SU) and HMV time scales comparison results on VNIIFTRI
- ▲ - measurements forecast
- - values obtained on basis of HMV time scale movement forecast and as amended relativistic and Sagnac effects corrections
- - UTC(PTB) and HMV time scales comparison results through C9 from PTB

MJD	UTC(PTB) – HMV ns	UTC(SU) – HMV (forecast) ns	Relativistic effects correction ns	Sagnac effects correction ns	UTC(SU) – HMV <sub>c</sub> * ns	UTC(PTB) – UTC(SU) ns	$u_B$ ns
56232.44	339.2	321.5	10.2	-5.4	326.3	12.9	3.0
56233.43	350.5	330.2	11.6	-5.4	336.4	14.1	3.0

\* HMV<sub>c</sub> – with relativistic and Sagnac effects corrections

# UTC(PTB) and UTC(SU) time scales comparison results



PTB03 – SU01 TWSTFT link calibration with the mobile TWSTFT station SU02, a transportable GNSS receiver and a transportable H-Maser have been successfully completed.

During this experiment calibration corrections CALR for the SU01 station relatively to PTB03 station were obtained which amount to 764.0 ns and an uncertainty  $u$  of less than – 1.1 ns. This result obtained with SU02 station was confirmed with the two other independent methods, although these were less accurate. The result was registered in BIPM and have identification CI 281.

	UTC(PTB) – UTC(SU) ns		
	Mobile TWSTFT station SU02	GNSS receiver TTS-3	Transportable H-Maser CH1-76A
MJD 56231.50		13.5	
MJD 56232.44	12.7	12.9	12.9
MJD 56233.43	13.0	12.4	14.1
$u_A$	$\leq 0.3$	$\leq 1.4$	$\leq 0.1$
$u_B$	$\leq 1.0$	$\leq 3.0$	$\leq 3.0$
$u$	1.1	3.3	3.0

# New ITU files in accordance with CI 281

```

* twsu56.439
* FORMAT      01
* LAB         SU
* REV DATE    2013-05-27
* ES SU01 LA: N 56 01 17.374      LO: E 37 12 52.220      HT: 257.12 m
* REF-FRAME   WGS84
* LINK 14 SAT: AM-2              NLO: E 80 0 0.000      XPNDR: 999999999 ns
*           SAT-NTX: 10960.0000 MHz SAT-NRX: 14260.0000 MHz BW: 2.5 MHz
* CAL 281 TYPE: PORT ES REL      MJD: 56232 EST. UNCERT.: 1.100 ns
* LOC-MON     NO
* MODEM       SATRE 435
* COMMENTS
*
* EARTH-STAT  LI  MJD  STTIME NTL          TW          DRMS SMP ATL          REFDELAY          RSIG  CI S          CALR          ESDVAR          ESIG TMP HUM PRES
* LOC  REM          hhmmss s          s          ns          s          s          ns          ns          CI S          ns          ns          ns degC % mbar
SU01 NPLI01 14 56439 110100 299 0.255710008551 0.611 300 299 0.000001351357 0.009 999 9 999999999 999999999 99999 999 999 9999
SU01 NICT14 14 56439 111300 299 0.266576019402 0.575 300 299 0.000001351376 0.011 999 9 999999999 999999999 99999 999 999 9999
SU01 NTSC02 14 56439 111900 299 0.259461971714 0.584 300 299 0.000001351369 0.014 999 9 999999999 999999999 99999 999 999 9999
SU01 PTB03 14 56439 112500 299 0.270973861017 0.587 300 299 0.000001351384 0.009 281 1 -764.000 999999999 99999 999 999 9999
SU01 TL02 14 56439 113100 299 0.260369306388 0.545 300 299 0.000001351384 0.010 999 9 999999999 999999999 99999 999 999 9999
SU01 NIM01 14 56439 113700 299 0.261919991069 0.572 300 299 0.000001351367 0.013 999 9 999999999 999999999 99999 999 999 9999
SU01 SU01 14 56439 114300 299 0.266616422979 0.485 300 299 0.000001351380 0.009 999 9 999999999 999999999 99999 999 999 9999
SU01 NPLI01 14 56439 120100 299 0.255716481575 0.592 300 299 0.000001351376 0.010 999 9 999999999 999999999 99999 999 999 9999
SU01 NICT14 14 56439 121300 299 0.266582477084 0.571 300 299 0.000001351380 0.011 999 9 999999999 999999999 99999 999 999 9999
SU01 NTSC02 14 56439 121900 299 0.259468489786 0.601 300 299 0.000001351392 0.012 999 9 999999999 999999999 99999 999 999 9999

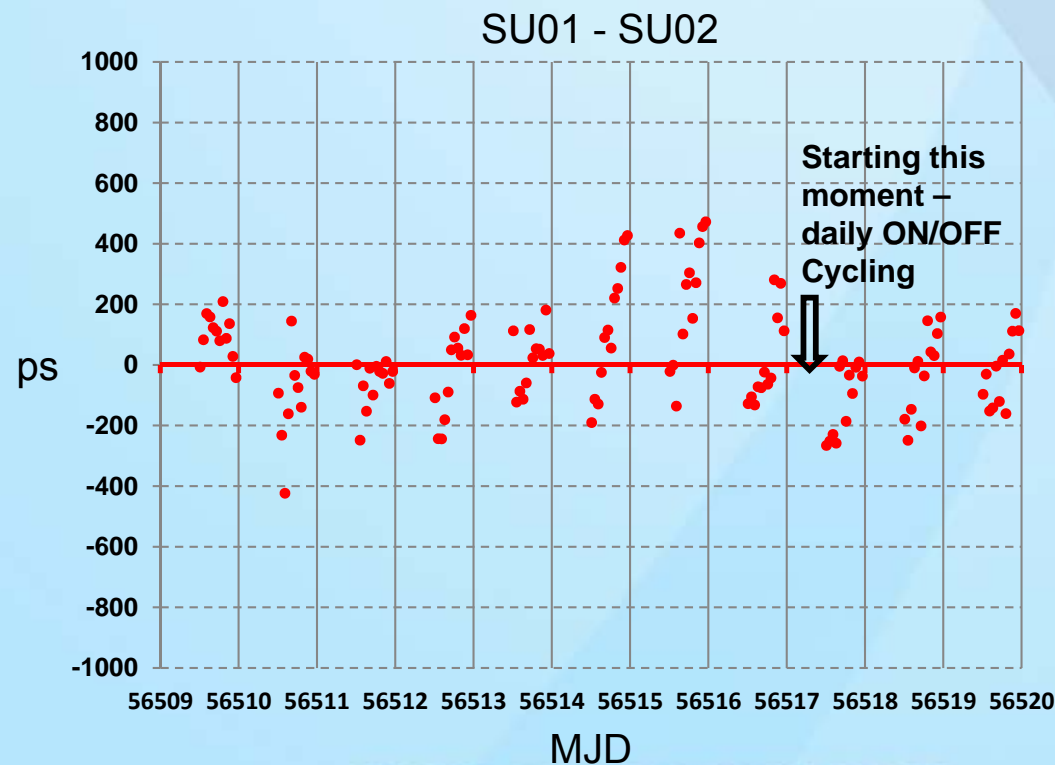
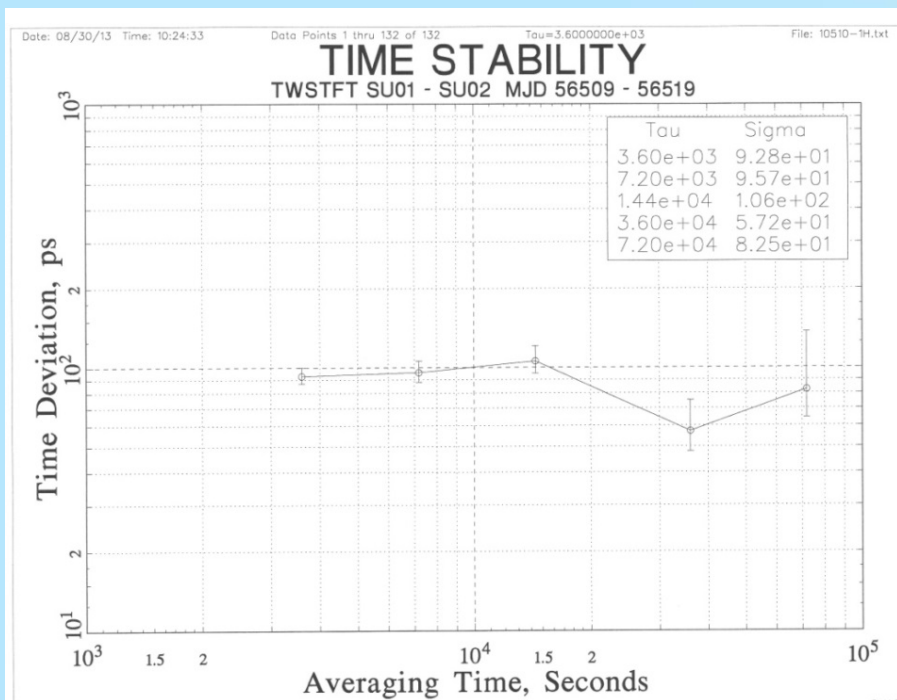
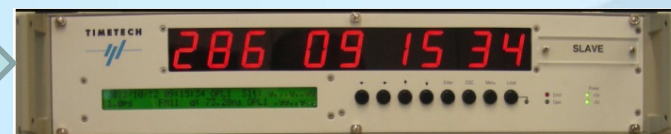
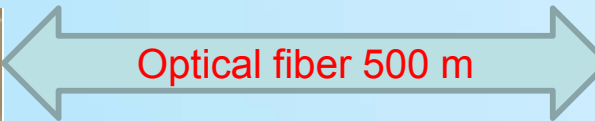
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# 3. TimeTech Optic Line testing results vs SU01 and SU02 in VNIIFTRI zero base

SU01

1 pps, 10 MHz, NTP Time

SU02



## 4. Current Status of SU01 station

- Starting from MJD 56352 SU01 TWSTFT data uploading to BIPM and VNIIFTRI ftp's
- From MJD 56439 CI 281 present in VNIIFTRI and PTB ITU files
- From MJD 56564 BIPM will going to UTC – UTC(SU) calculations from GPS/GLO to TWSTFT data

## 5. Information from Intersputnik about AM-2

- AM-2 guaranteed will operate up to 31 December 2013
- AM-2 possibly will operate in Jan and Feb 2014 (without guarantee)
- AM-4R will launched in year 2014 (no detailed information)



## **6. Information of 7-th International Symposium “Metrology of Time and Space”**

- VNIIFTRI in year 2014 (approximately in dates 8 - 14 September) is planning to organize and making 7-th International Symposium “Metrology of Time and Space” in Suzdal city, in Russia.
- VNIIFTRI invites to participate in symposium and ready to host the 22 CCTF TWSTFT WG in Russia jointly to the 7-th International Symposium Metrology of Time and Space.

**Welcome to Russia!**

VNIIFTRI

*Thank you for attention*

*Special thanks to  
Dr. A. Bauch and Dr. D. Piester for  
help and support with calibration*

VNIIFTRI