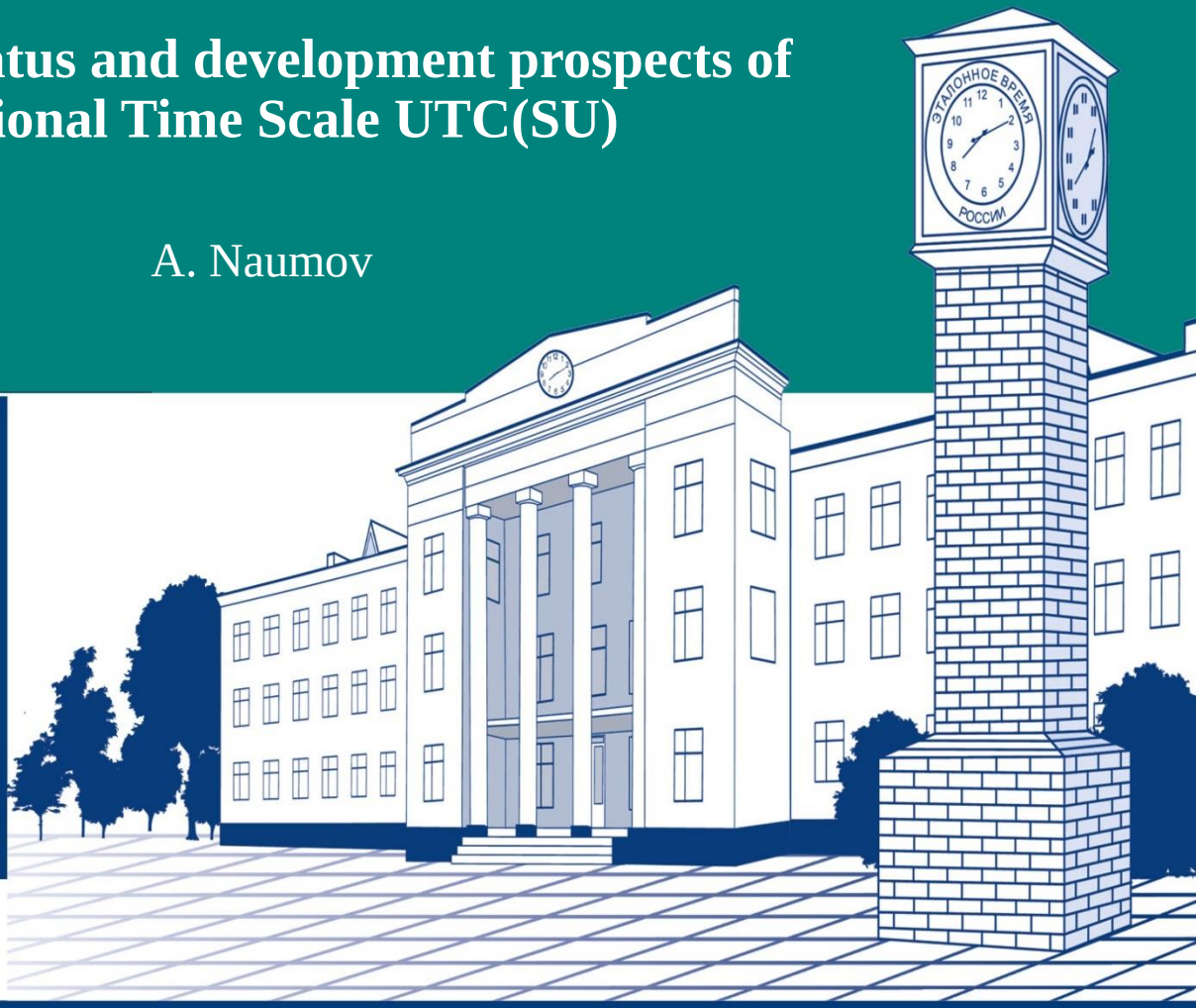
State Scientific Center
of the Russian
Federation

VNIIFTRI

National Research Institute for
Physical-Technical and Radio-Technical Measurements

Current status and development prospects of National Time Scale UTC(SU)

A. Naumov



ICG-14

Bangalore, India, 2019

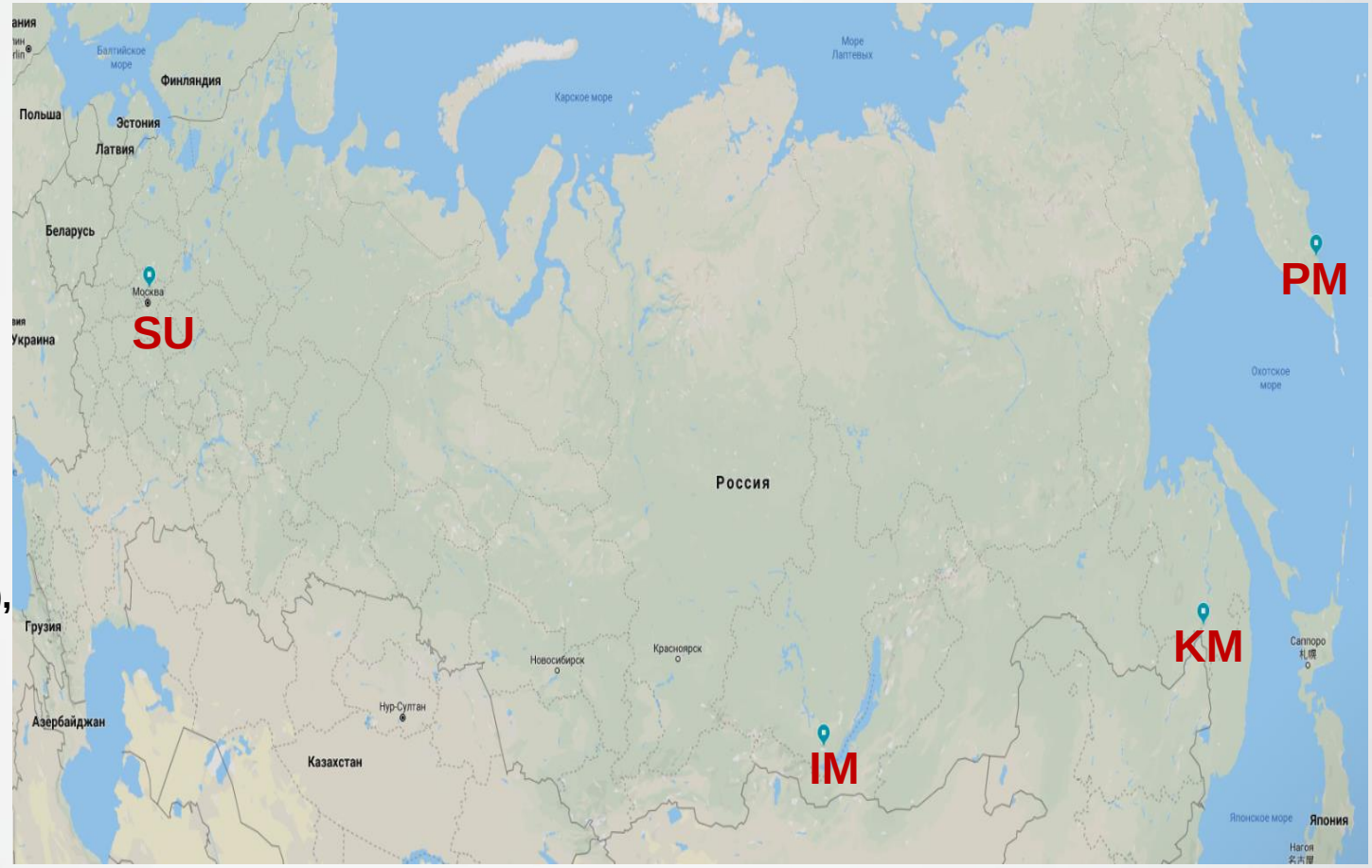
VNIIFTRI Branches Map

Main Branch (SU), Mendeleevo

East-Siberian Brunch (IM), Irkutsk

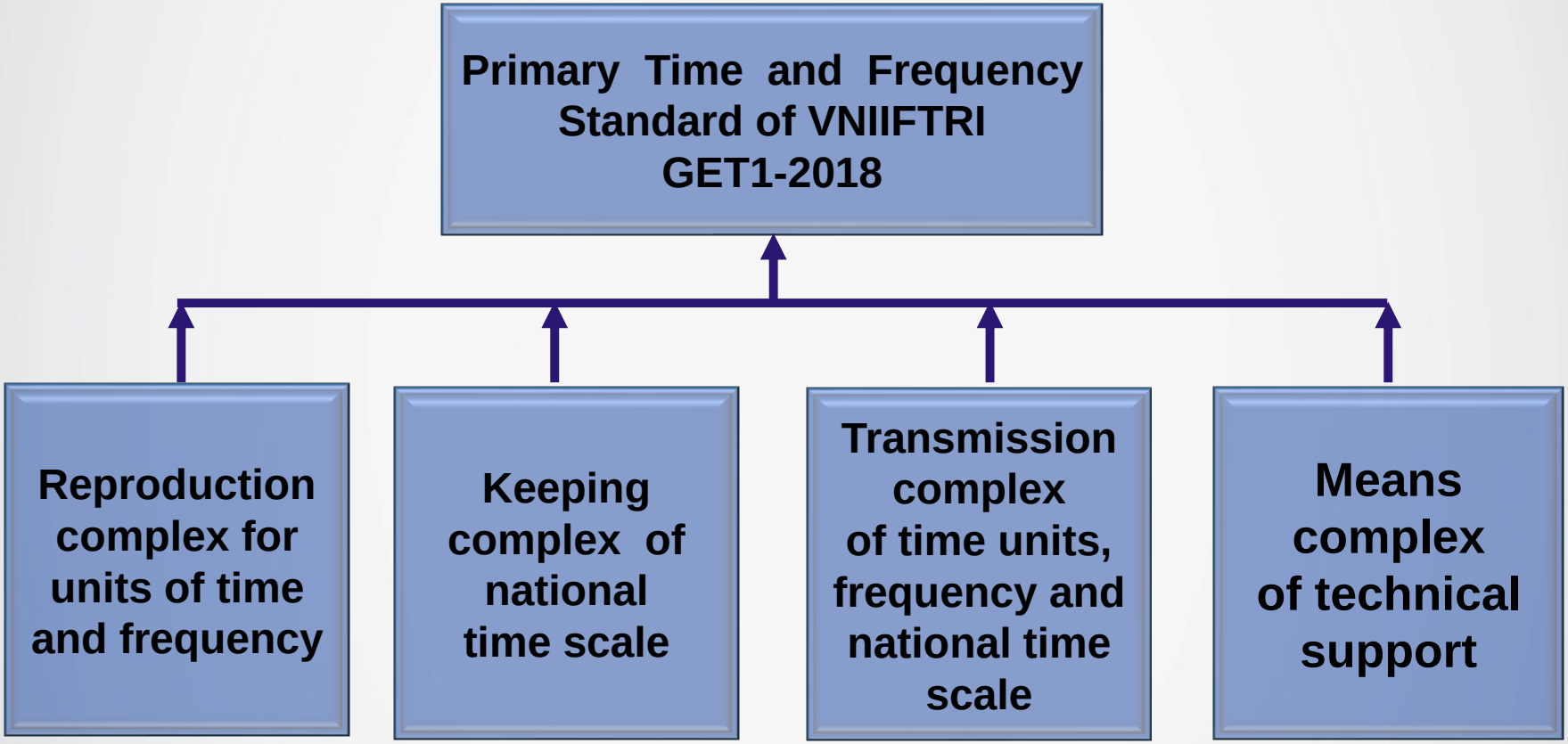
Far-East Brunch (KM), Khabarovsk

Kamchatka Brunch (PM), P.-Kamchatsky



NMI VNIIFTRI

Primary Time and Frequency Standard

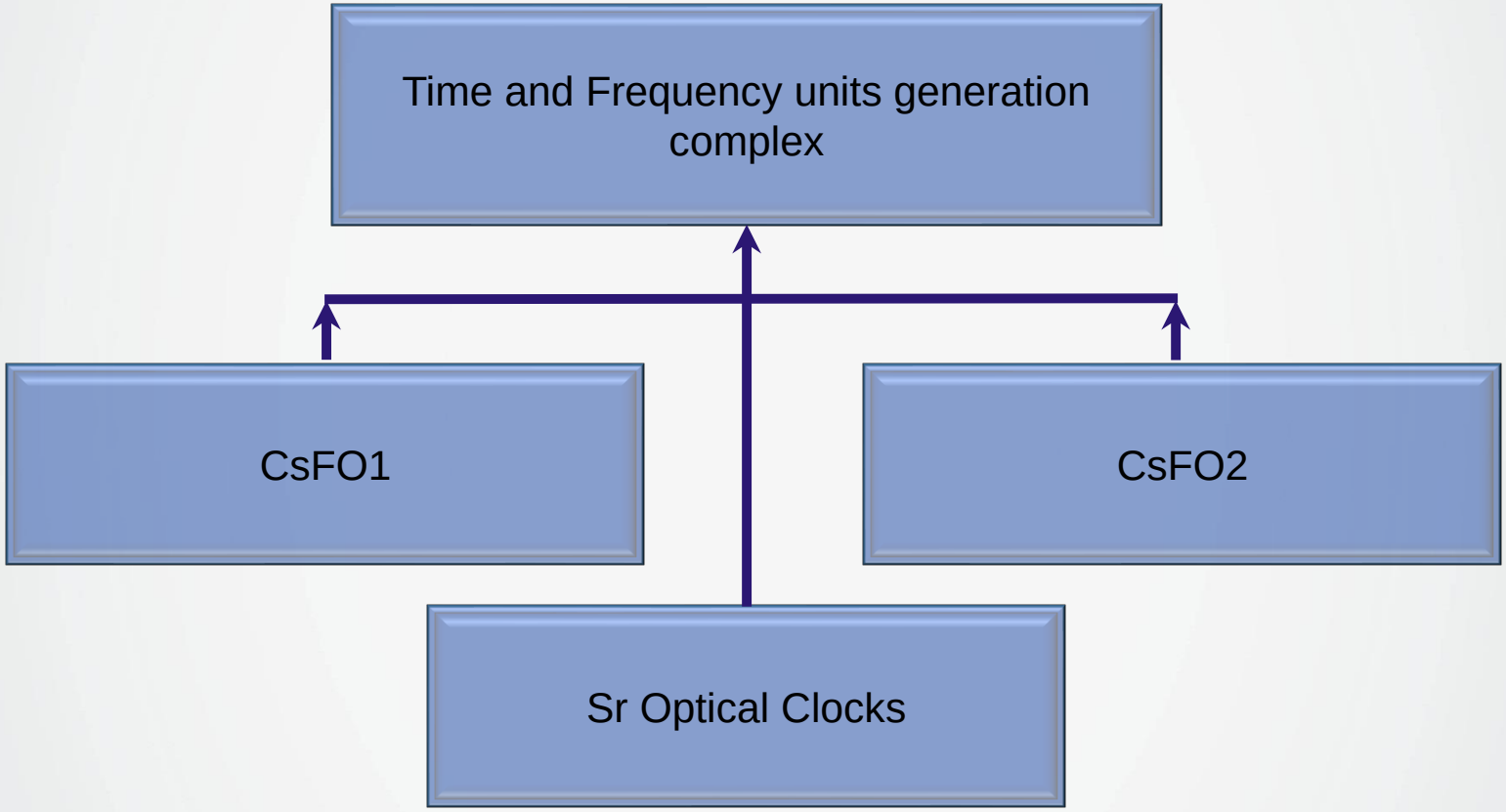


The new National Time and Frequency Standard of Russian Federation in pursuance of Decree No. 600 dated 02 April 2018 of Federal Agency on Technical Regulation and Metrology has been commissioned

Metrological Characteristics

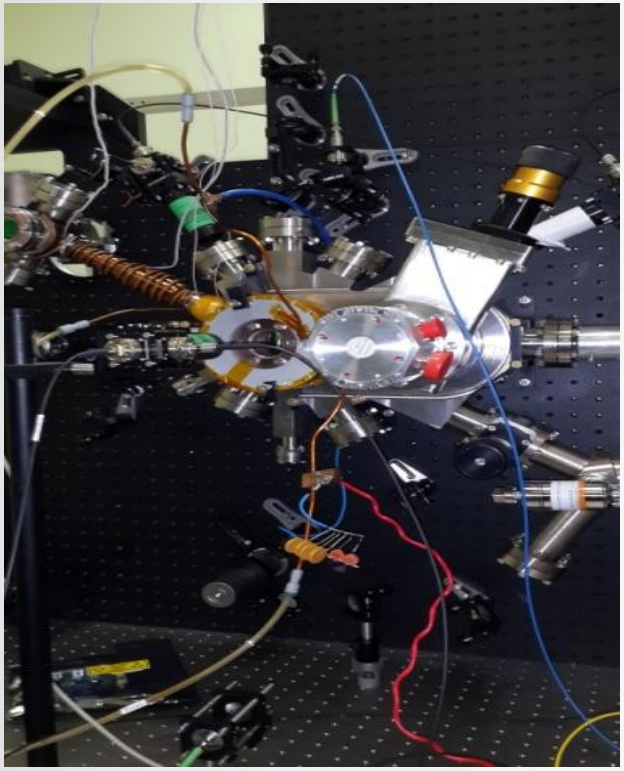
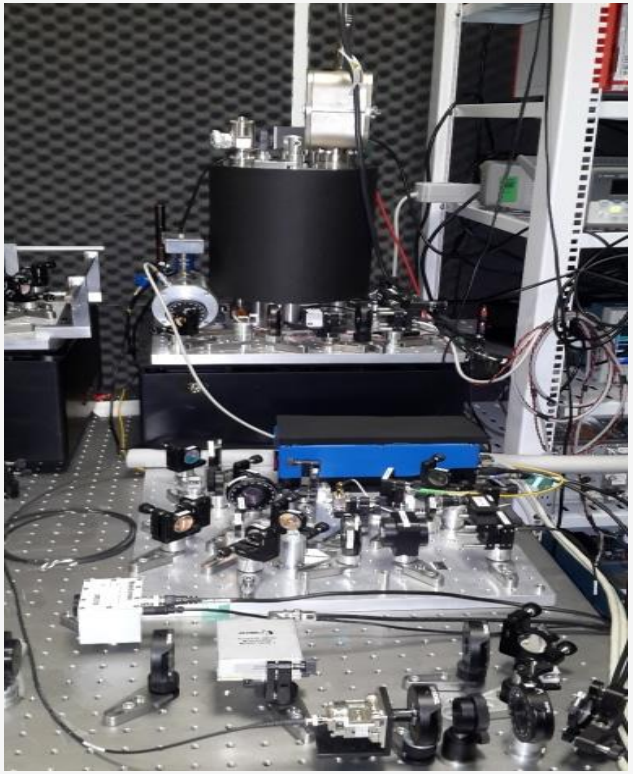
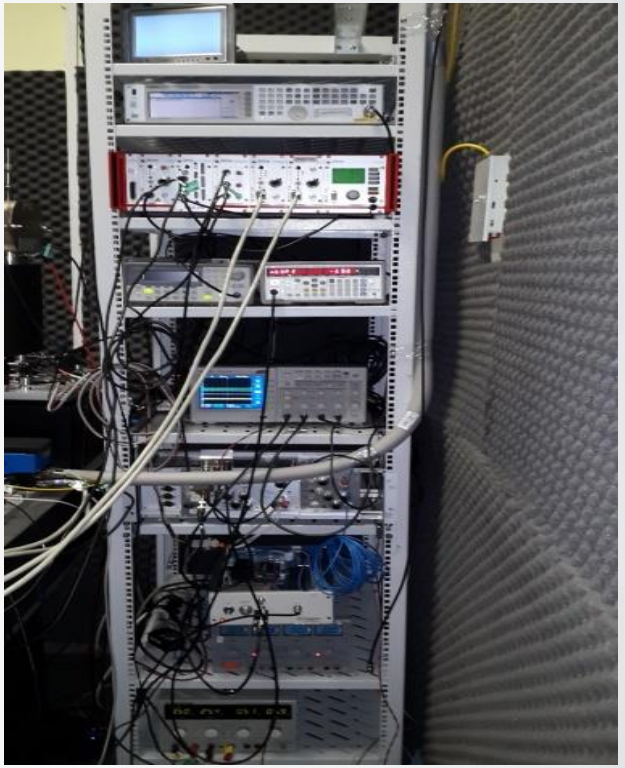
Characteristic, unit	Value
Reproducing units nominal frequency, Hz	9 192 631 770
Uncertainty budget	$\leq 5{,}0 \cdot 10^{-16}$
Time and Frequency relative uncertainty with measurement intervals 10 – 30 days and 1 year of observation	$\leq 1{,}0 \cdot 10^{-15}$
Measurement results RMS of time and frequency generation at 1 day measurements interval	$\leq 1{,}0 \cdot 10^{-15}$
Limits of UTC(SU) alowed biases reletively to UTC, ns	$\pm$ 4

Time and Frequency units generation complex



The complex is designed for independent generation of time and frequency units in accordance with the definition of a second in the International System of Units.

^{87}Sr neutral atoms in an optical lattice frequency standard

Uncertainty budget ^{87}Sr standard < 1×10^{-16}

Clock ensemble

CH1-75A

$\sigma_y(1\ day) \leq 5{,}0 \cdot 10^{-16}$

8 clocks

VCH-1003

$\sigma_y(1\ s) \leq 7{,}0 \cdot 10^{-14}$

4 clocks

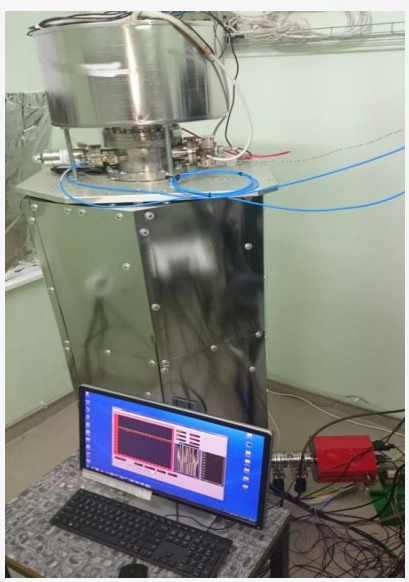
New H-Masers by Vremya-Ch

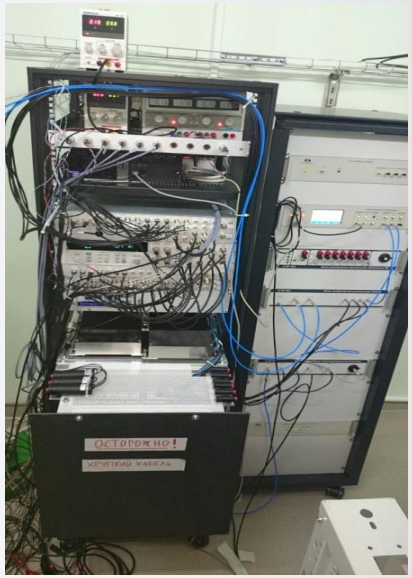
$\sigma_y(1\ day) \leq 3{,}0 \cdot 10^{-16}$

4 clocks

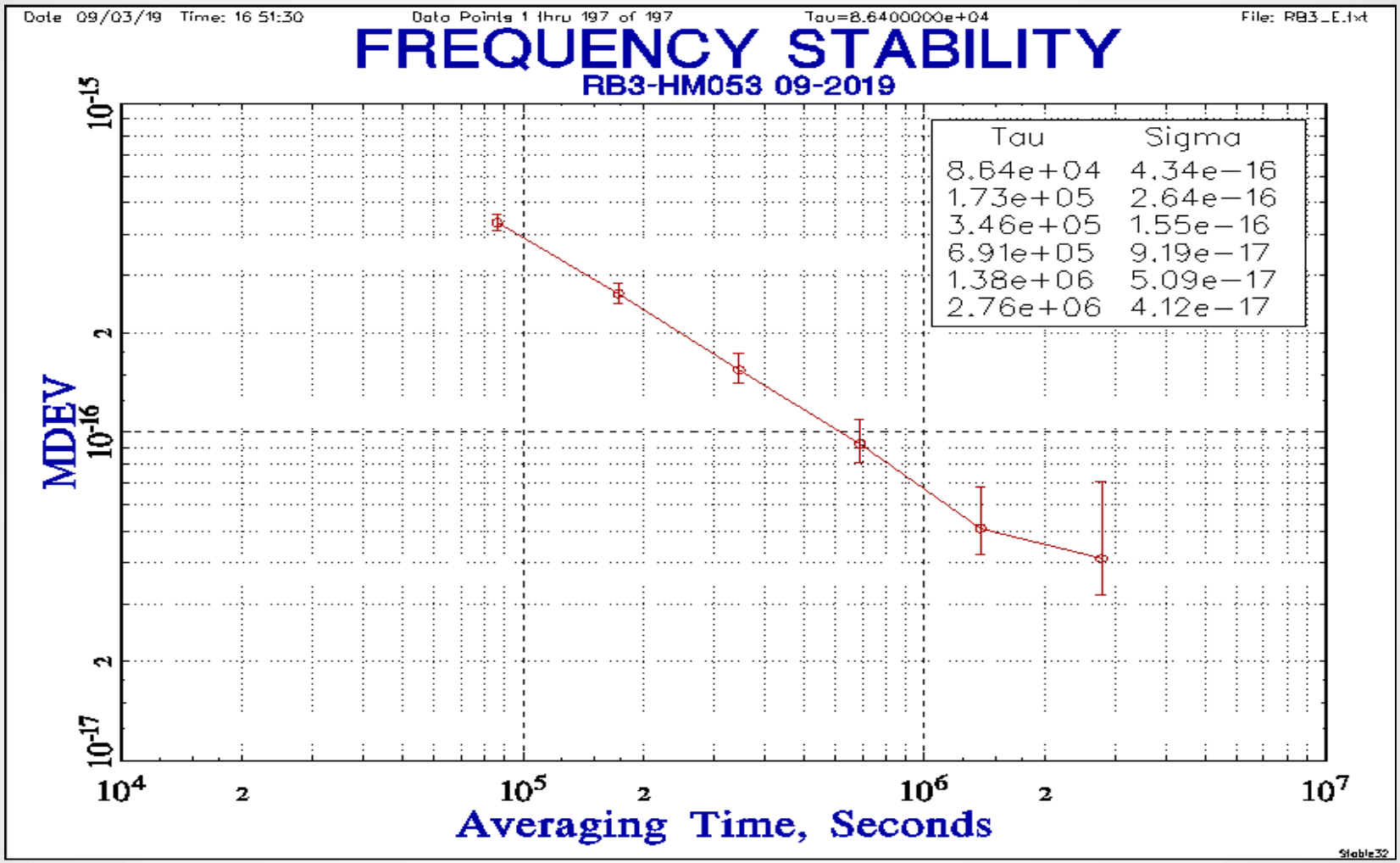
Two Rb fountains

Two Rb frequency reference



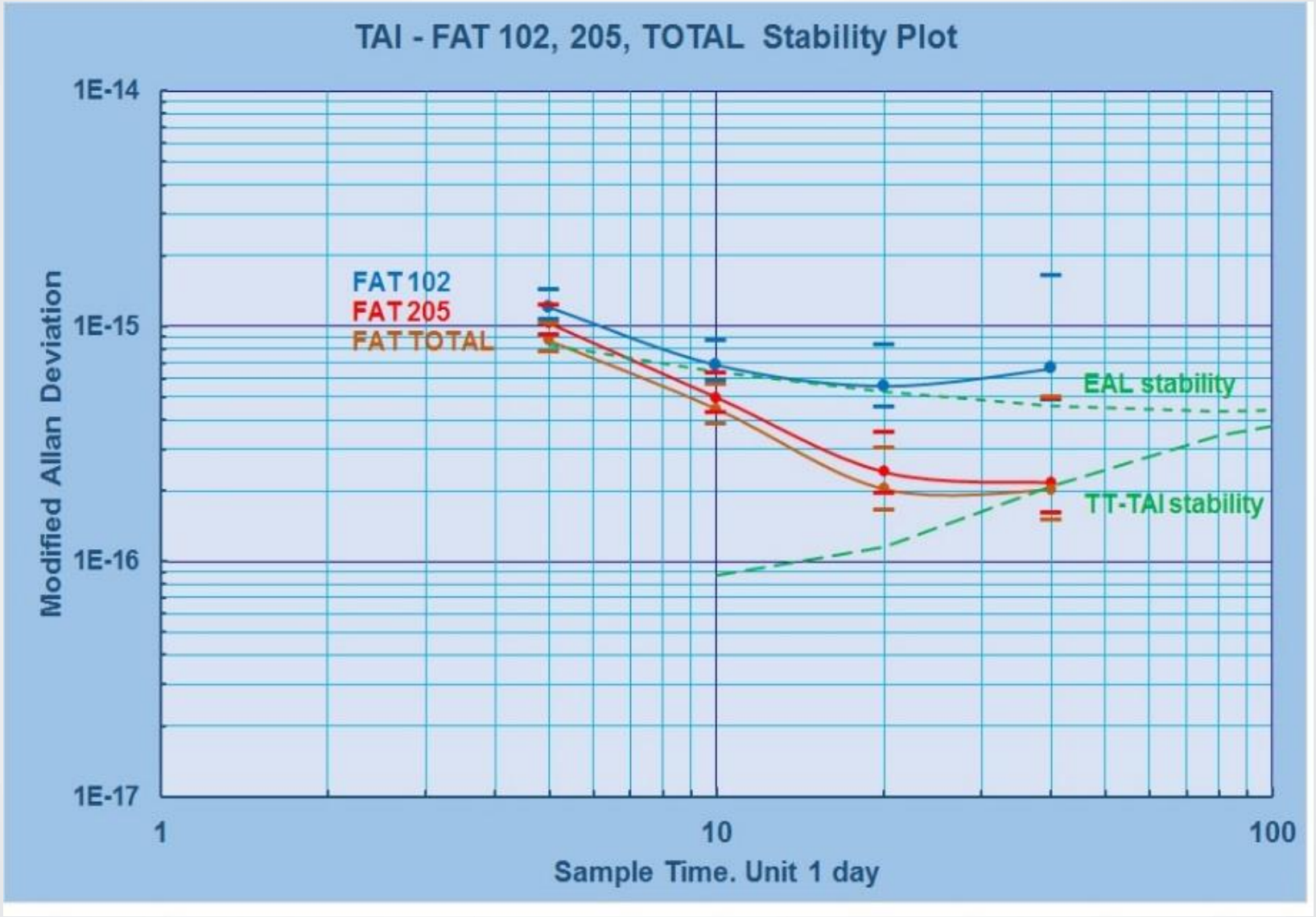


Stability measurements for Rb fountain

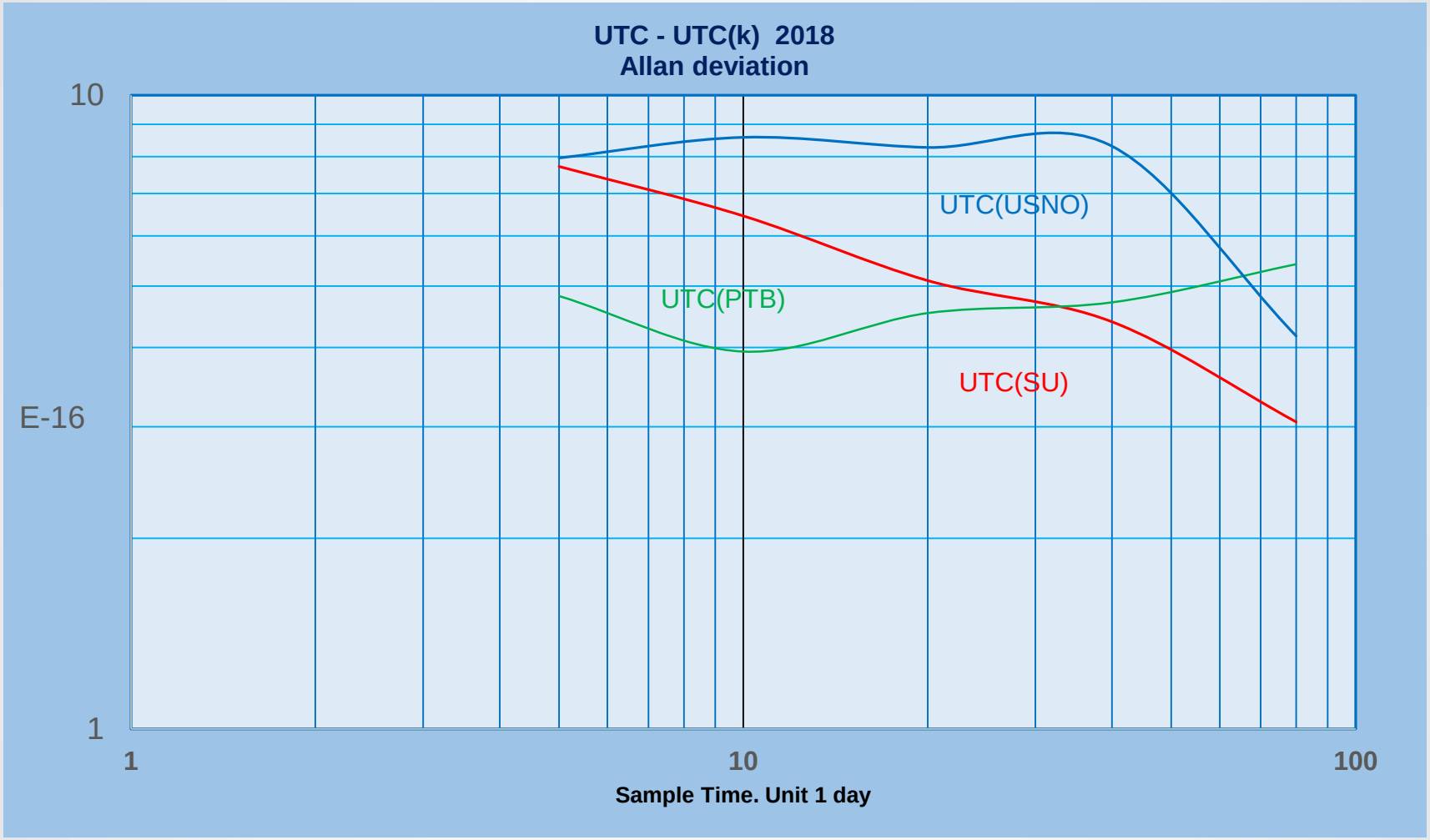


Rb 3 – HM_053: $\sigma_y(\tau) < 5.0 \times 10^{-17}$ τ = 30 days (February – August 2019)

Characteristics of TA(SU) generation

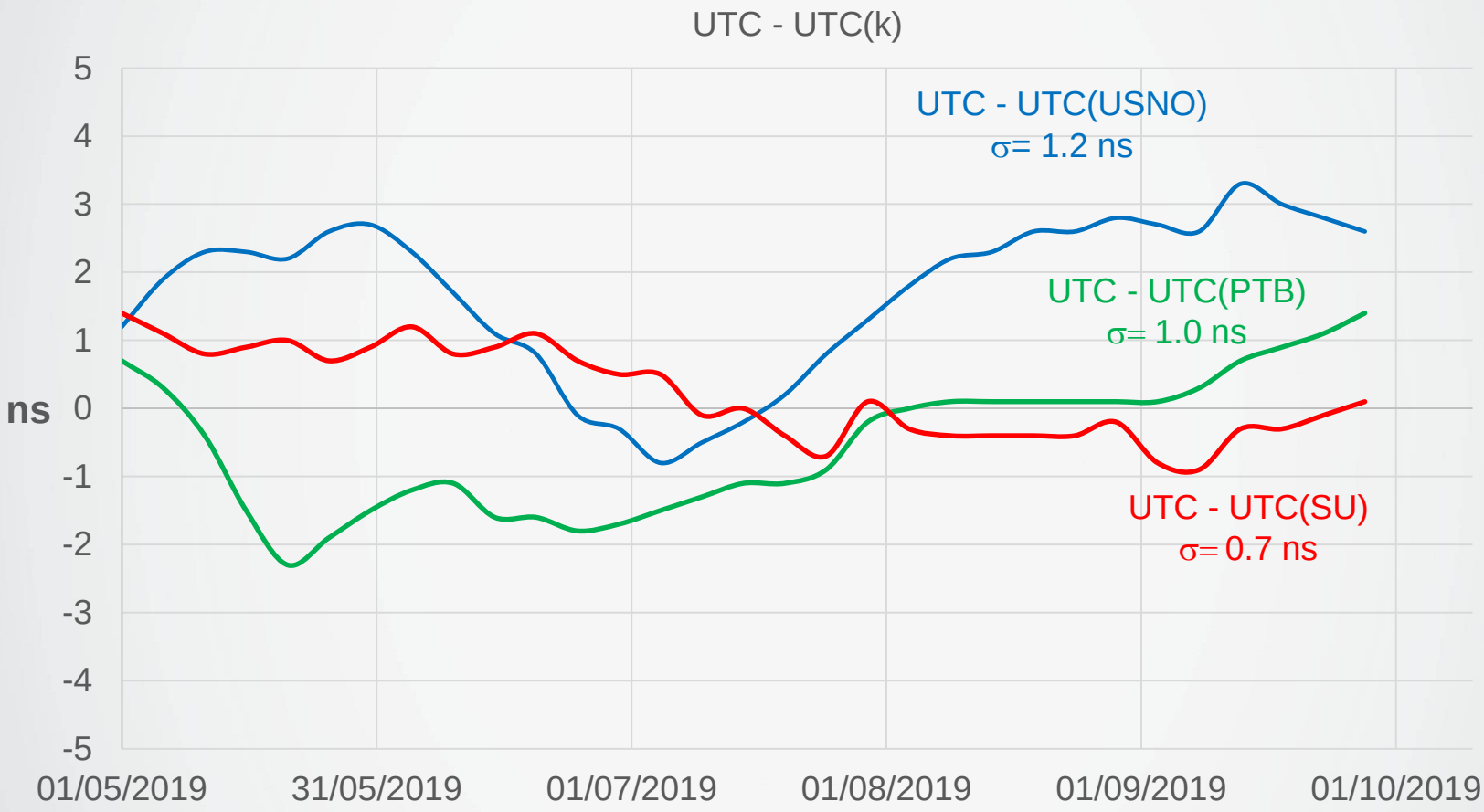


Characteristics of UTC(SU) generation



Measurement results of Cs and Rb fountains and also new generation H-Masers giving uncertainty of TA(SU) and UTC(SU) in a TAI and UTC level

UTC – UTC(k) in 2019



Difference of UTC-UTC(SU) is in within ± 4 ns

Time Comparison Equipment

3 TWSTFT fixed stations
(SU01, SU03, SU04)

TWSTFT mobile station
(SU02)

New TWSTFT mobile station (SU05)
- New DPN modem Vremya-Ch VCH-405
- SDR equipment

Time Comparison Equipment

GNSS Receivers

x1 TTS4 receiver

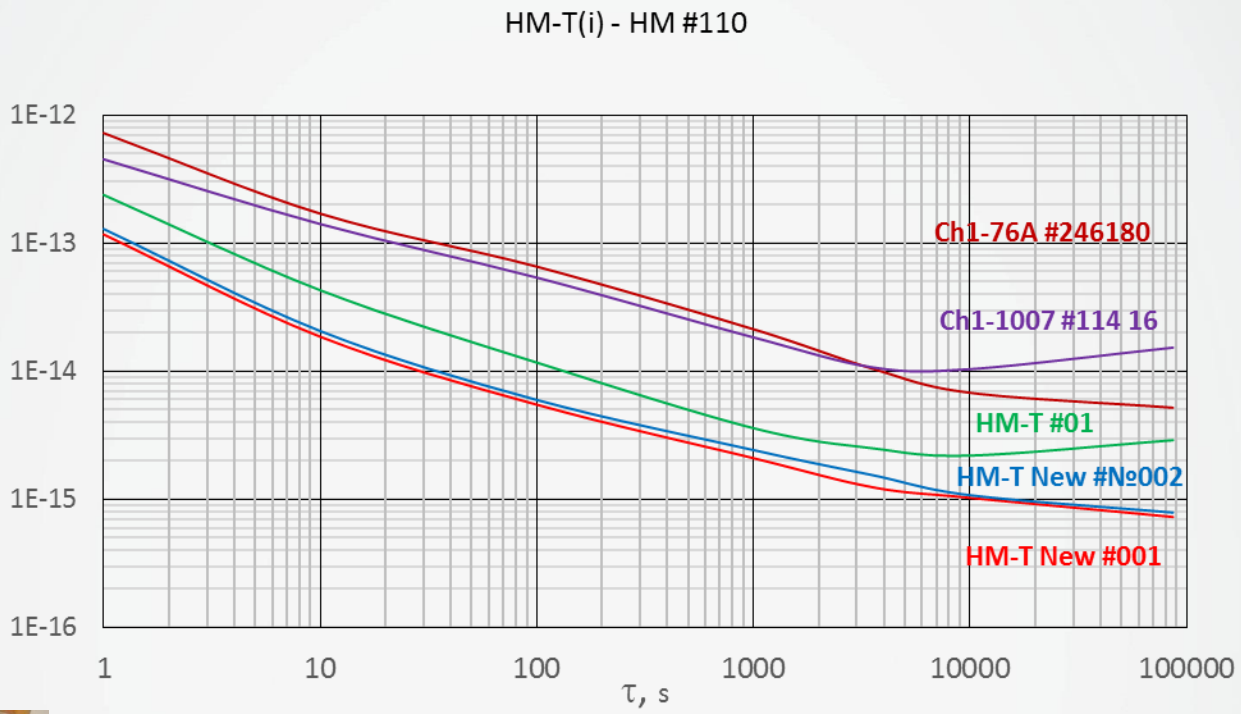
x4 GTR51 receivers

Transportable H-Masers

New active H-Maser Vremya-Ch

Passive H-Maser VNIIFTRI

New generation transportable H-Masers (HM-T). Measurements results.



Transportable HM-T developed by VNIIFTRI **green** curve

New transportable active HM-T developed by Vremya-Ch **red** and **blue** curve

Development Prospects of National Time Scale UTC(SU)

1. Modernization of the National Time Scale keeping complex to ensure consistency of comparison UTC(SU) - UTC with error no more than ± 3 ns
2. Developments of high-precision time comparison links to compare UTC(SU) with GLONASS System Time and other time laboratories
3. Studies on the creation of a high-precision links for transferring reference time and frequency signals over a fiber-optical lines
4. Improving of reproducing and keeping units of time and frequency in order to achieve the tactical and technical characteristics of the GLONASS system for year 2020
5. Improving of time scale algorithms calculations

Thank you
for your attention