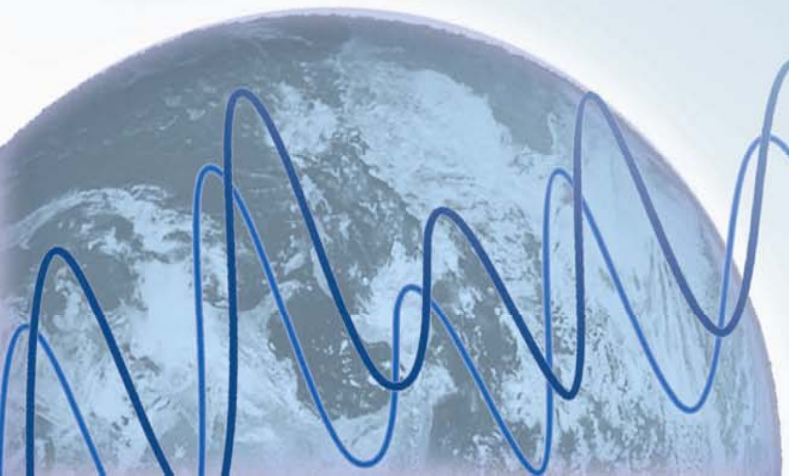
ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ
УНИТАРНОЕ ПРЕДПРИЯТИЕ

«ВСЕРОССИЙСКИЙ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ
ФИЗИКО-ТЕХНИЧЕСКИХ И РАДИОТЕХНИЧЕСКИХ ИЗМЕРЕНИЙ»

ВНИИФТРИ

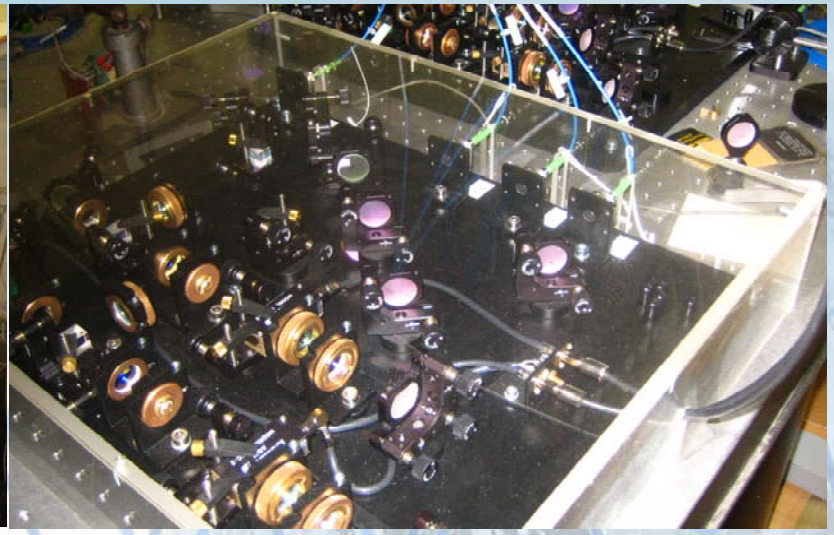
Time and Frequency Activity at the VNIIFTRI

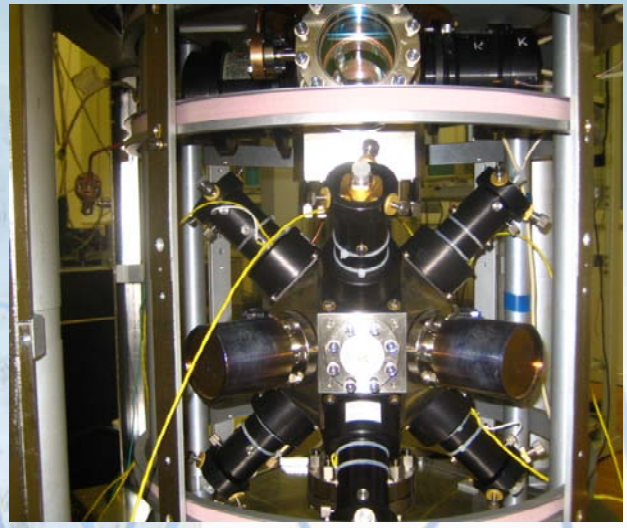


CONTENT

- Investigations on fountain primary Cs standard
- Changes in time keeping laboratories and the closest goals
- Conclusions

Investigations on Fountain Primary CS Standard





- The main goal of this year is achieve on this prototype accuracy level less than 3×10^{-15}.
- The next prototype of fountain primary Cs standard with expected accuracy level $\leq 5 \times 10^{-16}$ is scheduled to the end of 2011.

Changes in Timekeeping Laboratories and the Closest Goals

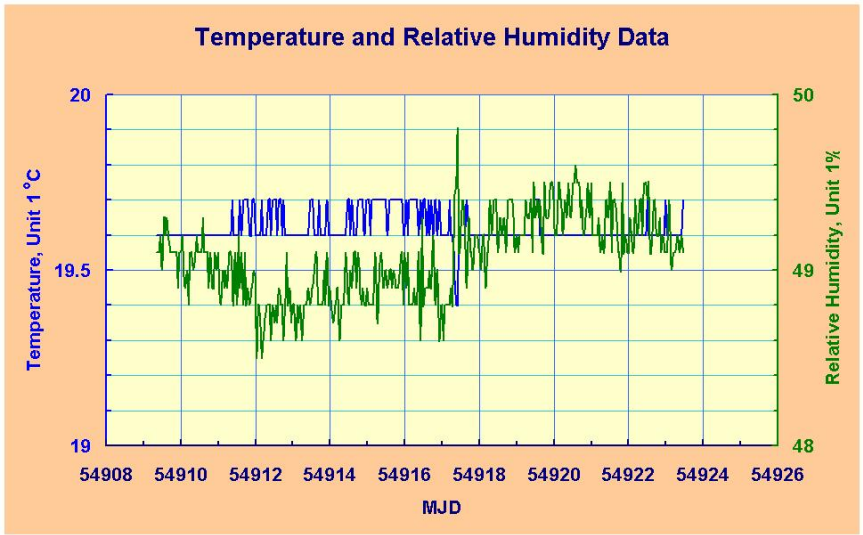
Many changes have happened since beginning 2007 in State Service for Time and Frequency (SSTF) and VNIIFTRI time keeping laboratory particularly. First of all was adopted retrofitting program for the SSTF primary (VNIIFTRI) and secondary time laboratories (Novosibirsk, Irkutsk, Khabarovsk and Petropavlovsk at Kamchatka peninsula) under supervision of the Rostechregulirovanie (former Gosstandard)

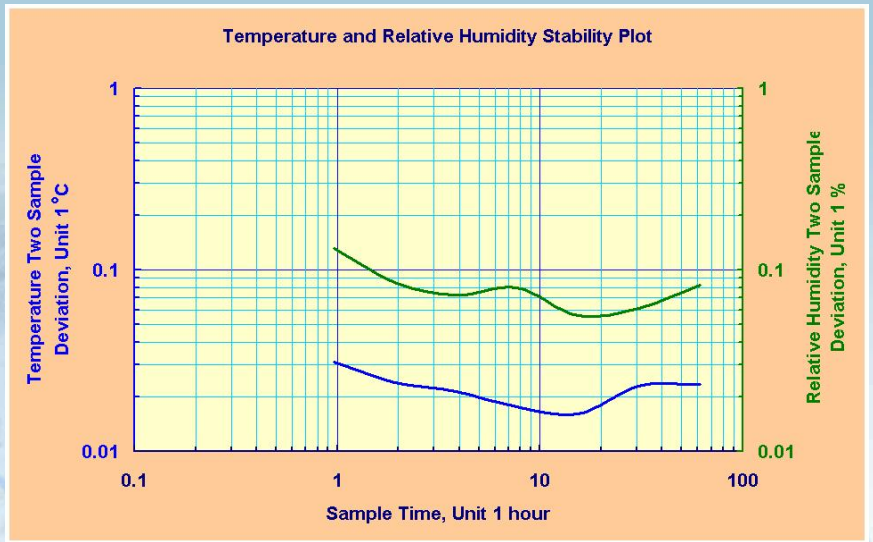
Changes in VNIIFTRI

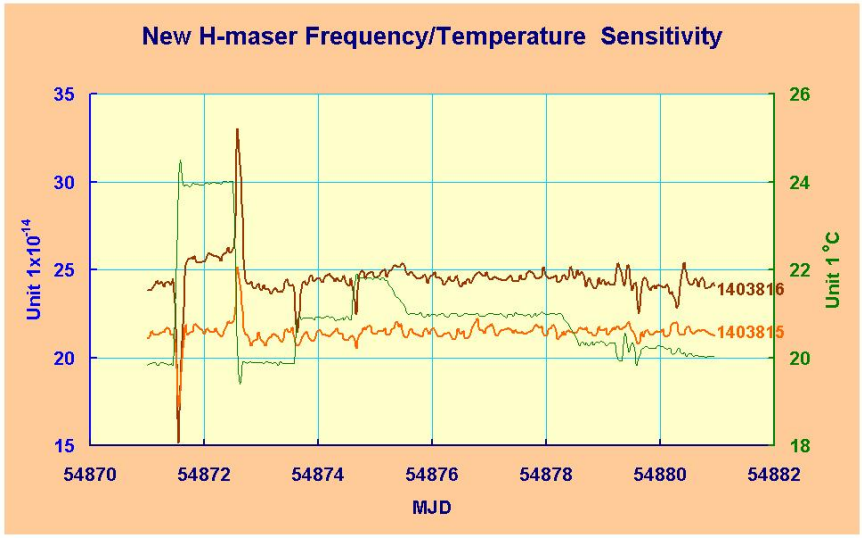
Today we have two specially designed climate controlled chambers for clocks and inter comparison instruments. The third one will be constructed in 2010.

Each one is designated for four H-masers type of CH1-75 with autonomous cavity auto tuning system. To reduce cable length and possible leakages and/or mutual influence of clocks the chamber contains distributing amplifiers and H-maser inter comparison system. Minimal number of signals from clocks in other chambers is connected to inter comparison system. Today we have two ensembles of 4 new H-masers, total number 8. In 2010 total clocks number in VNIIFTRI will be 12. Quite the same configuration of time keeping equipment will be installed in secondary laboratories with the only exception – each laboratory will possess only 4 H-masers. So total number of H-masers under VNIIFTRI supervision will be 24 .

Changes in VNIIFTRI







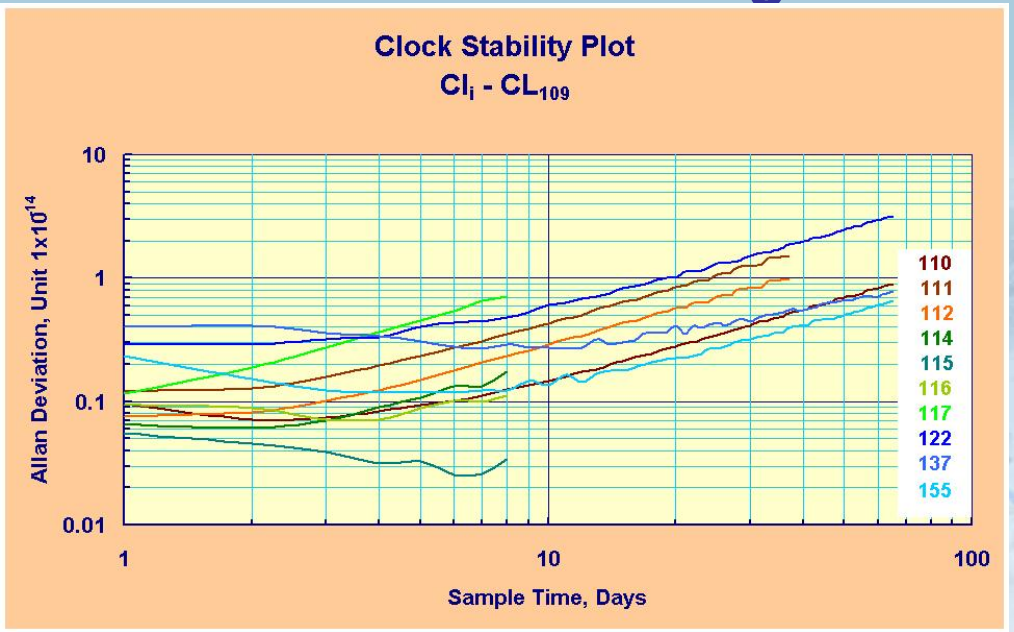
Temperature (T) and relative humidity (RH) performances of chambers.

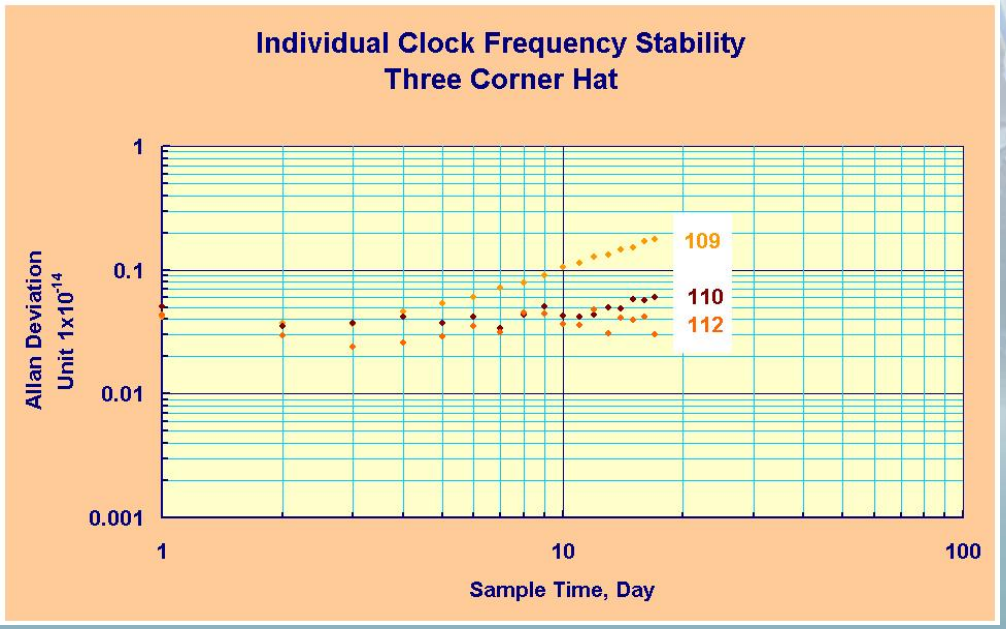
Such a level of T and RH stability is absolutely needed because of frequency/temperature sensitivity of H-masers is about 10^{-15}/K.

These figures have been confirmed experimentally and are in conformity with specification to the H-maser.

ВНИИФТРИ

Changes in VNIIFTRI



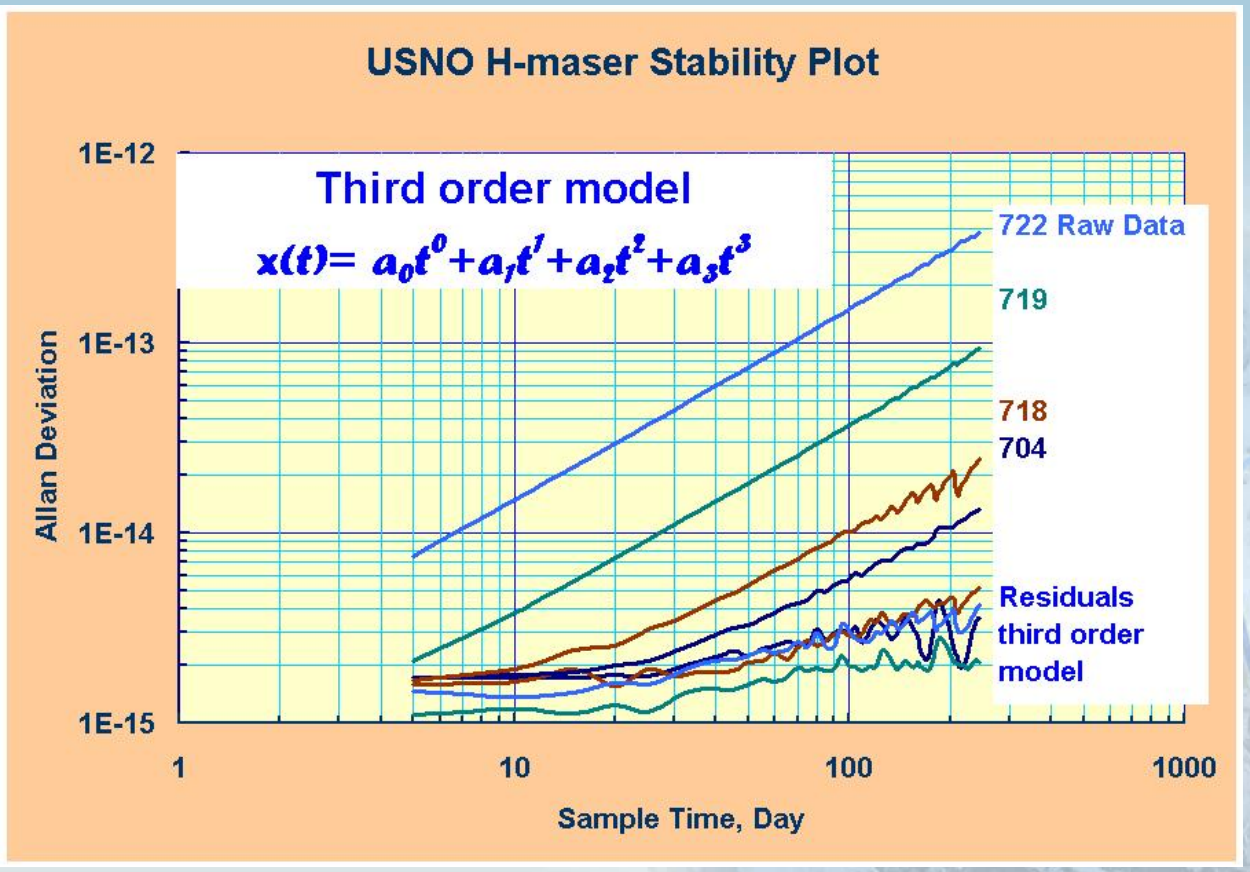


Frequency stability data for the best old H-masers and two ensembles of new one.

These figures have been obtained using old measuring system because of new one with considerably better time/frequency resolution till now is under construction.

ВНИИФТРИ

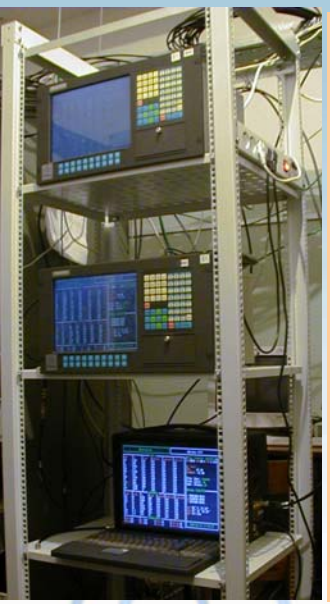
Changes in VNIIFTRI

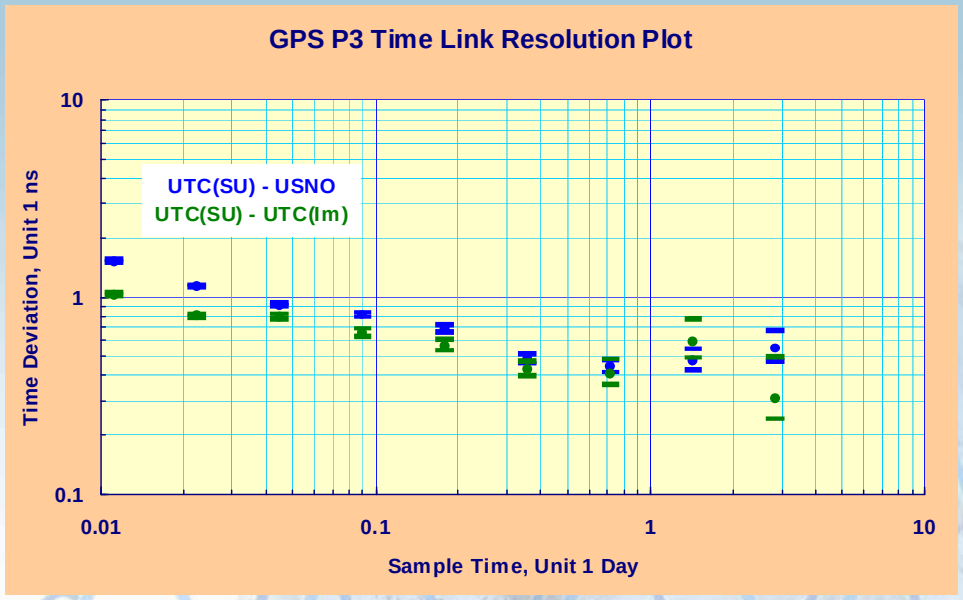


Keeping in mind elaborating time scale based on the ensemble of new H-masers not only in VNIIFTRI but in secondary laboratories also USNO H-masers clock data from BIPM ftp-server have been analyzed for the period of 2005-2008. The main goal was to elaborate clock model for prediction of the H-maser frequency

The analysis has showed that residuals of the third order time model (frequency difference, frequency drift and permanent change of frequency drift (permanent frequency acceleration)) manifests frequency flicker and frequency random walk noises up to sample time of some hundred days.

Changes in VNIIFTRI





Two such a receivers have been delivered to to Irkutsk and Khabarovsk, one more is waiting shippment to Petropavlovsk and other to Novosibirsk secondary laboratory.

Remote clock comparisons. For today we have several GPS/GLONASS time receivers of TTS-3 type. These receivers have been GPS differentially calibrated across TTR6 delivered many years ago from the BIPM. Implementation of this receivers into operational TAI time link improved u_A uncertainty in Circular T twice.

We have a preliminary agreement and necessary resource to install up to the end of the year TWSTFT station in VNIIFTRI. Today main goal is to join to European/Asia laboratories link through IS-4 satellite. As a next step will installation TWSTFT station in Eastern part of Russian Federation, preferably in Irkutsk.

ВНИИФТРИ

Conclusions

The modernization program of operational means and investigation programs will lead to considerable improvements in performances of the National Primary Time and Frequency Standard of Russian Federation and chain of secondary time laboratories.

These programs make provision to achieve following performances at 2011:

- **Accuracy CS fountain standard about 5×10^{-16}**
- **Time scale stability level 5×10^{-16} for sample time from 10 to 30 days**
- **Time link uncertainty level relative UTC about 1 ns**
- **RMS difference UTC – UTC(SU) ≤ 10 ns**
- **RMS difference UTC(SU) – Secondary Laboratories ≤ 10 ns**

All these achievement inevitably will be reflected into GLONASS UTC(SU) dissemination up to UTC(SU) – $UTC(SU)_{GLONASS}$ ≤ 10 ns.