RECENT PROGRESS OF THE RESEARCH WORKS ON FREQUENCY AND TIME AT THE NIM

Huang Bingying

National Institute of Metrology
Of China, Beijing

1. INTRODUCTION

Research works on frequency and time have been engaged for many years at the NIM. We do the research and development on the primary cesium beam standard and the high-precision crystal oscillator, keep the atomic time and calibrate frequency standards. We also study how to transfer the standard frequency and time at the highest precision. Now, our primary cesium beam installation has been operated to give an accuracy of $1.2 \cdot 10^{-12}$ (1σ). Basing on it, some improvements are being made to attain an uncertainty goal of the order of 10^{-13}. Furthermore, two important experiments have been done in the last two years. One of them was the standard frequency transfer via TV color subcarrier. The frequency stability of σ_y (30 min.) $= 4 \cdot 10^{-12}$ has been obtained. Another test was the time synchronization via the Germany-French "Symphonie" satellite. The best results are as follows: the random fluctuation of direct measurement data is $1\sigma_R$ (RMS) < 10 ns, and the absolute error of clock synchronization is $1\sigma_A$ (RMS) < 30 ns.

2. PRIMARY CESIUM STANDARD

In our cesium beam tube, the interaction region is 3.68 m in length. The Ramsey linewidth is about 46 Hz and the arrangement of the beam optics is a typical dipole system. Square wave phase modulation at 43 Hz is used. An accuracy of $1.2 \cdot 10^{-12}$ (1σ) and a stability (σ_y, 1 hour) of $5 \cdot 10^{-13}$ have been obtained last year. After that, we started to make some improvements on the beam optics, the cavity, the C-field, the vacuum system and the environment. Now, a narrower Ramsey linewidth of 28 Hz has been observed. It is expected that the uncertainty of the order of 10^{-13} will be attained after finishing all these improvements.

3. STANDARD FREQUENCY TRANSFER VIA TV COLOR SUBCARRIER

Firstly, we have developed some equipments for this experiment. The major one is the frequency synthesizer at 4.43 ··· MHz which is used for color subcarrier frequency in our TV system. We have measured the errors of these equipments and compared the simultaneously obtained data of standard frequency measurements made in Beijing and other cities such as Wuxan, Shanghai and Kuangchow. The results of these measurements show that the stability of the standard frequency transfer via TV color

subcarrier is about $4 \cdot 10^{-12}/30$ min. within our TV network. We plan to realize the standard frequency and time dissemination via the TV signal in the near future.

4. TIME SYNCHRONIZATION VIA THE "SYMPHONIE" SATELLITE

A series of tests about the two-way delayed noncoherent time synchronization via the Germany-French "Symphonie" satellite have been done in this year. The results obtained are listed in the following table:

Ground Stations	Type of the Errors (ns) σ_R (RMS)	σ_A (RMS)
Shanghai-Beijing March, 1979	70	71
Shanghai-Nanjing March, 1979	70	75
Nanjing (China)- Raisting (Germany) June, 1979	9	29

In this table, the σ_R and σ_A have the same meaning mentioned above.

Many other units, especially the PTB of FRG, have taken part in the experiments. Here, we would like to thank them for their valuable cooperation. We just attempted to march out the first step, and we shall continue to do more research works in order to build up the time synchronization system via the satellite in our country.

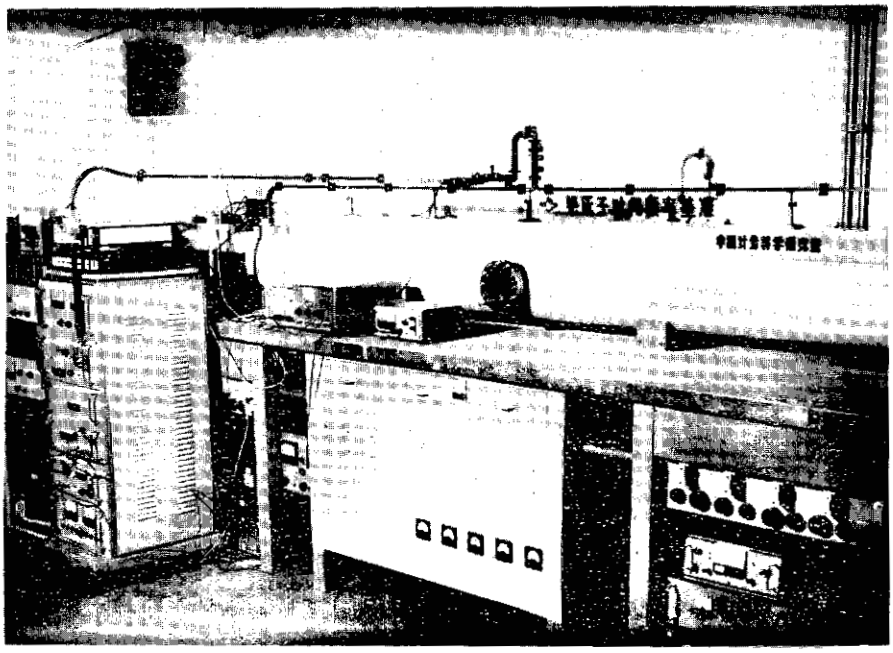

Fig. 1. Primary Cesium Standard

DR. COSTAIN:

Yes. Just very quickly, as I mentioned privately I think you will have very great difficulty in establishing the excellence of a primary standard when you only have a commercial standard as reference. I would suggest that the quickest and the best to do is to build another primary standard because you need something just as good or better to compare it with.

MR. Bing-ying Huang, National Institute of Metrology of China, Beijing

Thank you.