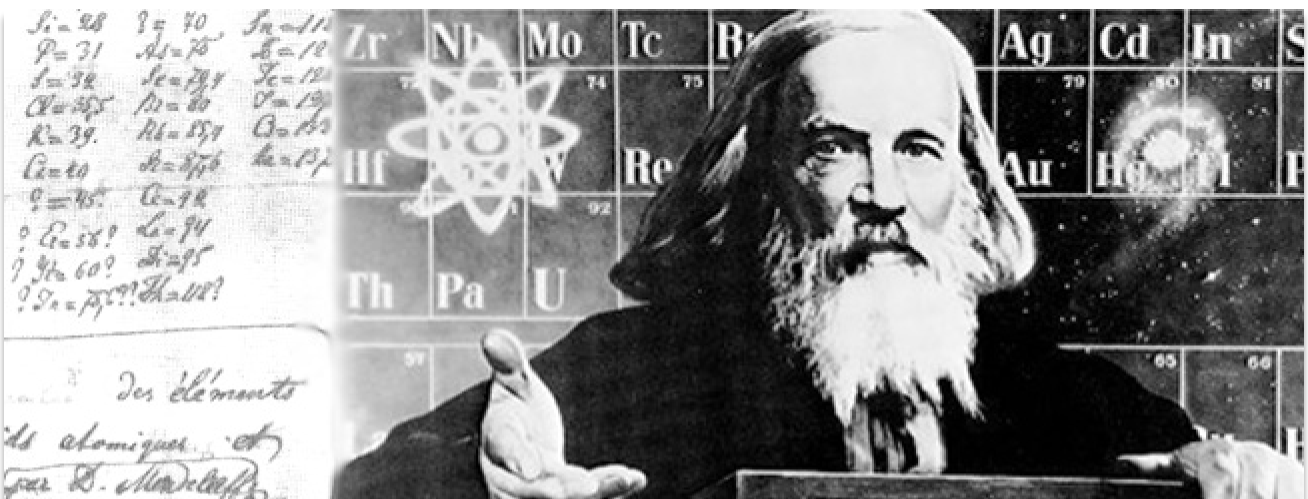
About
National Scientific Centre “Institute of Metrology”,
Kharkov, Ukraine,
for 25th meeting of CCU

National Scientific Centre
“Institute of Metrology”

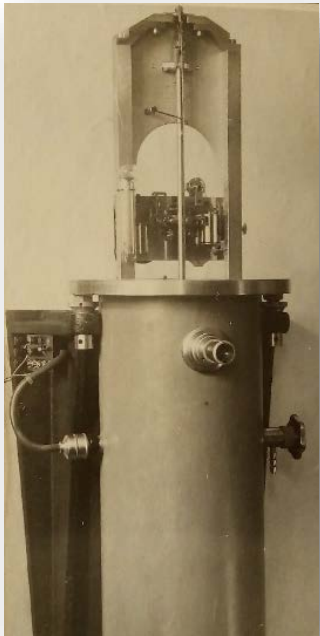
Prof. Pavel Neyezhmakov
General Director

National Scientific Centre “Institute of Metrology”
42 Myronosytska str., Kharkiv, 61002, Ukraine

The history of National Scientific Centre "Institute of Metrology" began on **8 October, 1901**, when at the initiative of an outstanding scientist Dmitry Ivanovich Mendeleyev the first Ukrainian verification chamber was established in Kharkiv with the functions of verification and stamping the trade weights and measures.



National Scientific Centre "Institute of Metrology"



Astronomical pendulum clock **AChF** with a daily variation of the stroke of **0.001 seconds**

1957

ASTRONOMICAL CLOCK AChF-1 WITH ISOCHRONOUS PENDULUM

F. M. Fedchenko

The astronomical pendulum clock AChF-1, developed by the author, differs from existing astronomical clocks(manufactured by the factory "Etalon" and the firm "Synchronome Ltd") in its simplicity of construction and high accuracy. The root-mean-square variation of its daily rate is less than 0.001 sec per day, i.e., it is much more accurate than existing first-class astronomical clocks.

AChF-1 works without a secondary clock; therefore, there is no need to synchronize the pendulums.

The accuracy of its rate is achieved by the use of a special three-spring isochronous pendulum suspension and a mechanism which delivers short mechanical or other impulses to the pendulum in its equilibrium position. Such a mechanism does not disturb the isochronism of the pendulum oscillation, which is attained by means of the suspension.

The principle of action of the isochronous suspension, and also that of the impulse mechanism with mechanical impulses, is described. Curves of the clock rate for November-December, 1955, and of variations due to gravity obtained by means of the astronomical clock, are given.

The AChF-1 clock can be used as a timekeeper and also as an instrument for observing variations of gravitational acceleration.

At the present time the astronomical pendulum clock whose use is most widespread is that of Shortt, manufactured by the English firm "Synchronome Ltd." A clock of similar construction in the Soviet Union is manufactured at the Leningrad factory "Etalon." The root-mean-square variation of the daily rate of the Shortt clock reaches ± 0.002 to 0.003 sec per day. Shortt's clock is complicated in construction. It consists of a primary and a secondary clock. The secondary clock exists solely to maintain the pendulum oscillation of the primary clock. The primary synchronizes the pendulum oscillations of the secondary clock. A small disturbance of pendulum synchronism leads to a deterioration of the clock rate, and sometimes to stopping the clock.

In the time laboratory of the Kharkov State Institute of Measures and Measuring Instruments (KhGIMIP), during 1954 and 1955, the author developed and built an astronomical pendulum clock of new design, the AChF-1, which differs from existing astronomical clocks in its simplicity and high accuracy. The root-mean-square variation of its daily rate is less than 0.001 sec by comparison with the KhGIMIP quartz clock, that is, it is much more accurate than existing first-class astronomical pendulum clocks. Accuracy is due to the following:

1. A high degree of pendulum isochronism through the use of an isochronous pendulum suspension.

2. Freer oscillation of the clock pendulum, attained through minimal coupling to the mechanism, and through the use of infrequent short impulses imparted to the pendulum at its equilibrium position.

3. Impulses of high constancy both in magnitude and in the phase at which they are imparted to the pendulum.

The AChF-1 functions without an auxiliary clock; hence there is no need for synchronization of the pendulums. A general view of the clock is shown in Fig. 1.

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In the time laboratory of the Kharkov State Institute of Measures and Measuring Instruments (KhGIMIP), during 1954 and 1955, the author developed and built an astronomical pendulum clock of new design, the AChF-1, which differs from existing astronomical clocks in its simplicity and high accuracy. The root-mean-square variation of its daily rate is less than 0.001 sec by comparison with the KhGIMIP quartz clock, that is, it is much more accurate than existing first-class astronomical pendulum clocks. Accuracy is due to the following:

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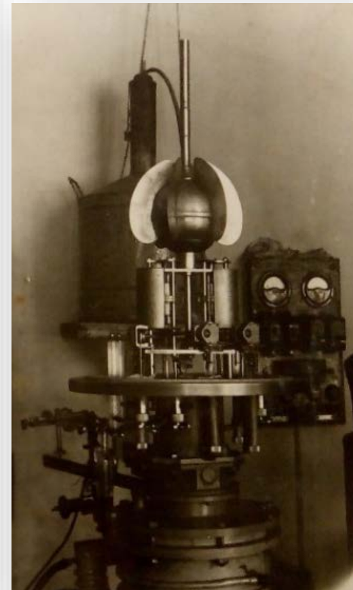

1970-1972

An experimental sample of **a molecular frequency standard** for reproducing the unit of time and frequency with an error **1×10^{-9}**

Work on the creation of a unified standard of time and length based on quantum generators in the **radio and optical range**.

COMITÉ INTERNATIONAL DES POIDS ET MESURES

PROCÈS-VERBAUX

DES SÉANCES

2e SÉRIE. — TOME 26-A

47e SESSION — 1958
(29 septembre-3 octobre)

ET

COMITÉ CONSULTATIF DE THERMOMÉTRIE
(5e Session - juin 1958)

PARIS
GAUTHIER-VILLARS, ÉDITEUR-IMPRIMEUR-LIBRAIRE
55, Quai des Grands-Augustins, 55
1959

ANNEXE T 18

Institut de Métrologie D. I. Mendéléev (U. R. S. S.)

NOUVELLE MÉTHODE
POUR L'ÉTALONNAGE DES PYROMÈTRES OPTIQUES.
NOUVEAU PYROMÈTRE OPTIQUE
DE PRÉCISION (1)

Par V. E. PHINKELSCHTEIN et V. V. KANDIBA

(Traduction)

On sait que l'étalonnage d'un pyromètre optique dans le domaine des hautes températures est effectué à l'aide d'un système de gradation qui permet de réaliser l'égalisation de la luminance d'un corps noir à la température T avec celle d'un corps noir à une température plus basse T_0 (2).

L'équation sur laquelle est basée l'extrapolation a la forme suivante

$$(1)\quad \int_0^\infty \lambda^{-5}\left(e^{\frac{c_2}{\lambda T}}-1\right)^{-1}\tau'_\lambda V_\lambda \tau_\lambda\, d\lambda = \int_0^\infty \lambda^{-5}\left(e^{\frac{c_2}{\lambda T_0}}-1\right)^{-1} V_\lambda \tau_\lambda\, d\lambda,$$

où τ'_λ, facteur de transmission du verre absorbant pour la lumière de longueur d'onde λ;
τ_λ, facteur de transmission du verre rouge du pyromètre;
V_λ, efficacité lumineuse relative de l'œil.

Comme systèmes de gradation on utilise ordinairement des verres absorbants, ce qui entraîne une diminution sensible de la précision dans la reproduction de l'échelle de température, car l'erreur de la mesure du facteur de transmission pour le verre absorbant est très grande.

(1) Trud. Inst. Metrol. D. I. Mendeleev, nº 36 (96), 1958, p. 16.
(2) Nous appellerons cette grandeur « température de luminance apparente ». Pratiquement, T_0 est toujours choisie inférieure à 2 000° K.

Institut de Métrologie D. I. Mendéléev (U. R. S. S.)

NOUVELLE MÉTHODE
POUR L'ÉTALONNAGE DES PYROMÈTRES OPTIQUES.
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Par V. E. PHINKELSCHTEIN et V. V. KANDIBA

Ph.D. V. Finkelshtein

Pyrometer EOP-51, which is kept in the museum of NSC "IM"

— T 149 —

l'œil de l'observateur. L'utilisation d'un tel diaphragme permet d'obtenir au cours des mesures la brillance la plus commode pour l'œil.

Le pyromètre est muni de quatre verres absorbants destinés à étendre le domaine de l'échelle. En outre, sa construction permet d'employer des secteurs tournants comme systèmes de gradation.

La combinaison des verres absorbants (pour les mesures des températures jusqu'à 3 000° C) est montée sur un support tournant situé entre l'objectif et la lampe pyrométrique.

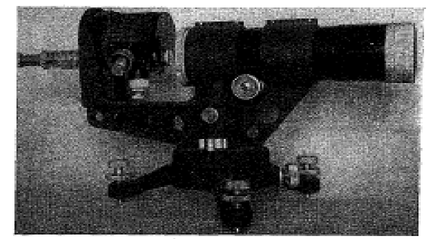

Fig. 3.

Le verre absorbant supplémentaire (п–6 000), destiné aux mesures dans l'intervalle 2 500-6 000° C, a un diamètre de 80 mm; il est placé devant le tube de l'objectif du pyromètre afin de diminuer son échauffement au cours des mesures aux hautes températures [5].

En introduisant simultanément les deux systèmes de verres absorbants — le verre п–6 000 et la combinaison de verres colorés, montés sur un support commun — on a la possibilité d'effectuer des mesures dans l'intervalle 2 000 à 6 000° C.

Les écarts moyens quadratiques du pyromètre ЭОП-51М sont donnés dans le tableau suivant.

Température.	Écart moyen quadratique.
1 400°C	0,1 %
2 000	0,2
6 000	1,0
10 000	1,5

(Avril 1958)

Les écarts moyens quadratiques du pyromètre ЭОП-51М sont donnés dans le tableau suivant.

Température.	Écart moyen quadratique.
1 400°C	0,1 %
2 000	0,2
6 000	1,0
10 000	1,5

(Avril 1958)

These studies have formed the basis for laser range measurements

REVIEWS OF MODERN PHYSICS

VOLUME 41, NUMBER 3 JULY 1969

Determination of e/h, Using Macroscopic Quantum Phase Coherence in Superconductors: Implications for Quantum Electrodynamics and the Fundamental Physical Constants

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The implications of the new determination of e/h using the ac Josephson effect in superconductors for both quantum electrodynamics (QED) and our knowledge of the fundamental physical constants are analyzed in detail. The implications for QED are investigated by first deriving a value of the fine structure constant α from experimental input data which do not require the use of QED theory for their analysis. These include the Josephson-effect value of e/h, the Faraday constant, the gyromagnetic ratio of the proton, the magnetic moment of the proton in units of the nuclear magneton, the ratio of the ampere as maintained by the United States National Bureau of Standards to the absolute ampere, and certain accurately known auxiliary constants. This is done by critically reevaluating all of the experimental data presently available on these quantities and applying the standard techniques of a least squares adjustment, including tests for imcompatibility. The value of α so obtained is then used to evaluate the theoretical expressions for the Lamb shift and fine structure splitting in hydrogen, deuterium, and ionized helium, the hyperfine splitting in hydrogen, muonium, and positronium, and the anomalous magnetic moment of the electron and muon. These theoretical values are compared with critically reexamined experimental values, thus providing a test of QED in which *a priori* information from QED itself is not essential. The consequences of the new measurement of e/h for our present knowledge of the fundamental physical constants are demonstrated by deriving new "best" values for the fundamental constants from a critically selected subset of all the available data. In addition to providing a consistent set of constants, this analysis focuses attention on areas in which there remain important questions which require clarification. The experimental and theoretical work necessary for the resolution of these questions is discussed, with emphasis on ways in which the study of quantum phase coherence effects in low temperature superfluid systems can make significant contributions.

CONTENTS

TABLE IV. Summary of some velocity-of-light measurements made since 1948 (MWI, microwave interferometer; IRRS, infrared rotational spectrum; FLRC, fixed-length resonant cavity; VLRC, variable-length resonant cavity). (Probable errors have been converted to standard deviations by multiplying by 1.48.) The errors quoted for the Kolibayev and Grosse geodimeter measurements are statistical only.

Year of publication	Author	Method	c (km/sec)
1967	Simkin, Lukin, Sikora, and Strelenskii	MWI	299 792.56±0.11
1967	Grosse	Geodimeter	299 792.5±0.05
1965	Kolibayev	Geodimeter	299 792.6±0.06
1950–1962	McNish (1962) summary of data of Bergstrand, USCGS, and others	Geodimeter	299 792.6±0.25
1958	Froome	MWI	299 792.50±0.10
1955	Florman[a]	RWI	299 795.1±1.5
1955	Plyler, Blaine, and Connor[b]	IRRS	299 792±6
1954	Froome [revised, Froome (1958)]	MWI	299 792.75±0.30
1952	Froome	MWI (first instrument)	299 792.6±0.7
1951	Aslakson[c]	Shoran	299 794.2±2.8
1950	Bol[d]	FLRC	299 789.3±1.0
1950	Essen[e]	VLRC	299 792.5±1.5
1949	Aslakson[c]	Shoran	299 792.4±3.6
1948	Essen and Gordon-Smith[f]	FLRC	299 792±4.5

[a] E. F. Florman, J. Res. Natl. Bur. Std. **54**, 335 (1955).
[b] E. K. Plyer, L. R. Blaine, and W. S. Connor, J. Opt. Soc. Am. **45**, 102 (1955).
[c] C. I. Aslakson, Trans. Am. Geophys. Union **32**, 813 (1951); **30**, 475 (1949); Nature **168**, 505 (1951); **164**, 711 (1949).
[d] K. Bol, Phys. Rev. **80**, 298 (1950).
[e] L. Essen, Proc. Roy. Soc. (London) **A204**, 260 (1950).
[f] L. Essen and A. C. Gordon-Smith, Proc. Roy. Soc. (London) **A194**, 348 (1948).

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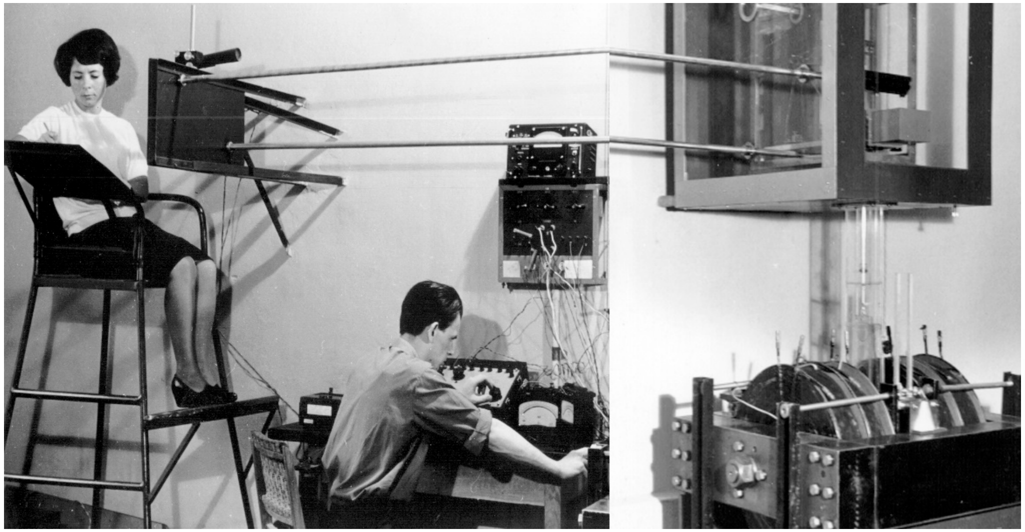

The 1973 Least-Squares Adjustment of the Fundamental Constants*

The 1973 Least-Squares Adjustment of the Fundamental Constants*

E. Richard Cohen

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and

B. N. Taylor

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This paper is a summary of the 1973 least-squares adjustment of the fundamental physical constants carried out by the authors under the auspices of the CODATA Task Group on Fundamental Constants. The salient features of both the input data used and its detailed analysis by least-squares are given. Also included is the resulting set of best values of the constants which is to be recommended for international adoption by CODATA, a comparison of several of these values with those resulting from recent past adjustments, and a discussion of current problem areas in the fundamental constants field requiring additional research.

Key words: Data analysis; fundamental constants; least-squares adjustments; quantum electrodynamics.

Contents

TABLE 14.1. Summary of γ_p' determinations

Publication date, laboratory[a], and author	γ_p'	γ_p'	γ_p'	Uncertainty (ppm)	Eq. No.
Low Field					
	$10^8\ s^{-1}\cdot T^{-1}_{LAB}$	$10^8\ s^{-1}\cdot T^{-1}_{BIPM}$	$10^8\ s^{-1}\cdot T^{-1}_{BI69}$		
1968, ETL Hara et al.[b]	2.6751384(107)	2.6751449(107)	2.6751156(107)	4.0	(14.1)
1972, NBS Olsen and Driscoll[c]	2.6751344(54)		2.6751370(54)	2.0	(14.2)
1965, NPL Vigoureux[d]	2.6751707(107)	2.651480(107)	2.6751187(107)	4.0	(14.3)
1971, VNIIM Malyarevskaya, Studentsov, and Shifrin[e]	See text.		2.6751100(161)	6.0	(14.4)
High Field					
	$10^8\ A_{LAB}\cdot s\cdot kg^{-1}$	$10^8\ A_{BIPM}\cdot s\cdot kg^{-1}$	$10^8\ A_{NBS}\cdot s\cdot kg^{-1}$		
1966, KhGNIIM Yagola, Zingerman, and Sepetyi[f]	2.675079(20)[h]	2.675101(20)	2.675130(20)	7.4	(14.5)
1971, NPL Kibble and Hunt[g]	2.675075(43)		2.675075(43)	16	(14.6)

[a] ETL = Electrotechnical Laboratory, Japan; KhGNIIM = Kharkov State Scientific Research Institute of Metrology, U.S.S.R.

[b] Refs. [0.1, 14.2]. [c] Ref. [14.3]. [d] Refs. [0.1, 14.4]. [e] Refs. [14.5, 14.6]. [f] Refs. [0.1, 14.7, 14.8].
[g] Refs. [14.9, 14.10]. [h] This result is in terms of A_{BIM}, the ampere as maintained at VNIIM.

Today. National Scientific Centre “Institute of Metrology”

National Scientific Centre “Institute of Metrology”

Metrology for society

Promoting the protection of the consumer rights, ensuring the high quality of life

- Development of measurement methods and instruments necessary for all spheres of human living and household activities
- Health and life protection
- Control of the environment and safety of working conditions
- Protection of consumers during trade operations and transactions
- Reliable measurements in the sphere of public utilities (electricity, gas and water supply)

Metrology for economy

Increasing the efficiency of economy, innovation, employment security

- Metrological certification, calibration and verification of measuring instuments
- Metrological review of technical documentation
- Development and certification of measurement techniques
- Development of the national measurement standards, including those harmonised with the international ones
- Certification of calibration laboratories

International relations

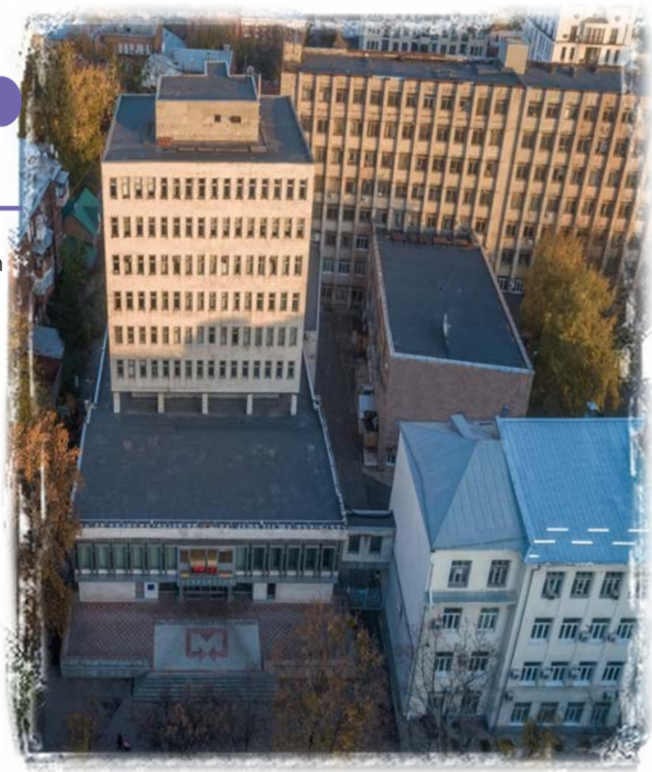
Elimination of technical barriers in trade, unification of measurement system

- Cooperation with other National Metrology Institutes
- Harmonisation of normative documents and elimination of non-tariff barriers in trade
- Participation in international metrological organisations
- Promoting the international unification of metrology

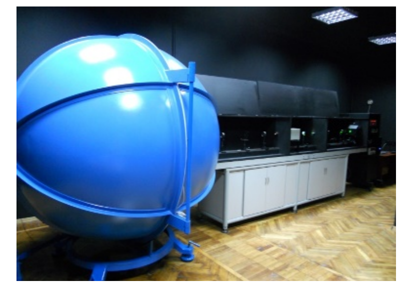
Fundamentals of metrology

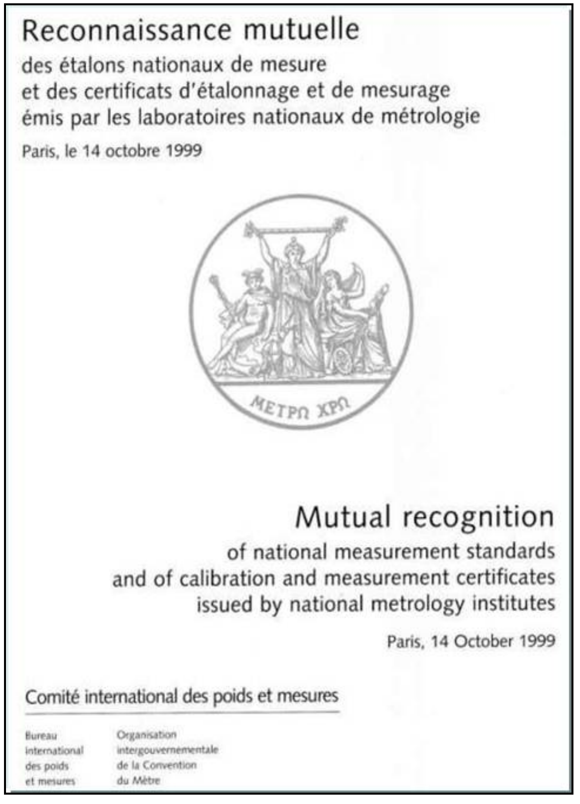
Developments related to reproduction, maintenance and transfer of SI units

- Fundamental and applied scientific research
- Creation of scientific and technical base for metrological system that meets up-to-date requirements
- Scientific and methodological support of metrological activity
- Certification training of metrologists



The National Measurement Standards of Ukraine




Reconnaissance mutuelle
des étalons nationaux de mesure
et des certificats d'étalonnage et de mesurage
émis par les laboratoires nationaux de métrologie
Paris, le 14 octobre 1999

Mutual recognition
of national measurement standards
and of calibration and measurement certificates
issued by national metrology institutes
Paris, 14 October 1999

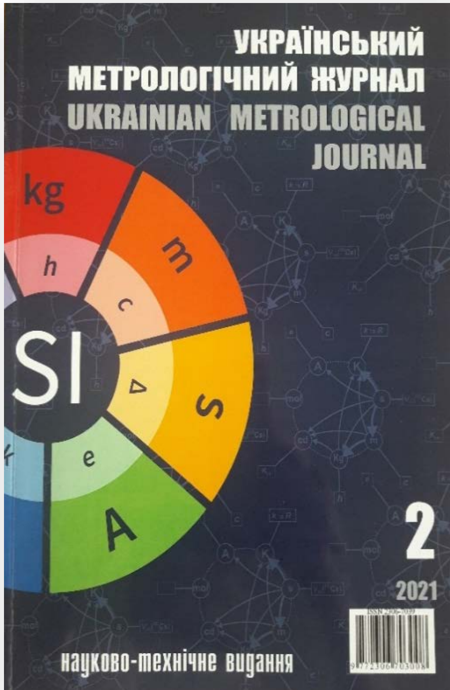
Comité international des poids et mesures

Bureau international des poids et mesures
Organisation intergouvernementale de la Convention du Mètre

Ukraine participates in the Arrangement since 2003

		Total	AUV	EM	L	M	PR	QM	RI	T	TF
NSC "Institute of Metrology”	KC	**17**	-	1	2	4	4	-	-	5	1
	SC	**44**	-	2	21	10	4	-	6	1	-
	CMC	**180**	-	19	28	7	8	-	15	73	30

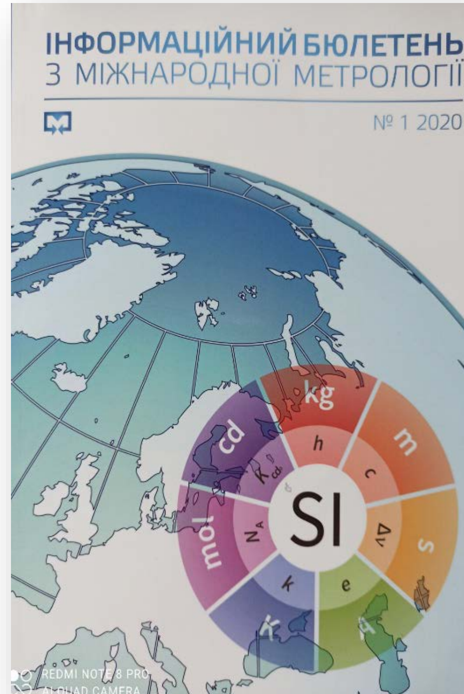
Publishing activity



Since 1995, NSC “Institute of Metrology” has been publishing **“Ukrainian Metrological Journal“ (UMJ)** specialized in scientific and technical edition.

UMJ web-site address:
www.umj.metrology.kharkov.ua

“Ukrainian Metrological Journal” is indexed by an international bibliometric and scientometric database of **Google Scholar**.



Since 2014, NSC “Institute of Metrology” has been publishing the **“Information Bulletin on International Metrology”**, which is published twice a year.

The edition has an identifier for a digital object (**DOI: 10.24027 / 2306-7039**).
In July 2019 UMJ was included in the leading scientometric, abstract, international citation database in the world **Web of Science** Core Collection (Web of Science until 2014).

The Bulletin acquaints readers with the activities of international and regional organizations on metrology and their documents, as well as with the metrological infrastructure of different countries of the world.

Since 1996 NSC “Institute of Metrology” performs biennially **International Scientific & Technical Conference “METROLOGY AND MEASUREMENT TECHNIQUES”**.

In 2020 there was held XII Conference.

The purpose of the conference is to promote the development of metrology and to implement its achievements in researches, practice and study.

138 reports were submitted from **10** countries: the Republic of Belarus, the Czech Republic, Estonia, Lithuania, Italy, the Russian Federation, the Republic of Poland, the Republic of Azerbaijan, the Republic of Uzbekistan and Ukraine.

The conference included 8 thematic sections and a seminar "Measurement Uncertainty: Scientific, Applied, Regulatory and Methodological Aspects".

BYM Competition 2021

COOMET

Ninth International Competition: “The Best Young Metrologist of COOMET 2021”

21–22 April 2021 (online)

Prof. Pavel Neyezhmakov, COOMET Vice-President
Mrs. Yuliya Bunyayeva, National COOMET Secretariat in Ukraine

The Ninth International Competition “The Best Young Metrologist of COOMET” was held online from 21–22 April 2021.

The history of the competition dates back to 2005, and is open to specialists up to and including the age of 35 who work in the field of scientific and applied metrology at NMIs or other metrology institutions of COOMET Member Countries, independently of their academic degree and position.

National Scientific Centre "Institute of Metrology"

In 2021 representatives of NSC "Institute of Metrology" took part in:

CIMP workshop "The International System of Units (SI) in FAIR digital data"
22–26 February 2021

International Scientific and Practical Conference "Sensor and Measurement Science International" (SMSI 2021)
3–6 May 2021

13th International Conference "Measurement 2021"
17–19 May 2021

14th International Conference on New Developments and Applications in Optical Radiometry (NEWRAD 2021)
21–24 June 2021

IMEKO XXIII World congress (IMEKO2021)
30 August – 3 September 2021

Participation in CCs meeting:

24th meeting of the CCPR, *19 to 20 September 2019*
29th meeting of the CCT, *October 2020 to February 2021*
22nd meeting of the CCTF, *October 2020 to March 2021*
18th meeting of the CCM, *20 to 21 May 2021*
28th meeting of the CCRI, *8 to 10 June 2021*

Thank you for your attention!

Prof. Pavel Neyezhmakov

National Scientific Centre
“Institute of Metrology”