



Физика и Метрология II

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International Seminar
*Mathematics, statistics and computation
to support measurement quality*

30.06.2009-02.07.2009, Sankt Petersburg, Russia



**Critical notes on some ISO GUM clauses that provoke
appearance of corrupted measured data in
scientific literature.**

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Highlights of Presentations

1. Metrology in Fundamental Sciences is URGENT!

Motivated by releases of ISO-GUM-2008, FPC-2006/2008, and papers:

С.Г. Каршенбойм, ЭЧАЯ 5 (2008) 522, (in russian) on the FPC-2002, and

С.Г. Каршенбойм, УФН 178 (2008) 1057, (in russian) on the FPC-2006.

2. Standardized Numerical Peer Review is URGENT in traditional and e-publishing:

- in authoritative scientific journals;
- in authoritative scientific data resources.

Stand
report

3. Suggestions how to improve situation with generation, preservation, and transfer of scientific measured data:

- Multimeasurand GUM is urgent;
- “New” form of e-publication → Traditional text + “Computational Object of Knowledge” + Standardized Numerical Peer Review.

Stand
report

**There are at least four tightly intertwined areas of intellectual activities that appeared and surviving due to measurements and handling measured data:
Science, Education, Metrology, and Industry**

To coordinate the uniformity of measurements and measured data quality there exists the planetary intergovernmental metrological system governed by the following international organizations

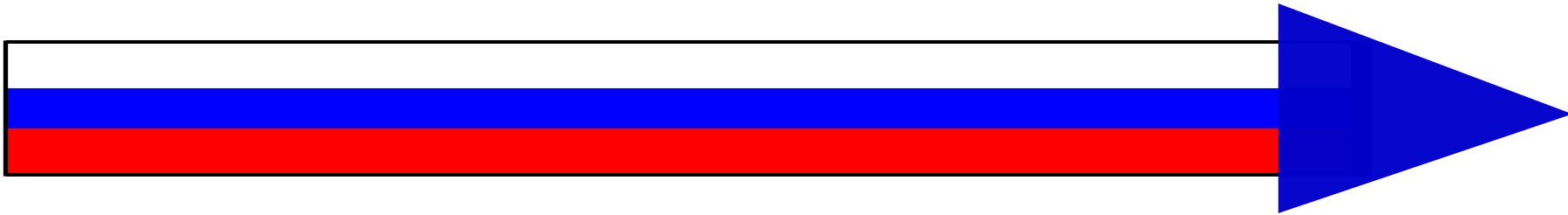
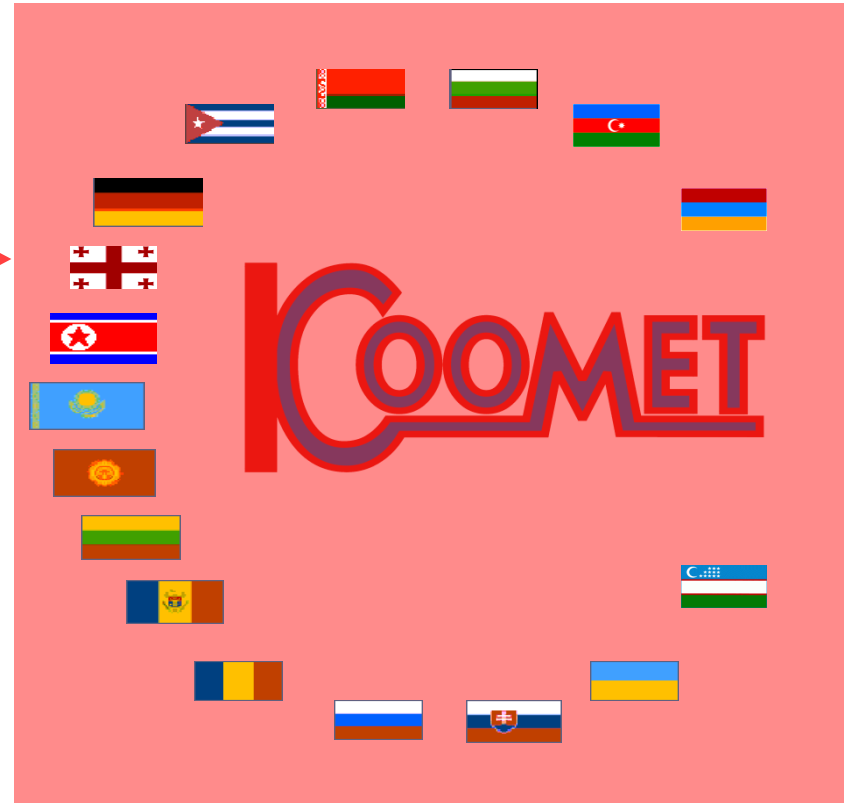


Regional Metrological Systems

National Metrological Systems

*Regional
Metrology organizations*

From: "Metrology - in short"
3-rd edition, 2008 by
P. Howarth and F. Redgrave



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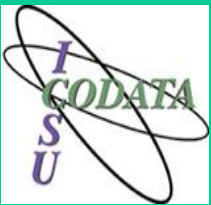
Ministry of Industry & Energy



Federal Agency of Technical Regulation & Metrology



19 Federal Metrology Institutions (VNIIM, ■ ■ ■)



COmmittee on
DATA for Science
and
Technology

The mission of CODATA is to strengthen international science for the benefit of society by promoting improved scientific and technical data management and use.

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RAS

Council on Metrological
Support and Standardization

Russian National CODATA
Committee



RWG on FPC

RWG on EM



HOWEVER

In spite of the mutual developments in Science, Metrology, Industry, and Education we still have a stable worldwide tendency of incorrect measured data presentation in scientific and technical reports, showing that the current practice of knowledge generation, transfer, and preservation is obsolete and wasteful.



In our presentations we give a number of evidences of such bad practice in physics journals of high impact factors and in products of the ISO and in products of authoritative physics data centers: FCDC_, AMDC_, NNDC_, PDG_.

[1.] **Guide for the Presentation in the Primary Literature of Numerical Data Derived from Experiments (CODATA Guide).**

CODATA Bulletin No.9, Dec.1973

[2.] **Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)**

[BIPM](#), [IEC](#), [IFCC](#), [ISO](#), [IUPAC](#), [IUPAP](#), and [OIML](#) ISO/IEC Guide 98-3:2008

[3.] **U.S. Guide to the Expression of Uncertainty in Measurement (US GUM)**

ANSI/NCSL Z540.2-1997 (R2002)

[4.] **Measurement uncertainty revisited: Alternative approaches to uncertainty evaluation**, EuroLab, Technical Report No. 1/2007, March 2007

[2.1.] **Руководство по выражению неопределенности измерения (ВНИИМ GUM)**. Перевод ISO GUM (ВНИИМ-1999)

[2.2.] **Применение “Руководства по выражению неопределенности измерения”**, РМГ 43 2001, Минск 2003

ГОСТ Р ИСО 5725: 1-6, 2002

[ISO 5725:1-6,1994/Cor 1:2001](#)

Joint Committee for Guides on Metrology (JCGM)

Working Group on the GUM

JCGM Future Products

<u>ISO/IEC FDGuide 98-1</u> Uncertainty of measurement — Part 1: Introduction to the expression of uncertainty in measurement	<u>50.60</u>
<u>ISO/IEC NP Guide 98-2</u> Uncertainty of measurement — Part 2: Concepts and basic principles	<u>10.99</u>
<u>ISO/IEC NP Guide 98-3</u> Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (revised GUM:1995) [GUM:95 withdrawn: Stage: <u>95.99</u> (2008-09-30)]	<u>60.60</u>
<u>ISO/IEC Guide 98-3/Suppl 1</u> ✖ Propagation of distributions using a Monte Carlo method	<u>60.60</u>
<u>ISO/IEC Guide 98-3/NP Suppl 2</u> ✖ Models with any number of output quantities	<u>10.99</u>
<u>ISO/IEC Guide 98-3/NP Suppl 3</u> Modelling	<u>10.99</u>
<u>ISO/IEC NP Guide 98-4</u> Uncertainty of measurement — Part 4: Role of measurement uncertainty in conformity assessment	<u>10.99</u>
<u>ISO/IEC NP Guide 98-5</u> Uncertainty of measurement — Part 5: ✖ Applications of the least-squares method	<u>10.99</u>

CONCLUSION on the GUM-2008

- ✘ The GUM-2008 should be corrected in places where the rounding rules for correlated data are discussed and used (**Clause 7.2.6, Example H.2**) ;
- ✘ The GUM formula for the nonlinear uncertainty propagation should be corrected to assure the positivity of combined variance (**Clause 5.1.2, Note**);
- ✘ In case of differential nonlinear uncertainty propagation the higher order sensitivities and higher order moments of the input probability distribution should be calculated and explicitly given with proper precision. This recommendation and our rule to find the order T of the Taylor polynomials to assure the positive definiteness of the correlation matrix for D -dimensional vector function depending upon I -random variables should be added to the extended **Clauses 7.2.5 or 7.2.7**.
- ✘ Statement on the obligatory quotation of the rounding thresholds for the positive definite correlation matrix, for the mean values, and their uncertainties should be included into the **Clause 7.2.5**;
- ✘ CAUTION: the rounding thresholds for the uniform rounding of correlated data impose severe requirements on the storage and exchange formats of the correlated data. This caution in proper wording should be added to the corrected **Clause 7.2.6**

WARNINGS derived from the tests of FPC-2006 data quality

1. Input data used in 2006 adjustments of the FPC are not reported on the NIST site. Input data presented in tables in publication *Rev. Mod. Phys. 80 (2008) 633* .
2. In publication the precision of the input correlation coefficients in data used to estimate the value of the Rydberg constant are enlarged to four digits after the decimal point. However the whole input correlation matrix (as it is presented in the TABLE XXIX on the page 692) is not the positive definite matrix. It has two negative non-negligible eigenvalues.
3. Correlation sub matrix of the adjusted FPC-2006 presented in TABLE L on the page 715 also is not the positive definite matrix. For some samples of the constants selected from the NIST site their correlation matrices turned to be not the positive definite matrices. To be specific:
 - (Planck constant, Elementary electric charge, Electron mass, Inverse fine structure constant);
 - (Proton mass in MeV, Neutron mass in MeV, Atomic mass constant in MeV).
4. Thus, data on FPC-2006 **could not be used for estimation of quantities expressed in terms of more than two adjusted constants** until the appearance of the numerical data associated with the 2006 least-squares adjustment of the values of the constants with enough significant figures to be useful in calculations of the derived constants and in other applied calculations.

CONCLUSION on the FPC-2006

Selective tests of the consecutive releases of the FPC-1986, FPC-1998, FPC-2002, and FPC-2006 shows that the technology to adjust FPC used in FCDC is questionable. The independent adjustments, but based on the same input data sample, are urgently needed.

It will be much helpful if Russian FPC Working Group could organize and conduct regularly the independent adjustments of the FPC and compare results with that of produced in FCDC(NIST).

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Summary & Plea to Russian CODATA Committee

The problems with numerical expression and presentation of correlated multidimensional data in publications and in computer readable files are common in the whole scientific community.

These problems are originated in the absence of the widely accepted standard to express numerically the multidimensional correlated data and the absence of the numerical peer review in traditional and electronic publishing.

NUMERICAL PEER REVIEW is impossible without uniformity in multidimensional data expression and exchange in computer readable and “computer understandable” forms.

STANDARDS for multidimensional measured data expression and publication in electronic media are urgently needed

As metrologists move too slow, we apply to **Russian CODATA Committee** to organize workout a draft of the standard and officially transfer it to Russian authoritative metrology organizations for expertise and implementation in Russian metrology system.

**РОССИЙСКАЯ АКАДЕМИЯ НАУК
ПРЕЗИДИУМ
ПОСТАНОВЛЕНИЕ**

**“Об утверждении Положения о Научном совете РАН по метрологическому обеспечению
и стандартизации и состава Совета
(представление председателя Совета)”**

Президиум Российской академии наук **ПОСТАНОВЛЯЕТ:**

В соответствии со статьей 29 Устава Российской академии наук утвердить Положение о Научном совете РАН по метрологическому обеспечению и стандартизации (приложение 1) и состав Совета (приложение 2).

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