

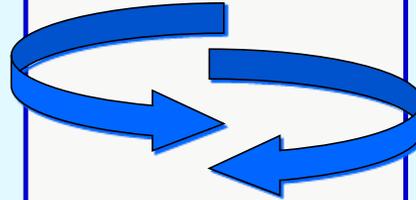


APEC Regional Workshop on Measurement Challenges in Renewable Energy and Climate Science



Capability Development to meet Measurement Challenges

**D.I. Mendeleev
Institute for
Metrology
(VNIIM)**



**National Research
University of Information
Technologies, Mechanics
and Optics
(ITMO University)**

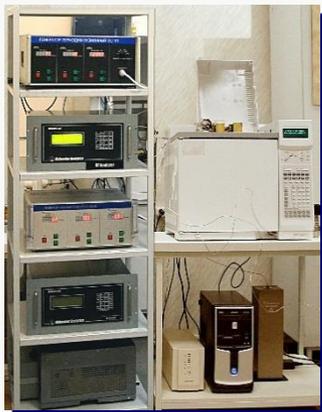
**Measurement Standards & Technologies
Research & Development
Training & Education**

October 29, 2015. Beijing, China



Measurement standards and technologies

National primary measurement standard of mole fraction and mass concentration of components in gas media GET-154-01



National primary measurement standard of mole fraction and mass concentration of components in gas media GET-154-01

Complexes of analytical and gas-mixing apparatus

$$\begin{array}{ll}
 (2,0 \cdot 10^8 - 99,999995)\% & (8,0 \cdot 10^3 - 1,5 \cdot 10^3) \text{ M/M}^3 \\
 u_{\text{Bo}} = (2,3 - 1,6 \cdot 10^6)\% & \Theta_0 = (5,6 - 4,0 \cdot 10^6)\% & u_{\text{Bo}} = (0,91 - 0,37)\% & \Theta_0 = (2,2 - 0,9)\% \\
 u_{\text{Ao}} = (2,4 - 3,0 \cdot 10^7)\% & \zeta_0 = (2,4 - 3,0 \cdot 10^7)\% & u_{\text{Ao}} = (0,85 - 0,35)\% & \zeta_0 = (0,85 - 0,35)\%
 \end{array}$$

Comparison standards

Pure gases, gas mixtures in cylinders
under pressure

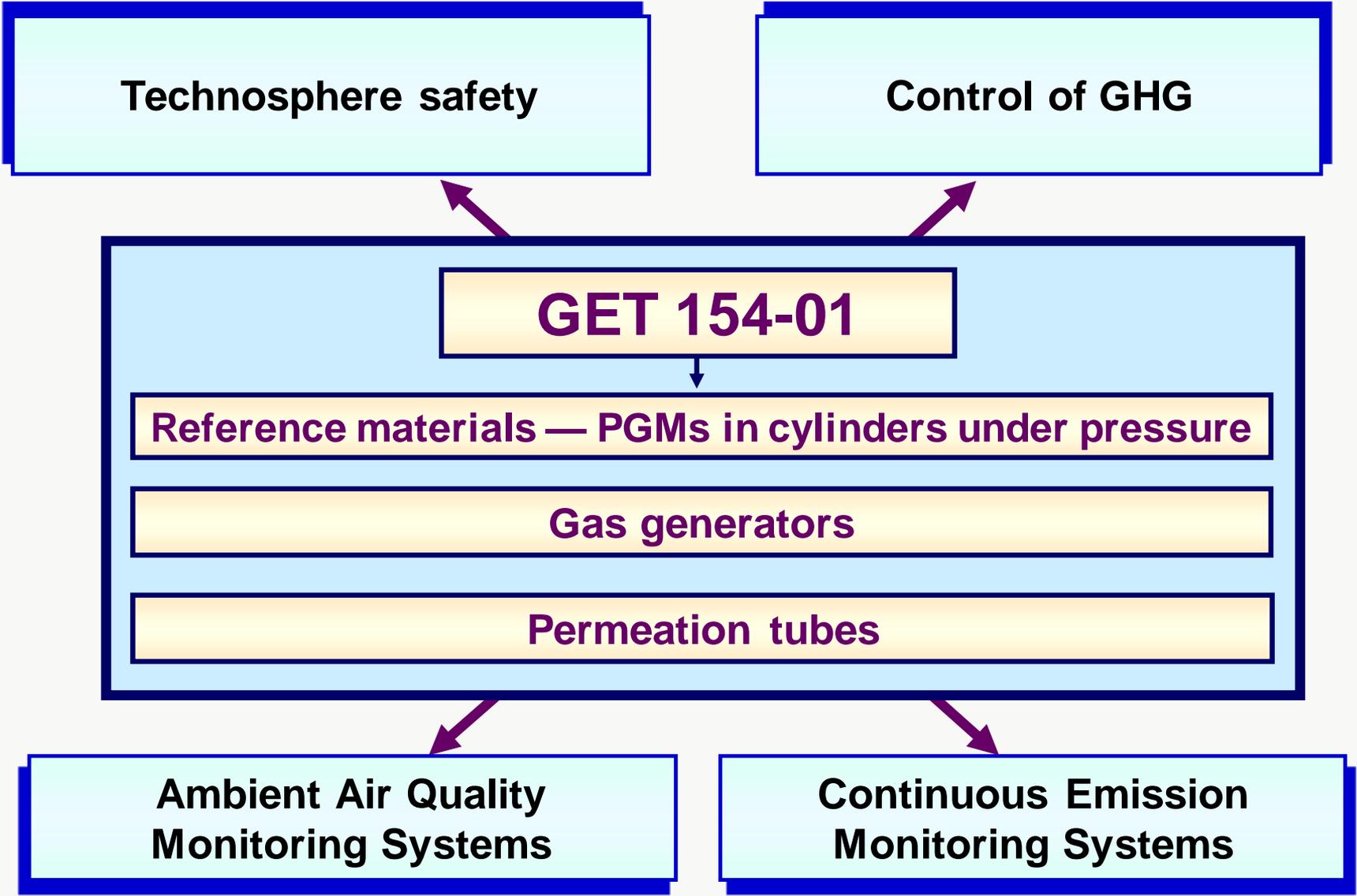


Comparison standards

Permeation tubes of gases
and vapours



Measurement standards and technologies





Measurement standards and technologies

State Primary Special Measurement Standard of mass concentration of particles in aerodispersed media GET 164-2003



High-precision radioisotope mass concentration meter

Radioisotope and gravimetric system for measuring the aerosol mass concentration in the range of $(0.1 - 1000) \text{ mg/m}^3$, consisting of a high precision beta-ray mass concentration meter and a mass comparator-balance.

System for generation of aerodispersed media with particles size in the range of $(0.5 - 1000) \mu\text{m}$, which consists of aerosol chambers (static and dynamic); optical microscope; multiple-purpose meter of disperse parameters of aerosols, suspensions and powdered materials for test aerosol media generation; flow meter; aerodynamic tunnel.

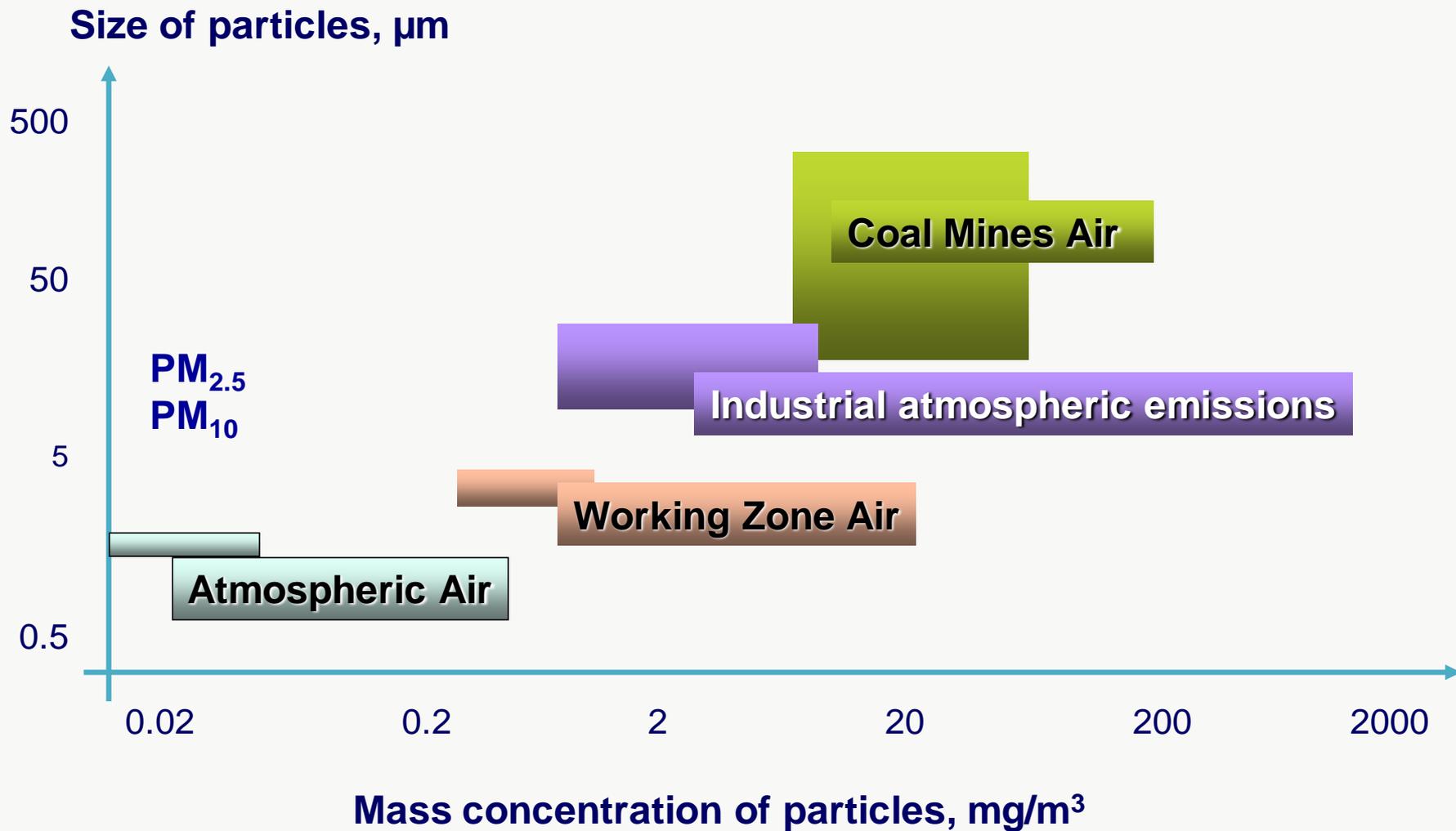


Aerosol chambers



Measurement standards and technologies

Generalized characteristics of the most common modern problems in the field of measurement the mass concentration of particles in the scope of the state regulation



Measurement standards and technologies
National primary measurement standard of unit of electrical conductivity of liquids GET-132-99



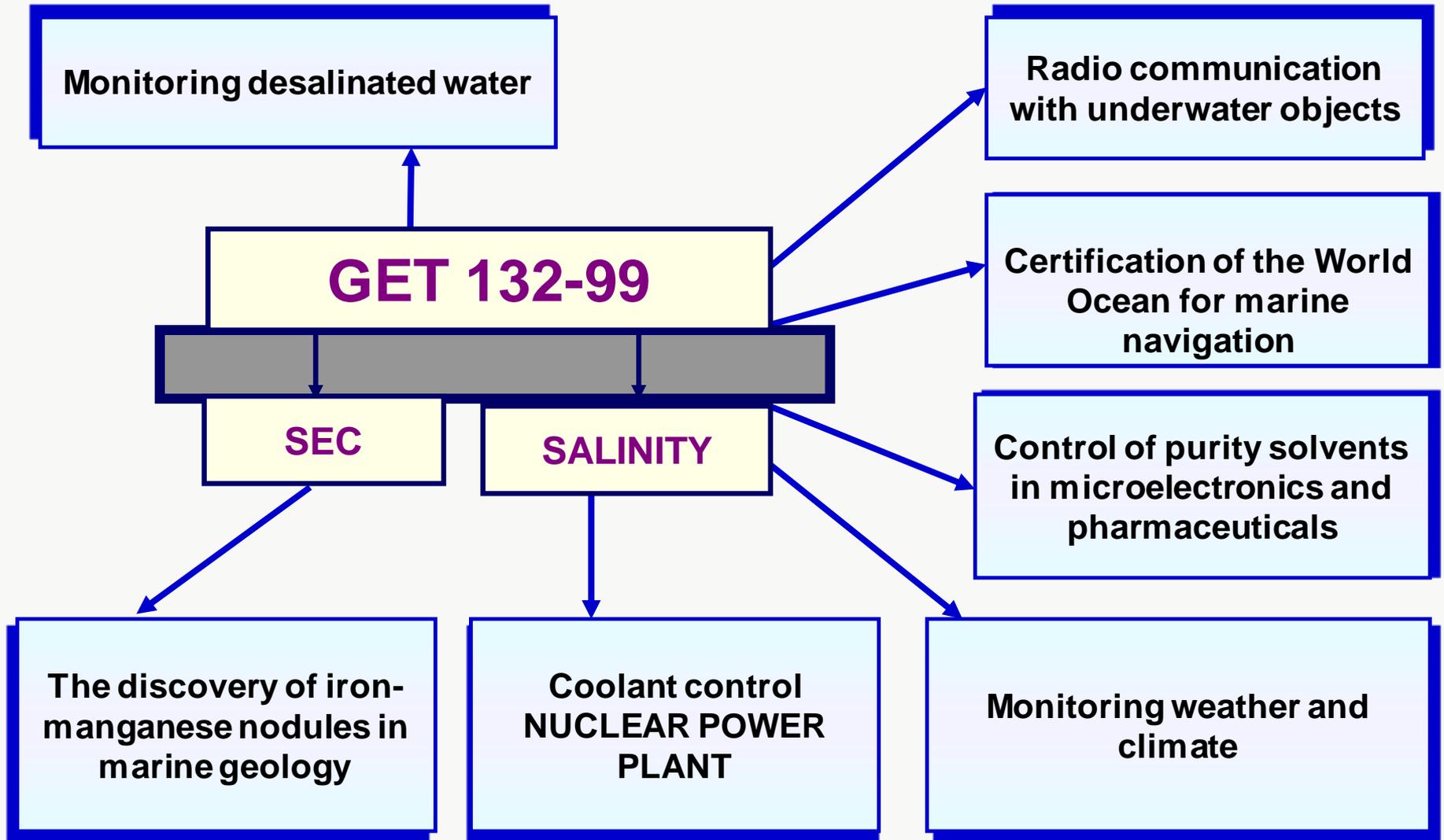
The standard provides reproduction of MSD not exceeding $1 \cdot 10^{-4}$ in 5 independent observations

Non-excluded systematic error not exceeding $2 \cdot 10^{-4}$ in the range from 0,1 to 10 S/m,
..... from $2 \cdot 10^{-4}$ to $5 \cdot 10^{-4}$ in the range from 0,1 to 0,0001 S/m,
..... from $2 \cdot 10^{-4}$ to $5 \cdot 10^{-4}$ in the range from 10 to 50 S/m.



Measurement standards and technologies

National primary measurement standard of unit of electrical conductivity of liquids GET-132-99





Measurement standards and technologies

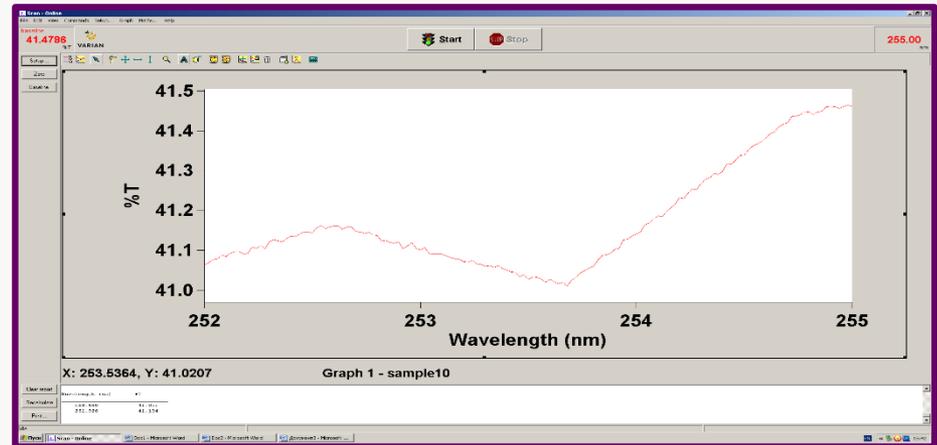
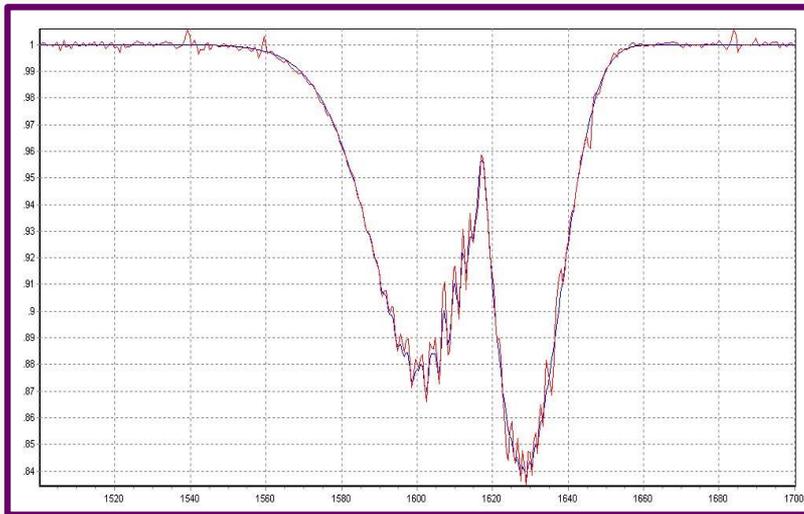
List of Key Comparisons in the field of environment and climate change

1	CCQM-K52	Carbon dioxide in the air at the atmospheric level (360 ppm)	2006
2	BIPM.QM-K1	Ozone at the atmospheric level	2007
3	CCQM-K68	N ₂ O at the atmospheric level (320 ppb)	2009
4	CCQM-K84	Carbon oxide in the air (350 ppb)	2011
5	CCQM-K82	Methane in the air at the atmospheric level (2 ppm)	2012
6	CCQM-P111	Determination of practical salinity and mass fraction of major components (Na ⁺ , Mg ²⁺ , Sr ²⁺ , Cl ⁻ , SO ₄ ²⁻) sea water	2008
7	CCQM-P142	The ratio of the electrolytic conductivity of sea water and a standard solution KCl	2012
8	BIPM.QM-K1	Ozone at the atmospheric level (80 and 420 ppb)	2014
9	CCQM-PXXX	Suspended particles at the atmospheric level	2016



Measurement standards and technologies

Analysis and obtaining spectra of atmospheric gases for calibration of gas analyzers



- analysis of existing spectroscopic databases (GEISA, HITRAN), spectral atlases (The MPI-Mainz UV/VIS Spectral Atlas), and other materials;
- analysis of performance attributes and metrological characteristics of modern UV spectrophotometers;
- analysis of algorithms of spectra handling and the choose of optimal algorithm to develop a procedure to control mole fraction of components in gas media;
- acquisition of high accuracy cross-sections in UV based on own experimental investigations;
- specification of PRGM and working standards certified with the use of UV spectrophotometers.



Data Transfer in the Field of Climate Change Control

VNIIM



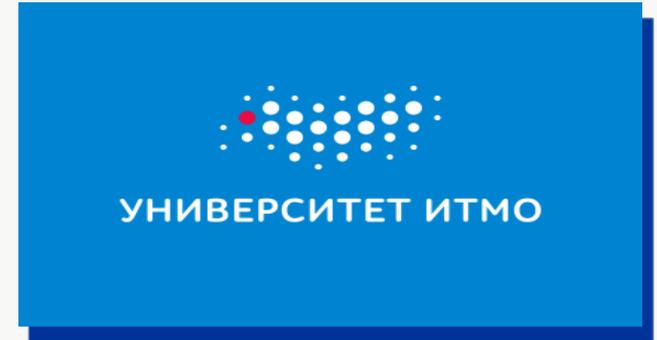
Scientific and
methodological
center for climate
control
The Voeikov
Geophysical
Observatory

The monitoring network of ambient air quality
Moscow, St.Petersburg, Ekaterinburg, Ufa, Sochi etc.



ITMO University

**Research & Development
Training and education**



- *Photonics and Optical Physics*
- *Development of Solar Cells*
- *Computer Technologies*
- *Environmental Control*



Training and education

ITMO University

УНИВЕРСИТЕТ ИТМО

FIGURES AT A GLANCE

13 000
student body

3 500
graduate students

800
post-graduate
students

1 200
lecturers,
professors

1 200
foreign students
from
26
countries

43
international
research centers

6
major research
fields

\$120
million
university total
budget for 2014

\$50
million
university R&D
budget for 2014

9th place among Russian Universities
(ranking of Webometrics 2015)

REPUTATION

In 2004, 2008, 2009, 2012, 2013 and 2015 ITMO University team became Absolute Word Champions at ACM World Programming Contest. Up to now, the team of ITMO University is the only six-time winner of the world championship.

Out of thousands of participants only 25 world's best programmers have qualified for the final. Among them are 5 students and graduates of the ITMO's chair of computer technologies.

August 15, 2014 – ITMO students win 1st and 2nd prizes at the Google Code Jam in Los Angeles, California.

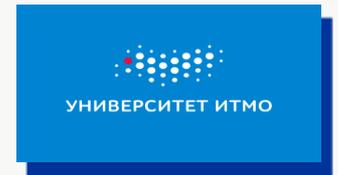
August 1, 2014 – ITMO student wins 1st prize in annual international programming championship, Yandex.Algorithm, Berlin, Germany.





Training and education

ITMO University



13

Chair of Ecology and Technical Sphere Protection (parented by VNIIM)

- Environment
- The instruments and methods of control of environment
- The standards and measurement technologies for the environment
- Metrology for life and sustainable development

