Industry

Nieves Medina, TC-M Chair
CEM, Spain

EMRP

- Two calls:

  - 2010 : 17 PROJECTS IN PROGRESS

  - 2012: 13 PROJECTS IN NEGOCIATION

ELECTROMAGNETISM

IND02-EMINDA

Electromagnetic Characterization of Materials for Industrial Applications up to Microwave Frequencies

IND08-MetMags

Metrology for Advanced Industrial Magnetics

IND16-Ultrafast

Metrology for ultrafast electronics and high-speed communications

DIMENSIONAL

IND05-MeProVisc

Dynamic Mechanical Properties and Long-term Deformation Behaviour of Viscous Materials

IND07-Thin Films

Metrology for the manufacturing of thin films

IND10-Form metrology

Optical and tactile metrology for absolute form characterization

DIMENSIONAL

IND11-MADES

Metrology to Assess the Durability and Function of Engineered Surfaces

IND17-Scatterometry

Metrology of small structures for the manufacturing of electronic and optical devices

TEMPERATURE

IND01-HiTeMS

High temperature metrology for industrial applications (>1000 ºC)

DIMENSIONAL AND TEMPERATURE

IND13-T3D

Thermal design and time-dependent dimensional drift behaviour of sensors, materials and structures

IONIZING RADIATION

IND04-MetroMetal

Ionizing Radiation Metrology for Metallurgical Industry

RADIOMETRY

IND06-MIQC

Metrology for Industrial Quantum Communications

PRESSURE

IND03-HighPRES

High pressure metrology for industrial applications

IND12-Vacuum

Vacuum metrology for production environments

TIME AND FREQUENCY

IND14-Frequency

New generation of frequency standards for industry

PRESSURE, FORCE, TORQUE, ELECTRICITY, MATHEMATICS

IND09-Dynamic

Traceable Dynamic Measurement of Mechanical Quantities

CHEMISTRY

IND15-SurfChem

Traceable quantitative surface chemical analysis for industrial applications

Contribution of the TC Time and Frequency to the topic

INDUSTRY

Andreas Bauch

PTB, Time and Frequency Department

IND14 ‘New generation frequency standards for industry’

JRP Coordinator: Patrick Gill, NPL (patrick.gill@npl.co.uk)

13 Partners

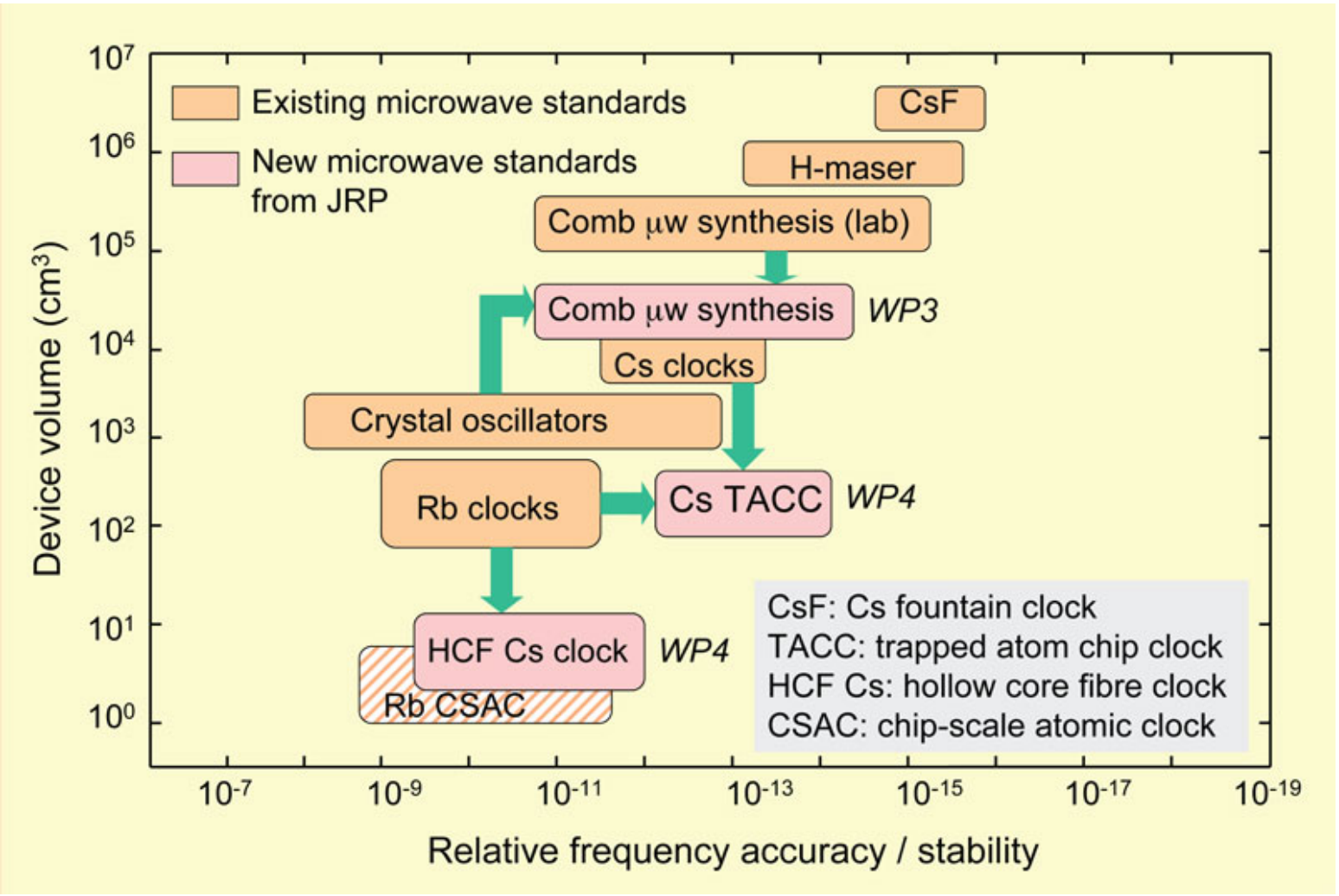
- Apply emerging alternative technologies to transform NMI-based frequency standards into compact, robust and turn-key standards for industrial applications

The availability of references for frequency, time interval and time-of-day (epoch) is a general requirement in many industrial, technical, and scientific applications.

Important industrial sectors are

- Electronics instrumentation production
- Telecommunications (equipment and network provider)
- Power generation and distribution

The applications require locally available frequency standards and dissemination / reception of timing signals via radio-signals and via the Internet.



Trend 1

Miniaturization at a certain level of accuracy.

Trend 2

Improving accuracy or instability at a certain level of size.

One contribution of the TC Length to the topic

INDUSTRY

Antti Lassila

MIKES, Length Department

IND 10- Form metrology

Optical and tactile metrology for absolute form characterization, **Michael Schulz, PTB**

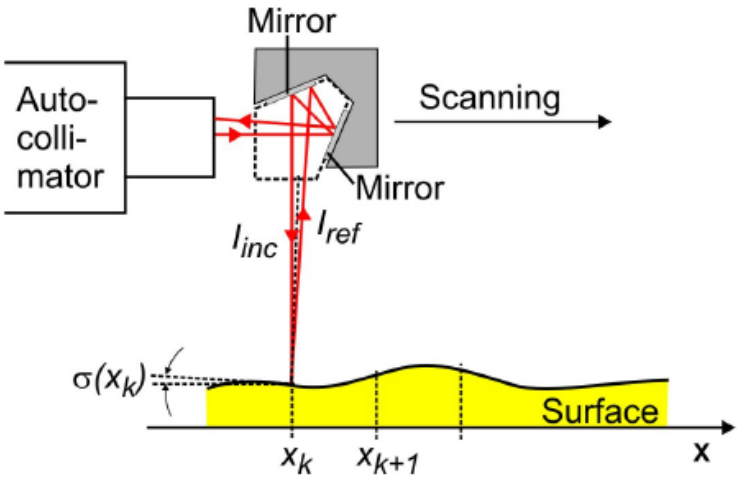
Project Partners:

PTB, CMI, METAS, LNE, MKEH, SMD, VSL
Fraunhofer Institute for Production Technology, TNO, Technical University of Illmenau, Universität of Stuttgart
XPRESS Precision Engineering, IBS Precision Engineering

Form measurements:

- on **flat surfaces** with uncertainties < 1 nm and
- on **curved surfaces** with uncertainties < 10 nm

using **imaging** (interferometric) and **scanning** (optical and tactile) **methods**, developing software for the handling of a large number of data points, investigating error influences for interferometric and tactile scanning methods by modelling and simulation.



Goals

- A setup for capacitive measurement of flatness was created and tested, which reached a repeatability of better than 10 nm for 1D profiles of flatness.

- Improvement in modeling, simulation and uncertainty evaluation:

  • A simplified optical model of the (full aperture) tilted-wave interferometer has been developed (asphere and free-form metrology using interferometry)

  • Development of the optical concept for a subaperture tilted-wave interferometer.

  • Accuracy in tactile scanning methods has been investigated by analysis of the error sources of machines available in the consortium.

IND 014- Vacuum metrology for production environments

SCOPE: Traditional measurements are based on the pressures of pure gases in stable conditions. In industry it is the opposite: gas mixtures and pressures changing with time.

GOALS: This research will lead to a facility for dynamic pressures and establish traceability for partial pressures, outgassing rates and leak rate measurement in industry.

PARTNERS: PTB, CEM, CMI, IMT, INRIM, LNE, UME, DANFOSS, INFICON, LAZZERO, VACOM.

Goals

- **Novel dynamic vacuum calibration facility under construction**

This facility will generate predictable pressure changes from 100 kPa to 100 Pa within 1 second.

- **Improvement of leak measurement and testing in industrial environment**

New leak elements like holes of 100 nm diameter drilled by focused ion beams (FIB) into 200 nm thin SiN-membranes were manufactured and geometrically characterized. Experiments will be performed to test the theory of flow through them to be able to predict the leak rate.

- **Providing traceability of industrial outgassing rate measurement and material characterisation**

Two outgassing rate standards are under development.

- **Providing traceability for partial pressure measurement in industry**

Long-term stability tests of quadrupole mass spectrometers are underway.

IND09: Traceable Dynamic Measurement of Mechanical Quantities

SCOPE: Many applications of the measurement of force, torque and pressure are dynamic (strong variation over time). Transducers are calibrated by static procedures but mechanical sensors exhibit distinctive dynamic behaviour.

GOAL: Traceability for force, torque and pressure for measurements under dynamic conditions.

PARTNERS: CEM, CMI, INRIM, LNE, MIKES, NPL, PTB, SP, UME.

EURAMET
European Association of National Metrology Institutes

Dynamic Sensors for Force (WP1), Pressure (WP2), Torque (WP3)

Measuring Amplifiers (WP4) (completing the measuring chain)

- development of dynamic calibration methods and procedures
- experimental validation

- description of meas. chain
- uncertainty components
- measurement data

- identified parameters
- analysis of comparisons

Mathematics (WP5)

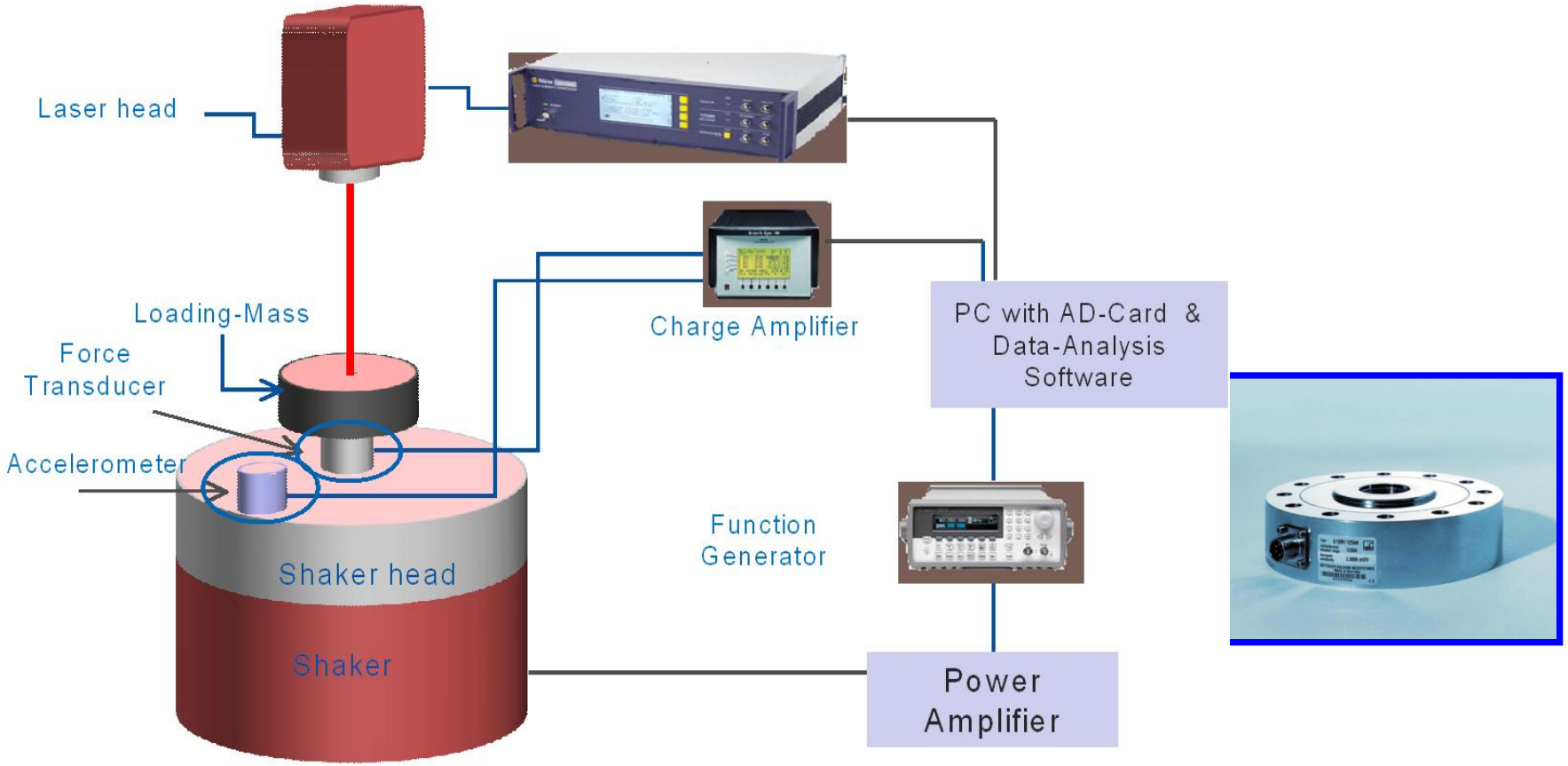
- data analysis
- mathematical and statistical methods and modelling
- evaluation of measurement uncertainty

Management (WP7)

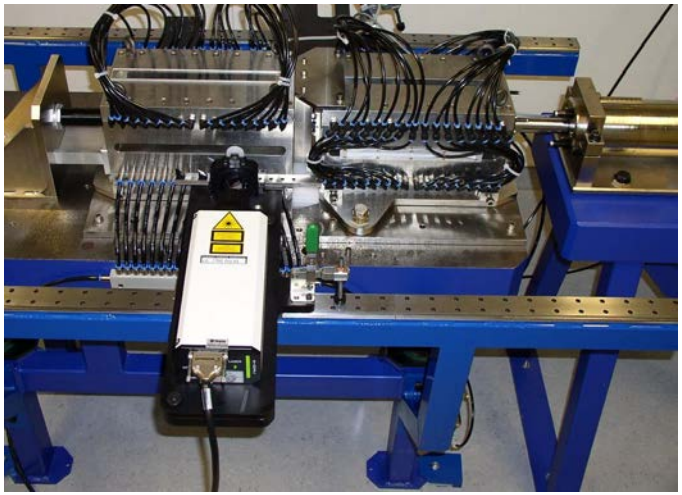
Impact (WP6)

- scientific papers
- reports
- guidelines
- workshops

WP 1 : Dynamic Force Facilities

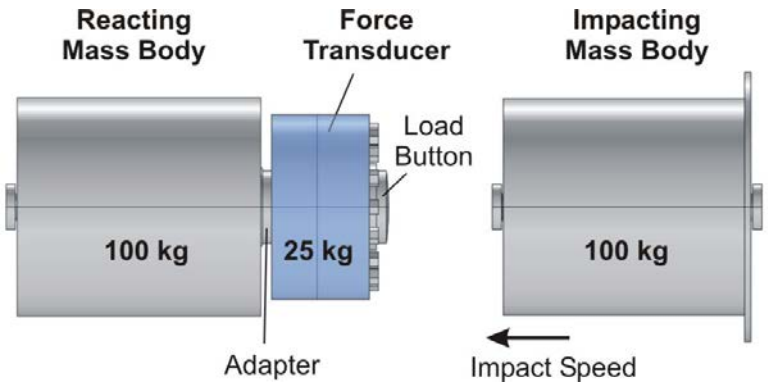


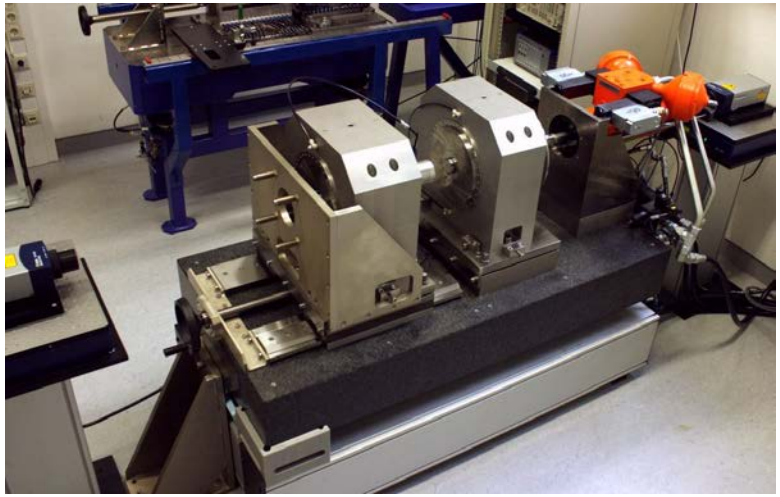
Shock force facilities



2 primary calibration devices for shock forces :

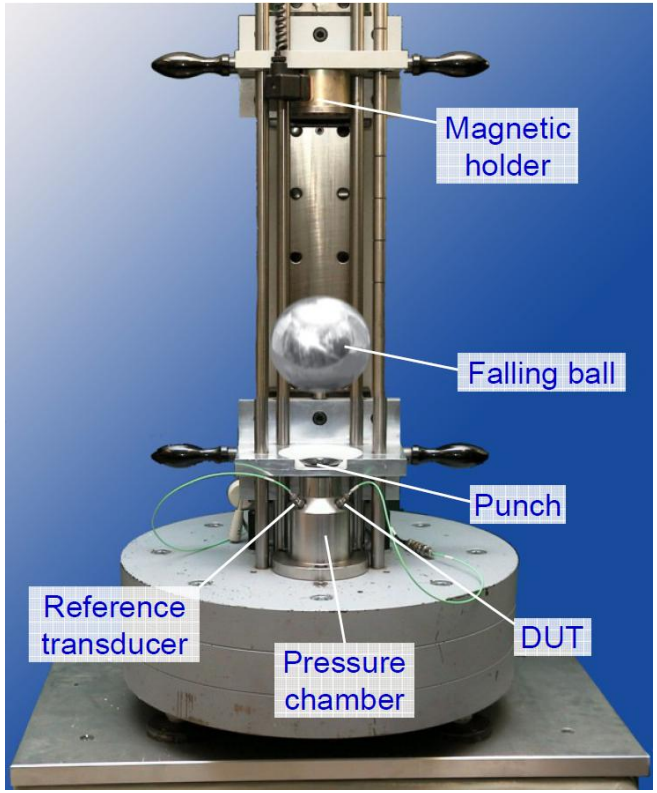
- **20 kN and 250 kN shock force amplitude**
- **colliding mass bodies, interferometric acceleration measurement**
- **Pulse shaped force**





WP 2 : Pressure facilities

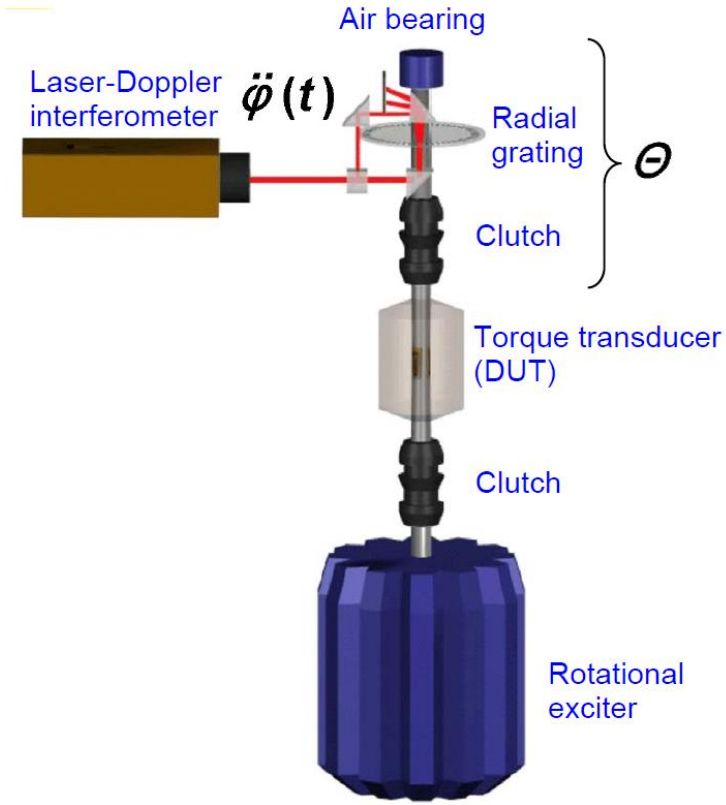
Drop weight machine



Shock tube

WP 3 : Torque facilities

Frequency range : 10 to 1 000 Hz
Torque range : up to 20 N.m



Dynamic Torque

$$M(t) = \Theta \cdot \ddot{\varphi}(t)$$

moment of inertia — angular acceleration

WP 4 : Measuring amplifiers

Frequency range : DC to 10 kHz

Charge amplifier

Bridge amplifier

WP 5 Mathematical and statistical methods and modelling

* To caracterize the input/output system with the system impulse response
* To develop parametric whitebox system models

Impact

- Workshops

- Specialised congresses and conferences

- Training courses (Form metrology)

- Websites

- Publications in journals

Technical Guide on the Use of GPSDO

Agreed at the 2009 TC meeting and about to be completed

EURAMET Project 1130, Peter Whibberley (NPL)

The objective is to produce a EURAMET guideline on the use of GPS disciplined oscillators in calibration laboratories.

GPSDO are the workhorses in most calibration laboratories, but also used in ten-thousands for the synchronization of telecommunication networks

EURAMET Calibration Guide 18 “Guidelines on the Calibration of Non-Automatic Weighing Instruments”

IMPACT: It has being adopted also by other RMOs and broadly used by accreditation bodies as mandatory

It is the most visited issue in the EURAMET website!!

New review under EURAMET project 1205 (17 participating NMIs)

First review with a direct collaboration of manufacturers

Second meeting is expected very soon

The End

Thank you for your attention