PT-Providers: Key Partners of European Metrology for Dissemination of Traceability in Analytical Chemistry

Detlef Schiel [(1)], Olaf Rienitz [(1)], Reinhard Jährling[(1)], Bernd Güttler [(1)], Holger Scharf [(2)], Ralf Matschat [(2)], Birkhahn [(2)], Paola Fisicaro [(3)], Guillaume Labarraque [(3)], Ulrich Borchers [(4)], David Schwesig [(4)]

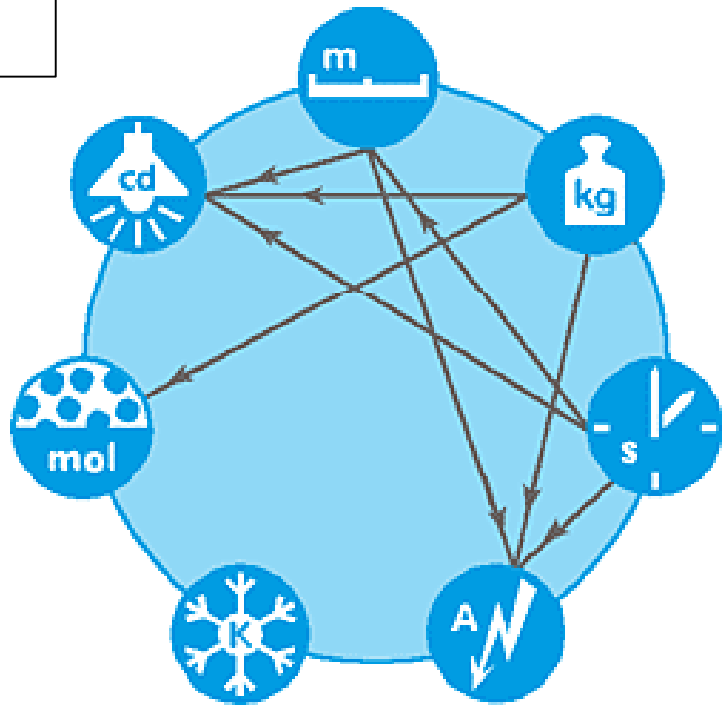
(1) Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany, (2) Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany, (3) Laboratoire National de Métrologie et d'Essais (LNE), Paris, France, (4) IWW Water Centre, Mülheim, Germany

Fundamental Constants

Federal Ministry of Economics and Technology

Physikalisch-Technische Bundesanstalt
German Metrology Institute

- **Realization and dissemination of the SI units**
- **Provision of the basis for reliable (traceable, comparable) measurement results**



Why comparability and traceability?

Increasingly required quality features of measurement results

Comparability **Traceability**

EU Water Framework Directive 2000/60/EC (WFD)

Groundwater Directive 2006/118/EC

Drinking Water Directive 98/83/EC

Marine Strategy Framework Directive 2008/56/EC

In vitro Diagnostica 98/79/EG

ISO/IEC 17025

ISO/IEC 17043

How can comparability be achieved ?

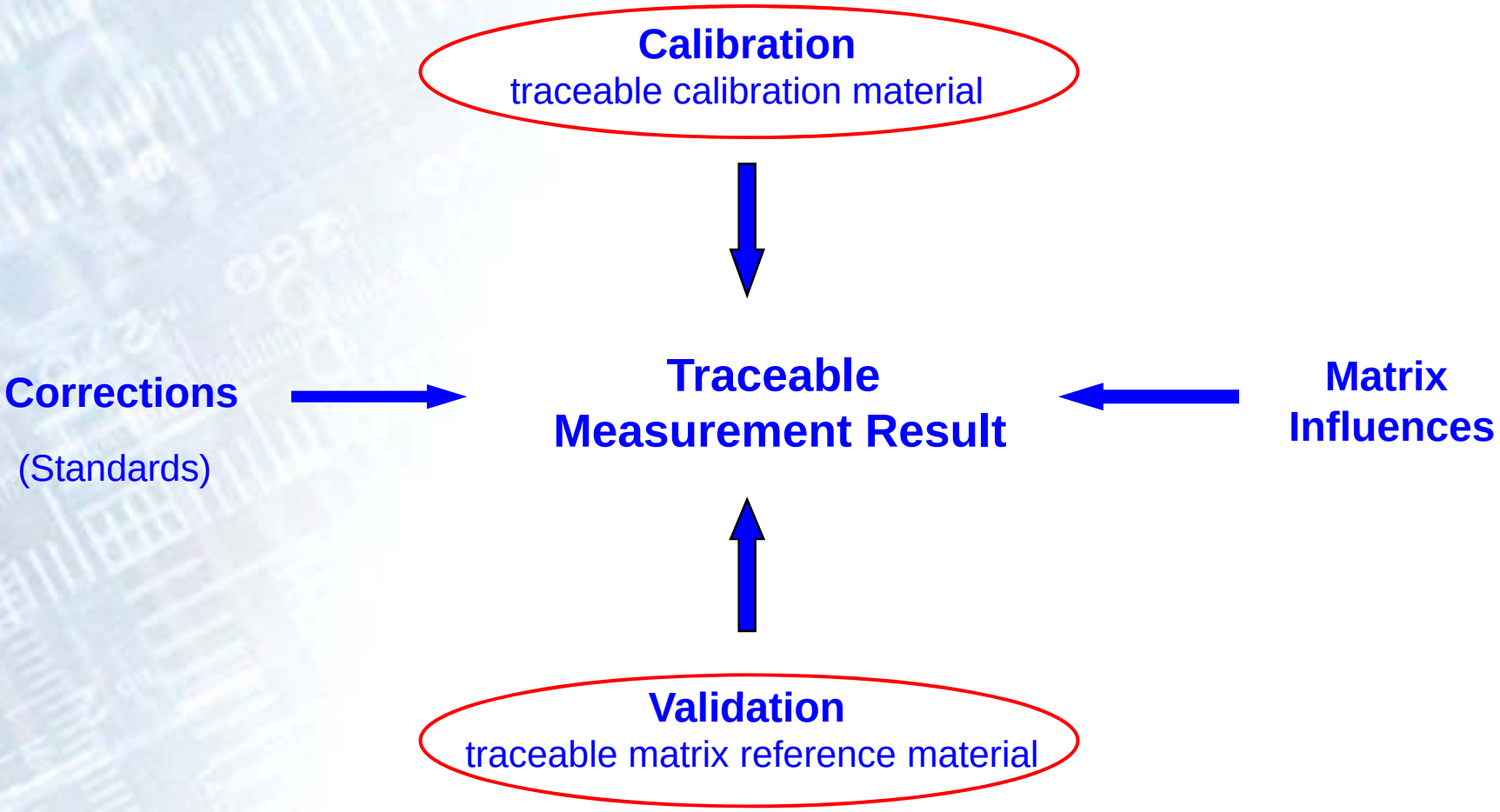
Comparison measurements using consensus values

- Snapshot in time and
- circle of participants
- uncertain reference

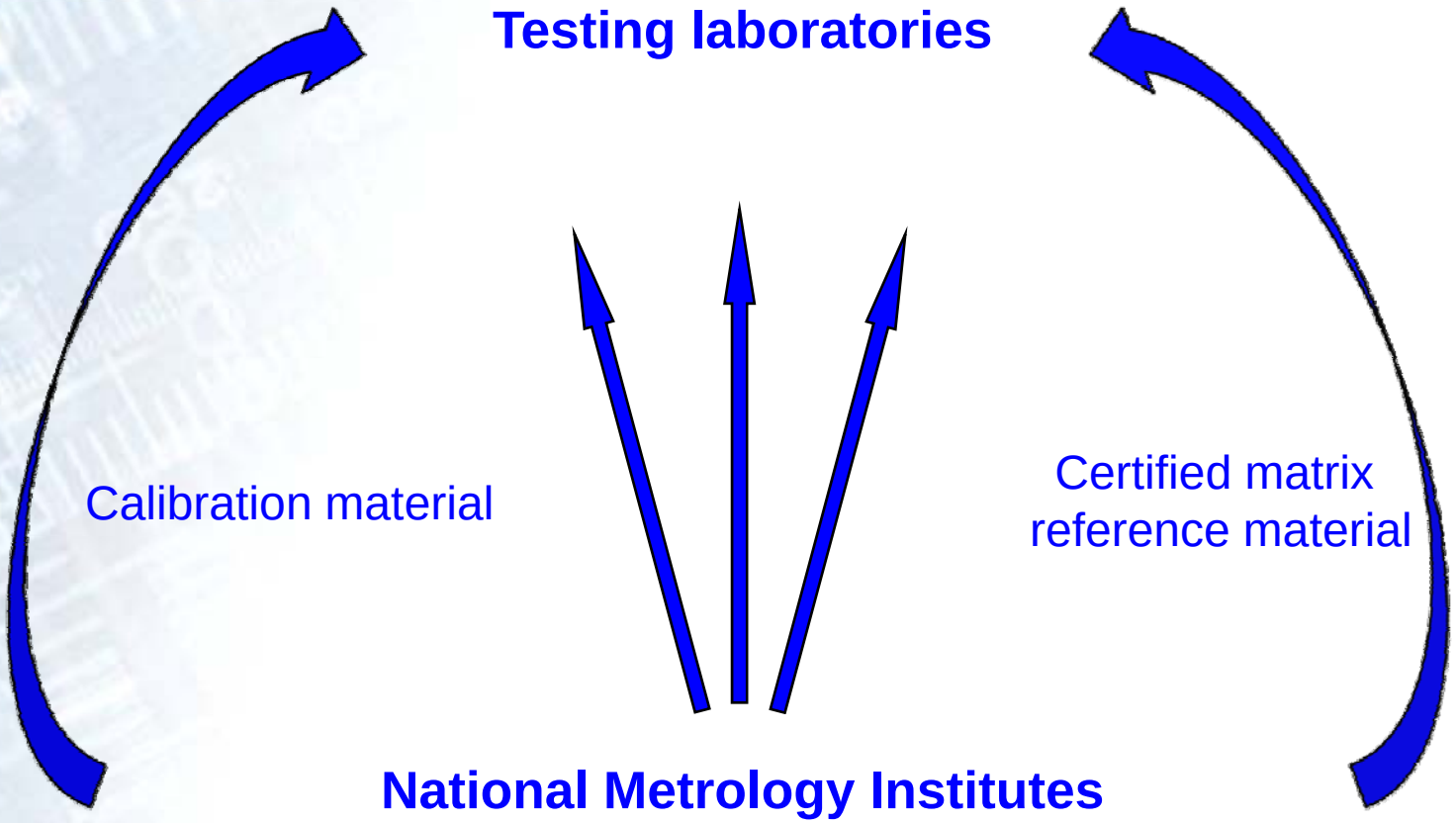
Traceability to the SI

- Internationally accepted reference
- Sustainable
- Independent on participants

How can traceability be achieved?

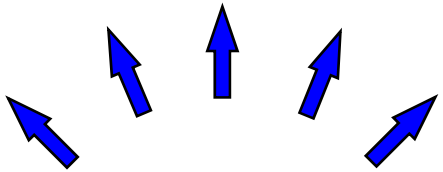


Dissemination as usual



Dissemination with partners

Testing laboratories



Multiplication effect

rational

EU-wide

Sustainable

PT- provider (matrix RM)
Calibration material producer

National Metrology Institutes
(Primary standards)

Primary elemental calibration materials

BAM

$$n = \frac{m \cdot w_{pur}}{M}$$

BAM-A-primary-Cu-1
LOT B27F17

	matrix in %	impurity in mg/kg	sum 'above' in mg/kg	um/2 'below' in mg/kg	not relevant (estimate)	under investigation
mass fraction	99,9968	32,33	22,38	9,95		
abs. uncertainty	0,0005	5,27	3,84	3,61		

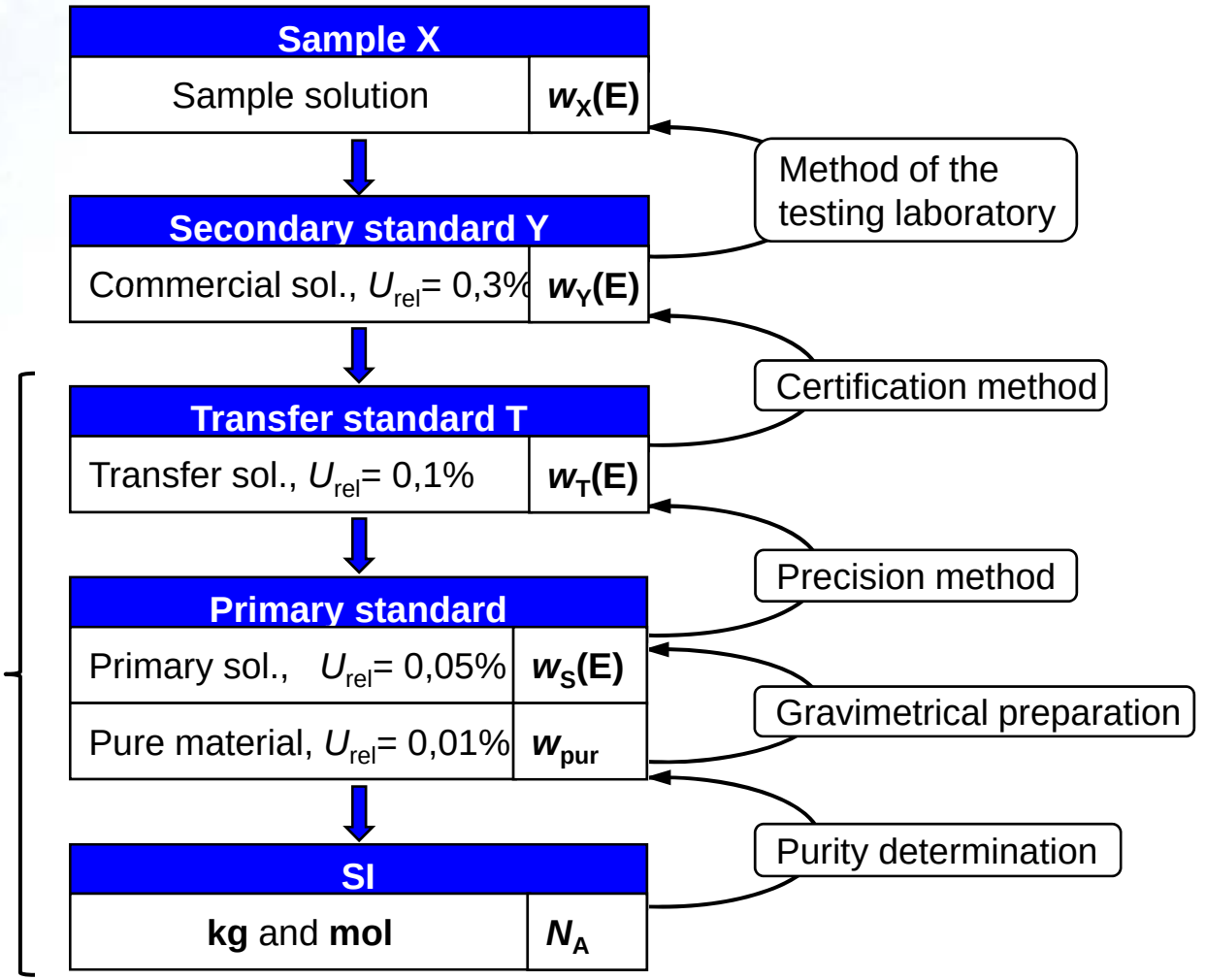
H < 2,1																	He < 0,001
Li < 0,31	Be < 1,1											B < 3,2	C 0,04	N 0,2	O 1	F < 2	Ne < 0,001
Na 0,002	Mg < 0,05											Al < 0,07	Si < 0,002	P < 2	S 5,4	Cl < 0,6	Ar < 0,001
K < 0,002	Ca 0,1	Sc < 0,06	Ti < 0,32	V < 0,04	Cr 0,07	Mn 0,01	Fe < 5	Co < 0,11	Ni 1,64	Cu matrix	Zn 0,057	Ga < 0,11	Ge < 0,12	As 0,5	Se 0,22	Br < 0,014	Kr < 0,001
Rb < 0,05	Sr < 0,014	Y < 0,03	Zr < 0,015	Nb < 0,02	Mo < 0,06	Tc < 0,001	Ru < 0,03	Rh < 1,6	Pd < 0,014	Ag 11,3	Cd < 0,015	In < 0,05	Sn 0,14	Sb 1	Te < 0,22	I < 0,09	Xe < 0,001
Cs < 0,0057	Ba < 0,017	La < 0,002	Hf < 0,003	Ta < 0,003	W < 0,12	Re < 0,009	Os < 0,004	Ir < 0,007	Pt < 0,007	Au < 0,008	Hg < 0,03	Tl < 0,005	Pb 0,47	Bi 0,23	Po < 0,001	At < 0,001	Rn < 0,001
Fr < 0,001	Ra < 0,001	Ac < 0,001															
			Ce < 0,0057	Pr < 0,002	Nd < 0,21	Pm < 0,001	Sm < 0,007	Eu < 0,003	Gd < 0,001	Tb < 0,001	Dy < 0,001	Ho < 0,001	Er < 0,001	Tm < 0,001	Yb < 0,001	Lu < 0,002	
			Th < 0,02	Pa < 0,001	U < 0,001												

Dissemination of elemental calibration materials

Testing laboratories

Calibration material producer

Primary basis (NMI)

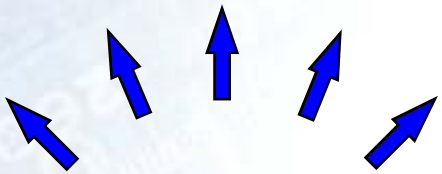


Matschat, R. et. al., ACQUAL 10 (2006), S. 633-639

Dissemination of matrix reference materials

Testing Laboratories (TL)

PT-providers need to be enabled to assign traceable reference values to ring trail samples



Comparison measurement (regular)

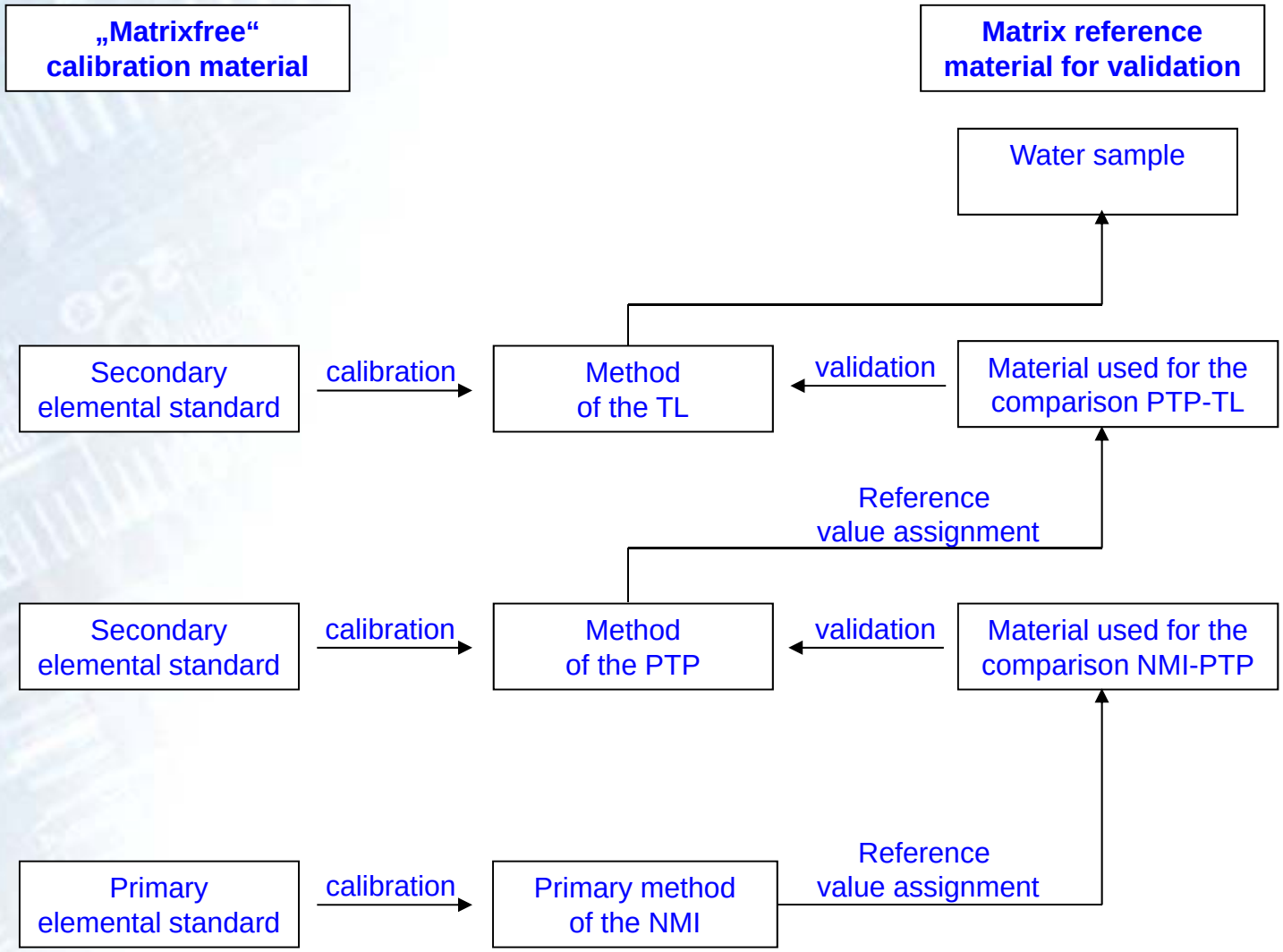
PT–Providers (PTP)
experienced in chemical analysis

Advice in metrological uncertainties calculation

Comparison measurement

National Metrology Institutes (NMI)

Dissemination scheme (Euramet project 924)



NMI: national metrology institute
PTP: calibration laboratory
TL: testing laboratory

European dissemination network (Euramet 924)

Demonstration of the applicabilty of this concept in the Euramet project 924 for priority substances Ni, Cd, Pb and Hg of the WFD as an example

Participants

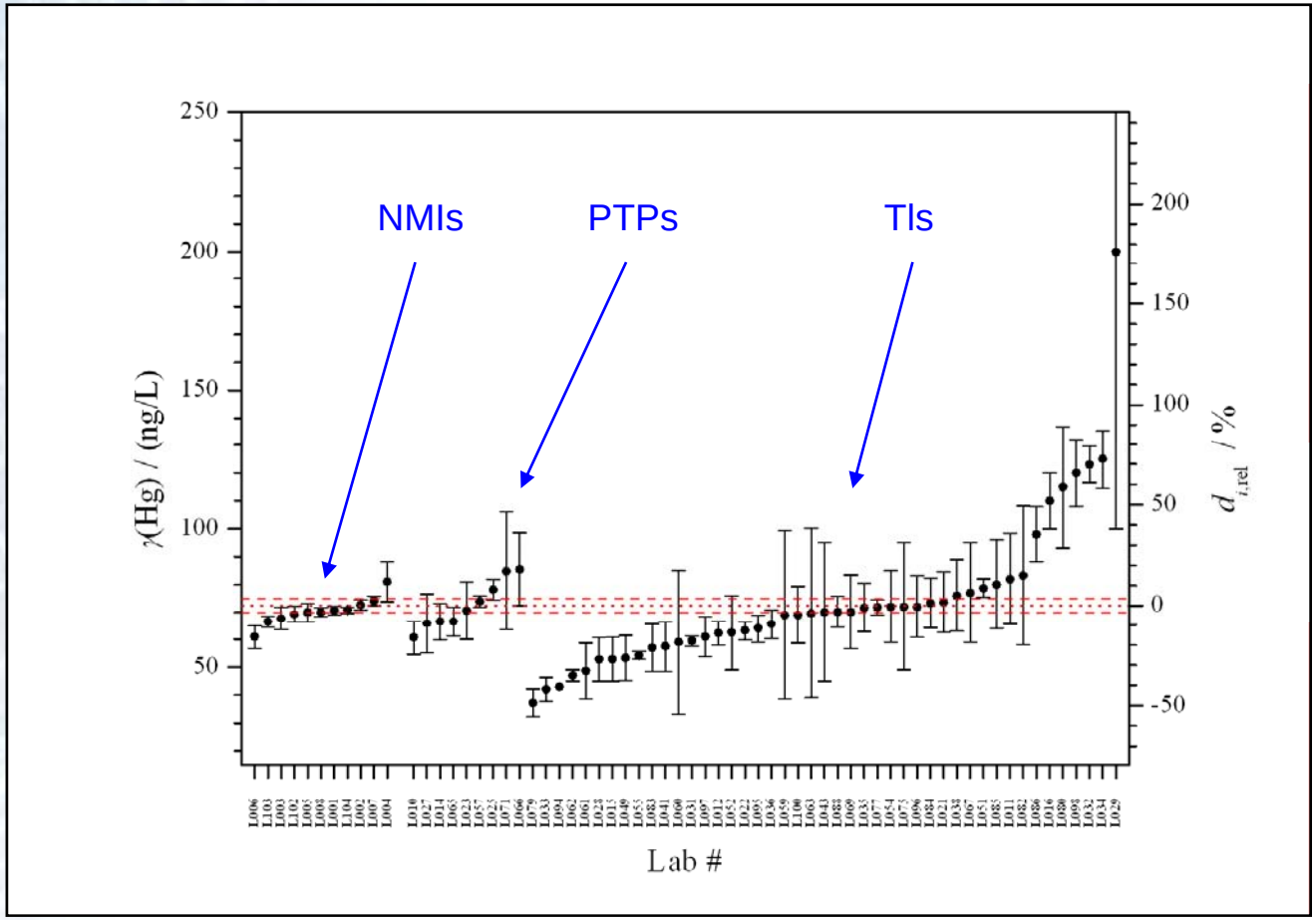
114 Laboratories from
17 European countries

Among them:

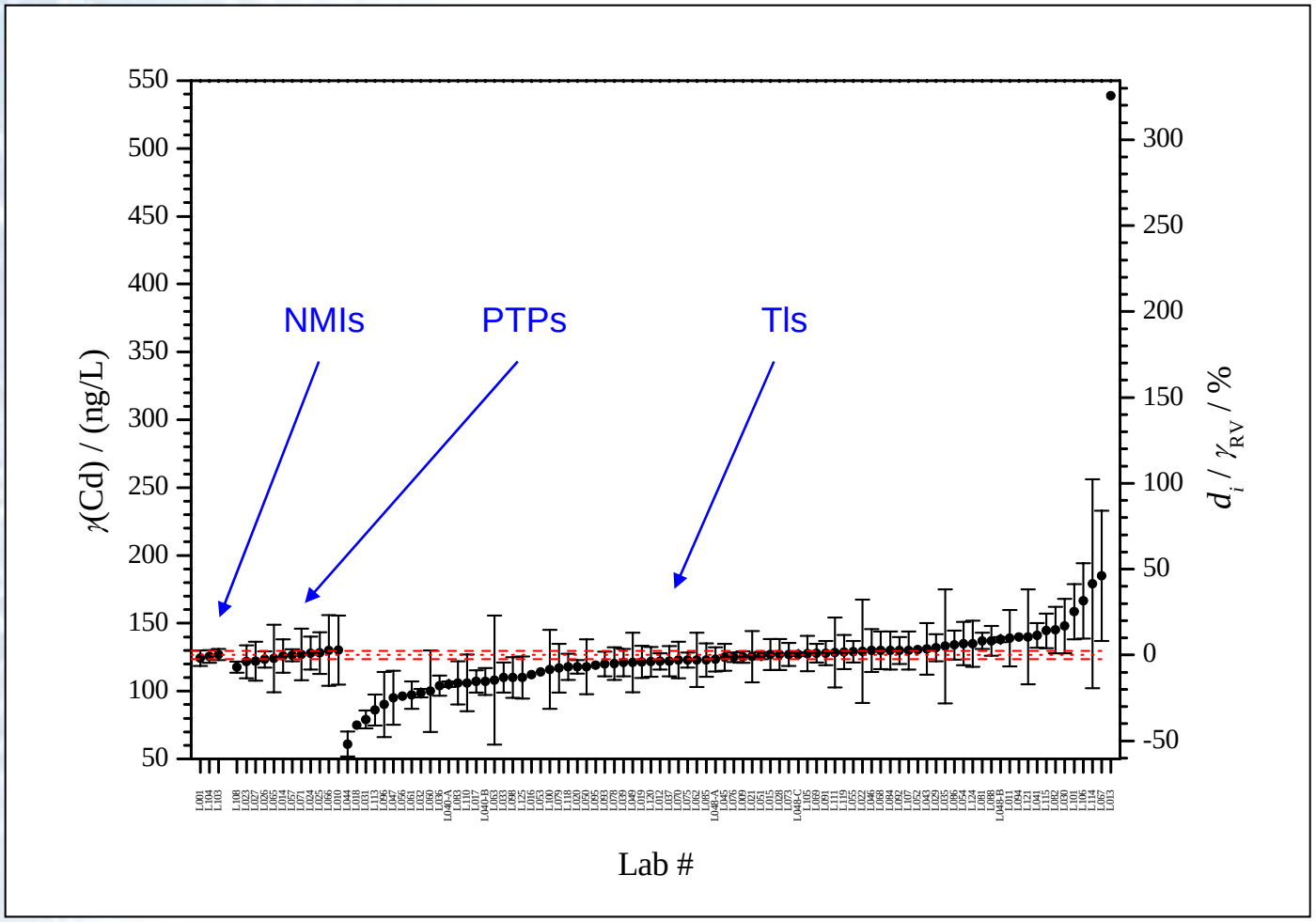
- 4 NMIs
- 22 PT-providers (expert lab.)

Schiel, D.;et. al, Accred Qual Assur (2011)16:489-498

Comparison measurement results of Hg



Comparison measurement results of Cd



Summary and conclusion

- Metrological network can be set up
  - using an hierarchial dissemination structure
  - providing the basis for comparability
  - aiming to improve the quality of measurement results and
  - helping to implement directives and standards
- Expert laboratories among the PTPs could take over a central role in metrological dissemination
- They demonstrated for environmental analysis their good measurement capability which is appropriate for collaborating in metrological dissemination
- Enabling of expert laboratories does not need large efforts
- PTB is ready for a close cooperation with the expert laboratories

Outlook

NMIs are going to develop primary methods and materials in several projects for :

- organic priority substances of the WFD e.g. TBT, PBDE, PAHs
- priority substances of laboratory medicine e.g. proteins and
- elemental calibration materials

Thank you
For your attention

Summary and conclusions

- European metrological network for environmental analysis
  providing the basis for comparability
  using an hierarchial dissemination structure
  has successfully been tested within Euramet project 924
- Expert laboratories of PTPs demonstrated their good measurement capability appropriate for collaborating in metrological dissemination
- Such a dissemination structure has already been established for laboratory medicine in Germany for more than15 years
- Outlook: NMIs are going to develop primary methods and materials for
  - organic priority substances of the WFD e.g. TBT, PBDE, PAHs,
  - priority substances of laboratory medicine e.g. proteins and
  - elemental calibration materials

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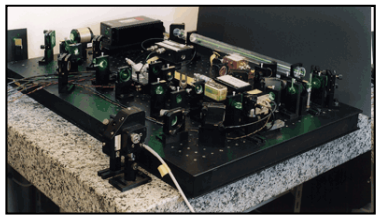
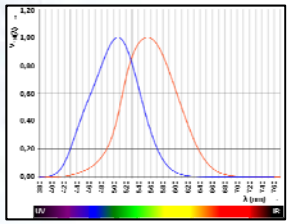
PTB

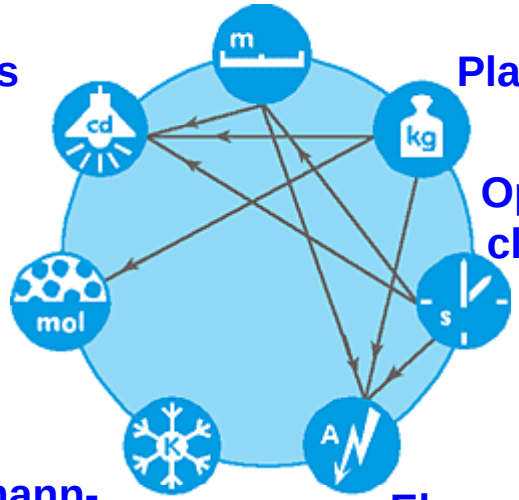
- **Realization and dissemination of the SI units**
- **Provision of the basis for reliable measurement results**



c = constant

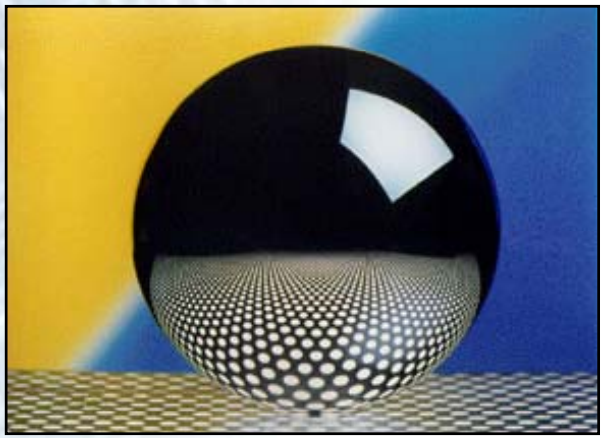


Luminous Efficacy



Planck- constant

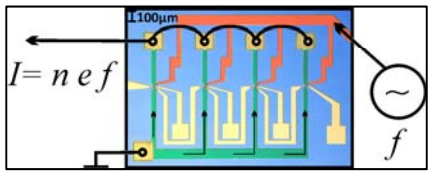
Optical clocks



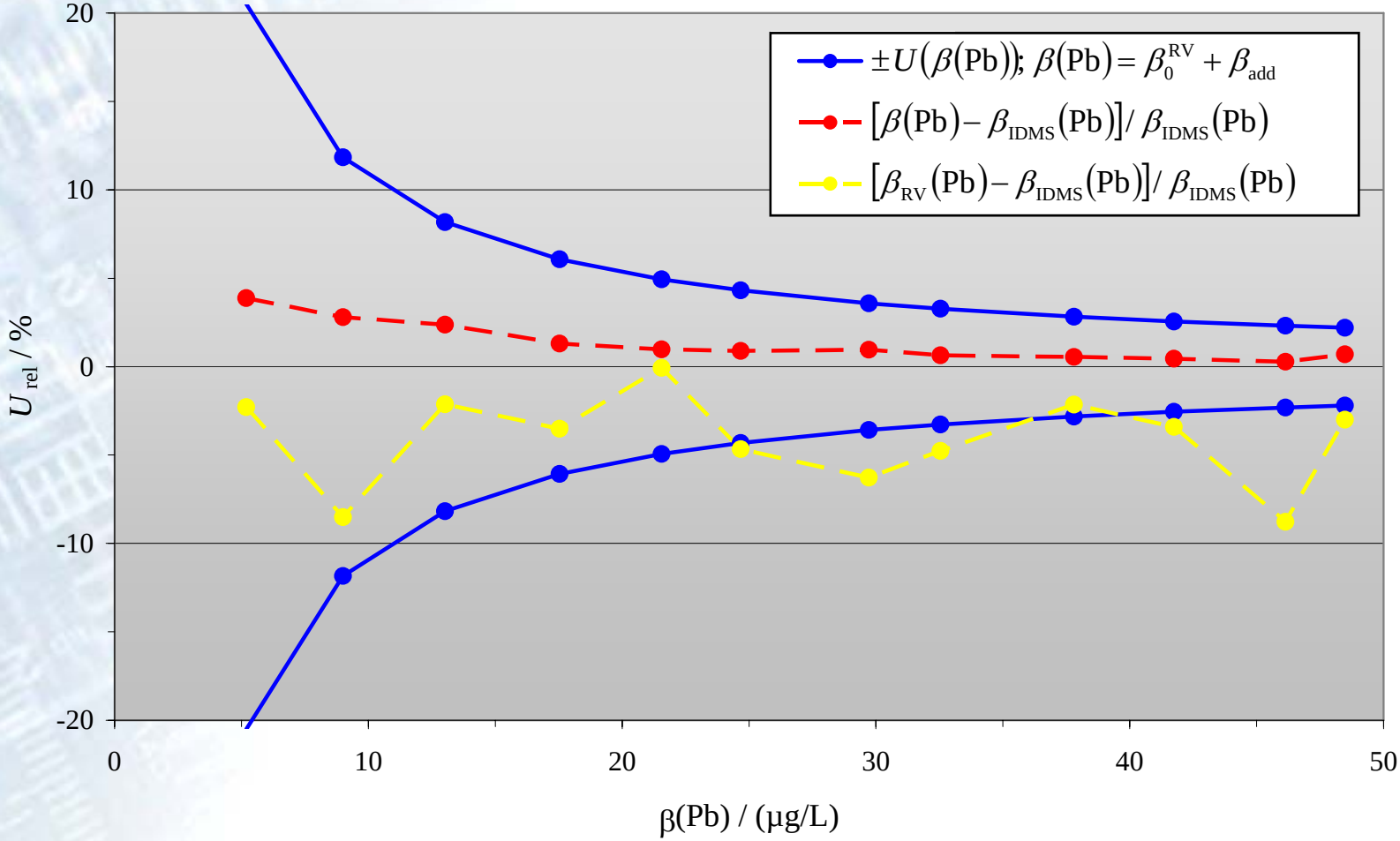
Avogadro-Constant

Boltzmann-Constant

Elementary Charge



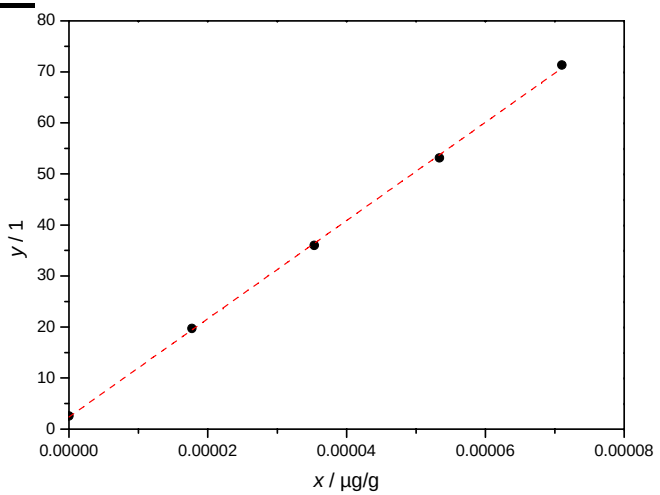
Traceable reference values for a drinking water ring trail from gravimetry and participants‘ results



O Rienitz, D Schiel, M. Koch, U Borchers, Accred. Qual. Assur. **12** (2007), 615-622

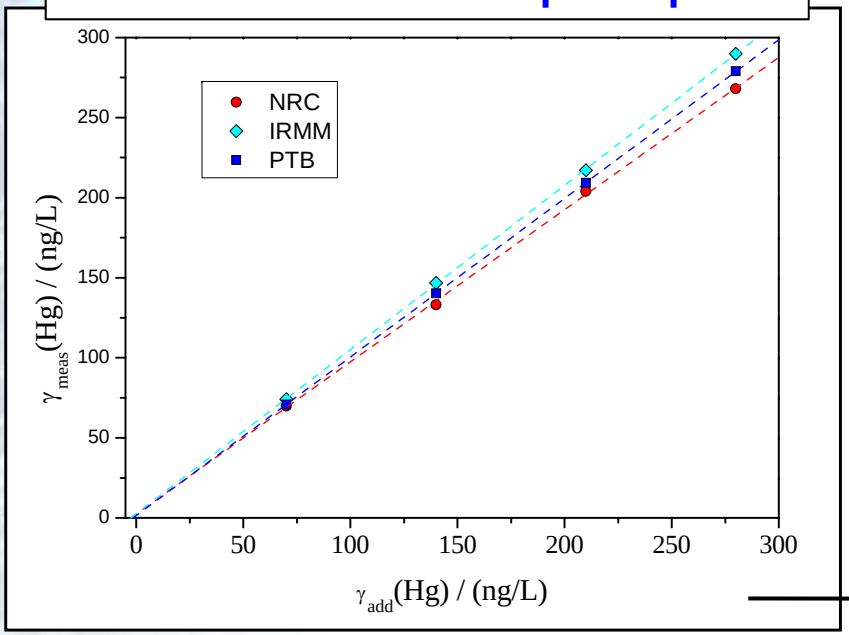
Hg content of the fresh water used for gravimetrical preparation of samples

Directly measured by standard addition IDMS



$\gamma_{0,\,IDMS}$ = (2.6 ± 0.5) ng/L

From the results of the participants



$\gamma_{RV} = \gamma_{add} + \gamma_0$

γ_{RV} = (72.4 ± 2.5) ng/L (k=2)

$\gamma_{0,p}$ = (2.1 ± 1.9) ng/L

Further applications

- Hierarchical dissemination structure has been established in laboratory medicine in Germany for more than 15 year
- Regular ring trails of JCTLM are used for linking reference laboratories with PTB