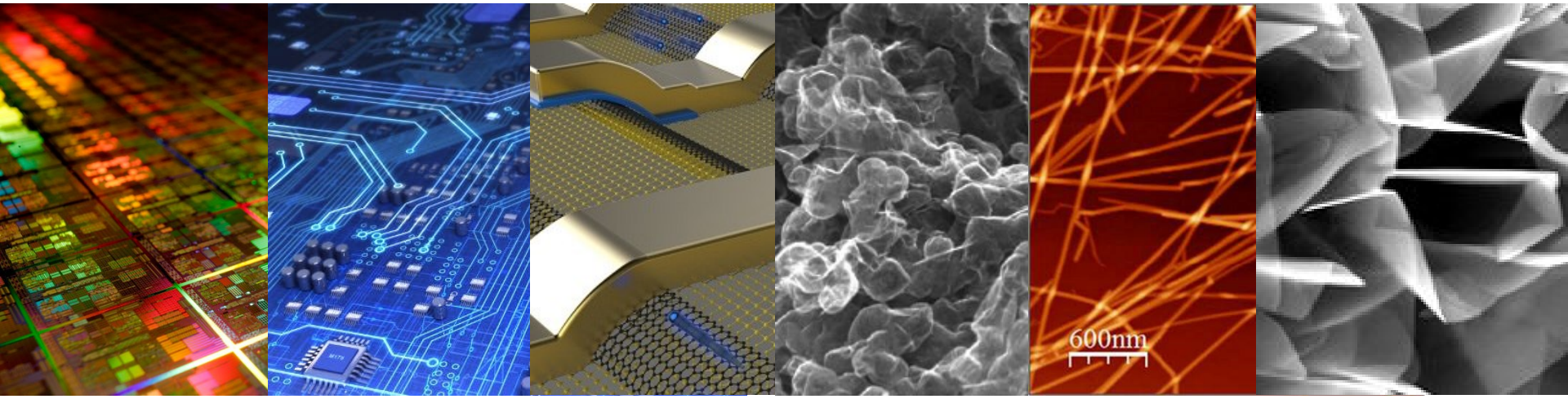


Particle Tracking Analysis for particle counting

Dr Denis Koltsov
Chairman of ISO TC229 (Nanotechnologies)
Director of BREC Solutions ltd

RSC Workshop (London,. UK)
24 April 2018

Introducing myself

Expert duties

- Chair of ISO TC229 (Nanotechnologies)
- Expert on ISO TC24/SC4 (Particle Characterisation)
- Expert on ISO TC281 (Fine Bubble Technology)
- Expert on CEN TC352 (Nanotechnologies)

Positions of responsibility

- Director of BREC Solutions limited
- Directoral Strategy Board of NanoReg2 (EU FP7)
- Stakehoders panel of nanoDefine (EU FP7)
- Steering board of Gracious (EU H2020)
- Board member of National Graphene Association

Summary

Global Nanotechnology Standardisation

Interaction between different bodies

About standards

PTA standard development history and things to come

Global Standardization Trends

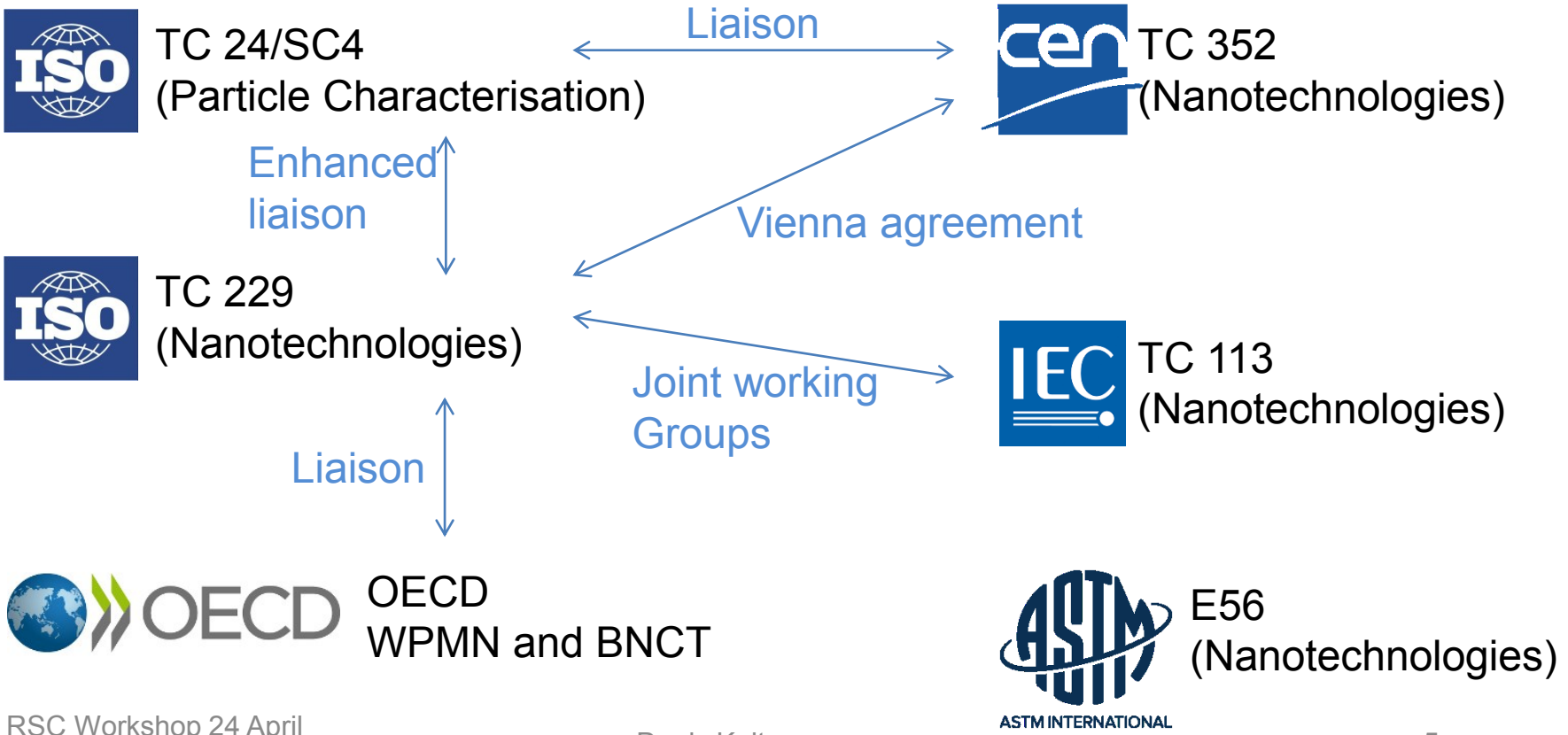
International Standardization Committees

Committee	When Founded	Membership	Developed Standards	Standards[2] under development
ISO/TC 229 Nanotechnologies	2005	35 Participating countries 16 Observing countries	64	40
CEN/TC 352 Nanotechnologies	2005	34 Countries	14	13
IEC TC 113 Nanotechnology for electrotechnical products and systems	2006	15 Participating countries 19 Observer countries	27	37
ASTM International TC E56 Nanotechnology	2005	Over 180 members	18	8

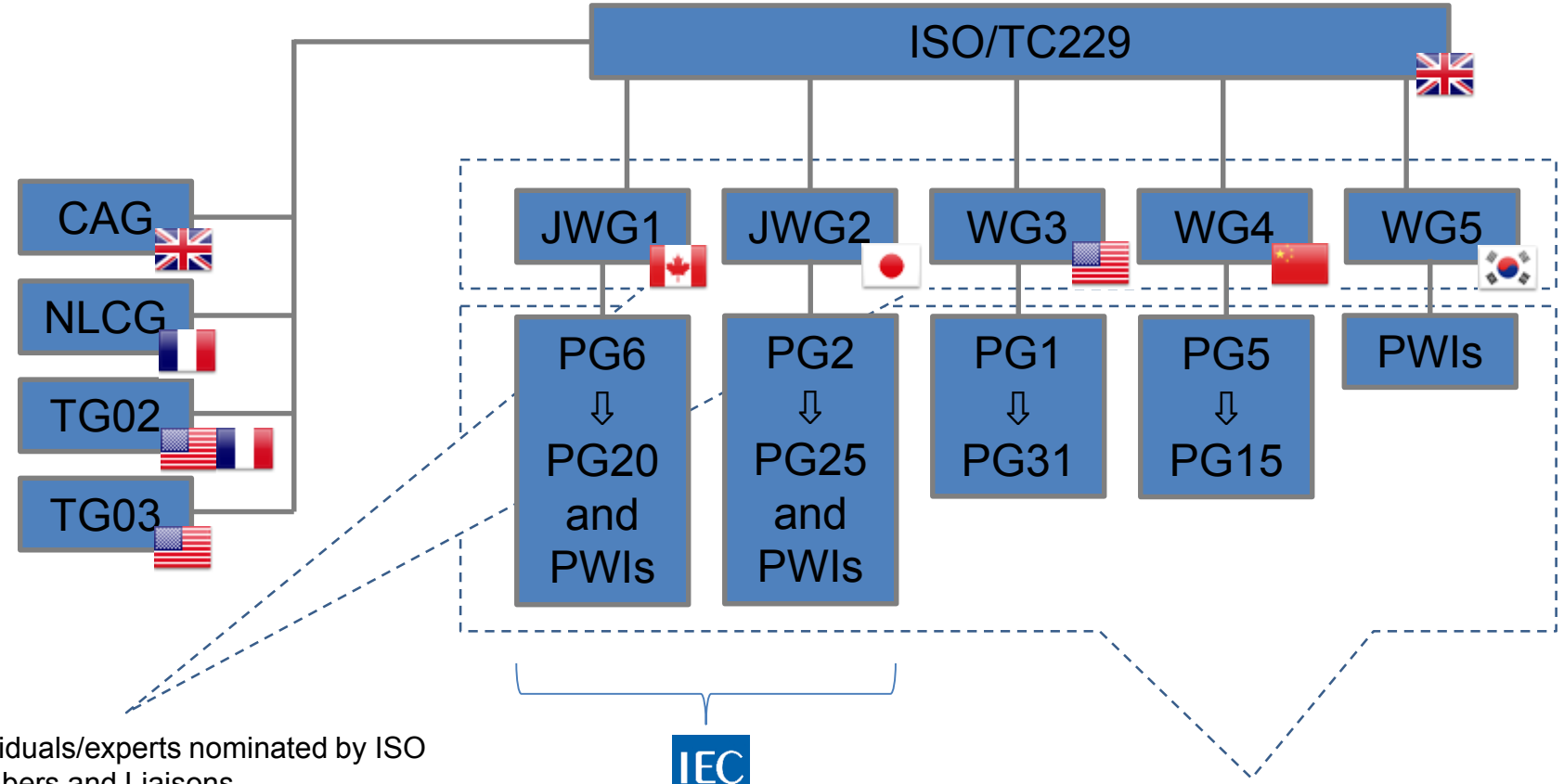
[1] ISO - International Organization for Standardization, CEN - The European Committee for Standardization, IEC - International Electrotechnical Commission

[2] Term "standard" used here includes technical reports, technical specifications and standard test methods.

Relationship Between Organisations and committees



ISO/TC229 Structure



Individuals/experts nominated by ISO Members and Liaisons
Operate by consensus.
Make recommendations to parent body, ISO/TC 229, for Resolution.

Joint working groups with IEC TC113 (Mode 5 cooperation).

Individuals/experts nominated by ISO Members and Liaisons.
Operate by consensus.
Report to WG on document progress.

TC229 Scope

Standardization in the field of nanotechnologies that includes either or both of the following:

1. Understanding and control of matter and processes at the nanoscale, typically, but not exclusively, below 100 nanometres in one or more dimensions where the onset of size-dependent phenomena usually enables novel applications,

2. Utilizing the properties of nanoscale materials that differ from the properties of individual atoms, molecules, and bulk matter, to create improved materials, devices, and systems that exploit these new properties.

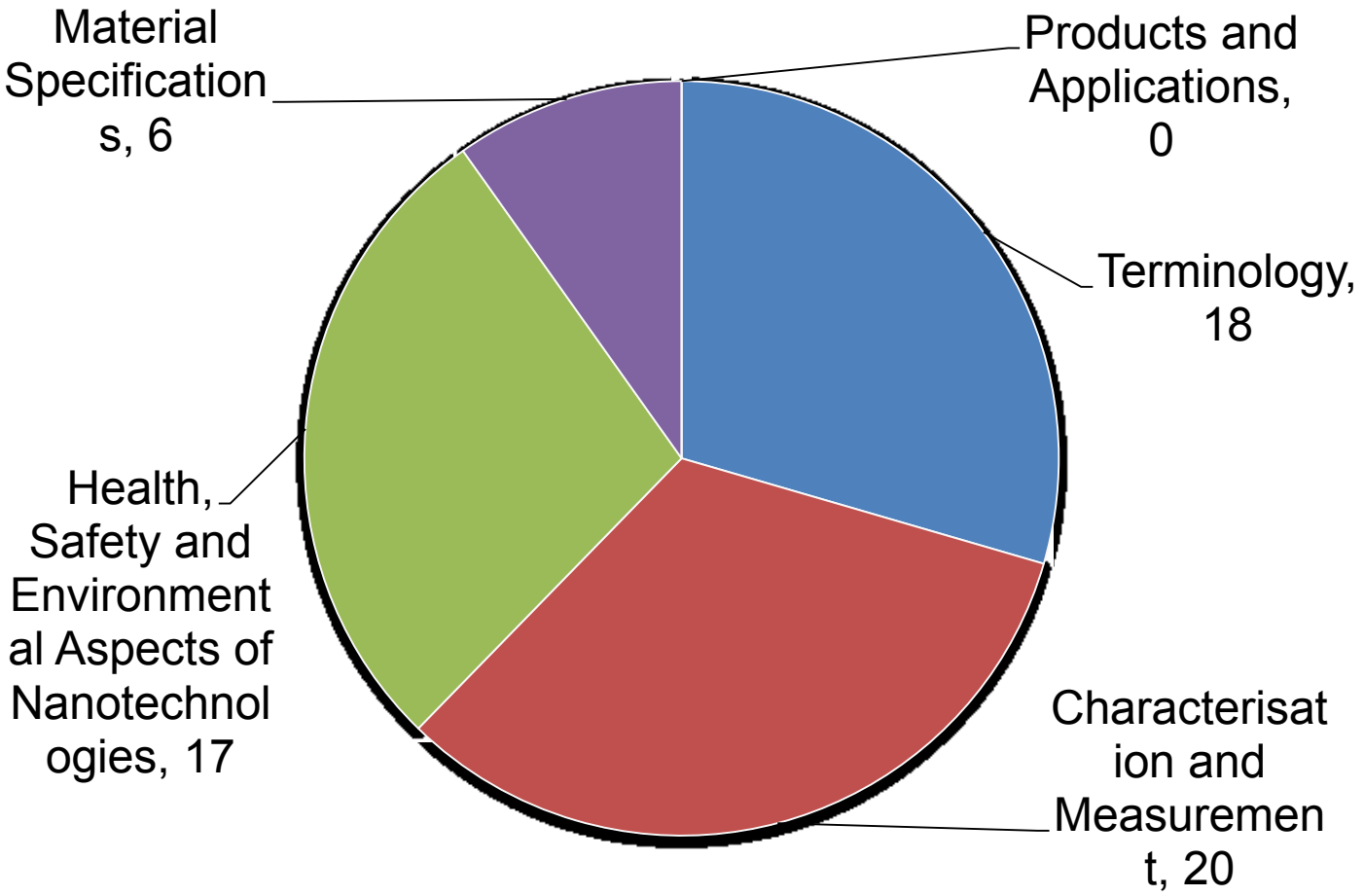
Specific tasks include developing standards for: terminology and nomenclature; metrology and instrumentation, including specifications for reference materials; test methodologies; modelling and simulation; and science-based health, safety, and environmental practices.

ISO TC229

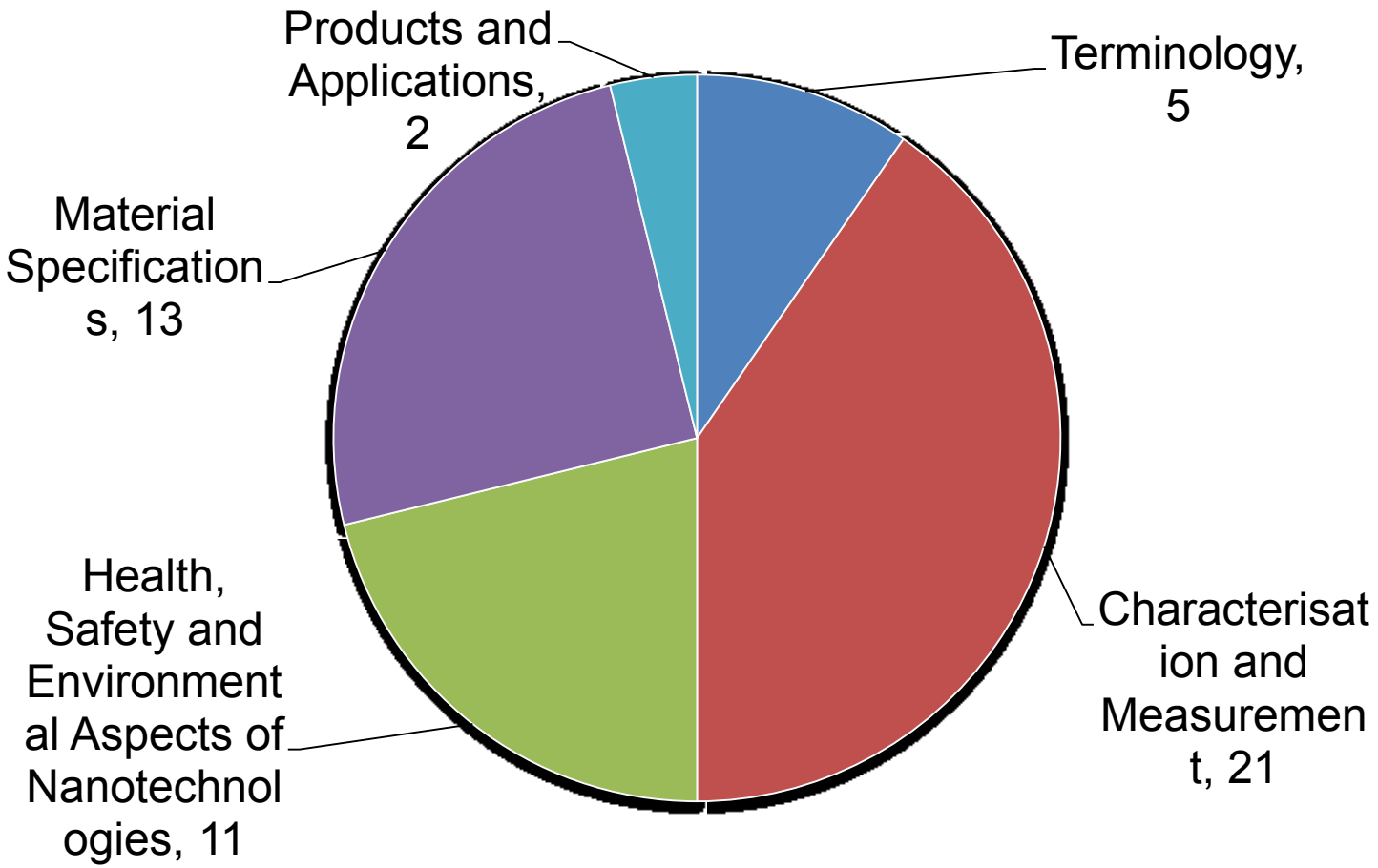
- 64 published ISO standards under the direct responsibility of ISO/TC 229
- 40 ISO standards under development under the direct responsibility of ISO/TC 229
- 35 Participating members
- 16 Observing members
- 150-200 expert attendance at plenaries

ISO TC229

Published Standards (up to Jan 2018)



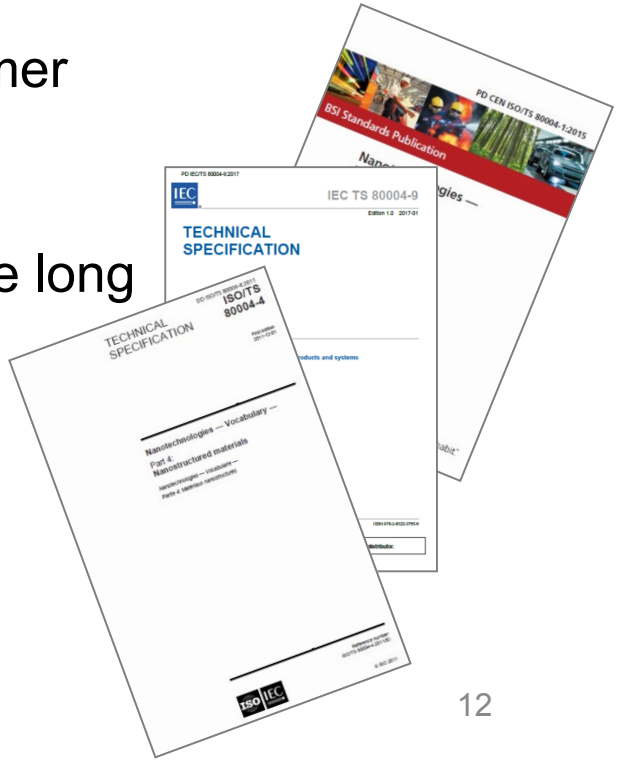
Standards Currently under development (in Jan 2018)



The use of standards

- Standards represent the best practice
- Standards are made by consensus of all stakeholders
- Standards allow compatibility and intercomparison of products
- Safety standards for products facilitate consumer acceptance
- While it may seem costly to comply at first, businesses save a lot of time and money in the long run

- What is a standard?



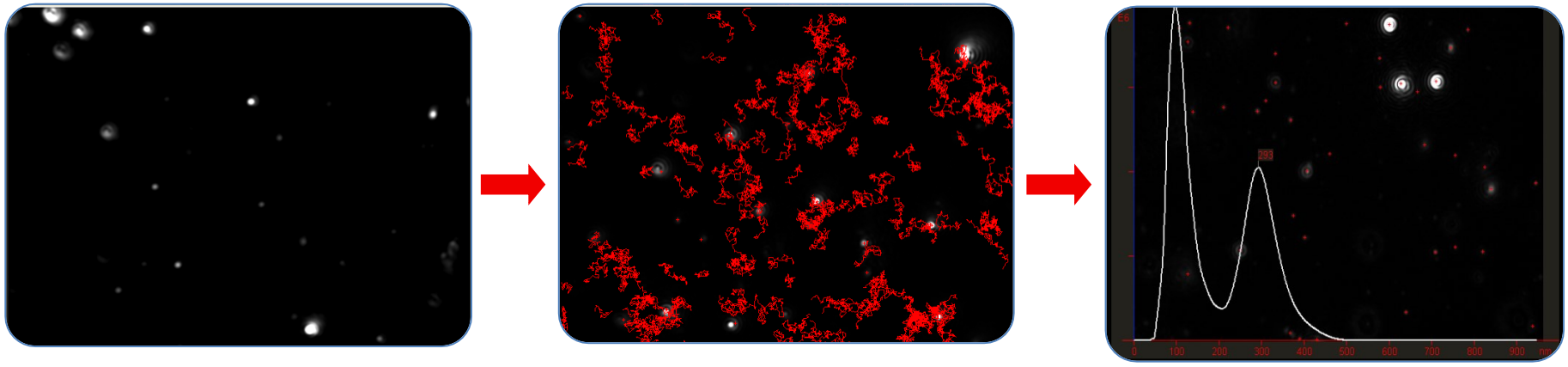
ISO 19430:2016

Particle size analysis -- Particle tracking analysis (PTA) method

Note: document is published. Follow on is being developed as part 2 to introduce particle counting routines.

Particle Tracking Analysis gives number-based particle size distribution and modal size in terms of equivalent hydrodynamic diameter.

Limit: does not cover accurate particle counting or number concentration measurements.



video *tracking* *analysis*

ISO 19430-1:2016

d

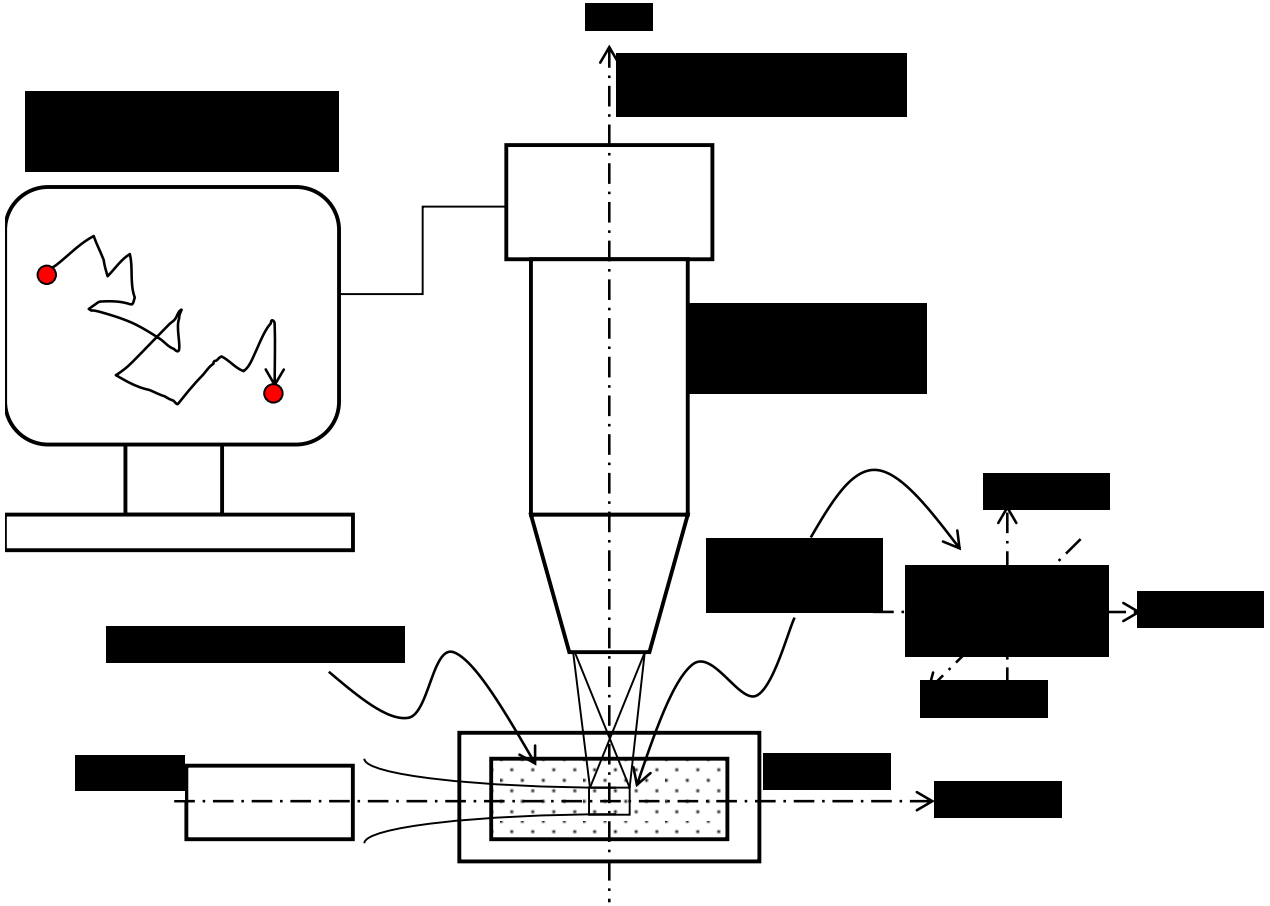


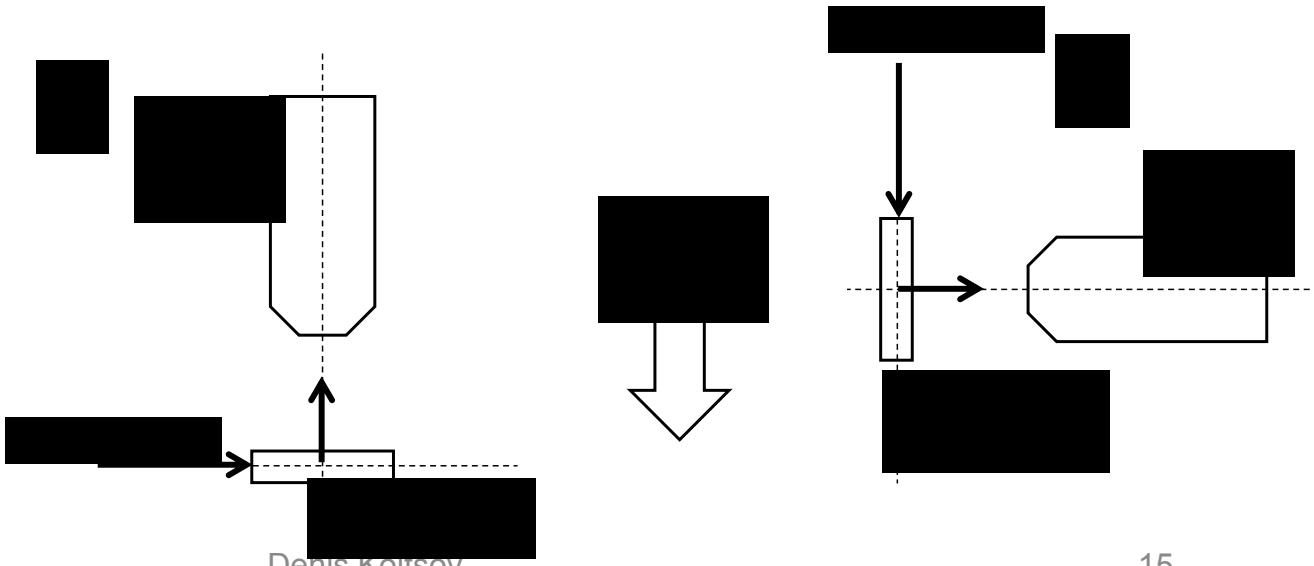
Figure 1 Schematic representation of the PTA experimental setup

ISO 19430-2:2016

Title: Particle size analysis – particle tracking analysis (PTA) - particle counting and number concentration evaluation

Scope: This technical specification describes the method of optical detection, tracking and counting of the objects (particles, bubbles or other entities) in a liquid dispersion by means of different types of particle tracking analysis methods described in this document. Images formed by scattered light are captured and analysed allowing the detection, counting and tracking of objects of sizes ranging from approximately 10 nm up to a few micrometers.

$$\overline{(x)^2} = D_x t = \frac{2k_B T t}{3\pi d_B}$$



Document Structure

Contents

At present only Brownian motion tracking is used.

These are in line with Part 1 document on sizing

Number concentration limits vary from instrument to instrument

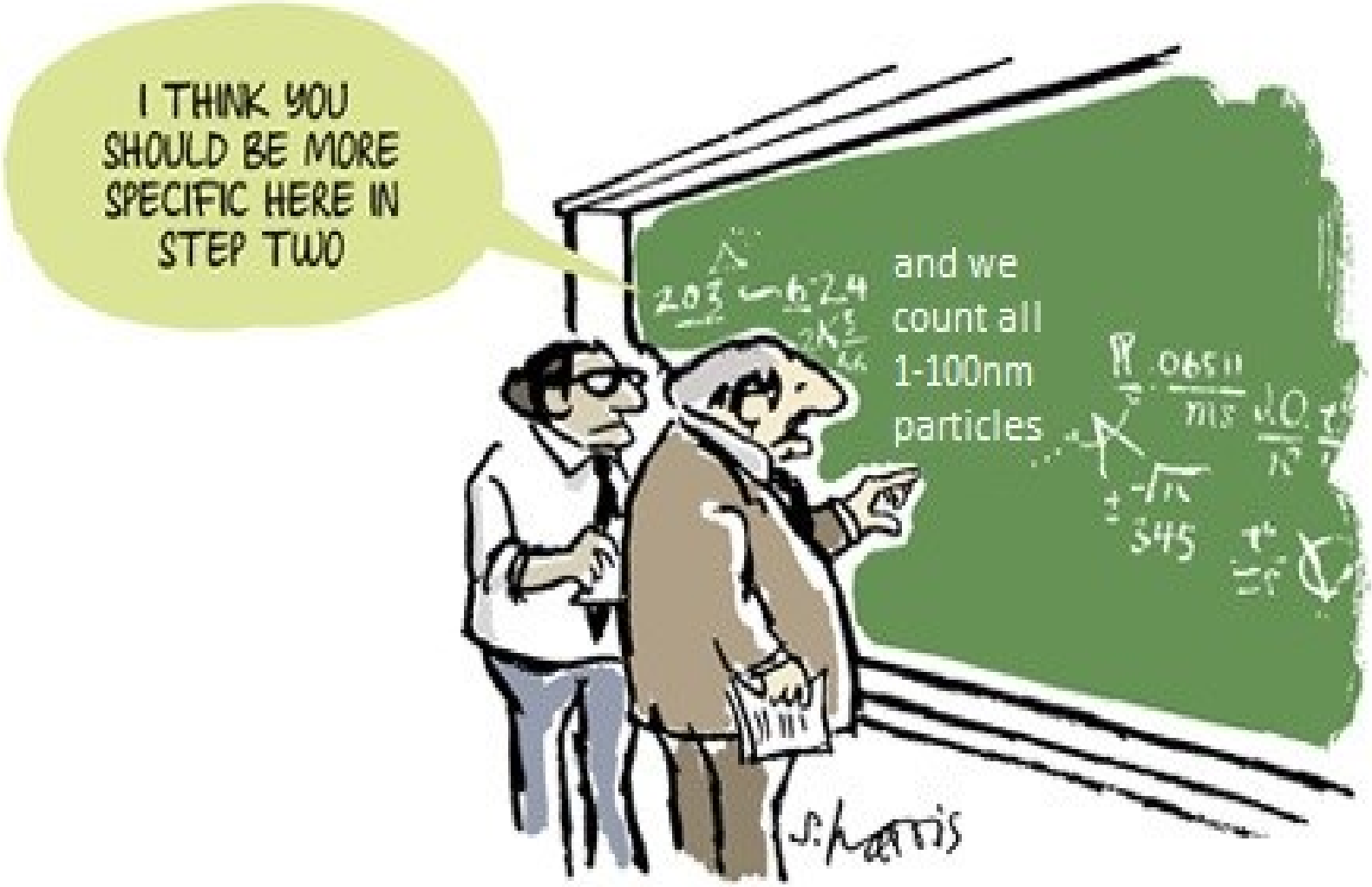
Precision and uncertainties values will be guided by the outputs of ILCs

It looks like noone is addressing polydispersity at the moment in ILCs

Key developments

At ISO TC24/SC4/WG7 meeting (April 2018) the following was agreed.

- Focus the document on counting (not on sizing)
- However the particle count without particle tracking and sizing was discarded as a measurand. This means we need to detect, image, track and size all particles
- Questions remain of the ability to detect, track and size all particles in the sampling volume.
- For quantitative measurement of particle density the size of the sampling volume is required.
- For transparent instrument comparability we need number concentration CRMs
- Still have the usual issues with polydisperse samples – using multiple lasers may present a solution



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