

## NANOSAFE 2

Safe production and use of nanomaterials

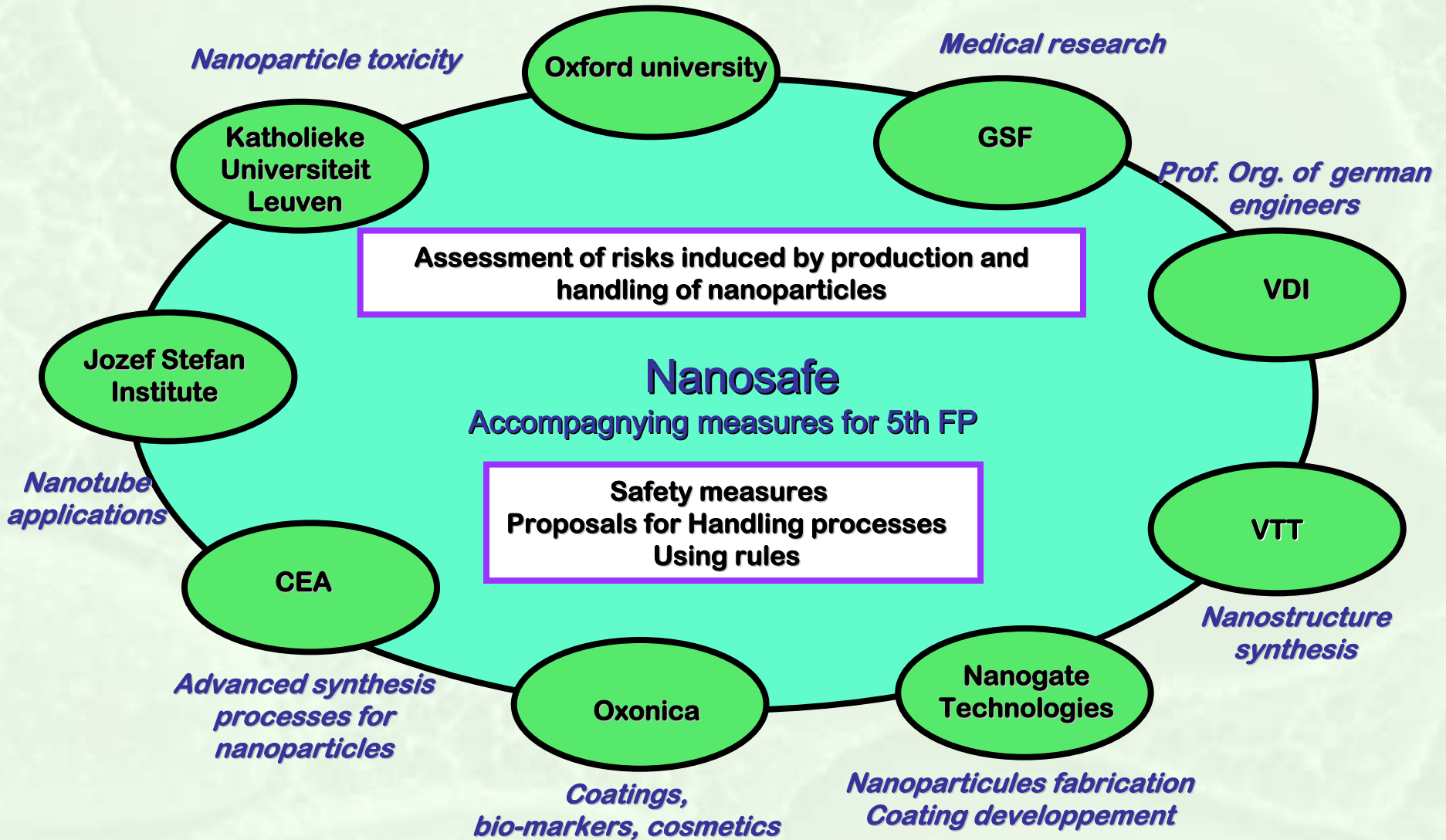
*April 2005 – April 2009*

*Frédéric Schuster*

### Outline

- Origin of the integrated project
- General overview of the project
- Work in progress

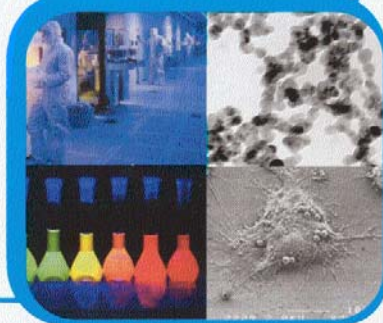
*R&D on nanoparticles applications*



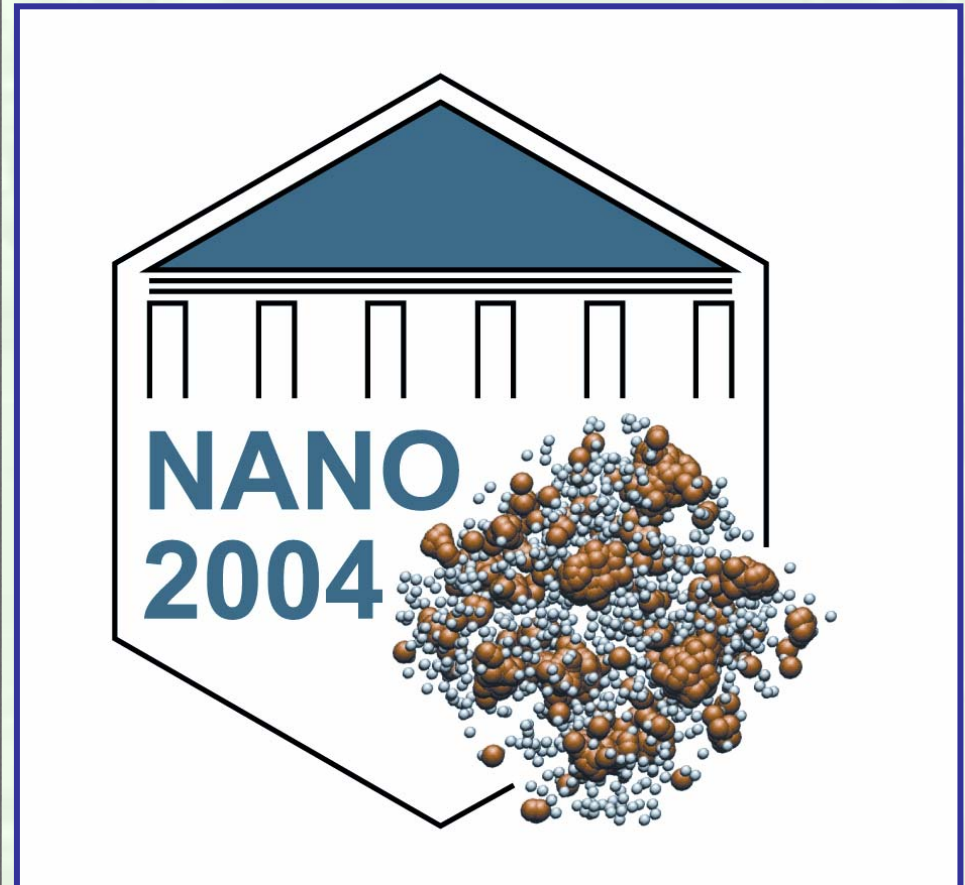
VDI Technologiezentrum

## Technological Analysis

Industrial application  
of nanomaterials –  
chances and risks

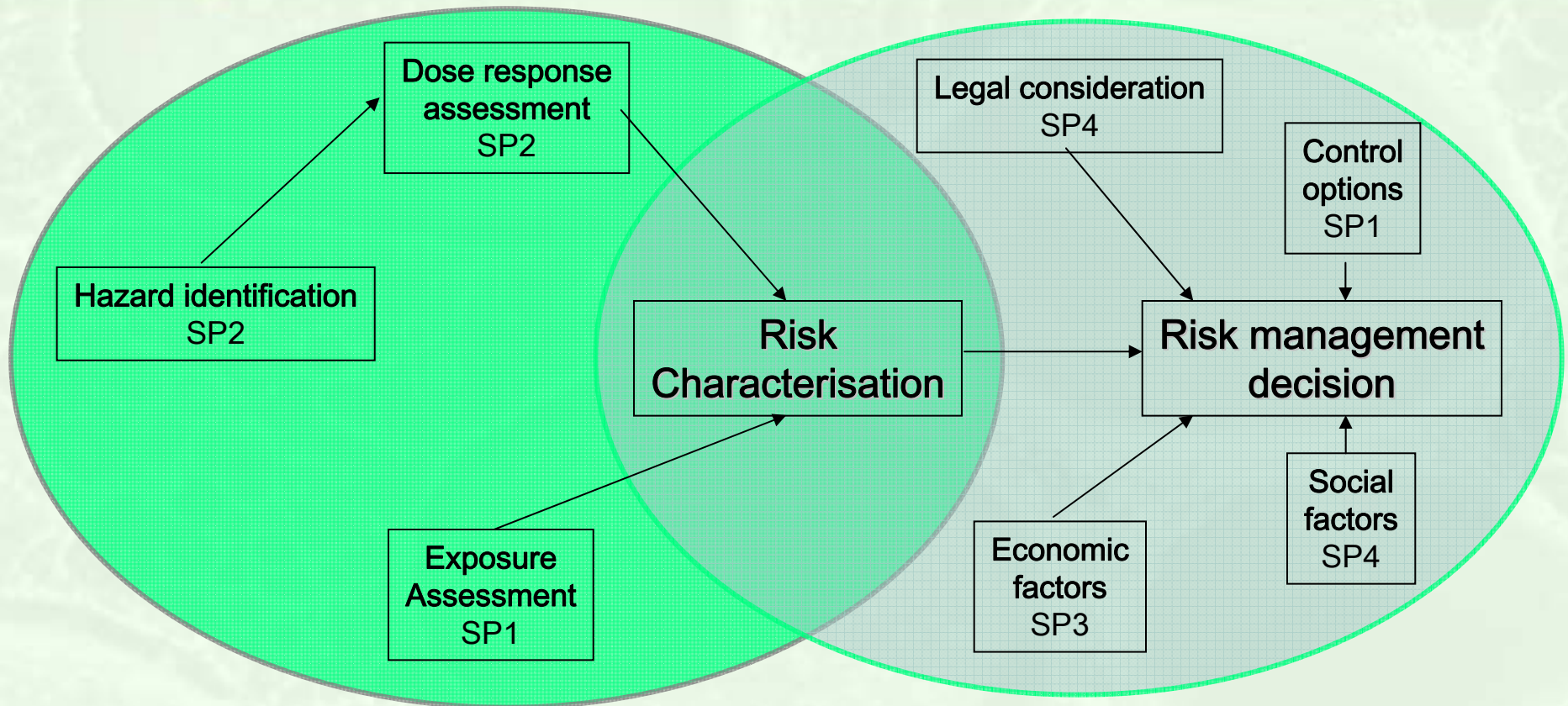


With the support of the European Commission

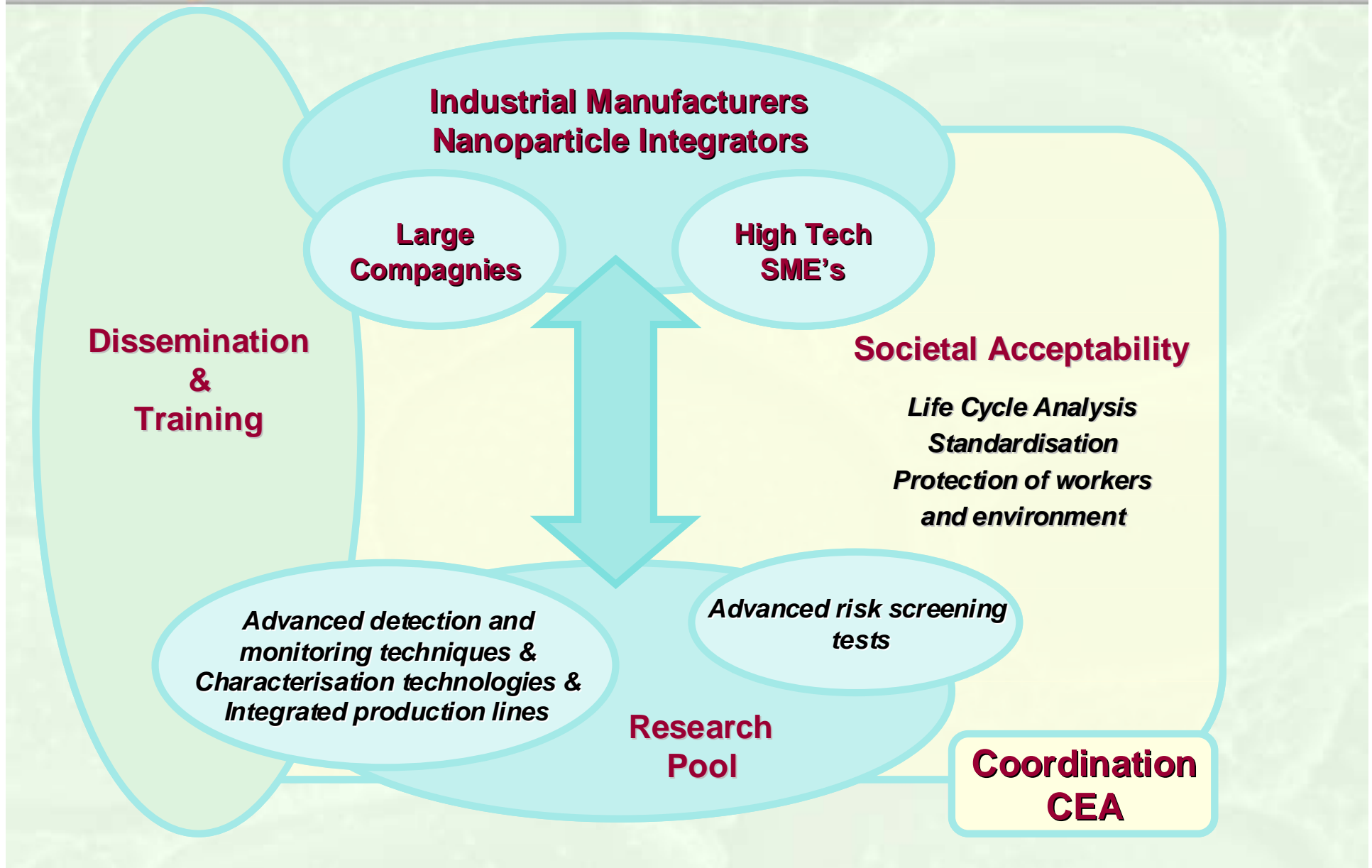


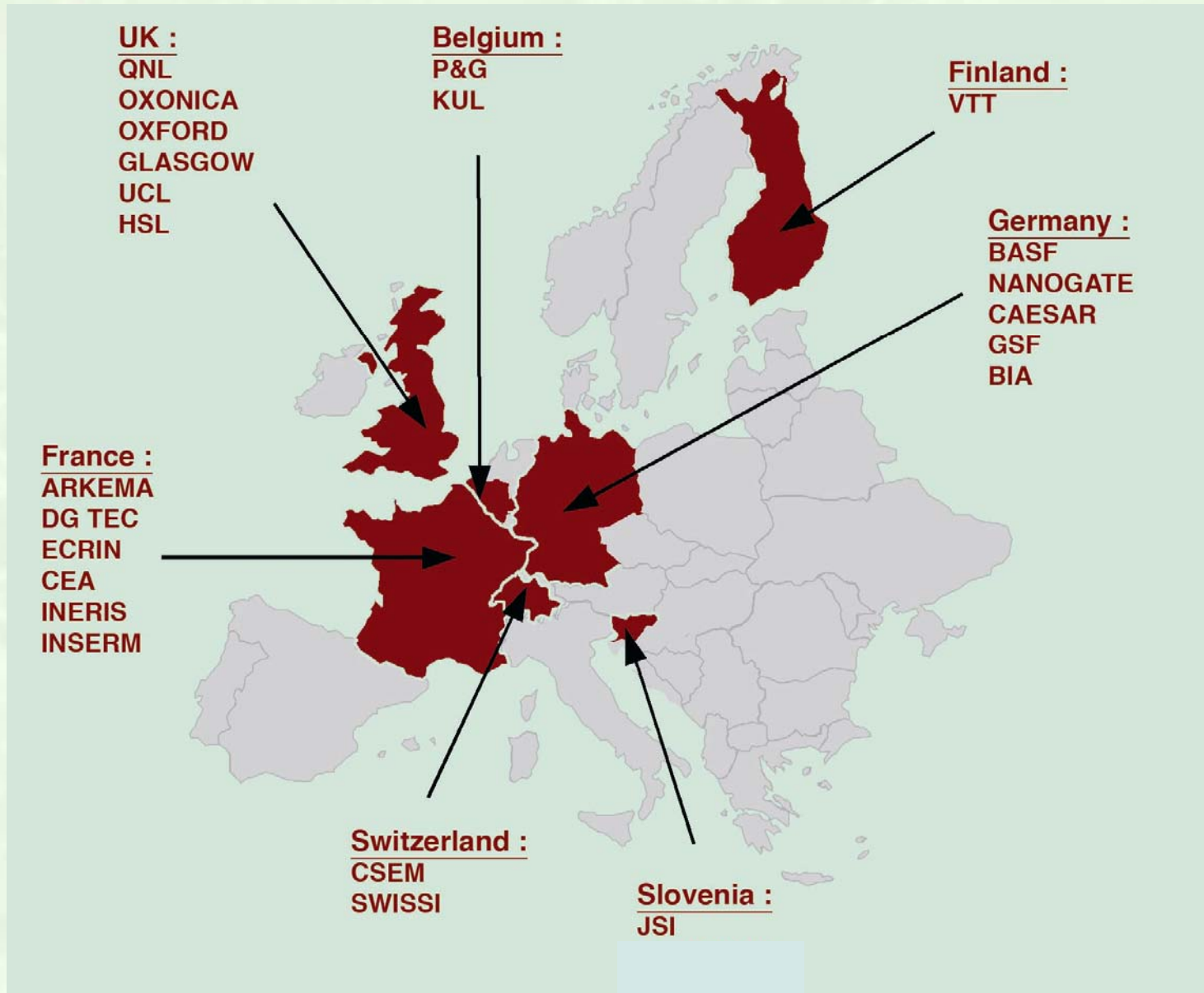
Overview of the NANOSAFE 2  
integrated project





A **consistent integrated** approach from risk assessment to risk management









Work in progress

## SP1

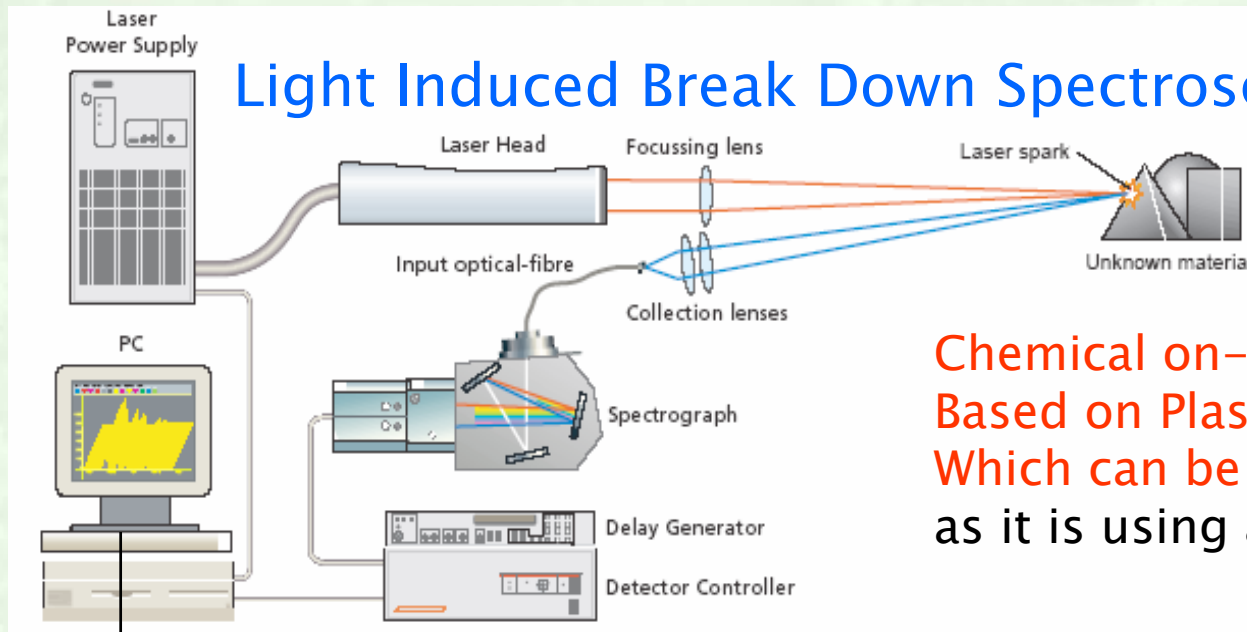
Advanced detection & monitoring  
technologies

### Existing equipment evaluation at Oxonica, Quinetiq, JSI, CEA, **VTT**

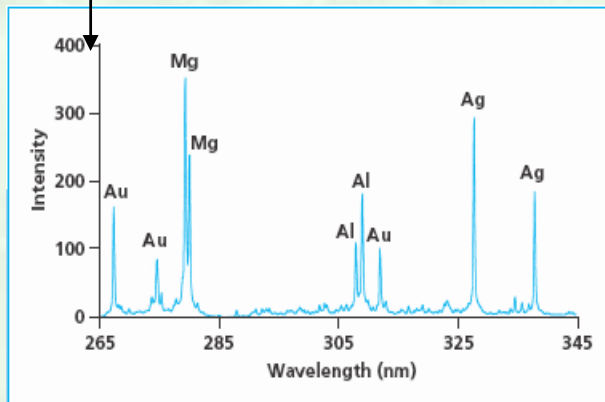
- TSI 3080 series Electrostatic Classifier
- TSI Model 3007 Condensation Particle Counter
- TSI 3090 Engine Exhaust Particle Sizer Spectrometer
- DEKATI
- GRIMM SMPS
- Low pressure impactor berner type (>21 nm)
- TSI FMPS
- NSAM
- TEOM
- ....



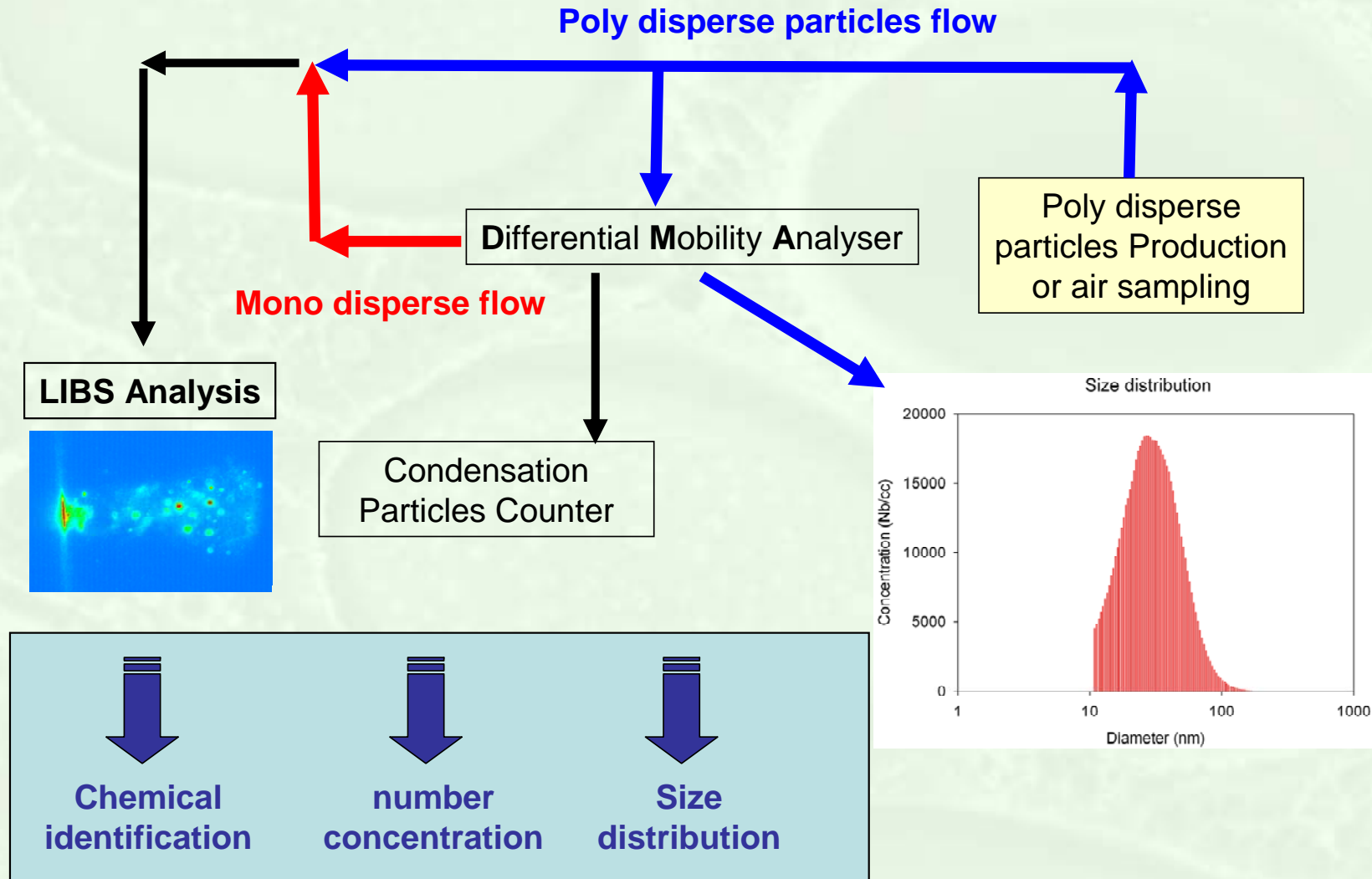
## Light Induced Break Down Spectroscopy (LIBS)

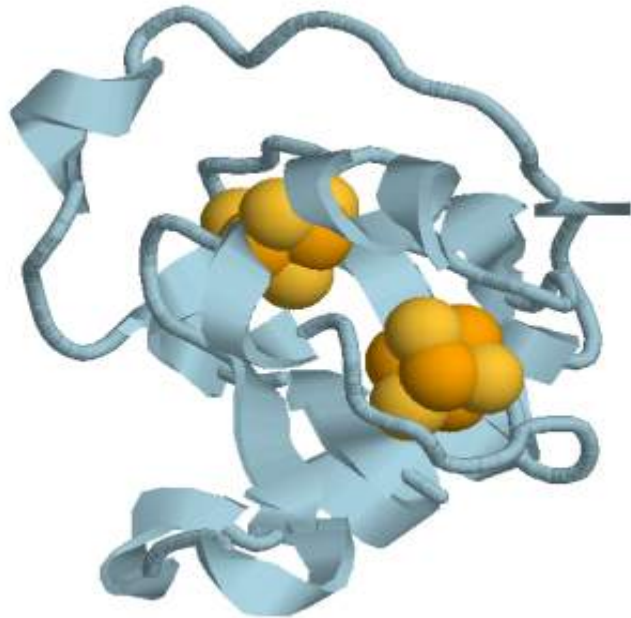
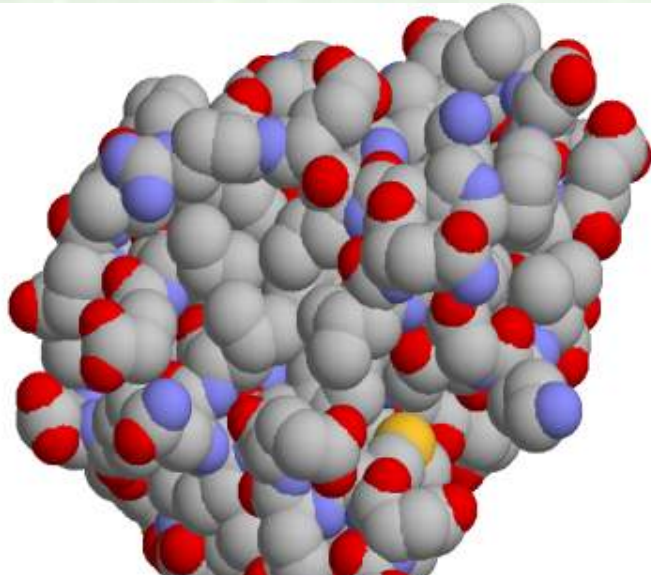


Chemical on-line analysis  
Based on Plasma spectroscopy  
Which can be remote (TRE-LIBS)  
as it is using an optical technique

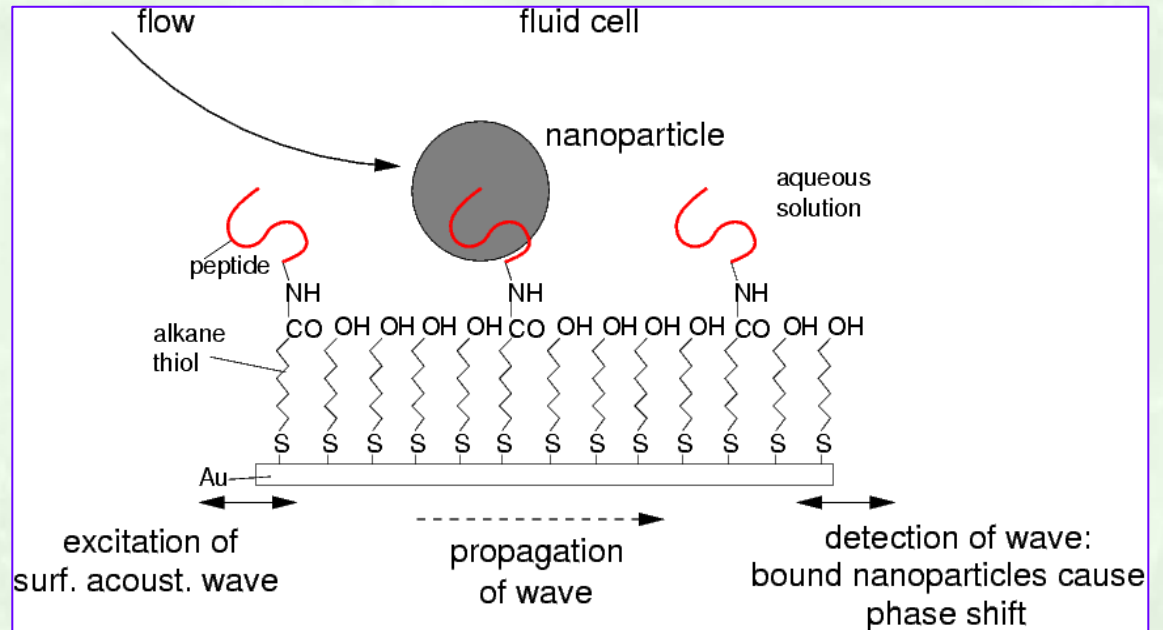


Generate a local plasma on a material  
using intense pulse laser  
Record spectra of plasma compounds  
using gated intensified CCD UV-IR  
Make a spectral analysis  
using NIST spectra (atom, molecule)



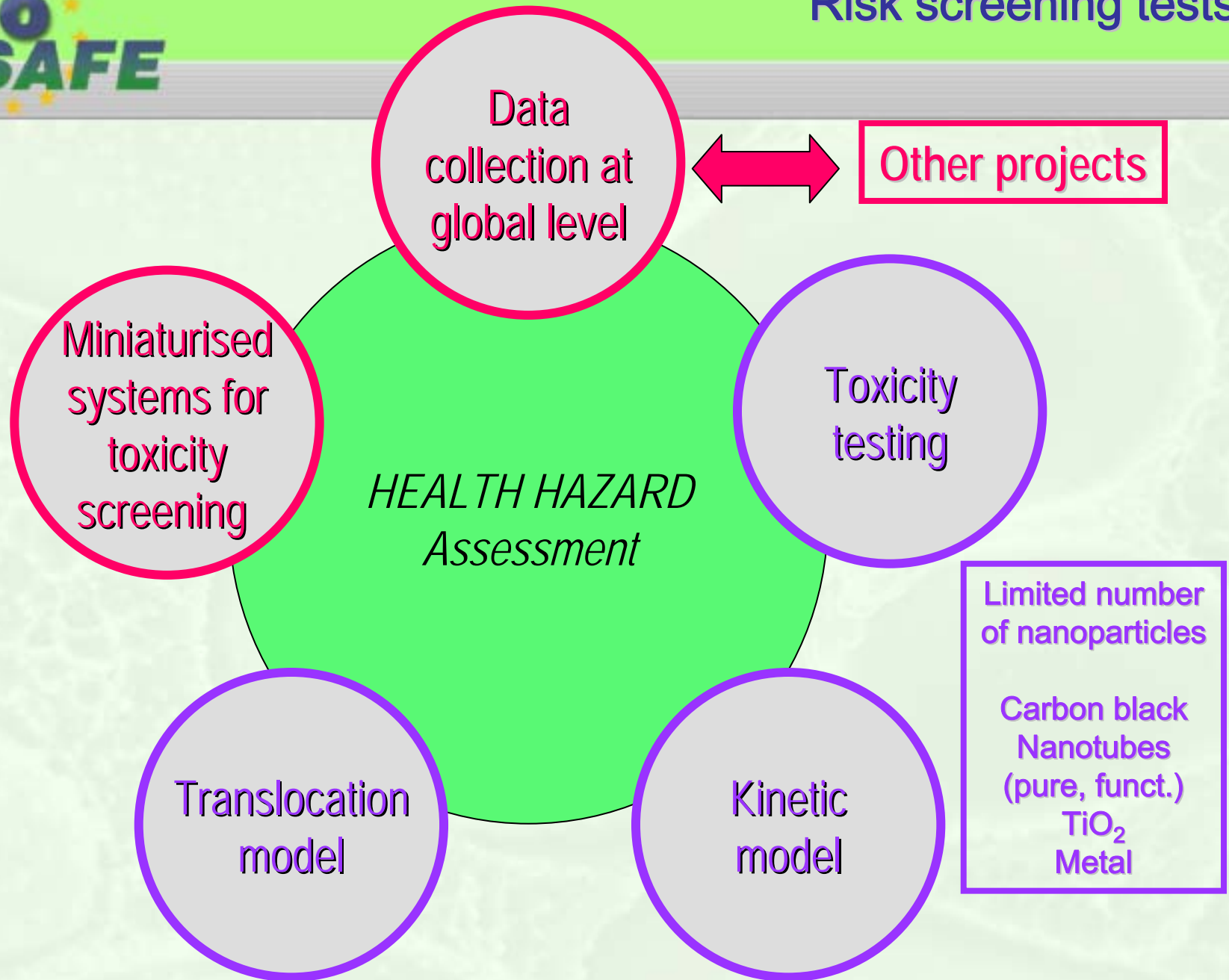


## Peptide selection at CAESAR for selective particle detection in liquid

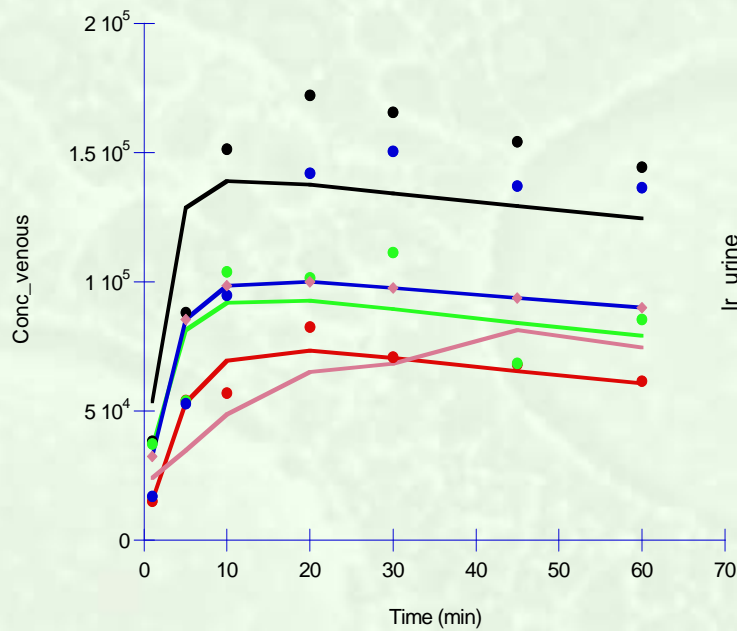


**SP2**  
Risk screening tests

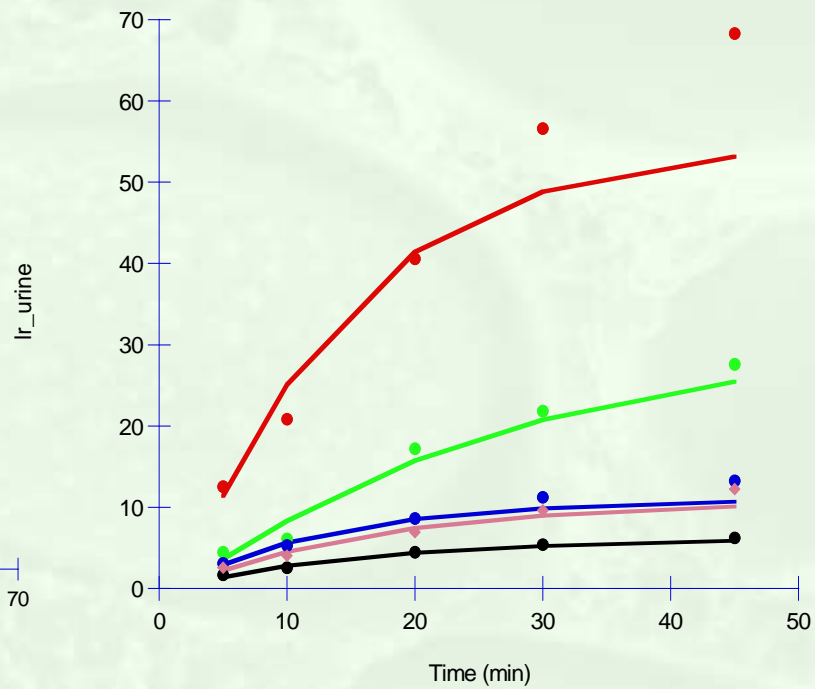




Simulation of body distribution



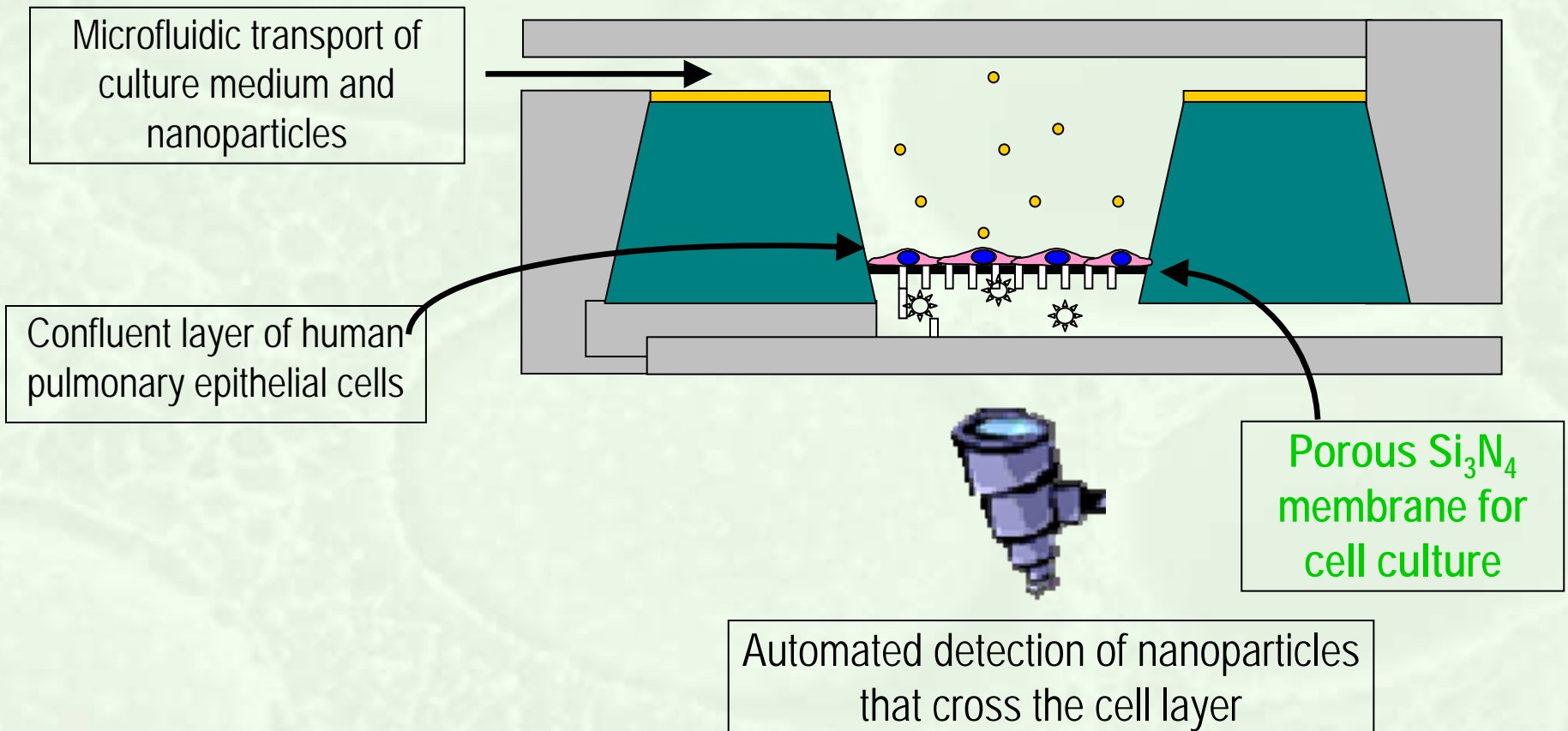
Simulated concentration in venous blood



Simulated Intensity in urine region



Simulated subject (Prediction)





Study Explosion Scale up effects  
Evaluate particle size dependence effects

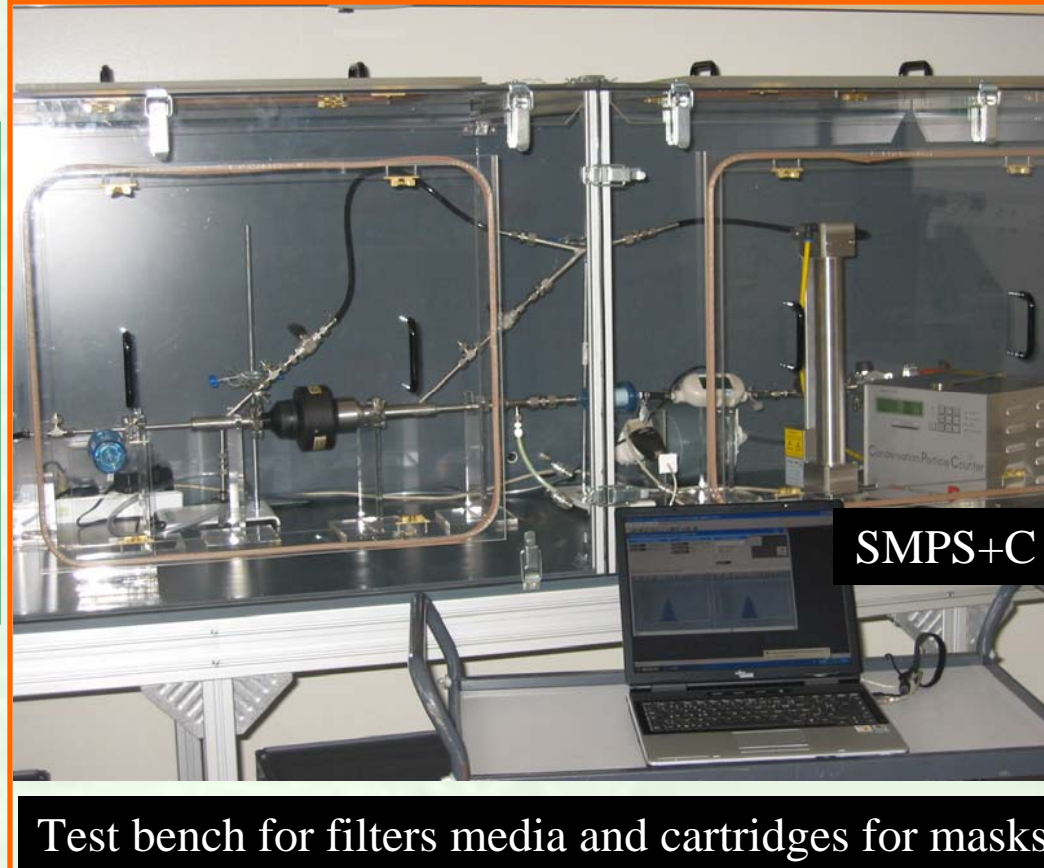
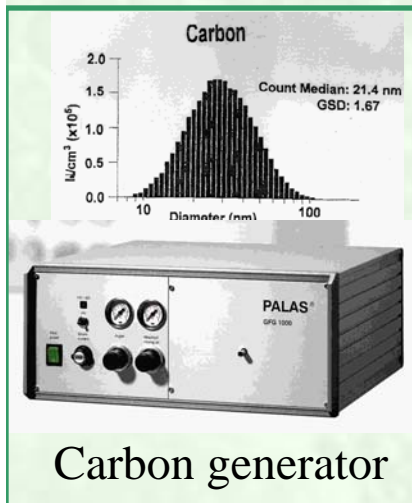


**SP3**  
Secure integrated industrial systems

Nanoparticles confinements and protections at working place

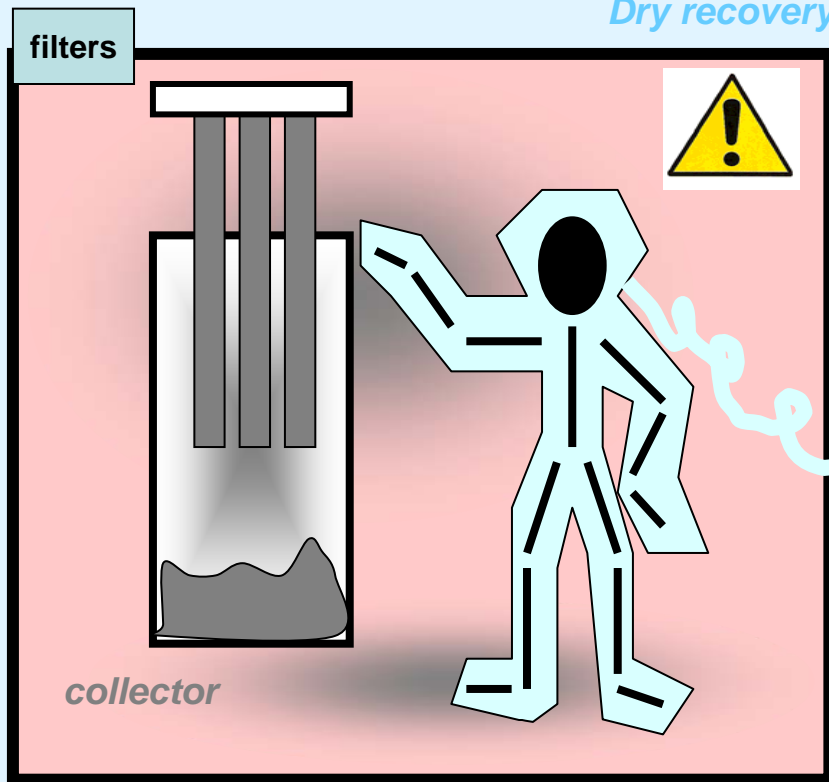
Design of 2 test benches reproducing the conditions of use for:

- HEPA Filters media and cartridges for masks: negative pressure from front to back side of the media
- Clothes and gloves: contact with nanoparticles on one side of the protection device

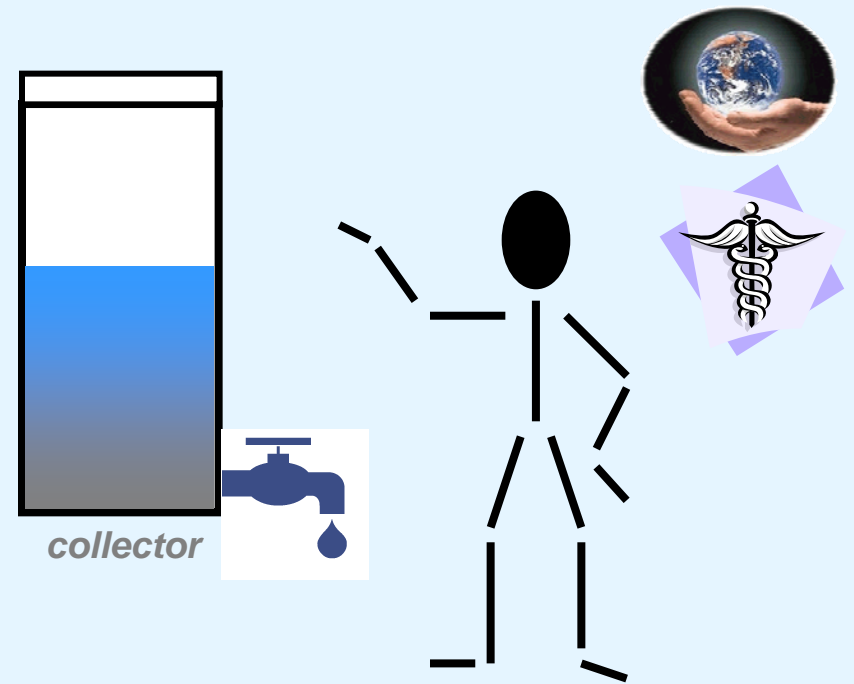


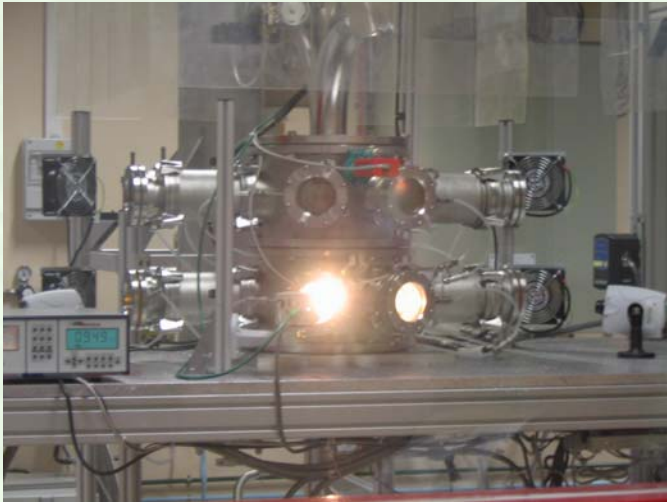
Liquid recovery of nanoparticles by produced by laser pyrolysis:  
Firsts tests of recovery

*Dry recovery*



*Liquid recovery*





*Pilot unit of CEA*



Prod. rates: 1 kg/h for SiC nanoparticles

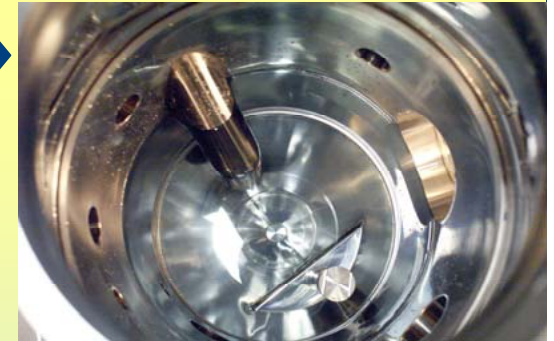


#### First test of recovery

- **bubbling** in a liquid using ultrasonic
- **In-situ cleaning of filters** using gas jets
- **pulverisation of liquid** (at the end of the experiment)



before →

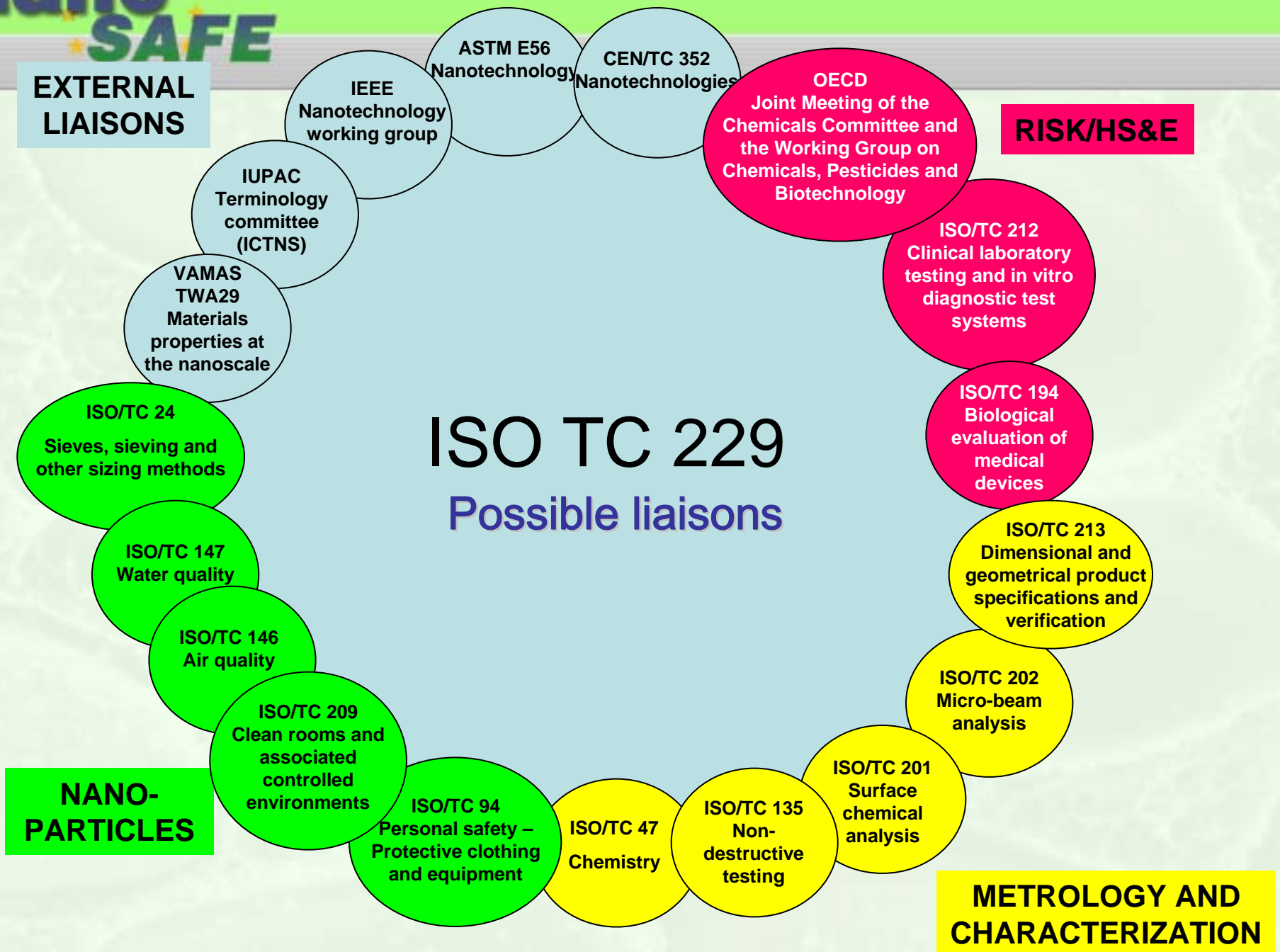


← after



**Recovery** of a suspension of TiO<sub>2</sub> nanoparticles in water (+ dispers. agent) using the equipment designed at CEA

**SP4**  
Societal & Environmental acceptability



- Courses at Master level (INERIS, Oxford)
  - March 17, ISI , Nancy France - 3 h (20 students)
- Courses at Professional Level (INERIS, HSL, BGIA and ECRIN)



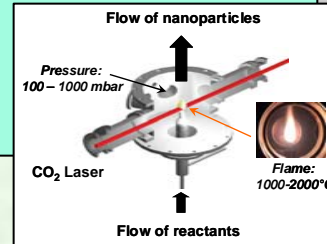
...end of chain

### Raw material resources

- metals & ceramics
- Liquid precursors
- Reactive gases
- Industrial liquid wastes
- biogases

### Safe production of nanoparticles

- laser
- plasma
- CVD



### Conditioning & Net shape processing



**Solutions for recycling**  
*on a limited number of representative examples*

### Dissolution & Liquid precursor synthesis

### Separation / Machining

- MMC
- Gradient materials

Use of residual wastes



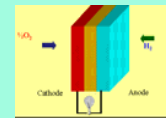
Automotive



Construction



Aeronautics



Energy

The industrial production and use of nanoparticles will be the driving force for the emerging new materials industry of the 21st century

## Project summary

Submitted by [admin](#) on 6 April, 2005 - 20:15. [Articles](#)

The rapidly developing field of nanotechnologies presents many opportunities and benefits for new materials with significantly improved properties as well as revolutionary applications in the fields of energy, environment, medicine, etc. The industrial production and use of nanoparticles will be the driving force for the emerging new materials industry of the 21st century. In terms of economics, analysts have estimated that the worldwide market for nanomaterials will be 700-1000 billion Euro in 2011. However, the potential impact of these new materials on human health and the environment is viewed with apprehension. This new industry can only develop dynamically if these preoccupations are satisfactorily allayed.

[» read more](#)

## Project objectives

Submitted by [admin](#) on 6 April, 2005 - 20:06. [Articles](#)

The overall aim of NANOSAFE2 is to develop risk assessment and management for secure industrial production of nanoparticles. As the world of nanoparticles is already very wide today, only a finite

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