

The Italian metrological institute



MISSIONE

L'**INRiM** è un **ente pubblico di ricerca scientifica** che svolge per l'Italia le funzioni di **istituto metrologico nazionale**, costituendo il presidio di gran parte della metrologia, la scienza delle misure.

L'INRiM realizza, mantiene e sviluppa i **campioni di riferimento nazionali** delle sette unità di base del **Sistema Internazionale (SI)** - **metro, kilogrammo, secondo, ampere, kelvin, mole e candela** - e delle rispettive unità derivate. Attraverso tali campioni garantisce l'affidabilità delle misure a livello nazionale e la loro comparabilità a livello internazionale.

L'attività metrologica fondamentale è sostenuta e affiancata dalla ricerca di base e applicata in numerosi settori: la **scienza dei materiali**, le **nanoscienze**, l'**ottica quantistica**, lo **sviluppo di tecnologie e strumenti di misura innovativi**, gli studi sulle **costanti fondamentali della fisica**.

Conferenze, mostre, manifestazioni e congressi sono lo strumento con cui l'INRiM **comunica e divulga** i risultati delle proprie ricerche. Assicura la **formazione e l'addestramento** di giovani ricercatori attraverso corsi di dottorato, borse e assegni di ricerca.

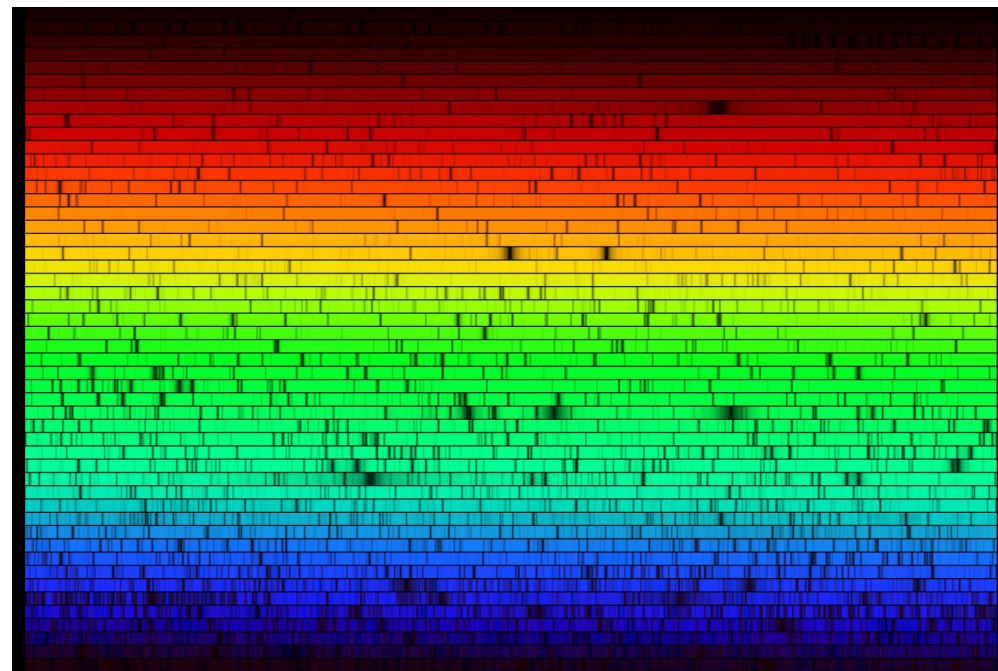
Per rispondere alle esigenze dell'industria l'Istituto possiede una struttura dedicata all'innovazione e ai servizi tecnologici avanzati, che interagisce direttamente con le aziende e il mondo della produzione e presta **servizi di consulenza, taratura e prova**.

L'INRiM opera a sostegno del **Sistema Nazionale di Taratura**, garantendo la qualità dei riferimenti metrologici e curando la disseminazione dei campioni nazionali delle unità di misura.

New narrow lasers for spectroscopy

Non-invasive, fast environmental analysis

Lucia Duca, Elia Perego, Carlo Sias



Collaborative Project Building Day
Polo Mesap

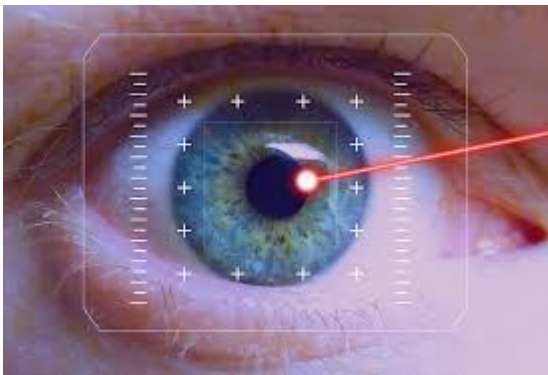
Unione Industriale di Torino – Sale Sindacali, Torino, 23rd November 2018

Why “narrow” lasers

Powerful tool



Precise tool

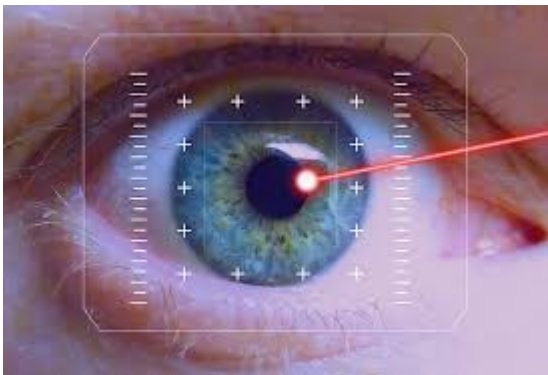


Why “narrow” lasers

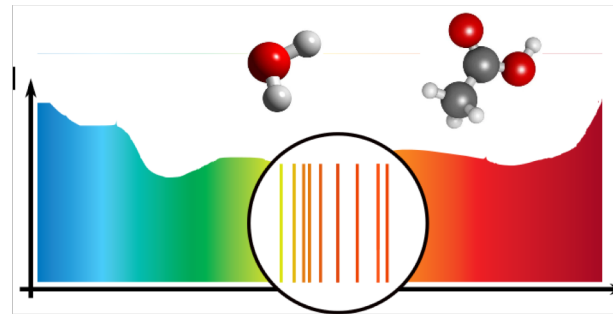
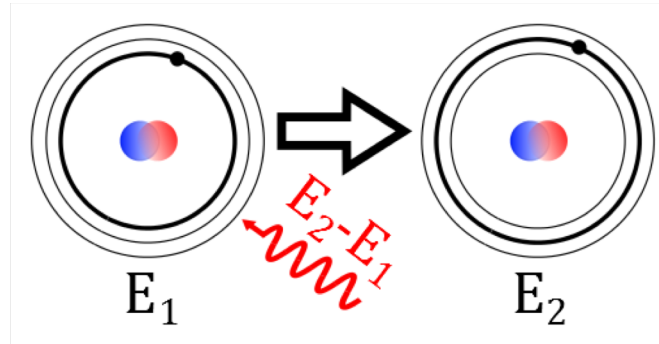
Powerful tool



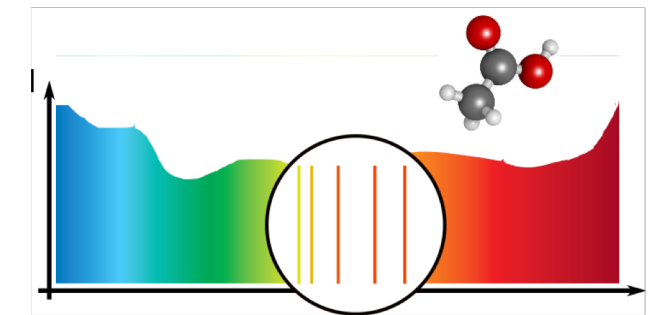
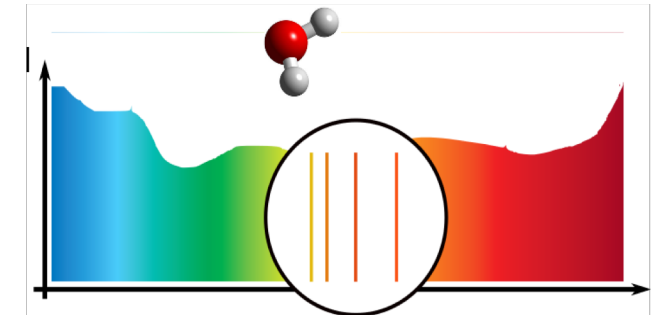
Precise tool



Light is made of single «lines»



Learning what elements
are around us

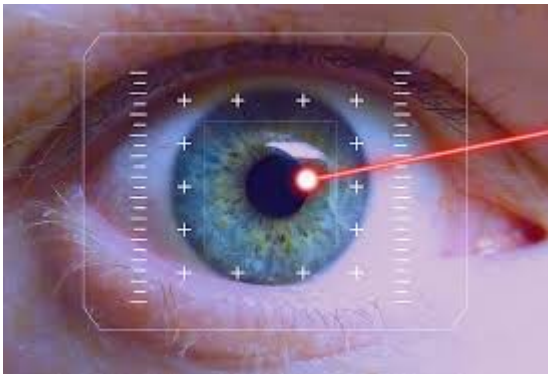


Why “narrow” lasers

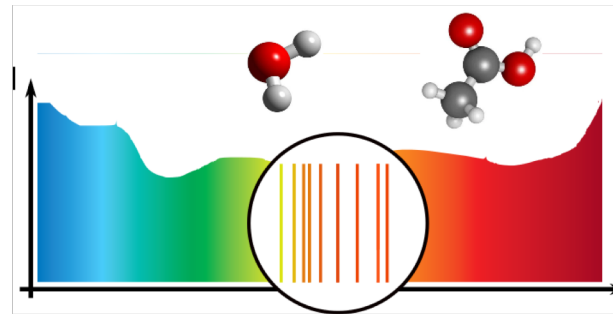
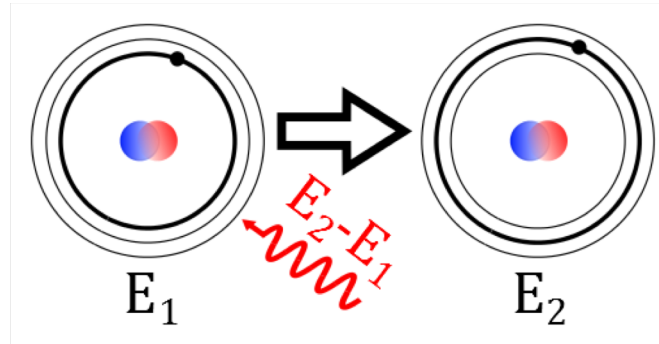
Powerful tool



Precise tool

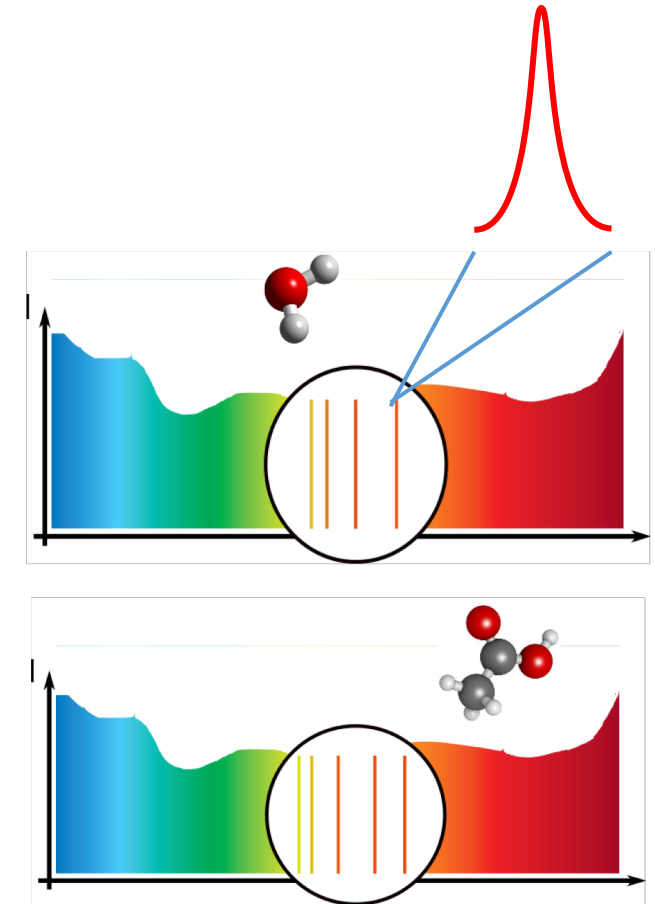


Light is made of single «lines»



Learning what elements
are around us

I need a precise laser!

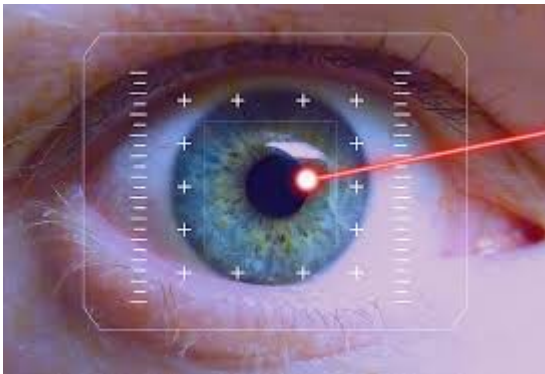


Why “narrow” lasers

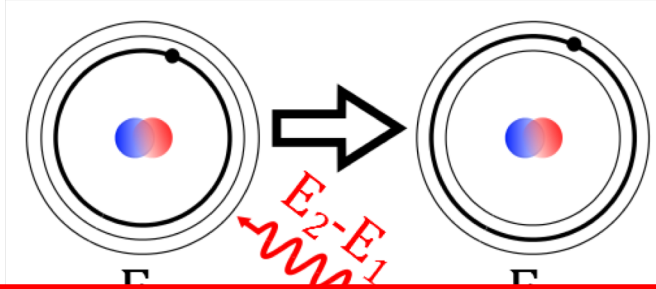
Powerful tool



Precise tool

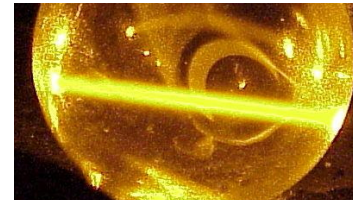


Light is made of single «lines»



Applications

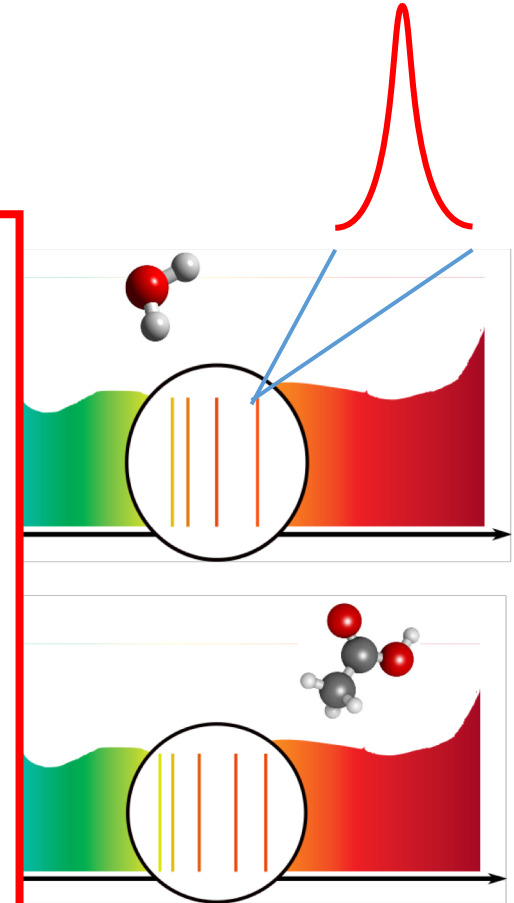
Precision
measurements



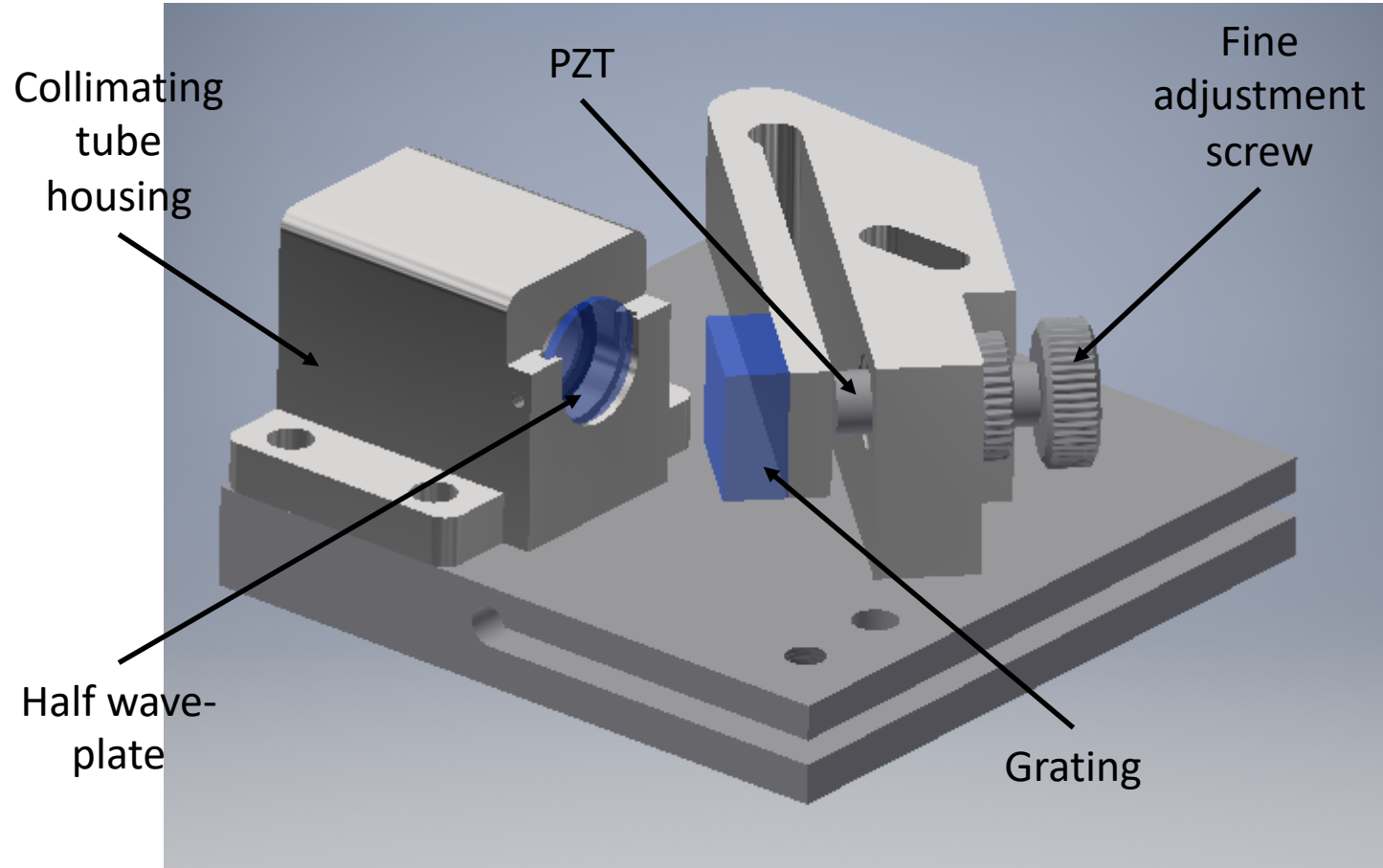
Non-invasive analysis
of the environment



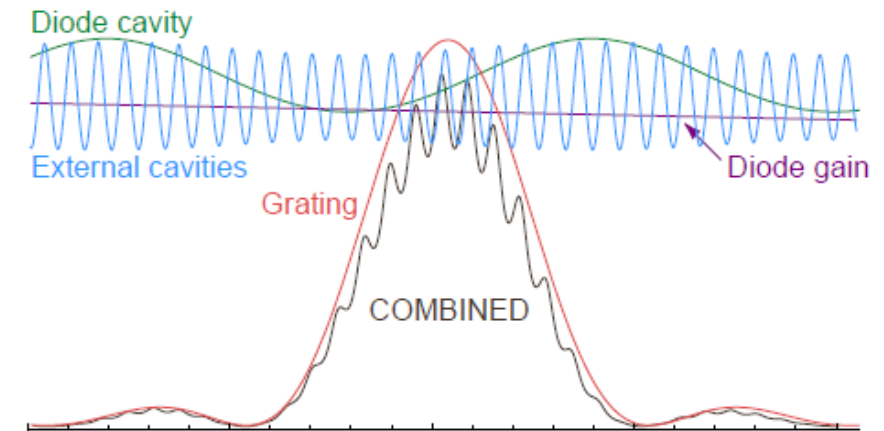
I need a precise laser!



Extended cavity diode lasers

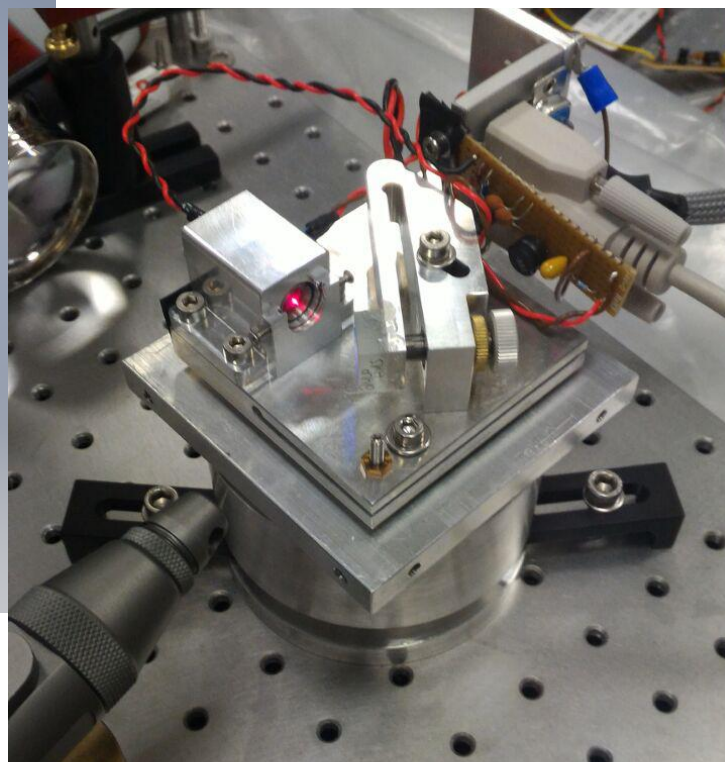
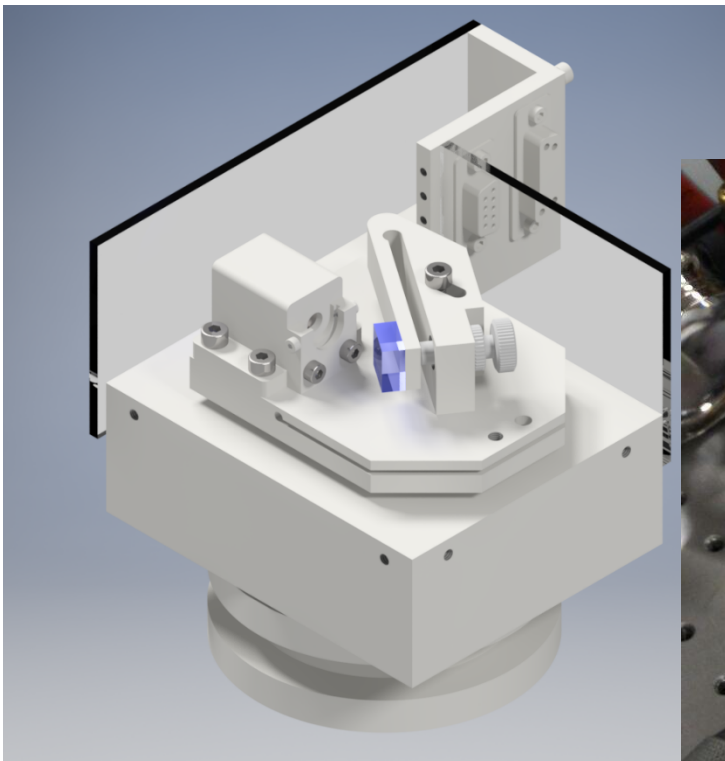


Narrow linewidth lasers!

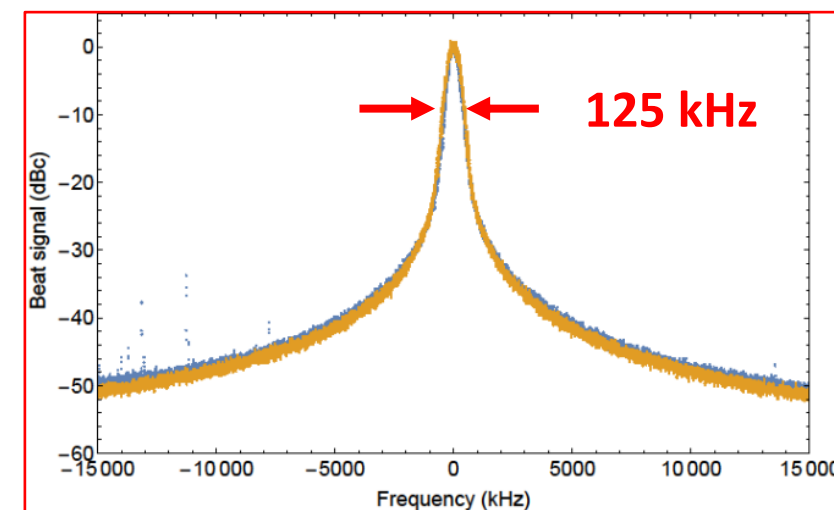


Our solution

Patent pending

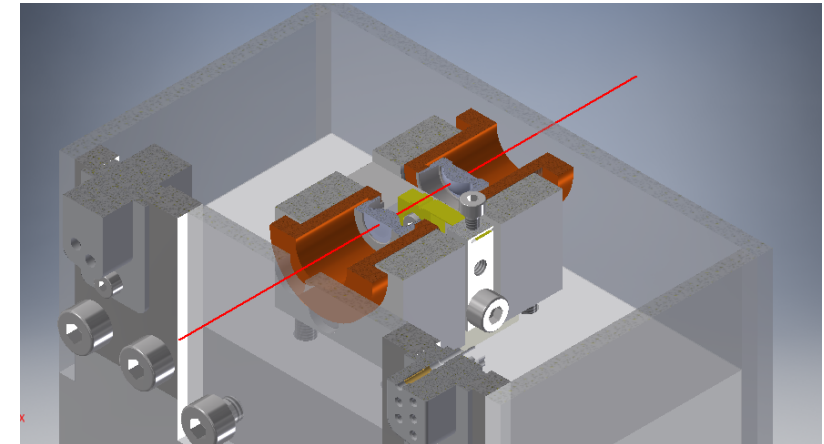


- Enhanced mechanical stability
- Excellent linewidth performance
- Excellent reproducibility



Future – towards applications

- Miniaturization → making it **transportable** (see ppqSense)
- Amplification → making it **powerful**
- Stabilization → making it **more precise**



INRiM activities in Nanometrology Laboratory

Metrology of functional surfaces

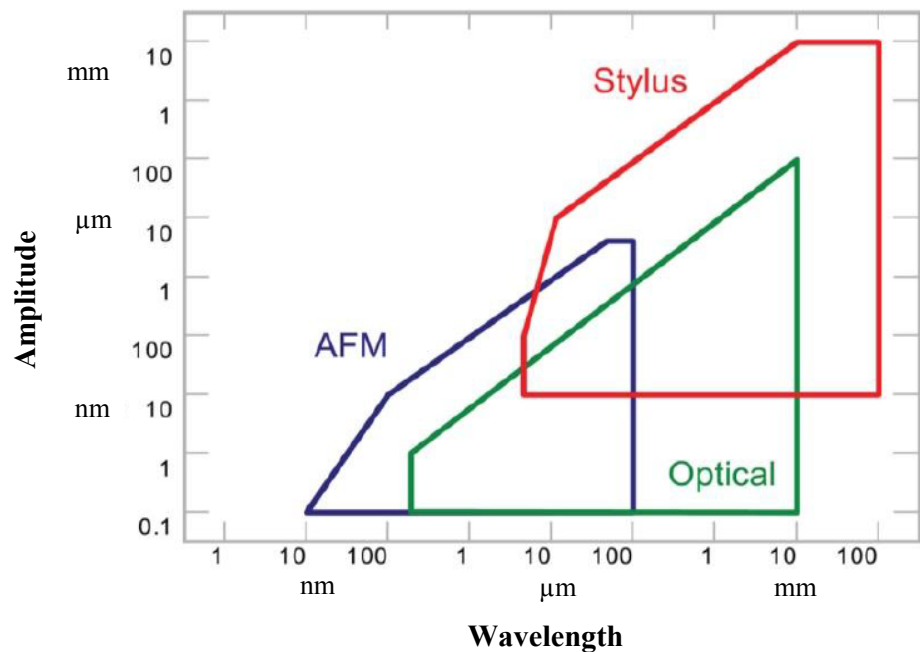
Gian Bartolo Picotto, Luigi Ribotta (INRiM, STALT Division, Nanometrology Laboratory)
Valter Maurino, Francesco Pellegrino (UniTo, Chemistry Department, CEA group)

Collaborative Project Building Day
Polo Mesap

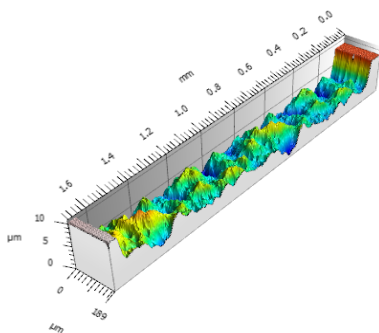
Unione Industriale di Torino – Sale Sindacali, Torino, 23rd November 2018

Surface texture

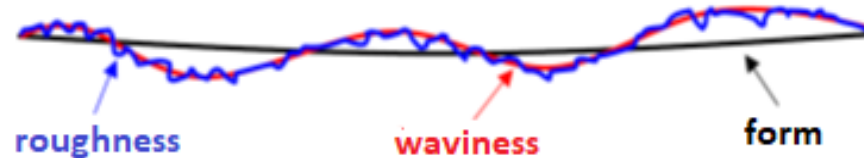
ISO 25178 – GPS (Geometrical Product Specifications)



roughness standards

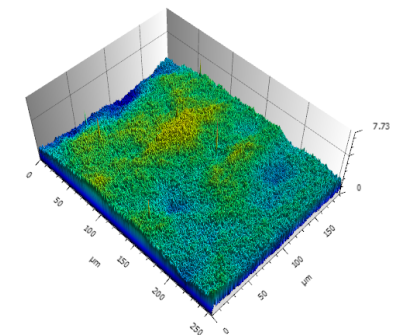


2D profile texture parameters



primary, waviness and roughness profiles

3D areal texture parameters



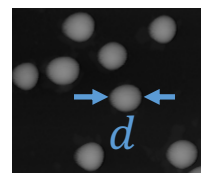
surface parameters

uncertainty: $10 \text{ nm} + 30 \times 10^{-3} \cdot R_a$
($0.01 \text{ μm} < R_a < 20 \text{ μm}$)

stylus profilometer

Measurands capabilities

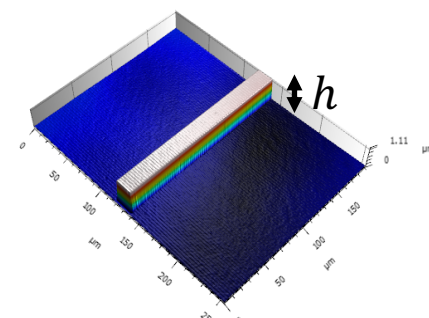
nanoparticles
(spherical, platelets)



uncertainty: $2 \text{ nm} + 3 \times 10^{-3} \cdot d$
($10 \text{ nm} < d < 500 \text{ nm}$)

metrological
atomic force microscope

groove and step-height
standards



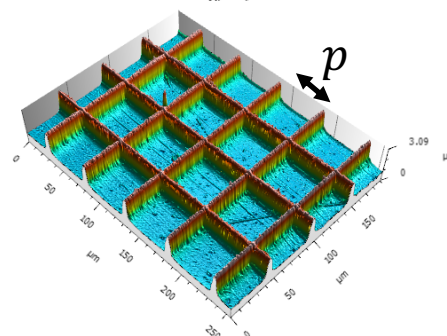
uncertainty: $1 \text{ nm} + 4.7 \times 10^{-3} \cdot h$
($0.01 \mu\text{m} < h < 15 \mu\text{m}$)

stylus profilometer

uncertainty: $2.2 \text{ nm} + 11 \times 10^{-3} \cdot h$
($0.01 \mu\text{m} < h < 20 \mu\text{m}$)

interference microscopy

1D/2D gratings



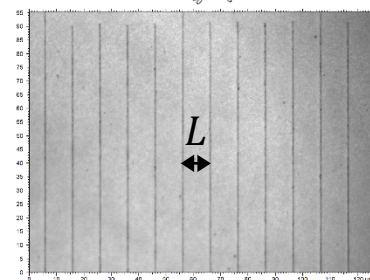
uncertainty: $2 \text{ nm} + 1 \times 10^{-3} \cdot p$
($0.1 \mu\text{m} < p < 5 \mu\text{m}$)

metrological
atomic force microscope

uncertainty: $0.05 \cdot p$
($0.3 \mu\text{m} < p < 50 \mu\text{m}$)

laser diffractometer

linescales



uncertainty: $80 \text{ nm} + 0.87 \times 10^{-6} \cdot L$
($0.1 \text{ mm} < L < 280 \text{ mm}$)

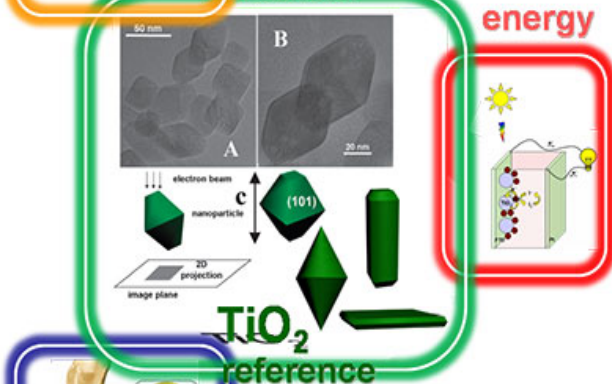
optical microscope

Nanoparticles chemistry

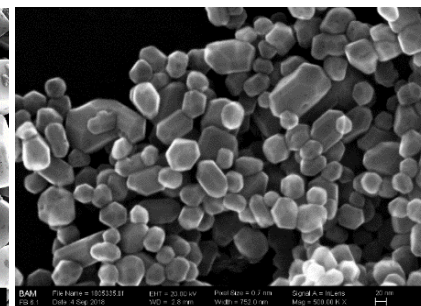
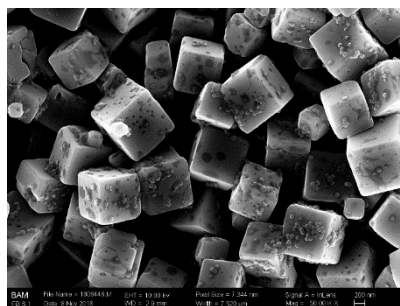
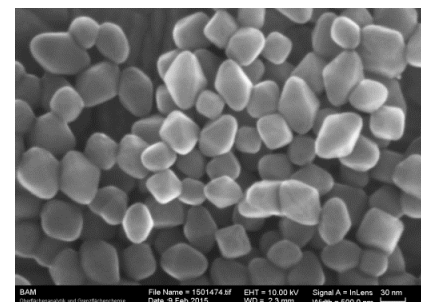
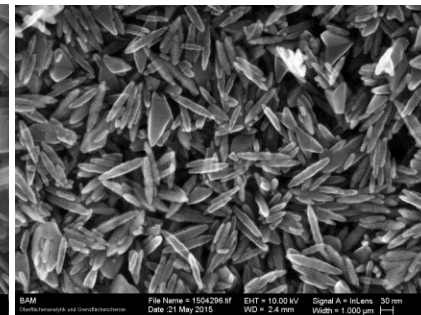
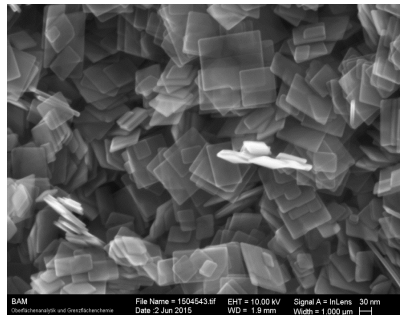
environment



candidate



health



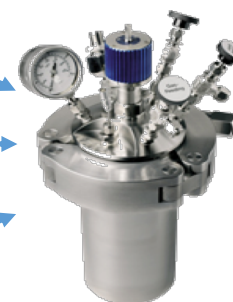
high temperature

pH

time = 24 hours

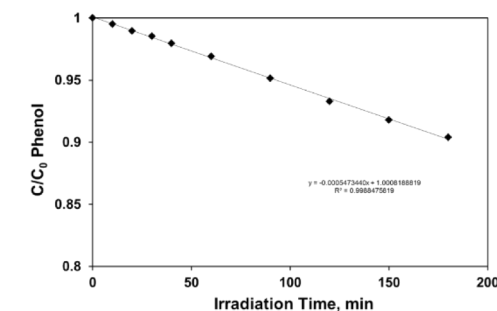
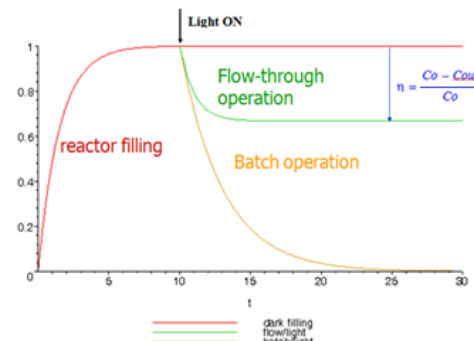
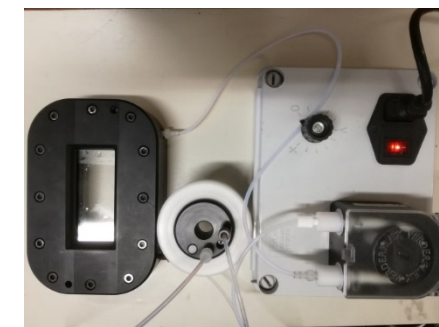
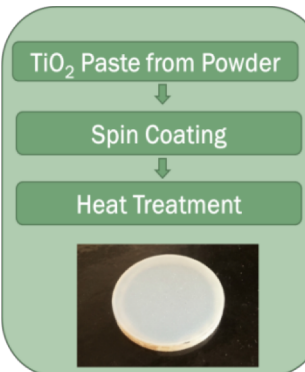
organic precursor

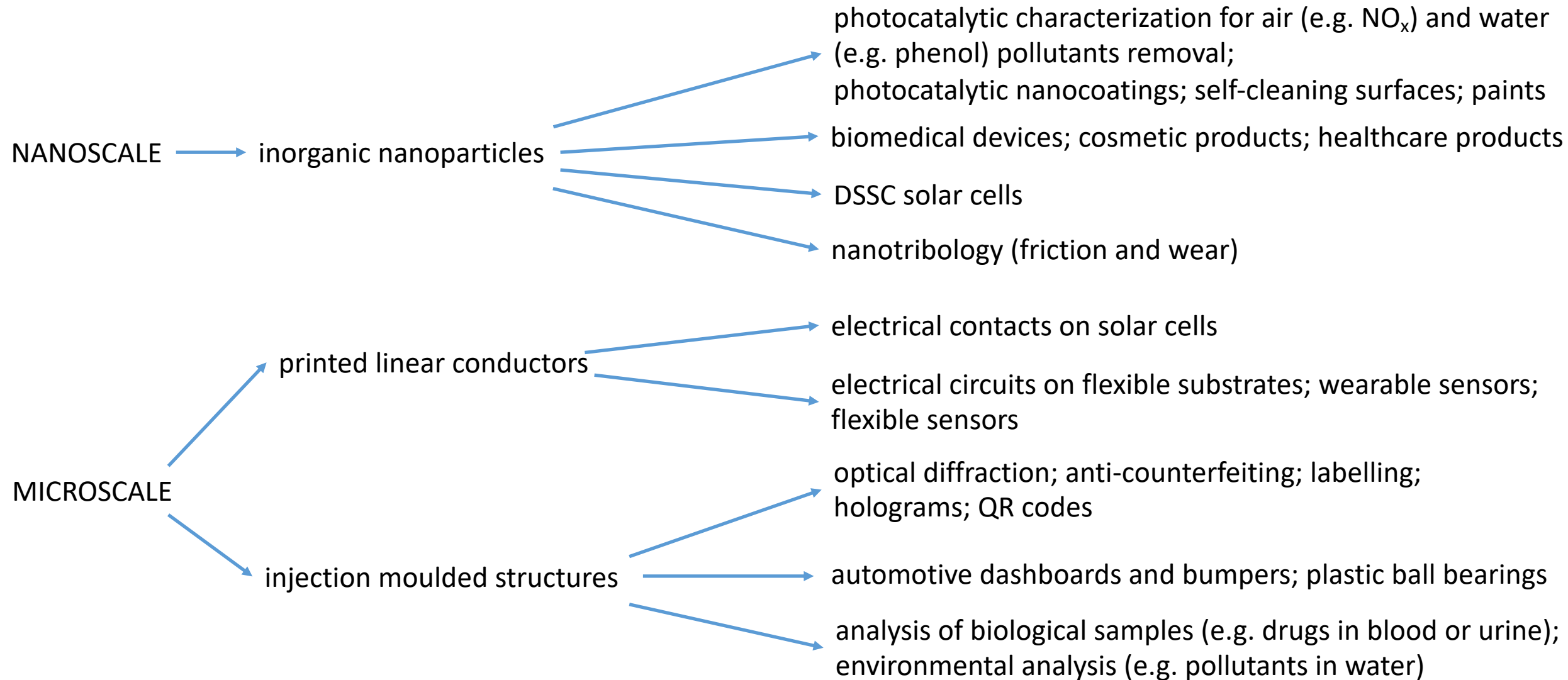
shape controller



GAS/SOLID PHOTOREACTOR

LIQUID/SOLID PHOTOREACTOR







Thank you for your kind attention!