INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

International Iberian Nanotechnology Laboratory

Your Worldwide Science and Innovation Partner

Director General: Prof. Lars Montelius

GOVERNO DE PORTUGAL

GOBIERNO DE ESPAÑA

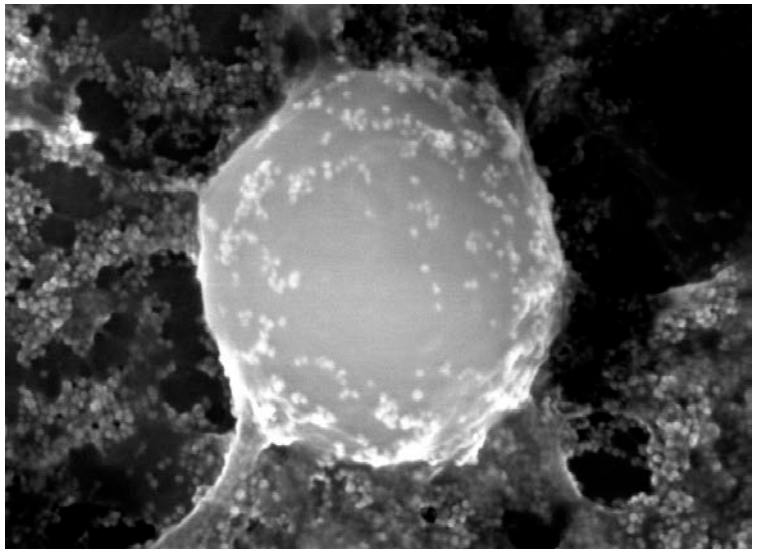
History of INL

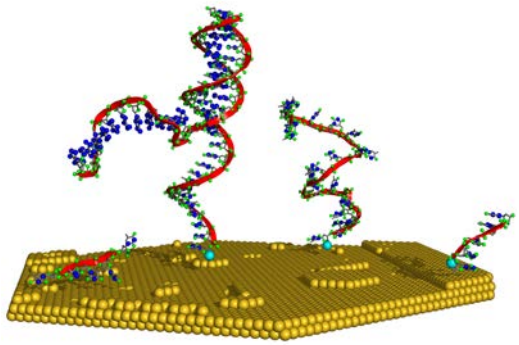
2007

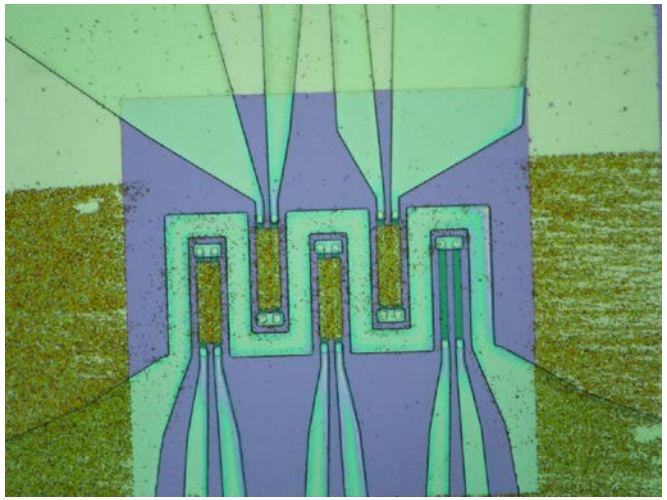
- Jointly founded by Portugal and Spain
  - Concept in 2005, construction in 2008, personnel in 2011
- Current statistics in 2016
  - Located in Braga, Portugal
  - About 400 researchers from over 30 countries
  - Main building: 22000 m^2; laboratories 7500 m^2; cleanroom 1000 m^2
  - Modern infrastructure, integrated nano-incubator, social facilities

Integrated Research Organization

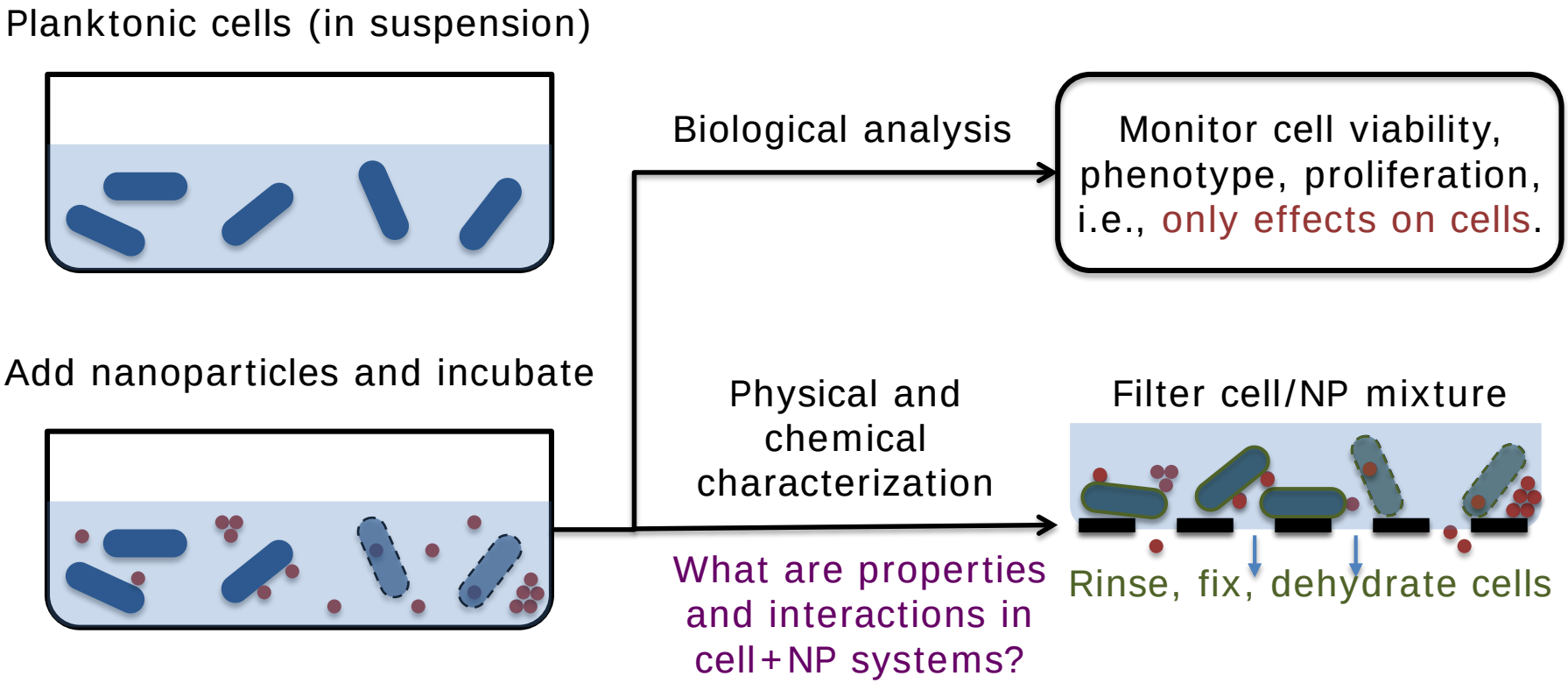
- Integrated internally
  - Life sciences
  - Physical sciences
  - Micro- and nano-fabrication
  - Engineering and system integration
- Integrated with partners
  - Academic, research, and industrial
  - Regional, European, and global





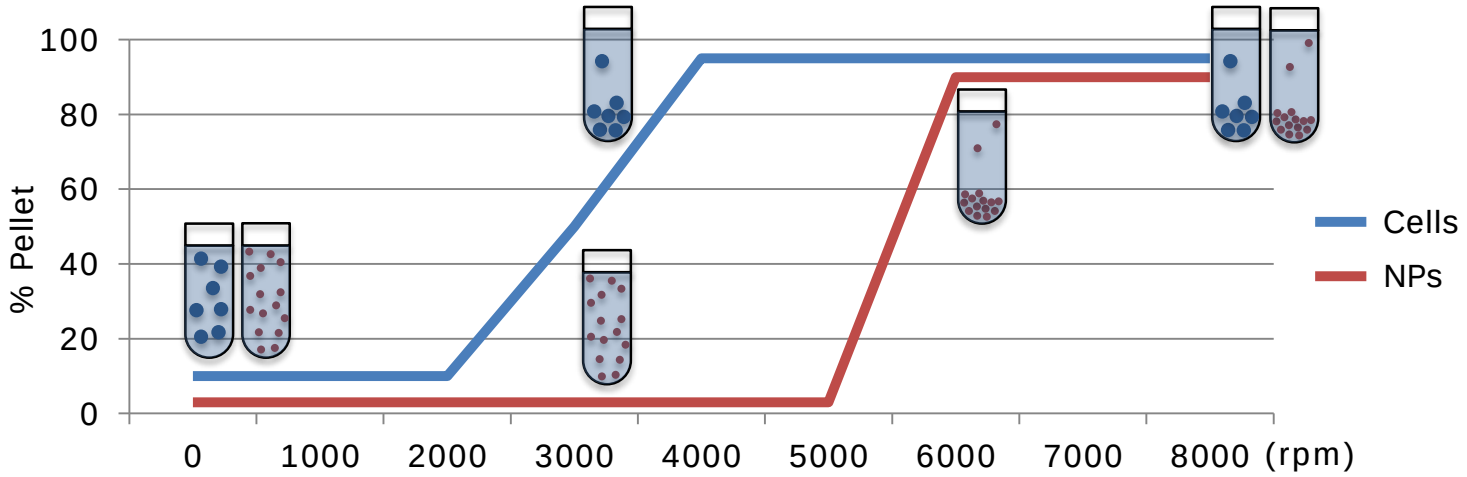


Physical Chemistry and Bioanalytics



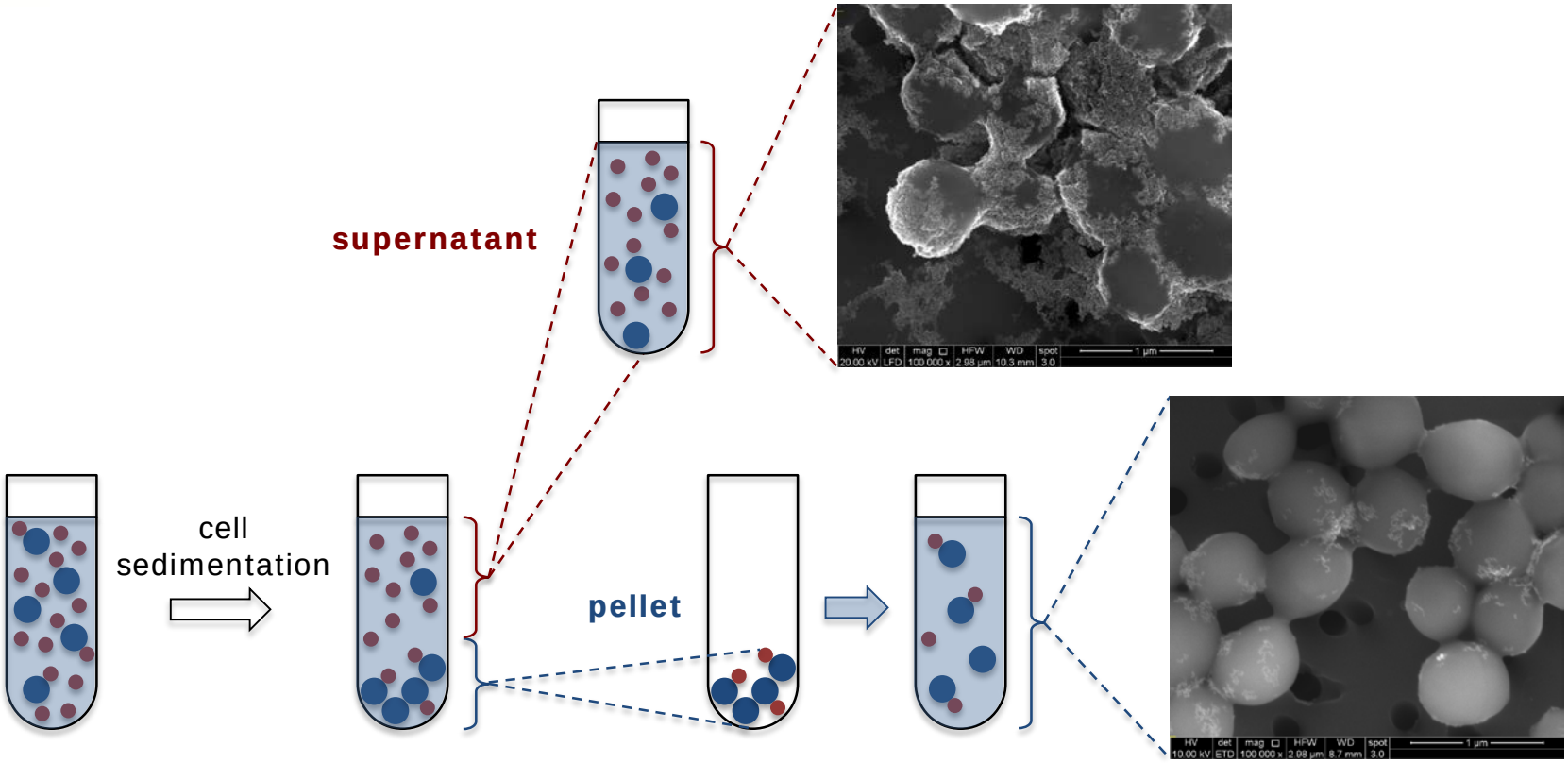
- Physical chemistry strongly impacts NP–cell bioanalytics
  - NP–cell interactions may not be just biological
  - Presence of NPs may affect biological assays

Differential Sedimentation Approach



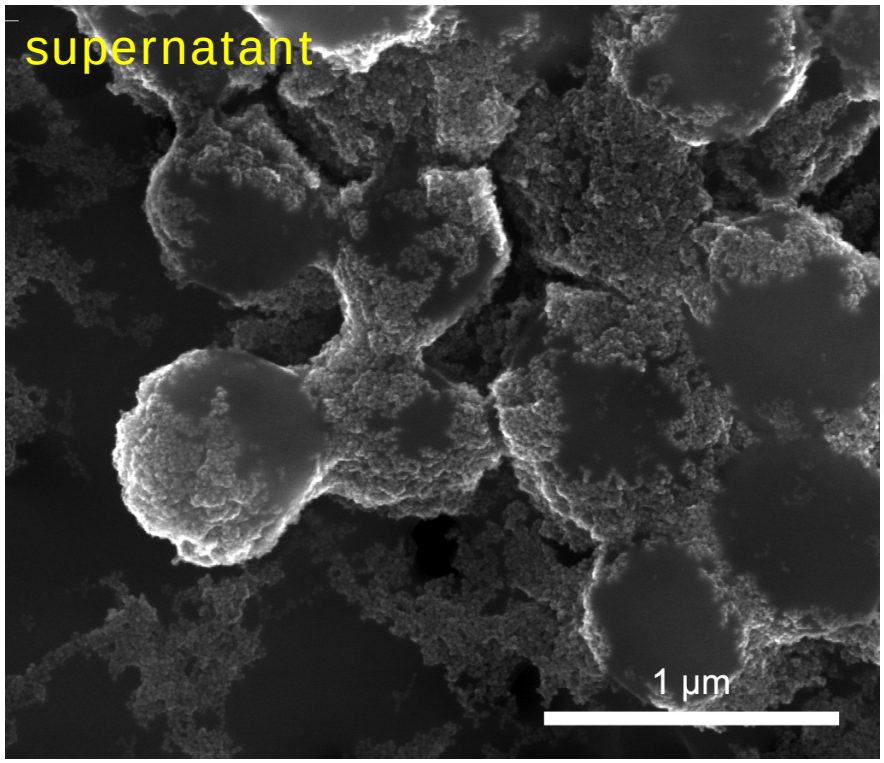
- Density-based sedimentation may not be sufficient
  - For low NP-loading limit, density changes will be minimal
- Exploit different physicochemical properties of cells and NPs
  - Solution conditions for different sedimentation thresholds?
    - Viability of cells often limits the range of solution conditions
- Establish sedimentation thresholds for cells and NPs separately
  - Colloidal stability differences are hard to predict *a priori*

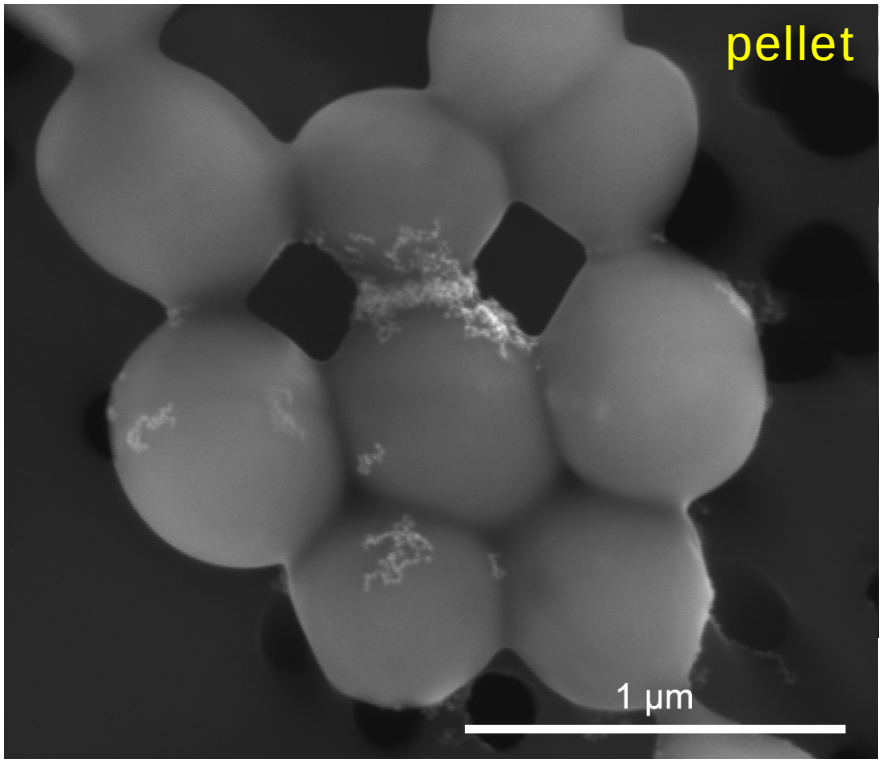
Differential Sedimentation Scheme



- Centrifugation just above cell sedimentation threshold
  - Supernatant contains free NPs and some cells
  - Pellet contains cells with any attached/loaded NPs for analysis

Separation of Free NPs & Cells+NPs





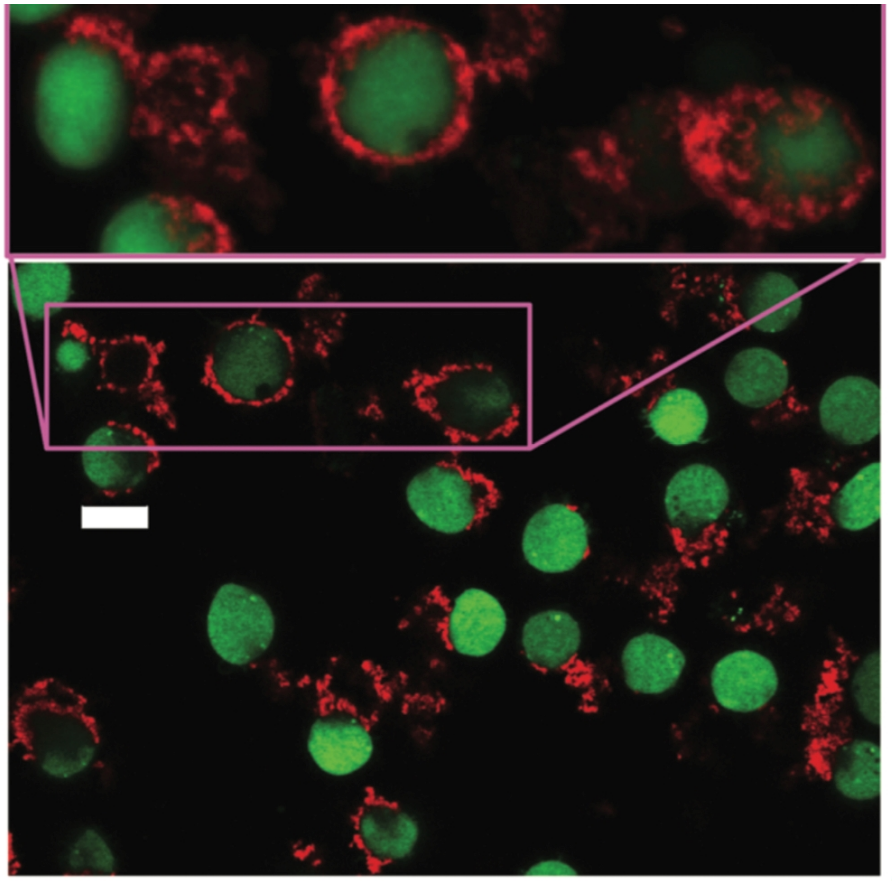
- Supernatant: some cells, many NPs aggregated during drying
- Pellet: Only NPs attached to cells *in solution* are observed by SEM
  - No free NPs in the background, different loading of adjacent cells
- Protocol allows us to preserve evidence of NP–cell interactions

Details of NP-cell Interactions

Combining CXCR4-targeted and nontargeted nanoparticles for effective unassisted in vitro magnetic hyperthermia

Vânia Vilas-Boas, Begoña Espiña, Yury V. Kolen'ko, Manuel Bañobre-Lopez, José A. Duarte, Verónica C. Martins, Dmitri Y. Petrovykh, Paulo P. Freitas, and Felix D. Carvalho

- NPs functionalized to target cancer cells
  - Targeting CXCR4 receptor overexpressed in Jurkat cells
- Targeting visualized by confocal microscopy
  - The NPs are recognizing the Jurkat cells
  - The high loading of NPs around each cell is primarily due to NP-NP interactions



NP-related Artifacts in Assays

Contents lists available at ScienceDirect

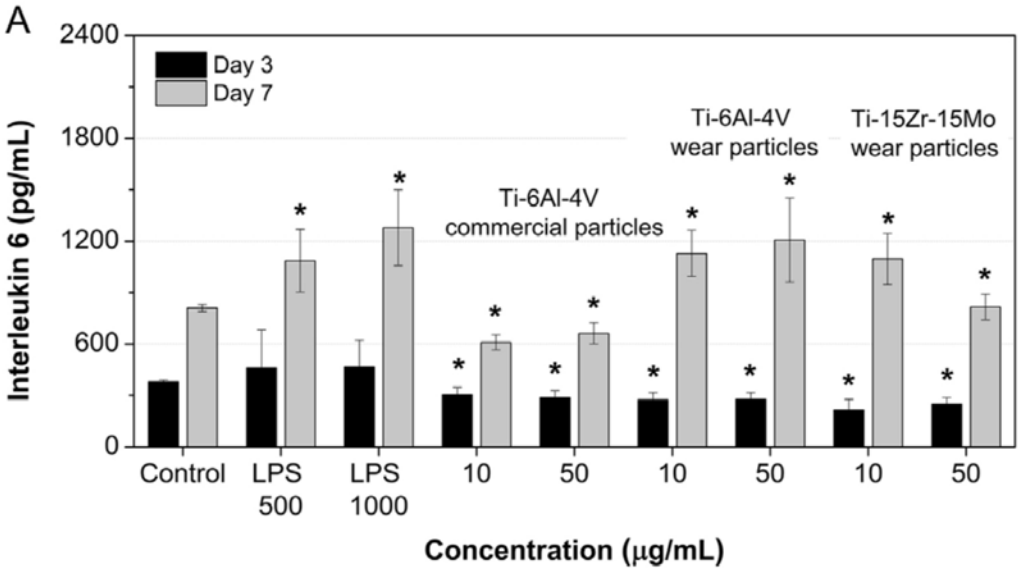
Journal of the Mechanical Behavior of Biomedical Materials

journal homepage: www.elsevier.com/locate/jmbbm

Exposure effects of endotoxin-free titanium-based wear particles to human osteoblasts

Bruna C. Costa[a,*], Alexandra C. Alves[b], Fatih Toptan[b,c], Ana M. Pinto[b,c], Liliana Grenho[d,e], Maria H. Fernandes[d,e], Dmitri Y. Petrovykh[f], Luís A. Rocha[g], Paulo N. Lisboa-Filho[g]

- Metabolic assays can be affected by NP contamination
  - E.g., endotoxin (LPS) in cytokine assays
- NPs can produce artifacts in assays
  - Particularly in colorimetric ones



Nanosafety Activities at INL

- Expertise
  - Nanosafety in the context of nanomedicine, food, environment
  - Setting up an ERA Chair on Nanosafety
- Technology
  - Toxicology assays: zebra fish, cell culture, and specialized formats
  - Electron and optical microscopy of nanoparticles in cells
  - Extensive state-of-the-art nanocharacterization
- Network and history
  - Past and current nanosafety projects: EU, regional, national
  - Active interactions with major projects on nanoparticle characterization in nanomedicine and metrology contexts
  - Membership in organizations involved in nanosafety: ETPN, NIA
- Questions?
  - Dmitri Petrovykh: dmitri.petrovykh@inl.int