ARC Centre of Excellence in
CONVERGENT
BIO-NANO SCIENCE
& TECHNOLOGY

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# Signature Projects

Our CBNS Signature Projects draw on the capabilities of our expert researchers to solve the big questions in bio-nano research.

# PREDICTING BIO-NANO INTERACTIONS

Leaders: Professor Stephen Kent, Professor Edmund Crampin
Co-Leaders: Dr Mattias Björnmalm, Dr Adam Wheatley, Mr Matt Faria

## THE PROJECT

Understanding how materials and cells interact will be key to the future development of improved nanomedicines and vaccines. We aim to understand the rules by which immune cells interact with a range of nanoengineered particle systems with tailored physical properties. The combined effects of size, charge, surface chemistry and other physio-chemical characteristics will be studied for their effect on particle interactions with a wide range of immune cells.

## THE BIG QUESTIONS

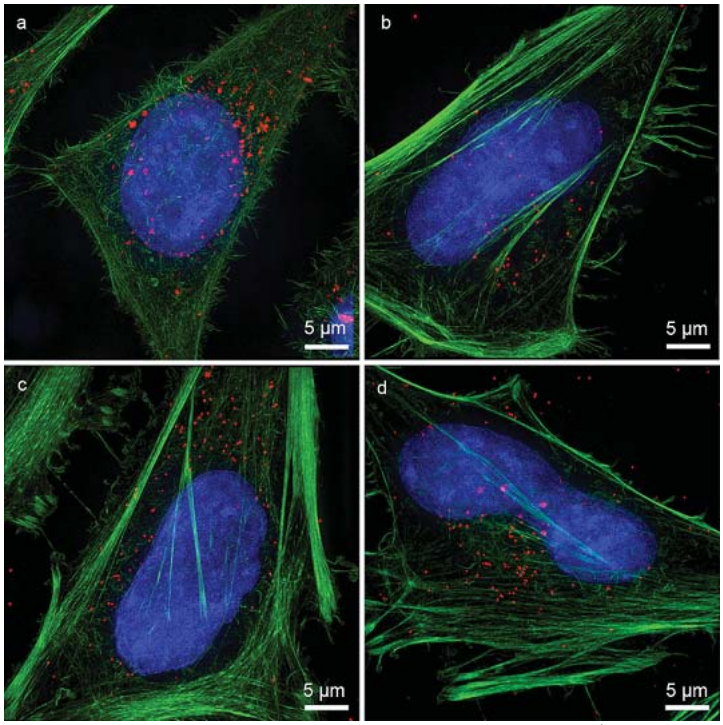
- How does simultaneously varying 2, 3 or more physico-chemical characteristics of nanoparticles influence their interactions with immune cells *in vitro* and *in vivo*?
- Are there trends in how nanoparticle characteristics affect immune cell interactions, that can be generalised across multiple particle technologies?
- Can we standardise the way in which nanoparticle-cell interactions are studied, such that we can generate predictive algorithms for these interactions?

## The benefits of this research

- The experimental and theoretical techniques we develop will provide a roadmap for biological analysis of newly developed nanomaterials for the global research community.
- Our fundamental understanding of the relative importance of nanoparticle physicochemical properties will be advanced, leading to more rational design of these materials.
- By developing our ability to predict bio-nano interactions prior to clinical evaluation, we will vastly accelerate our ability to evaluate and design nanoparticles for diagnostic and therapeutic purposes.

## Our goals

- To develop novel experimental assays and theoretical models that can predict the biological fate of engineered nanomaterials.
- To use our techniques, to assess panels of nanomaterials created by experts across the CBNS, advancing our fundamental understanding of how these complex materials interact with biological systems.

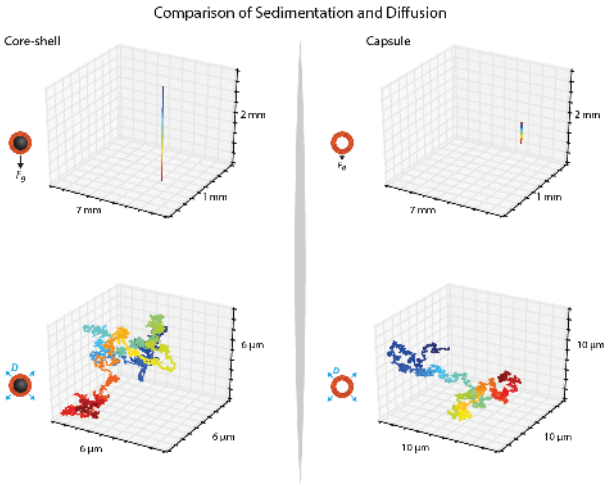



HeLa cells incubated with PMA hydrogel particles. “Reprinted with permisson from 10.1021/acs.langmuir.6b01634. Copyright © 2016, American Chemical Society”.

# PREDICTING BIO-NANO INTERACTIONS

## Recent publications

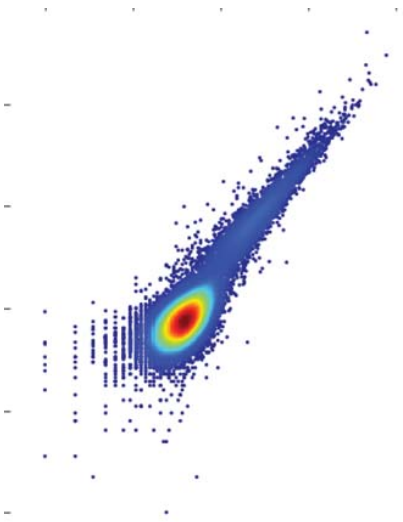
- Thiol-Reactive Star Polymers display enhanced association with distinct human blood components; ACS Applied Materials & Interfaces; 9, 12182-12194; 2017.
- Immunological principles guiding the rational design of particles for vaccine delivery; ACSNano; 11, 54-68; 2017.
- Charge has a marked influence on hyperbranched polymer nanoparticle association in whole human blood; ACS Macro Letters; 6, 586-592; 2017.
- Increasing the Impact of Materials in and beyond Bio-Nano Science; Journal of the American Chemical Society; 138 (41) pp 13449–13456; 2016.




Single particle simulation of sedimentation and diffusion for two particle systems.

## Signature Project collaborations: Predicting bio-nano interactions

| Institution | Collaborator |
|---|---|
| Imperial College, London | Professor Molly Stevens |
| University of Queensland | Professor Robert Parton<br>Associate Professor Kris Thurecht |
| Monash University | Dr Angus Johnston<br>Dr Simon Corrie |
| University of Melbourne | Professor Frank Caruso |



Flow cytometry cell data.

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