Mesoscale Priority Research Direction

Self-assembly and dis-assembly of VNPs with cargos

Opportunity

Viral nanoparticles (VNPs) have become tools in materials science and medicine. VNPs orchestrate self-assembly into defined structures with atomic precision. They naturally encapsulate cargos (their genome). Learning from nature provides an opportunity for scientists and engineers to build the next-generation of hybrid or composite materials.

Approach

Measure the materials parameters such as optical spectra, charge distribution, object shape and solution conditions that set the magnitude and dominance patterns of electrostatic interactions, polar attractions and van del Waals interactions that dominate stability properties. To assemble a database tool and define design rules.

Meso Challenge

The meso challenges are:

i) to understand the parameters that trigger assembly, dis-assembly, cargo loading and unloading,

ii) to tailor VNPs to encapsulate any cargos and release these cargos on any environmental trigger,

iii) to connect fundamental interactions on the atomic level to the macromolecular level.

References: Pokorski & Steinmetz, Molecular Pharmaceutics, 2011, 8,29-43.

Impact

A rational framework theory and database that facilitates the design of cargo-loaded VNPs *in silico* is required. The ability to learn from nature and then apply this knowledge to assembly environmentally response materials has the potential to make a transformative impact in nanomedcine, plasmonics, data storage, … .

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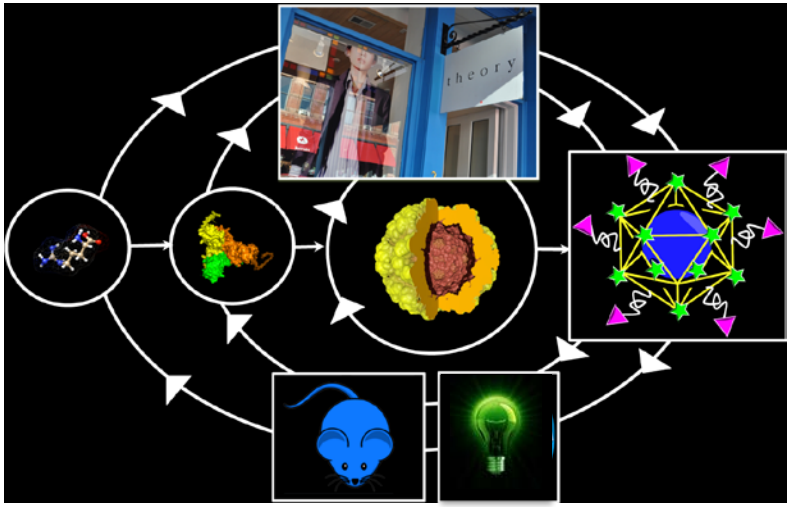
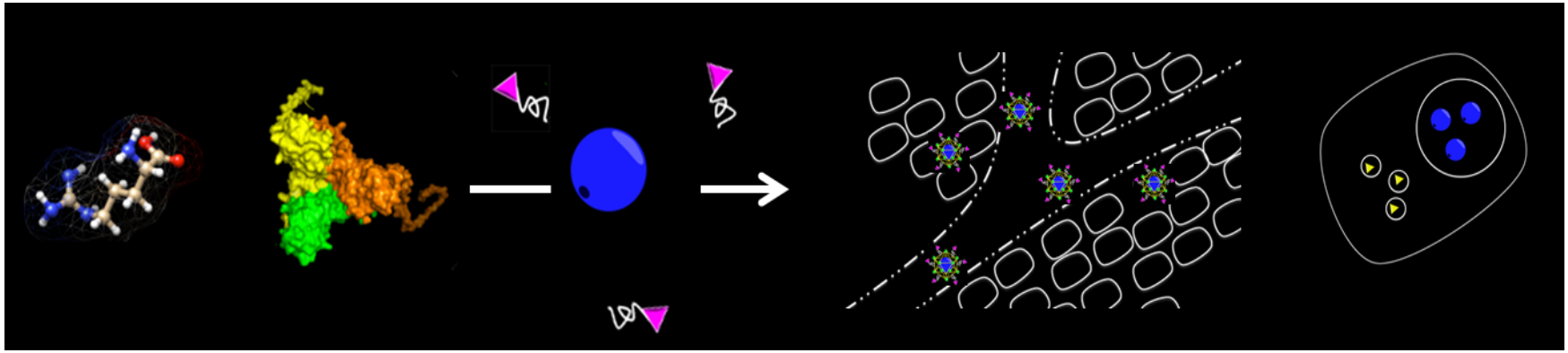
A feedback loop of measurement, learning, modeling, engineering, and application



Life of a nanomedical VNP



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