Yale Institute for Nanoscience and Quantum Engineering

Friday- November 8, 2013

12:00 to 1:00 p.m.

Becton Seminar Room

Light lunch will be served at 11:45 a.m.

Alyssa Siefert

Department of Biomedical Engineering, Yale University

"A Rationally Designed Artificial Bacteria Nanoparticle Vaccine Platform"

Vaccines are effective treatments for many diseases because they educate and amplify the immune system against specific antigens, leveraging the body's ability to fight diseases and clear pathogens. Antigen-encapsulating nanoparticles are especially efficacious vaccines for numerous reasons. Comprised of well-characterized biomaterials, such as the FDA-approved, biocompatible polymer poly(lactic co glycolic acid) (PLGA), nanoparticle vaccines can be formulated to encapsulate one or more antigens (including proteins, peptides, and nucleic acids) and myriad structurally- and functionally-diverse immunostimulatory molecules (adjuvants) and small molecule drugs. The tunability of nanoparticles allows researchers to compose vaccines that target certain cell types and deliver specified antigens and adjuvants, tailoring the immune response in both magnitude and direction. In this work, we seek to rationally design nanoparticle vaccines that mimic natural pathogens, creating "artificial bacterial vaccine nanoparticles" that are recognized by the innate and adaptive immune system and mount a robust, antigen-specific response. Using immunostimulatory molecules derived from bacterial cell walls and DNA, termed pathogen-associated molecular patterns (PAMPs), we demonstrate *in vitro* and *in vivo* the effects of differential combinations and presentation methods of PAMPs on nanoparticles. Optimization of this biomimetic platform is beneficial for innumerable pathologies, as these modular vaccine nanoparticles can encapsulate any antigens and adjuvants of interest.

Andrei Petrenko

Department of Applied Physics, Yale University

"Progress towards an error correction scheme in quantum computing:

monitoring single photon loss in real-time"

A quantum computer promises to solve certain problems significantly faster than a classical computer, but is much more susceptible to errors. These errors are one of the greatest impediments to realizing a successful quantum computer, therefore making a robust quantum error correction (QEC) scheme imperative. One candidate for such a scheme relies on encoding a quantum bit of information onto a state of light in a cavity, and then proceeding to measure the photon number parity of that cavity state repeatedly in real-time. This measurement-based QEC, where the error syndrome is a change of photon number parity induced by the decay of single photons, requires highly quantum non-demolition measurements that are fast compared to the average lifetime of the cavity. Here we show the first realization of a fast and repeated monitoring of photon number parity in real-time. Our results indicate that we are very sensitive to the decay of single photons and that our measurements do not induce extra decay channels

for the cavity state. This successful monitoring of an error syndrome for quantum error correction presents an important step towards extending the lifetime of a quantum bit.

HOST: Paul Fleury