Physics 123, Spring 2016

Here is the line up for the Physics 123 speakers scheduled for this spring term. The presentations are in Olin 149 on Fridays during 6th period (3:30 - 4:30 PM). The only requirement for this 1 credit course, beyond attending five talks, is to read an assigned article beforehand and then to submit a short (one page) typed essay afterwards commenting on both the talk and the reading. Speakers will be available for informal discussions over refreshments afterward their presentations. If you have any questions, contact Bill Titus, Olin 201, x4386, btitus@carleton.edu.

Jake Phillips, '07 (April 01)

Manager of Trading at ACES North Regional Trading Center in Minneapolis

The energy industry is rapidly evolving due to an influx of renewable energy, booming natural gas production, and significant regulatory changes. The increase of wind energy in the past decade has had both positive and negative implications, and the increasing use of solar energy will have similar effects. Shale gas production has dramatically decreased domestic natural gas prices, reshaping what types of generating units supply the U.S. with electricity. New government regulations continue to put pressure on utilities and will have far-reaching impacts on your electric bill in the future. Jake Phillips, Class of '07, is the manager of trading at ACES North Regional Trading Center in Minneapolis. Jake will discuss what an energy trader does, and he will address some of the biggest questions facing the industry due to these shifts.

Val Wiesner (April 08)

Research Materials Engineer in the Ceramic and Polymer Composites Branch at NASA Glenn Research Center in Cleveland, Ohio

Developing Protective Coatings Resistant to Particulate Damage for Next-Generation Ceramic-Based Aircraft Engines

In order to improve fuel economy in commercial aircraft, ceramic matrix composites (CMCs) are widely considered a leading material system to replace metal-based turbine engine components, due to their lower density and high-temperature capabilities compared with other conventional structural materials. However, silicon-based CMCs are susceptible to oxidation and corrosion in the harsh combustion environment found in air-breathing engines. Environmental barrier coatings (EBCs) are being developed to protect and to improve the durability of underlying CMC components in hot-sections of the engines. The development of robust EBCs is threatened by sand, volcanic ash and other organic debris, which are regularly ingested by aircraft engines. At target operating temperatures of future CMC-based aircraft engines (>1200°C), the ingested particulates melt, resulting in molten deposits with compositions corresponding to calcium-magnesium-aluminosilicate (CMAS). Molten CMAS behaves like a viscous glass that can infiltrate and chemically interact with protective coatings, ultimately causing premature failure of the ceramic-based engine component. In support of NASA's Aeronautics Research Mission, NASA Glenn Research Center has developed and assessed a variety of candidate EBC materials to protect ceramic-based components for use in future, highly efficient turbine engines. An overview of the current status of CMAS/EBC research at NASA Glenn, as well as personal insight into what a research career in government is like, will be shared.

Sarah Vigeland (April 15)

Looking for Black Holes with Gravitational Waves

Black holes are some of the most exciting objects in the universe, but they are very difficult to find since by their very nature they do not give off light. But with gravitational wave detectors, we can observe black holes directly and use them to study gravity, astrophysics, and cosmology. I will talk about how groups like NANOGrav are working to detect gravitational waves using pulsar timing and what we hope to learn from them.

Monika Scheleier - Smith (April 22)

Assistant Professor of Physics, Stanford University

Monika Schleier-Smith did her undergraduate degree from Harvard and did her PhD work at MIT. In her research she aims to advance understanding of many-particle quantum systems by learning to assemble highly entangled states of laser-cooled atoms. By coupling these atoms with photons in an optical cavity, new opportunities for engineering and probing many-body quantum states will arise. She is pushing the boundaries of precision which are only limited by Heisenberg.

Armando Manduca (April 29)

Professor of Biomedical Engineering and Radiology, Mayo Clinic

Magnetic Resonance Imaging and Applications

MRI exams are an integral part of modern medicine and can provide detailed anatomical and functional images of the human body non-invasively. MRI can also depict or measure an amazingly wide variety of other phenomena: neural activity in the brain, water diffusivity, local microstructural properties, details of blood flow within a vessel or aneurysm, and metabolite concentrations in vivo. How does MRI work? We'll discuss the basic physical principles involved in MRI, survey a wide variety of applications (and how they work), and then talk in depth about MR elastography: the imaging of acoustic wave propagation through tissues or other materials, leading to images depicting the *elasticity* of objects. This can be thought of as quantitative, non-invasive touching or poking of structures inside the body, with significant clinical implications.