ACSCOLI Meeting Notes, 7/7/10

Present: Dan Simmons, Eugene Haller, Michael Todd, A. Paul Alivisatos, Ron Nelson, Mary Croughan, Chris Yetter, Bob Van Ness, John Birely, Michael Colvin , Jim Chalfant (UCPB) (by telephone), Jim Krupnick, Todd Giedt, Bob Powell, Greg Miller (UCORP), Bill Eklund, Bob Van Ness, Bruce Darling, and Clare Yu (by telephone)

I. LBNL Overview/Joint LBNL/UCB Appointments

A. ***LBNL Overview***: Director Paul Alivisatos stressed LBNL's deep integration with UC—not only in terms of its synergistic goals and world class infrastructure, but also in the number of UC faculty who are currently working at LBNL (UCB-205, UCD-14, UCLA-1, UCSF-12, UCSB-3). LBNL is also the oldest national lab, and was established in1931. Currently, LBNL has a budget of $717M (in addition to stimulus funding of $300M), with about 4,000 employees. The evolution of the budget over the last three decades provides a valuable perspective on LBNL's changing focus. In the 1970s, LBNL was devoted to high energy physics and general sciences, with smaller portions of the budget devoted to the energy sciences and the biosciences. In the 1970s, LBNL applied the concept of team sciences with an Energy Sciences Division (1972) and to a lesser extent, research areas in the biosciences. In the 1990s, the energy science and biosciences demanded much larger fractions of LBNL's budget. Today, physics is balanced out by computational sciences, energy/environmental sciences, and the biosciences. LBNL currently is engaged in five strategic initiatives—Carbon Cycle 2.0, the Next Generation Light Source (NGLS), community relations, safety/efficiency, and rejuvenating LBNL's lab and office space onsite while exploring a second campus.

The "Carbon Cycle 2.0" initiative at LBNL is centered on climate modeling and energy analysis with research in artificial photosynthesis, bio-fuels, carbon capture and sequestration, energy storage, solar PV and geothermal, efficiency, and combustion. New materials are being developed that could capture the CO_2 at a much lower cost than is possible today; the Energy Frontier Research Center is conducting research on what happens to CO_2 when it is placed underground with the long-term goals of creating fuels from CO_2, H_20 and energy from the sun (artificial photosynthesis). LBNL is also working on a project called "Energy in the Developing World"; recent practical applications from this project include the Berkeley Darfur Stove and the UV Waterworks (see below). The China Energy Group, which looks at energy use in China, has been in existence for 20 years, and has been engaged with China on developing standards, regulations, and rules for increasing energy efficiency in China. The NGLS is a soft X-ray free electron laser array. Its purpose is to understand and control matter and energy at fundamental scales. By collmating the x-rays and electrons, one can create alternative sources of light generation. The laser would be placed in a tunnel, with the light transported to an experiment hall on the current Bevatron

site and would be used for biological imaging (structures of proteins, etc.), energy harvesting and conversion, and construction of complex correlated materials.

Maintaining good community relations is very important for LBNL. Towards that end, LBNL has engaged in a new approach to community relations, which includes regular meetings with the mayor and city council members, co-cooperation with the city on the energy efficiency of municipal buildings, the creation of a community advisory group, and a broad educational outreach (including workshops, summer institutes, and middle school visits). LBNL has also worked hard to improve its safety record and overall efficiency. Initiatives in this area include a disciplined project management approach in response to HSS review; management-driven culture change, which builds on the progress of the last two years; and engaging staff to think creatively about safety. Finally, LBNL is looking into establishing a second campus simply because the current campus is running out of space and infrastructure. Currently, there are sites in Oakland (Oakland Scientific Facility), Emeryville, and Walnut Creek; LBNL is looking for a site to consolidate all of these activities and are focusing on two or three sites, which must also be pristine without environmental contamination. The most probable sites are located in the Richmond Field Station (100+ acres, but does have some contamination issues, and is located on landfill), Albany (Golden Gate Fields), West Berkeley, the Marchant Building, straddling the Berkeley/Oakland city line), Emeryville, and West Oakland. Financing will be a key component of any planned expansion; DOE may fund part of it, along with debt service from UC (pay back from research funding).

B. ***Joint Appointments*** (V. Potapenko): There are four joint-appointment categories: 1) faculty scientists and engineers, in which the entire salary is paid by the campus (148); 2) faculty scientists and engineers with summer salaries (61); 3) shared faculty scientists and engineers, whose salaries are paid by the campus, but a percentage of their time is reimbursed by LBNL (24); and 4) joint appointments, which is a 50/50 arrangement, with LBNL reimbursing the campus for 50% of the appointment (5). This last category was established by a 2007 MOU with shared recruitment. In the latter two categories, merit reviews are done at both locations (LBNL and the campus). Joint appointments are often difficult for faculty members, even with a reduced teaching load on the campus, as it is hard to meet the standards at both locations in terms of merit reviews. While LBNL scientists can also serve as adjuncts on the Berkeley campus, this depends on the department, and many departments do not allow adjuncts, so this number remains small. There are a significant numbers of LBNL scientists who want to teach (there is a rule for Lab employees to teach one class every two years without campus compensation); this is very good for scientists' professional development (and is a good recruiting tool for LBNL). ACSCOLI members mentioned that the compelling teaching needs on the campuses are really in the undergraduate arena; this would not meet the recruiting needs of LBNL however. Director Alivisatos remarked that the connection to

teaching (both undergraduate and graduate) is quite energizing for LBNL scientists. He added that joint appointments are important for LBNL managers as well. In the past, Division Directors had retained half teaching appointments, but this is not the case today (due to the heavier workload of current managerial roles). Allowing LBNL managers to go back to the campus, after serving at LBNL, is one option/avenue that the Lab is exploring. That said, promotional issues need to be worked out to make this a reality.

II. UC Office of the President Update

A. ***LBNL Board*** (Harry Powell): At its last meeting on March 15 & 16, the Board did hear the five initiatives (see above), and is actively supporting the Director in their execution. It is also undertaking a self-examination, and is looking into expanding its ranks by three new members (physics, technology management, and biology). The Board is very supportive in linking LBNL's goals with national goals (environment/climate modeling), as well as local goals (safety, efficiency). Space issues are also prominent, along with community outreach and relations. Regarding ACSCOLI's representation on the LBNL Board, one ACSCOLI member spoke out against one-year terms, given that it takes at least one year to get up-to-speed. Chair Simmons agreed that multiple year appointments may be a possibility. The imperative, however, is to have someone who is actively involved with the Senate to serve on the Board.

B. ***Bruce Darling***: EVP Darling briefed members on the DOE Reform Initiative. With respect to plutonium pit production, LANL will produce five war reserve plutonium pits this year, which is consistent with recent history.

III. Climate Change & Bella (Margaret Torn & Wim Leemans)

A. ***Climate Change Presentation*** (Margaret Torn): In the last 150 years, the temperature increased by 1.5 degrees Celsius, and the ice caps/sheets are indeed melting. At the same time, the permafrost is thawing, undermining building foundations and forests. Melting permafrost will also release methane, which is also rising from other human activities. A number of LBNL initiatives are attempting to answer the following questions: 1) What are the risks of abrupt climate change? How will ecosystems feedback into climate change? How will land ice evolve? How will the environment and society interact? While the primary tool to answer these questions is climate modeling using computers, LBNL is also looking at the chemical foundations of climate change, and trying to incorporate such input into climate models. Some examples of other models include marine ice sheet instability (BISICLES), a boreal arctic feedback model, a methane bio-geochemistry model, and permafrost microbial genomics (probing microbial genomics of soil at LBNL). The largest environmental sequencing project to date is also being done at LBNL, with both microbial identities and functions revealing (a new microbial bacterial that produces methane was discovered through this project). Research into methane hydrates is another example, which involves the

enormous amounts of carbon that is trapped in the arctic and oceans (e.g., 10,000 giga tons of carbon, which is 10X what is in the atmosphere right now). For instance, methane plumes were recently observed near Norway. As part of LBNL's research into this phenomenon, a 2D hydrate model was developed, which showed that these plumes could be related to warming. Finally, methane climate forcing and climate/ methane mitigation is another area that LBNL is working on. LBNL has shown that methane mitigation could be done more quickly than CO_2 mitigation. There can be up to a 20% difference in global climate models; LBNL has been doing a lot of work to decrease these differentials via work on the line by line code. The connections with UC Berkeley include the Department of Integrative Biology, Earth and Planetary Science, the Department of Environmental Science, and the Department of Geography, as well with collaborations with other national labs and universities. Four post-docs were just hired, along with two more junior scientists; there are about 11 graduate students in the program.

B. ***BELLA Project at LBNL*** (Wim Leems): BELLA is a laser plasma accelerator (LPA) that is being developed at LBNL, and is associated with the LOASIS Program. A LPA is a high intensity laser pulse that generates the plasma wave that drives the electrons (separates the electrons from the ions), and allows particle accelerations. Current LPAs allow for 1 giga electron volt (GeV) in < 3 cm; the BELLA Project will allow 10 GeVs in < 1 m. To do so, BELLA builds upon the LPAs developed at LBNL in the 1990s—especially TREX, which was developed between 2002-05. BELLA's budget is approximately $27.2M and will be finished by 2012. Applications for BELLA include a compact accelerator for basic science (5th generation light source); medical (e.g., radio-isotope production of short lived isotopes) and homeland security; and a compact light source based on Berkeley's LPA technology. The BELLA program attracts a significant number of students, including some international students. In all, 80 students and 15 PhDs have gone through the "program", but there is no formal department or program in "accelerator science". UC does not recognize "accelerator science" as a science, and with no formal graduate program, there is only one part-time faculty at UC Berkeley.

IV. Science Solutions for the Developing World (Ashok Gadgi)

In terms of global income distribution, in 2000 the poorest 20% of the world's 6.1B population only enjoyed 2% of the income. LBNL's contributions to the area of development include the UV Waterworks and the Berkeley Darfur Stove:

- *UV Waterworks*: Every hour, 200 children die from dirty drinking water; there are four billion annual episodes of diarrhea, which exhaust physical strength to perform labor and costs billions of dollars in lost income. The UV Waterworks provides affordable safe drinking water to poor communities in poor countries. Basically, the UV Waterworks produces safe drinking water by radiating biologically contaminated water via a UV lamp as

it flows through a curved stainless steel pan (approximately the size of a microwave oven). This technology solution is both scalable and financially viable. One UV Waterworks center can serve 6,000 people and produce 10L per person daily; all assets belong to the village council. The price is .2 cents per liter. The price of bottled water is 120 times this price. The most immediate market is India, but some units were recently brought to Haiti after the earthquake.

- *Darfur Stove*: The Darfur Stove was designed to reduce the violence and rape of women in Darfur. While the UN provides food, it does provide not fuel to afflicted communities in Darfur. Therefore, women and girls routinely risk rape and mutilation when they leave their camps to gather fuel wood; a typical trip lasts seven hours. There is also leakage of UN food rations in exchange for cash to buy fuel wood. The stove was designed to triple or even quadruple the efficiency of the traditional three-stone stove, which is commonly used in throughout Africa; one stove can feed 5-7 people. However, the Darfur Stove is not a permanent solution, but it does serve as a band aid. In 2006, these stoves were field tested for six weeks with great success. In essence, they are constructed from flat kits made of steel sheets, which can be produced locally. When fully staffed, it is possible to assemble 2,000 stoves per month from the kits locally. LBNL is collaborating with Oxfam America in this venture. 1,000 stoves were manufactured in 2009, and another 2,000 in spring 2010; shipment of the next 6,000 flat kits are on the way to Sudan in July 2010. Each stove costs $25, and saves $250/year in fuel wood costs, and lasts for five years (it offsets 2 tons of CO_2 per year). World Vision has approached LBNL to modify these stoves for Ethiopian fuel sources (financing them with carbon credits). The unmet needs in global stove research include: 1) world-class engineering science systematically applied to stove designs; 2) attention to user feedback; and 3) independent field verification of stove performance. The project's website is www.darfurstoves.org.

LBNL's contributions to these "basic" innovations include the breadth of knowledge that its scientists can contribute to both of these products. Both designs took a fair amount of intelligent planning and design, which would probably surpass that the capabilities of a local machine shop or high school physics teacher. There is also a gap between NGOs, engineers, and scientific applications (e.g., mechanical tasks, etc.), which LBNL can help bridge (at least in these two cases).

V. **Bio-fuels and Artemisinin** (Blake Simmons)

There is a growing demand for energy, but a finite availability of traditional energy feedstocks (oil and gas). On the other hand, lignocellulose biomass is sustainable. The Joint BioEnergy Institution (JBEI) is located in Emeryville, and is one of the DOE's bio-energy research centers. JBEI is funded by a $134M, five-year DOE OBER program with six partners and four science divisions (feedstocks, deconstruction, fuels synthesis, and cross-cutting technologies). All of JBEI's labs are interdisciplinary, with its partners co-located at a single location, which

facilitates a mission-orientated program. JBEI's approach to bio-fuels production is very integrated (feedstocks to deconstruction to fuels synthesis). This process moves from CO_2/plant, to biomass, via pre-treatment to cellulose, via enzymes to sugar, and finally, utilizing microbes to produce ethanol, which is a bio-fuel. JBEI does research on the best and most efficient processes to convert bio-fuel mass to ethanol. JBEI's initial target bio-fuels include alcohols, alkanes (diesel or gasoline replacements), esters (diesel replacements), and cyclic alkanes/alkenes (jet fuel replacements). JBEI has produced 112 publications, 260 presentations, 43 technical disclosures, 18 patent applications and 2 registered software copyrights. JBEI also hosted eight visiting international researchers (Chile, Brazil, Sweden, Australia, and New Zealand). 21 student interns and 13 graduate students have worked or engaged in research at JBEI.

VI. Cancer Research (Mark LaBarge)

Life sciences research at LBNL emphasizes multi-disciplinary team science and tackling complex problems, and includes radiochemistry, instrumentation, and nuclear medicine; genome packaging and function; protein structure and function; and radiation biology and cancer. In FY 2008, LBNL's Life Science Division was funded at $58.5M, but funding has increased since that time due to increases in large program grants funding interdisciplinary biology (half of its funding comes from the NIH). Dr. LaBarge studies breast cancer, and explained that cancer is not only a genetic disease, but a disease of the micro-environment. He noted that LBNL is at the core of several large-scale efforts to understand the genetic and micro-environmental components of cancer, which includes the DOE Low Dose Program, the Integrative Cancer Biology Program, the Tumor Microenvironment Network, the Physical Sciences in Oncology Center, the Cancer Genome Atlas, and *Stand Up to Cancer*. With respect to breast cancer, its incidence occurs at the interface between age, the microenvironment, and gene mutations. First, 80% of breast cancers occur in women over 50. Indeed, breast cancer in old and young patients may be different diseases. The breast microenvironment changes with age, which influences the expression of the cancer gene. LBNL research in this area has shown that the microenvironment is important, and changes in the microenvironment can unleash premalignant cells. This research has also lead to alternative treatment models. Adult stem cell studies are especially important in this area, as mammary glands are made and maintained by adult stem cells. LBNL researchers have conducted studies of human mammary stem cells in organotypic cultures, which facilitate functional studies of human mammary stem cells. Dr. LaBarge, in collaboration with his colleagues at LBNL, has developed highly parallel bioengineered culture technologies for functional dissection of complex microenvironments. This research has led to the development of a MicroEnvironment Array (MEArray), which is a highly parallel cell-based functional screening platform. A number of undergraduate and graduate students have also become involved with Dr. LaBarge's lab, which facilitates this type of research.

VII. ACSCOLI Executive Session

Notes were not taken during the executive session.