

First Commercial Course on Low Energy Nuclear Reactions

David J. Nagel

Additional reporting and photos by Marianne Macy.

Thirty people participated in the short course “Perspectives on Low Energy Nuclear Reactions.” It was held at the Hyatt Regency Hotel in Crystal City, Virginia on October 3 and 4, 2011. Participants came from four countries on three continents, from all three major sectors of industry, academia and government, from startup companies to a Fortune 10 firm, and were in diverse stages in their careers from undergraduate to retired. Physicists, chemists, materials experts, experimental and theoretical scientists, company leaders, technology scouts and consultants were among the skills and functions of the participants. The course was another milestone in the development and broadening of the field.

Current interest in Low Energy Nuclear Reactions (LENR) is based on both 22 years of sound experimental results, and on the possibility of near-term commercialization of fundamentally new energy generators. Many experiments have shown that a combination of nuclear and atomic levels might result in very promising new energy sources. These will be based on what was poorly called “cold fusion” and is now termed LENR. Such sources can be safe, and will produce neither greenhouse gases nor radioactive waste. Various power levels for diverse applications can be generated by the new heat sources. The production of electricity, as well as heat, is expected to be possible. LENR power sources might be small and, hence, distributed. Dependence on large central power plants, and the expensive and vulnerable grid, may be avoidable. The possibility that LENR energy sources might be on the market next year has attracted much more attention to the field during 2011.

Science

The subject of LENR was a legitimate field of scientific inquiry from its origins in 1989, although it was not viewed as such by many people. It remains a challenging complex of nuclear and atomic physics. Many types, characteristics

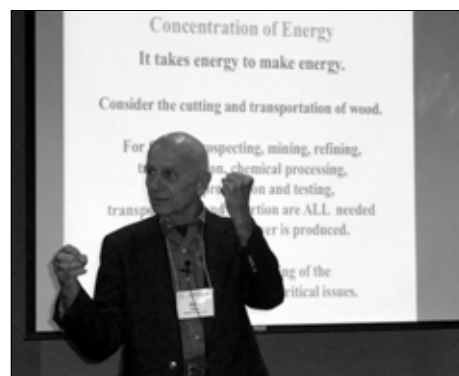
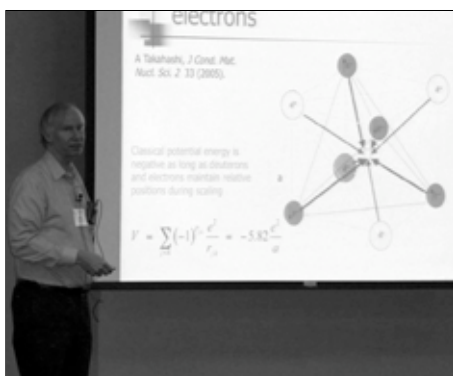
and reactions of nuclei have been implicated during the experimental study of LENR. There are also many relevant factors at the atomic level, including molecular and solid-state effects. The role of a lattice of atoms is widely recognized, although questions remain about the details, including compositional and structural factors. It is still debated whether LENR occur exclusively on surfaces or also in the interiors of lattices. Similarly, the question of whether there is only one, or more than one, mechanism active to produce LENR and their diverse results is unresolved. In short, the study of LENR remains a very open and challenging field at a basic science level, despite all of the experimental and theoretical work over the past 22 years.

Engineering

If a new effect might actually be useful, it is necessary to design, fabricate and test prototypes of possible products. The effect has to be both reproducible and controllable. That is, prototype energy sources must be able to be turned on, ramped up, held constant, ramped down and turned off in any sequence for various applications. This is entirely similar to the control widely available for automobile engines. During the past two years, Andrea Rossi has engineered prototype energy sources based on LENR. After their design and fabrication, they have been tested repeatedly in recent months. Many of the descriptions and results of those tests are available on various websites. The conduct, data and interpretations of the tests are widely discussed now, without agreement on some of the most fundamental points. Demonstration by Rossi of a 1 MW LENR generator is planned during late October of this year.

Commercialization

The prototypes that Rossi produced and tested may be the basis of products manufactured within 2012. Ambitious



NUCAT course presenters Kenneth Grabowski, Peter Hagelstein and David Nagel.

plans to produce thousands of LENR sources were announced. It remains to be seen how the commercial sources being developed by Rossi and others perform, and if they are reliable for useful periods of time. Widespread use of small and distributed LENR energy sources, which are safe and green and free of dangerous immediate radiation and radioactive waste, would have substantial environmental benefits. A smaller rate of global warming could follow from widespread use of LENR generators.

Education

If, as planned, many energy sources based on LENR are produced and sold, it will be necessary to educate a workforce in their design, manufacture, installation, maintenance and other functions. This will require knowledgeable managers, engineers, technicians and sales people. In addition to the recent commercial short course, textbooks on LENR are now being written. A graduate course about the topic is planned for the fall of 2012 at The George Washington University.

Short Course

A company was formed in June of this year to offer short courses and other services for LENR. It is NUCAT Energy LLC, with the website: <http://nucat-energy.com>. The company name derives from the words NUClear and ATomic, the two levels of matter that are involved in LENR. The short course in early October near Washington, D.C. was the first offering of the company. The course was held in a theater-style room with U-shaped seating to promote interactions during and after the lectures. It was taught by seven internationally-known leaders in the field. The overall agenda for the two-day course was as follows:

Topic	Instructor
Introduction to Course and LENR	D.J. Nagel
History of LENR	M.E. Melich
Overview of Energy Generation	D.J. Nagel
Ni-H System: Recent Developments	M.E. Melich
Electrochemical Loading and Results	M.C.H. McKubre
Gas Loading Issues and Results	D.A. Kidwell
Calorimetry Options	M.C.H. McKubre
Nuclear Ash and Fast Particles	K.S. Grabowski
Materials Challenges	M.A. Imam
Theoretical Challenges	P.L. Hagelstein
Nano-Scale Materials	D.J. Nagel
Overview of Theories	P.L. Hagelstein
Design & Manufacture of LENR Generators	D.J. Nagel
Performance and Validation Testing	M.E. Melich
Applications of LENR	D.J. Nagel
Prospects and Discussion	M.E. Melich

The course was dominantly an ordered review of most of the major topics in the field. But, it also included substantial new material which was not previously presented. For example, Melich showed the set-up and described the conduct and results of a test of one of Rossi's devices in the fall of 2009. He also summarized early work on the nickel-hydro-

gen system by Mengoli and Piantelli. An overview of some of the Rossi tests, which used gas loading of hydrogen onto nickel, was presented by Hagelstein and Grabowski. McKubre gave a pair of lectures, one on the tools used for quantification of excess power and heat, and another on the results from calorimetric measurements in electrochemical experiments. Kidwell reviewed his gas loading work, a compliment to the talk on electrochemical loading. Grabowski addressed the methods and diverse results of transmutation and energetic particle measurements.



Sunwon Park, ICCF17 chairman.

Materials and theory are central topics to the conduct of LENR experiments and their eventual understanding. So, half a day was devoted to those topics. Imam gave a review of materials science, quite generally, and then addressed the role of materials in LENR experiments. His talk mainly had to do with the interior of materials. Nagel addressed the surfaces of materials, especially nano-scale particles, which have given important LENR results. Hagelstein presented two new lectures on the challenges of formulating and testing theories for LENR. He also provided an evaluation of several of the more sophisticated LENR theories now under consideration. In very general terms, there are problems with all theories of LENR.

The final afternoon of the course included a look ahead at the engineering and production of LENR energy sources, their testing and their many prospective applications. It is expected that the design of LENR generators will employ modern computational tools. Similarly, their cost-effective manufacture should involve the use of robotic and other techniques and processes. Validation tests of devices like Rossi's are very important to the field now. Performance testing is critical to both the manufacturers and the users of LENR products. Applications at power levels ranging from milliwatts to megawatts were examined prior to the discussion session. That last session gave participants a chance to return to topics not completely treated earlier during the lectures and to bring up new topics.

Overall, the course was quite intensive for both instructors and participants. Long mid-morning and mid-afternoon breaks, and long lunches, were used to ensure good networking between participants and instructors and within the group of participants. Both communication and networking aspects of the course were successful, according to the participants. A similar course is tentatively planned for the spring of 2012.

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