Diurnal Variations in LENR Experiments

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Abstract. Two very different LENR experiments exhibited daily variations in their characteristics or outputs. Comparison of the variations for the experiments forces the conclusion that the measured variations are artifactual. That is, they are not due to the influence of an external diurnal mechanism such as cosmic rays. However, the causes of the observed variations are not understood. Such understanding is important for the conduct of robust LENR experiments to obtain credible data. It is also critical to the reliable operation of eventual LENR power sources.

1. Introduction

Diurnal variations occur over the course of a day, and typically recur every day. Daily variations in light and temperature due to the rotation of the earth are familiar examples. Low Energy Nuclear Reaction (LENR) experiments should not be subject to diurnal variations. However, there have been reports of daily cyclic changes in the conditions and output of LENR experiments. The purpose of this paper is to report and examine such variations in two experiments, one in Hokkaido, Japan, and the other in Texas, U. S.

2. Mizuno Experiment

The first experiment, which exhibited long term diurnal variations, was aimed at the study of transmutation reactions [1]. Some of the equipment for that electrochemical experiment is shown in Fig. 1. The experiment was pressurized to about 7.4 atmospheres and operated at temperatures near 375K. The D/Pd loading ratio was measured for the duration of the experiment (about 800 hours).

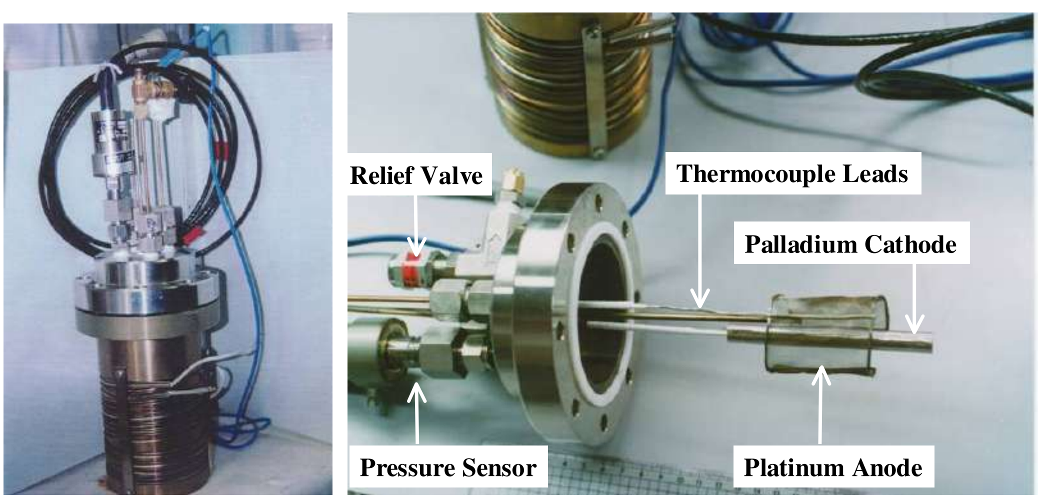

Fig.1 – Exterior and interior of the pressure vessel for a search for transmutation products in Hokkaido.

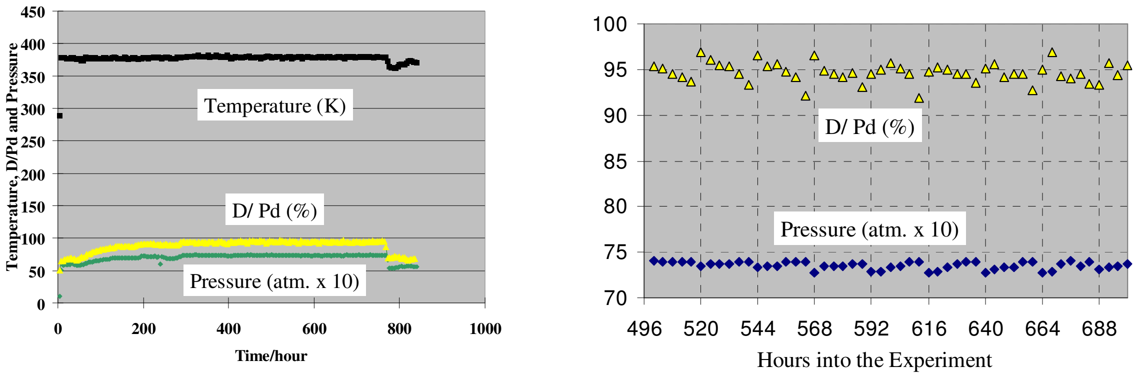

Fig. 2. Time histories of the pressure, loading and temperature for the high-pressure transmutation experiment.

The long-term record of the pressure, loading and temperature for the experiment is given in Figure 2. A blow up of the data from 500 to 700 hours is also in that figure. It can be seen that the pressure (P) and loading (L) vary inversely with each other on a 24 hour cycle. The degree of the two modulations is small in both cases, with $\Delta P/P$ and $\Delta L/L$ both being a few percent. The variations have sawtooth shapes, with the discontinuity occurring at midnight local time. The regularity of the sawtooth shapes evolved during the experiment. Variations in the ambient temperature in the laboratory cannot account for the measured variations because the temperature of the experiment was much greater than the laboratory temperature.

3. Letts-Cravens Experiment

The experiment in Texas was run for a much shorter time than the one in Hokkaido. It involved the use of laser stimulation and the measurement of excess heat. The experiment was controlled remotely via the internet from Cambridge MA during the 10th International Conference on Condensed Matter Nuclear Science [2]. Figure 3 shows the equipment for the experiment.

Figure 4 shows the excess power (mW) for somewhat over 2.5 days of the experiment. It is seen that the signal-to-noise for the excess power measurement is about 10. The power varies with a cycle time of about one day, although the shape of the daily variation is not the same on each of the days. The peaks of maximum output power occur in the range of 1800 to 2000 local time. The most remarkable aspect of the

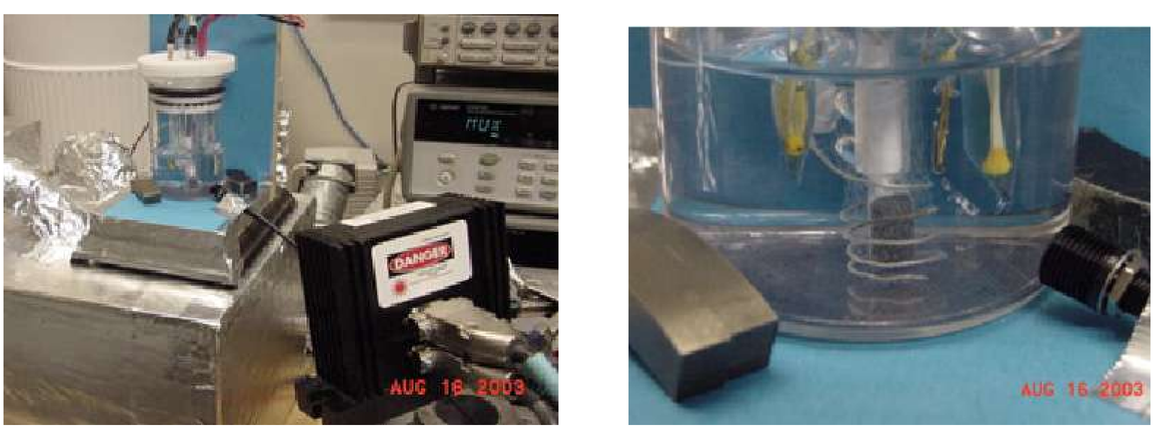

Fig.3. Overall photograph of the excess power experiment and close-up of the electrochemical cell in Texas.

power data in Figure 3 is the depth of the modulation. The variation the first day is from a low near 50mW to a peak at 450 mW. The corresponding variation the second day is from 200 to 600 mW. The third day exhibits a variation of about five-fold from 150 to 750 mW.

The time history of the laboratory temperature during the experiment in Texas is also in Figure 4. It is seen that the magnitude of the noise decreases noticeably when the excess power is high. However, the temperature variations both during and between episodes of peak excess power is 0.5 C or less. These are small changes compared to the large modulation of the excess power. Nonetheless, the clear changes in the noise of the temperature measurements over the course of this experiment are interesting.

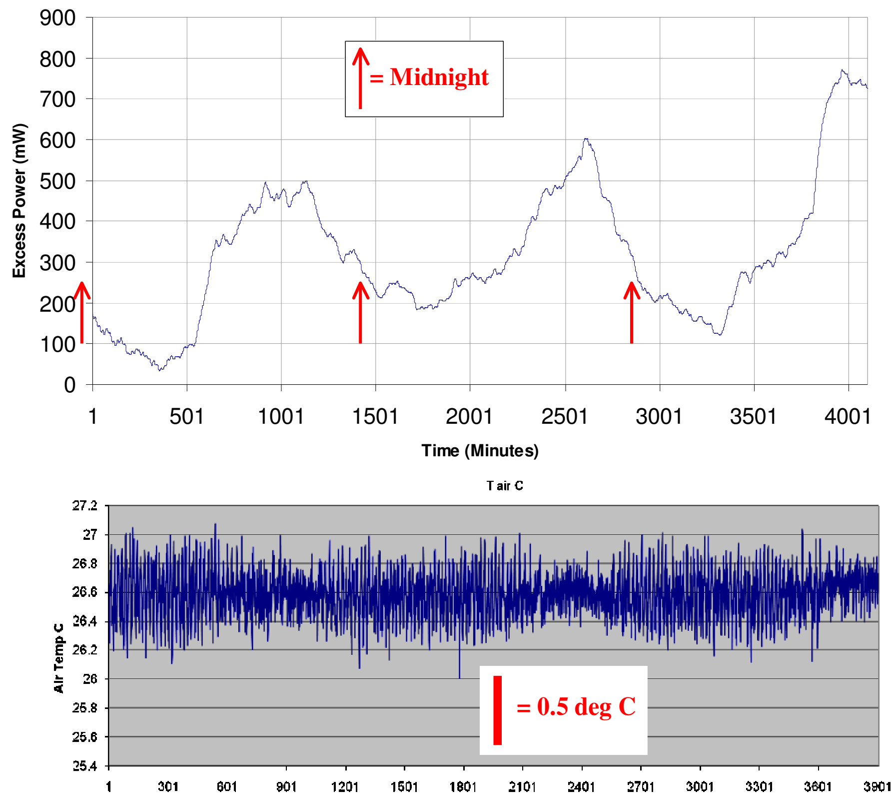

Fig. 4. Time histories of the excess power and the laboratory temperature in the laser-stimulation experiment. The two time traces are aligned vertically to permit comparison of power excess and temperature variations.

4. Discussion and Conclusion

One of the primary motivations for this study was to learn if the observed diurnal variations in LENR experiments could be due to cosmic ray particle bombardment. That was not thought to be likely because of two reasons. First, the fluxes of cosmic rays at sea level are relatively small, save for neutrinos, for which the interaction cross section in experiments, such as the two of concern here, is negligible. Second, if globally-present cosmic rays were involved in LENR experiments, diurnal variations would be more widely observed in the field. However, if a connection between observed variations in LENR experiments and cosmic rays could be made, then LENR experiments might be made to serve as cosmic ray detectors. In that case, comparing the responses of LENR experiments on the surface of the earth and in deep mines would take on another significance.

What if the case can be made for the fundamental reality of diurnal variations in LENR experiments can be made? Then, there would arise the need for their theoretical and computational explanations. This would further complicate the understanding of LENR.

Contrasting the daily variations in the Hokkaido and Texas experiments is instructive, as shown in Table 1.

Table 1. Comparison of the Characteristics of Two LENR Experiments Exhibiting Diurnal Variations

Factors	**Mizuno**	**Letts-Cravens**
Duration of experiment (Days)	35	2.7
Shape of Daily Variation Curve	Sawtooth	Pseudo-Sinusiodal
Peaks (Local Time)	Midnight	1800-2000
Depth of Modulation (% of Average)	About 2	> 50

The major variations in the shapes, local times for peak values and extent of daily swings in Table 1 indicate that the variations are probably not due to some external cause, such as daily variations in cosmic ray neutron or other fluxes [3]. That is, the variations appear to be artifactual. It remains to be seen if an explanation for the observed variations can be found for either experiment.

Understanding and explaining uncontrolled variations in the behavior and output of LENR experiments is important for two reasons. The first is the ability to conduct scientific experiments that yield reproducible, reliable and credible data. Given the large daily variations in the excess power in the Texas experiment, the controllability, and hence the utility of potential engineered commercial LENR power sources, are at stake.

Acknowledgements

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