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Clear proof

The final demonstration of the failure of cold fusion.

Jeff Hecht

Repetition of experiments is important both to verify results and to resolve any questions about their interpretation. This is particularly vital for the experiment shown in the most-watched video on the Internet, 'The Final Demonstration of the Failure of Cold Fusion, as expounded by Professor Madeline Hou'.

Recorded in standard-definition two-dimensional colour, the video doubtless benefits from Professor Hou's presentation. A born entertainer with a gift for showwomanship, at the time of the recording she was strikingly attractive with jet-black hair that hung down almost to her waist. But the real allure is the demonstration itself.

"No experiment is perfectly repeatable," she begins. "On a fundamental level, the uncertainty principle says we cannot simultaneously measure position and momentum of any particle with infinite precision. On a practical level, it is impossible to control all variables that might conceivably affect experimental results, such as the weather here in Boston in January."

Although the video does not show the students in the lecture hall, it picks up their laughter. National Weather Service records show that six inches of snow fell that morning, following a prediction of 'partly cloudy'.

"This is the eighth in my series of annual demonstrations of the failure of cold fusion," she says, flirting with the camera. "Although I use the same equipment, the same procedures, and even wear the same clothing, it is impossible to control every possible influence, such as the flux of wireless signals from your laptops, smartphones and personal contact interfaces."

She unveils a classic Pons–Fleischmann cold-fusion cell, displaying heavy water, palladium electrodes and a calorimeter linked to a large classroom meter with an old-fashioned analogue galvanometer needle. "We know that this equipment did not produce heat beyond that expected from classical electrochemistry in my seven past Intersession demonstrations. Yet Pons and Fleischmann claimed to observe the release of excess energy, which they attributed to the fusion of two deuterium atoms to yield tritium and a neutron. That reaction should have released a dangerous flux of neutrons. Where were the dead graduate students?"

Chuckles are audible from the mostly undergraduate audience.

Hou smiles. "We need to consider the possibilities. Other experimenters claim to have observed excess energy, but curiously they cannot reproduce their own experiments reliably. Could they have failed to note special conditions needed to generate excess heat? What might such conditions be?"

It was a rhetorical question, but she could count on the students to shout out answers. "True belief in cold fusion," says one. "Freedom from doubt," says another.

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"The absence of verification," says a third. Comparison with recordings of prior lectures shows these are the first, second and third most common answers over the eight-year series. Students who attended the seventh demonstration say that chanting answers in that sequence was a campus ritual.

Hou also is carefully choreographed. She shows video clips of the palladium rods being taken from the previous year's apparatus, heated in a vacuum to remove the deuterium, reloaded with the gas and mounted in the electrochemical apparatus. Verified digital date stamps on each clip show when the procedures were done.

"We are now prepared for the moment of truth," she says. "Of course, you must realize that the precise value of truth in experimental practice is subject to statistical variation, but after an experiment has been conducted several times, it is possible to rule out some values with reasonable confidence. What observations can we rule out if the experiment is properly conducted?"

The students shout out a cacophony of answers. "Melting the apparatus", "cooling the room to one nanokelvin", "nuclear fusion in the air" and "nothing" are audible.

"Personally, I continue to believe that there is a small but finite probability that variations in results from repetition of the experiment will teach us something, although that probability declines with each repetition," Hou says. "However, we can be confident that it will not release as much energy as the Hiroshima bomb."

As the audience chuckles, the camera zooms in to focus on Hou's right hand poised on the handle of a large antique knife switch inscribed 'Tesla Co.'. She pulls the switch down to apply a voltage across the cell.

The video switches to a split screen, with one side showing the meter and a timer, and the other the cold-fusion cell. For the first 42 seconds, neither image changes. At the 43rd second, the needle moves slightly above zero and a small bubble appears in the cold-fusion cell. More bubbles appear in succeeding frames, and the needle moves upwards.

"That's funny," Hou's voice says, off-camera. A smartphone QuickVid sent in real time by a student shows a surprised look spread across her face as she looks at the moving meter. The bubbles multiply and the meter accelerates. "Uh-oh," Hou says, reaching towards the switch.

A blinding flash ends the video and smartphone transmissions.

Substantial uncertainty remains in the estimates of the energy released by the Final Demonstration, although measurements of the crater indicate that it was significantly less than the Hiroshima bomb. Unfortunately, the Final Demonstration vaporized all the experimental apparatus, and no records survive of activities being conducted in the building or of wireless signals in the vicinity. Nonetheless, we can be confident that the energy release was orders of magnitude higher than the total from any previous 'controlled fusion' experiment.

With new energy sources critically important, the Department of Energy has scheduled its attempt to replicate Hou's demonstration at the Nevada Nuclear Test Site. ■

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