[Reprinted from the March 16, 2007 issue of ***New Energy Times*** *(www.newenergytimes.com.]*

Extraordinary Courage: Report on Some LENR Presentations at the 2007 American Physical Society Meeting
By Steven B. Krivit

[This is the third in a series of articles relating to the SPAWAR San Diego co-deposition experiment and the New Energy Institute Galileo Project, reported previously in the September 10, 2006 and November 10, 2006 issues of New Energy Times*.]*

At 8 a.m. sharp, the presentations at the American Physical Society March meeting, billed as the largest physics conference in the world, kicked off at the Colorado Convention Center in downtown Denver.

Members of the condensed matter nuclear science community, science press and military personnel listened to 18 presentations on the field formerly known as cold fusion. The tenor of the meeting was generally low-key, with the exception of a barrage of technical questions from one member of the audience from Lockheed Martin.

Photo: S. Krivit
LENR Researchers at APS 2007. From left to right: Winthrop Williams, Frank Gordon, Edmund Storms, Pamela Mosier-Boss, Michael Melich, Larry Forsley, John Dash, Scott Chubb, Michael McKubre, Ludwik Kowalski, Melvin Miles. (Not pictured: Roger Stringham, George Miley, Heinrich Hora, Peter Hagelstein.)

Four of these presentations, including a last-minute surprise presentation by Ludwik Kowalski, a retired physics professor from Montclair State University, reported new research based on the SPAWAR co-deposition experiment. This experiment, which uses the electrochemical co-deposition method developed by SPAWAR researchers Stan Szpak and Pamela Mosier-Boss, claimed to be repeatable on demand by its originators, also appears to be reproducible by others on demand. Two independent replicators, participants in the New Energy Institute Galileo Project, both showed similar evidence of particle emissions from their replications of the SPAWAR experiment. This appears to be the first highly reproducible nuclear evidence in the 18-year history of this field.

The results that were reported are intriguing and encouraging, though not all researchers shared similar conclusions about their work. The major struggle facing the researchers is detection limits, not having the ideal tools for post-experiment analysis. High-resolution optical microscopes with rear illumination has not been easily available to all researchers, nor has automated scanning equipment and software to collect and analyze data from the thousands of pits often seen in these CR-39 detectors. As well, most of the researchers have not taken the time to perform sequential etching, which would provide added confidence that the pits seen show the expected geometry, the conical shape, of a particle track.

Slide Presentations and Video Recordings

Pamela Mosier-Boss et al., "Production of High Energy Particles Using the Pd/D Co-Deposition Process"	Slide presentation	Video
Larry Forsley et al., "Time Resolved, High Resolution, Gamma-Ray and Integrated Charge and Knock-on Particle Measurements of Pd:D Co-deposition Cells"	Slide presentation	Video
Steven B. Krivit, *New Energy Times*, "Low Energy Nuclear Reactions: 2007 Update"	Slide presentation	Video
Winthrop Williams et al., U.C. Berkeley, "Search for Charged Particle Tracks Using CR-39 Detectors to Replicate the SPAWAR Pd/D External Field Co-Deposition Protocol"	Slide presentation	Video
Ludwik Kowalski et al., Montclair State Univ., "Our Galileo Project March 2007 Report"	Slide presentation	Video

Winthrop Williams, a physicist on staff at the University of California, Berkeley, and Kowalski each followed the Galileo Project experimental protocol rigorously and were rewarded with clear data. Kowalski's very first attempt at the experiment was successful. Williams' first attempt may have been successful; however, the batch of CR-39 he initially used did not hold up well to the electrochemical environment and resulted in a fogging appearance that covered most of the detector. Williams' second experiment, using a different batch of CR-39 detectors, showed clearer results.

The core of the SPAWAR method is the use of the electrochemical co-deposition method. The essential benefit of this method over other LENR methods is that the required loading ratio (atomic ratio) between palladium and deuterium is achieved easily, instantly and reliably. LENR researchers agree that a minimum loading ratio must be achieved in order to expect to see an apparently nuclear reaction. A ratio below 80 percent rarely yields positive results, a ratio of 85 percent shows some results, and a ratio of 90 percent to 100 percent, if attained, almost always produces a reaction, so long as the other parametric requirements are in place. In most experiments, a minimum current density is required, as well as a dynamic trigger, though these second and third parametric requirements are not as critical as the loading ratio, particularly when experiments use the co-deposition method. In the famous claims of the "failures to replicate" the results of Fleischmann and Pons in 1989, the chief reason for their failure to obtain a positive result was an insufficient loading ratio. For example, Nathan Lewis, at Caltech, reached a maximum loading of only 80 percent in his team's cold fusion experiment.

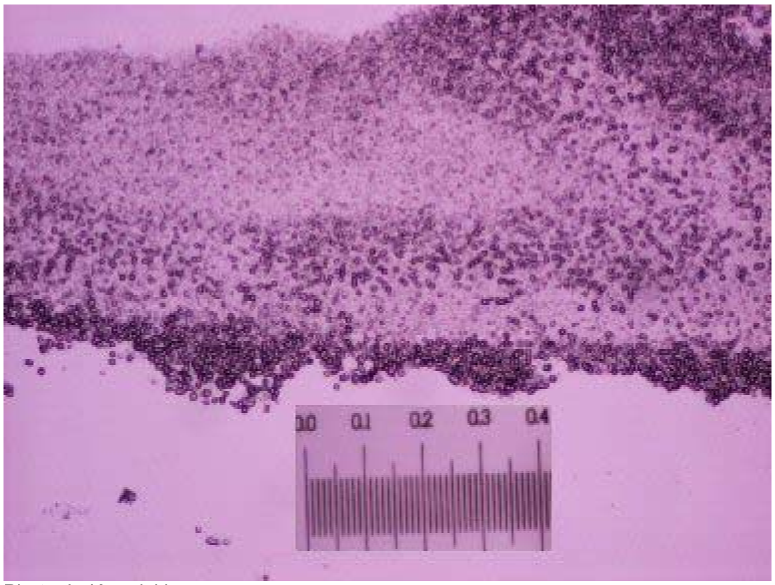


Photo: L. Kowalski
Tracks from Pd/D co-deposition cell from Montclair State University. Smallest marks in scale are 10 microns apart. Click for larger image.

Kowalski's interpretation and presentation at APS was somewhat ambiguous; however, his results looked identical to those of SPAWAR. Shown below is a 40x magnification photograph of the CR-39 detector from the vicinity of the silver cathode wire in his experiment. The overall pattern of pits is spatially related to the cathode wire, and within this view, distribution patterns parallel to the cathode wire are visible. Also visible are precisely defined pits with clean, distinct circumferences and uniformity in size and contrast.

The detector showed tracks only where the cathode wires were closest to the chip, right near the edge where they were attached to the detector.

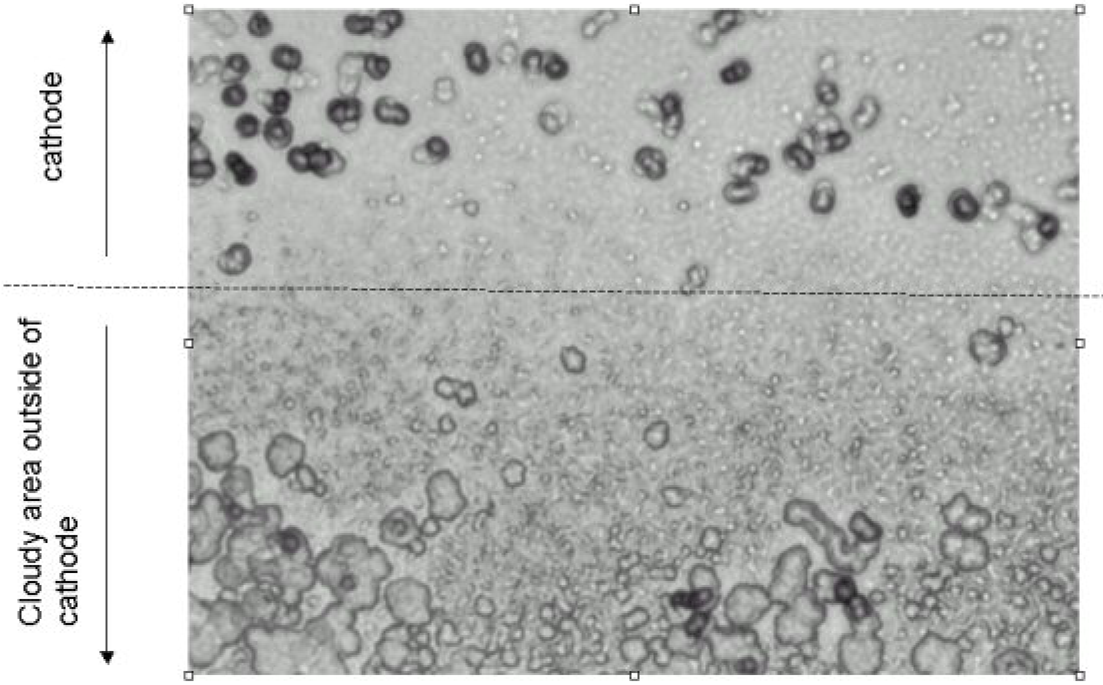
Kowalski's abstract says, "Our attempt to replicate a SPAWAR [LENR co-deposition] experiment was highly successful. Like SPAWAR researchers, we observed copious pits at the detector near the silver cathode in an electrolytic cell with magnets and no such pits in an identical cell without magnets."

Kowalski's interpretation of the pits left some ambiguity; he and Steven Krivit discussed these ambiguities in detail after the conference.

"It's Not Real Science Without a Published Paper"

At the APS meeting Mosier-Boss presented improved photomicrographs and a review of a broad array of tests performed to isolate various possible contaminations that might be responsible for false positives. She also displayed images depicting different types of chemical damage that could occur by the use of CR-39 detectors in electrolytic solutions.

Pd-D co-dep in magnetic field, TASL CR-39, 2 hr etch. Chip had no fogging where it was in close proximity to cathode. Remaining areas were cloudy. Below see interface (transition from cloudy area to area near cathode) 500X



Chemical damage shown adjacent to apparent particle tracks.

Her paper, "Further Evidence of Nuclear Reactions in the Pd/D Lattice: Emission of Charged Particles," was written with colleagues Stan Szpak and Frank Gordon of SPAWAR and published a few weeks ago in *Naturwissenschaften*. The process took six months with Naturwissenschaften. They had submitted it to three other journals before that, though none of the other journals was willing to send it out for review.

The application to the first journal, personally transmitted to an editor through an associate of theirs, was rejected with the comment, "[The authors] would be best advised to seek publication elsewhere. I can only speak for [our journal], and we wouldn't want it, but I doubt that they'd get much joy at [our other journals], sorry."

The second journal editor to reject it stated, "We are not persuaded that the firm conclusions that can be drawn from this current work will have a sufficiently immediate impact on our broader readership to justify publication."

The third journal editor to refuse to send the paper out for review wrote, "While your observations of charged particles emitted during electrolysis may well be of some interest to others in the field, I am afraid that, based on the brief information provided, we are not persuaded that these specific results will be of sufficiently immediate and general conceptual and fundamental interest to a wide materials research readership or represent a sufficient technological advance. ... I hope you will rapidly receive a more favourable response elsewhere."

New Energy Times asked Gordon for a clarification on their use of the term "reproducible" in the SPAWAR paper. He explained that their group is able to repeat the experiment on demand and that, in the 2006 spring semester, a group of students at University of California San Diego replicated their results. *New Energy Times* noticed that SPAWAR did not cite the published Widom-Larsen paper which also discusses a low energy neutron theory.

Limitations of Detection Limits: A Chemist's Perspective on CR-39 Analysis

On its path of destruction through the CR-39 plastic, an electromagnetic interaction occurs between charged particles and the plastic, breaking the chemical bonds, which causes the resulting pit. Neutrons do not cause pits, because they have no electrical charge, but they can knock onto other nuclei, like billiard balls, which then, in turn, result in pits.

What is not visible from many photographs from these experiments is the telltale sign of the pinpoint of the conical etch-pit, indicative of the path of the particle responsible for the pit. A charged particle passing through the detector would be on the order of one-billionth the size of the overall pit. A minimum of 500 or 1000x magnification is required even to get close to seeing a conical shape.

Even then, it can be challenging. Also, most of the results from these experiments typically suggest particle impacts that are normal—that is, perpendicular to the surface of the detector. Consequently, only a few tracks show signs of gross ellipticity. However, when researchers have performed automated scans of thousands of pits per detector, they have reported statistically significant ellipticity.

The appearance of a conical shape, with a pinpoint tip in the center of the pits on these detectors is an important aspect of detection and interpretation. Such pinpoints are difficult to explain by any means other than a charged particle track. The diagram below represents a variety of the different type of tracks that CR-39 detectors can show. The blue circle shows a pair of tracks, one on the front (facing toward the emitting device) and another on the backside (facing away from the emitting device) that are spatially aligned. Where spatially-correlated pits appear on the front and backside of CR-39 detectors, the question of the existence of a nuclear reaction becomes nearly indisputable.

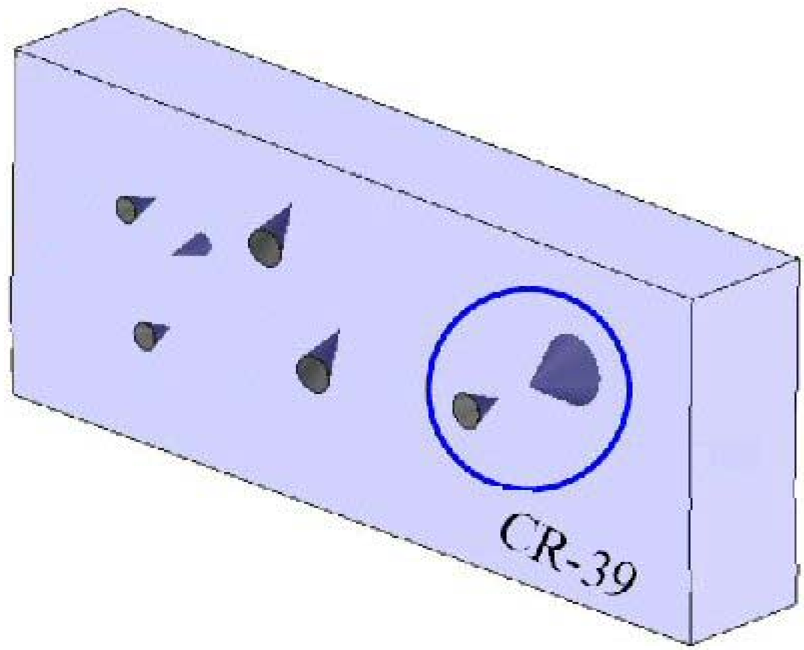


Diagram modified from original diagram by Michael J. Canavan of MIT

The best optical technique to view this conical shape is to be sitting at the microscope and operate the focus adjustment to observe the changing depth of field through the focus adjustment. Perhaps someone will connect a video camera to one of these microscopes someday so the rest of us can "look through the microscope," but for now, we are limited to still, digital images.

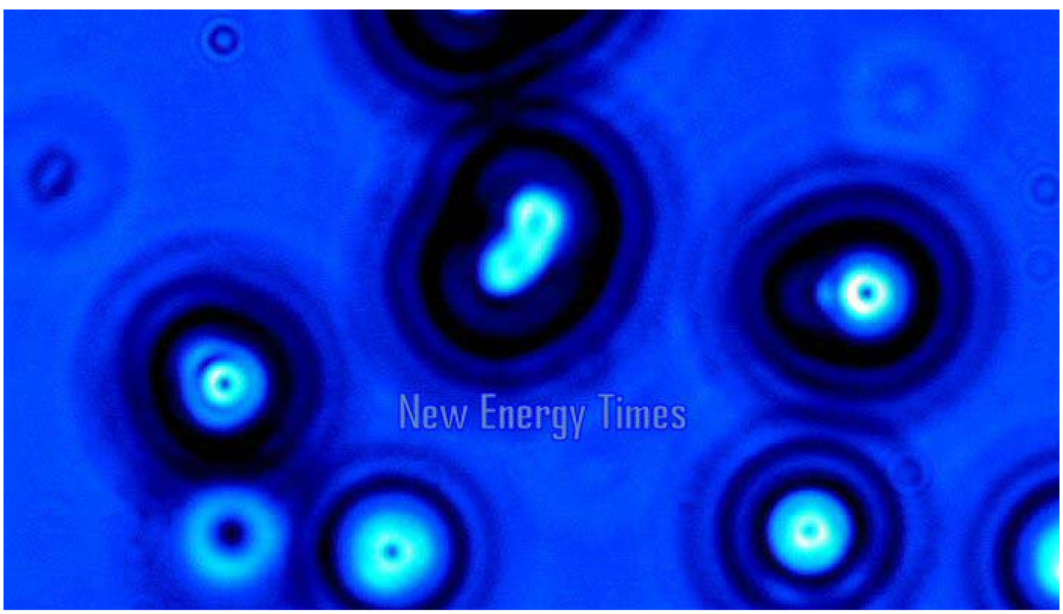


Photo: P. Mosier-Boss

High-contrast, color-enhanced image showing tiny point in center of pit.

Recent developments from Mosier-Boss' research incorporates improved photomicrography and color and contrast enhancements to help present a slightly three-dimensional view of the etched detectors in a two-dimensional medium such as a photograph. Mosier-Boss has started using a method which combines an overlay of two focus depths of the same view.

Mosier-Boss has used the overlay method on her own, as well as on other detectors from other participants in the Galileo Project. The first image shows a monochrome, single-depth image of pits from an experiment performed by Kowalski.

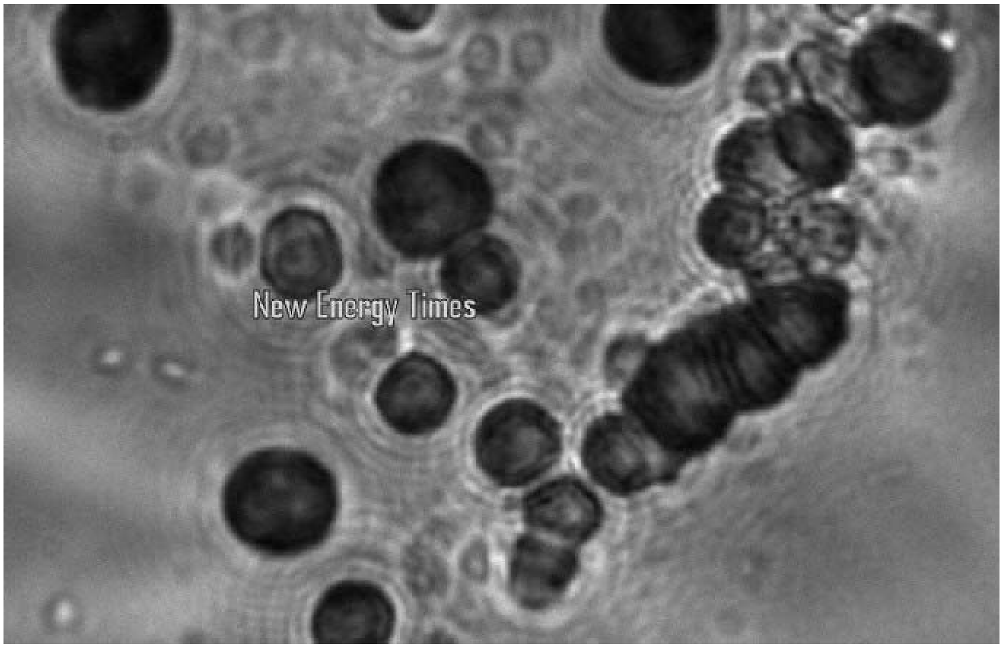


Photo: P. Mosier-Boss

Monochrome, single-depth image of Kowalski experiment.

The next image is the same view but an overlay of two images, one focused toward the surface of the pit, the other focused toward the point of the pit, and the two distinguished with two colors. A concentric radial pattern terminating in a pinpoint supports the claim of the presence of the expected conical geometry of a particle track.

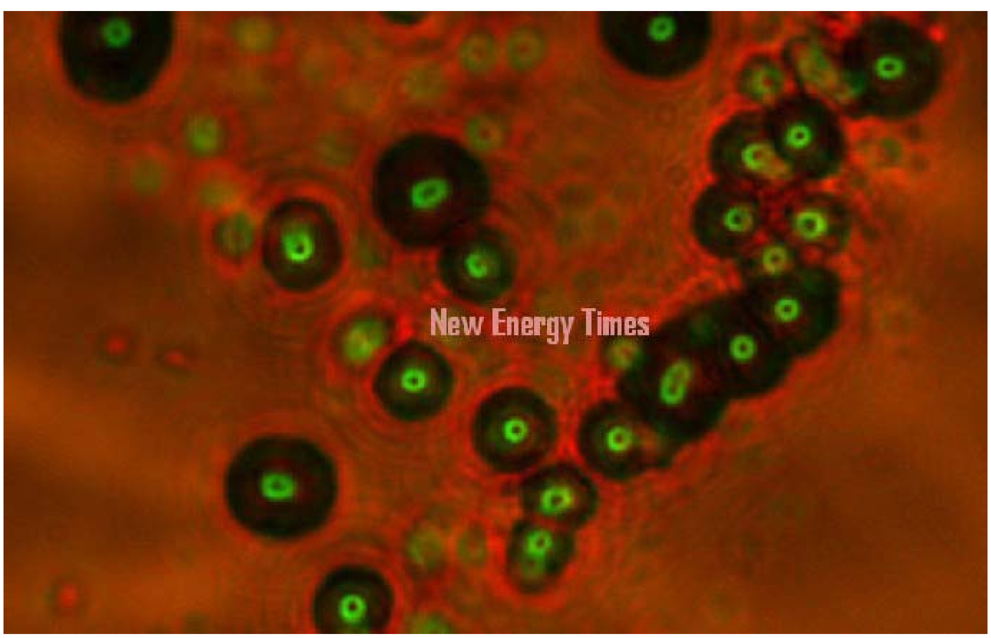


Photo: P. Mosier-Boss

Color overlay of Kowalski experiment.

The next two images show another, wider field of view of the Kowalski CR-39 detector. Again, the difference between the two types of images is readily apparent.

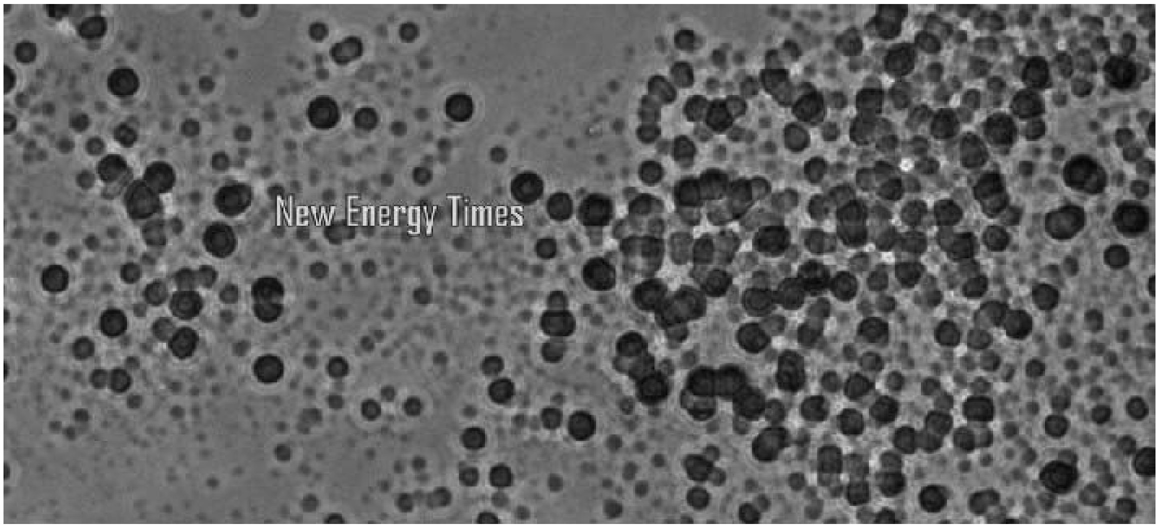


Photo: P. Mosier-Boss

Monochrome, single-depth image of Kowalski experiment.

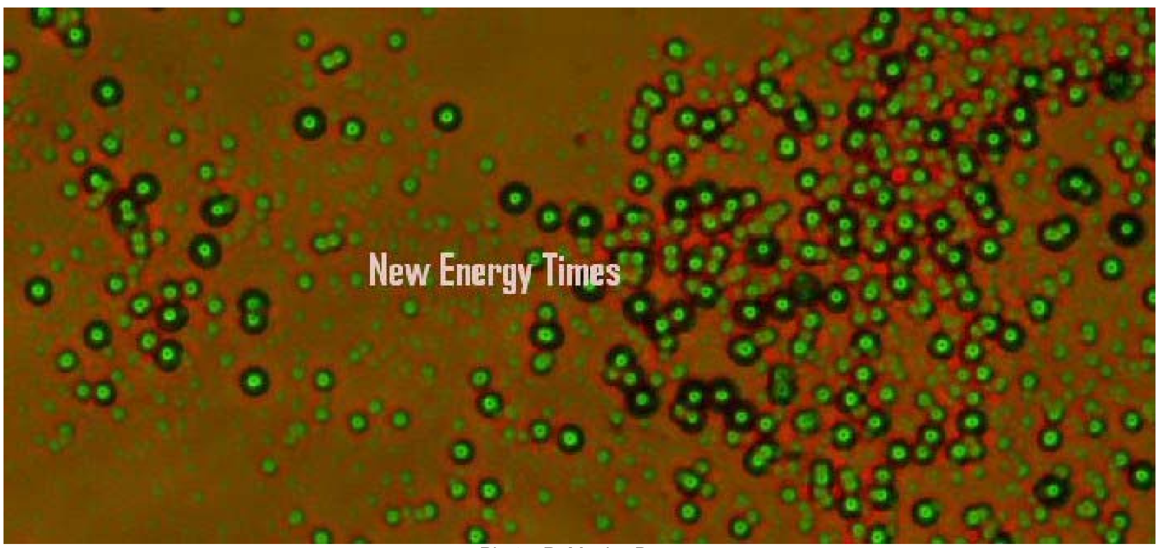


Photo: P. Mosier-Boss

Color overlay of Kowalski experiment.

Also at the APS meeting, Winthrop Williams, a physicist with U.C. Berkeley reported seeing similar pits, though again, the resolution of his digital image does not support a clear interpretation of the pits. Two interesting things are apparent. First, the distributions of the pits are in two groups; one about 2.5 times larger than the other. Second, Williams' cell #2 did not have magnets yet produced pits. As Williams reported, he has more work ahead of him to make sense of these observations.

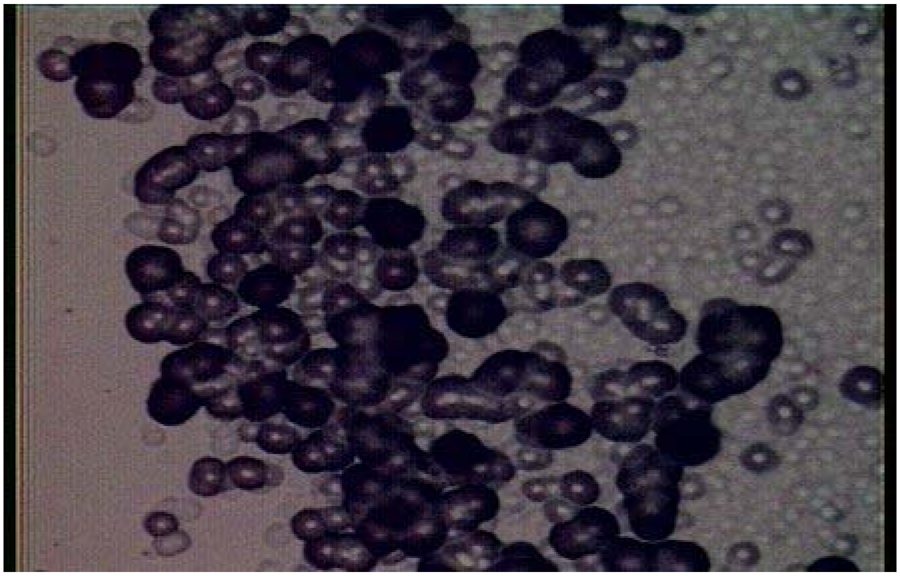


Photo: W. Williams

Williams Experiment #2, Cell #1, Design #1, with magnets.

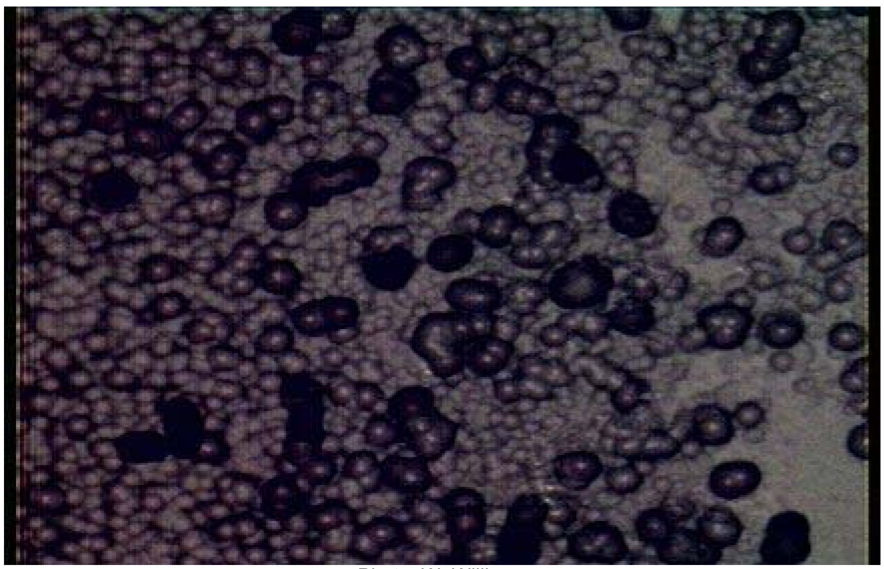


Photo: W. Williams

Williams Experiment #2, Cell #2, Design #1 with magnets.

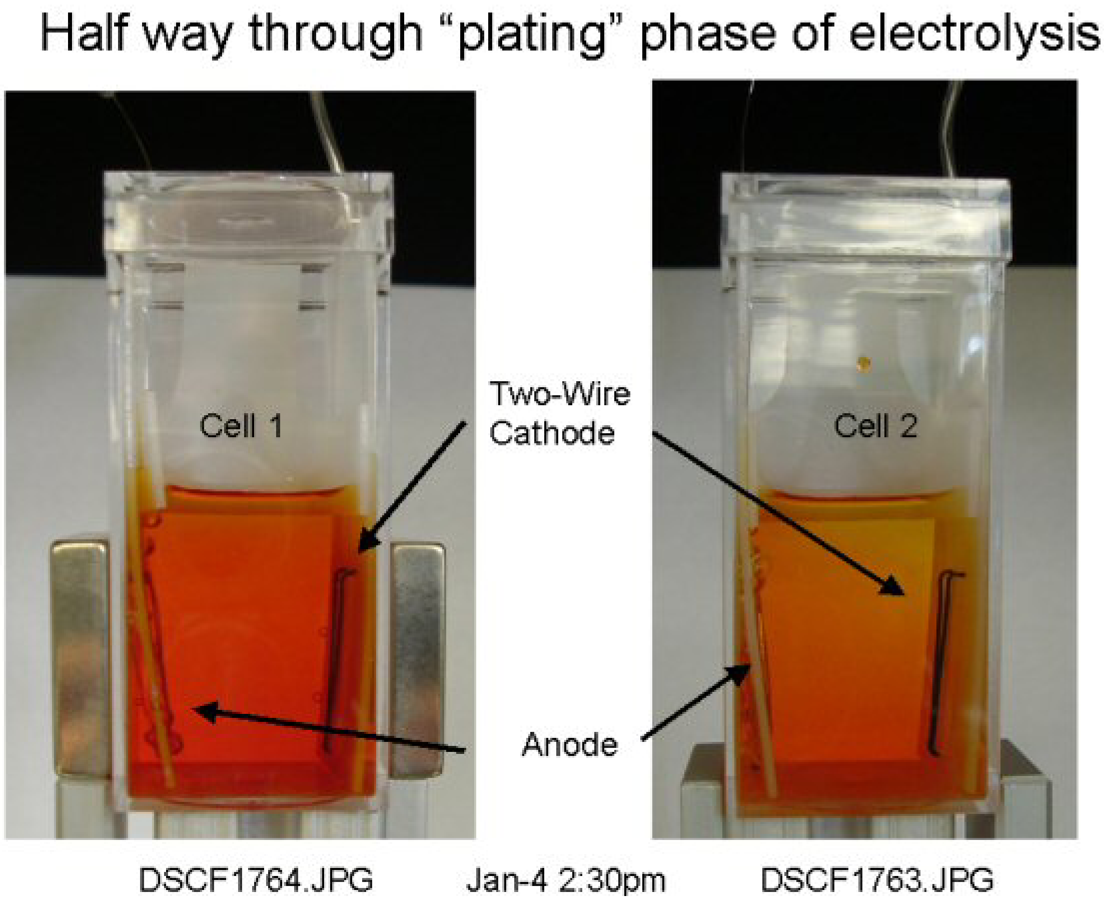


Diagram of William's cell design #1 (Replication of SPAWAR design).

A Physicist's Analysis

Forsley, who is working with the SPAWAR group, presented a rapid-fire download of an array of data that suggested their experiments had shown evidence of gamma ray emission and knock-on tracks from neutral particles. His fourth slide showed results of apparent tracks from "dry" CR-39 experiments, where the CR-39 is physically and chemically isolated from the electrolyte by a thin barrier. The track density is far lower than in "wet" experiments, where the detectors are immersed in the electrolyte. However, Mosier-Boss later confirmed that the track count was more than seven times the background.

Forsley's fifth slide showed a graphical data analysis of the detected tracks obtained by the use of an automated computer scanning system. The extraordinary track density is not news to New Energy Times readers. However, the visual display of track distributions on a single detector with three cathode wires strung across it provides a remarkably clear illustration.

But wait, there's more—tracks on the backside of the CR-39. How did they get there? Is there any other imaginable mechanism that can pit holes through this piece of hard plastic, sitting in a low-power electrolytic solution? And are the holes on the backside coming through the material, or are they just random pits created by some prosaic mechanism? There is a distinct spatial relationship of the pits on the backside to the pits on the front side.

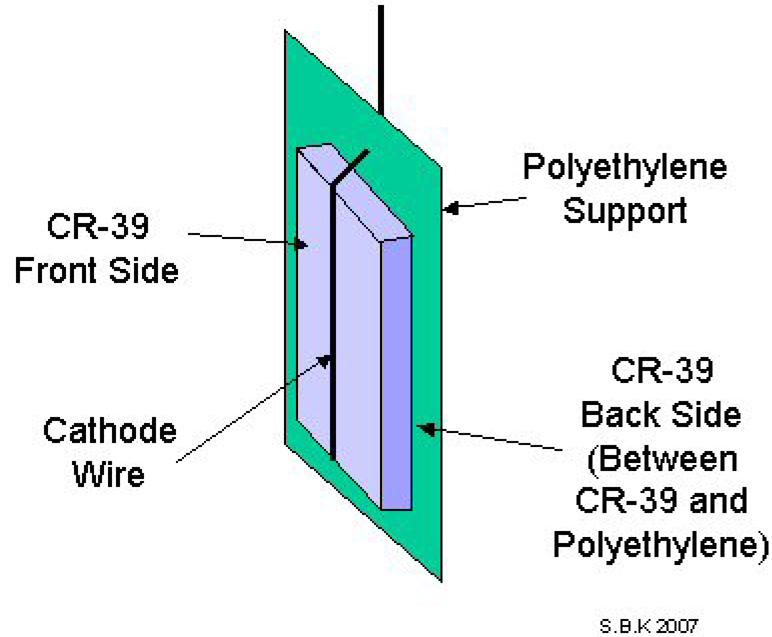
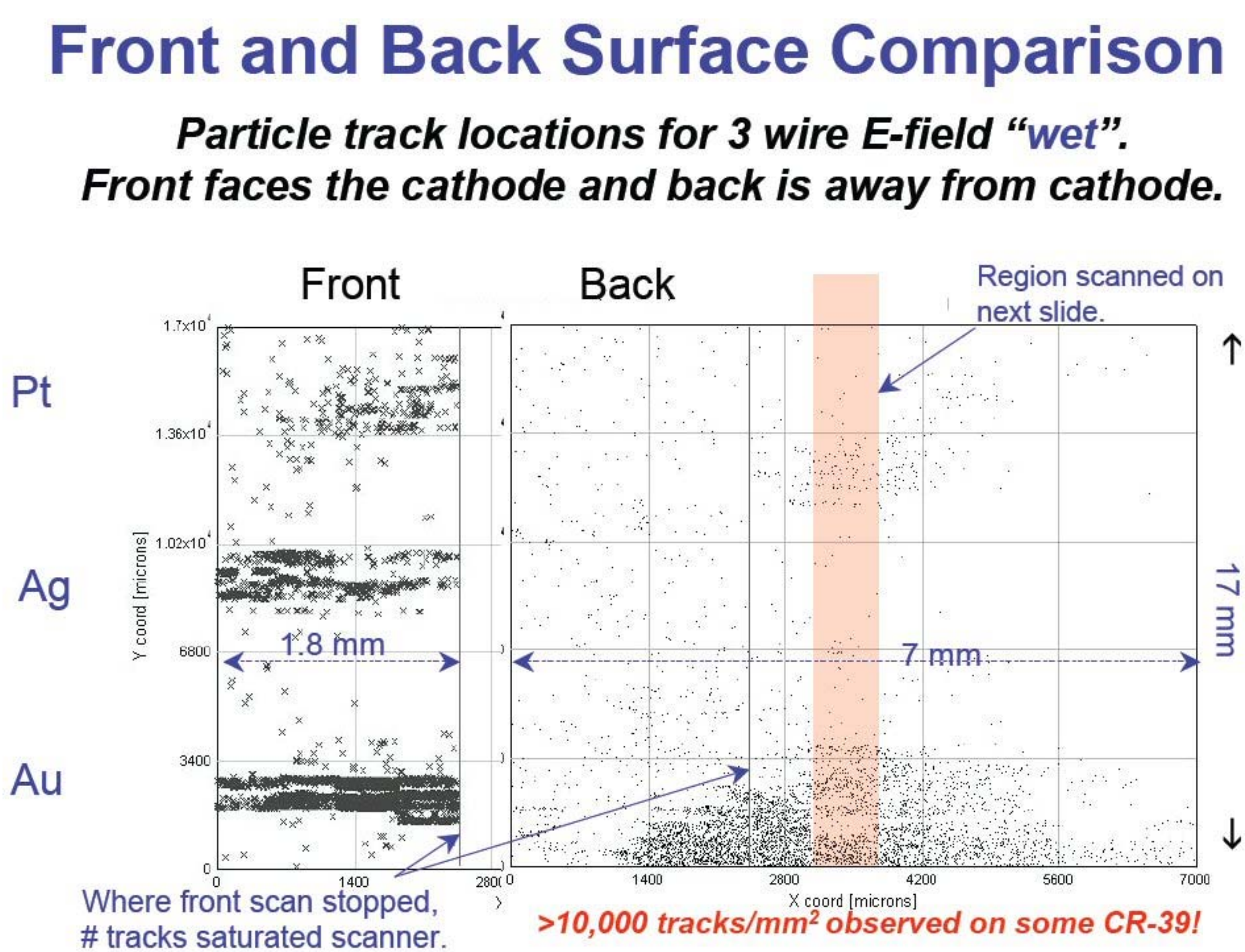
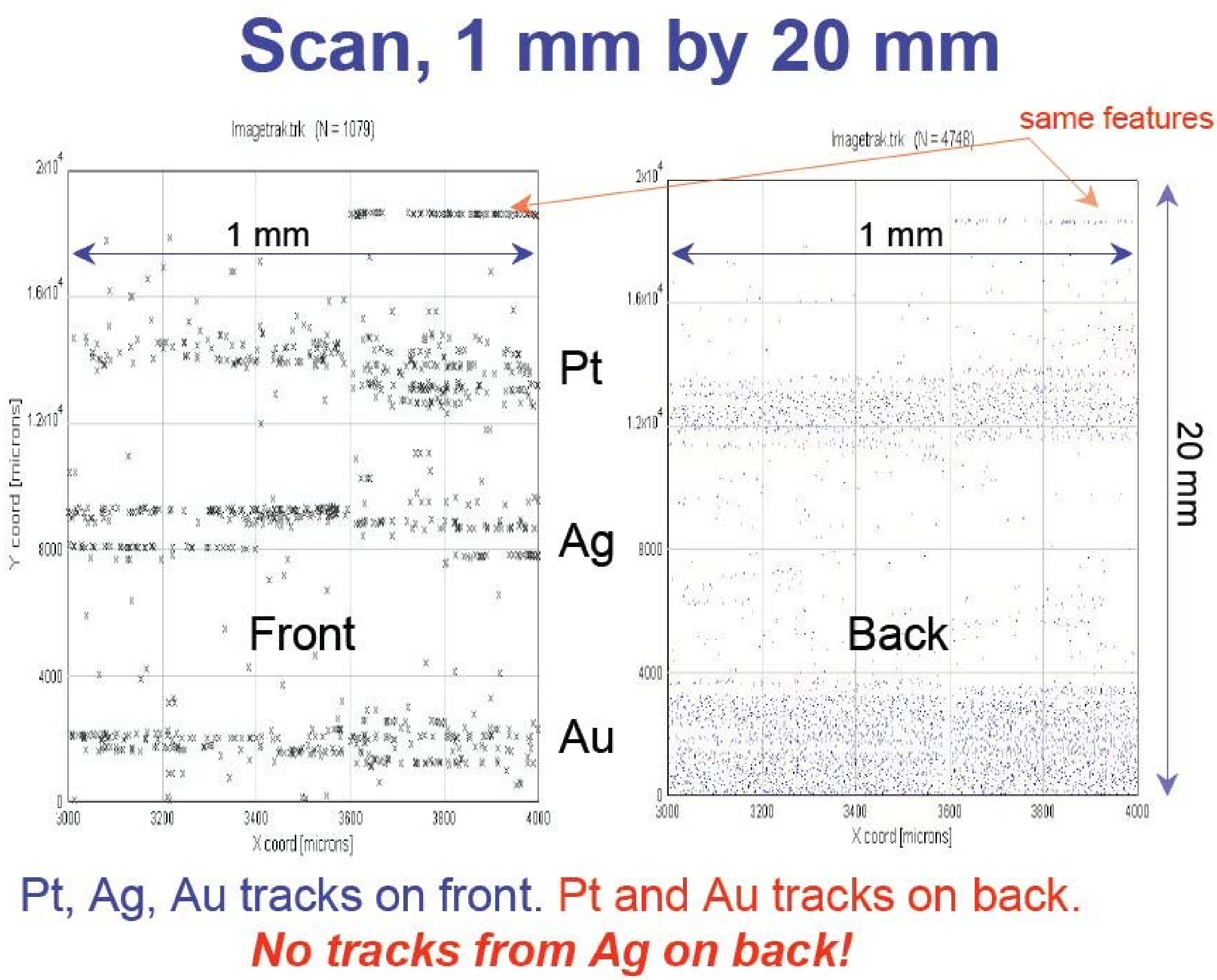


Diagram Showing Front and Back Side Relationship to CR-39 Detector



Computer analysis of SPAWAR CR-39 detector showing front and rear track correlation.



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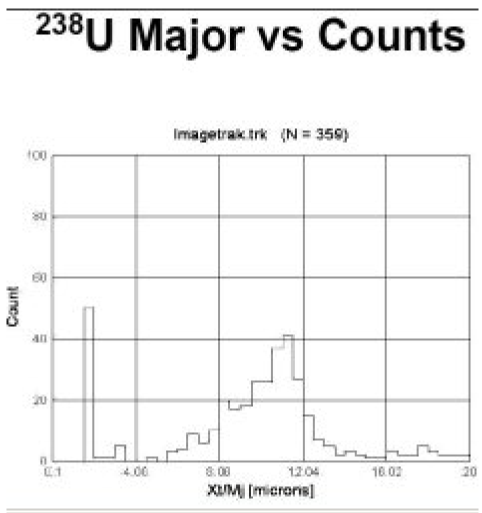
Detail of computer analysis of SPAWAR CR-39 detector showing front and rear track correlation.

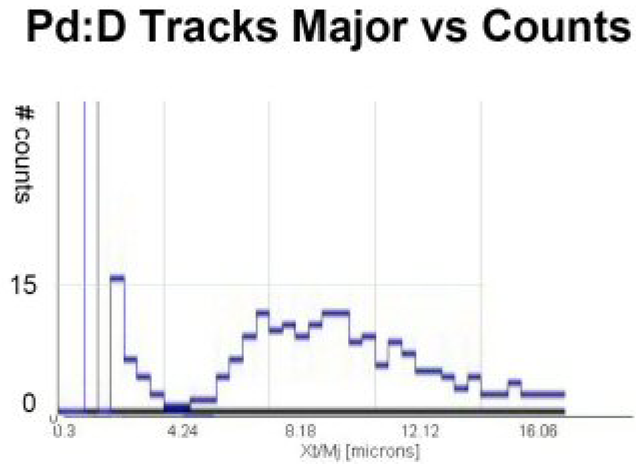
Mosier-Boss was the first to find the tracks on the back side—by accident.

"One day while taking images of an experiment," Mosier-Boss wrote, "we discovered that the focus was actually on the back of the chip and that there were pits on the backside of the CR-39, as well as the front side. As the CR-39 chip is ~1 mm thick, the implications are that either very energetic charged particles went through or the pits are due to knock-ons created by neutral particles traversing the chip."

Forsley's seventh slide shows something interesting, as well. In the first image, he displays a spectrum of alpha track diameters from a calibration experiment using uranium-238. It shows a narrow peak around two microns, a major range between 6 and 14 microns. A spectrum of pit sizes from the SPAWAR experiment shows a nearly identically shaped curve and range; however, the Pd/D experiment has far fewer pits.



Distribution of Major Axis of Pit Sizes
From Alpha Particles From U238 Source



Distribution of Major Axis of Pit Sizes
From SPAWAR Pd/D Experiment

A similarly shaped curve and distribution range was displayed by Williams in his APS presentation, as well. There is much more to report on the Forsley presentation, so *New Energy Times* will present additional analyses in future issues.