ICCF24 Solid-State Energy Summit

Christy L. Frazier

Photos courtesy of David Nagel.

The ICCF24 Solid-State Energy Summit was held during the last week of July 2022 in Mountain View, California at the Computer History Museum. The event was sponsored and organized by the Anthropocene Institute,[1] a Palo Alto, California company that connects investors, scientists and institutions to solve the climate crisis. Anthropocene, and its co-founder Carl Page, has been interested in cold fusion (what Page terms solid-state fusion) for a number of years. Anthropocene fosters science, backs technologies and tries to influence policy.

Anthropocene's Carl Page

ICCF24 had approximately 150 in-person attendees, with an additional online attendance of almost 150. Online participation was facilitated via Hopin, and was very user-friendly (*IE* staff participated this way). A chat feature enabled viewers to discuss presentations as they were happening, and also included at least one poll question each day that was based on a talk given that day.

Online participation had much flux based on the various time zones around the world, but the lowest number of participants we noticed at any one time was 85. Online attendees were treated to previews and recaps of presentations. Before each day began and during breaks, Anthropocene's Anna Michel and Paloma Ledesma highlighted particular talks. They presented creative content and materials from sponsors and organizations of interest, and often provided the results of a daily poll question.

The Anthropocene team deserves much praise and credit for ensuring a safe, and enjoyable, conference. Since Covid cases were on the rise again at the time of the event, organizers instituted many safety protocols for in-person attendees. These included daily testing, recommendation of wearing masks, social distancing in seating and having meals and social events outside. Airlock 389 provided free anti-viral respirators that purify air rather than simply filter it, and had three air purifiers in the main meeting room. In a poll after ICCF24, organizers learned that no one seems to have contracted Covid at the event.

It should be noted that the conference organizers did a remarkable job of adhering to a very strict timetable. The start of the day and all talks began on time, with very immediate transitions from one speaker to the next and no noticeable technical glitches. Due to Covid concerns and travel restrictions, numerous speakers attended virtually, and this in no way detracted from the effectiveness of the presentations. It is hoped that this high-tech approach to the conference, including the ease and usefulness of online attendance, continues in the future.

Nearly all of the presentations from the conference are available on the ICCF24 Solid-State Energy Summit YouTube channel.[2] See, especially, the playlist[3] or individual videos for the keynote and technical talks.

David Nagel was Chair of the Technical Review Committee. The book of abstracts for the Technical Program is available on the ICCF24 website.[4] This portion of the ICCF24 program kicked off on Day 2 in the afternoon session, with nine talks. I was able to see most of the technical presentations live. They were fantastic. I missed the final day of the conference, but have been able to view most of those talks on the ICCF24 YouTube channel.[2] In the process of looking over my notes for the final version of this conference summary, I realized how fortunate *Infinite Energy* has been in the past to have scientists in the field review the technical program of the ICCFs. In recent years, David Nagel stepped up to take on this monumental task, providing seven important ICCF technical reports (ICCF15 through ICCF21), and I am immensely grateful to him. I believe the *IE* technical reports of the conference are an important historical tool/resource. We are fortunate that most conference organizers make the Abstracts available during the conference and eventually Proceedings are published, as these documents also build the historical record, help to better grasp the work presented and illustrate the incredible depth and breadth of work being done in LENR. Anthropocene has provided the added benefit of having video of nearly all of the talks available shortly after the conference ended (see the ICCF24 YouTube channel[2]).

In this report on ICCF24, I have focused on the keynote addresses, roundtables/chats and "newsy" aspects of the program. Our goal is to publish highlights of the technical talks in the next issue of *IE*. In this issue, we simply note the speaker, affiliation and title of each talk on the Technical Program. I would ask that readers do the following if they are able to: download the Abstracts[4] and read each overview closely; bookmark the YouTube channel and watch the talks that are of most interest (or watch them all!). Additionally, consider joining the fantastic LENR forum created by David Nygren in 2010 (https://www.lenr-forum.com/forum/). In addition to offering a great space for debates and information exchange about LENR, the site typically has real-time reports from the various LENR events around the world. For ICCF24, a number of conference participants were posting daily updates on the forum, including overviews of most of the talks. (The *IE* daily reports of the conference will remain

online as well.[5])

Recent ICCFs have had a Short Course the day before the event begins, a session focused on major areas in the LENR field. For ICCF24, the Short Course was prepared ahead of time, organized by David Nagel and focusing on the status, potential and momentum of the field. The Short Course videos are available on the ICCF24 YouTube channel playlist[6] and include:

- Introduction and Issues (David Nagel)
- Electrochemical Loading (Michael McKubre)
- Hot Gas Loading (Shinya Narita)
- Plasma Loading (Lawrence Forsley)
- Calorimetry and Heat Data (Edmund Storms)
- Transmutation Data (Jean-Paul Biberian)
- Materials Challenges (Ashraf Imam)
- Theoretical Considerations (Peter Hagelstein)
- Commercialization (Steve Katinsky)
- Applications and Impacts (Jed Rothwell)

Day 1 — July 25, 2022

The conference kicked off with a short anime video titled "Run, LENR, Run." This set the tone for the many innovative approaches taken by Anthropocene.

Anthropocene's Carl Page (Co-Founder and President) and Frank Ling (Chief Scientist) presented a touching tribute to Richard Chan, who passed away earlier this year in the midst of planning ICCF24. He was Anthropocene's Executive Director and a former U.S. Patent Office patent examiner.

Opening Remarks were given by Page and Ling. Ling noted that Anthropocene is a "team of artists, designers, scientists and communicators" whose goal is to better communicate scientific ideas and breakthroughs to the public. Page has become known to the LENR community in recent years and has provided support to many projects. Page acknowledged the dedication of researchers in the field, noting "this is a community that understands that 'too good to be true" is not a scientific principle."

One of the more innovative and interesting creative approaches taken by Anthropocene was to commission rap songs from Baba Brinkman of Event Rap. Their Opening Remarks were followed by a video of the theme song for the conference, titled "You Must LENR."[7] A full story about Brinkman's songs and performances is in this issue of *IE* (p. 35). In it, Page notes that one main goal for the conference was "to attract young STEM students and entrepreneurs into the promising field of solid-state fusion energy." Among other approaches, they employed music for this purpose.

The morning session of the first day consisted of three keynote addresses.

Nobuo Tanaka, former Executive Director of the International Energy Agency (IEA, 2007-2011), spoke on "The Geopolitics of Energy Security and Transformation Toward Carbon Neutrality." He noted that the IEA was formed in 1974 in response to the first "oil shock" to prepare for oil supply disruption. IEA has responded to various main supply disruptions, including the Gulf War, Hurricane Katrina and the Libyan crisis. Most recently, the Russian invasion of Ukraine caused IEA to release its largest strategic stock of oil. One of Tanaka's graphs showed that the United States is the only current top net gas and oil importer that will move towards more exporting than importing (thanks in part to shale). Tanaka said, "To achieve carbon neutrality, we need all technologies," hinting that the energy sector should be open to even new, underdeveloped technologies like LENR. He said that "hydrogen is a common element of our energy future" that can: provide storage for renewables; help carbonize hard-to-update sectors; provide energy security. (See the IEA's "The Future of Hydrogen Report."[8]) He recently learned about Clean Planet,[9] a Japenese company developing quantum hydrogen energy (QHe). Tanaka noted, "Quantum hydrogen technology may provide the way to use hydrogen and fusion together."

Florian Metzler, Research Scientist at the MIT Industrial Performance Center, discussed "Solid-State Fusion: The Formation of a Scientific Field." He began by posing the question of why conventional plasma fusion has had "enormous momentum…over the last year" while at the same time the solid-state fusion (LENR) field has had little or no attention. He explored this question by situating solid-state fusion historically and conceptually with an easy-to-understand overview and steps to take towards a proof-of-principle experiment. Metzler had seven main takeaway points: 1) Solid-state fusion can be situated within fusion research overall. 2) Prolonged ambiguity and polarization has been seen in other fields, such as semiconductors. 3) Anomalies are important guidelines, but not sufficient. Control of materials and a theoretical picture at the nanoscale are needed. 4) Even with some data being ambiguous or even wrong, a bigger picture can still be discernable. 5) Understanding of the underlying mechanism, as represented by a proof-of-principle experiment, is likely necessary for a large-scale deployment. 6) Characterize inputs at the nanoscale and focus on experiments with nuclear products, and build on what Metzler calls "information dense" experiments." 7) There are known mechanisms that can explain anomalous results.

Scott Hsu, Senior Advisor and Lead Fusion Coordinator at the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E), presented "Perspectives on the ARPA-E LENR Workshop" held in October 2021. The workshop objective was to "explore compelling R&D opportunities in Low-Energy Nuclear Reactions (LENR), in support of developing metrics for a potential ARPA-E R&D program in LENR."[10] The two-day event featured about 100 government representatives and known LENR players. (See links to slides of many of the talks on the workshop site.[10]) Hsu announced that ARPA-E was moving ahead with a Teaming Partner List for a possible Funding Opportunity Announcement (FOA).[11,12] The announcement notes, "ARPA-E acknowledges the complex, controversial history of LENR beginning with the announcement by Martin Fleischmann and Stanley Pons in 1989...LENR as a field remains in a stalemate where lack of adequate funding inhibits the rigorous results that would engender additional funding and more rigorous studies." The announcement notes that the goal of the FOA would be to "to establish clear practices to rigorously answer the question, 'should this field move forward given that LENR could be a potentially transformative carbon-free energy source, or does it conclusively not show promise?'"

On September 13, 2022, the DOE announced an ARPA-E LENR Exploratory Topic with "up to $10 million in funding to establish clear practices to determine whether LENR could be the basis for a potentially transformative carbon-free

energy source."[13] The deadline for submission is November 15; watch the *IE* website and future issues of the magazine for more information.

Before the lunch break, Carl Page made an important announcement—the formation of a Solid-State Fusion Prize. He called the Prize, which is still in the early stages of planning, an "engine of innovation we might bring to bear on this problem and speed things up." He noted that "something magical happens when you announce a new competition...the implausible suddenly becomes the inevitable." He considers a Prize a sort of PR exercise, a way to "draw attention to the space and the people involved." Page asked for ideas and suggestions for the Prize, the plans for which may be finalized by the end of the year. (Watch *IE* for more details as they become available.)

The afternoon session began with a focus on funding, from prize incentives to investment approaches.

The first "Fireside Chat" on "Why Prizes Accelerate Moonshot Technologies" featured Huw Price (Professor Emeritus, Bonn University) and Peter Diamandis, founder of the XPrize. Diamandis highlighted how prizes have accelerated advances or breakthroughs throughout human history. The XPrize, in particular, draws new thinkers and innovators to a subject, with new approaches, and also provides a place for smaller, non-traditional teams to flourish. He noted, "Prizes provide a level playing field so we can compare lots of different approaches…We get not a single solution but lots of solutions and hopefully kick off an entire industry." Diamandis said that XPrize was on the verge of getting a wildfire prize funded, with the questions: Can you detect a wildfire at ignition? If it's greater than 2 meters in size, or if it's moving, can you put it out in 10 minutes?

Price indicated that he called for a Prize for LENR in a 2015 essay.[14] The Solid-State Fusion Prize announced by Page earlier in the day is not likely to become an XPrize, but Diamandis is not ruling out the possibility there will be an XPrize for LENR. Diamandis said, "We are looking for the intersection of audacious and achievable prizes…You really want to have prizes for areas that are not moving fast enough or there's no capital flowing into that sector, or people thinks it's not possible… I have always felt like a great use for an XPrize would be something around cold fusion/LENR…A few decades ago, there was a series of events that led to a great stigma about 'well you can't do research in that area.'" He stated, "The day before something is truly a breakthrough, it's a crazy idea…So we need to have a sufficient number of people inside government, inside companies, inside scientific institutions, working on crazy ideas. Otherwise, you're stuck in incrementalism." He noted that finding capital for prizes can be difficult, but he thinks an LENR prize "should be $100M." Diamandis has conferred with Anthropocene about how to set guidelines for its prize.

Jeffrey Bohn, Chief Strategy Officer at OneConcern who is affiliated with the UC Berkeley Consortium for Data Analytics in Risk, spoke on "Risk Transfer Approaches to Achieving ESG & Resilience Objectives." (ESG is Environmental, Social and Governance and refers to investing approaches.) Broadly, he discussed how investors quantify the economic value of things (including new energy sources), and how they look at "dependency risks" and other risk factors. He said, "Data is more important than models," not just in science but in determining investment approaches. Bohn quoted Galileo: "Measure what is measurable and make measurable what is not so."

Huw Price (L) and Oliver Barham (R)

Carly Anderson, chemical engineering Partner at venture capital firm Prime Movers Lab, which invests in breakthrough science start-ups, discussed "Funding Moonshots." She said. "We invest in early stage companies…We don't invest in pure software. Over the past 20 years we got Facebook instead of fusion and flying cars. We believe it's time to put our resources and brainpower towards moving humanity forward." Prime Movers Lab has already invested in two fusion companies—Commonwealth Fusion Systems and Focus Energy. Anderson defined "moonshots" as: ambitious, exploratory and groundbreaking; risky but impactful; undertaken without the assurance of near-term profitability or benefit. Moonshots typically "created something entirely new or something that was absolutely better—they are transformative." Anderson overviewed successful moonshots and how they have been funded, with notes about risk factors related to deep tech investing. She provided tips on raising private capital: make progress and hit milestones; build credibility (publishing, third party validation, etc.).

The afternoon transitioned from approaches to funding and investments to talks by two scientists working on funded LENR projects at government labs.

NASA Glenn Research Center Principal Investigator Theresa Benyo presented "The History of LENR Research at NASA Glenn Research Center." The decade-long project, first known as the Advanced Energy Conversion Project, is now called the Lattice Confinement Fusion (LCF) Project. NASA got involved in this work because they do "a lot of missions in extreme environments that require novel power sources." Benyo stated that "LCF may be the key to harnessing fusion within a compact system," by: eliminating highly enriched uranium; reducing safety, security and supply concerns; being compact and controllable; having near zero radioactive waste. She explained, "Traditional fusion heats plasma ten times higher than the sun, which is hard to control. We address the pressure and temperature and containment challenges, where we heat a very few select atoms at a time. We can approach solar fuel density and the lattice provides the containment…We also have a cloud of electrons that makes the deuterons look like they're neutral to each other." Additional details of the NASA approach and history of the LCF Project and results were presented in Benyo's second

talk. In 2020, NASA Glenn published two papers in *Physical Review C*.[15,16]

Oliver Barham, a Project Manager for the U.S. Naval Surface Warfare Center Indian Head Division, gave a personal narrative approach to the Navy's LENR-related work in a talk titled "A Rising Scientific Tide Will Lift All Boats in This Field." As Barham worked with colleagues Carl Gotzmer and Lou DeChiaro on other projects, they turned him on to LENR. He got very interested in developing a Navy project on cold fusion. He thought, "If anyone should be doing high risk research and development, it should probably be us." They focused on wet electrochemistry experiments, with a theoretical approach based on density functional theory. The HIVER (^{2}**H**-Pd-L**i** **V**ersatile-Modeling & **E**valuation of **R**esults) project, sponsored by DARPA, involved a team of collaborators from government organizations, industry and academia. He recommended that others in the field "take similar approaches in teambuilding efforts." Results of the project were included in Barham's technical talk on the final day.

The formal program for the day ended with another "Fireside Chat." Carl Page and G. Nagesh Rao, Eisenhower Fellow and Board Director at Enchroma, talked about "Innovation and Investment in Our Clean Energy Future." Rao called Page a "luminary of luminaries" who puts "his own personal resources on the line to save the planet." Page joked, "I'm a crew member on Spaceship Earth…and I don't know who the manager of the engineering team is!" Page noted that it "shouldn't be a real surprise that a paradigm change could be on year 33" of discovery, using the history of the development of the computer as an example of just one technology that took many years to develop. He lamented a widespread "hyperconservatism in terms of taking technological risks" and stated, "Science is not a matter of consensus." About solid-state fusion in particular, he said, "This research is not expensive compared to everything else the government pays for…The beautiful thing about solid-state fusion is that it is small and can go into markets where there is no competition." Page wants the field to focus on ensuring that the right research gets done, with the right analytical tools. He acknowledged that the mainstream publishing embargo on LENR papers was an important issue to address in the field.

Rapper Baba Brinkman closed out the day with a short freestyle rap prepared on the spot, what he calls a "Rap Up." He performed a nearly 10-minute rap about the day's presentations and major points. He sat in the audience taking notes on talks and managed in a few short hours to prepare an overview of the day that included speaker names, direct quotes and general themes. (See the story about Brinkman's various songs and performances on p. 35.)

Day 2 — July 26, 2022

The second day of ICCF24 began with brief Opening Remarks from Greg Tanaka, a member of the Palo Alto City Council and former Congressional candidate who ran on a pro-nuclear platform. He spoke about the need for expanding the use of nuclear energy, noting the following: In 2020 over 50% of carbon-free electricity used in the U.S. was nuclear. Nuclear power is considered safer, cheaper and cleaner than every other power source. He said, "Nuclear power is a viable solution to climate change."

Huw Price, of the Centre for the Study of Existential Risk and Professor Emeritus at Bonn University, spoke on "Risk and Reputation," highlighting the important reasons why scientists must sometimes risk personal reputation to conduct "risky" new science. He said, "Science tends to look under the lamppost, where things are most illuminated" but that "great research often comes from the shadows." Price has written two mainstream articles about cold fusion[14,17] and has a chapter, "Risk and Scientific Reputation: Lessons from Cold Fusion," in the forthcoming book *Managing Extreme Technological Risk*.

Venture capitalist (currently with DCVC) and former Google program manager Matt Trevithick moderated a panel on "Some Accumulated Wisdom: A Historical Look Back." Panelists included Robert Duncan (Texas Tech University Physics Professor; former University of Missouri Vice-Chancellor of Research who appeared in the "60 Minutes" cold fusion piece), David Nagel (George Washington University Research Professor, formerly with the Naval Research Laboratory) and Thomas Schenkel (Lawrence Berkeley National Laboratory Program Head for Fusion). Trevithick noted that he has lived in Silicon Valley (location of the conference) for more than 20 years. He said, "Silicon Valley is more than just a physical place…[it] is a state of mind. If you believe that technology will help solve the world's ills, this is the place for you. If you have a healthy disregard for the impossible, this is the place for you." Trevithick was an exceptional moderator, posing four key questions. Each question, and the responses from the panelists, are as follows:


Matt Trevithick

1. Describe one or two experimental results that cause you to remain interested in LENR.

Nagel noted that he went to the Patent Office in 1989 to read the Fleischmann-Pons patent. He cited exciting early work (1995 experiments of Yoshiaki Arata and Yue-Chang Zhang that sustained excess power over 100 days) as well as more recent work (2014 Dawn Dominguez *et al*. Naval Research Laboratory experiment with power gain of 40x). Nagel said, "We have what I consider to be an absolutely bulletproof set of experimental data taken by competent people with good instruments, good procedures, calibrations, tests, everything that's needed in order to demonstrate the reality and promise of LENR."

Duncan came into the field as a result of being asked by CBS in 2007 to be a principal investigator of the Energetics Technology LENR work featured on "60 Minutes."[18] He said, "As a thermal physicist trained in quantum fluids, it was fascinating to see this level of power output compared to in." He was fascinated to learn that others at the time, and since, have "seen results of this magnitude." A recent example of exciting work, he noted, is the 2021 quantum nucleonics work of Lars Bocklage *et al*.

Schenkel came into the field as part of the Google team cold fusion work. He noted his team's own 2019 work at Lawrence Berkeley Lab, which resulted in "fusion rates

Thomas Schenkel

>100x higher than expected."

Trevithick commented that the ongoing involvement of the panelists in LENR research shows that cold fusion is "a problem you can't quit." Schenkel said, "As a scientist, I guess am attracted to problems. That might be a character flaw! But we also are attracted to solutions…If you can understand this better, it will very likely lead to impactful things."

2. If you had $10 million over two years to invest in LENR, what would you do?

Trevithick noted that the $10 million amount harkens back to the Google project original scope and is also in line with what the EU is currently investing in the CleanHME (Hydrogen Metal Energy) project. Duncan, who has had large programs under his wing, stated that the structure of a Prize is a great approach, perhaps with a focus on good measurement tools. Schenkel commented on the general needs of the field that could be addressed with that level of funding, and mentioned the exploration of tunneling rates, branching ratios and excitation field effects on nuclear reactions. Nagel would like to see a program established, the goal of which is a reproducible experiment done at various places by various people (he noted a favorite candidate—an electromigration experiment). A requirement would be to use modern tools, like synchrotron radiation.

3. Which experiment would you most like to see compete for the Solid State Fusion Prize?

Schenkel said a prize "can mobilize a lot of momentum." He envisions submitting his tunnel barrier experiments to a Prize contest. Trevithick said of the Schenkel team work: "What I always appreciated that your lab did is it took the rates of fusion, and stretched that data set into places that were really hard to find, the lower energy end of the spectrum, where data was sparse and the error bars were large." Nagel reiterated that he thinks the Celani/Preparata-type electromigration experiments are a good candidate for a Prize focus. The 1990 Preparata experiment has "screamed" to Nagel over the years "to redo it." Duncan noted that the field is "cooperative, but competitive" and for that reason he would most like to see his own experiment compete for the Prize. (He said, "I won't talk about what that experiment is, because it hasn't reproduced.") But, Duncan said that the interest in coherent phononic excitations, shock wave effects and lattice dislocations that may create anomalous heat could lead to interesting Prize ideas.

4. What advice do you have for an early career scientist or engineer interested in LENR?

The panelists' responses to this question were encouraging. Nagel noted that even if LENR captured just a very small part of the energy sector, it could be as much as a $10 billion market. He suggested that there are three outlets for those interested in pursuing the field: science, engineering and business. His advice is "to learn the fundamentals of one of these three and apply it in this field for the good of mankind."

Duncan hopes that young scientists will apply their "curiosity and ingenuity to expand" their education. He stressed that it is key to follow the Scientific Method. Duncan said, "Once you answer all the questions fairly well, now question all the answers." He cautioned that scientists should not "trip over their frontal lobe" by getting a mental model so ingrained in their heads that "when you see something surprising you think it must be an outlier."

Schenkel echoed the need for a strong foundation based on the Scientific Method. He stressed that one must have the "courage to be critical" but "notice what excites you and follow that instinct." He noted the importance of seeking out peers and mentors who can be trusted.

Trevithick wrapped up the panel discussion by reminding attendees of the ARPA-E announcement and the plans for a future prize. He said he would love to "see some great groups come together" out of the conference and become teams for either of those endeavors.

John Dodaro of Aquarius Energy presented "Lattice-Catalyzed Fusion: A First-Principles Approach to an Irrefutable Proof of Principle," an Aquarius project partnered with Stanford University, where Dodaro is a Visiting Scholar, and funded by a venture capital group. He noted that there are a lot of insights the LENR field can learn from the history of the superconductor, in particular, "materials control and variability when dealing with complex systems and complex materials." He discussed theoretical motivations that guided the work (Julian Schwinger, in particular). The "irrefutable proof of principle," they believe, "requires a 'smoking gun'" and they have focused on addressing the problems of measuring heat to quantify the reaction and uncontrolled materials variability. Aquarius has developed "a library of reproducible catalyst recipes motivated by first

Nicola Galvanetto (L) and Florian Metzler (R)

principles theory" and built a reactor with real-time helium detection, with the goal of expanding the program to explore the key parameter space.

Nicola Galvanetto of the University of Zurich spoke about "Making Sense of Solid-State Fusion with Known Physics," particularly related to work he is doing with Peter Hagelstein and Florian Metzler. He laid out the "roadmap" his team is using to reach a proof of principle, which includes theory and experiment. Experimental milestones include showing: the minimal proximity in the Pd lattice, the non-radiative excitation transfer between nuclei and also between D_2 and an acceptor nucleus.

Stephen Bannister, an economist at the University of Utah, presented on "Technology Growth: Intersection of Energy, Economics and Geopolitics." His belief in anthropogenic global warming science led to a greater sense of urgency about the importance of LENR research and engineering. Bannister noted that LENR as an energy source could "expand the frontiers of science" by providing cheaper new sources of energy that can replace or eradicate carbon sources. He advised that "economic growth often relies or depends heavily on new technologies" and if we are able to "deploy new, scaleable, cheap and clean energy sources, we could have another industrial revolution." He laid out numerous reasons carbon combustion energy sources should be abandoned: eliminate price variances in global oil markets that cause inflation and recessions; oil is the most important global commodity, leading to geopolitical instability; equity and energy insecurity (in 2010, 10% of global population lived without access to electricity); eliminate the second-order risk of geoengineering as a solution (seeding the atmosphere or oceans); eliminate significant negative health impacts (morbidity and mortality). Towards the end of his talk, Bannister said, "I'm not a net zero person, I am a zero-zero person!"

The morning session closed with Michael McKubre teasing the afternoon session of experimental talks. He noted that not a single conference has occurred without him "learning something unexpected and substantial and surprising" in the experimental arena. He challenged speakers to "surprise" and give him "something new to chew on." (*IE* will report more on the Technical Program of ICCF24 in the next issue.)

The first technical talk was by Yasuhiro Iwamura of the Research Center for Electron Photon Science (Japan), who discussed his team's "Anomalous Heat Burst Triggered by Input Power Perturbations Observed in Ni-based Nanostructured Thin Films with Hydrogen."

Edmund Storms (R) receives the Toyoda Gold Medal from Bill Collis (L).

Technova's Masahiko Hasegawa (Japan) overviewed his team's "MHE Reaction in New Experiments by D-System."

Francesco Celani of the National Institute of Nuclear Physics (Italy) presented his team's "Progresses on Confirming Simple Procedures to Produce AHE and Investigate Their Origin by Thin Constantan Wires Under H_2, D_2 Gases at High Temperatures."

Dimiter Alexandrov (Lakehead University, Canada) talked about his successful experiments in "Cold Nuclear Fusion Reactions in Constantan."

Jean-Paul Biberian (Retired from Aix-Marseille University, France) provided an update on "Excess Heat in Nano Particles of Nickel Alloys in Hydrogen."

Edward Beiting discussed replication studies he and colleague Dean Romein have undertaken at TrusTech (U.S.), in a talk titled "A Search for Excess Heat: Replication Studies."

Mitchell Swartz of JET Energy (U.S.) discussed how "Synchronization of Vacancy-Loaded Deuterons Enables Successful LANR Mass-Energy Transfer."

Anatoly Klimov (Moscow Power Engineering University, Russia) and his team at the Prometheus Technical Centre (Russia) have been working on "Water Plasma Vortex Reactor and Obtaining of ExtraThermal Energy and Transmutated Chemical Elements."

Si Chen spoke on the work that he and Hang Zhang have done at Qiuran Lab (China) on "Excess Heat in a $D_2(H_2)$-Ni(Pd) Reaction System with Multiple Oxidation of the Ni-Pd Alloy Powder."

Steve Katinsky, of LENRIA, presented some perspectives on the LENR field and invited attendees to Poster Session 1, which ran concurrently with a Sponsor Showcase in the Grand Hall. See the full list of Posters on the ICCCF24 website.[19]

Baba Brinkman again finished the day's events with a "Rap Up." One line of the song noted that those in the room had a "healthy skepticism of the impossible."

The Banquet

The ICCF24 formal banquet was held outside on day two, the evening of July 26. Online attendees did not have access to the event, but Anthropocene kindly provided some of the entertainment and presentation video to *Infinite Energy*.

Chef Martin Yan, of "Yan Can Cook" fame, showed how to prepare a specialty salad guests had just dined on (with chicken, fruit and nuts) and demonstrated other cooking techniques. He drew some parallels between science and cooking. He said, "In science you call it a formula, and we call it a recipe. In science you do a lot of experiments, but in the kitchen we test and develop recipes." Yan called cooking "a bridge…that can bring all of us together."

Bill Collis of the International Society for Condensed Matter Nuclear Science (ISCMNS) presented the Minoru Toyoda Gold Medal. Made of 94 grams of 18 carat gold, the medal has only been awarded one other time: to Martin Fleischmann in 2009. It is awarded to someone who has made "outstanding contribution to the promotion and progress of CMNS." Collis said, "We're all holding a banner

in our hands, carrying forward Martin's vision of clean nuclear energy."

The Toyoda Gold Medal was presented to Edmund Storms, who Collis said "stands head and shoulders above most other researchers." He stated, "We all know that we're standing on the shoulders of giants, like Ed Storms." Storms has published nearly 100 papers in the field and two books, *The Science of LENR* and *The Explanation of LENR*. He worked at Los Alamos National Laboratory for over 30 years. He is an experimentalist and theorist, still doing important work in both areas in the LENR field.

In a short acceptance speech, Storms remarked: "When I got into this Alice in Wonderland effort 33 years ago now roughly, I never imagined I would be sharing an award that had once been given to Martin Fleischmann."

Artist Yiying Lu presented Storms with an original piece of art created just for the conference, featuring the Silicon Valley Skyline.[20] Lu, who is famous for her NFT and emoji art, presented an art showcase earlier in the evening.

Rapper Baba Brinkman of Event Rap performed a half-hour set, including the debut of another LENR rap song, "Cold Fusion Renaissance,"[21] as well as other songs related to climate and technology. (See the story on p. 35.)

Day 3 — July 27, 2022

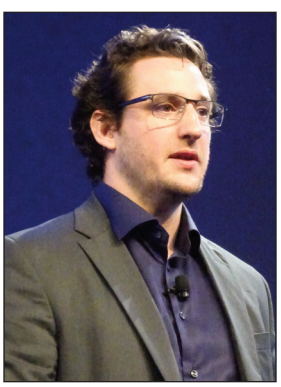
The conference program got more dense and complicated on the third day. Presentations were being held in two separate conference rooms. Online attendees could hop between stages if desired. For the purposes of this overview, we will note the full day's schedule of talks for each stage separately.

The main stage (Hahn Auditorium) featured 16 technical talks, with Opening Remarks on "Modeling Energy Exchange, Excess Heat, Transmutation and Other Effects" by Peter Hagelstein of the Massachusetts Institute of Technology (U.S.). Hagelstein then presented his team's "Models for Accelerated Nuclear Deexcitation: Dicke-enhanced Excitation Transfer on the 14.4 keV Transition in Fe-57."

Akito Takahashi (Technova, Japan) discussed "Understanding of MHE Power Generation Patterns by TSC Theory."

Vladimir Vysotskii (Taras Shevchenko National University, Ukraine) presented on "The Self-sustaining Flashing LENR in Magnetized Low-temperature Plasma."

On behalf of George Miley (University of Illinois, U.S.), Erik Ziehm presented the talk "Advances in Understanding Cluster Type Reaction Sites."



Erik Ziehm

Lawrence Forsley of the NASA Glenn Research Center (U.S.) and Global Energy Corporation (U.S.) gave a talk on "Electron Screened and Enhanced Nuclear Reactions."

Graham Hubler of the University of Missouri Medical School (U.S.) discussed "Microscopic Insights into the Anomalous Heat Effect that Unify Disparate Experimental Results."

Anthony Zuppero of Tionesta Applied Research Corp. (U.S.) presented "Electron Quasiparticle Catalytic Binding in Chemical Reactions with a Proposed Nuclear Analogy."

Erik Ziehm (University of Illinois, U.S.) spoke on "Detection of Alpha Particles using CR-39 During a Deuterium DC Glow Discharge with Pd Electrodes."

Takehiko Itoh (Research Center for Electron Photon Science, Japan) presented "Analysis of Photon Radiation for Spontaneous Heat Burst Phenomena During Hydrogen Desorption from Nano-sized Metal Composite."

Rakesh Dubey (University of Szczecin, Poland) discussed his team's "Experimental Study of Electron Emission in the DD Reactions at Very Low Energies."

Shyam Sunder Lakesar of the Indian Institute of Technology (India) presented "Lower-Bound Voltage for Transmutation Using Half-Wave Rectifier in Light Water Electrolysis."

George Egely (Egely Ltd., Hungary, and *IE* editor) presented on "Direct Electric Energy Production by LENR"; his talk was preceded by a video from his partner, Lindsay Newton of Gaia Energy (New Zealand), who overviewed the design of the Egely generator prototype. (See an interview Egely did with E-Cat World after the conference.[22])

Three talks related to a device called a lattice energy converter (LEC) finished out the day's presentations on the main stage. Frank Gordon of INOVL (U.S.) overviewed his accidental discovery of what he calls the LEC in a talk titled, "Increasing the Output of the Lattice Energy Converter." The device has been replicated by numerous parties, including the two speakers Antonio Di Stefano of Prysmian Electronics (Italy, "Experimental Observations on the Lattice Energy Converter") and Jean-Paul Biberian ("Lattice Energy Conversion Replications"). Alan Smith *et al.* at LENR-Forum earlier this year prepared two videos about Gordon's LEC, one an overview by Gordon,[23] and the other a panel discussion[24] about the LEC.

The secondary stage was the Lovelace Room, which featured generally less technical, but very interesting, talks.

Thomas Grimshaw of LENRGY provided an overview of the LENR Research Documentation Initiative (LRDI). The main goals for the LRDI project are to capture records while they are still available, preserve those records for re-analysis and honor the LENR "heroes." So far, Grimshaw has worked with 28 participants (see *IE* stories about some of the work: Ludwik Kowalski,[25] Stanislaw Szpak,[26] Peter Gluck[27]). Grimshaw noted that the J. Willard Marriott Library (University of Utah) has an existing Cold Fusion Special Collection that he anticipates will house some of the collections he has been helping to organize; he has negotiated with the Library to process the collections of Edmund Storms and Thomas Passell. See Grimshaw's *IE* article, "Documenting Cold Fusion Research"[28] for more information about the LRDI process.

Jed Rothwell, creator of the e-library lenr-canr.org, spoke on "How to Fix Global Warming with Cold Fusion." His 2004 e-book *Cold Fusion and the Future*[29] predicted possible impacts of cold fusion, which he believes still exist: energy 200 times cheaper than today's cost; crop fields in the U.S. would be grown inside buildings; desalination and water treatment would be used to convert deserts into verdant land; the threat of global warming would be eliminated. He noted five things that are necessary for cold fusion to address all of those applications: 1) reasonably high power density; 2) reasonably good Carnot efficiency; 3) high energy density; 4) perfected safety

with no tritium or at least no tritium leaks; 5) complete control over the reaction. He noted that Requirement (5) is the only one not currently satisfied, but that "with enough funding and research, we can get control over the reaction." Rothwell said, "The whole history of science and technology says it [control of reaction] can be done." Some steps he proposes for not just stopping but reversing global warming with cold fusion are: stop emitting carbon dioxide; put carbon back underground where it came from (he suggests growing billons of trees, cutting them down when old and burying them in abandoned coal mines).


Nancy Bowen

David Firshein, Chief Financial Officer of Brillouin Energy, gave an update about the status of Brillouin's Hydrogen Hot Tube (HHT) technology. They have built small test devices (19", 3/8" in diameter) and are working on scaled-up commercial systems, based on the invention of their Chief Technology Officer Robert Godes. Firshein noted that reacting hydrogen in the HHT device has the potential of powering "30,000 homes on the amount of hydrogen in a glass of water." Brillouin has had a long-term research agreement with SRI; Francis Tanzella and his team at SRI have independently validated and replicated the heat output. Firshein's slides indicated that Brillouin has worked closely with other researchers on verifications; see Marianne Macy's 2015 story "On the Quest for a Commercial LENR Reactor with Robert Godes and Brillouin Energy"[30] for more on those collaborations and the work done by Godes.

Masami Hayashi, Global Strategy Director at Clean Planet, spoke about Clean Planet's role in "New Energy, New Future: Inventing an Alternative to Fire." Founded in 2012 by Hideki Yoshino in response to the 2011 Fukushima earthquake and tsunami that severely damaged the Fukushima Daini Nuclear Power Plant, Clean Planet has an impressive R&D team familiar to those who follow LENR: Yasuhiro Iwamura, Jirohta Kasagi, Takehiko Ito, Yoshito Endo. Their process, termed "quantum hydrogen energy" (QHe), produces "heat generated by quantum phenomenon during the hydrogen diffusion process in nano-sized Ni-based composite material." They have three locations and an experiment at the Kawasaki Base has shown long-term heat generation for over one year. Clean Planet currently has 57 patents in 21 countries and partnerships with major Japanese companies. They are currently completing: QHe Module #001; a prototype for 2.8 kW boilers; scaling up an industrial boiler application; R&D of other QHe-powered products. The Clean Planet goal is to bring one or more QHe-powered products to the market by 2025 to bring a "green transformation to the world."

Bill Collis of the ISCMNS (Italy) gave a talk on "Exotic Neutral Particles as a Comprehensive Explanation for CMNS." I had jumped to the main stage at this point and there is no video available of the talk, so *IE* will try to have an overview of this talk in the Technical Program overview in the next issue.

Kazuaki Matsui, Senior Fellow at the Institute for Applied Energy in Japan, primarily focused on the "New Hydrogen Energy (NHE) Project of Japan" that ran for about five years in the 1990s. See the *IE* story on the NHE.[31]

Mikio Fukuhara of Tohoku University discussed "Earth Factories: Nuclear Transmutation and the Creation of the Elements." Fukuhara reviewed the conventional theory of the creation of elements and proposed a new model for the formation of nitrogen, oxygen and water.

Nancy Bowen of Colorado Mountain College discussed "Applying Nuclear Engineering Considerations to the Nuclear Active Environment for LENR." She posited that LENR "can be explained using conventional physics and standard engineering."

The second stage had a workshop session on "Rapid World Building: Our Clean Energy Future," moderated by Bodhi Chattopadhyay and Bergseinn Thorsson of CoFutures. The workshop was only accessible to on-site invited participants.

The Day 3 evening program featured the Solid-State Fusion & Atomic Energy Demos Exposition, and the second (and final) Poster Session. Over the two nights, 50 posters were presented. Online attendees were able to view slides or the presentation poster. In some cases, poster presenters had pre-taped talks about their posters; some presenters were available for live interaction. In the exposition space, materials, videos and devices were shown by Frank Gordon, Larry Forsley and Brillouin Energy.

Day 4 — July 28, 2022

Thursday, July 28 was the final day of the ICCF24 conference, packed with technical talks.

The second stage (Lovelace) featured a panel made up of Shally Shankar, Michael Halem, Valerie Gardner and Malcolm Handley, discussing "Perspectives in Investing in Innovative Nuclear."

The only talk on the second stage on the final day was by Charles Martin of Calculation Consulting (U.S.) on the "Use of AI as a Tool for LENR Research." He noted that once Machine Learning codes are developed for LENR, AI will become useful in evaluating experiments.

A one-hour roundtable discussion on "Applications of S-SAFE" (solid-state atomic fusion energy) finished the second stage day. Tom O'Sullivan (Mathyos Global Advisory) moderated, with guests Tito Jankowski (Air Miners), Michael Gurin (Cognitek), Bo Varga (WBGlobalSemi) and Peter Shannon (Radius Capital).

The following Technical Program presentations wrapped up the final day of ICCF24 on the main stage (Hahn):

Edmund Storms (Kiva Labs, U.S.) talked about advances in his theoretical thinking in "The Nature of Cold Fusion (Cold Fusion Made Simple)." He is collaborating with NASA on applications of LENR for space propulsion (see the interview with Storms in *IE* #161[32]).

Konrad Czerski of the Maritime University of Szczecin (Poland) discussed "Experimental and Theoretical Arguments for the DD Threshold Resonance in ^{4}He."

Theresa Benyo reported further on the NASA Glenn Research Center (U.S.) work, in "A Theory for Transmutations Observed as a Result of Deuterium Gas Cycling of a Palladium Silver Alloy."

Jirohta Kasagi (Research Center for Electron Photon Science, Japan) gave a "Comparison of Excess Heat Production in NiCu Multilayer Thin Film with H_2 and D_2 Gas."

Jean-Paul Biberian presented his second talk, "Reaction of Hydrogen in Nickel Based Alloys Under a Variable Magnetic Field."

Natalia Targosz-Sleczka (University of Szczecin, Poland) spoke about her team's "Study of LENR with Light Nuclei in Zr and Ni Based Alloys using UHV Accelerator."

Peter Hagelstein presented his second talk, "Ion Beam Experimental Set-up and Results So Far."

Oliver Barham reported further on the "U.S. Navy HIVER Project: Nuclear, Thermal and RF Results."

Benjamin Barrowes of the U.S. Army Corps of Engineers presented the "New U.S. Army LENR Replication Efforts: HIVER Co-deposition and Gas Loading."

Monu Kumawat (Indian Institute of Technology, India) spoke on "Trends in Transmutation Products and Hydride Formation in Brass, Bronze, Solder and Silver Brazing Alloy Cathodes During Light Water Electrolysis."

Agata Kowalska (University of Szczecin, Poland) discussed "XRD and PAS Investigations of Deuteron Irradiated Zirconium Samples."

Konrad Czerski

Guido Parchi (FutureOn Srl, Italy) discussed his team's "Evidence of Reproducible Tritium Production in a Pulsed Electrolytic Cell."

Pamela Mosier-Boss of Global Energy Corporation (U.S.) presented "The Case of the Missing Tritium."

Lawrence Forsley gave his second talk, "Contamination, Transportation or Transmutation in LENR Material Analyses."

Daniel Gruenberg (Mizuno Technology, Thailand) works with Tadahiko Mizuno and presented an update on "The Role of Appropriate Calorimetric Methods for Scaling-up LENR Devices and the Irrelevance of Coefficient of Performance (COP)."

Jacques Ruer (SART von Ruhr, France) spoke about "A Technological Foresight for the Future Deployment of Different Types of LENR Energy Sources."

David Nagel, who was Chair of the Technical Review Committee for ICCF24, closed out the conference with a summary and closing remarks. Importantly, he placed ICCF24 in the context of the other 23 meetings in this series:

> From my perspective, the ICCFs have been *valuable*. Every time it has been exciting. New collaborations, new contacts, new knowledge, new techniques. I would characterize the events that we just had as *invaluable*, historic. I suspect that when we go down the road 10 years or 20 years, we will look back at this time and find that it really was a turning point in the field.

Nagel noted that the LENR field has two problems: materials and theory. He said that two "treasures" of the field addressed these problems in new and different ways.

Of materials, Nagel noted: "Storms addressed how to make materials that may be reliable...I would ask you to imagine a plot with composition on one axis and structure on another axis. There's a spot in there where things work the way we want them to work. So we start out with a material and what happens as soon as we load it? It changes. So we have to anticipate the changes…Ed has given a recipe where you produce particles inside of palladium and when you load it, it expands and creates controllable gaps…"

On theory, Nagel noted that Hagelstein brainstormed a new theory on nuclear molecules in April and worked very hard to be able to present the idea at ICCF24.

Nagel recognized the organizers for their focus on the science, engineering and business phases, noting, "This brought full attention to the full bandwidth. Previous conferences were focused on science, but it's nice to look at the whole picture at once."

The team at Anthropocene and the vendors they used for organizing and conducting the event should be commended for presenting a fantastic conference.

ICCF25 Scheduled

The next conference will be held in Szczecin, Poland in September 2023. Szczecin is located near the Baltic Sea and the German border (near Berlin). Konrad Czerski, a LENR researcher and Professor in the Physics Department at the Maritime University of Szczecin, will chair ICCF25.

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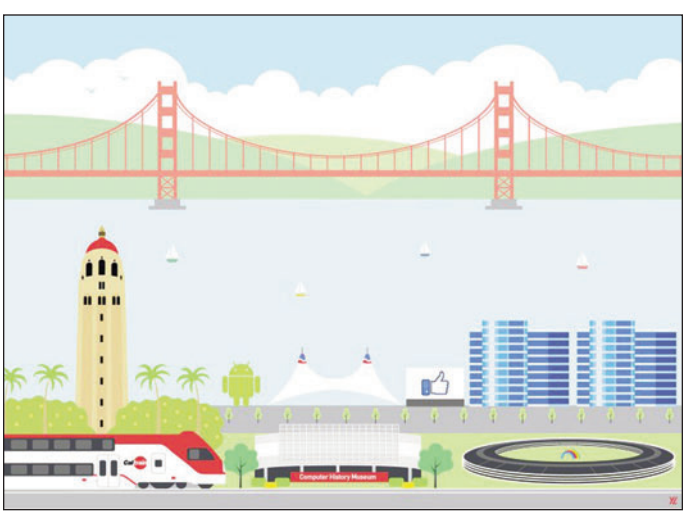
Chef Martin Yan

Robert Godes and Robert Duncan at the banquet.

The salad created by Chef Yan during his cooking demo.



Yiying Lu's Silicon Valley Skyline was presented to Edmund Storms.

The Anatomy of Creation — Cosmic Cuisine

Jesper Overgaard

From a distant antiquity, when humanity was younger and possibly more alert, we have received a puzzling message, informing us that what we perceive as "something" is in reality "nothing," and vice-versa.

It does sound nonsensical, after all our environment would appear to be perfectly tangible, but the statement undeniably has a point. As a logical necessity, physical substance *must* have an energetic origin—matter *has* to spring from something simple and immaterial, which is somehow capable of "condensing" into complex matter. The other option, that matter should be born of matter, answers precisely nothing.

Elementary particles can be viewed as nodal patterns in a static, elastic medium, or as standing waves in a flowing medium. Either way, the basic components of the physical universe must therefore be permanently immersed in, and every instant interact with, the very substrate that surrounds them, and out of which they were woven. Everything material can be sensibly described as local events or states in a homogeneous, universal medium.

Accordingly, the actual processes that have built the material world must also be at work here and now, as the universe could not otherwise subsist for a single moment: standing waves exist only as long as something is flowing through them, and nodal patterns no longer than the sound that shapes them.

It follows that the physical universe was not created as a unique event, once in a nebulous past. Creation is at work every instant, everywhere, from beginning to end, then, now and always, and it is its various stages and aspects that will be considered in the following.

Unreason and superstition have for all too long distorted the basic, physical sciences. The utter philosophical failure of a long, divisive century has been covered up with irrational evasions, and fresh generations are systematically being radicalized and trained to swallow abstract concoctions of bizarre inconsistencies. Basic physics has taken a rather wrong turn, and collective self-deception has become the order of the day.

The following is a lay, but concerned, citizen's effort to bring attention to that Ariadne's thread, the general, natural principle, that was still objectively in sight some hundred years ago, when the debate began to deteriorate into pure abstraction, until a universal ether was finally done away with by the hard-nosed, tone-deaf materialism of the 1930s.

1. From "Nothing" to Ether, from Yang to Yin

The smallest fundamental unit in the known universe, the simplest, stable configuration that can be envisioned, is a formation of two minimal, opposite electrical charges: an electron-positron pair (hereafter "epo"[1]).

Geometrically, the charges are located in the loops of an eternity sign, around the focal points of a three-dimensional lemniscate of well-defined length: $1.87 * 10^{-15}$ m. This is very tiny indeed, and there is ample room for some thousand billions on the tip of a needle.

Epos are everywhere in unlimited numbers, are neither suddenly "created" nor "annihilated" and constitute the very fabric of the universe. Their shape must be pictured as two drops, or eggs, with their pointed ends joined into a waist, and with a twist along their common axis.

Their two electrical poles are integral parts of the same circulation—it is one thing with two faces. An epo is outwardly neutral, mass-free and thus "undetectable," as charges and torques cancel out.

Most remarkably, the circulation of all epos is absolutely synchronous, in the universe as a whole! We have become so saturated with the mantra "everything is relative" and with the notion that distances and speeds are equivalent to differences in time, that the concept of an absolute "universal time" seems almost contra-natural. However, it could not possibly be any other way. If the basic substance of the universe ever got out of step with itself, everything physical would be unmade and collapse into chaos. The universe is very much a unity, and "everything is related" would be more descriptive!

Electrical polarities are determined by either left- or right-handed rotation and, in this configuration, where the circulation bites its own tail, the complex, self-contained flow-pattern is turned inside out like a Möbius strip, is alternatively facing inward and outward, converging and diverging, the two opposite charges "instantaneously" swapping identities for every half turn.

An epo is an oscillator but, as all epos are in time with each other, our physical reality remains outwardly stable, though it is inwardly a ceaseless flickering between plus and minus.

Flow patterns in water and air illustrate how whirls with contrary rotation will tend to approach each other and support each other's flow patterns, as they cooperate in accelerating and "rarefying" the substance that separates them,