THE VORTEX

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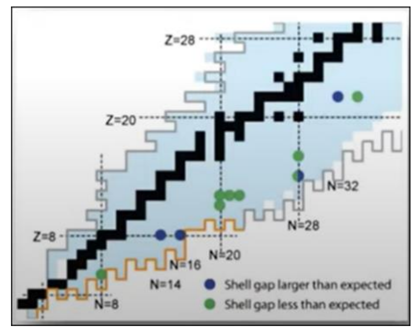
Meetings, Activities, and News

Up Coming Events

History, Education, Employment, and Career

Review



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Cover Image Credits:
Upper Left: Handing the gavel off to the new section Chair. – Photo provided by Atefeh Taheri.
Lower Left: ACS
Upper Center: https://www.snoopyshomeice.com/
Upper Right: Chart of the Nuclides blow up emphasizing magic number nucleons. Image from Nicki Davis.
Lower Right: Right: December Social Table. Provided by Atefeh Taheri.

If you have material you think is worthy, submit it to donald.maclean.acs@gmail.com.

Chair Message

Dear Vortex Readers,

I hope this letter finds you in good health and high spirits as we step into the new year. It is with great enthusiasm that I write to you, serving in my second term as the Chair of the California Section of the ACS. The momentum we built last year under the leadership of Atefeh Taheri has set the stage for an exciting 2024.

I am pleased to announce that Alex Madonik is the Chair-Elect, joining Atefeh and me in leading the California Section. Together, with the unwavering support of our dedicated Executive Committee members, the invaluable efforts of our trusted office administrator Julie Mason, and the numerous volunteers across the California Section, we are poised to make 2024 a remarkable year.

Our calendar is filled with annual staple events that continue to highlight the excellence and passion within our community. From the Chemistry Olympiad (https://calacs.org/chemistry-olympiad/) and Project SEED (https://www.acs.org/education/students/highschool/seed.html) to Chemistry Week Events and Science Cafe, we are committed to fostering a love for chemistry and scientific inquiry. Moreover, our participation in the national ACS events, set to take place in New Orleans in the Spring and Denver in the Fall of 2024, will showcase the strength and unity of our section. The Bay Area Chemistry Symposium, co-sponsored with the Silicon Valley ACS has been a huge success and we look forward to another exciting event in the Fall of 2024 (https://www.bayareachemistrysymposium.com/). My primary goal for the year is to establish a robust succession plan for these annual events, ensuring that the legacy of these annual events endures well beyond 2030. Your involvement and support are crucial to achieving this aim.

Looking ahead, we have initiated plans for a Western Regional Meeting scheduled for the fall of 2025 to take place near Santa Clara in close collaboration with the Silicon Valley section and members from our neighboring sections. Vanessa Marx is leading this effort, and we are actively seeking volunteers at every level. If you are interested in contributing to this exciting event, please reach out to us at office@calacs.org.

As we enter an election year, it is imperative that our local members have a voice in shaping our future. I am committed to providing avenues for our community to engage with local and state legislatures, advocating for our common interests in the field of chemistry.

I am genuinely honored to serve as your Chair in the coming year, and I am confident that, with your continued support, we will achieve great heights together. Wishing you and your loved ones a joyous and prosperous New Year!

Warm regards,

Patrick S. Lee Ph.D. Chair, California Section of the ACS

Upcoming Events

Julie Mason, Alex Madonik, Vanessa Marx, and Donald MacLean

1. February 10th – WCC Winter Meeting- Speaker Sonya M. Schuh, PhD (Organizer: Elaine Yamaguchi). Toxic Beauty: The Effects of Phthalates and Bisphenols on Human Stem Cells and Embryo Development

Abstract

Dr. Schuh's research focuses on reproductive and developmental biology and toxicology. Her talk delves into the prevalent challenges of the current plastics and environmental toxin crisis, and their effects on human health, fertility, and congenital defects. Ubiquitous chemicals like bisphenol A (BPA) and phthalates, present in a wide variety of plastics, cosmetics, personal care, and household products, disrupt hormones and pathways and act as endocrine-disrupting chemicals (EDCs) in the body. Despite efforts over the last several years to replace BPA with alternatives labeled "BPA-Free," Dr. Schuh's work has revealed that these substitutes actually carry similar, and in some cases much worse, toxic risks. She and her all–woman undergraduate research team were recently featured in a docuseries on HBO Max entitled "Not So Pretty," which highlights their research on the toxic and teratogenic effects of bisphenols and phthalates on embryo development. Schuh, a self-proclaimed "Science Queen" and her team of "STEM Chicks," also did testing of chemicals in various beauty products featured by the series. The Schuh lab has since filmed another upcoming documentary and has published several impactful manuscripts, with this work getting national and global attention. All of Dr. Schuh's recent findings emphasize the potential implications for human health and fertility, especially for women, urging consumer awareness, policy reform, sustainable alternatives, and putting 'people over profit.'

About The Speaker

Dr. Sonya Schuh is a passionate mother, teacher, scientist, artist, athlete, environmentalist, and STEMinist. Originally from San Diego and inland Southern California, she grew up exploring nature, the ocean, and enjoying all things outdoors. An inquisitive bold nature, fascination with life and the natural world, and being the product of educator parents, would eventually lead her to a science career. She earned a BS in Marine Biology and Zoology from Humboldt State University, where she conducted marine research and worked as a Marine Naturalist. She then completed her PhD in Physiology and Biophysics at the University of Washington in Seattle, focusing on chemical effects on sperm. Later, at Stanford's Stem Cell Biology Institute, she delved into genes and environmental factors affecting human fertility and led the largest study to date on genes linked with ovarian reserve (oocyte number) in women. Joining Saint Mary's College of California in 2013, she initiated a research program on the impact of endocrine disruptors on embryos of various species and animal and human stem cells. Dedicated to teaching and diverse collaborations, her most cherished accomplishment is her three children, inspiring her ongoing commitment to shaping a better world. Dr. Sonya says, “Of all my accolades and work, my three amazing children are hands-down my best and proudest accomplishments, with my long list of wonderful students coming in second. They all inspire me to continue paving new paths, breaking barriers, challenging status quos, and working towards a better future. We can make a difference by the way we pursue answers and solutions, communicate our work, treat other people, and care for all people and life of this earth. I still have a lot of hope.”

Zoom link to be shared with attendees the day of the event.

Please register before Thursday, February 8, 2023, 12 noon. Your email address is needed to send the Zoom link, which will be shared with attendees on or before the day of the event via Brown Paper Tickets.

Please visit the CalACS website www.calacs.org to register for this meeting or use Brown Paper Tickets.

The event is FREE and open to the community. More information: e-mail WCC co-chair Elaine Yamaguchi.

2. February 27th- “CALACS Partners Networking Event: GWB2024 Catalyzing Diversity in Science” 5 pm – 8 pm, on zoom followed by an in person meet-up at the Emeryville Public Market.

Join us on February 27, 2024 for the IUPAC Global Women’s Breakfast (#GWB2024). Held in conjunction with the U.N. Day of Women and Girls in Science, the goal of the GWB series is to establish an active network of people of all genders to overcome the barriers to gender equality in science. Over the last five years, more than 1500 GWB events have been held in 100 countries. We invite you to add your event to the global map.

The theme of #GWB2024 is “Catalyzing Diversity in Science”. Groups from all types of science organizations from high schools, to science societies, universities, companies, governments and non-governmental organizations are invited to host events. Event leaders are encouraged to reach out and collaborate with organizations in different sectors and to include scientists from multiple disciplines.

3. March 9th – North Bay Science Discovery 10:00 am -4:00 pm-Sonoma County Fairgrounds.

North Bay Science Discovery Day

March 9, 2024 @ 10:00 am – 4:00 pm America/Los Angeles Time Zone
Sonoma County Fairgrounds
1350 Bennett Valley Rd
Santa Rosa, CA 95404
COST: Free
See: https://www.northbayscience.org

North Bay Science Discovery Day returns to Santa Rosa on Saturday, March 9th, 2024, and Cal ACS will be there for one of our favorite public outreach events. Rain or shine, we'll join close to 100 community organizations and companies to present hands-on science to a varied and enthusiastic crowd. **If you're interested in helping out, please contact Alex Madonik.**

Recommended Activity – Ice Skating on Real, Fake, and Synthetic Ice

Donald MacLean

This month's recommended science activity is ice skating. You might be thinking solid water ice skating, but there are synthetic ("fake ice" refers to refrigeration-induced ice) ice rinks like the one in San Francisco that replaces ice with plastic that mimics the cold ice-skating experience.

Water Phase Diagram

The water phase diagram shown in Figure 1 has the three traditional phases (solid, liquid, gas) and other notable items such as triple point and critical point. The three traditional phases are separated by solid lines. The topic at hand is the solid liquid transition. On the Temperature versus Pressure diagram the solid phase – liquid phase transition slope is positive (solid green line) for most materials, but water is unusual for its negative slope (dotted green line). If enough pressure is applied the ice will melt. For this reason, the past explanation for how ice skating works was that the pressure (weight divided by surface area) from the narrow blade melted the ice then the water refroze when the pressure was removed. However, if you calculate the pressure applied to the ice by the blade, this cannot be the slipperiness mechanism as it is insufficient to melt the ice.

The average weight of a person is 75 kg which is approximately 750 Newtons (1 N = 1 kg m/s^{2}, with acceleration of gravity at 9.8 m/s^{2}). The average blade area of two skates is about 0.003 m^{2} (assuming that each blade is about 0.5 cm wide and 30 cm long). The pressure a person is exerting on the ice is: 750 N / 0.003 m^{2} = 250,000 N/m^{2} = approx. 2.5 atm (1 atm = 101,325 Pascals = 101,325 N/m^{2}) which would raise the temperature of the ice layer below the blades by only about 0.02 °C. At 1 atm ice melts at 0 °C (273 K). The melting point of ice falls by 0.0072 °C for each atm applied. The ice is below 0°C, most likely minus 4°C. The old blade pressure explanation fails as ice skating can be done at very cold temperatures, indicating that another mechanism is at play.[2] Another problem with the blade-induced phase transition is that the ice slipperiness would mean that when standing and walking on ice should be safe, but as we all know icy roads are dangerous for driving and walking on. The current thinking is there is a very small layer of liquid water on top of ice. The bulk ice is different than surface ice.

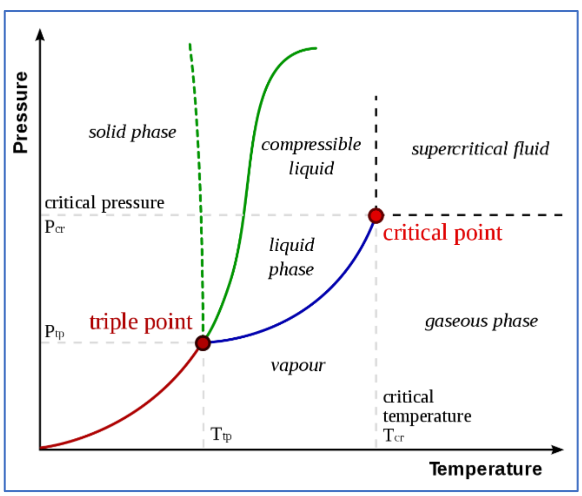

Figure 1. Water Phase Diagram. The green dotted line is the ice-water phase boundary. The solid green line is the solid – liquid phase boundary for most materials. Critical point is where liquid and gaseous phases become indistinguishable and become a supercritical fluid. The water critical point occurs at T_c = 647.096 K (373.946 °C), p_c = 22.064 MPa (217.75 atm).
The triple point of water is at 273.16 Kelvin (0.01 °C or 32.02 °F) and a pressure of 611.7 pascals (6.117 millibars, 0.0060373057 atm).[1]

Real ice, Fake ice, Synthetic ice

Figure 2. Pile of up-side down buckets are used to assist with stability while on real / fake ice.

Real ice is created by natural means. Fake ice is created by refrigeration. Synthetic ice is an ice-like material that is not made from water.

For synthetic ice, the slipperiness is from lubricants added to the molded high-density polymer (i.e., polyethylene (HDPE)). These materials have 10 to 15% more friction than natural ice and wear the blade down faster than real ice. As with all things, quality varies. Supposedly synthetic ice looks and feels like real ice (skating action but not the cold), while offering multiple benefits that will save you a considerable amount of cash and time. Synthetic ice has a claim that it is an all-season product that allows you to skate year-round, no matter the weather. The only limitation is toe-pick jumping while figure skating. Activities like curling, shooting and goal tending practice can be done using the synthetic ice alternative. One synthetic ice drawback is that they wear faster so blades need to be sharpened more often.

Figure 3 shows an example of Table Hockey (not the one that uses blown air to slide the puck or the spin handle versions) using the synthetic ice. Shuffleboard, and curling can also be played on synthetic ice.

Figure 3. Table Hockey Game.

Cleaning difference

Real / Fake ice uses a Zamboni to clean it by melting the ice and spraying water to fill in the divots and cracks. The synthetic ice also requires cleaning but here they sweep, vacuum, or blow the shavings off.

Locations

Most ice rinks are seasonal.

Real ice locations – not in the Bay Area. Need to go to the Sierra Nevada and will be weather dependent as these are outdoor rinks.
Fake (refrigerated floor) ice locations –Santa Rosa, Oakland, Fremont, San Francisco, etc.
Synthetic ice location – San Francisco Chase Center, etc.

References

1. Water Phase Diagram: https://en.wikipedia.org/wiki/Phase_diagram#/media/File:Phase-diag2.svg

2. Physics and Astronomy Online: https://www.physlink.com/education/askexperts/ae357.cfm#:~:text=The%20average%20blade%20area%20of,only%20about%200.02%20%C2%B0C
3. Glice website: https://www.glicerink.com/

WCC Report
The Physics and Chemistry of the Atomic Nucleus Saturday, September 16, 2023
Online Zoom Meeting

Nicki Davis

On Saturday, September 16, 2023, Dr. Heather Crawford, a nuclear scientist at Lawrence Berkeley National Laboratory, described her studies of the forces that hold together the protons and neutrons in the atomic nucleus. Her team conducted the first experiment at the Facility for Rare Isotope Beams (FRIB), the newest and most powerful large-scale accelerator built for this purpose. The team measured the half-lives of neutron-rich isotopes around ^{38,40}Mg (Z=12, N= 26, 28), which provided insights into the structure and properties of these nuclei and allowed the results to be compared with theoretical predictions.

What is low-energy nuclear structure physics?

Low-energy nuclear structure physics is the study of the structure of the atomic nucleus and the strong nuclear force that holds the protons and neutrons together. In contrast, high-energy physics deals with the internal structure of protons, neutrons, and other elementary particles, which involve energies much greater than 100 MeV. Studying low-energy nuclear structure can provide insights into the nuclear reactions that occur in stars, stellar explosions, and collisions. This knowledge can answer questions about how the elements that exist on Earth came to be. Such advances in basic science could lead to insights that might one day be applied to medicine or nuclear reactors.

Chart of nuclides

The Chart of Nuclides is a plot of atomic number (Z) versus neutron number (N) for each element (**Figure 1**). Each square on the chart represents a specific isotope of a specific element, and a horizontal line represents all the isotopes of a given element. The Z=20 line, for example, corresponds to isotopes of calcium. The black squares represent the 254 stable isotopes, the colored squares represent the approximately 3,000 unstable nuclei that have been observed so far, and the gray area represents isotopes that are predicted by current theory but not yet observed. The lower boundary on the plot represents the limit to the number of neutrons that can exist in the isotopes of a given element. This limit is referred to as the *neutron drip line*, because neutrons can be said to drip out of neutron-rich nuclei beyond this boundary.

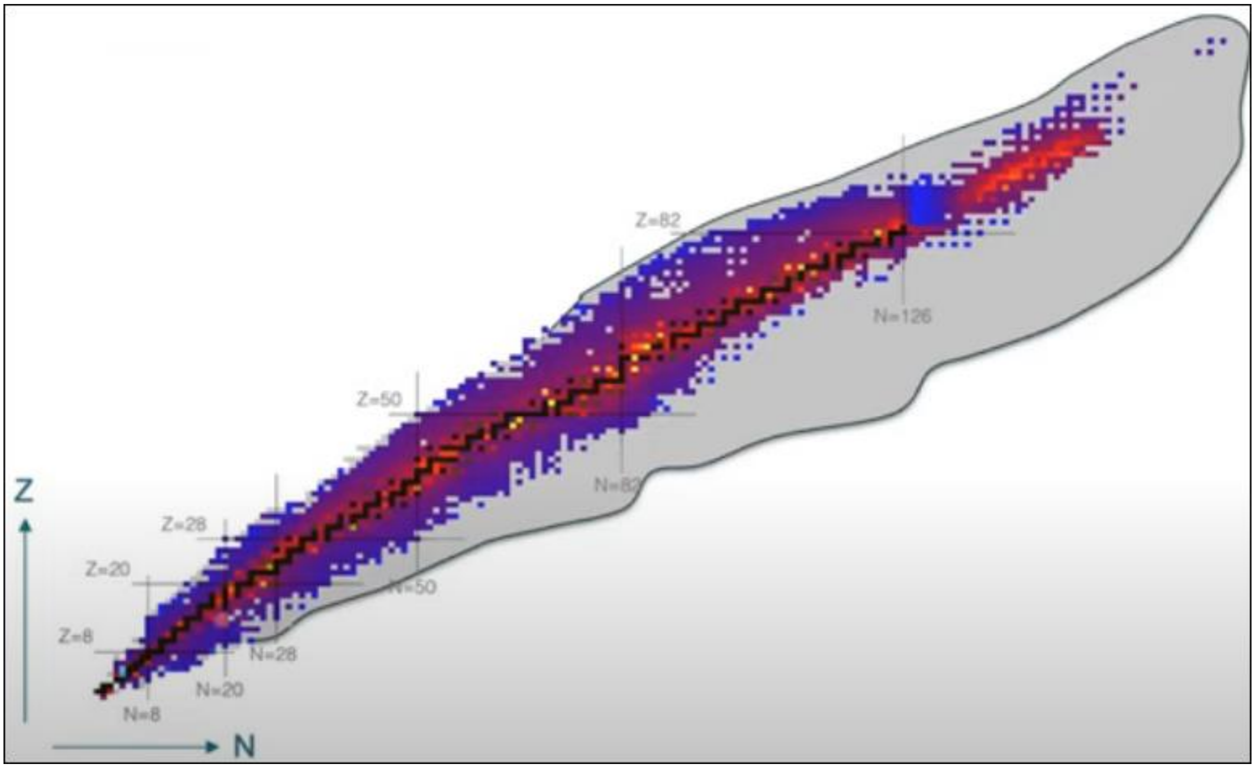

Figure 1: Chart of Nuclides

It has been observed that the energy required to remove a proton or neutron from the nucleus is particularly high in nuclei with so-called “magic numbers” of protons or neutrons: 2, 8, 20, 28, 50, 82, 126. This is akin to the atomic magic numbers: 2, 10, 18, 36, 54, 86 and 118 for ionization potential. Nuclei with magic numbers of both protons and neutrons are said to be “doubly magic” and are exceptionally stable (examples include ^{4}He, ^{16}O, ^{40}Ca, ^{48}Ca, ^{48}Ni, and ^{208}Pb). These observations, among others, led to the postulation of the so-called shell model of the atomic nucleus, for which Maria Goeppert-Mayer and Hans D. Jensen won the 1963 Nobel Prize in physics. According to the shell model, magic numbers of protons and/or neutrons correspond to closed shells, analogous to the closed shells in the electronic structure of the atom. Single-particle levels are grouped into shells of protons and neutrons, with stabilizing gaps (*shell gaps*) between groups of states with magic numbers of protons or neutrons.

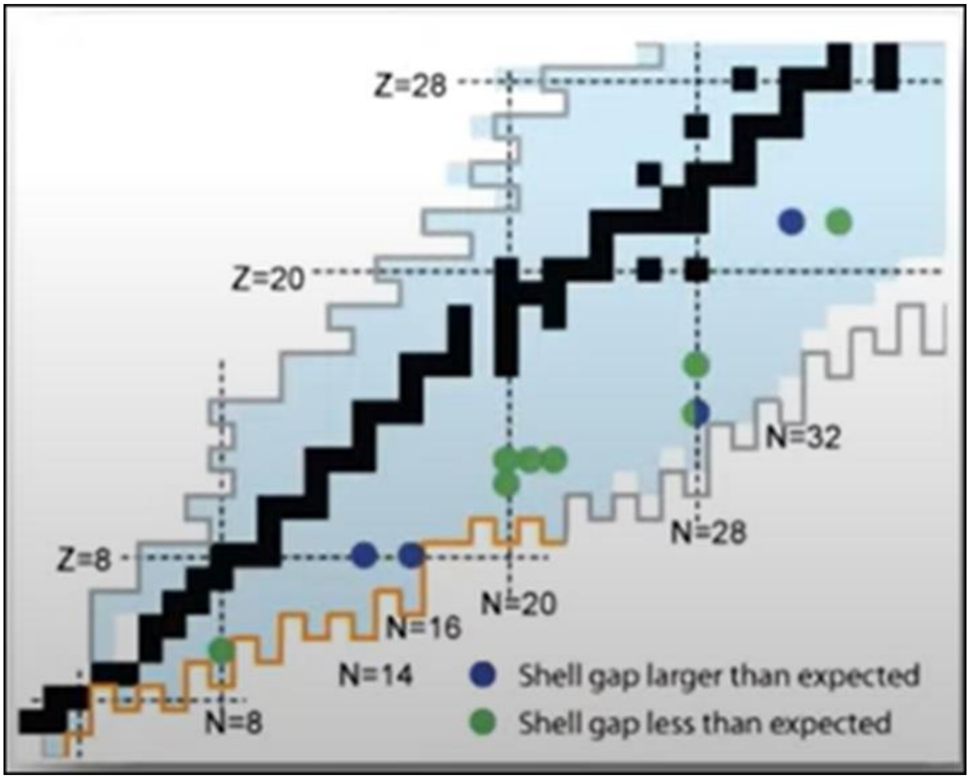

Figure 2 Shell Gaps for Neutron-rich Isotopes

The shell model has been shown to work well for stable isotopes, but not so well for unstable isotopes. In a stable system, the energies of the highest neutron and the highest proton within the nucleus are similar. As we add neutrons and approach the neutron drip line, the energy of the neutrons with respect to the protons increases. Figure 2 shows a portion of the chart of nuclides from Figure 1, where each circle represents a location where a shell gap was either smaller or larger than current theory predicts. Measuring the properties of nuclei near the neutron drip line provides information we can use to further refine the shell model for unstable isotopes.

Making exotic nuclei

To create exotic nuclei for study, Dr. Crawford's team used a method called *fragmentation + in-flight separation*. In this experiment, a linear accelerator aims a beam of stable isotopes of heavy atoms at a target comprised of a light atom like carbon. In the process, the heavy-beam fragment breaks apart and can form any isotope lighter than itself. The unstable isotopes produced are collected to form beams, thereby allowing these isotopes to be studied and their half-lives measured (Figure 3).

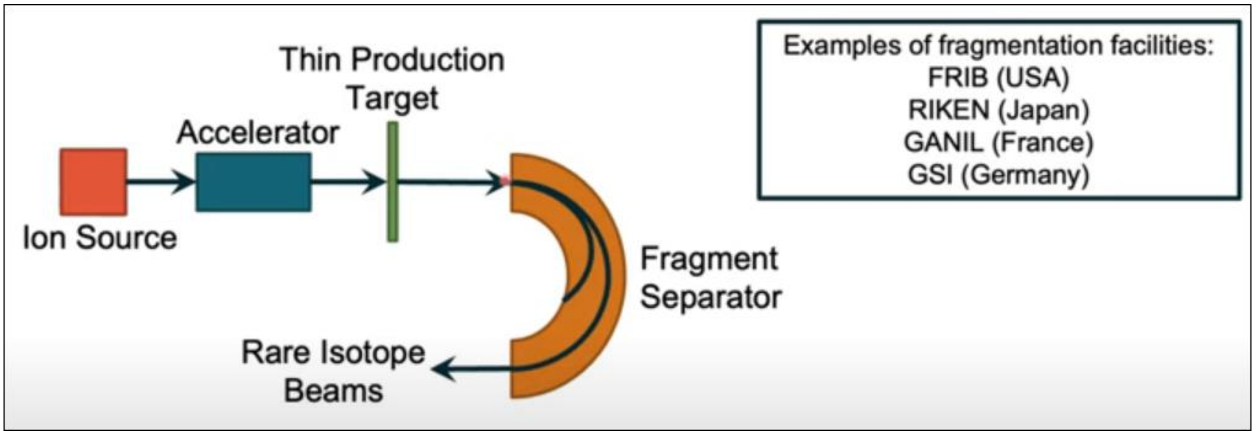

Figure 3: Fragmentation + In-flight Separation Experiment

Several facilities around the world can perform this type of experiment. The newest one is the Facility for Rare Isotope Beams (FRIB) at Michigan State University. FRIB comprises a superconducting linear accelerator that can provide high-intensity beams of almost every stable isotope. FRIB's 400 kW beam will provide the highest power beams for this type of research of any facility built to date.

Results of experiments at FRIB

When FRIB started operations in May 2022, Dr. Crawford's collaboration performed the very first fragmentation + in-flight separation experiments there. They fragmented a beam of ^{48}Ca nuclei on a beryllium target (Z=5) and used an instrument called the FRIB Decay Station Initiator to measure the half-lives of the resulting nuclei.

Dr. Crawford and her team were interested in neutron-rich isotopes near the neutron magic number of N=28. Previous studies of ^{32}Mg, which has a magic number of 20 neutrons (Z=12, N=20), had shown that it does not behave like a magic nucleus: it is not spherical, but is shaped like a rugby ball, and the shell gap is smaller than expected.

For nuclei with the next magic number, N=28, the nuclear shape evolves from spherical at the doubly-magic nucleus ^{48}Ca (Z=20, N=28), through a rugby ball shape at ^{46}Ar (Z= 18, N= 28) and ^{44}S (Z= 16, N= 28), to a pancake shape at ^{42}Si (Z= 14, N= 28). ^{40}Mg (Z=12, N=28) appears to resemble a ^{38}Mg (Z=12, N= 26) nucleus surrounded by a halo of two weakly bound neutrons (Figure 4).

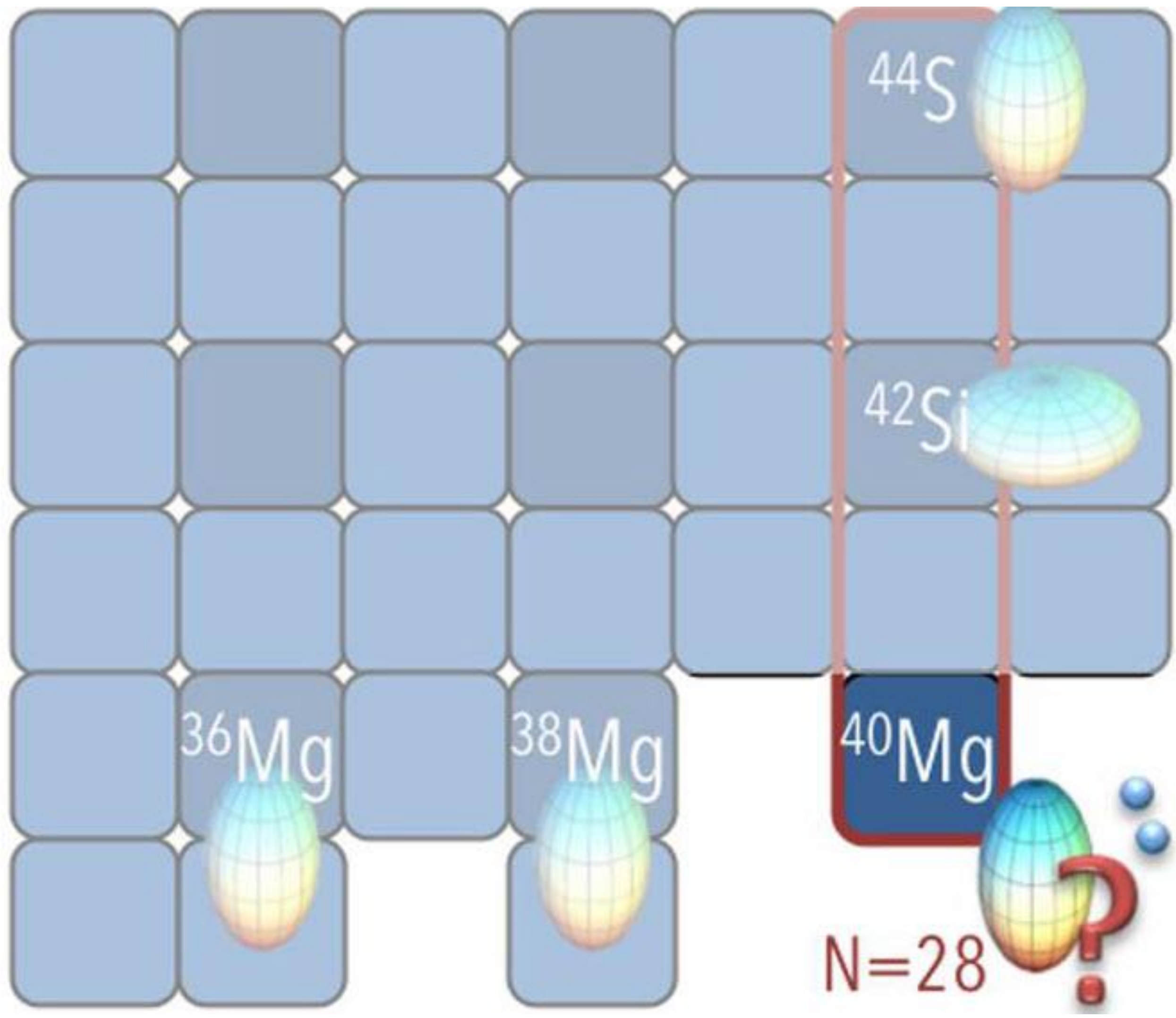

Figure 4: Shapes of Nuclei Near N=28

Dr. Crawford's team created five exotic nuclei - ^{45}P, ^{43}Si, ^{40}Al, ^{41}Al and ^{38}Mg - all of which lie close to the neutron drip line and contain about 28 neutrons (^{45}P Z=15, ^{43}Si Z= 14, ^{40}Al Z= 13, ^{41}Al Z= 13, ^{38}Mg Z=12). The half-lives of these nuclei had been previously unknown. When they compared their results with theoretical predictions, they found agreement for four of the nuclei, but the half-life of ^{38}Mg turned out to be shorter than expected. This result will necessitate some fine-tuning to the current shell model of the nucleus.

Dr. Crawford is planning additional experiments, when a beam of much higher intensity at FRIB should give them access to additional neutron-rich isotopes and enable further refinement of the shell model.

Report of the December Social

By Atefeh Taheri
Edited by Donald MacLean

As the curtain fell on 2023, it also marked the end of my tenure as the Chair of the California Section of the American Chemical Society (ACS). This important role has been nothing short of a remarkable journey, a period in my life that I will always hold dear.

The final official event under my stewardship was a heartwarming celebratory luncheon in mid-December at Lara's Fine Dining in Richmond. It was an intimate gathering of ACS colleagues and friends, a fitting moment to express gratitude and look forward with hope. The ceremonial passing of the chair gavel to Patrick Lee, the Chair for 2024, was a poignant moment. Patrick is not new to this role; his vast experience and unwavering dedication are invaluable assets that will undoubtedly steer our section towards continued success.

Reflecting on 2023, it was a year marked by a spectrum of experiences that spanned both my professional and personal life. It was a rollercoaster of emotional highs and lows, yet the underlying theme was growth.

As I penned these thoughts, I found myself in the transit lounge of an airport, returning from a well-deserved long vacation. The trip was an opportunity to reconnect with family and old friends, a chance to immerse myself in their love and warmth. I hope many of you also managed to take a break, to reflect and rejuvenate during the holidays.

I step into 2024 filled with gratitude for the past year's experiences and brimming with excitement for what lies ahead. My journey continues, both on a personal and professional front. This year, I take on the role of a councilor for our section and embark on my inaugural term as a member of the Women's Chemist Committee at ACS National.

As I transition from the role of Chair, I carry with me not just memories but invaluable lessons and friendships. I am enthusiastic about contributing to our community in new capacities and am eager to witness the continued growth and success of the California Section ACS under Patrick's leadership. Thank you for a memorable year, and here's to a promising 2024!
The following are photos that were provided at the event.

Photo 1: L to R: Margareta Sequin, Elaine Yamaguchi, Linda Wraxall, and Michael Cheng

Photo 2: L to R: Juuso Lehtinen, Patrick Lufkin, Nicki Davis, Dupeng Liu, Bryan Balazs

Photo 3: L to R: Julie Mason, James Postma, Paul Vartanian, Charles Gluchowski, Venessa Marx, Patrick Lee, Sarah Bronner

Photo 4: Atefeh Taheri and Juuso Lehtinen

Photo 5: Eileen Nottoli. Eileen is part of the Guide Dogs for the Blind Program (San Rafael).

Photo 6: 2023 Chair Atefeh Taheri passes gavel to 2024 Chair Patrick Lee.