Fall 2024
Georgia Tech
Postdoctoral Research Symposium

Friday, November 8, 2024
Petit Institute for Bioengineering and Bioscience (IBB)
Suddath Room

Abstract Book

CELBRATING 10 years

Postdoctoral Services

Research Talk Session I: 10:00 – 11:05 a.m.

01. Fundamental understanding and sequential recovery of critical metals from solid wastes

Yinghao Wen,* Emily L. Tribby, Yuanzhi Tang

With a rising urge to build a net-zero economy, rare earth elements (REE), a group of critical metals, are currently among the most strategic resources owing to their pivotal roles in clean energy technologies (e.g., electric vehicles, wind turbines). However, techno-economic and environmental limitations of mining have become the bottleneck of global REE supply, which propelled significant endeavors in recent years to recover REE from different waste feedstocks such as mine tailings and incineration byproducts. However, applications of REE recovery in real practices have been largely limited by the low economic interests and difficulty in metal separation/purification due to the relatively low REE concentration and abundance of many interfering metals in these wastes. Therefore, development of a feasible technology to maximize the recovery benefits and improve metal separation is critically needed. To address these challenges, this study aims to design a treatment system for sequential recovery of multiple critical metals along with REE and efficient metal separation by combining experimental data and thermodynamic modeling. Since our previous study has demonstrated the efficient metal extraction from an incineration byproduct using citrate as a non-hazardous ligand, the extraction solution is used as the feedstock in this study. REE and four other critical metals (Al, Fe, Cu, and Zn) that are abundant in the feedstock are selectively precipitated via three chemical precipitation processes. The ligands used in each precipitation process are selected based on their complexing abilities with target metals, and the underlying metal-ligand interactions are elucidated using thermodynamic modeling. This study can contribute to filling up current knowledge gaps in metal-ligand interactions in a complex matrix and addresses technical challenges in sustainable recovery of critical metals from waste byproducts.

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02. Computational insights into the enforced concerted mechanism of amdase catalyzed decarboxylation of vinylic substrates

Bruno Di Geronimo, Gyula Hoffka, Elske van der Pol, Thomas Schlatzer, , Johannes Eder, Anna Schweiger, Marianna Karava, Roland C. Fischer, Daniel Kracher, Dominik Groß, Romas Kazlauskas, Kenji Miyamoto, Rolf Breinbauer, Robert Kourist, Shina Caroline Lynn Kamerlin*

Enzymes are natural catalysts that speed up chemical reactions, often with remarkable precision and selectivity. Arylmalonate decarboxylase (AMDase) is an enzyme that breaks down specific types of molecules, producing highly valuable compounds for pharmaceuticals and other industries. Typically, this enzyme works with molecules that contain aromatic (ring-like) structures. However, we explored how AMDase functions when tasked with breaking down vinylic molecules—compounds with straight-chain structures that are important in various chemical processes. In this study, we used advanced computational methods to investigate the mechanism by which AMDase interacts with these vinylic substrates. Through detailed simulations, we discovered that the enzyme follows a slightly different reaction pathway compared to its action on aromatic molecules. Specifically, the breakdown of vinylic molecules happens through a process we call an “enforced concerted mechanism.” This means that key steps in the reaction, including the release of carbon dioxide and the transfer of a proton, occur almost simultaneously, which differs from the step-by-step process seen with other molecules. Additionally, we found that changing certain parts of the enzyme's structure allows it to bind and process a broader range of molecules than previously thought. This new understanding opens up exciting possibilities for engineering AMDase to create novel chemicals, such as new drug compounds, more efficiently. Overall, our work sheds light on how this enzyme can be fine-tuned for industrial applications and expands the scope of what AMDase can do beyond its traditional role in breaking down aromatic compounds. This insight could lead to more efficient methods for producing important synthetic materials.

03. Development of all-polymer sorbents for high capacity carbon di-oxide (CO_2) capture

Ankana Roy, Hannah E. Holmes, Lisa S. Baugh, David C. Calabro, Johannes Leisen, Yi Ren, Simon C. Weston, Ryan P. Lively, M. G. Finn*

Abstract cannot be shared publicly.

04. Nanoscopic structural control in lower-dimensional metal halide perovskite semiconductors through physical vapor deposition

Kunal Datta, Esteban Rojas-Gatjens, Sanggyun Kim, Diana LaFollette, Pranav Khadilkar, Ruipeng Li, Honghu Zhang, Carlo Perini, Carlos Silva-Acuña, Guoxiang Hu, Juan-Pablo Correa-Baena*

Abstract cannot be shared publicly.

05. Can light sinter ceramics? Exploring the potential of flash lamp annealing in ceramic additive manufacturing

Eren Özmen, Mark D. Losego*

Recently, there is a great interest in the direct additive manufacturing (AM) of ceramics where consolidation and sintering of a part is completed in a single step, without the need for post processes like debinding and sintering. Existing AM methods such as selective laser sintering,melting (SLS/SLM), digital light processing (DLP), and Stereolithography (SLA) include the use of high-energy sources like Nd:YAG and CO_2 lasers or UV curing light. Here we examine a different approach, the use of flash lamp annealing (FLA) combined with an inorganic binder chemistry. FLA is an interesting alternative because these systems can deliver extremely high photonic energies (4.3 kW/cm2) over large surface areas, unlike the small spot size of the lasers used in SLS/SLM that creates a localized stress. Also, FLA can interact with a wider variety of materials since it is equipped with a xenon lamp that emits a broad spectrum of wavelengths (400-800 nm) beyond just the UV region. Aqueous slurries of Al_2O_3 and Cr:Al_2O_3 powders blended with aluminum dihydrogen phosphate (ADP, $Al(H_2PO_4)_3$) were spray cast onto soda-lime glass slides and then heat treated with FLA and conventional furnace heating. Using x-ray diffraction, we can track the transformation of ADP to the aluminum metaphosphate ($AlPO_4$) phase. Minimum FLA energy densities of 300-350 J/cm2 (which takes 45 seconds to 1 minute to deliver) are determined to be sufficient to drive the ADP to $AlPO_4$ transformation. Color measurements and the thermochromism of these Cr:Al_2O_3 coatings were tested using a UV-Vis spectrometer, and showed good thermochromic transitions (color change between pink and gray) even after 5 rounds of heating (up to 400oC) and cooling. As a result, this study demonstrates that FLA can be offered as an alternative to laser-based methods for producing stable oxide ceramic coatings with a potential for scaling to other additive manufacturing approaches.

06. In vivo engineering of autoreactive T cells to prevent type 1 diabetes

Fang-Yi Su, Jamison Siebart, Ching Shen Chan, Matthew Wang, Gabriel Kwong*

Abstract cannot be shared publicly.

Lightning Talk Session I: 11:10 – 11:45 a.m.

07. The current state of health disparities in biomedical engineering curricula

*Julia Brisbane**

Biomedical engineering (BME) education plays a crucial role in the healthcare system by training engineers to address health disparities. While existing literature on health disparities in curricula predominantly focuses on science and medical disciplines, literature has highlighted efforts to integrate this topic in BME education. The recent update to ABET standards, requiring diversity, equity, and inclusion (DEI) in biomedical engineering curriculum, pushes departments to address health disparities in the classroom. Therefore, there is a need to explore how these concepts are incorporated in BME undergraduate programs. To assess the current landscape, a scoping literature review was conducted. Three databases were searched with the intention of finding papers in biomedical engineering and engineering education. Additionally, handsearching was conducted in Google Scholar, American Society of Engineering Education PEER repository, and biomedical engineering and engineering education journals. Criteria were chosen to center research that examined biomedical engineering undergraduate courses. From the criteria, only eight papers passed screening. This study found that incorporation of health disparities in biomedical engineering curriculum often happens in a single course as opposed to throughout the four-year curriculum. Additionally, there were a variety of modalities in which concepts were incorporated in the curriculum. Lastly, three papers highlighted cross-disciplinary courses that integrated biomedical engineering students with peers from other engineering and non-engineering disciplines, suggesting there are diverse approaches to enhancing students' understanding of health disparities. In conclusion, the scoping review found that while the research is limited, biomedical engineering departments have begun to incorporate health disparities into undergraduate curriculum and assess their students' knowledge of health disparities. Future work includes a case study of how current undergraduate BME programs at varying institution types prepare students for addressing health disparities. Overall, this review contributes to our understanding of how BME departments can incorporate DEI concepts in their curriculum.

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08. How clientelist party mobilization closes the gender turnout gap: theory and evidence from India

*Franziska Roscher**

When do women turn out in elections at equal rates to men? My dissertation re-investigates this question in the context of developing countries. Existing theories of women's political participation are largely resource-based, arguing that individuals need education, income, and/or political knowledge in order to participate. Yet in many developing countries, women turn out at par with men in the face of low levels of economic development and female labor force participation, and despite gendered differences in individual-level resource endowments. Based on an in-depth investigation of India, I argue that there is a second path to women's equal political participation that does not rely on individual-level resources, but instead depends on clientelism and household support for female turnout. Where households are supportive, they can bridge the resource gap for women. Household support, in turn, depends on high levels of clientelist returns to a vote, that is, on the direct exchange of votes for valuable state resources. I provide several pieces of empirical evidence from India consistent with this theory, based on two original surveys and a novel panel dataset on clientelist party mobilization. I show that female turnout is higher in a poorer and more clientelist state than in a better developed but less clientelist state, and that household support for female turnout – but not other forms of political participation – is high under clientelism. I also demonstrate that increases in levels of clientelist mobilization – measured as a rise in the number of ethnic groups targeted by clientelist parties – leads to smaller gender turnout gaps at the constituency level across several states.

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09. Simultaneous dimensionality reduction: A possible solution to neuroscience's data complexity

Eslam Abdelaleem, K. Michael Martini, Ahmed Roman, Ilya Nemenman*

In neuroscience, we seek to understand the correlations between neural firing and behavior. Recent technological advances enable the recording of data from thousands of neurons and the precise tracking of behavioral patterns. To uncover correlations between these datasets, dimensionality reduction techniques are often employed. Typically, each dataset is reduced independently before seeking correlations between the reduced forms. An alternative approach is to simultaneously reduce both datasets, retaining only the components most relevant to each other. Previous research has demonstrated that this joint reduction approach can outperform independent reductions in certain tasks, requiring fewer samples and lower dimensions to achieve comparable accuracy. However, the conditions under which these methods excel remain partially understood. Through both numerical simulations and analytical studies, we have confirmed the superior efficiency of simultaneous reductions compared to independent ones. Additionally, we have developed a versatile framework for variational losses, leveraging neural networks to capture complex, nonlinear data structures. This framework led to the creation of a novel method, the Deep Variational Symmetric Information Bottleneck, which outperforms several existing general-purpose dimensionality reduction methods. Our adaptable framework allows for customization to suit diverse research questions.

10. Utilizing machine learning to optimize limestone calcined clay cement (LC3) mix designs

Daniel Benkeser, Kimberly Kurtis*

The utilization of limestone calcined clay cement (LC3) is a promising advancement in the mitigation of the embodied CO2 emissions associated with cement production. However, the inclusion of calcined clays in these mixtures interfere with the fresh and hardened properties of these cements, the degree of which changes based on the physical properties and design of the LC3. This complexity increases the amount of testing required to optimize the performance of LC3 mixtures. It is proposed that machine learning models can be utilized to predict the optimal ratios and sulfation of LC3 mixtures through certain performance metrics. These models were developed by utilizing gradient boosting trees via XGBoost on several hundred unique mixtures collected from existing literature and laboratory experimentation. Databases were filled with values describing LC3 hydration kinetics, workability, and compressive strength on paste, mortar, and concrete mixes. The resulting accuracy plots all possess an R2 of between 0.70-0.93 allowing for the accurate prediction of LC3 performance. Subsequently, this enables the development of tools capable of predicting the optimal ratio of cement, limestone, calcined clay, and sulfur content for a given LC3 performance metric. These tools can potentially allow for the minimization of testing required to optimize LC3 performance.

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11. Understanding the Biochemistry of Glaucoma-Relevant Protein LOXL1

Hannah Youngblood, Hailee Scelsi, Raquel Lieberman*

Glaucoma is the number one cause of irreversible blindness around the globe. Variants within the lysyl oxidase like 1 (LOXL1) gene have the strongest genetic association with pseudoexfoliation glaucoma (XFG), one of the most common subtypes of glaucoma. These genetic variants lead to changes in the amino acid sequence of the protein product of LOXL1, which could potentially alter the structure and function of the protein. Variants associated with XFG as well as variants of unknown pathogenicity are located in important parts of the LOXL1 protein, including in/near sites necessary for protein activation/inactivation, sites that interact with other proteins, and the site that catalyzes the tropoelastin crosslinking reaction. Currently, little is known about the structure and other biophysical characteristics of human LOXL1, thereby limiting our understanding of the effects of disease-relevant variants. Therefore, this project sought to characterize the most common form of human LOXL1 protein. This project has expressed and purified the LOXL1 protein, examined the secondary structural characteristics of the protein, assayed the presence/absence of metal cofactors, and measured the activity of the protein to create a baseline for variant comparison. As a result, this work builds a foundation necessary for understanding the effects of LOXL1 variants on XFG etiology.

12. Modeling intermolecular coulombic decay with non-hermitian real-time time-dependent density functional theory

Yi-Siang Wang, James X. Zhong Manis, Matthew C. Rohan, Thomas M. Orlando, and Joshua S. Kretchmer*

The ionization of an inner valence or core electron can initiate competing electronic relaxation pathways that occur on an ultra-fast timescale, such as Auger-Meitner, intermolecular Coulombic decay (ICD), and electron transfer mediated decay (ETMD) processes. These processes play an important role in surface-science fragmentation and biological systems; the initial electron dynamics governs the subsequent fragmentation product distribution due to the Coulomb explosion of charged species in close proximity. In general, the majority of theoretical analysis of such processes has relied on static electronic structure calculations involving analyzing the ionization spectrum, density of states, or the broadening of the electronic states through non-Hermitian techniques. However, with the advent of attosecond spectroscopy, it is now possible to have experimentally time-resolved observation of ultra-fast processes with sub-femtosecond resolution. Therefore, there is a benefit to develop practical simulation methods that go beyond static techniques and can more directly report on such experiments. Real-time electronic structure methods, that directly solve for the time-propagation of the electronic wavefunction, provide a powerful class of techniques to accomplish such a goal. In this work, we develop a practical simulation protocol to use real-time-time dependent density functional theory (RT-TDDFT) to simulate the real-time ICD dynamics following an inner-valence ionization event. The ICD process involves initial ionization of a low lying electronic level. The hole left behind is filled from an electron in a higher lying electronic level on the same molecule. The energy released from this relaxation process is transferred to a neighboring molecule to ionize that molecule. In comparison to previous work, we employ a complex absorption potential (CAP) to account for the ionized secondary electron to accurately capture the dynamics.

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Research Talk Session II: 12:45 – 1:40 p.m.

13. Rules of life from nematode *C. elegans*: How do natural genetic changes shape molecular traits?

Avery Davis Bell, Francisco Valencia, Annalise Paaby*

A central question in biology is how each individual's genetic (DNA) complement is translated into the collection of each individual's traits. An early step along this path is DNA's expression as RNA, the molecule that codes for the proteins that perform most cellular functions; how changes in DNA change RNA expression represents a fundamental rule of life. What proportion of naturally occurring DNA changes impact RNA expression and what evolutionary forces shape these patterns remain incompletely understood. *Caenorhabditis elegans* is uniquely well positioned to shed light on these and other questions; e.g., its self-mating results in individuals with a wide range of genetic differences. Leveraging such advantages, we determined expression at every gene in a population of wild *C. elegans* and their hybrid offspring via RNA sequencing. This experimental design, combined with careful statistical methods, enabled many RNA expression comparisons: between the versions of the genes within the hybrid offspring; between the different parents; and between parents and offspring. Each comparison yielded unique understandings of how DNA regulates RNA. Among other insights, analyses of this dataset showed that 1) increasing DNA changes led to increasing RNA changes and 2) genes with RNA expression changes were less likely to be essential to the organism's survival and on average produced lower amounts of RNA (lower expression). This novel latter observation seems universal rather than *C. elegans*-specific: in existing human gene expression data, we found that genes with higher average expression were less likely to have changed expression. Taken together, our results suggest that important genes are less likely to have DNA changes affect RNA expression, implying that evolutionary forces exert stabilizing pressure on RNA expression levels. This work represents a valuable resource for the large community of researchers who use *C. elegans* to answer critical questions across many domains of biology.

14. An ultra-low-cost handheld electroporator for intradermal delivery of mRNA

Pankaj Rohilla, M. Saad Bhamla, Mark R. Prausnitz*

Significant advances and widespread distribution of mRNA-based COVID vaccines have established gene-based vaccines as the main approach to vaccination. Electroporation is an alternative physical technique of carrier-based delivery (e.g., lipid nanoparticles), which employs micro- to milli-second pulses to transiently permeabilize cell membranes to enable cellular uptake of mRNA. However, usage of electroporation is limited by bulky, expensive, and non-portable electroporators. Here, we present an ultra-low-cost (< USD 1) handheld electroporator (ePatch) which consists of a microneedle electrode array and a hand-operated piezoelectric pulser. The ePatch device generates µs-long bipolar oscillatory waveforms with peak voltages ranging from ~250-300 V in ex vivo porcine skin. In BALB/c mice, the intradermal delivery of luciferase-encoded mRNA with an ePatch significantly enhances protein expression over two weeks, achieving an area-under-the-curve ~50 times greater than that of mRNA injection without electroporation, and comparable to results from a commercial electroporator which costs up to ~$25,000. Moreover, the ePatch device achieves protein expression levels similar to those obtained through lipid nanoparticle (LNP)-mediated mRNA delivery. Electroporation using the ePatch enhances cellular uptake of naked mRNA, as evidenced by in vivo protein expression levels comparable to those achieved with a commercial electroporator and LNP-mediated mRNA delivery. This suggests that ePatch is an effective and low-cost alternative for democratizing mRNA-based vaccination and therapeutics.

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15. aiDance: How can we quantify a plie?

*Milka Trajkova**

Artistic human performance is at the brink of a data-driven transformation. While sports analytics have unveiled rich narratives behind athletes, classical ballet, with its technical precision and creative expression, has remained largely unchanged since the 18th century. Traditional teaching tools and feedback mechanisms provide limited support for dancers and instructors, lacking effective, more objective, and timely augmented feedback due to the subjectivity of visual assessments. This research introduces aiDance, an AI-based system using non-invasive motion tracking to model ballet plié errors, transforming implicit teaching insights into explicit, actionable knowledge for both learners and educators to enhance skill acquisition. aiDance was developed through an iterative design process with ten expert teachers. The process began with data collection, gathering video recordings of ballet pliés and expert feedback, capturing both explicit instructions and deeper, tacit knowledge. Through interviews, observations, and creative video exercise, key performance indicators for pliés were identified, including the causes of errors and mitigation cues. In the data preparation phase, videos were segmented, key movement markers were identified, and errors were video annotated. The data cleaning phase ensured any inconsistencies were removed, organizing the data for machine learning. The AI model was then trained to detect common plié errors accurately. Using this model, the ideation and prototyping phase developed a user-friendly platform that provided real-time feedback for dancers and teachers. Finally, the evaluation phase tested the system with ballet teachers, incorporating their feedback to refine the tool. Results showed an AI model with 98% accuracy in detecting plié errors, and teacher evaluations demonstrated how this tool bridges traditional ballet pedagogy with modern, data-driven assessment. This work represents a meaningful step towards standardizing motor learning feedback, enhancing student engagement, and promoting accessible, transparent evaluation in classical ballet, empowering both dancers and educators for improved performance, assessment, and learning.

16. Building plumbing influences the microbial diversity and turnover patterns of the drinking water microbiome

Huanqi He, Linxuan Huo, Solize Oosthuizen-Vosloo, Kelsey J. Pieper, Aron Stubbins, Byungman Yoon, Ameet J. Pinto*

Microbes living in building plumbing systems can significantly influence the drinking water quality at the point of use (i.e., customer taps). Thus, it is critical to understand what factors are shaping the microbial communities in building plumbing systems. In this study, we collected tap water samples from both commercial buildings (n = 60) and residential households (n = 40) in Boston, MA from June to November 2020. We used DNA sequencing techniques and bioinformatics tools to investigate the microbial composition and diversity, as well as how they changed over time. We found that the microbial communities had building-impacted diversity and turnover patterns. Specifically, microbial communities in commercial buildings showed higher variability in composition and lower diversity than residential communities. The lower diversity was also associated with reduced stability and population abundance. We also found that the commercial microbial communities were highly isolated, being less intruded by incoming microbes from city water supply. This is consistent with the larger plumbing sizes and the fact that water in commercial buildings can often stay unused over weekends or holidays. In residential households, the microbial communities were largely governed by environmental selection. Interestingly, the measured water chemistry parameters like pH, temperature, and disinfectant concentrations were not correlated with the selection-driven community in residential locations. Rather, local plumbing conditions, such as pipe diameters and materials, may be the primary drivers shaping the residential communities. Our study shows that the building plumbing systems play an important role in shaping the microbial communities in drinking water. This highlights the need for tailored building water management strategies.

17. Quantification and analysis of human physiological response to a hip exoskeleton via inverse reinforcement learning

Keya Ghonasgi, Matthew Gombolay, Aaron Young*

Abstract cannot be shared publicly.

Lightning Talk Session II: 1:45 – 2:15 p.m.

18. Experiments at nuclear reactors unravel what mobile electrons do within inorganic molecules

Christiansen, R. T., Timco, G. A., Winpenny, R. E. P., Balz, C., Le Mardelé, F., Orlita, M., Clérac, R., Ollivier, J. & Baker, M. L.*

Important technologies such as lasers, semiconductors and magnetic resonance imaging machines all exploit the laws of quantum mechanics, which govern the physical world at sub-nanometer length scales. Nowadays, the emergence of new quantum technologies with enormous potential, e.g., quantum computers and sensors, have put us at the brink of a quantum revolution. Molecules containing unpaired electrons are promising building blocks for developing quantum technologies because they provide a plethora of addressable quantum states and are highly customizable due to the versatility of coordination chemistry. Molecules in which the unpaired electrons become delocalized are particularly appealing because they are theorized to be more sensitive to convenient external stimuli, such as applied electric fields. However, molecules with delocalized unpaired electrons have thus far not been used for quantum technologies because the quantum mechanics that govern them are poorly understood. Here, I present our ongoing efforts to use state-of-the-art reactor-based experiments to directly probe molecular quantum mechanics. We find that inelastic neutron scattering experiments provide quantitative information about the distribution and degree of delocalization of unpaired electrons at the atomic level. With our findings, it is finally possible to precisely quantify the underlying quantum mechanics of molecules with delocalized unpaired electrons. This could pave the way for incorporating such molecules into new-and-improved quantum technologies.

19. Communication-aware map compression for online path-planning: a rate-distortion approach

Ali Reza Pedram, Evangelos Psomiadis, Dipankar Maity, Panagiotis Tsiotras*

Abstract cannot be shared publicly.

20. Electromagnetic signatures of massive black hole binaries heading for merger

Chi-Ho Chan, Vishal Tiwari, Tamara Bogdanović, Yanfei Jiang, Shane Davis*

The Laser Interferometer Space Antenna (LISA), scheduled for launch in ~2035, will detect gravitational waves (GWs) from inspiraling and coalescing massive black hole binaries (MBHBs). Localizing these binaries will require knowledge of the electromagnetic (EM) emission unique to them. Simultaneous detections in EM and GW can also revolutionize our understanding of massive black hole (MBH) growth in the context of galaxy evolution. As preparation for LISA science, we investigate the EM signatures of inspiraling MBHBs by performing radiative magnetohydrodynamics simulations of the gas flow around them, specifically, the circumbinary disk around both MBHs and the minidisks around individual MBHs. The MBHB under consideration consists of two MBHs of 10^7 solar masses each, on a circular orbit with an orbital separation of 100 gravitational radii; such a MBHB will merge years later within the LISA sensitivity band. Our simulation captures the effects of magnetic stresses driving accretion, the density- and temperature-dependent opacity of the gas, and the complex propagation of radiation through the inhomogeneous disks. We examine how our disks are different from those around single MBHs, make predictions about disk EM signatures, and discuss strategies to hunt for these signatures in current and upcoming observational surveys.

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21. Tailored approaches for individualized internal dosimetry

Lotem Buchbinder Shadur, Shachi Deo, Martin S. Graffigna Palomba, Vanessa Wei, Ignacio R. Bartol, Emmanuel Matey Mate-Kole, David Sundberg, David Carpio Gonzalez, Shaheen A. Dewji*

In the study of internal dosimetry, we employ biokinetic models to predict the biological effects of ionizing radiation. These models view the human body as a series of interconnected compartments, a method that helps us represent the complex and ever-changing processes that occur within us, such as inhalation, digestion, and more. They are particularly useful in predicting the effects of radiation when radioactive material enters the body after medical treatment or emergency events, like a nuclear power plant accident. Until now, these models have focused on an average person's physical attributes like height and weight to calculate the biological effect of ionizing radiation as an effective dose. When age is a factor, we divide pediatrics into five age groups and once again examine the average as representative. In some cases, we found up to 40% difference in skeleton intake between adults and pediatric individuals, while the whole-body difference stands at only merely 10%. These results demonstrate the importance of age-specific calculation and per-organ system comparison. In my presentation, I will highlight the pressing need to diversify the existing biokinetic models. These models, while effective, have limitations as they are based on the average physical attributes of a person. We are making significant progress in developing a more tailored approach that can cater to a diverse group of individuals. Our path forward involves the use of computational phantoms, Monte Carlo simulations, and AI, combined with statistical knowledge from the CDC on the US population.

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22. "The Gold Bug" as red herring in The Fall of the House of Usher (2023)

*Scott Caddy**

"The Gold Bug" was arguably Edgar Allan Poe's most widely read and successful short story in his lifetime. However, the purpose of the eponymous gold bug from the tale is equally absent and essential to the "red herring" it serves, distracting the narrator from detecting Legrand's descent into faux madness until it is revealed. This paper argues that the adaptation of "The Gold Bug" in Netflix's 2023 limited series The Fall of the House of Usher follows a similar functional trajectory as the gold bug in the original tale. The "Goldbug" episode is actually another red herring; that is, it adapts two of Poe's other works ("Tamerlane" and "The Story of William Wilson") to tell a new "Goldbug" story. Much like the original Poe tale had little to do with the gold bug, the adapted "Goldbug" also has little to do with the source material, save for the name and an appearance of a gold bug as the logo of a multilevel marketing product. Instead, elements from "The Story of William Wilson"—that the narrator appears to be following a ghost of himself—appear throughout "Goldbug". The inclusion of Tamerlane as a character (not present in "The Gold Bug") also signals that this adaptation may be a misnomer—except that the original tale is, arguably, also a misnomer. This talk argues that such misdirection and mis-adaptation results in an episode that is, at its core, faithful to the confusing and seemingly meaningless object of the "gold bug" from the original tale. Thus, a suspenseful and psychologically challenging episode is created—and one that is the most faithful to the horror of Poe's original short stories.

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