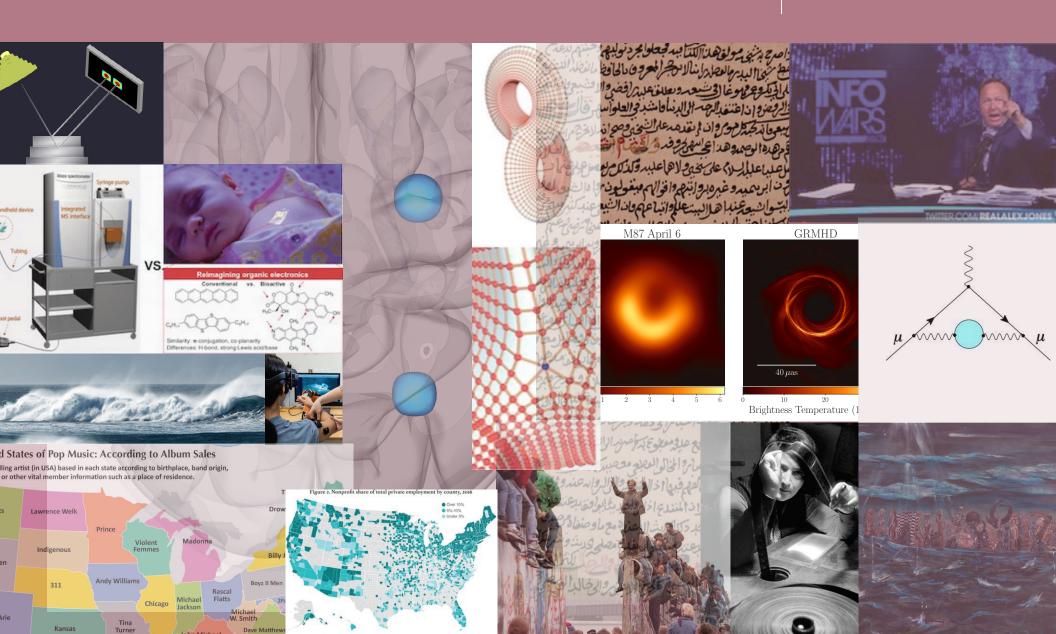
RESEARCH APPOINTMENTS / ASSOCIATES AND FELLOWS 2019 - 20

University of Illinois Urbana-Champaign



WHY PEOPLE BELIEVE STRANGE THINGS: UNDERSTANDING PSEUDO-REALITIES AND PSEUDO-THEORIES • HOLOMORPHIC DIFFERENTIALS IN MATHEMATICS AND PHYSICS • FROM COFFEE **ESTATES TO THECOFFEE STATE: A GLOBAL HISTORY OF THE COLOMBIAN COFFEE ECONOMY** IN THE TWENTIETH CENTURY THREE-DIMENSIONAL MAPPING OF SEMICONDUCTOR DEVICES • DEVELOPMENT OF CHEMICAL TOOLS TO STUDY HOW STEM CELLS AGE • POWERFUL MEMORIES, PREGNANT SILENCES: SHI'ISM AND THE MAKING OF THE SUNNI HADITH TRADITION • REINVENTING MOLECULAR ELECTRONICS FOR ULTRASENSITIVE BIOCHEMICAL DETECTION ON A CHIP • THE MUON AS A WINDOW TO NEW PHYSICS • COUNTERLIFE: SLAVERY AFTER RESISTANCE AND SOCIAL DEATH • UNDERSTANDING THE FIRST IMAGES OF A BLACK HOLE. BREAKING, PEAKING AND DISINTEGRATION. DEVELOPING THEORETICAL AND COMPUTATIONAL MODELS OF HABITUATION TO CHRONIC TINNITUS • THE VISIBLE AND THE INVISIBLE: SOVIETCINEMA AND WOMEN'S WORK • FORCE FEEDBACK OF LOW DIMENSIONS IN VIRTUAL REALITY FOR MOVEMENT REHABILITATION AND CHARACTERIZATION IN CEREBRAI PALSY • QUANTITATIVE ANALYSIS OF THE NONPROFIT ECONOMY • DETECTION AND CHARACTERIZATION OF PATIENT SUBGROUPS WITH HETEROGENEOUS BEHAVIOR • REMEMBERING 1989: FUTURE ARCHIVES OF PUBLIC PROTEST • WITNESS: TESTIMONY AND THE ENDS OF REFUGE • UNITE THE TRIBES • TRACKING THE GRAVITATIONAL FOOTPRINTS OF DECOUPLED DARK SECTORS

Research Appointments 2019-20

Lach year, the tenured and untenured University of Illinois faculty are invited to submit scholarly/creative proposals for consideration by the Center's permanent Professors. Faculty members with winning proposals are appointed Associates and Fellows and awarded one semester of release time to pursue their projects in the coming academic year.

In accordance with the Center's mission, these appointments provide an incentive to pursue the highest level of scholarly achievement. They also provide faculty members with an unusual opportunity to explore new ideas and demonstrate early results.

Along with the Professors, Associates and Fellows form the intellectual core of the Center for Advanced Study community. They participate in a yearly roundtable discussion of research interests, are invited to participate in CAS events, and have opportunities to present their work to the CAS community. Thus, each year brings together the established and the new in an ever-changing flux of ideas and disciplines.

In this brochure we are pleased to introduce the projects of the 2019-20 CAS Associates and Fellows.



CAS Review Committee

The review committee for the Associates and Fellows program consists of the Center for Advanced Study Professors. These senior scholars represent a wide range of disciplines. Their permanent appointment to the Center is among the highest forms of campus recognition.

The current Center for Advanced Study Professors and their fields of expertise are:

James D. Anderson

education policy, education desegregation, African-American public education

Renée L. Baillargeon

early conceptual development, infant cognition

Tamer Basar

distributed decision making, robust estimation and control, dynamic games, network economics

May R. Berenbaum

entomology, chemical ecology

Antoinette Burton

British empire, colonial India, race and sexuality mobility

David M. Ceperley

quantum Monte Carlo methods, quantum many-body systems

Leon Dash

immersion journalism, domestic and international reporting

Gary S. Dell

language production, speech errors

Eduardo H. Fradkin

quantum field theory, condensed matter physics

Matthew W. Finkin

labor and employment law, legal issues in higher education

Martha U. Gillette

cellular neuroscience, circadian rhythm

Nigel Goldenfeld

condensed matter physics, evolution, microbial ecology, statistical mechanics

Martin Gruebele

computational modeling, laser techniques, complex molecular systems

Bruce Hajek

communications engineering, stochastic methods

Anthony James Leggett

low-temperature physics, superconductivity

Stephen P. Long

environmental physiology, global atmospheric change, C4 photosynthesis

Michael S. Moore

law and philosophy, jurisprudence, criminal law, ethics and metaethical philosophy, philosophy of punishment and responsibility, philosophical psychology

Catherine J. Murphy

nanomaterials, cellular imaging, chemical sensing, photothermal therapy

Tere O'Connor

dance, choreography, consciousness

Gene E. Robinson

genomics, social behavior, social insects

Jay Rosenstein

journalism, film, documentaries

Jonathan Sweedler

bioanalytical chemistry, peptide hormones, neurotransmitters, neuromodulatory agents

Maria Todorova

history, Balkans, nationalism

Lou van den Dries

model theory, o-minimality

Dale J. Van Harlingen

experimental low-temperature physics, superconductivity, microfabrication of superconductor devices, scanning probe microscopy, mesoscopic systems

Invitation to Apply

We invite the campus faculty to submit proposals for the **2020-21** academic year Associates and Fellows Program. For more information, please consult our website at www.cas.illinois.edu

Application deadline: October 2. 2019

Contents

02 WHY PEOPLE BELIEVE STRANGE THINGS: UNDERSTANDING PSEUDO-REALITIES AND PSEUDO-THEORIES

> Dolores Albarracin Associate

03 HOLOMORPHIC DIFFERENTIALS IN MATHEMATICS AND PHYSICS

Steven Bradlow Associate

04 FROM COFFEE ESTATES TO THE COFFEE STATE: A GLOBAL HISTORY OF THE COLOMBIAN COFFEE ECONOMY IN THE TWENTIETH CENTURY

Marcelo Bucheli Associate

05 THREE-DIMENSIONAL MAPPING OF SEMICONDUCTOR DEVICES

David Cahill Associate

O6 DEVELOPMENT OF CHEMICAL TOOLS TO STUDY HOW STEM CELLS AGE

Jefferson Chan Beckman Fellov

07 POWERFUL MEMORIES, PREGNANT SILENCES: SHI'ISM AND THE MAKING OF THE SUNNI HADITH TRADITION

Michael Dann Beckman Fello 08 REINVENTING MOLECULAR
ELECTRONICS FOR ULTRASENSITIVE
BIOCHEMICAL DETECTION ON A CHIP

Ying Diao Beckman Fellow

09 THE MUON AS A WINDOW TO NEW PHYSICS

Aida El-Khadra Associate

10 COUNTERLIFE: SLAVERY AFTER RESISTANCE AND SOCIAL DEATH

Christopher Freeburg Associate

11 UNDERSTANDING THE FIRST IMAGES OF A BLACK HOLE

Charles Gammie Fellow

12 BREAKING, PEAKING AND DISINTEGRATION

Vera Mikyoung Hur Associate

13 DEVELOPING THEORETICAL AND COMPUTATIONAL MODELS OF HABITUATION TO CHRONIC TINNITUS

Fatima Husain Associate

14 THE VISIBLE AND THE INVISIBLE: SOVIET CINEMA AND WOMEN'S WORK

Lilya Kaganovsky Associate 15 FORCE FEEDBACK OF LOW DIMENSIONS
IN VIRTUAL REALITY FOR MOVEMENT
REHABILITATION AND CHARACTERIZATION
IN CEREBRAL PALSY

Citlali López-Ortiz Fellow

16 QUANTITATIVE ANALYSIS OF THE NONPROFIT ECONOMY

Benjamin M. Marx Fellow

17 DETECTION AND CHARACTERIZATION OF PATIENT SUBGROUPS
WITH HETEROGENEOUS BEHAVIOR

Naveen Naidu Narisetty Beckman Fellow

18 REMEMBERING 1989: FUTURE ARCHIVES OF Public protest

Anke Pinker Associate

19 WITNESS: TESTIMONY AND THE ENDS OF REFUGE

Gilberto Rosas Associate

20 UNITE THE TRIBES

Alex Shakar Associate

21 TRACKING THE GRAVITATIONAL FOOTPRINTS
OF DECOUPLED DARK SECTORS

Julia "Jessie" Shelton

WHY PEOPLE BELIEVE STRANGE THINGS: UNDERSTANDING PSEUDO-REALITIES AND PSEUDO-THEORIES

Dolores Albarracin Associate

Psychology

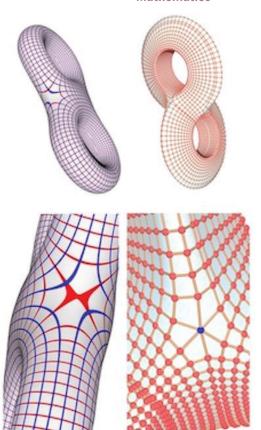


Professor Albarracin's theoretical framework explains how, in the face of evidence to the contrary, individuals come to believe in conspiracies and other seemingly bizarre ideas. Conspiracy theories (the belief that a powerful agent or group is responsible for and has covered up an event) provide clarity of vision and justifications for the confusions, frustrations, and insecurities of living in contemporary societies characterized by rapid social changes and profound inequality. In other words, conspiracy theories arise to explain social phenomena that are difficult to comprehend. A fundamental premise of Professor Albarracin's model is that the misconceptions created in response to the threat are not random. She will test this model with a national probability survey to be conducted in the next 6 months, and will also conduct follow-up experiments. Her CAS appointment will allow her to analyze and write up this data for publication.

HOLOMORPHIC DIFFERENTIALS IN MATHEMATICS AND PHYSICS

Steven Bradlow Associate

Mathematics



Mesh of lines determined by a holomorphic differential on a two-holed torus.

During his CAS Associate appointment, Professor Bradlow will co-organize one of the featured programs for Fall 2019 at the Mathematical Sciences Research Institute (MSRI) in Berkeley. Entitled *Holomorphic Differentials in Mathematics and Physics*, the program will bring together mathematicians and physicists with diverse backgrounds and perspectives but with a common interest in the central objects of the program.

Holomorphic differentials first appeared in late 19th-century mathematics. The simplest examples—differential 1-forms on a two-dimensional plane—are part of the basic machinery of calculus. More exotic versions of such differentials can be constructed on curved surfaces. After 150 years of study intricate links have been established between the resulting holomorphic differentials and geometric and analytic properties of the underlying surfaces.

Participants in the MSRI program include experts on the role of holomorphic differentials in settings as diverse as geometric structures on surfaces (Teichmüller theory), the evolution of complex systems (dynamical systems), string theory and quantum field theory, and moduli spaces in algebraic geometry. Bradlow's main interest has so far been in the relation between holomorphic differentials and moduli spaces of Higgs bundles. While at MSRI he plans to expand his research in directions championed by the other participants.

FROM COFFEE ESTATES TO THE COFFEE STATE: A GLOBAL HISTORY OF THE COLOMBIAN COFFEE ECONOMY IN THE TWENTIETH CENTURY

Marcelo Bucheli Associate

Business Administration

For much of the 20th century, Colombia was synonymous with superior quality coffee. From Coffee Estates to the Coffee State: A Global History of the Colombian Coffee Economy in the Twentieth Century places Colombian coffee in a global context and shows that this differentiation of Colombian coffee was the result of a complex history of corporate strategy, political economy, and foreign policy.

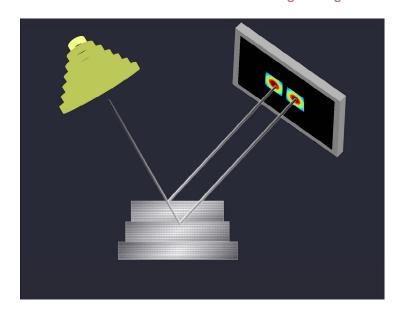
Professor Bucheli will analyze the strong influence wielded over the Colombian economic and political system by a private entity: the FNCC (Federación Nacional de Cafeteros de Colombia). Based on privileged access to previously unexplored FNCC archives, this book will show how the firm strategically molded the Colombian economy and state to its interests, then cleverly

influenced coffee prices and American policy towards Latin America from the Global Depression of the 1930s through the end of the Cold War in the 1980s. The influence of the FNCC in Colombian economic and foreign policies decreased after 1989, when with the collapse of the Soviet Union, the United States lost interest in subsidizing coffee exports. New industries such as oil and coal (as well as the illegal cocaine exports) emerged in Colombia and competed with the FNCC for political influence, and a new technocratic elite adopted free market policies that meant decreasing subsidies to coffee exports.

THREE-DIMENSIONAL MAPPING OF SEMICONDUCTOR DEVICES

David Cahill Associate

Materials Science & Engineering



The measurement of temperature is ubiquitous in science, engineering, and medicine. Most often, temperature is measured at a single point in space that is accessible to a thermometer. Thermometry at higher dimensions—e.g., a two-dimensional imaging of temperature across a surface or a threedimensional mapping of temperature throughout a volume of material—is needed to support technologies as varied as construction engineering, thermally-driven medical therapies, and information technology. An important trend in the design of computing systems is vertical stacking of integrated circuits to reduce power, decrease footprint, and increase performance. In a three-dimensional device architecture, however, the management of heat becomes a limiting factor and there is currently no method available to measure the temperature distribution within a vertical stack of integrated circuits.

Professor Cahill will study the physical principles and practical implementation of synchrotron-based x-ray scattering and nuclear magnetic resonance methods for mapping the three-dimensional temperature distribution within stacked semiconductor wafers during operation. In addition to these applications to information technology, advances in three-dimensional thermometry could broadly impact the development of more efficient and reliable technologies for energy storage, power controls, lighting, and electric vehicles.

DEVELOPMENT OF CHEMICAL TOOLS TO STUDY HOW STEM CELLS AGE

Jefferson Chan Beckma<u>n Fellow</u>

Chemistry

The aberrant production of highly reactive aldehydes can have a major influence on the aging of stem cells. Molecular level changes that result from aldehydes include important alteration to DNA and this can lead to a variety of human diseases including autoimmune diseases, cancer, diabetes, and neurological disorders. Unfortunately, our general understanding of the mechanisms involved are insufficient owing to a dearth of methods to non-invasively detect reactive aldehydes, manipulate their subcellular concentrations, as well as to monitor the activity of aldehyde processing enzymes.

Professor Chan plans to address each of these three areas of research through the development of new chemical tools. He will draw from his established expertise in molecular imaging and probe design to develop fluorescent and photoacoustic probes to non-invasively visualize the abnormal production of aldehydes at the cellular and whole animal levels, respectively. He will complement this work by developing new aldehyde donor molecules that can be employed to deliver a specific aldehyde species on demand using light. Since light can be focused with high precision onto small volumes within a cell, the delivery of a given reactive aldehyde can be achieved with unprecedented control over the location and time of delivery. Lastly, he will develop new fluorescent substrates to monitor the enzymatic activity of aldehyde processing enzymes implicated to play a crucial role in mediating the aging of stem cells. The integrated approach in this proposed research spanning chemical synthesis to molecular imaging offers an exciting opportunity to study the biology of reactive aldehyde species related to aging and associated disease states.

POWERFUL MEMORIES, PREGNANT SILENCES: SHI'ISM AND THE MAKING OF THE SUNNI HADITH TRADITION

Michael Dann Beckman Fellow

Religion

للوسعديد عارالص وومرعا إذراجه فهوغا الحسيعد وبعلاف عدر فضي الاق علياعلياعا ي عالمي واعتقداله لا احتى الحلا فريعد مرو البصل معرع ابتر للعد دجالسنيع اوطربع عطريف احاوما بدغنهاها نموعون الصائرة دماز وججدو بلونها فيسدوا ولك فاعد فرم وحدان فضرا اح علم الاعدى ورائده صلوا مرجع عدور معنوع بدراص برالاب كرفي طبغ اندوة فالحلاف دتد فغذطع عدعا مذالعدم وألمهاج زوالانصار والمخال العصع معصير كاروز عاصاده والم واما وسايرالا مكاع مالاسعلق العقا بدفه وعنلون فالففي فيها اذااصفظ واالالرواد عندوعى فرصاه اكفظ ارجيع يعصرا بازى بدن مالعطد أند فاؤا داكمنند واذارواهد بقابول فاسيعند فلإ اح إذ البيعنندوا طفالنام وان لم يولفغه احدولم بوجد وكالجديث الاعنية مع ماوصفاة م الخنلف صواوامام ومشهور سبرعند مماسعة المسبع كالمؤواله والدخالد

Folio from al-Ḥasan b. Isḥāq, *Bulūgh al-umniyya fī izḥār makhāzī Ibn Taymiyya*, private collection.

In this book, Professor Dann explores the phenomenon of Sunni-Shi'ite ambiguity over time through the lens of the lives, literary contributions and posthumous reception of Shi'ites who made indispensable contributions to the Sunni hadith tradition. Active chiefly in the eighth and ninth centuries when sectarian boundaries had not yet crystallized, these narrators embodied the full range of potential Shi'ite orientations, ranging from central fixtures of proto-Sunni traditionalist milieus who were tinged by Shi'ite sentiments, to architects of nascent Zaydi and Imami sectarian identities, to "extremists" condemned as heretics by their contemporaries. As sectarian boundaries crystallized in the ninth and tenth centuries and the canonical hadith collections of Sunnis and Shi'ites took shape, authors from both sects bifurcated the literary contributions of these narrators in their works, incorporating those elements that supported their respective visions of orthodoxy and ignoring or suppressing those that challenged them.

Beginning in the fifteenth century, the ambiguous legacy of these narrators became a fertile site for the continual renegotiation of sectarian boundaries in biographical and polemical genres. Ranging from Sunnīs writing in fifteenth century Syria, to Zaydi Shi'ites writing in seventeenth century Yemen, to Imami Shi'ites writing in eighteenth century India, to authors of all three sects throughout the contemporary Muslim world, scholars have recast the significance of these narrators in a diverse array of efforts to maintain, dissolve, challenge and reconfigure inherited sectarian boundaries.

CAS RESEARCH APPOINTMENTS 2019-2020

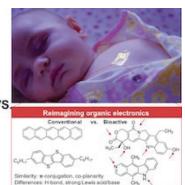
REINVENTING MOLECULAR ELECTRONICS FOR ULTRASENSITIVE BIOCHEMICAL DETECTION ON A CHIP

Ying Diao Beckman Fellow

Chemical & Biomolecular Engineering



08



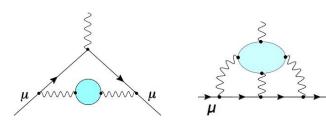
Professor Diao plans to develop a powerful new tool for broad spectrum biochemical detection at ultrahigh sensitivity, by bridging molecular electronics, medicinal chemistry and biochemical sensing for the first time. Biochemical sensing at ultrahigh sensitivity is critical to realizing personalized health monitoring and medical diagnosis by detecting molecular signatures of illness, as opposed to observing bodily symptoms. However, established analytical techniques rely on bulky, sophisticated instrumentation or expensive essays to attain high sensitivity and specificity. On the other hand, mammals utilize molecular-recognition-triggered electrical signals to detect biochemical cues. Developing miniaturized electronic devices for rapid broad-spectrum biochemical detection represents a new frontier in analytical chemistry and biomedical sciences. Recent years, conventional electronics have been intensely investigated for this purpose. However, they are severely limited in terms of materials selection and weak coupling between molecular recognition and electronic structure.

The novelty of Professor Diao's approach lies in re-purposing medicinal compounds which already evolved high binding affinity and specificity with biomarkers as molecular electronics. This work will not only lead to discovery of new electronic materials inspired by plant-derived semiconductors, but also usher electronic biochemical sensing into a new era of personalized health monitoring, prognosis and diagnosis.

THE MUON AS A WINDOW TO NEW PHYSICS

Aida El-Khadra Associate

Physics



The muon g-2 experiment, which started running at Fermilab, uses muons as a window to search for new physics. The Fermilab experiment aims to measure the magnetic moment of the muon with exquisite precision reducing the already very small uncertainties of previous measurements by over a factor of four. It turns out that the muon's magnetic moment is sensitive to the presence of new (as yet unknown) particles through their virtual effects. But the muon's magnetic moment also receives contributions from virtual effects of all known particles. These effects are predicted, in principle, within the Standard Model of particle physics. However, the contributions from particles that experience the strong interactions (hadronic corrections) are very challenging to calculate and are therefore the dominant source of theory error. Hence, in order to use the Fermilab experiment to discover new physics, these theoretical uncertainties must be reduced to match the target precision.

During her CAS appointment, Professor El-Khadra will refine her collaboration's calculation of the hadronic corrections to include missing contributions, which will produce theoretical predictions with significantly reduced uncertainties. She will also organize a workshop of the Muon g-2 Theory Initiative in September of 2019. The initiative, which she chairs, includes over 60 researchers from three continents, and brings together the different communities that are engaged in theoretical calculations of the muon magnetic moment, to enhance and coordinate the individual efforts, inspire new efforts, and to provide updates and summarize the status of the theory.

CAS

COUNTERLIFE: SLAVERY AFTER RESISTANCE AND SOCIAL DEATH

Christopher Freeburg Associate

English



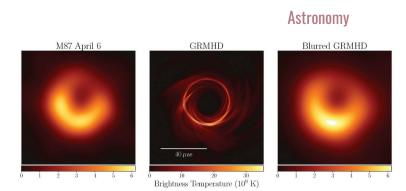
Radcliffe Bailey, *Western Currents*, 2012. © Radcliffe Bailey. Courtesy of the artist and Jack Shainman Gallery, New York.

Through a rich array of cultural forms literature, music, comedy sketches, and film— Counterlife deepens and broadens how we view portrayals of enslaved Africans in the US. This book conceptualizes slave social life and art discourse as counterlife. Counterlife emphasizes uncertainty, unaccountability, and instability that unsettles singular narratives and teloses, fixed categories and oppositions. For Professor Freeburg, the term "counterlife" is inspired by reading and observing of the work of artists and art curators like Philip Roth, Ralph Ellison, Thelma Goldman, and Radcliffe Bailey whose work emphasizes that concrete situations have multiple and simultaneous points of view.

Professor Freeburg will deploy counterlife to rediscover more profound mystery and instability than critics usually realize in the relations among black social life, artistic expression, and oppressive institutions. Thinking through counterlife helps to squarely address the relationship between the most influential frames for analyzing slave texts and their limitations. While many scholars of slavery studies frame their discussion in terms of political traction, Professor Freeburg will focus on how slaves establish religious practices, perform historical memory, and find meaning in artistic creation that does not achieve its force because of its refutation or entanglement of white domination.

UNDERSTANDING THE FIRST IMAGES OF A BLACK HOLE

Charles Gammie Fellow



Left: Real data from EHT; Center: Theoretical model of the Galaxy M87; Right: Theoretical model blurred to the resolution of the real data.

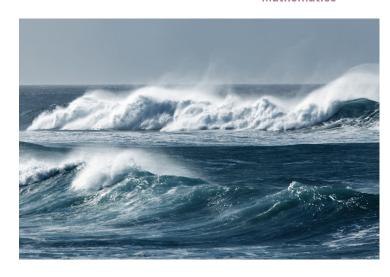
Black holes are believed to sit at the center—the nucleus—of nearly every galaxy in the universe, including our own Milky Way. Nuclear black holes draw in gas—accrete from their surroundings that heats up and becomes luminous, producing radiation that spans the electromagnetic spectrum. Professor Gammie's research group is a world leader in using computer models to take ideas about how black holes accrete and translate them into predictions for what telescopes on Earth and in orbit around the Earth will see. His group is especially focused on results from an experiment called the Event Horizon Telescope (EHT); Professor Gammie co-leads the theory working group within the EHT collaboration. EHT operates by combining signals from millimeter wavelength telescopes around the

globe to produce very high angular resolution images of astronomical sources, especially black holes. EHT released the first spatially resolved image of a black hole in April 2019 and is expected to steadily release better understood and higher quality images thereafter.

11

BREAKING, PEAKING AND DISINTEGRATION Vera Mikyoung Hur Associate

Mathematics



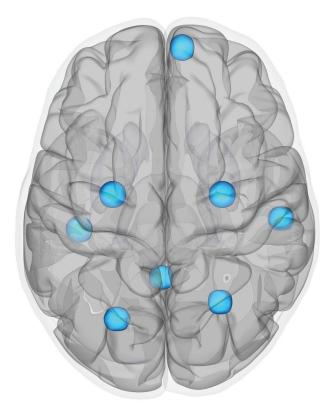
The water wave problem, in the simplest form, concerns the wave motion at the surface of an incompressible inviscid fluid, below a body of air, acted on by gravity. Describing what one may see or feel at the beach or in a boat, water waves are a prime example of applied mathematics. They host a wealth of wave phenomena, from ripples to tsunamis and to rogue waves. They have stimulated a considerable part of the historical development of wave motion, such as the discovery of the Korteweg-de Vries soliton. The water wave problem presents profound and subtle challenges. For one thing, the interface between the water and the air is free and to be determined as part of the solution. Free boundaries are mathematically challenging in their own right and they occur in many other situations, such as melting of ice and stretching of a flexible membrane over an obstacle. Moreover, free surface conditions are nonlinear.

During her CAS appointment, Professor Hur will put together rigorous analysis, numerical computation and modeling to address fundamental issues in the mathematical aspects of water waves. Particularly, she will focus on global regularity versus finite time singularities, the existence of traveling waves and their characterization, and the stability and instability of traveling waves. She will emphasize large scale dynamics and genuinely nonlinear behaviors, such as breaking, peaking and touching waves, and the Benjamin-Feir instability. She will expand the use of computational methods to support theoretical advances. Progress in the proposed research will lead to the resolution of several outstanding problems surrounding water waves, and engineering applications.

DEVELOPING THEORETICAL AND COMPUTATIONAL MODELS OF HABITUATION TO CHRONIC TINNITUS

Fatima Husain Associate

Speech & Hearing Science



Tinnitus is a subjective condition, affecting between 10-15% of the general population and its incidence increases with age. It is characterized by a phantom perception of sounds in the absence of external sources. Most individuals who develop chronic tinnitus eventually habituate to it and do not require continued attention from a health-care professional. However, a minority (about 20-30%) will exhibit distressing reactions related to tinnitus, reporting sleep difficulties, cognitive and communication challenges, and comorbid depression or anxiety. There is no cure for tinnitus, but there are therapies that seek to reduce its bothersome symptoms.

Although several theories have been proposed to account for the development of tinnitus, few frameworks have accounted for the adaptation process occurring as tinnitus becomes chronic. In this project, Professor Husain will build on two ongoing projects in her lab: (1) multi-modal brain imaging to

better understand the neural correlates of tinnitus and (2) development of computational models to objectively diagnose the condition of tinnitus. In the proposed study, using data from cross-sectional studies, she will develop computational models of different stages of habituation as shown by individuals in subgroups differing in severity. She will test these models using data from two longitudinal interventional studies that aim to shift individuals from the bothersome to the mild group. The immediate impact of such models will be the development of robust objective biomarkers of tinnitus, allowing us to better evaluate existing interventions and leading to customized therapies for individual patients. The project will also accelerate neuroscientific understanding of tinnitus and generate hypotheses for future experiments.

THE VISIBLE AND THE INVISIBLE: SOVIET CINEMA AND WOMEN'S WORK

Lilya Kaganovsky Associate

Comparative and World Literature



Esfir Shub at flatbed with celluloid-strip (BFI).

The Visible and the Invisible: A History of Soviet Women's Cinema, 1920s-1980s tells a new history of Soviet cinema from the prospective of the women film pioneers who were instrumental to its development, but whose contributions have gone largely unnoticed. This study shifts the definition of "Soviet cinema" to include those who have been relegated to its margins. By focusing on a wide range of women's cinematic production in the USSR and looking closely at the work of Soviet women directors, editors, composers, cinematographers, scriptwriters, and film critics, this project resituates the work of women within the Soviet cinema industry, providing a new historical and theoretical lens through which to understand their contributions.

Building on Professor Kaganovsky's earlier work on masculinity and the body in Stalinist culture, and early Soviet film sound, this study focuses on gender and technology, by placing the work of women at the forefront of the history of Soviet cinema. This project is motivated in part by recent reexaminations of the history of women in the silent film industries, and in part by a lack of scholarly attention to Soviet women's cinema by critics both inside and outside of Slavic studies. The Visible and the Invisible will significantly broaden our understanding of Soviet cinema, women's cinema, and film history, while also serving as a model for new directions in feminist film studies.

FORCE FEEDBACK OF LOW DIMENSIONS IN VIRTUAL REALITY FOR MOVEMENT REHABILITATION AND CHARACTERIZATION IN CEREBRAL PALSY

Citlali López-Ortiz Fellow

Kinesiology & Community Health



Cerebral palsy (CP) is the most common developmental motor disorder in children. Individuals with CP demonstrate abnormal muscle tone and motor control. These neurological impairments manifest at an early age and tend to worsen with time. The main goals of rehabilitation in CP include physical therapy interventions that consist mainly of intensive stretching and strengthening exercises and more recently, high dosage robotic training aimed at restoring locomotion, reaching ability, and ankle mobility. However, meaningful clinical improvements are limited for children with dystonic movements.

Professor López-Ortiz hypothesizes that motor learning of force efforts using feedback in low dimensional visual mappings will facilitate arm movements in children with dystonia and with combinations of dystonia and spasticity. As the child generates force against a robot, she receives real time feedback of the forces and torques generated in a lower dimension virtual reality game (VR). The child in training must learn implicitly which muscle activation patterns successfully match the mapped force targets in the VR game. Since there is redundancy in the solutions due to the reduction of dimensions in the feedback space, the child with CP can successfully match targets with atypical solutions. This game-like intervention will also provide an objective and quantitative characterization of dystonia and spasticity through principal component analysis of the forces, torques, and muscle activity patterns generated in learning to play the game.

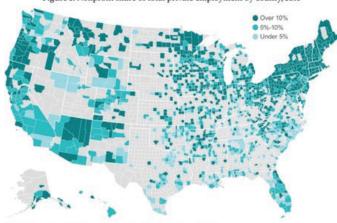
QUANTITATIVE ANALYSIS OF THE NONPROFIT ECONOMY

Benjamin M. Marx Fellow

Economics

CAS

Figure 2. Nonprofit share of total private employment by county, 2016



Note: Data are not available for greyed-out counties due to BLS disclosure limitations. See Appendix A for more information on BLS disclosure rules.

From Lester M. Salamon and Chelsea L. Newhouse, "The 2019 Nonprofit Employment Report," *Nonprofit Economic Data Bulletin #47.* (Baltimore: Johns Hopkins Center for Civil Society Studies, January 2019).

Available at ccss.jhu.edu.

Nonprofit organizations provide a wide variety of services, including arts, education, and healthcare. Estimates suggest that the nonprofit sector has been growing faster than the rest of the U.S. economy for several decades. Income inequality has also grown over this period. Are these phenomena related? Has one trend caused the other, or perhaps mitigated the other? What explains the rapid growth of the nonprofit economy, and what are its effects?

This research will describe the scope of the U.S. nonprofit sector using data from the IRS and U.S. Census Bureau, including confidential administrative data that can only be accessed in a small number of Federal Statistical Research Data Centers (FSRDC). The project will examine the quality of publicly available data and will study determinants of growth of a community's nonprofit sector and its effects.

DETECTION AND CHARACTERIZATION OF PATIENT SUBGROUPS WITH HETEROGENEOUS BEHAVIOR

Naveen Naidu Narisetty Beckman Fellow

Statistics

The rapid developments in collecting, storing, transmitting, and managing massive amounts of data have led to unique opportunities and challenges in Statistics and the emerging field of Data Science. Motivated by large-scale medical studies where huge volumes of data with complex structures are produced, Professor Narisetty aims to develop a novel statistical framework to detect patient subgroups which exhibit heterogeneous behavior and to characterize these subgroups based on their biological and clinical features. The statistical framework developed will introduce novel statistical models, methodology to estimate the models, and computational algorithms scalable to Big Data settings. Quantile regression models and Bayesian techniques will be utilized for developing this framework.

To make the proposed statistical and computational research suitable for a variety of scientific applications, high dimensional and complex structures of the features will be accommodated. In the medical context, the research methods will be useful for personalized medicine so that patients belonging to more responsive subgroups can be treated and those belonging to subgroups with side effects can be avoided. Software packages in R will be developed to make the proposed methods for subgroup analysis accessible for wide use by scientists and practitioners.

CAS RESEARCH APPOINTMENTS 2019-2020

REMEMBERING 1989: FUTURE ARCHIVES OF PUBLIC PROTEST

Anke Pinkert Associate

Germanic Languages and Literatures



Remembering 1989: Future Archives of Public Protest examines the massive unrest in the streets of East Germany which led to the fall of the Berlin Wall. Shrouded by the false narrative of the inevitability of German reunification, these protests have yet to find a place in Germany's memorial public sphere. Professor Pinkert turns to a range of cultural productions – literature, film, installation art, photography, memorials – in order to assemble an entirely new dynamic archive of 1989 that accounts for the open-ended promises of the uprising.

We have become all too accustomed to the idea that the past is controlled by the present, ignoring the un-archived knowledge that lingers underground and across temporal zones (outside authorized histories, sites, and commemorations). Shifting memory studies from the now-familiar critique of the powerful to an archive for the future shapes the foundational argument of the book. This allows a new

understanding of popular movements which have been forgotten or considered failures. Although the nascent impulses of these movements may not come into view within the official historical record, Professor Pinkert aims to retrieve their open-ended signals in vibrant, though often hidden, memory ecologies today. She will focus on post-1989 German culture, but the argument will have ramifications for scholars working on other transitional periods and other parts of the world. Remembering 1989 will alter our understanding of revolutionary protest and its potent, yet often intangible, afterlife, and will allow us to consider the world we care for now and what we pass on to the next generation.

WITNESS: TESTIMONY AND THE ENDS OF REFUGE

Gilberto Rosas Associate

Anthropology and Latino/a Studies

During his CAS appointment, Professor Rosas will complete *Witness: Testimony and the Ends of Refuge*, a book that addresses the competing ends of refuge as it plays out in the complexities of immigration and asylum proceedings and the often-divisive discourses that surround them. Witness will be among the first books to capture an emergent current of migration from Mexico: those who are fleeing the drug war and resisting deportation by struggling for recognition as asylees. It takes its vantage point from Professor Rosas's experience providing expert testimony on behalf people in asylum and related legal proceedings and related ethnographic research.

Witness captures and analyzes lived experiences of individuals in immigration proceedings and their links to larger structural forces, as they resist detention and banishment. Witness takes the practice of expert testimony and related witnessing as key sites of knowledge production in the human sciences, including the accompanying social relations of working with judges, attorneys, and respondents. It captures the political struggles undergirding contemporary asylum practices. Asylum traffics in immigrant death and persecution. Asylum seekers from Mexico and elsewhere must grapple with the deep suspicion that they are economically motivated immigrants rather than politically persecuted refugees. This entrenched imperial ideology is rapidly being supplanted by another that equates all immigration, regardless of motivation, with criminality.

UNITE THE TRIBES

Alex Shakar Associate

English

CAS



It has been remarked that music is a universal language. In these times of widening cultural chasms in America, might music still be our lingua franca? Or is this hope naïve: are our musics as divided as we are?

The idea that our music culture reflects our fracturing political, social, and economic lives, yet still perhaps offers some interconnection, makes possible Professor Shakar's new novel, *Unite the Tribes*. In it, the story of a mysterious singer on a genre-crossing music tour makes possible a revealing take on American geographies, cultural pockets, ideological wormholes, and little-known

crossroads. Readers who take the trip with the road novel's characters will have a perspective that inspires reflection upon the scars on our landscape and the contradictions within our myths. America's fraught history of cultural ascendancy, its commoditized media ecosystem, its "culture wars," and its tensions between individualism and solidarity are themes explored along the way. Threaded through the narrative is a meditation on tribal-ness, belonging, and social, cultural, and physical displacement.

TRACKING THE GRAVITATIONAL FOOTPRINTS OF DECOUPLED DARK SECTORS

Julia "Jessie" Shelton Fellow

Physics

An unknown, "dark" form of matter makes up a quarter of the energy in the present-day universe, five times more than the total contribution of everything made out of ordinary matter, and behaves gravitationally like a massive particle that does not interact with the forces that hold ordinary matter together. While the Standard Model of particle physics has been resoundingly successful at explaining the results of terrestrial experiments, it notoriously lacks any particle that could possibly account for this mysterious matter. Dark matter and the dynamics that produced it in the early universe are thus one of the biggest outstanding puzzles in particle physics.

Dark matter may easily and generically have its main interactions in the early universe with other related dark particles, now long gone from the present-day universe. In this case, when dark matter is part of a bigger dark sector thermally decoupled from ordinary matter, terrestrial experiments searching for dark matter will come up empty-handed. To deduce the particle physics of dark matter, it then becomes necessary to look to the cosmos to observe the gravitational imprint of dark sectors, beyond that of dark matter itself. Professor Shelton's proposed research will establish the gravitational footprints of a dark thermal plasma present in the hot and dense early universe. Such a plasma is a generic feature of self-interacting dark sectors, and thus these studies will apply to a broad and general class of dark matter theories, significantly advancing prospects for unraveling dark particle physics using its subtle gravitational footprints in the sky.

CENTER FOR ADVANCED STUDY: 1959-2019

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