Research, Information, and Academic Centers

The Arrighi Center for Global Studies

The Arrighi Center for Global Studies was established in 2012 as a transdisciplinary research center devoted to the study of urgent contemporary problems arising from processes of globalization. It expands upon the work done in the previous 40 years by the Institute for Global Studies in Culture, Power, and History and the Program in Atlantic History, Culture, and Society. The Center is named in memory of Giovanni Arrighi (1937-2009), former Director of the Institute for Global Studies and George Armstrong Kelly, Professor of Sociology.

The objective of the Center is to undertake a serious rethinking of dominant intellectual paradigms combined with rigorous empirical research on themes related to contemporary processes of globalization including financial crises, environmental sustainability, shifts in the geographical center of world-economic growth and political power, the crisis of welfare states and the rise of a politics of austerity, and the emergence of new forms of war, violence, and social conflict.

The Arrighi Center aims to serve as a hub for international collaboration between Hopkins faculty, graduate students, advanced undergraduate students, and counterparts from around the world, especially Asia, Africa, Latin America, and the Middle East. The Center carries out its mission through various activities including sponsoring research working groups; organizing seminar series, workshops, and mini-conferences; hosting post-doctoral fellows and visiting scholars from around the world; establishing partnerships with local civil society organizations working in the Center’s main areas of concern; and promoting transdisciplinary graduate and undergraduate training through collaborative research projects and curriculum development.

For more information visit http://arrighi.jhu.edu.

Biocalorimetry Center

The Biocalorimetry Center is dedicated to the development and application of new technologies aimed at measuring the energetics associated with protein interactions and the development of thermodynamic-based algorithms for drug design. The algorithms developed at the Center are widely acknowledged to be at the forefront of the available technologies for drug development.

During the last decade, extraordinary advances have been made in technologies for the structure determination of biological macromolecules. The structures of thousands of protein molecules have been determined at atomic resolution, opening the doors to new developments in our understanding of biological systems. Since all biochemical reactions, including the binding of pharmaceutical drugs to their targets, are controlled by their energetics, knowledge and manipulation of the energetics at the atomic level provides the researcher with an unprecedented degree of control over biological binding reactions. Having access to the overall and atomic-level partitioning of the binding energetics effectively accelerates the design of new and more effective drugs toward specific targets.

The research work at the Biocalorimetry Center involves the application of state-of-the-art microcalorimetric instrumentation to biological systems, the development of new computational algorithms for thermodynamic analysis, the development of molecular computation models aimed at dissecting the binding energetics of drug/protein interactions, and the development of thermodynamic based strategies for drug design and optimization. The Biocalorimetry Center collaborates with academic and pharmaceutical laboratories around the world.

Center for Astrophysical Sciences

The Center for Astrophysical Sciences (CAS) is an organization created at the Johns Hopkins University in 1985 to promote and coordinate the development of research in astrophysics and closely related sciences on the campus, with the goal of establishing the university as a world leader in the field. Its current director is Professor Timothy Heckman. Complementing the activities of the Space Telescope Science Institute, also on the university’s Homewood campus, CAS fosters a broad range of scientific activities in theoretical, experimental, and observational astrophysics and planetary space science.

Members of the center come primarily from the faculty and research staff of the university’s department of Physics and Astronomy. At present, the center has about a hundred members, engaged in a wide variety of research projects ranging from laboratory studies and spectroscopy of the Earth’s upper atmosphere to observational and theoretical investigations of the origin and destiny of the universe.

Hopkins is one of a small number of universities that builds and flies space instrumentation. Hopkins astronomers helped build the Faint Object Spectrograph for the Hubble Space Telescope (HST) and one of the two instruments (COSTAR) that corrected the spherical aberration in the HST’s primary mirror. They then used the corrected HST instruments to demonstrate the presence of a 2 billion solar mass black hole in the center of M87.

The Hopkins Ultraviolet Telescope (HUT) flew twice aboard the space shuttle, obtaining spectra of active galaxies, hot stars, supernova remnants, and planets. The most significant result obtained was the first measurement of the amount of ionized helium in the intergalactic medium. Ionized helium is an important tracer of the evolution of structure in the universe, and this measurement is the first hard constraint for current cosmological models.

From 1999 through 2007, CAS operated the Far Ultraviolet Spectroscopic Explorer (FUSE), a satellite for high-resolution spectroscopy. FUSE observed with much higher sensitivity and spectral resolution than HUT. Its primary scientific accomplishments were to measure the deuterium abundance in different environments throughout the galaxy, a key parameter in models of Big Bang cosmology, and to determine the distribution of hot gas in the interstellar medium of our own galaxy.

CAS led the development of the Advanced Camera for Surveys (ACS), which was launched aboard the space shuttle Columbia on March 1, 2002. A CAS team of scientists used ACS to study the evolution of galaxies and clusters of galaxies at high redshift, investigate Jupiter and Io, and discover planets and protoplanetary disks around nearby stars. ACS increased the discovery efficiency of the HST by a factor of 10 or more in the blue and the near infrared. ACS has been a major contributor in our expansion of knowledge about the universe.

The Wilkinson Microwave Anisotropy Probe (WMAP) was a major NASA mission led by CAS. WMAP’s observations of the subtle structures present in the cosmic microwave background (the universe at an age only 300,000 years after the Big Bang) have resoundingly substantiated
the Big Bang model and confirmed the existence of Dark Energy WMAP ushered in the era of "precision cosmology".

CAS was a major partner in the Galaxy Evolution Explorer (GALEX) satellite. GALEX surveyed the entire sky for stars, galaxies, and quasars that are bright in the ultraviolet. GALEX helped determine the history of star formation in galaxies at redshifts from 0 to 2, and identify one million quasars. The GALEX data archive is been developed and managed in a major part by JHU astronomers and computer scientists.

CAS’s NASA-supported sounding rocket program is one of only a small number of such programs nationwide. They offer students the opportunity to gain hands-on experience building payloads for sub-orbital rocket flights at White Sands, New Mexico.

CAS is involved in a number of ways with the JHU Applied Physics Lab (APL) in areas of space science and technology. Examples include the "New Horizons" mission to Pluto which is scheduled to arrive at Pluto in July 2015, and a project to develop the next generation of CMOS detectors that have application to both optical and X-ray astronomy.

CAS is also heavily engaged in major programs in ground-based astronomy, particularly those that involve large surveys. This involvement includes both the scientific exploitation of these surveys but also the development of the advanced data-mining tools that allow scientists to use these vast databases to make discoveries.

CAS plays a leading role in the Virtual Astronomical Observatory (VAO), which is uniting the astronomical databases of many earthbound and orbital observatories. This project is taking advantage of the latest computer technology, data storage, and analysis techniques to build the framework for the Virtual Observatory, a facility that will organize all available astronomy data and literature into a coherent whole, regardless of differences in data formats. The VO will be accessible by anyone, from anywhere on the Internet. The National Science Foundation, which has started this project with a five-year, $10 million Information Technology Research grant titled “Building the Framework of the National Virtual Observatory,” announces that this will “put the universe online." The system will provide an efficient synthesis of data over a wide range of wavelengths and time intervals, from many different observatories and instruments. It will open up new areas of research that are currently impractical or impossible.

The Virtual Observatory will provide a unique and powerful base for teaching astronomy, for demonstrating the process of scientific discovery to students and the public, and for sharing the benefits of new developments in information technology.

CAS is an active partner in the Sloan Digital Sky Survey (SDSS). CAS members served as the CEO and Program Manager of the SDSS project during its construction phase, built the two spectrographs for the 2.5-m SDSS telescope, and designed the data structure and software for the SDSS data archive. SDSS has surveyed one-quarter of the sky in five colors, providing the raw data from which a catalog of 100 million objects, associated photometric parameters, and postage stamp images has been produced; spectra have also been taken of 1 million galaxies and 100,000 quasars. These data have been to measure the structure of the universe and the formation and evolution of galaxies and black holes. The SDSS is currently undertaking a new survey of our Milky Way Galaxy, is also measuring the properties of Dark Energy, and is searching for planets orbiting other stars.

CAS is also a member of the Pan-STARRS1 project which built on the heritage of the SDSS by conducting a series of multicolor imaging surveys of the sky using the world’s most advanced astronomical

“gigapixel” camera and a widefield 1.8-m telescope in Hawaii. Pan-STARRS1 has opened the time domain to a wide range of scientific areas, including everything from the detection of near-Earth asteroids to the detection of extra-solar planets, to the determination of the cosmic evolution of Dark Energy. CAS members are playing leading roles in several of the science-driven key projects and are playing a key role in the development of the massive Pan-STARRS data archive.

CAS has joined the Subaru Prime Focus Spectrograph (PFS) project, which over the next several years will build a 3-channel spectrograph that will cover the full wavelength range from 380 to 1300 nm using 2400 robotically deployed fibers at the prime focus of the 8.2 meter Subaru Telescope at Mauna Kea. Over a five year program beginning in 2017 PFS will undertake a 300 night program that encompasses cosmology, galaxy evolution, and Galactic archaeology. PFS will be far and away the most powerful optical/near-IR spectrograph in the world for undertaking large surveys.

CAS is a member of the Large Synoptic Survey Telescope, recently endorsed as the highest-priority new large project in ground-based astronomy by the National Academy of Sciences decadal survey “New Worlds, New Horizons in Astronomy & Astrophysics”. CAS members served on both the main decadal survey panel and its program prioritization panel for Electromagnetic Observations from Space.

CAS is home to a major effort in experimental cosmology, focused primarily on observations of the cosmic microwave background (CMB). They have lead roles in the NSF-funded Cosmology Large Angular Scale Surveyor project, Atacama Cosmology Telescope, and the Atacama B-mode Search project.

Members of CAS also undertake a vibrant and wide-ranging program in theoretical and computational astrophysics with topics ranging from the formation and dynamics of planetary systems, to the properties of super-massive black holes, to the nature of dark energy.

Graduate students at JHU participate in all aspects of research within the center. Students at JHU, in calibrating optics and detectors for space instruments and then using data from these instruments for their thesis, are working at the forefront of observational astrophysics.

**Center for Imaging Science (CIS)**

The CIS was established in 1998 as a research center at The Johns Hopkins University, Whiting School of Engineering. The CIS brings together a diverse group of scientists whose work is highly interdisciplinary, revolves around the symbolic interpretation of high-dimensional data, and rests on theoretical advances in mathematics and statistics, traditional signal and systems processing, and information theory.

The director of CIS is Dr. Michael I. Miller. CIS faculty has their principal appointments across a wide range of academic units, including Computer Science (Greg Hager), Applied Mathematics and Statistics (Donald Geman, Bruno Jedynak, Carey Priebe, Laurent Younes), Electrical and Computer Engineering (John Goutsias), and Biomedical Engineering (Patrick Barta, Michael Miller, Tilak Ratnakar, Rene Vidal). More information about participating faculty and their research can be found at cis.jhu.edu.

**Research**: Researchers at CIS conduct foundational and multidisciplinary research in modern imaging science, which is viewed in very broad terms. The focus is on the development of the mathematical and algorithmic foundations of imaging science, including
image formation, analysis, representation, synthesis, and compression and especially image understanding including specific applications, for instance to neuropsychiatry and machine vision.

**Education:** The educational program at the CIS is embedded within the newly-created Institute for Computational Medicine, which offers a multi-year plan for a coherent, cross-departmental program of study in imaging science, accounting for necessary preparation in mathematics, computer science and classical signal and image processing.

**Technology Transfer:** The CIS faculty is also involved in student consulting, patent protection, software licensing and industrial collaboration. In addition, the CIS sponsors weekly seminars presented by researchers who are leaders in imaging.

Visit the Center for Imaging Science website for more information at cis.jhu.edu or contact Erika.Lance@jhu.edu.

**Center for Language and Speech Processing**

The Center for Language and Speech Processing (CLSP), housed in Hackerman Hall, was established in the Whiting School of Engineering in 1992. CLSP receives substantial support from the federal government to promote education and research in the science and technology of language and speech. Multidisciplinary in nature, the center has close ties to faculty in the Whiting School of Engineering, the Krieger School of Arts and Sciences, and the School of Medicine. CLSP also maintains relations with industrial, academic, and governmental organizations all over the world.

CLSP maintains a comprehensive research and education program leading to a Ph.D. degree. Research is conducted by faculty, and graduate students affiliated with five associated academic departments: Biomedical Engineering, Cognitive Science, Computer Science, Electrical and Computer Engineering, and Applied Mathematics and Statistics. The research involves work in all aspects of language and speech science and technology, with fundamental studies under way in areas such as language modeling, pronunciation modeling, natural language processing, machine translation, neural auditory processing, acoustic processing, optimality theory, and language acquisition. Graduate students interested in conducting research at the center must first be admitted to a graduate program in one of the departments associated with CLSP.

The center coordinates a full complement of courses dealing with language or speech science and technology, taking advantage of the latest biological, physiological, biomedical, psychological, cognitive, linguistic, mathematical, and engineering resources available. CLSP regularly updates the subject material and augments the course offerings to reflect the changing technology. As part of its educational mission, the center offers a wide range of lectures from prominent speakers throughout the academic year and organizes summer research workshops. Selected for their current achievements, expository ability, and lecture subjects, internationally known speakers present the seminars. The workshop is an intensive six-week research effort by CLSP affiliates and participants from other universities, industry, and the federal government.

CLSP serves as a centerpiece for world-class research at Johns Hopkins in speech and language processing. Visit the CLSP website for more information at clsp.jhu.edu.

**Center for Social Organization of Schools**

The Center for Social Organization of Schools (CSOS) is an educational research center at the School of Education, funded through federal grants from the Department of Education, National Institutes of Health and other agencies, as well as private foundations and organizations. The center has two primary objectives:

1. to develop scientific knowledge about how schools affect their students and
2. to use this knowledge to develop better school practices and organization.

The center focuses on K-12 programs in high-poverty, low-achieving schools throughout the country, especially the comprehensive Talent Development secondary reform model. The common objectives of the center’s programs are to apply scientific designs, measures, and methods to provide clear tests of the true impact of new educational approaches and to provide empirical evidence on how to improve the education of students in high-poverty schools.

CSOS also includes the Center on School, Family, and Community Partnerships. The mission of this center is to conduct and disseminate research, development, and policy analyses that produce new and useful knowledge and practices that help families, educators, and members of communities to work together to improve schools, strengthen families, and increase student success. Major projects include the National Network of Partnership Schools, which includes schools, districts, and state educational agencies that are working to develop partnerships.

Work at the center maintains a balance among basic research, studies of specific problems in schools, and development of useful products and information for school use. The Talent Development secondary implementation center works with more than 50 middle and high schools across the country, providing professional development, curriculum materials, and school organization assistance, as well as the broader services of school transformation plans.

In partnership with the Baltimore City Public Schools, CSOS opened the Baltimore Talent Development High School in September 2004 with approximately 150 ninth-graders. The school graduated its first class in 2008 with a graduation rate of more than 80 percent.

Curriculum developers continue to develop social studies, math, and language/literature materials for both middle and high school courses used by many schools across the country. A new social and study skills course, Mastering Middle Grades, addresses issues that keep adolescents from adjusting to, and succeeding in, grades 6-8.

The center’s research serves a variety of audiences: scientists in the sociology of education and the social psychology of the learning process, education policymakers, and state and local education personnel all the way into the classroom.

CSOS also houses The Baltimore Education Research Consortium (BERC), a partnership of Johns Hopkins, Morgan State University and Baltimore City Public Schools (baltimore-berc.org) and the Everyone Graduates Center (every1graduates.org). BERC’s purpose is to coordinate and disseminate long- and short-term data analysis and research to help Baltimore students and their families. The Everyone Graduates Center brings together the research and best practices of all programs at CSOS, in an attempt to identify and eliminate the hurdles that keep
students from graduating from high school ready for college, career training and a productive civic life.

CSOS is also home to Diplomas Now (http://www.diplomasnow.org) a new collaboration that helps the toughest middle and high schools in America’s largest cities ensure that every student graduates ready for college or career. Diplomas Now is a partnership among Talent Development, City Year and Communities In Schools; it is the first fully integrated approach to improving a school’s curriculum and instruction, while providing the right students with the right support at the right time.

In 2010, Diplomas Now won a federal Investing in Innovation grant to expand this program to 60 more schools in the next four years. In 2012-2013, Diplomas Now worked in more than 40 schools in 12 cities.

Center for Talented Youth
A global leader in gifted education, The Johns Hopkins University Center for Talented Youth (CTY) identifies and develops the talents of the most advanced precollege learners worldwide. As part of Johns Hopkins, CTY helps fulfill the university’s mission of preparing students to make significant future contributions to our world.

CTY was founded in 1979 by Dr. Julian Stanley, then professor of psychology at Johns Hopkins, based on his pioneering work from 1971 onward with precocious middle school students. His work built the foundation for the Talent Search model, which uses above-level testing to identify students whose abilities can benefit from the additional challenge and intensity of CTY’s summer programs (9,450 enrollments in 2012) and CTY Online courses (12,800 enrollments in 2012). Rounding out the Center’s services are family learning programs, a magazine for gifted students, specialized testing, college counseling, and services to profoundly gifted young people offered through the Study of Exceptional Talent (SET).

CTY makes special efforts to recruit and serve top students from groups historically underrepresented in gifted programs. The Center also carries out research to inform and improve education for advanced learners. More recently, CTY’s approach is being adopted in countries around the world. CTY has a main office located in Baltimore and a regional office in Los Angeles.

Chemical Propulsion Information Analysis Center
The Chemical Propulsion Information Analysis Center (CPIAC), continuously operated by The Johns Hopkins University since 1946, is a full-service Department of Defense (DoD) information analysis center in the fields of missile, space, and gun propulsion technologies. The mission of the CPIAC is to serve as the U.S. national clearinghouse for worldwide information, data, and analysis on chemical, electrical, and nuclear propulsion for missile, space, and gun propulsion systems. The CPIAC library contains over 115,000 documents dating from the 1930s.

The technical scope involves collection, analysis, synthesis, and dissemination of scientific and technical information to support research, development, technology, engineering, acquisition, logistics, and maintenance activities carried out by the DoD and their contractors, and appropriate international organizations.

The products and services provided by the CPIAC are thorough, unbiased, and referenced propulsion information and data for the propulsion community in the form of literature and data compilations, technical inquiry responses, technology assessments, publications, propulsion manuals, computer codes, web-based databases, and technical and administrative support of the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee and its 11 subcommittees.

A third function of the CPIAC is to perform technical area tasks (TATs) relevant to our core mission. TATs are analytical and technical in nature and are separately sponsored and funded.

Institute for Biophysical Research
The Institute for Biophysical Research was established in 1988. It spans two campuses and includes researchers from four schools. Its mission is focused on collaborative efforts and training in integrative biophysics.

Since its inception, the institute has been interdisciplinary and includes an affiliated NIH predoctoral program (Program in Molecular Biophysics). Associated activities include an annual retreat where groups present their latest work and a well-attended monthly ‘Chalk it Up to Biophysics’ seminar series.

The Institute for Computational Medicine
The Institute for Computational Medicine (ICM) was launched in 2005. The mission of the ICM is to develop quantitative models of human disease, and to apply these models to improve individualized health care. The Institute is based in Hackerman Hall, and consists of one other affiliated center—The Center for Imaging Science. Research is focused in three broad areas. Computational Molecular Medicine is developing new methods for statistical modeling of molecular networks in health and disease, and for discovery of new network-based disease biomarkers. Computational Physiological Medicine is improving the understanding and treatment of disease through development of dynamical systems models. Current research areas are integrative modeling of heart disease to develop improved therapies for preventing life-threatening arrhythmias, systems-level modeling of neuronal networks and their application to develop new therapies for treating motor and seizure disorders, and computational modeling of the microvasculature, the process of angiogenesis, and individualized treatments in cancer. Research in the area of Computational Anatomy is directed at mathematical characterization and computational analysis of anatomic shape and structure, and its variation in health and disease. These methods are being used to identify structural changes in the brain that are early anatomic biomarkers of different neuro-developmental and neuro-psychiatric diseases. Each of these research areas brings together teams of ICM researchers, clinicians, and clinician-scientists to advance individualized medicine.

Institute for Policy Studies
Public Policy, M.P.P. has moved to the Bloomberg School of Public Health, Department of Health Policy and Management. For more information, please visit jhsphealth.jhsphs.edu/academics/degree-programs/ (http://www.jhsphs.edu/academics/degree-programs) or contact Dr. Carey Borkoski, Assistant Director at ccborkoski@jhu.edu .

The Integrated Imaging Center
The Integrated Imaging Center (IIC, jhu.edu/iic ), established in 1998, is a Homewood campus microscopy and imaging resource serving the diverse research needs of the Whiting School of Engineering and the Krieger School of Arts & Sciences. It is variously located in Dunning and Olin Halls on the Johns Hopkins University Homewood campus; and it is
a close partner with the Institute for NanoBioTechnology. Additionally, it also houses the imaging core for the Engineering in Oncology Center; the Homewood Flow-Cytometry Resource; and the High-Resolution Analytical Electron Microbeam Facility.

As rapid advances have been made in the development of new techniques for cellular, environmental, and materials imaging, the visualization of molecules and proteins at the light and electron microscopic level has become an essential component of any comprehensive study of the natural and engineering sciences. This is because cutting-edge microscopy can provide detailed information on the relative distribution/relationship of molecules within cells and materials that cannot be obtained by any other method. Accordingly, microscopy not only complements but greatly extends the results obtained by other approaches such as biochemical, immunochemical, and analytical methods. Such state-of-the-art tools and methodologies employed regularly by the IIC include fluorescence and laser scanning confocal microscopy; scanning and transmission electron microscopy, cryoTEM, fluorescence correlation spectroscopy, phosphorimaging, and energy dispersive and electron energy loss spectroscopy.

The Center has become an essential partner in numerous research projects with investigators at Hopkins, as well as with other researchers at institutions nationally and internationally. Moreover, the IIC offers both undergraduate and graduate courses in microscopy (as well as regular workshops) as a means of providing to the JHU community training and exposure to the latest, most advanced microscopy techniques, emphasizing the cooperative integration of these techniques with other biological/engineering research tools.

Maryland Space Grant Consortium

Established in 1989, the National Space Grant College and Fellowship Program now consists of 52 partnerships (one in every state, plus the District of Columbia and Puerto Rico) funded by NASA to encourage cooperative university, government, and industry interdisciplinary research, training, and public service aerospace programs; to promote science, mathematics, and technology education; and to recruit and train women and minorities for aerospace careers. One of the partnerships is Maryland Space Grant Consortium. Its membership of ten institutions includes The Johns Hopkins University (Lead Institution) and the JHU Applied Physics Laboratory.

Maryland Space Grant Consortium offers a constantly changing variety of programs. The Earth/Space Science teacher certificate Program for Elementary and Secondary Mathematics and Science Teachers offers training consisting of graduate courses in Earth and space science. The Outreach Programs include a Balloon Payload Program, where students launch payloads to near space on weather balloons.

Undergraduate scholarships and graduate fellowships are provided from NASA and consortium funds for selected students pursuing studies in the space-related subjects. Small amounts of funding for research activities are also available in cases where the proposed research involves students, females, and/or underrepresented minorities, and more than one member institution. To find out more, visit md.spacegrant.org/ (http://www.md.spacegrant.org).

Materials Research Science and Engineering Center (MRSEC)

Nanostructured materials with nanometer-scale entities have created a new area of materials research and made possible device applications that depend on the physical dimensions and intricate structures of these materials. In recent years, magnetic nanostructures have provided some of the most exciting areas for the exploration of new physical phenomena and new technologically important devices such as spin-valve giant magnetoresistance read heads, and magnetic random access memory (MRAM).

The Materials Research Science and Engineering Center (MRSEC) at the Johns Hopkins University (JHU), one of 26 MRSECs funded by the National Science Foundation, is composed of scientists at JHU, Brown University, Carnegie Mellon University, and the National Institute of Standards and Technology (NIST). Research in the center focuses on the science and engineering of magneto electronics. Research areas include:

- Perpendicular spin transport in magnetic tunnel junctions.
- Magnetic nanorings and other novel device architectures.
- Materials with perpendicular magnetic anisotropy
- Spin transfer torque effects
- Organic magnetoelectronic materials.
- Explorations of magnetoelectronic effects in lateral structures.

The research effort encompasses synthesis and processing, characterization of nanostructures, measurements of properties, theoretical modeling, and prototype device fabrication and applications. These five tightly linked components form the research basis of this MRSEC.

The JHU MRSEC also has extensive Education Outreach programs and extensive collaborations with other academic institutions, national labs, and industrial concerns.