Proposal:
Supporting Complexity Theory Research in Cuba

Sponsors and participants:
Friends of Havana's January Complexity Seminars
Washington, D.C. USA

Institute for Analytic Journalism
Santa Fe, New Mexico USA

Colegio Mayor Universitario de San Gerónimo
La Habana, Cuba

Cátedra of Complexity of the Instituto de Filosofía
La Habana, Cuba

Cátedra of Complexity of the University of Camagüey
Camagüey, Cuba

Cátedra of Complexity of the Camagüey Branch
of the Higher Institute of Art
Camagüey, Cuba

Center of Medicine and Complexity
"Carlos J. Finlay" Medical University of Camagüey
Camagüey, Cuba

Cátedra of Complexity Studies
University of Holguín
Holguín, Cuba

Cátedra of Complexity Henri Poincare
Physics Department
Universidad de La Habana
La Habana, Cuba

Contact:
Alicia Juarrero
Friends of Havana's January Complexity Seminars
Washington, D.C. 20007-2019
ajuarrero@friendsofcomplexitytheoryincuba.org
202-342-6128 or 202-669-7343

Tom Johnson
Institute for Analytic Journalism
Santa Fe, New Mexico
tom@jtjohnson.com
505-577-6482 or 505-473-9646

Executive Summary

- Complexity Theory, Complex Adaptive Systems and Agent-Based Modeling may well have the impact on the social sciences of the 21st century that quantum mechanics did on the hard sciences in the 20th century.

- Scholars in Cuba and throughout Latin America have an extremely broad and deep knowledge of the *theory* of Complexity Studies and Complex Adaptive Systems, but there is little tradition of coupling that theory with computer-driven data collection and simulation modeling. Historically, this is a result of insufficient computing resources – both hardware and software – and lagging access to high-speed Internet connections.

- Santa Fe, New Mexico is the home of the Santa Fe Institute, the "mother church" of Complexity Theory, research and applications. The presence of The Institute has produced an emergent community of independent researchers and practitioners who are building on Complexity Theory by using computer simulation programs — notably Netlogo — to understand a variety of phenomena ranging from how cases pass through the legal system in Alameda County, California, to the movement of boat traffic on the canals of Venice. They are studying how to best evacuate a city in the event of natural disasters such as forest fires and hurricanes or understanding the spread of disease in a population. (For examples, see http://www.redfish.com/projects/index.html)

- The recently inaugurated Colegio Mayor Universitario de San Gerónimo, located behind Havana's historic Plaza de Armas, on the site of the original campus of the Cuba's first university, was created with the explicit purpose of serving as a "beautiful symbol of the universalization of learning," in the words of its director, Eusebio Leal. The modern structure is equipped with classrooms with the necessary IT connectivity to support state-of-the-art research, but lacks the actual IT equipment.

We seek funding for the following projects (costs exclude shipping of equipment):

• To support a team of seven scholars and researchers from the U.S. – along with two high school students from New Mexico – traveling to Camagüey, Cuba in February 2008. There, they will conduct and participate in various workshops teaching "applied complexity simulation modeling" to their Cuban and Latin American colleagues also attending the III Biennial International Trans-disciplinary Workshop on Complexity.	$30,847
• To support the making of a video documentary on the rise of "Complexity Theory studies in Cuba." The filmmakers will follow the creation, preparation, travel and interactions of the Santa Fe Complexity Team with their Cuban and Latin American colleagues.	$30,000
• To equip a "complexity classroom" at the Colegio Mayor Universitario San Gerónimo.	$13,760
• To support travel by four Chairs of Complexity Theory in Cuba to attend Congreso Internacional Pensamiento Complejo, Hermosillo, México 21-24 October, 2008 Cost: $838.41 per person	$3,354
• To support travel by 4 Cuban biologists and ecology scholars invited to speak on complexity and biology at the in the International Congress of Systematic and Evolutionary Biology (ICSEB), Veracruz, Mexico, 5-10 July, 2009 Cost: $589 per person	$2,356
Total funding sought	**$80,317**

Background on Complexity in Cuba

During the past eight years, the academic research community in Cuba has demonstrated remarkable interest in non-linear, far-from-equilibrium dynamic systems theory. After fellows at Havana's Instituto de Filosofía began studying the philosophical implications of this new science in 2000, scholars from disparate disciplines throughout the island — physicists and physicians, linguists and ecologists, philosophers and sociologists — began to conduct research from the perspective of this new theoretical approach pioneered by Nobel Laureate Ilya Prigogine during the second half of the 20th century and subsequently greatly enriched by the collaborative work at the Santa Fe Institute (www.santafe.edu).

This new scientific focus is often also called Complexity Theory. Its subject matter is open systems with emergent properties, that is, systems that exchange matter and energy with their environment and that are composed of interconnected parts. Taken as a whole, these systems exhibit properties and behaviors that could not have been deduced from the properties of the component parts or the system's initial state. Complex systems are also systems which, once they self-organize from the bottom-up, are characterized by their distributed and evolutionary nature, as opposed to top-down and centralized-control hierarchies.

Of particular interest is the subset called Complex Adaptive Systems, which as the name implies, are "adaptive in that they have the capacity to change and learn from experience." Examples of complex adaptive systems include the stock market, social insect and ant colonies, the biosphere and the ecosystem, the brain and the immune system, the cell and the developing embryos, manufacturing businesses and any human social group-based endeavor in a cultural and social system such as political parties or communities. Complex systems are studied by many areas of natural science, mathematics, and social science. Fields that specialize in the interdisciplinary study of complex systems include systems theory, complexity theory, systems ecology, and cybernetics.

To date, eight cátedrae (or research centers) of Complexity Studies have been officially recognized by Cuba's Academy of Sciences. Housed at research and even cultural centers throughout the island, from the city of Holguín in Cuba's easternmost province to Havana in the west, their combined effort is truly interdisciplinary. Havana's cátedra (www.complexity-cuba.org) is dedicated to the philosophical implications of complexity theory; its board is unique in the interdisciplinary background of its members; another cátedra studies the physics of Complexity Theory (www.complexperiments.net). And affiliated groups such as one on Complexity and Language are also self-organizing and beginning to collaborate with the established cátedra with which they are affiliated.

Havana's Cátedra of Complexity Studies, the first on the island, offers annual post-graduate courses in Complexity Theory (enrollment grew from 75 per year in 2001 to over 200 at present), a *Diplomate* (intermediate between a bachelor's and a master's degree), mini-courses and workshops, and the well-attended International Biennial Seminar, which drew capacity audiences in 2002, 2004, 2006 and 2008, with increasing participation by Cuban nationals. *Complejidad 2002*, the first of the four held to date, was trailblazing in that the call for papers was published and disseminated online. This procedure has been followed in all subsequent conferences, with great success. *Complejidad 2006* included workshops on Complexity in Biological Systems, Complexity, Art & Aesthetics, and Complexity in Physics. Parallel symposia focusing on Complex Educational Systems, Complex Environmental Systems, and Complexity and Organizations rounded out a full program. *Complejidad 2008* (www.friendsfocomplexitytheoryincuba.org/activities) also included workshops on Complexity and Organizations, and on Complexity and Language.

Three cátedrae have been formed in Camagüey province alone where, arguably, knowledge of Complexity Theory predates that of the other jurisdictions. The most dynamic of these camagüeyana cátedrae is the Centro de Medicina y Complejidad, attached to the Carlos J.

Finlay Instituto Superior de Ciencia Médica, and dedicated to studying problems at the interface between complexity and medicine. (See www.complejidad-camaguey.org). With meager resources, its young board members – also from interdisciplinary backgrounds and structured, like its subject matter, in decentralized fashion – have in a very short period of time compiled an impressive list of publications, as have their counterparts at Havana's Poincaré Chair of Complexity Studies, housed in the University of Havana's Physics Department (See www.complexperiments.net.)

Thanks to the efforts of American scholars who attended *Complejidad 2002*, Havana's Cátedra at the Instituto de Filosofía began assembling a small library with about 125 books on Complexity Theory donated for the most part by MIT Press and Editorial Tusquets in Barcelona. Because scholars on the rest of the island are in desperate need of resources in order to carry out their academic work, ***Friends of Havana's January Complexity Seminars***, a 501c3 non-profit association was established in 2006 to support this effort (see www.friendsofcomplexitytheoryincuba.org). In furtherance of these organization goals, *Friends* applied for and received OFAC licenses authorizing travel to the island for purposes of delivering these informational materials.

Until recently, donations had been limited to informational materials on theoretical and applied topics directly related to far-from equilibrium, non-linear, dynamical systems theory, chaos and catastrophe theory, and self-organization and complexity theory, or on related subjects from mathematics and physics such as non-linear time series analysis, network theory, etc., After November, 2007, and in response to specific requests from Cuban scholars, books on social science applications of Complexity Theory were purchased and delivered in January, 2008.

To date a total of more than $5,000 in books and informational materials have been successfully delivered to complexity scholars on the island.

Since by law United States entities are also allowed to defray publishing costs of fully completed manuscripts, *Friends* is also charged with investigating completed manuscripts in the field of Complexity Studies for publication. **CubaLibri,** the publishing arm of *Friends,* recently released the text and CD version of a major, 600+ page tome, *Archipiélago cubano: biogeografía histórica y complejidad* by Jorge L. Fontenla and Antonio López, active members of Havana's Cátedra de Complejidad since its inception. Another significant work, a *Cuban Atlas of (Linguistic) Entonation*, awaits funding.

Future Activities:

The most pressing needs now are (1) increased exposure to and training in computer-based modeling of complex dynamical systems, (2) a well-equipped space where scholars of Complexity Theory can meet and work on ongoing projects, and (3) increased exposure to international scholarship in complexity theory.

To that end *Friends of Havana's January Complexity Seminars* and the Institute for Analytic Journalism are involved in the following projects:

PROPOSED PROJECTS:

I. Camagüey Workshop in Complexity and Agent-Based Modeling

Complex systems such as epidemics must be modeled using tools and techniques appropriate to complex systems, not the tools and techniques based on linear models that were once used for that purpose.

"**StarLogo** is an agent-based simulation language developed by Mitchel Resnick, Eric Klopfer, and others at MIT Media Lab and MIT Teacher Education Program. It is an extension of the Logo programming language, a dialect of Lisp. Designed for education, StarLogo can be used by students to model the behavior of decentralized systems."

"**Netlogo**" was first created in 1999 by Uri Wilensky at the Center for Connected Learning and Computer-Based Modeling, then at Tufts University in the Boston area. NetLogo grew out of StarLogoT, which was authored by Wilensky in 1997. In 2000, the CCL moved to Northwestern University. NetLogo 1.0 came out in 2002, 2.0 in 2003, 3.0 in 2005, and 4.0 in 2007."

We propose to take a team of seven senior researchers and scholars highly skilled in using and teaching simulation modeling to the III Biennial International Trans-disciplinary Workshop on Complexity in Camagüey, Cuba, February 24-27, 2009. We expect approximately 75 Cuban participants and and additional 125 scholars and researchers from throughout Latin America. The Santa Fe team will conduct hands-on workshops on how to use Netlogo to model issues related to public health, education, response to natural disasters and transportation planning. Additionally, the team will include two bi-lingual high school students who have demonstrated unusual skills in programming with Starlogo, a more elementary simulation modeling program. The student will work with their Cuban peers.

We estimate that the inclusive cost of the trip will be approximately $3,400 per person. Consequently, we are seeking to raise a total of $30,847 to fund this educational and scientific effort.

II. Documentary on the Rise of Complexity Theory in Cuba

The rise of Complexity Theory in Cuba is noteworthy for many reasons, not the least of which is that it has brought together scholars from various disciplines into an interdisciplinary collaboration. That is something so unprecedented in Cuba that at least one master's thesis in sociology is currently being written on the origin and explosive growth of Complexity Studies on the island. A video documentary on what some in Cuba are saying has become a "movement," would record and preserve for posterity the social and intellectual sources of this remarkable interest group along with our efforts to unshackle scholarly exploration long restrained by government policies.

Dr. Ben Daitz – professor emeritus of family medicine at the University of New Mexico, a practicing physician, and a veteran filmmaker – has agreed to produce and direct the 30-

minute documentary on the Santa Fe team's preparations, trip and intellectual exchange in Cuba. Dr. Daitz is uniquely qualified for this task: he is fluent in Spanish, has worked in community & public health his entire career, and embodies a unique combination of medical scientist and creative filmmaker. Dr. Daitz' films have won numerous national awards, and his most recent film about children with disabilities was aired nationally on PBS. "Whose Home on the Range?", a film about environmental conflict, is distributed by Bullfrog Films (www.bullfrogfilms.com/about.html), the oldest and most respected publisher of videos and films about the environment in the United States .

Dr. Daitz has agreed to produce the documentary largely pro bono, needing only financing for travel, hiring two crew members (ideally, Cubans), filming, and post-production expenses. We estimate these expenses to total $30,000 for a 30-minute video suitable for broadcast on PBS TV. (A detailed budget can be provided on request.)

III. "Aula de Complejidad"[1] at the Colegio Mayor Universitario de San Gerónimo, La Habana

Because Cuban scholars in Complexity Theory must of necessity travel to the capital several times a year to meet with advisors and colleagues, obtain requisite permits and licenses and authorizations, conduct bibliographic and archival research, etc., Havana can be expected to continue to be the center of administration and organization of research in Complexity Studies in Cuba.

For the last eight years, the task of coordinating the explosive growth and work of the various cátedrae of complexity (now numbering eight) has fallen to the Chair of Complexity Studies at Havana's Instituto de Filosofíia, currently located on Calle Calzada # 152 esq J., Vedado. However, after Hurricane Mitch damaged much of the Instituto, the Chair of Complexity Studies was forced to do most of the work from his personal residence in La Víbora, using only an old 256MB desktop computer, a printer with a ribbon cartridge, no working fax or copying machine, etc.

The current level of interest in Complexity Studies throughout the island, combined with the fact that the building housing the Instituto de Filosofía is scheduled to undergo major structural repairs beginning in Fall, 2008, means that present working conditions are unsustainable. The eight cátedrae of Complexity Studies are in immediate need of a new and better-equipped home.

To that end, representatives of the eight cátedrae have approached Dr. Eusebio Leal with the request for an "Aula de la Complejidad," a classroom dedicated to Complexity Theory research and located in the recently inaugurated Colegio Mayor Universitario de San Gerónimo, a new institution in a brand new structure behind the Plaza de Armas on the site of the first campus of the University of Havana. The classroom will be used by Cuban scholars in Complexity Theory for collaborative research, as a meeting place that will double as a bibliographic repository, and as a centralized location from which to coordinate and support the other complexity cátedrae throughout the island.

We seek funding to furnish such a classroom at the San Gerónimo with the equipment necessary to allow researchers in Complexity Theory to work collaboratively to conduct simulations and computer modeling, scholarly research; host lectures and small meetings; etc. The estimated cost of the equipment necessary to furnish an "aula de complejidad" is $13,760. *Friends of Havana's January Complexity Seminars* can provide a detailed budget breakdown.

IV. Cuban scholars' travel to International Conferences

Cuban scholars must update their knowledge and understanding of Complexity Theory. To that end, attending international conferences where they can interact with other scholars in the

[1] "Aula de Complejidad" is a "Complexity Classroom" or laboratory.

field, present and receive invaluable feedback on their own research, and be exposed to the research of their colleagues, is indispensable.

I. After Professor Edgar Morin, one of the founders of French scholarship in Complexity Theory, addressed *Complejidad 2006*, collaboration between Cuban scholars in Complexity and Edgar Morin has been vigorous and fruitful. Organizers of Congreso Internacional Pensamiento Complejo, to be held in Hermosillo, Mexico, October 2008, have invited the various chairs of complexity cátedrae throughout the island to attend. We expect Congress organizers to waive registration fees for Cuban scholars, and provide assistance with their lodging/meals during their stay in Hermosillo.

Plane fare, however (HAV-Hermosillo) for 4 Chairs of Complexity Theory is estimated at US $838.41 per person for a total of $3,353.64.

II. As a consequence of the many Latin Americans who attended *Complejidad 2002, 2004, 2006 and 2008*, the work of Cuban scholars in Complexity Theory has begun to attract the attention of academics throughout Latin America.

Organizers of the International Congress of Systematic and Evolutionary Biology (ICSEB), to be held in Veracruz, Mexico, 5-10 July, 2009, have requested that a panel composed of biologists and ecologists from Cuba present their research at their upcoming meeting next year, the 150 anniversary of the publication of Darwin's Origin of Species and of Alexander Humboldt's death. (Humboldt is quite well-known in Cuba for his visit in 1800.) ICSEB organizers will waive the Congress's registration fee for Cuban scholars, and will assist with arranging lodging and meals during their stay in Veracruz.

Plane fare, however (HAV-Veracruz) for 4 Cuban biologists/ecologists is estimated at US$589 per person, for a total of $2356.

Caveats:

We have some qualifications regarding our proposal and grant requests:

- Financial contributions will not be accepted from <u>any</u> federal or state government or governmental agency.
- Contributions shall be made to the "Friends of Havana's January Complexity Seminars," a 501c3 organization, or to "The Santa Fe Complex," an organization currently applying for 501c3 non-profit tax status. Donations supporting Santa Fe's "Complexity in Camagüey" team responsible for the Camaguey Workshop and the "Complexity in Cuba" documentary film will be passed to the Institute for Analytic Journalism, the designated project coordinator and responsible agency.
- Travel policies of both the U.S. and Cuban governments are rarely predictable or consistent. In the event that the team of scholars and researchers from the United States cannot get formal invitations or visas from the Cuban government or permission from the U.S. government to attend the 2009 meeting in Camagüey, we shall ask donors to bear with us for 12 more months. During that time, all funds shall be held in escrow in the hope that there will be change in the political winds and the team can attend the Biennial Complexity Seminar in Havana scheduled for January 2010. If we cannot get permission to attend that congress, then all contributions shall be returned to the donor(s).

We believe that past educational and humanitarian activities related to Cuba are necessary and of great value. But we also believe what we are proposing constitutes the beginning of a significant investment in Cuba's future in terms of scholarship and, ultimately, positive relations with colleagues in many nations.