

CALENDAR

SEPTEMBER 13-16, 2006
VIÑA DEL MAR, CHILE

Southern Workshop on Granular Materials, partially supported by the Consortium, stressing the physics, mathematics and engineering of sand and related matter. <http://www.dfi.uchile.cl/~granular06/>

NOVEMBER 27-30, 2006
PUCÓN, CHILE

Quantum Optics III: a forum to discuss recent developments in quantum optics and quantum information with topics such as nonlinear optics, atom optics, laser cooling, cold atoms, Bose-Einstein condensates, quantum interference, and quantum information processing. Sponsored by the Consortium of the Americas, Universidad de Concepción, Universidad de Santiago, Pontificia Universidad Católica, Universidad Católica Del Norte, Centro Latinoamericano de Física, and Iniciativa Científica Milenio. <http://quantum-optics.cfm.cl/>

JANUARY 9-12, 2007
TAXCO, GUERRERO, MÉXICO

XXXVI Winter Meeting on Statistical Physics will bring together international, qualified experts from different research groups to discuss problems in basic statistical physics and its applications to technological, chemical and biological research. <http://paginas.fisica.uson.mx/winter/>

CALLING JUNIOR USA SCIENTISTS!

**We are interested in helping provide
international experience in Latin America
to junior scientists and students
from the USA.**

**We have resources for this purpose,
a network of contacts – particularly in
Argentina, Brasil, Chile, and México –
and strong encouragement by the
International Division of the NSF.**

Contact us immediately if interested.



1 University of New Mexico
MSC07 4220
Albuquerque, NM 87131-0001



Consortium of the Americas
for Interdisciplinary Science

DIRECTOR OF THE CONSORTIUM

Professor V. M. (Nitant) Kenkre
(505) 277-4846
kenkre@unm.edu

ASSISTANT TO THE DIRECTOR

Adriana Recalde
(505) 277-0848
adrirec@as.unm.edu

800 Yale Blvd NE
University of New Mexico
Albuquerque, NM 87131
USA

**RECENT VISITORS
TO THE CONSORTIUM**

- * Maximino Aldana (México)
- * Gloria Buendia (Venezuela)
- * Julián Candia (Argentina)
- * Ana Tereza Costa Silva (Brasil)
- * Mario Cosenza (Venezuela)
- * Victor Dossetti (México)
- * Karina Mazzitello (Argentina)
- * Paul Parris (USA)
- * Alexandre Rosas (Brasil)
- * Francisco Sevilla (México)

VISIT OUR WEBPAGE AT:
<http://consortium.unm.edu>

NEWSLETTER EDITOR:

Stephanie Martin
smartin@unm.edu



**SEPTEMBER 15, 2006
VOLUME I, ISSUE 8**

A Center of the College
of Arts and Sciences
University of New Mexico



CONSORTIUM NEWS

MESSAGE FROM THE DIRECTOR

The Consortium recently arranged two events, one on July 20 to gather ideas about ways and means of encouraging more USA junior scientists to spend time in Latin America in order to acquire international experience in a scientific context, and another on August 18 to explore avenues of collaborative research between social scientists on the one hand and physicists/mathematicians on the other. Both were highly successful and have generated a great deal of discussion and planned activities for the future. The July 20 event was attended by a number of faculty members from New Mexico universities and representatives of other institutions such as the Santa Fe Institute, and UNM administrators such as Vera Norwood, Dean of UNM's College of Arts and Sciences and Paul Nathanson, UNM's Associate Provost in charge of international affairs.

The August 18 event, organized by the Consortium in collaboration with the Office of Policy, Security and Technology, consisted of a short but directed meeting of social and physical scientists. The goal of the meeting was a discussion of aims and methods of the social sciences and of the question whether theoretical tools of the physical scientists do or do not have the potential to be useful in investigations of social dynamics. The meeting was attended by over 30 scientists with varying backgrounds. They included, among the social scientists, UNM Professors Andrew Ross, John Roberts, Andrew Schrank, Bert Useem, Catherine Krause, and Christopher Butler.

During the event, a questionnaire was put forward, initiated by physicists, through which requests were made of sociologists. The questions addressed the nature of research problems in social sciences, the graduate curriculum, the use of computer simulations in social sciences research, and the extent of a quantitative element in the approaches used. A discussion was also initiated about the value of the concept of "phase transitions" in the social sciences, a concept that is very common and highly relevant in physics. (For instance, do wars represent phase transitions?) Network theory and the role of external influences, such as media, on a society were also discussed briefly.

Surely, there have been many activities, in places such as the Santa Fe Institute and elsewhere, centered on such queries but this Consortium-OPST event initiated an in-house interactive discussion on these issues at UNM.

As a result of the event, there have been regular meetings between professors in political science, other social sciences, and physics. Talks have been scheduled starting with "Sociology for Non-Sociologists" given at the Consortium by Professor Andrew Schrank already. Discussions are going on about whether there can be observations in the social sciences quantitative enough to justify physics type approaches. There are plans at the Consortium to invite expert scientists at the Santa Fe Institute and at Los Alamos working on these issues. Perhaps fruitful collaborations will develop. We have to wait and see.

— V. M. Kenkre, September 15, 2006

A JOURNEY ACROSS COMPLEX NETWORKS AND INTERDISCIPLINARY PHYSICS

JULIÁN CANDIA

I joined the Consortium six months ago, as a Latin American visitor, with the aim of exchanging ideas on complex network theory and related topics. Taking advantage of the opportunity to contribute to the Consortium newsletter, I would like to share here my recent experiences in complex networks and interdisciplinary physics, as well as some promising prospective research. Although just a very limited and personal recollection of ideas and experiences, I hope that my scientific journey will stimulate in the reader a curiosity about and interest in these truly exciting fields of current research.

I got in closer contact with the topic of complex networks last year, during a conference held at the Abdus Salam ICTP in Trieste (Italy). Still a High Energy theoretician, I was working as a postdoctoral researcher there, but I used to greatly benefit from the hectic activity going on in terms of schools, workshops and conferences on many different areas. My curiosity was aroused when I heard of the ubiquity

See **JOURNEY** Page 2

JOURNEY from Page 1

and universal properties of complex networks. Many recent empirical observations, which were performed on real networks as different as the Internet and the World Wide Web, ecological and food webs, power grids and electronic circuits, genome and metabolic reactions, collaboration among scientists and among Hollywood actors, and many others, have shown some striking similarities in their structure and topology. For instance, the existence of hubs, a small number of nodes that monopolize the vast majority of the network links, is a common feature of all these types of networks. Think of the few web pages we all know (and connect to) as an everyday matter, and the hundreds of millions of unknown web pages. Or, looking at the network of movie actors, compare the role of the world famous stars with the overwhelmingly more numerous villains, extras and stuntpeople who just scratch glory with a few minutes (or even seconds!) of fame.

In passing, note that complex networks offer what is perhaps the unique point in common between scientists and Hollywood actors. We should be glad indeed that, despite lacking their fame and money, the citation and collaboration networks we form resemble the casting networks of the celebrities!

Going much beyond these simple analogies, physicists have devoted much work during the last years to understanding the topological properties of these structures, to modeling the dynamics of many processes taking place on them, and to explaining their formation and predicting their future development. A particular phenomenon seen in networks is the so-called *small world effect*, which is the observation that even in a large network system with many nodes the typical distance between any pair of them is very short (or, in more precise terms, that this distance scales only logarithmically with the system size).

This phenomenon was indeed observed for the first time in a sociological experiment carried out by Stanley Milgram in the '60s, which led to the popular expression of "six degrees of separation" as representing the distance, via mutual acquaintances, between any two people in the society. By the way, right now a television show with this title is about to begin!

At the ICTP network conference, I got so excited that I started working on a project right afterwards. For many years, in collaboration with Professor Albano from the University of La Plata (Argentina), I had been working on nonequilibrium dynamics and phase transitions of spin systems on the lattice. Although this work had focused on ferromagnetic, field- or thermally-driven transitions of different kinds (bulk order-disorder phase transitions, surface growth and morphological transitions, wetting and wedge filling phenomena, etc.), for my new project I had the idea of studying nonequilibrium binary mixtures growing on small-world networks. It certainly could still be a work with application to materials science (since, for instance, many structural properties of polymers can be explained in terms of small-world networks), but it could also be seen as a model to represent opinion spreading in a social group, if seen in light of Milgram's seminal ideas.

Indeed, in previous works, equilibrium Ising-like systems defined on complex networks were studied as models of social dynamics, in which the spin states could denote different opinions or preferences. The coupling constant was interpreted as the convincing power between interacting individuals, which is in competition with the "free will" given by thermal noise. Moreover, magnetic fields were introduced to add a bias that could be interpreted as "prejudice" or "stubbornness." My work, being based on a model far from equilibrium, provides a complementary view that I hope will contribute to further developments in the fields of complex networks and nonequilibrium statistical physics. The article I wrote will appear in one of the September issues of Physical Review E.

After arriving at the Consortium, Professor Kenkre proposed to me some nice ideas to extend his previous investigations on traversal times for random walks in small-world networks, which he had done the year before in collaboration with Professor Parris from the



University of Missouri-Rolla. Basically, they addressed the problem of optimizing existing information networks by adding a small number of fast shortcut connections, which in their work were connected forming small-world networks. Additionally, they developed a very nice effective medium theory that gives an accurate analytic description of the problem. So, we focused on a series of related issues that extend significantly the original scope of their work: how do these phenomena depend upon the network structure of the shortcut connections? What is the role played by hubs in this random-walk problem? How can one extend the original effective medium theory? Are there other relevant observables to be studied? After some months of hard

work, we could find the answers to these questions. The curious reader will find these answers in the two articles we have just written.

My interdisciplinary journey at the Consortium got boosted in new directions by some recent events. First, the arrival of Professor Cosenza, from the University of Los Andes in Merida, who delivered two very interesting seminars on Axelrod's model for social influence. Robert Axelrod, a professor of Political Science and Public Policy at the University of Michigan, proposed a mathematical model of social influence based on the fact that the "cultural state" of each individual could be represented by a vector of their "cultural attributes." Then, the interaction between neighboring individuals was modeled taking into account two basic sociological observations:

- (i) the social interaction is more likely between individuals that share some or many of their cultural attributes;
- (ii) the result of the interaction is that of increasing the cultural similarity between the individuals involved.

This simple local dynamics lead to a very rich phenomenology, e.g., the existence of absorbing states belonging to either an ordered (culturally polarized) phase or to a disordered (culturally fragmented) phase.

Professor Cosenza and collaborators have extended these previous works by considering the effect of mass media, modeled by either

external or local/global autonomous fields. These recent contributions definitely caught my interest, and just days ago this finally led to a shared project with other visitors to the Consortium, namely Professor Mazzitello (from the University of Mar del Plata in Argentina) and Dr Dossetti (from Benemérita Universidad Autónoma de Puebla, Mexico). By focusing on alternative prescriptions to introduce the interactions, we aim at obtaining different kinds of order-disorder phase diagrams, which could then explain (at least at a qualitative level) the trend of actual sociological observations. Although still at its early stages, we hope to soon be able to contribute with our project to this exciting interdisciplinary field.

An interdisciplinary meeting organized by the Consortium, and held on August 18, gave us the opportunity of having a first-hand impression of the methodologies and interests of social scientists. This event, which was followed by other smaller, more informal meetings, aimed at assessing possible topics of mutual interest and certainly constitutes an important step forward in bringing scientific efforts across disciplines closer.



In this regard, it is impossible to exaggerate the invaluable role played by the Consortium of the Americas for Interdisciplinary Science. Its mission is that of bringing barriers down, in many ways. On the one hand, the Consortium accomplishes its interdisciplinary mission by stimulating the exchange of ideas among scientists of different disciplines, setting up free, openminded and prejudiceless environments of discussion, either in the form of workshops, seminars, or more informal meetings. But, more importantly, by bringing together scientists from Latin America, the United States, and other countries, the Consortium serves the purpose of building lasting ties between people and institutions, ultimately fostering mutual understanding among different cultures and societies.

I hope to have succeeded in conveying at least part of the great excitement of my ongoing scientific journey. Certainly, since I have focused only on my own research experience, I have depicted just a minimal part of the lush fields of Complex and Interdisciplinary Physics. The tremendously vigorous progress in these areas promises, no doubt, new adventures and great surprises on the way. ✱

CONSORTIUM VISITOR

BRUCE WEST



Bruce J. West visited the Consortium recently to give a series of three talks. These talks focused on the topic of interdisciplinary science, beginning with “A Primer on Complexity Science: Selective History and Principles.” The interdisciplinary nature of West’s work is amply demonstrated in many of the titles of his books and publications, such as *Fractal Physiology and Chaos in Medicine* (Studies of Nonlinear Phenomena in Life Science, Volume 1), *Mathematical Models as a Tool for Social Sciences*, and most recently, *Where Medicine Went Wrong: Rediscovering the Path to Complexity*. Dr West holds a joint position with the Army Research Office (Mathematical and Information Sciences Directorate) and Duke University.

Dr West began his career studying nuclear physics, switched to statistical physics and went on to do post-doctoral studies with Elliot Montroll. In 1970, West began studying biomedical and complex phenomena. In the early years of interdisciplinary science, West says, “there was a tremendous amount of inertia.” In the early ’80s, it took West three years to get a paper on cardiac chaos published. That paper addressed the use of pacemakers, arguing that there is a great deal of irregularity in heartbeats that pacemakers should mimic.

“Scientists are by and large pragmatic, they want to see the benefit of doing what they attempt,” West said. He sees two “camps” in relation to interdisciplinary science: one is receptive but not sure how to establish and implement collaborations across disciplines, and the other is more traditional. In medicine, West said, critical care physicians are especially receptive because “they don’t have time for empty theory or doing something just because it’s always been done that way.” West’s research has also demonstrated that the measure of variability in blood pressure is a better indicator of health than the average of readings.

Dr West loves to read, and brought three books with him for his short stay in Albuquerque, including Stephen King’s recent novel, *Cell*. He has two sons, one of whom is a designer of video games and another who is following him into physics and currently attends Texas Tech University.

Dr West’s lectures were greatly appreciated at the Consortium by seminar attendees from a variety of backgrounds, including physicists, mathematicians, biologists and medical scientists.

REPORT FROM THE WORKSHOP

On July 20, the Consortium held a “brainstorming” event designed to elicit ideas about generating interest among US junior scientists for studying in Latin America. After a general introduction to the Consortium and its mission to create greater cultural understanding and international cooperation in the sciences, attendees discussed over lunch various ways that US students might be encouraged to explore the many opportunities available in Latin America. A number of specific activities have been identified as a result of the event. It is planned to implement them in the near future.

A ciência é bonita e profundamente estética; portanto, devemos exibi-la à sociedade. —José Reis