

## The Fifth Annual q-bio Conference on Cellular Information Processing

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## EDITORIAL

# The Fifth Annual q-bio Conference on Cellular Information Processing

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This special section, the second to appear in *Physical Biology*, consists of four original research reports and one review that elaborate on work presented at The Fifth q-bio Conference on Cellular Information Processing, which took place from 10–13 August 2011 on the campus of St John's College in Santa Fe, New Mexico, USA.

The q-bio conference is a yearly summer event that develops and promotes integrated *modeling, theoretical and quantitative experimental* approaches aimed at understanding cellular information processing and other related complex biological phenomena. The organizers have aimed to advance the following research areas in particular: modeling of genetic regulatory and signal-transduction systems; theory of cellular information processing and general design principles of regulatory systems; quantitative experimental studies at the system level that are directly relevant for physics- and chemistry-based modeling and theoretical studies; and emerging areas in systems biology.

The campus of St John's College is located in the foothills of the Sangre de Cristo Mountains, not far from the historic plaza of Santa Fe, the art galleries of Canyon Road and hiking trails that lead into the wilderness. The main program has a single track, and most participants eat and sleep on site, which increases interaction. The q-bio and its intimate venue facilitate the free exchange of scientific ideas and the formation of multidisciplinary collaborations, which are absolutely essential for advancing modern biology. Quantitative biology requires the integrated application of diverse skills, and the expertise of a team of researchers trained in a variety of disciplines. A conference where these researchers can come together, share results and plan future research endeavors is critical for the success of the field.

The q-bio conference attracts participants from around the world who enjoy a highly interactive atmosphere. Indeed, building a vibrant q-bio community is one of the main goals of the organizers. A significant fraction of the program is reserved for contributed talks, and most often, junior researchers are selected by the program committee to present these talks. In addition, the conference is affiliated with a summer school, which begins 16 days before the conference. Students in the summer school attend the conference, which is often regarded as the capstone of a transformative experience. The school and conference together provide an intense three-week survey of quantitative biology. The conference and affiliated summer school serve to nucleate a community of researchers dedicated to understanding cellular regulatory systems through modeling and quantitative systems approaches. It especially promotes the career development of junior researchers.

The q-bio conference was inaugurated in 2007 and it is now a familiar and well-regarded event in the systems biology community. In 2011, the organizers made a conscious decision to decrease the number of talks from invited speakers (i.e. talks from senior investigators) relative to previous years (only 17 invited talks) and to increase the number of talks selected on the basis of submitted abstracts (33 contributed talks and 12 poster spotlight talks). This decision led to more presentations from junior researchers, while maintaining the high quality of talks and excellence of the science. In addition to talks, the conference included

six tutorials on the opening day and two lively evening poster sessions, with a total of 139 posters presented. The conference was attended by 227 registered participants, of which roughly two thirds received some form of financial support. Distinguished talks included the opening banquet talk of Dr Dennis Bray (University of Cambridge) and the closing banquet talk of Dr Peter K Sorger (Harvard Medical School). Other invited talks in the main program were presented by Drs Réka Albert (Penn State), Uri Alon (Weizmann), Vittorio Cristini (University of New Mexico School of Medicine), Michael W Deem (Rice), Alexander Hoffmann (UCSD), Nicole King (UC Berkeley), Michael T Laub (MIT), Wallace F Marshall (UCSF), Tobias Meyer (Stanford), Alan S Perelson (Los Alamos), Peiter Rein ten Wolde (AMOLF) and Stanislav Y Shvarstman (Princeton). The complete program is available at the archived conference web site (<http://guest.cvent.com/d/8dqhzx>).

On 14 August, the 2011 q-bio conference was followed by a satellite workshop, 'Second Workshop on Rule-based Modeling of Biochemical Systems', which included an additional 13 talks attended by approximately 60 researchers.

The conference was generously supported by multiple sponsors, including NIH/NIGMS (through an R13 conference grant), the US Department of Energy via the Center for Nonlinear Studies (CNLS) and the Information Science and Technology Center at Los Alamos National Laboratory, the New Mexico Consortium, and the Center for the Spatiotemporal Modeling of Cell Signaling, a multi-institutional NIH/NIGMS-supported national center for systems biology ([systemscenters.org](http://systemscenters.org)). On-site support was provided by the hospitable and professional staff of CNLS and St John's College.

In alignment with the goal of advancing the careers of junior researchers in quantitative biology, the conference is affiliated with a summer school, which, as usual, took place immediately before the conference. School participants met in Los Alamos, New Mexico, USA from 25 July through 9 August 2011. A total of 39 researchers from 34 different institutions participated as students. Among the institutions represented were Cambridge, the Courant Institute, MIT, Sloan Kettering, UCSF and the University of Tokyo. Over 20 researchers lectured in the school. Students were exposed to a broad spectrum of work in quantitative biology and various specialized modeling techniques useful for understanding biomolecular dynamics, cell signaling, and gene regulation. All students attended two core lectures each morning and then worked on a mentored project, participated in a hands-on computer lab, presented a talk about their research or research interests, or attended an elective lecture in one of three courses, entitled 'Stochastic effects in gene regulation', 'Cell signaling systems' and 'Spatio-temporal properties of signaling molecules'. The division of students into courses was new in 2011 and was motivated by the larger number of students than in previous years.

The emphasis on education and promotion of junior scientists (e.g., availability of 20-minute talk slots for graduate students and postdoctoral researchers in a single-track program) is one of the distinctions of the q-bio conference and summer school events. Another distinctive feature is the program of talks, which tend to cover quantitative experimentation in support of model-based analyses, mathematical/computational modeling of cellular regulatory systems, or theoretical studies of general design principles of cellular information processing. Work in these areas is routinely presented at other systems biology meetings, but usually only as a minor part of the scientific programs.

New in 2011 and going forward, the conference program included a 'pioneer talk', the purpose of which is to support and encourage new directions in quantitative biology. The inaugural pioneer talk was entitled 'DNA: Not Merely the Secret of Life' and was presented by Dr Nadrian Seeman, the recipient of the 2010 Kavli Prize in Nanoscience 'for development of unprecedented methods to control matter on the nanoscale'. Also new in 2011 was a special talk (and jam

session) devoted to social aspects of science, which was entitled ‘Love and Fear in the Lab’. Dr Uri Alon presented this talk, which can be found on YouTube if you search for ‘Social Aspects of Science, Uri Alon’ (in five parts).

Since the inception of the q-bio conference, the organizers have asked participants to contribute to a special section each year. This special section is the second to be published by *Physical Biology* and the first in a series of three special sections aimed at increasing the impact of the annual proceedings and bringing attention to important work discussed at the conference. The organizers, with Dr Ilya Nemenman providing leadership, are working with Andrew Malloy, in the role of Publisher, and Dr Nigel Goldenfeld, in role of liaison between the Editorial Board and the organizers, to increase the attractiveness of contributing to the special section and the timeliness of the issue. The organizers are grateful to Mr Malloy and Dr Goldenfeld for their support and commitment to promoting quantitative biology.

In this special section, the organizers are proud to present five papers that reflect the scientific excitement of the 2011 q-bio conference, which was attended not only by modelers and theoreticians but also experimentalists dedicated or open to quantitative and systems approaches, technologists and multidisciplinary researchers. Of course, these papers do not reflect the full breadth of work presented at the meeting, but the contributions do reflect the interplay of experimental and computational work that characterizes most work discussed at the meeting.

The special section starts with a review ‘Boolean modeling in systems biology: an overview of methodology and applications’ by R-S Wang and colleagues [1]. This authoritative exposition will likely become a go-to manual for anyone interested in using Boolean networks to model biological data. This review is followed by two computational studies, ‘Dynamics of a stochastic spatially extended system predicted by comparing deterministic and stochastic attractors of the corresponding birth–death process’ by Zuk *et al* [2] and ‘Coupling between feedback loops in autoregulatory networks affects bistability range, open-loop gain and switching times’ by Tiwari and Igoshin [3]. The subjects, the style and the approaches of these papers are representative of computational studies typically presented at q-bio: the authors extend knowledge gained from specific experiments to analyze general properties and design principles of broad classes of biological networks. The special section concludes with two papers that we consider the hallmarks of q-bio. Both ‘The synthesis–diffusion–degradation model explains Bicoid gradient formation in unfertilized eggs’ by Drocco *et al* [4] and the ‘Quantitative measurements and modeling of cargo–motor interactions during fast transport in the living axon’ by Seamster *et al* [5] are examples of very tight, synergistic collaborations between precise, physics-style experimentation and mathematical modeling. We are pleased to present all five of these papers to the *Physical Biology* readers.

What’s next for q-bio? As organizers, we would like the conference and the summer school to continue to evolve and increase in impact. However, we realize that the current size and the interaction-promoting venue of the conference are largely responsible for its intimate and dynamic feel, and hence for its success. Thus instead of growing in numbers, we would like the q-bio to continue a gradual expansion in scope, promoting or embracing a parallel expansion within quantitative biology. Thus, starting in 2012, the conference will be known simply as ‘The q-bio Conference’, dropping ‘on Cellular Information Processing’ from the title to emphasize the breadth of the conference and the intention of the organizers to promote emerging areas in systems biology. Additional events will be organized under the q-bio umbrella, such as ‘The Winter q-bio Conference’, <http://w-qbio.org>. In addition, continual revitalization is needed to build a self-sustaining infrastructure for the conference more fully representative of the q-bio scientific community. Therefore, for 2013 and beyond, we will be seeking

to diversify the pool of organizers, program committee members and summer school lecturers. We encourage you to participate in the 2013 conference and experience the results of these changes firsthand!

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