

# Systems Biology Research Symposium

## Oral Presentation Session

Grand Ballroom  
Tuesday, June 5th  
7:00-8:30pm

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Evolution of Metabolic Networks Organization

Aurélien Mazurie<sup>1</sup>, Danail Bonchev<sup>2</sup>, Benno Schwikowski<sup>1</sup>, and Gregory A. Buck<sup>2</sup>

<sup>1</sup>Systems Biology Group, Institut Pasteur, 25 rue du Docteur Roux, 75015 Paris, France, <sup>2</sup>Center for the Study of Biological Complexity, Virginia Commonwealth University, Richmond, VA 23284-2030, USA

Presenter's email address: [dgbonchev@vcu.edu](mailto:dgbonchev@vcu.edu)

**Motivation:** Comparison of metabolic networks across species is a key to understand how evolutionary pressures shape these networks. By selecting taxa representative of different lineages or lifestyle and invoking a comprehensive set of descriptors of the structure and complexity of their metabolic networks, we can highlight both qualitative and quantitative differences in the metabolism organization of species subject to distinct evolutionary paths or environmental constraints.

**Results:** We used a novel representation of metabolic networks, termed network of interacting pathways or NIP, to focus on the modular, high-level organization of the metabolic capabilities of the cell. Using machine learning techniques we identified the most relevant aspects of the cell organization that change under evolutionary pressures. We considered the transitions from Prokarya to Eukarya (with a focus on the transitions among the Archaea, Bacteria and Eukarya), from unicellular to multicellular species, from free-living to host-associated bacteria, as well as the acquisition of cell motility.

**Conclusion:** Extending the intuitive idea that organisms with more complex lifestyle have more complex and robust metabolic networks, we demonstrate for the first time that such organisms not only harbor larger, denser networks of metabolic pathways but also more efficiently organized cross-communications, as revealed by subtle changes in network topology. These changes are not evenly distributed among metabolic pathways, with specific categories of pathways being promoted to more central and efficient locations in the cell metabolism as an answer to environmental constraints.