INFORMATION INTEGRATION AND ENERGY EXPENDITURE IN EUKARYOTIC GENE REGULATION

Postdoctoral Research Fellowship at Harvard Medical School, Department of Systems Biology
Application deadline : Ongoing until filled

We invite applications for a postdoctoral research position with Professors Angela DePace and Jeremy Gunawardena on an NIH funded project (GM122928) using theory and quantitative experiments to probe the molecular mechanisms of eukaryotic gene regulation. The DePace lab studies the mechanisms and evolution of transcription in animals, using Drosophila embryos as a model system. The Gunawardena lab studies cellular information processing using a combination of experimental, mathematical and computational methods. The successful candidate will be jointly supervised and work with both laboratories, which are on the same floor.

In recent work (PMID 27368104), we developed a theoretical framework, anchored in physics, to analyze enhancer activity. We used this framework to probe the limits of the bacterial paradigm, based on transcription factor binding at equilibrium, for reasoning about eukaryotic gene regulation. We introduced two concepts necessary to reconcile theory with experiment for eukaryotic genes: "higher-order cooperativity" and "Hopfield barriers". Eukaryotic gene regulation differs in important ways from bacterial mechanisms. Eukaryotes integrate information from many widely dispersed sites across the genome and they exploit energy dissipating mechanisms, such as chromatin modification and remodelling, and post-translational modification of transcription factors, co-regulators and the basal transcriptional machinery. We believe that a new theoretical foundation, based on the ideas we have put forward, is essential to understand how eukaryotic genes work and to correctly interpret the data emerging from single cell and single molecule approaches. The aim of the postdoctoral research fellowship is to help lay this theoretical foundation, in the context of experimental data in early Drosophila embryos. It covers the position previously held jointly in our labs by Dr. Javier Estrada.

The position is available for one year, with the expectation of renewal for a further two years. Applicants should have a PhD in one of the mathematical or physical sciences, a strong interest in applying mathematical tools to modern biology and experimental data and a good track record of creative work. Applications should be sent to both Dr. DePace and Dr. Gunawardena and should include a CV, a cover letter describing research interests and suitability for this specific project and contact details for three referees. We are an equal opportunity employer and all qualified candidates will receive consideration for the position.