JUAN DÍAZ-COLUNGA

Post-doctoral Associate
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research statement

It has become increasingly clear that many complex behaviors of biological systems emerge from the interactions of their individual components and the states that result from their assembly into connected networks. This realization, together with the development of high throughput technologies, has forced a paradigm shift in biological research: today, biology is more quantitative and integrative than ever, which has generated a need for tools from physics, mathematics and computer science.

I became interested in systems biology early in my undergraduate years. As a physicist with a passion for mathematical modeling, computer simulation and data analysis, I went on to pursue a master's degree in biomedical engineering followed by a PhD in computational biology. During that time, I focused my work on the origins of cell-to-cell phenotypic differences and how they induce variable apoptotic responses. I used tools such as kinetic modeling and stochastic simulation, sequencing data processing and image analysis. Later, I moved to the field of ecology and evolution for a 6-month stay at the Gore lab at MIT. There I gained valuable wet lab experience while developing a project on the emergence of inducibility in *E. coli* promoters. I am currently a postdoc at the Universidad Autónoma in Madrid, where I keep working on evolution in the context of cancer heterogeneity.

I consider myself a curious and versatile researcher with broad interests. My aim is to combine theory and experiments that elucidate the mechanisms through which evolution generates novel behaviors and shapes the structure of cellular communities and their interactions with the environment.

education

PhD in Biophysics
Universidad Autónoma de Madrid, 2015-19

MSc in Biomedical Engineering
Universidad Politécnica de Madrid, 2013-14

BSc in Physics
Universidad Autónoma de Madrid, 2009-13

academic awards

PhD *cum laude*
2019

'Severo Ochoa' Excellence PhD Fellowship
2015-2019

Comunidad de Madrid Award for Excellent Undergraduate Students
2009-13

research experience

Post-doctoral Associate
Yale University
Department of Ecology & Evolutionary Biology
New Haven, USA (2020-present)

Post-doctoral Researcher
Universidad Autónoma de Madrid (UAM)
School of Medicine – department of Biochemistry
Madrid, Spain (2019-2020)

Visiting Researcher
Massachusetts Institute of Technology (MIT)
Gore Lab for Ecological Systems Biology
Boston, USA (2018)

Pre-doctoral Researcher
Spanish National Center for Biotechnology (CNB)
Biological Noise lab
Madrid, Spain (2015-19)

publications

Diaz-Colunga J*, Lu N*, Sanchez-Gorostiaga A*, Chang CY, Cai HS, Goldford JE, Tikhonov M, Sanchez A (2022). Top-down and bottom-up cohesiveness in microbial community coalescence. *PNAS* (*equal contribution)

Diaz-Colunga J & Diaz-Uriarte R (2021). Conditional prediction of consecutive tumor evolution using cancer progression models: What genotype comes next? *PLOS Computational Biology* **17**(12): e1009055

Sanchez A, Vila JCC, Chang CY, **Diaz-Colunga J**, Estrela S & Rebolleda-Gomez M (2021). Directed Evolution of Microbial Communities. *Annual Review of Biophysics* **50**:323-341

Chang CY, Vila JCC, Bender M, Li R, Mankowski MC, Bassette M, Borden J, Golfier S, Sanchez PGL, Waymack R, Zhu X, **Diaz-Colunga J**, Estrela S, Rebolleda-Gomez M & Sanchez A (2021). Engineering complex communities by directed evolution. *Nature Ecology & Evolution* **5**:1011-1023

Díaz-Colunga J*, Márquez-Jurado S*, das Neves RP, Martínez-Lorente A, Almazán F, Guantes R & Iborra FJ (2018). Mitochondrial levels determine variability in cell death by modulating apoptotic gene expression. *Nature Communications* **9**:389 (*equal contribution)

Lima AF, May G, **Díaz-Colunga J**, Pedreiro S, Paiva A, Ferreira L, Enver T, Iborra FJ & das Neves RP (2018). Osmotic modulation of chromatin impacts on efficiency and kinetics of cell fate modulation. *Scientific Reports* **8**:7210

Marcos-Villar L, **Díaz-Colunga J**, Sandoval J, Zamarreño N, Landeras-Bueno S, Esteller M, Falcón A & Nieto A (2018). Epigenetic control of influenza virus: role of H3K79 methylation in interferon-induced antiviral response. *Scientific Reports* **8**:1230

Guantes R, **Díaz-Colunga J** & Iborra FJ (2016). Mitochondria and the non-genetic origins of cell-to-cell variability: More is different. *BioEssays* **38**:64-76

talks & seminars

XXIX Workshop: Advances in Molecular Biology by Young Researchers Abroad
Spanish National Center for Biotechnology (CNB)
Madrid, Spain – virtual seminar (2021)
Talk: *Engineering microbial communities with global epistasis*

Evolutionary & Ecological Systems Biology Talks
MIT – Physics of Living Systems
Boston, USA – virtual seminar (2021)
Talk: *Top-down and bottom-up co-selection in microbial community coalescence*

Microbial Ecology & Evolution (MEEvirtual)
Virtual seminar (2020)

Heterogeneity and Evolution in Cancer
Spanish National Cancer Research Center (CNIO)
Madrid, Spain (2019)

Physics of Living Systems Seminar Series
MIT – Physics of Living Systems
Boston, USA (2018)
Talk: *The energy cost of living and dying*

MIT Biophysics Retreat
MIT – Physics of Living Systems
Cape Cod, USA (2018)

Quantitative Principles in Biology
European Molecular Biology Laboratory (EMBL)
Heidelberg, Germany (2017)
Talk: *Mitochondrial regulation of extrinsic apoptosis*
Poster presentation: *Mitochondrial levels determine variability in cell death by modulating apoptotic gene expression*

Canceromatics III – Tumor Heterogeneity
Spanish National Cancer Research Center (CNIO)
Madrid, Spain (2016)
Poster presentation: *Mitochondrial levels determine variability in apoptosis through global modulation of gene expression*

The Physics of Living Systems: from Biomolecular Nanomachines to Tissues and Organisms
'Nicolás Cabrera' Institute
Madrid, Spain (2016)
Poster presentation: *Mitochondria and the non-genetic origins of cell-to-cell variability*

XIX Young Researchers Meeting
'Nicolás Cabrera' Institute
Madrid, Spain (2016)
Poster presentation: *Cell-to-cell differences in mitochondrial content induce phenotypic variability*

CNB Seminar Series
Spanish National Center for Biotechnology (CNB)
Madrid, Spain (2016)
Talk: *Can we predict apoptosis?*