MARC DUQUE RAMÍREZ

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EDUCATION

2020 **Ph.D. in Neuroscience**
Division of Medical Sciences, Harvard University
Current year: **G6** Expected graduation: **2026** Lab: **Engert Lab**

2019 **M.S. in Neuroscience**
College of Biology, University of Barcelona, Barcelona
Thesis Title: *Channel-mediated modulation of neural activity with ultrasound in vitro*
GPA: 3.6 (9.4/10)

2018 **B.S. in Biochemistry**
College of Biology, University of Barcelona, Barcelona
Thesis Title: *A division detector to study the role of cell divisions in morphogenesis and size control*
GPA: 3.7 (9.3/10)

RESEARCH INTERESTS

I am deeply interested in the way that spatially and functionally complex systems like the brain or the developing embryo form from disparate but highly interconnected parts. My primary research experiences thus far have used advanced imaging techniques combined with innovative computer programming and quantitative analysis pipelines to reveal fundamental biological discoveries in the way that complex systems are organized.

RESEARCH EXPERIENCE

February 2022 – Current **Graduate Student, Harvard University, HHMI Janelia Research Campus**

Advisor: Florian Engert, Ph.D.

Studying the role of glia in behavior and molecular computations in larval zebrafish

February 2019 – April 2021 **Research Assistant, Salk Institute for Biological Sciences**

Advisor: Sreekanth Chalasani, Ph.D.

Advancing sonogenetics to develop a new non-invasive neuromodulation technique using ultrasound

February-August 2018 **Undergraduate Scholar, HHMI Janelia Research Campus**

Primary Advisor: Philipp Keller, Ph.D.

Co-advisor: Jan Funke, Ph.D.

Utilized a novel deep-learning approach to analyze next generation light-sheet microscopy data of cell division in post-implantation mouse embryos. Showed cell division events cluster at the leading edge of growing tissues.

March-December 2018 **Undergraduate Research, University of Barcelona**

Advisor: Jordi Soriano, Ph.D.

Applied modeling and advanced calcium imaging to study the evolution of functional connectivity in primary cultured rat neurons. Developed an optogenetic system for in vitro stimulation to show the complexity of patterned activity.

Summers 2015 & 2016 **Undergraduate Research Fellow, EMBL Heidelberg**

Advisor: Takashi Hiiragi, M.D., Ph.D.

Studied the response to pre-implantation stress on gene expression and cell cycle regulation of mammalian embryos using confocal and SPIM microscopy. Created novel advanced imaging analysis tools to show that embryos halved at the two-cell stage do not recover cell number until after the 128- cell stage.

TEACHING EXPERIENCE

2021-2025 Teaching assistant. **MCB80 Introduction to Neurobiology.** Harvard University.

2022-2024 Teaching assistant. **GenED 1037 Great Experiments that Changed Our World.** Harvard University.

2023-2024 Teaching assistant. **GenED 1125 Artificial and Natural Intelligence.** Harvard University.

2024-2025 Teaching assistant. **Neuro125 Molecular Basis of Behavior.** Harvard University.

PUBLICATIONS & PRESENTATIONS

Articles:

- **Duque M.**, Chen A., et al. *Ketamine induces plasticity in a norepinephrine-astroglial circuit to promote behavioral perseverance.* Neuron. **2025**.
- Chen A., **Duque M.**, et al. *Norepinephrine changes behavioral state via astroglial purinergic signaling perseverance.* Science. **2025**.
- Chen A., **Duque M.**, F. Engert. *Seeing stars: Astroglia modulates visual circuits during behavioral-state transitions.* Neuron 111 (24). **2023.**
- Ori H., **Duque M.**, Cohen A. et al. *Observation of topological action potentials in engineered tissues*. Nature Physics. **2023**.
- C. Procko et al. *Mutational analysis of mechanosensitive ion channels in the carnivorous Venus flytrap plant*. Current Biology, 33 (15). **2023**
- **Duque M.**, Lee-Kubli C., Tufail Y. et al. *Sonogenetic control of mammalian cells using exogenous Transient Receptor Potential A1 channels*. Nature Communications **2022**.
- Vasan A. et al. *Microscale concert hall acoustics to produce uniform ultrasound stimulation for targeted sonogenetics in hsTRPA1-transfected cells.* Advanced Nano Biomed Research. **2022**
- Vasan A. et al. *Ultrasound mediated cellular deflection results in cellular depolarization.* Advanced Science, 9(2) **2021**.

Posters & Talks:

- Duque M., Funke J., McDole K., Branson K., Keller P.*A 4D-Unet to Detect Cell Divisions in Light-Sheet Microscopy*. HHMI Undergraduate Scholars Annual Symposium; **2018** August 2; Ashburn, VA.
- Duque M., Chen B. A., Fishman M., Ahrens M., Engert F. *Virtual reality forced swimming in zebrafish reveals astrocytic mediation of fast antidepressant action.* 4DCP Janelia HHMI Symposium; **2022** October 12-14; Ashburn, VA.

- Duque M., Chen B. A et al. *Astroglial mediation of fast-acting antidepressant action.* GRC; **2023** March 5-10; Ventura, CA. Poster prize.
- Duque M., Chen B. A et al. *Ketamine induces plasticity in a norepinephrine-astroglial circuit to promote behavioral perseverance.* Allen Institute Lake Conference for Neurobiology of Mental Health; **2024** March 5-10; Thun, Switzerland.

Patents:

- "Sonogenetic stimulation of cells expressing a heterologous mechanosensitive protein". 19 May 2022. International Publication Number WO2022/103788A1
- "Sonogenetic stimulation of cells expressing TRPA1". European Patent Office, EP4181960A4

HONORS AND AWARDS

2025	Rising Stars in Neuroscience, University of Utah
2023	Boehringer Ingelheim PhD Fellowship
2018	HHMI Undergraduate Research Scholar, Janelia Research Campus.
Summer 2016	EMBL Undergraduate Fellow, EMBL Heidelberg.
Summer 2015	EMBL Undergraduate Fellow, EMBL Heidelberg.
2014	Silver medalist in Catalan Biology Olympiad.
2014	Invited to Spanish Biology Olympiad.
2014	Medalist in Catalan Physics Olympiad.
2014	Honorable mention in Spanish Physics Olympiad.
2014	PAU award for university entrance exams.

LANGUAGES

Native in Catalan. Native in Spanish. Advanced Certificate in English (C1). Basic German (B1 equivalent).

APPLICABLE SKILLS

Laboratory: mouse model- injection, embryo removal and culture, embryo transfer, immunocytochemistry assays; **tissue culture**- primary embryo culture and manipulation, single cell injection using micromanipulators, culture and transduction of primary neurons; **microscopy**- confocal microscopy, selective plane illumination microscopy (SPIM), SIM-view advanced light sheet microscopy; **larval zebrafish –** virtual reality behavior in tail free larvae, whole-brain immunohistochemistry, calcium imaging

Computer: ChemDraw, wxMaxima, ADT tools and docking software, Imaging platform from Zeiss for confocal microscopy and Leica for SPIM. **Programming –** C++, Python, Java, Matlab, Deep Learning with Tensorflow, specialist in image processing, U-Net with 4D convolutions.