



Research Networking Programmes

Science Meeting – Scientific Report

Proposal Title: Visualisation and Manipulation of Signals and Forces in Developing Tissues

Application Reference N°: 5019

1) Summary

The International Symposium “Visualization and manipulation of signals and forces in developing tissues” was held in Santiago, Chile on May 12-16th 2014. The venue chosen for the event was the Telefonica OpenFuture Branch of Urban Station, located in the heart of the city and very accessible. The aim of the symposium was to promote scientific interactions by bringing together a small group of scientists from around the world interested in morphodynamics of cells and tissues from different perspectives. The symposium congregated 26 speakers from different institutes and universities of Europe (17), USA (6) and Chile (3), and attracted over 100 participants from Latin America (66%), USA (10%), Europe (23%) and Middle East (1%). Besides the main talks given by the invited speakers, participants had the opportunity to present their work either as short talks (8 selected from applicants) or as posters. Between the attendees, we counted undergrad and grad students, postdocs, and well as young and senior investigators. Such broad spectrum of backgrounds and experiences created a rich environment for scientific exchange. Presentations were organized by topic, in different sessions that included regular lectures and short-talks, as well as one poster session. Speakers started out with a general introduction to capture the interest of the audience and provide a background for those not familiar with the particular field of study; then they showed their most recent research, focused primarily on unpublished data. All presentations were followed by interesting questions and discussions. In between sessions, coffee breaks allowed further interaction and discussion among the participants. An international course for latin american students was held in parallel to the symposium at the University of Chile, where many speakers participated as teachers. In addition, an outreach activity was carried out at the National Congress building in Santiago, where two speakers from the symposium gave lectures about the origin of animal form in development and evolution to an audience of over 400 people, among them 300 high school students. Overall, the symposium was a high-quality scientific experience and a great opportunity to discuss the most recent advances in cell and tissue morphodynamics and strengthen of scientific international networks in a warm and stimulating atmosphere.

2) Description of the scientific content of and discussions at the event

While the whole symposium was based on developmental biology, the primary focus was the importance of shape in biology and the study of the forces (chemical - physical) that are needed to generate a particular shape in a developing tissue.

The first talk of the meeting was a plenary lecture by Ray Keller, entitled: "Convergence movements: mechanisms, concepts and emerging principles". On it, Keller explained the bases of convergent-extension movements, in a historical journey from the original experiments to the most recent discoveries.

Presentations included regular lectures, short talks and posters, and were grouped in 8 sessions, by topic. Some highlights of the main results discussed at the sessions are given below (see full list of presentations in annexes):

Session 1 (Tissue Morphogenesis): Hadjantonakis revealed that during mouse gastrulation, visceral and definite endodermal cells intercalate to give rise to the gut endoderm. Heisenberg demonstrated a role for osmolarity in generating differential surface tension during progenitor cell segregation in zebrafish gastrulation. Using *Drosophila*, Bellaiche discussed the role of pten in junctional remodeling in the developing wing while Jacinto showed a role of calcium in the dynamics of myosin and F-actin underlying tissue deformation during epithelial wound repair.

Session 2 (Cell Migration): Concha showed how embryonic cells sense the overlying epithelium to become dispersed during teleost epiboly. Raz showed how initiation of motility and maintained at the target site is controlled in zebrafish primordial germ cells. Mayor revealed a requirement of the solid-to-fluid tissue change underlying EMT for collective cell migration under physical constraints. Lopez-Schier showed an intriguing inversion of polarity during hair cell development of the zebrafish posterior lateral line.

Session 3 (Stem cells and Regeneration): Greco showed that differentiated cells are extruded during regression of the hair follicle *in vivo* using two-photon microscopy. Martinez-Arias revealed that specific *in vitro* culture conditions allow mouse embryonic stem cells to express their full capabilities for self organisation.

Session 4 (Cytoskeletal Dynamics): Salbreux presented the mechanisms of a novel friction-based mode of cell migration that is adhesion-independent. de Rooij showed a new role of the cadherin complex as a mechanotransducer.

Session 5 (Imaging and Mathematical Approaches): Kubitscheck and Keller explained the bases of light sheet fluorescence microscopy and its use for tracking single particles in 3D and for imaging development in whole embryos with cellular resolution, respectively. Torres-Padilla presented the importance of heterochromatin organization in the zygote.

Session 6 (Tissue Morphogenesis and External Mechanical Stress). Stainier talked about organogenesis, particularly about cardiac development and the importance of cell dynamics. Vermot explained the biological flows generated in the cardiovascular system in zebrafish development, and the importance of mechanotransduction.

Session 7 (Posters).

Session 8 (Signaling and Epithelial Morphogenesis). Gonzalez-Gaitán revealed an intrinsic Sara-endosomal mechanism underlying asymmetric intestinal stem cell mitosis in *Drosophila*. Tada discussed the role of filamin in apical cell extrusion of transformed cells in the surface epithelium of zebrafish. Glavic talked about the role of Prpk in the formation/stabilisation of lamellipodia in *Drosophila* haemocytes.

The symposium ended with a plenary lecture by Stuart Newman entitled: “Ancient genes, mesoscale physics, and the origins of animal development”.

3) Assessment of the results and impact of the event on the future directions of the field

The International Symposium “Visualization and manipulation of signals and forces in developing tissues” was recognized by the participants (and in particular by the speakers) as a high-quality meeting that gathered a well-balanced combination of established researchers and young investigators carrying out forefront research on the signals and mechanisms responsible of shaping developing embryos. Approaches were from different perspectives (theory to experiment, molecules to cells, and cells to organisms) that shared a common goal to understand how the combined role of chemical and physical forces shape tissues, using state-of-the-art imaging, advanced genetic approaches and sophisticated techniques for measuring and manipulating forces in developing tissues. Such multidisciplinary perspective, which also included theory and modeling, was recognized as a unique, instructive and very stimulating experience to which many of the attendants were not exposed before, and which they stated ‘should definitively be repeated in the future’. Indeed, we heard from email communications after the symposium that there is a plan to organize a similar meeting in the USA in the near future. Overall, one main lesson from the meeting was that interdisciplinary initiatives of this kind are not only necessary but could also be transforming (in the way we think, approach and communicate science), as they widen our perspectives of scientific research by building bridges among disciplines that in combination have a potential synergistic effect on the quality and impact of our science.

The meeting also allowed the generation and strengthen of scientific international networks in the field of cell and tissue morphodynamics. These networks will help to boost collaborative research between Europe, USA and Latin America, and is a desired outcome that we expect to have a long-term impact in the field. Novel collaborations that emerged from the symposium will be materialized by applications to existing bilateral international collaborative programs, and also by multilateral collaborative initiatives such as those supported by the European Union (e.g. Horizon 2020).

4) **Annexes 4a) and 4b): Program of the meeting and full list of speakers and participants**

Monday 12 May 2014

09:00-13:00 **International Course "Optics, Forces & Development"**

13:00-14:40 **Registration**

14:40-14:50 **Symposium Opening**

14:50-16:00 **Plenary Lecture "John P. Trinkaus"**

Chair: Miguel Concha

Ray Keller

Convergence movements: mechanisms, concepts and emerging principles

16:00-16:30 -COFFEE BREAK-

Session 1: Tissue Morphogenesis

Chair: Hernán López-Schier

16:30-17:00 Anna-Katerina Hadjantonakis

Guts and gastrulation: cell dynamics and the morphogenesis of the early mouse embryo

17:00 - 17:30 Carl-Philipp Heisenberg

Cell and tissue mechanics in zebrafish gastrulation

17:30 - 18:00 Yohanns Bellaïche

Multiscale imaging and quantification of tissue morphogenesis: from gene to forces

18:00 - 18:30 - COFFEE BREAK -

18:30 - 19:00 Antonio Jacinto

Tissue dynamics in *Drosophila* epithelial repair

19:00 - 19:30 Primoz Ziherl

Mechanical models of ventral furrow formation in *Drosophila*

19:30 - 19:45 Evan Heller - *selected short talk*

Forces generated by cell intercalation tow epidermal sheets in mammalian tissue morphogenesis

19:45-20:00 Claudio Araya- *selected short talk*

Understanding *in vivo* cell and tissue dynamics during organ midline formation

21:00 Free

Tuesday 13 May 2014

09:00 - 13:00 International Course "Optics, Forces and Development"

Session 2: Cell Migration

Chair: Guillaume Salbreux

15:00 - 15:30 Miguel Concha

Contact guided migration of deep cells during teleost epiboly

15:30 - 16:00 Erez Raz

Motility and guided migration of primordial germ cells in zebrafish

16:00 - 16:30 Roberto Mayor

Neural crest migration as an emergent property of cell interactions

16:30 - 16:45 Santiago Cerrizuela - *selected short talk*

Role of Gli2 transcription factor in the development of *Xenopus laevis* neural crest

16:45 - 17:15 -COFEE BREAK-

17:15 - 17:45 Xavier Trepap

Control of collective cell migration by intercellular adhesion complexes

17:45 - 18:15 Hernán-López Schier

Dynamics and constrains of collective cell movement

18:15 - 18:45 Ajay Chitnis

Using agent based models to understand morphogenesis of the zebrafish posterior lateral line primordium

18:45-19:00 Eduardo Pulgar - *selected short talk*

Pulling forces, tissue morphogenesis and cell fate specification during zebrafish laterality organ development

20:00 Free

Wednesday 14 May 2014

09:30 - 13:00 **Outreach Activity - OpenLecture**

Session 3: Stem Cells and Regeneration

Chair: María Elena Torres-Padilla

15:30 - 16:00 Juan Larrain

***Xenopus laevis*: a model organism to study spinal cord regeneration**

16:00 - 16:30 Valentina Greco

Uncovering cellular and signaling mechanisms of skin regeneration using two-photon microscopy

16:30 - 17:00 Alfonso Martínez-Arias

Symmetry breaking and polarisation in ensembles of mouse ES cells

17:00 - 17:30 - COFFEE BREAK -

[Session 4: Cytoskeletal Dynamics](#)

Chair: Antonio Jacinto

17:30 - 18:00 Stephan Grill (CANCELED)

Morphogenetic functions of actomyosin

18:00 - 18:30 Guillaume Salbreux

Foces exerted during adhesion-independent migration

18:30 - 19:00 Johan de Rooij

Mechanotransduction at the Cadherin-actomyosin interface

19:00 - 20:00 [Network Meeting](#)

21:00 [Dinner for Speakers \(Mesón Patagónico\)](#)

Thursday 15 May 2014

09:00 - 13:00 [International Course "Optics, Forces and Development"](#)

[Session 5: Imaging and Mathematical Approaches](#)

Chair: Valentina Greco

15:00 - 15:30 Ulrich Kubitscheck

Two new tricks with the light sheet fluorescence microscope: fast confocalline scanning and 3d-single particle tracking *in vivo*

15:30 - 16:00 Philipp Keller

Reconstructing development and function of the nervous system using light-sheet microscopy

16:00 - 16:30 María Elena Torres-Padilla

Epigenetic mechanisms in early mammalian development

16:30 - 16:45 Fernán Federici - *selected short talk*

Engineering morphogenetic mechanisms in bacterial biofilms

16:45 - 17:15 -COFEE BREAK -

[Session 6: Tissue Morphogenesis and External Mechanical Stress](#)

Chair: Marcos González-Gaitán

17:15 - 17:45 Didier Stainier

Cardiomyocyte dynamics during heart development

17:45 - 18:15 Julien Vermot

The role of fluid flow in shaping developing epithelia

18:15 - 18:45 Patricio Olgún - *selected short talk*

Do tendons and neurons use the same mechanism for adaptation to mechanical stress and layer-specific axon targeting?

18:45-19:00 Ben Nelemans – *selected short talk*

The forces that shape our spine: mechanics of somitogenesis

19:00 - 21:00 [Session 7: Posters \(Cocktail\)](#)

21:00 Free

Friday 16 May 2014

[Session 8: Signaling and Epithelial Morphogenesis](#)

Chair: Alfonso Martínez-Arias

09:00 - 09:30 Marcos González-Gaitán

Morphogenetic growth control by time derivatives of signalling

09:30 - 10:00 Masazumi Tada

Live-imaging and genetic analyses of transformed cell extrusion from the zebrafish embryonic epithelium

10:00 - 10:30 Alvaro Glavic

Complex functions for an ancient complex: from lamellipodia dynamics to animal growth

10:30 - 10:45 David Flores-Benitez - *selected short talk*

The FERM-binding motif of Crumbs regulates the contraction of amnioserosa cells during dorsal closure in *Drosophila*

10:45 - 11:20 - COFFEE BREAK -

11:20 - 12:30 [Plenary Lecture “D’Arcy W. Thompson”](#)

Chair: Carl-Philipp Heisenberg

Stuart Newman

Ancient genes, mesoscale physics, and the origins of animal development

12:30 - 12:45 [Prizes](#)

12:45 - 13:00 [Concluding Remarks](#)

13:00 - 19:00 [Lunch & Trip to Vineyards for Speakers and Course Students](#)

Annex 4b: Full list of speakers and participants

Speakers:

Bellaiche Yohanns
Institute Curie
France
yohanns.bellaiche@curie.fr

Chitnis Ajay
NICHD-Bethesda
USA
chitnisa@mail.nih.gov

Concha Miguel
Universidad de Chile
Chile
mconcha@med.uchile.cl

de Rooij Johan
Hubrecht Institute
The Netherlands
j.derooij-4@umcutrecht.nl

Glavic Álvaro
Universidad de Chile
Chile
alglavic@uchile.cl

González-Gaitán Marcos
University of Geneva
Switzerland
Marcos.Gonzalez@unige.ch

Greco Valentina
Yale School of Medicine
USA
valentina.greco@yale.edu

Hadjantonakis Anna-Katerina
Sloan-Kettering Institute
USA
hadjanta@mskcc.org

Heisenberg Carl-Philipp
IST Viena
Austria
heisenberg@ist.ac.at

Jacinto Antonio

I.Glubenkian
Portugal
ajacinto@fm.ul.pt

Keller Philipp
Janelia Farm-HHMI
USA
kellerp@janelia.hhmi.org

Keller Ray
University of Virginia
USA
rek3k@virginia.edu

Kubitscheck Ulrich
University of Bonn
Germany
U.Kubitscheck@uni-bonn.de

Larraín Juan
P. Universidad Católica de Chile
Chile
jlarrain@bio.puc.cl

López-Schier Hernán
HMGU-Munich
Germany
hernan.lopez-schier@helmholtz-
muenchen.de

Martínez-Arias Alfonso
Cambridge University
UK
a.martinezarias@gen.cam.ac.uk

Mayor Roberto
CDB-UCL
UK
r.mayor@ucl.ac.uk

Newman Stuart
NY Medical College
USA
newman@nymc.edu

Raz Erez

ZMBE-Munster
Germany
erezraz@uni-muenster.de

Salbreux Guillaume
Max Planck Institut for the Physics of
Complex Systems
Germany
salbreux@pks.mpg.de

Stainier Didier
Max Planck Institute for Heart and
Lung Research
Germany
Didier.Stainier@mpi-bn.mpg.de

Tada Masazumi
CDB-UCL
UK
m.tada@ucl.ac.uk

Torres-Padilla Maria Elena
IGBMC-Strasbourg
Francia
maria-elena.torres-padilla@igbmc.fr

Trepat Xavier
IBEC-Barcelona
España
xtrepat@ibecbarcelona.eu

Vermot Julian
IGBMC-Strasbourg
France
julien.vermot@igbmc.fr

Ziherl Primoz
University of Ljubljana
Slovenia
primoz.ziherl@ijs.si

List of Participants:

A

Allende Camilo

Universidad de Chile
Chile
allende.camilo@gmail.com

Araya Claudio

Universidad Austral de Chile
Chile
claudio.araya@uach.cl

Artigas Claudio

Universidad Autónoma de Chile
Chile
claudioartigas1@gmail.com

B

Balayo Tina

Cambridge University
UK
cb268@cam.ac.uk

Barriga Elias

Universidad Andrés Bello
Chile
elianbarriga@gmail.com

Behrndt Martin

IST Viena
Austria
behrndt@ist.ac.at

Beiza Natalia

Universidad de Chile
Chile
nbeiza@ug.uchile.cl

Benavides Isabella

Universidad Andrés Bello
Chile
isabeki@hotmail.com

Borgonovo Janina

Universidad de Chile
Chile
janiborgonovo@gmail.com

Bruno Renzo

P. Universidad Católica de Chile
Chile
renzobruno@gmail.com

Burgos Johanna

Universidad Austral de Chile
Chile
jburgos@cecs.cl

C

Catañeda Victor

Universidad de Chile
Chile
vcastane@gmail.com

Cerda Mauricio

Universidad de Chile
Chile
mauriciocerda@med.uchile.cl

Cerrizuela Santiago

Universidad Nacional de Tucumán
Argentina
santicerri@gmail.com

Colombo Alicia

Universidad de Chile
Chile
acolombo@med.uchile.cl

Córdova Aléx

Universidad de Chile
Chile
cordova.alex@gmail.com

Costa Angela

CNPEM/LnBio
Brasil
angela.costa@lnbio.cnpem.br

D**Dalle Nogare Damien**

NIH
USA
dalledam@mail.nih.gov

Dehkordi Fujan

Universidad de Chile
Chile
fujan.nuryan.dehkordi@gmail.com

Diez Daniela

Universidad Mayor
Chile
danigab.diez@gmail.com

E**Espina Jaime**

Universidad Andrés Bello
Chile
jaime.espina2501@gmail.com

F**Faunes Fernando**

P.Universidad Católica de Chile
Chile
ffaunes@bio.puc.cl

Federici Fernán

P. Universidad Católica de Chile/
Cambridge
Chile/UK
ffederici@bio.puc.cl

Figuroa Ricardo

Universidad de Chile
Chile
ricardofiguroa.bq@gmail.com

Flores Daniela

Universidad de Chile
Chile
danielaflorescampos@gmail.com

Flores-Benitez David

Max-Planck Institute of Molecular Cell
Biology and Genetics
Germany
flores@mpi-cbg.de

G**García Alejandra**

Universidad de Chile
Chile
alecitagarcia@gmail.com

Gómez-González Gabriela

UNAM
Mexico
gabeyre@gmail.com

Guerrero Néstor

Universidad de Chile
Chile
nestorguerrero71@yahoo.com

H**Härtel Steffen**

Universidad de Chile
Chile
shartel@med.uchile.cl

Heller Evan

The Rockefeller University
USA
eheller@rockefeller.edu

Hermosilla Viviana

Universidad de Concepción
Chile
vhermosilla@udec.cl

I**Iglesias Vanessa**

Universidad de Chile
Chile
vanesa.iglesiasfdez@gmail.com

J**Jain Akanksha**

Max-Planck Institute of Molecular Cell
Biology and Genetics
Germany
ajain@mpi-cbg.de

Jara Jorge
Universidad de Chile
Chile
jjaraw@gmail.com

L

Lalena Almudena
Universidad de Chile
Chile
almudena.lalena@gmail.com

Larenas Valeria
Universidad de Chile
Chile
valerialarenas@gmail.com

Lee-Liu Dasfne
P. Universidad Católica de Chile
Chile
dasfnelee@gmail.com

Lemus Carmen Gloria
Universidad de Chile
Chile
yoyalemus@gmail.com

Leyton Lisette
Universidad de Chile
Chile
lleyton@med.uchile.cl

M

Manieu Catalina
Universidad de Chile
Chile
cmanieus@ug.uchile.cl

Marchant Cristián
Universidad Andrés Bello
Chile
foo.marchant@gmail.com

Maureira Miguel
Universidad de Chile
Chile
miguel.maureira@bq.uchile.cl

McDole Kate
Janelia Farm-HHMI
USA
mcdolek@janelia.hhmi.org

Melani Mariana
Fundación Instituto Leloir
Argentina
mmelani@leloir.org.ar

Mertz Aaron
The Rockefeller University
USA
aaron.mertz@yale.edu

Meynard Margarita
Universidad de Chile
Chile
mmeynard@med.uchile.cl

Molina Claudia
Universidad de Chile
Chile
cmolina@med.uchile.cl

Muñoz Leonel
Universidad de Valparaíso
Chile
sagredoster@gmail.com

Muñoz Rosana
P. Universidad Católica de Chile
Chile
rdmuno1@uc.cl

N

Nelemans Ben
VU University-Amsterdam
The Netherlands
b.nelemans@vumc.nl

O

Olguín Patricio
Universidad de Chile
Chile
patricioolguin@med.uchile.cl

P

Palma Karina
Universidad de Chile
Chile
anubis1008@gmail.com

Pasten María Consuelo
P. Universidad Católica de Chile
Chile
mconsuelopasten@yahoo.es

Pérez María Eugenia
Universidad Nacional de Tucumán
Argentina
ma.eugen@gmail.com

Pirez Nicolás
Fundación Instituto Leloir
Argentina
npirez@leloir.org.ar

Pulgar Eduardo
Universidad de Chile
Chile
eduardopulgar.bioq@gmail.com

R

Ramírez Omar
Universidad de Chile
Chile
ojanor@gmail.com

Recabal Antonia
Universidad de Concepción
Chile
antorecabal@udec.cl

Reig Germán
Universidad de Chile
Chile
gerreig@yahoo.com.ar

Reyes Ariel
Universidad Andrés Bello
Chile
ariel.reyes@unab.cl

Marion Rodríguez
Universidad de Concepción
Chile
marionrodriguez@udec.cl

Rosa Viviane
Universidad de Campinas
Brasil
viviane.rrosa@gmail.com

S

Sabio Germán
Weill Cornell Medical College
USA
ges2021@med.cornell.edu

Sangiuliano Federico
ITBA
Argentina
fsangiul@itba.edu.ar

Santibáñez Felipe
Universidad de Chile
Chile
fsantibanez@med.uchile.cl

Schmitz Manuel
VU University-Amsterdam
The Netherlands
b.nelemans@vumc.nl

Sepúlveda Néstor
Universidad de Chile
Chile
nesepulv@gmail.com

Sigle Stefan
Universidad de Chile
Chile
ssigle@stud.hs-heilbronn.de

Signore Iskra

Universidad de Chile
Chile
ailen.signore@gmail.com

Sigot Valeria

Universidad Nacional de Ente Rios
Argentina
vsigot@bioingenieria.edu.ar

T

Tapia Victor

P.Universidad Católica de Chile
Chile
victor.tapia.o@gmail.com

Tinoco-Cuellar Maryana

UNAM
México
mtinoco@email.ifc.unam.mx

Tobias-Santos Vitoria

Universidad Federal Rio de Janeiro
Brasil
vickytsantos@gmail.com

Toledo Jorge

Universidad de Chile
Chile
jorgetoledoh@gmail.com

Torrejón Marcela

Universidad de Concepción
Chile
matorrejon@udel.cl

V

Vega Franco

Universidad de Chile
Chile
franco.vega.2714@gmail.com

Villalón Aldo

Universidad de Chile
Chile
aldo.villalon@gmail.com

Villaseca Soraya

Universidad de Concepción
Chile
sorayavillaseca@udec.cl

Z

Zampedri Maria Cecilia

UNAM
México
czampedri@email.ifc.unam.mx

Zúñiga Nikole

P.Universidad Católica de Chile
Chile
nizuqu@gmail.com