

## Course: Optics, Forces and Development

In vivo 3-D microscopy for the analysis of cell behaviour in developing embryos.

Santiago, Chile, January 14-28th, 2012

|               | m-14 | tu-15 | wed-16         | th-17          | fr-18 | 19 | 20 | m-21 | tu-22 | w-23 | th-24 | fr-25 | 26 | 27 | m-28 | 29 |
|---------------|------|-------|----------------|----------------|-------|----|----|------|-------|------|-------|-------|----|----|------|----|
| 9:00 - 10:30  | 1    | 2a-6b | 2b-4c-6a       | 2c-4b-5a       |       |    |    | 7    |       |      |       |       |    |    |      |    |
| coffee        |      |       |                |                |       |    |    |      | 10    | 11   | 12    | 1     |    |    |      |    |
| 11:00 - 12:30 | 1    | 3a-6c | 3b-4a-5c       | 3c-5b          |       |    |    | 8    |       |      |       |       |    |    |      |    |
| Lunch         |      |       |                |                |       |    |    |      |       |      |       | 3     |    |    |      |    |
| 14:00 - 15:30 | 2    | 4     | 6              | 3              | 4     |    |    | 9    | 9     | 10   | 11    |       |    |    |      |    |
| coffee        |      |       |                |                |       |    |    |      |       |      |       |       |    |    |      |    |
| 16:00 - 17:30 | 3    | 1     | 2              | 1              | 1     |    |    | 5    | 6     | 7    | 4     |       |    |    |      |    |
| coffee        |      |       |                |                |       |    |    |      |       |      |       |       |    |    |      |    |
| 18:00 - 20:00 | 1    | 5     | 7a,b1<br>8b2,c | 7a,b1<br>8a,b1 | 2     |    |    |      | 2     | 3    |       |       |    |    | 5    |    |
|               |      |       |                |                | 2     |    |    |      |       |      |       |       |    |    |      |    |

### Teachers

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### Course organisers

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### Participants

|    |                                                                                                                                                                       |
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| Theoretical Sessions |                                                                                                                                                                          |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                    | Introduction to cell labelling for <i>in vivo</i> imaging. Approaches. Pros & Cons. ( <a href="#">Germán Reig</a> )                                                      |
| 2                    | Introduction to microscopy for <i>in vitro</i> and <i>in vivo</i> imaging. Approaches. Pros & Cons. ( <a href="#">Steffen Hartel</a> )                                   |
| 3                    | Meeting the biological models: zebrafish and killifish ( <a href="#">Miguel Concha</a> )                                                                                 |
| 4                    | Microscopy Theory: Theory of fluorescence. Diffraction theory & diffraction limited resolution. Point Spread Function and convolution ( <a href="#">Steffen Hartel</a> ) |
| 5                    | Microscopy Acquisition: Nyquist / Sampling Theorem. Signal/noise ratio. Deconvolution ( <a href="#">Steffen Hartel</a> )                                                 |
| 6                    | Digital image formation and restoring: digital images, deconvolution, thresholding, pixel-level filters ( <a href="#">Jorge Jara</a> )                                   |
| 7                    | <i>In vitro</i> and <i>in vivo</i> approaches to cell migration ( <a href="#">Germán Reig</a> )                                                                          |
| 8                    | Image Analysis 1: registration, segmentation, object representation ( <a href="#">Jorge Jara</a> )                                                                       |
| 9                    | Image Analysis 2: shape and topology description ( <a href="#">Mauricio Cerda</a> )                                                                                      |
| 10                   | Optical approaches to measure forces in development ( <a href="#">Carl-Philipp Heisenberg</a> )                                                                          |
| 11                   | Image Analysis 3: motion estimation: diffusion (FRAP), optical flow, tracking ( <a href="#">Mauricio Cerda</a> , <a href="#">Felipe Santibáñez</a> )                     |

| Practical / Tutorial Sessions |                                                                                                                                                                                             |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                             | Manipulation of embryos: zebrafish ( <a href="#">Janina Borgonovo</a> , <a href="#">Néstor Guerrero</a> ) and killifish ( <a href="#">Valeria Larenas</a> )                                 |
| 2                             | Microinjection of embryos - zebrafish ( <a href="#">Janina Borgonovo</a> , <a href="#">Néstor Guerrero</a> )                                                                                |
| 3                             | Microinjection of embryos - killifish ( <a href="#">Germán Reig</a> )                                                                                                                       |
| 4                             | Photoconversion of fluorescent proteins ( <a href="#">Carmen Lemus</a> )                                                                                                                    |
| 5                             | <i>In vivo</i> electroporation ( <a href="#">Margarita Meynard</a> )                                                                                                                        |
| 6                             | Fluorescent Recovery After Photobleaching - FRAP ( <a href="#">Omar Ramírez</a> )                                                                                                           |
| 7                             | Confocal microscopy Image Acquisition: Spinning disc (PPo: <a href="#">C. Lemus</a> , <a href="#">M. Cerda</a> ); Leica LSI (DCs: <a href="#">G. Reig</a> , <a href="#">F. Santibáñez</a> ) |
| 8                             | Image restoring - deconvolution (PPo and ER: <a href="#">Omar Ramírez</a> )                                                                                                                 |
| 9                             | Mechanics and estimation of forces in cell biology ( <a href="#">Roberto Bernal</a> )                                                                                                       |
| 10                            | Laser mediated cell ablation & estimation of forces in developmental biology ( <a href="#">C.P. Heisenberg</a> , <a href="#">Eduardo Pulgar</a> , <a href="#">Germán Reig</a> )             |
| 11                            | Shape and topology description (Segmented cells of PPo and DCs: <a href="#">Mauricio Cerda</a> )                                                                                            |
| 12                            | Motion estimation (Tracking and optical flow for sperm motion and light sheet microscopy): <a href="#">Víctor Castañeda</a> )                                                               |

| Lectures on Applications of Advanced Biological Imaging |                                                                                                           |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 1                                                       | Analysis of molecular mobility by microscopy ( <a href="#">Ulrich Kubitscheck</a> )                       |
| 2                                                       | Application of Light Sheet Microscopy ( <a href="#">Jan Spille</a> )                                      |
| 3                                                       | Practical aspects of confocal laser scanning microscopy ( <a href="#">Ulrich Kubitscheck</a> )            |
| 4                                                       | Biophysics at the microscale: Optical trapping and applications ( <a href="#">Juan Pablo Staforelli</a> ) |
| 5                                                       | Cell mechanics in Cell Biology ( <a href="#">Roberto Bernal</a> )                                         |
| 6                                                       | Measurement of cell adhesion in zebrafish gastrulation ( <a href="#">Carl-Phillip Heisenberg</a> )        |
| 7                                                       | Image analysis to study structure and dynamics of the cytoskeleton ( <a href="#">Florian Rehfeldt</a> )   |

| Seminar presentations by participants / Discussion of papers |                                                                                                                                                                     |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                                            | Super-Resolution Microscopy ( <a href="#">Mauricio Cerda</a> , <a href="#">Felipe Santibáñez</a> ) - <u>Participants</u> : Akle, Bahamondes, Díaz                   |
| 2                                                            | Forces and Microscopy ( <a href="#">Carl-Philipp Heisenberg</a> ) - <u>Participants</u> : Esparza, Figueroa, Glavic                                                 |
| 3                                                            | Differentiation of adult stem cells guided by matrix mechanics ( <a href="#">Florian Rehfeldt</a> ) - <u>Participants</u> : Lepanto, Olguín, Ortiz                  |
| 4                                                            | Image Processing ( <a href="#">Jorge Jara</a> , <a href="#">Mauricio Cerda</a> , <a href="#">Felipe Santibáñez</a> ) - <u>Participants</u> : Pereira, Plavan, Ulloa |

|   |                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------|
|   | Evaluation seminar of participants / Discussion of integrative papers                                                                   |
| 1 | Integrative Seminars ( <a href="#">Miguel Concha</a> , <a href="#">Steffen Hartel</a> ) - <u>Participants</u> : all divided in 4 groups |

|   |                                                   |
|---|---------------------------------------------------|
|   | Mini-seminars of student projects (15 mins talks) |
| 1 | Students a - b1                                   |
| 2 | Students b2 - c                                   |

|   |                                                   |
|---|---------------------------------------------------|
|   | Other Events                                      |
| 1 | Introduction to the course                        |
| 2 | Social activity: dinner at "Los Buenos Muchachos" |
| 3 | Course Evaluation                                 |
| 4 | Social activity: trip & BBQ in Cajón del Maipo    |
| 5 | Closing Event of BNI Symposium                    |

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
|   | BNI NETWORK SYMPOSIUM on Advanced Microscopy ---- January 28th, 2013 ---- 10-16 hrs                                                 |
| 1 | Tutorial on Super-resolution fluorescence microscopy ( <a href="#">Jorg Enderlein</a> )                                             |
| 2 | Strategies for the analysis of cell dynamics ( <a href="#">Steffen Härtel</a> )                                                     |
| 3 | Carbon nanotubes reveal single and collective dynamics of proteins in cells and in whole organisms ( <a href="#">Nikta Fakhri</a> ) |
| 4 | ER dynamics ( <a href="#">Andrés Couve</a> )                                                                                        |
|   | LUNCH                                                                                                                               |
| 5 | Structure and dynamics of the stem cell cytoskeleton - mechanics matters ( <a href="#">Florian Rehfeldt</a> )                       |
| 6 | Collective cell migration and tissue morphogenesis ( <a href="#">Miguel Concha</a> )                                                |
| 7 | Cell and tissue mechanics in zebrafish gastrulation ( <a href="#">Carl-Philip Heisenberg</a> )                                      |
| 8 | Mechanosensing with primary cilia ( <a href="#">Christoph Schmidt</a> )                                                             |