



## Plachta Group

Revealing the dynamic mechanisms that pattern a mammalian embryo is key to understanding human biology and disease, yet few experimental systems permit to study the dynamic physical aspects of cells and molecules in living mammalian embryos.

The Plachta Group combines single-cell imaging and quantitative methods to discover how the dynamic behaviour of DNA-binding molecules controls the development of the first specialised cells in living mouse embryos. The Group recently established new experimental assays to visualise the movement of transcription factors, which are key regulatory molecules controlling gene expression, in four dimensions (x, y, z and time).

The Group's experiments are undertaken at the single cell level, in real time in intact embryos. This approach allows them to probe biochemical events typically studied in fixed specimens or in cell homogenates often lacking the spatiotemporal dynamics of in vivo systems.

They extend these studies by comparing pluripotent cells in the embryo to several stem cell lines cultured in vitro, which are derived from the actual embryo (such as ES cells) or that are reprogrammed from somatic cell lineages (iPS cells). In addition, the Group's has developed live imaging tools to study the cellular mechanisms governing the formation of the first tissue-like structures in the embryo, with a particular focus on cell movements and formation of the central nervous system.

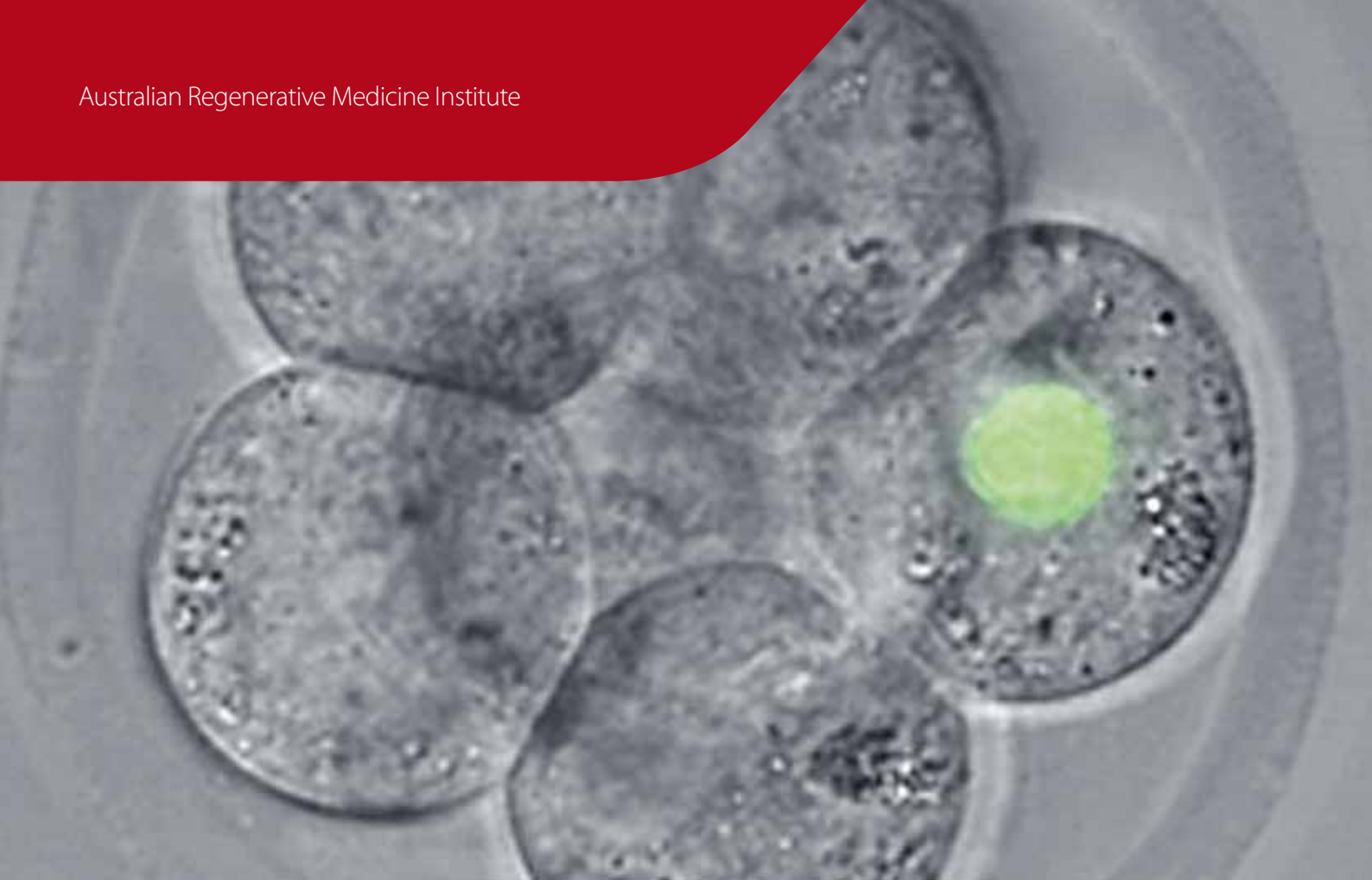
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### **Dr Nicolas Plachta**

Dr Plachta is an expert in biological imaging and embryonic development. His research provides insights into how cells and molecules interact during the early stages of life and may provide knowledge that is key to understanding, preventing and treating a range of diseases. Dr Plachta has recently been able to study key biological processes guiding embryonic development, such as gene expression dynamics in intact mammalian embryos.

Before joining ARMI as the second EMBL Australia Partner Laboratory Network Group Leader, Dr Plachta worked at the Biological Imaging Centre of the California Institute of Technology and at the Biozentrum of the University of Basel.





## Research themes

### Dynamics of gene regulatory molecules in living embryos

Little is known at present about the kinetic movement of transcription factors in intact organisms. The Plachta Group recently developed new imaging tools to study the mobility of gene regulatory proteins in live mouse embryos at the quantitative and single-cell levels. Using these tools, the Group has measured in the early embryo the main kinetic behaviours exhibited by the transcription factors that are essential to control the pluripotent state of cells. This led to the discovery that not all blastomeres exhibit the same transcription factor kinetics, and that distinct kinetic states are important to predict the establishment of the pluripotent and the extra-embryonic cell lineages of the embryo. These studies now help us to understand how identical cells adopt different fates during embryonic development and to identify transcription factor kinetics as a new mechanism to establish cell-to-cell variability in vivo. The Group is currently trying to understand the main molecular mechanisms controlling the kinetics of transcription factors in vivo.

### Cell dynamics of tissue formation

In addition to studying the movement of gene regulatory molecules, the Plachta Group uses quantitative live imaging tools

to understand how single cells move and interact with each other to form some of the first tissue-like layers of the embryo. They can now visualise the main morphological changes and the migratory behaviour of single cells in live mouse embryos as they form some of the first muscles and main structures of the central nervous system. To better understand how tissues and organs first form in the embryo, and to better plan strategies to repair adult organs, the Group wants to understand how single cells behave in different parts of the embryo and how individual genes control cell dynamics in vivo.

*Top: Real-time live imaging of a mouse embryo undergoing its first mitotic division (0.5 days post fertilisation). Separating chromosomes are labelled green and the cell membrane red.*

*Right: Real-time live imaging of a mouse after completion of gastrulation surrounded by extra-embryonic membranes (8 days post fertilisation). The closing head folds and future umbilical cord are visible.*



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Dr Plachta is the second EMBL Australia Partner Laboratory Network (PLN) Group Leader. The PLN is based on the highly successful EMBL model. It comprises distributed, tightly integrated research centres that focus on complementary aspects of biological research.

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