

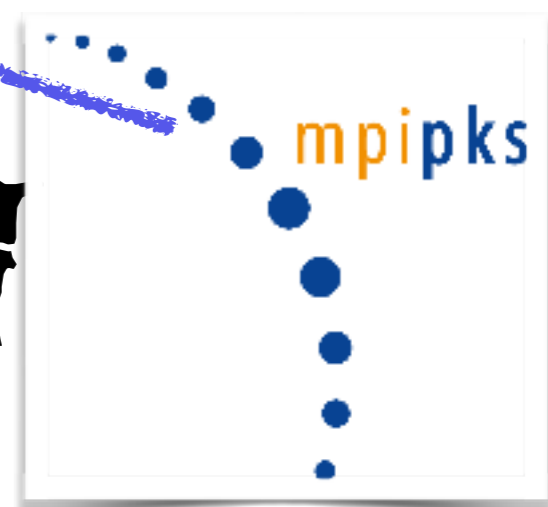
BSYT Alumni day November 2014

Jens Karschau

career path and projects from 2008 up to today

studienarbeit 2008

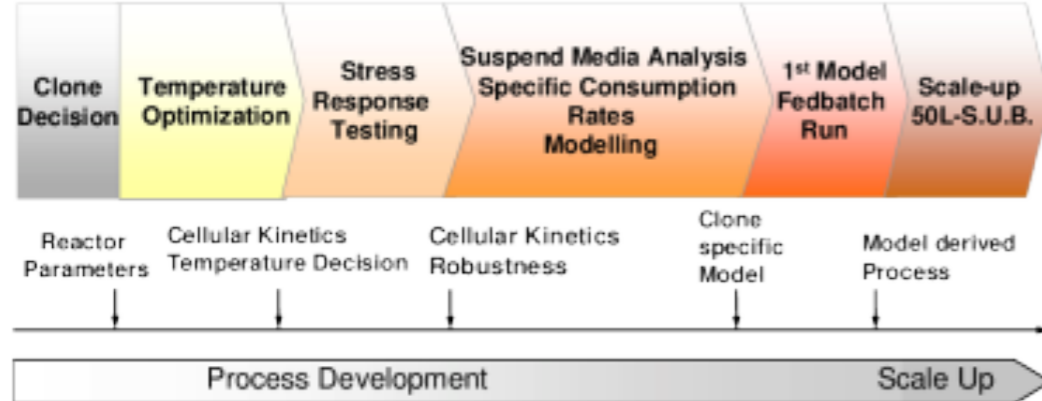
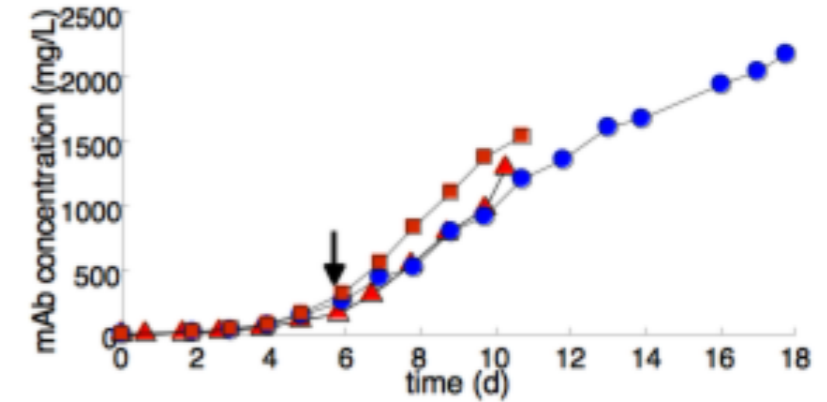
PhD Physics 2009-2013



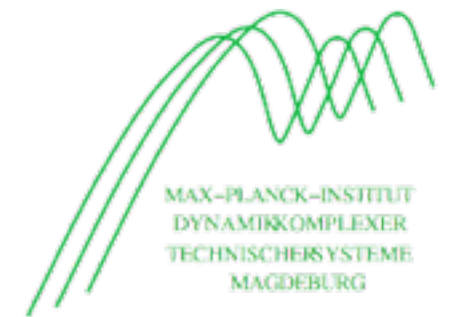
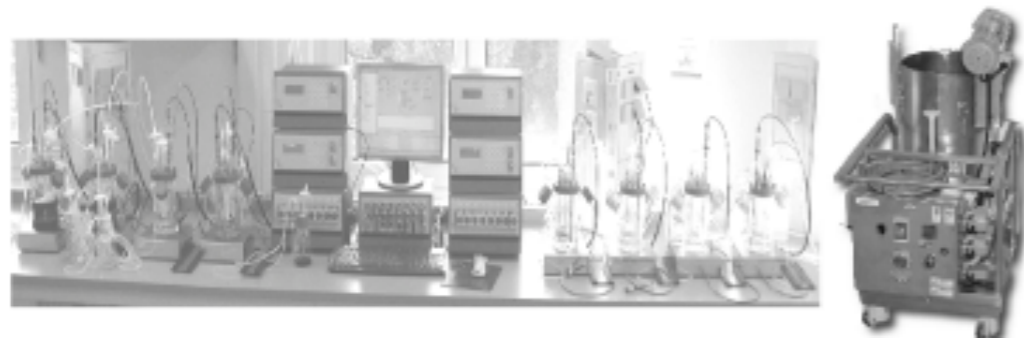
guest scientist
2014-present

Animal Cell Process Engineering

How to increase product yield of a process for monoclonal antibody production?



- Design of experiments
- Experimental and theoretical investigation of clonal diversity
- Identification of growth condition dependant nutrient needs along with metabolic flux-balance modelling
- Optimal process control for maximal product yield



Udo Reichl
Andreas Kremling
Yvonne Genzel

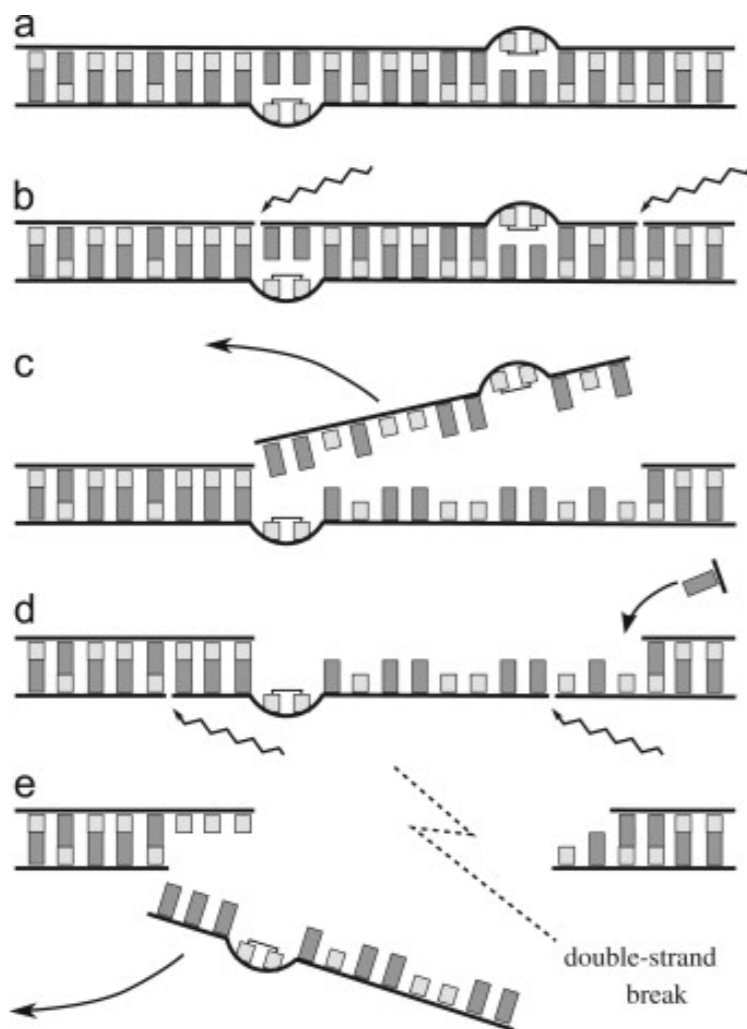
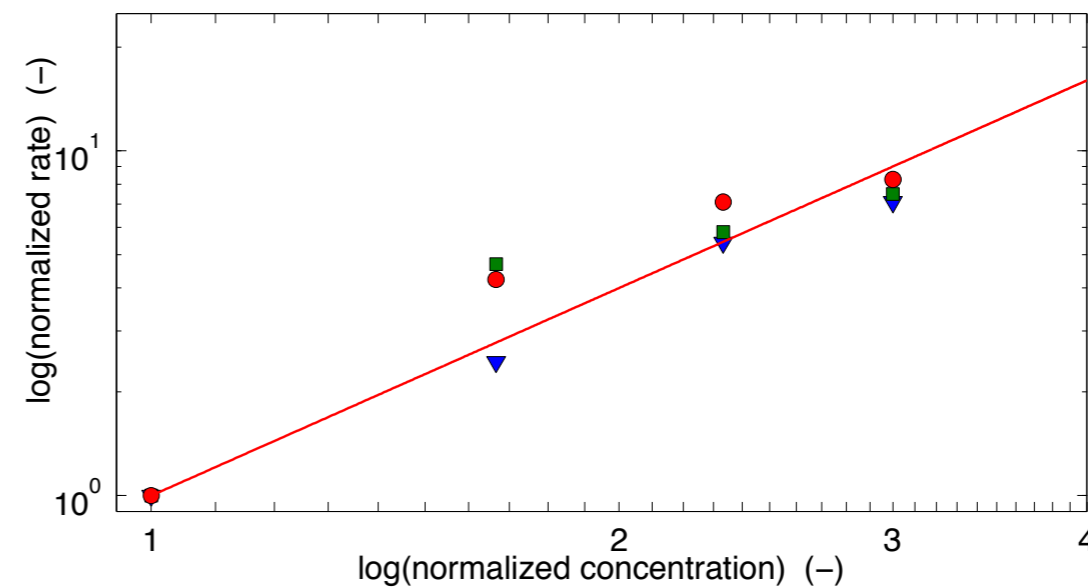
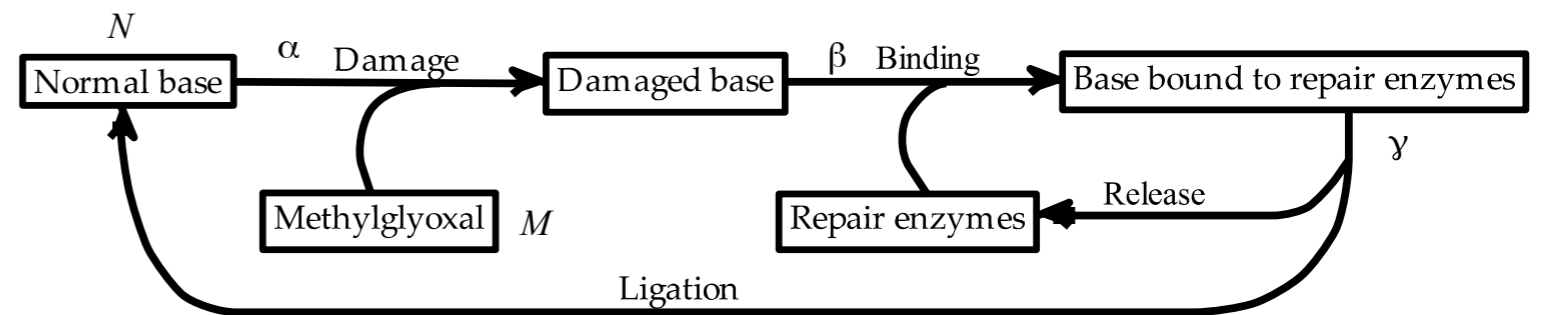
©Jens Karschau 2014

DNA damage and repair

A Matter of Life and Death
 Stochastic Modelling of *E. coli* Exposed to
 Methylglyoxal Stress

J. Karschau *et al.*, Biophysical Journal. 2011; 100(4) 814-21

Survival:
$$T = \frac{2\gamma \ln 2}{\alpha^2 L} N^{-1} M^{-2}$$



M. Richard *et al.*, J. Theo. Biology. 2012; 292 39-43

MAX-PLANCK-INSTITUT
 DYNAMIK KOMPLEXER
 TECHNISCHER SYSTEME
 MAGDEBURG



Ian R. Booth
 Alessandro de Moura
 Celso Grebogi



Andreas Kremling
 (now TU Munich)

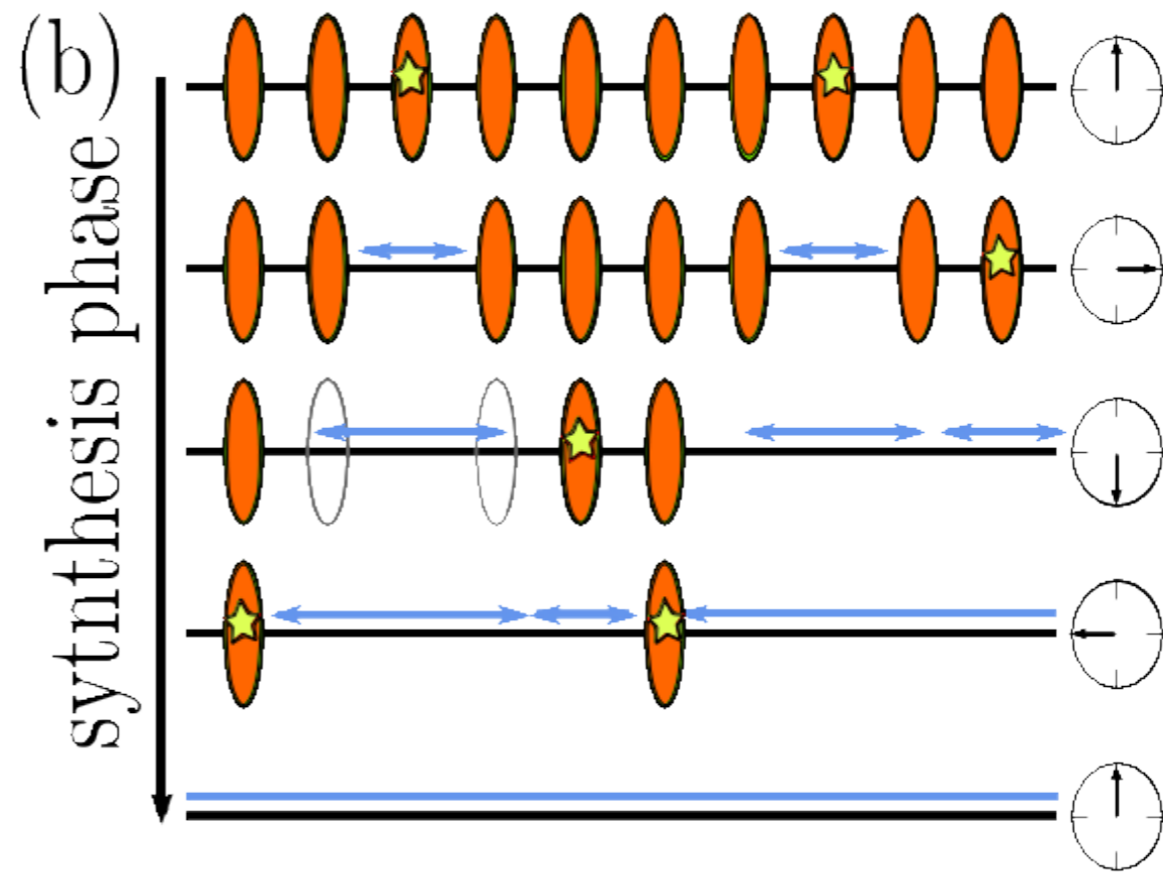
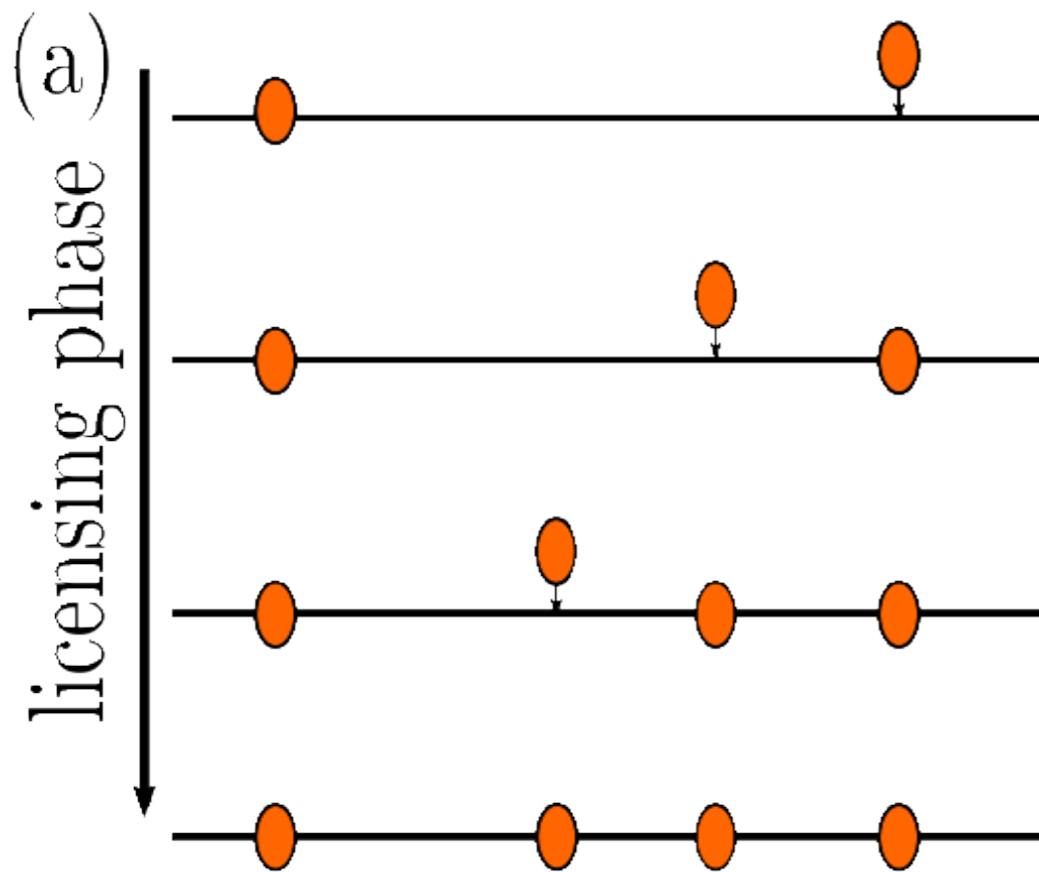
©Jens Karschau 2014

Mechanisms of DNA replication

Origin licensing and their activation are timely separated.

DNA replication is divided into **two distinct phases** to avoid re-replication of already replicated DNA.

- 1) Origin licensing
- 2) Origin activation and DNA synthesis in S-phase

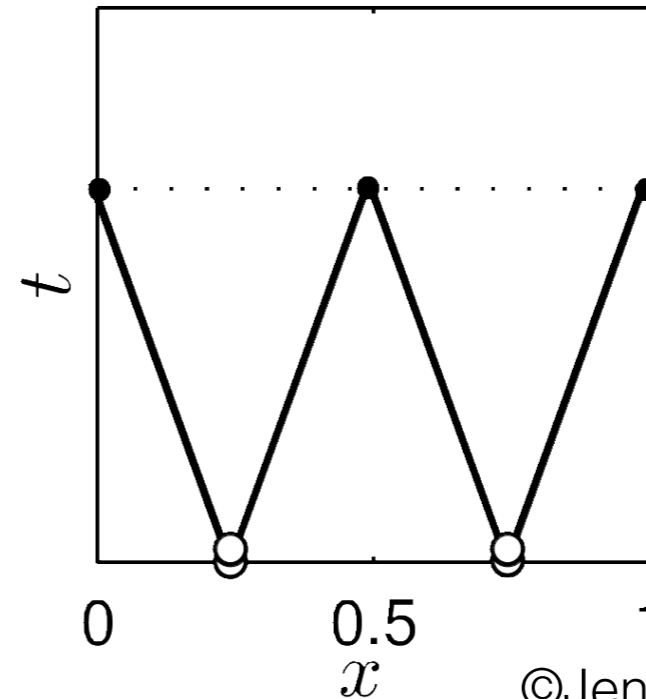
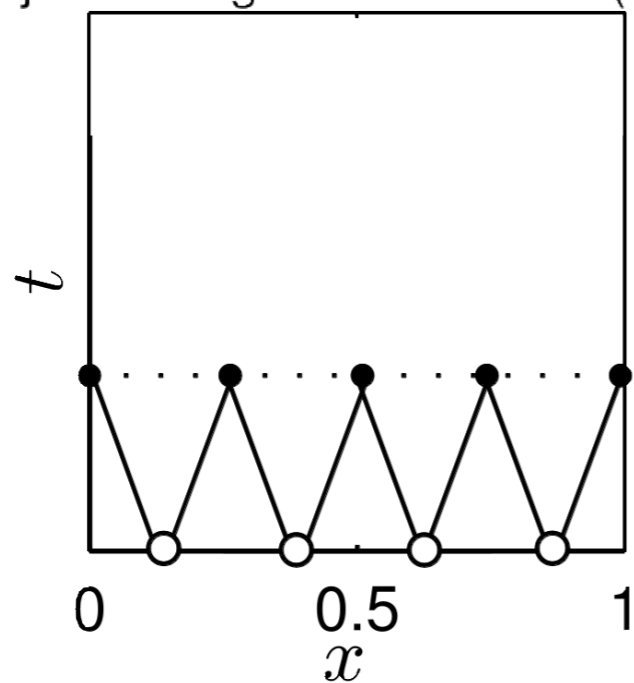
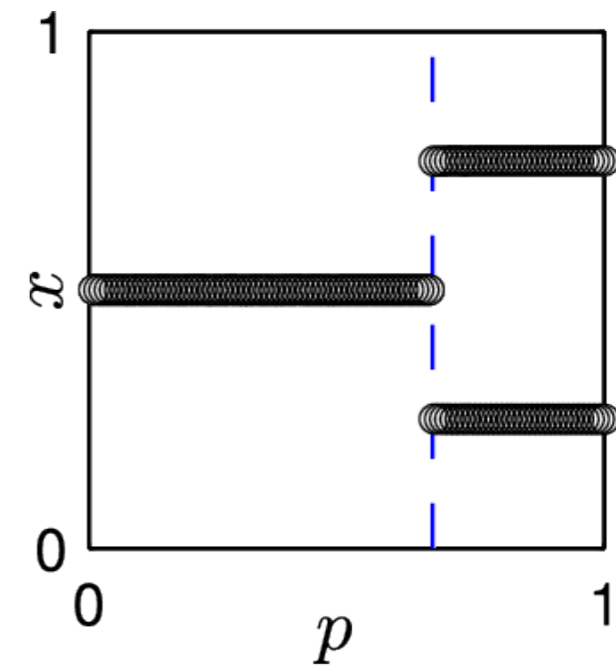
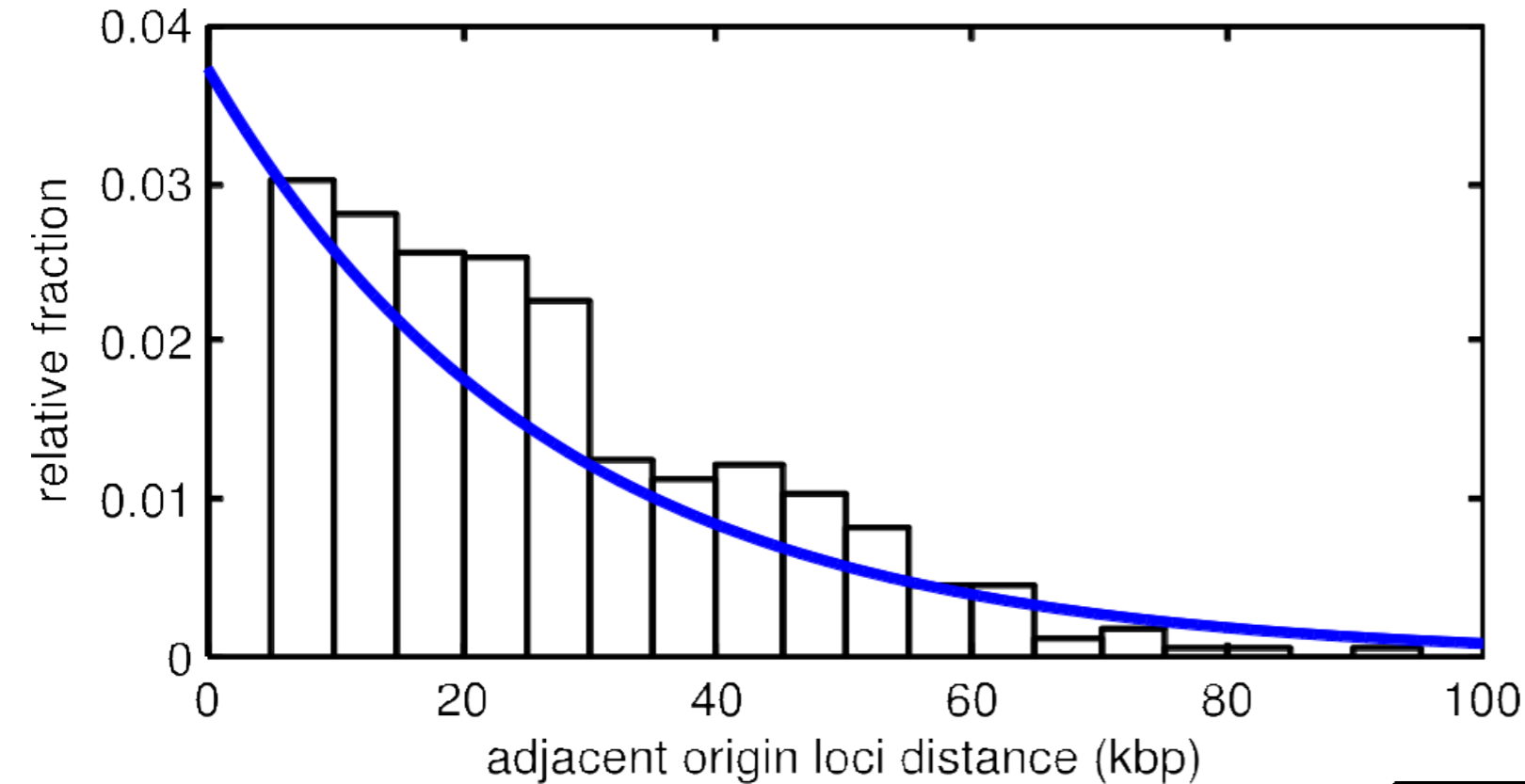


Minimum Replication Time

Optimal Placement of Origins for DNA Replication

J. Karschau, J.J. Blow, and A.P.S. de Moura. Physical Review Letters. 2012; 108(5):058101.

What are preferred locations for origins
if their licensing and activation are stochastic?



J. Julian Blow



Alessandro de Moura



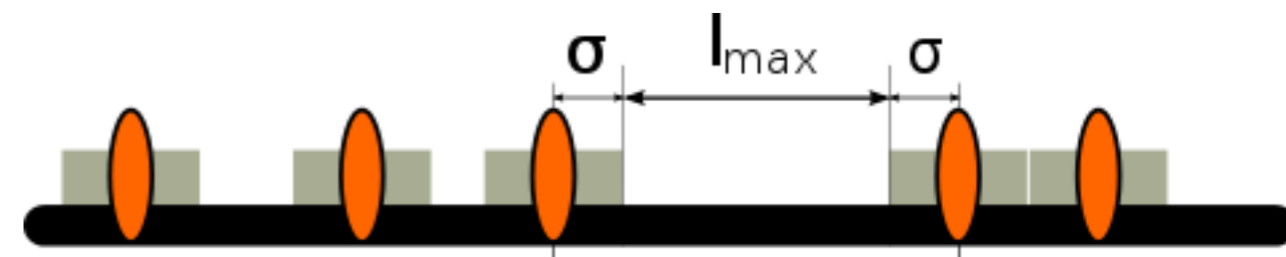
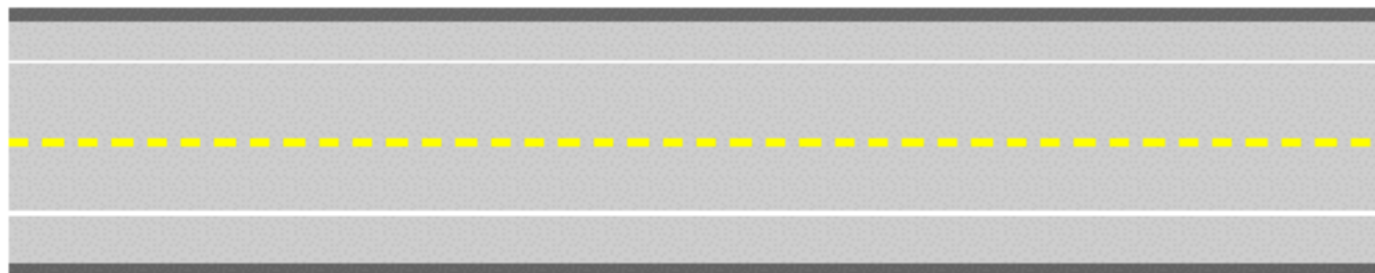
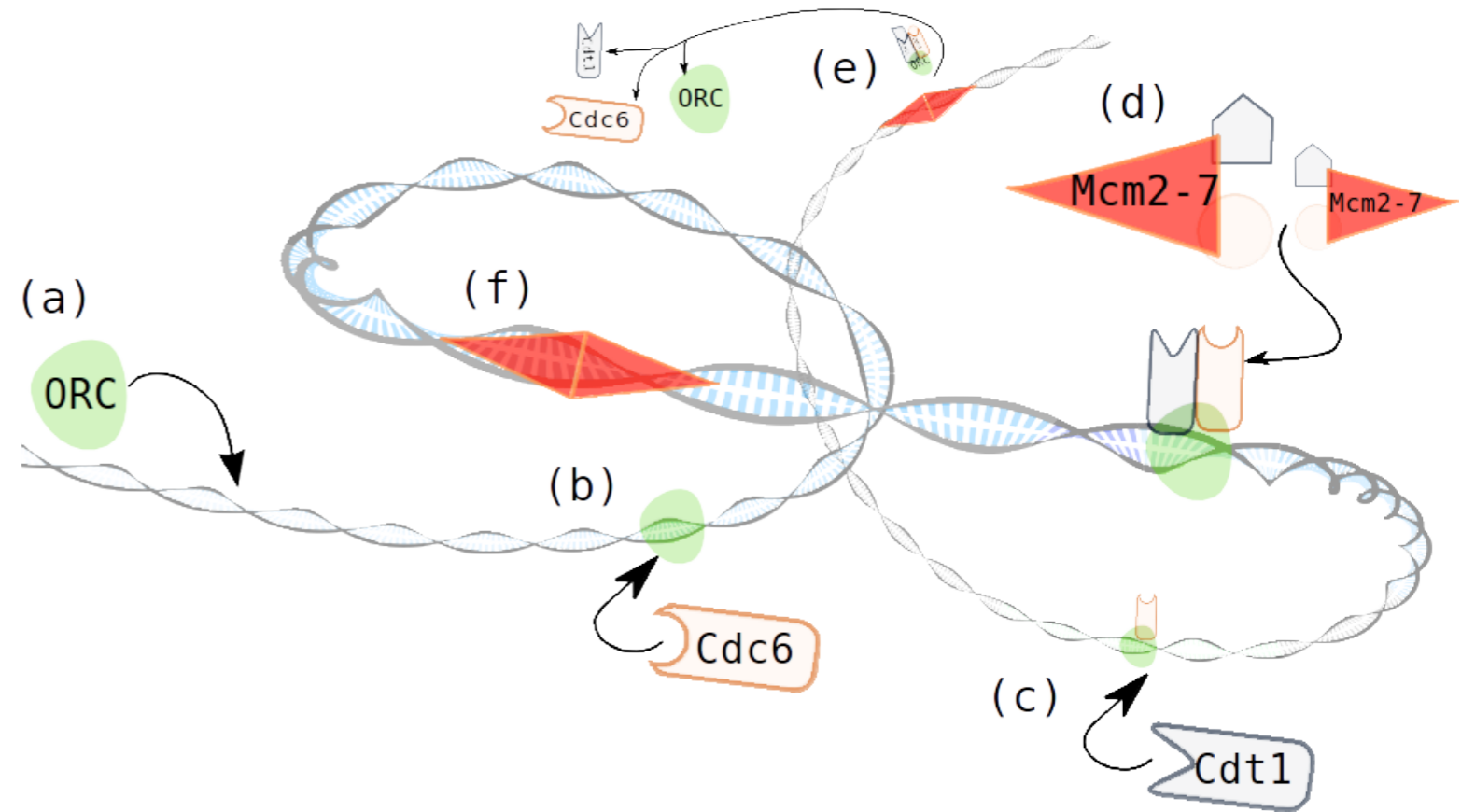
©Jens Karschau 2014

The random completion problem – a car-parking problem

P. Gillespie*, J. Karschau*, J. Kisielewska, J.J. Blow and A.P.S. de Moura, *in preparation*.

*equal contribution.

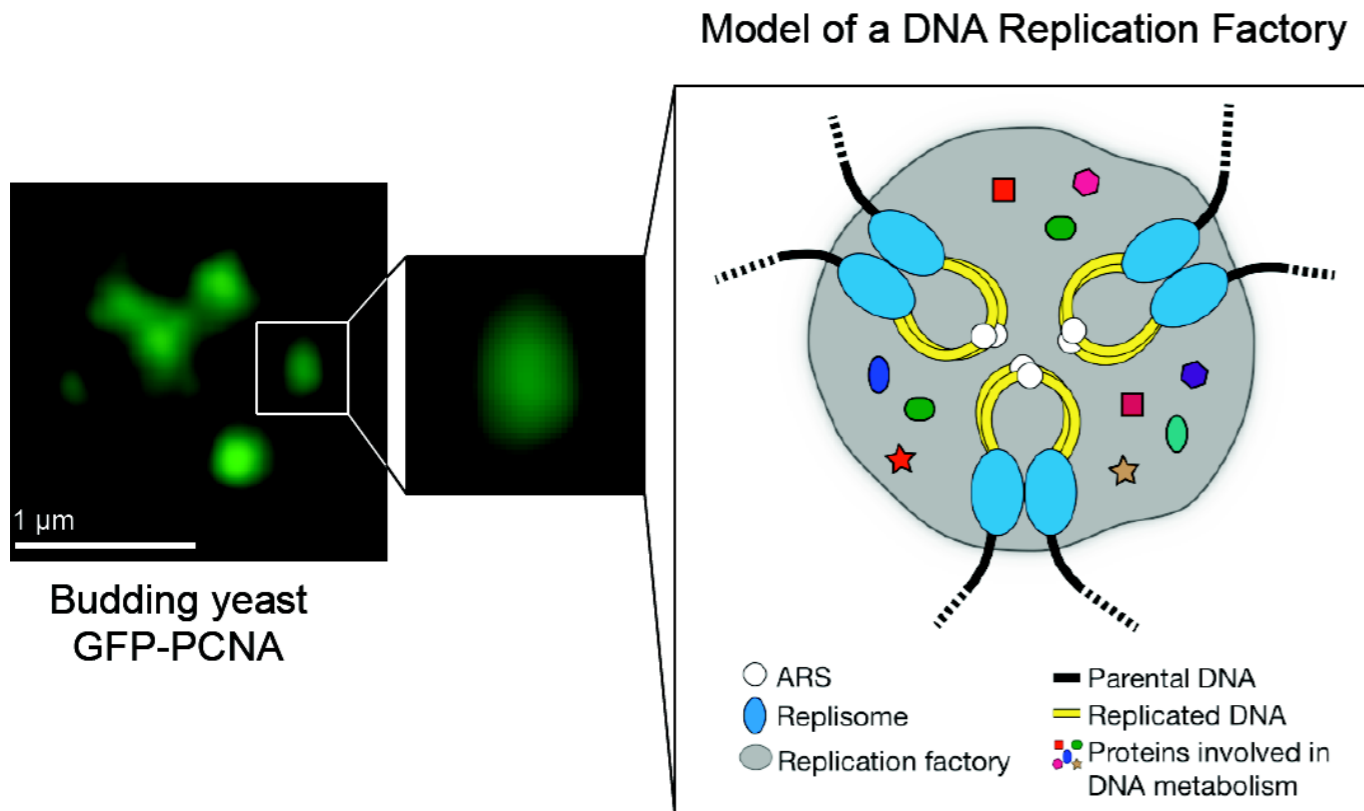
Modelling of the process of protein binding to DNA in an analogy to cars parking along a street.



Replication Factories

Spatial Organisation of DNA Replication within the yeast nucleus

N. Saner, J. Karschau, T. Natsume, M. Gierlinski, R. Retkute, M. Hawkins, C. Nieduszynski, J.J. Blow, A.P.S. de Moura, T. Tanaka,
Stochastic Association of neighboring replicons creates replication factories in budding yeast. Journal of Cell Biology 7(202):1001-12. 2013



Adapted from Frouin, I *et al.* 2003
Falaschi, A. 2000
Kitamura, E *et al.* 2006

Sites at which DNA replication takes place

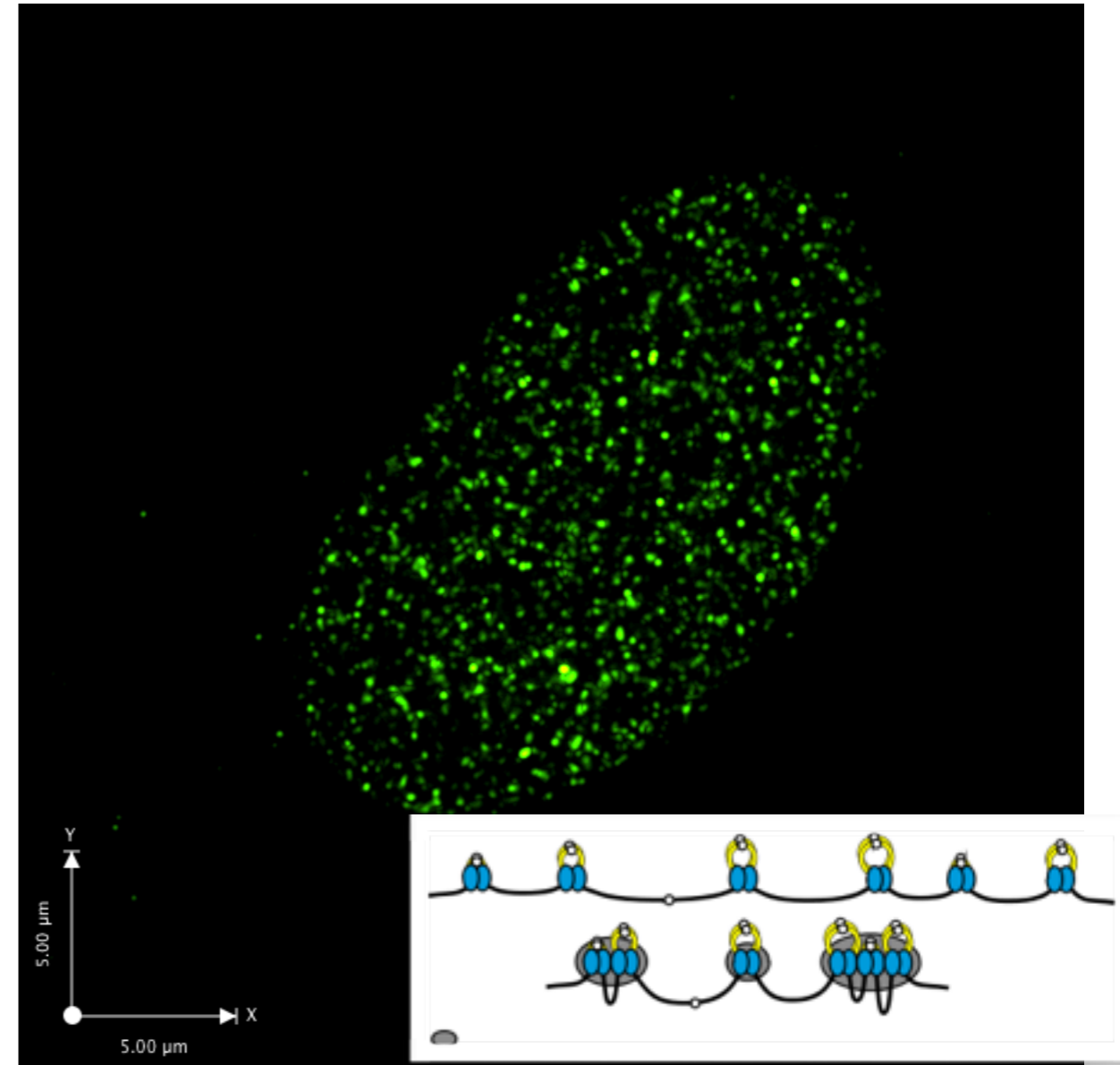


Photo: Debbie McIntosh, J.J.B. lab

Replication factories are compartment-like structure
However there is no physical boundary that keeps
replication forks together.



Tomoyuki Tanaka
Julian J. Blow
Nazan Saner

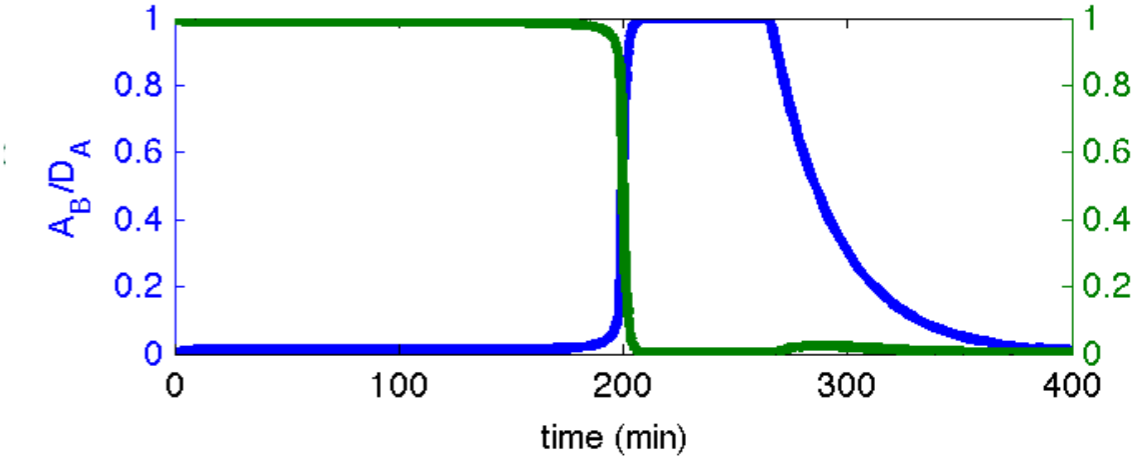
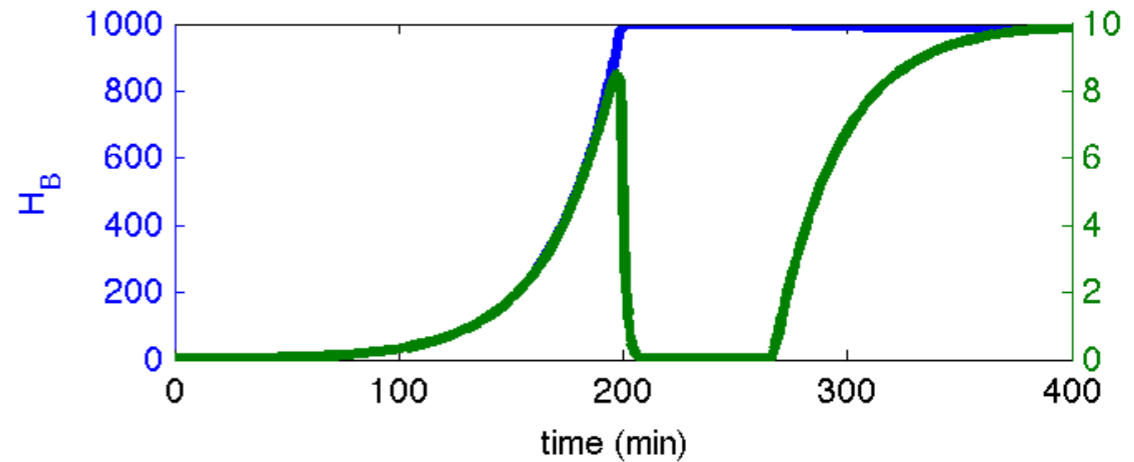
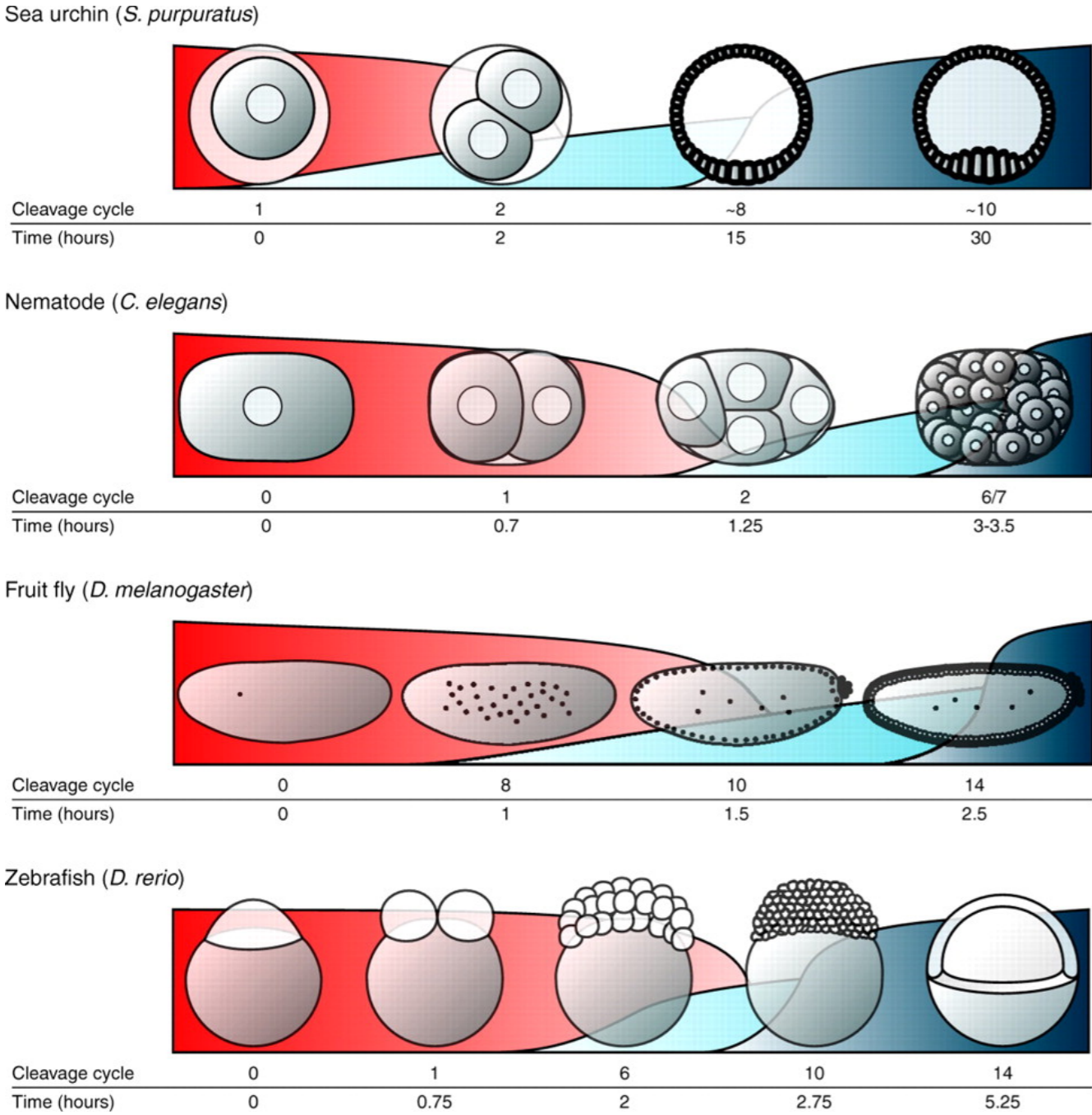


Alessandro de Moura



Conrad Nieduszynski
©Jens Karschau 2014

Genome activation in early embryos



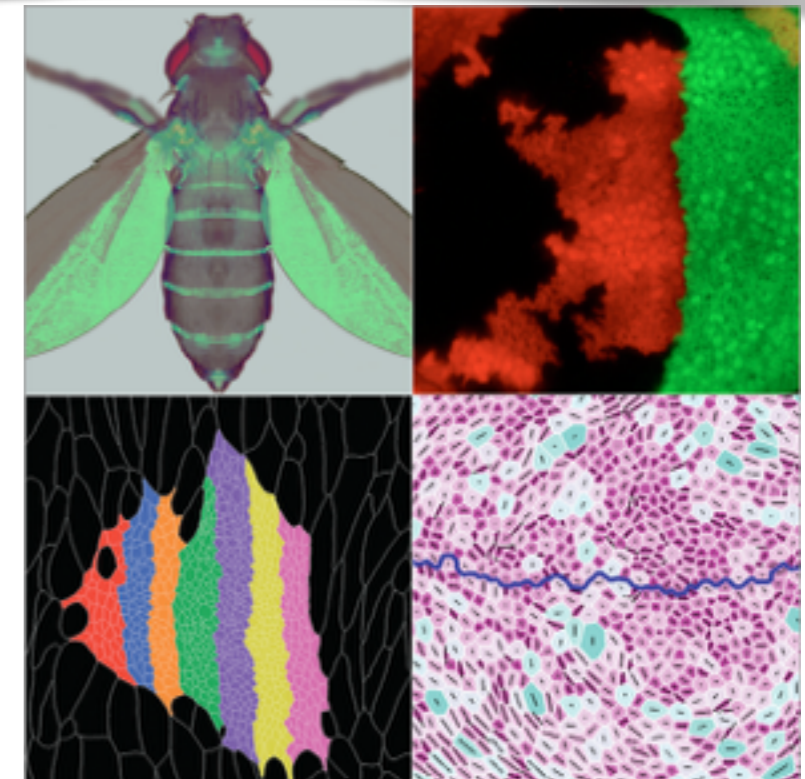
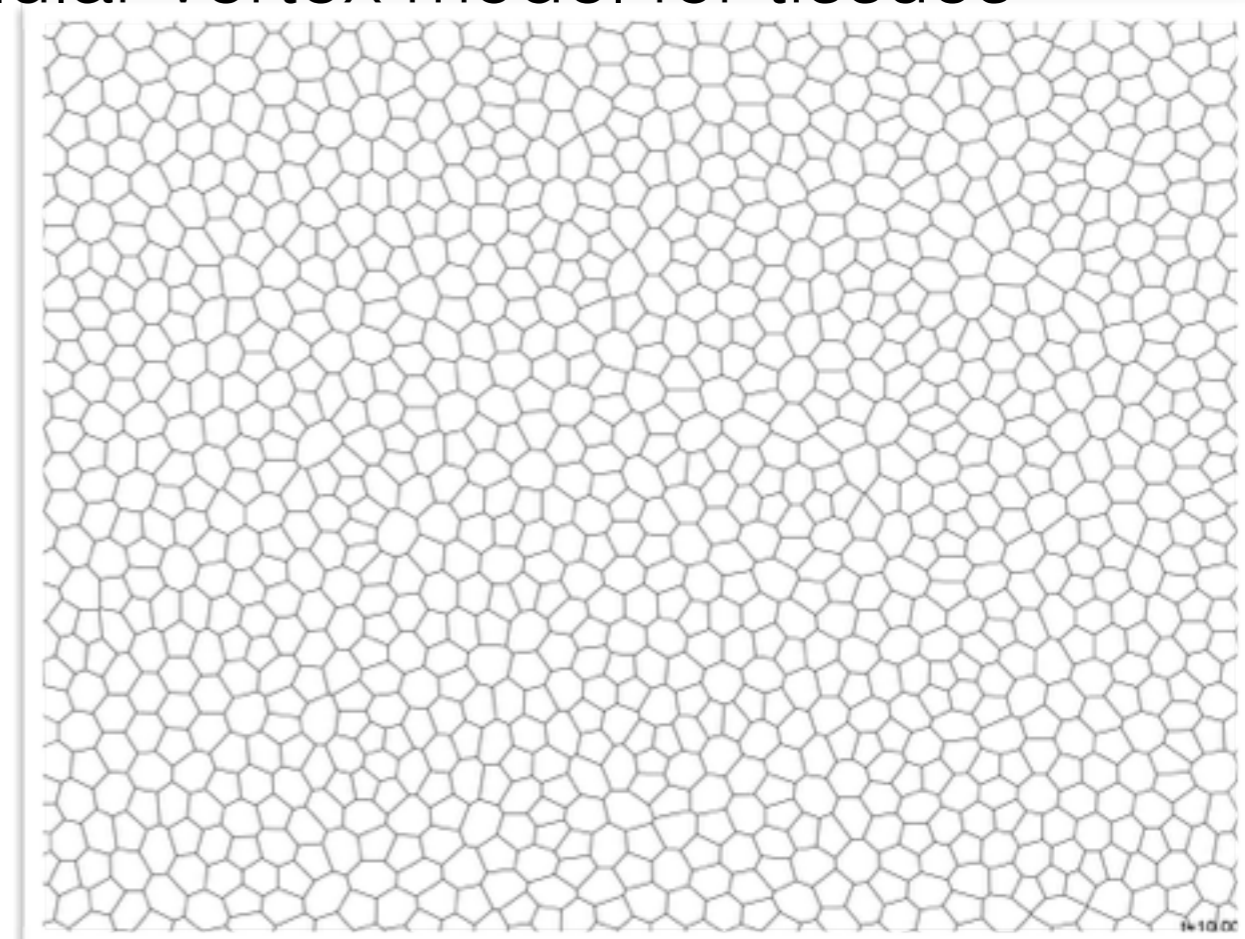
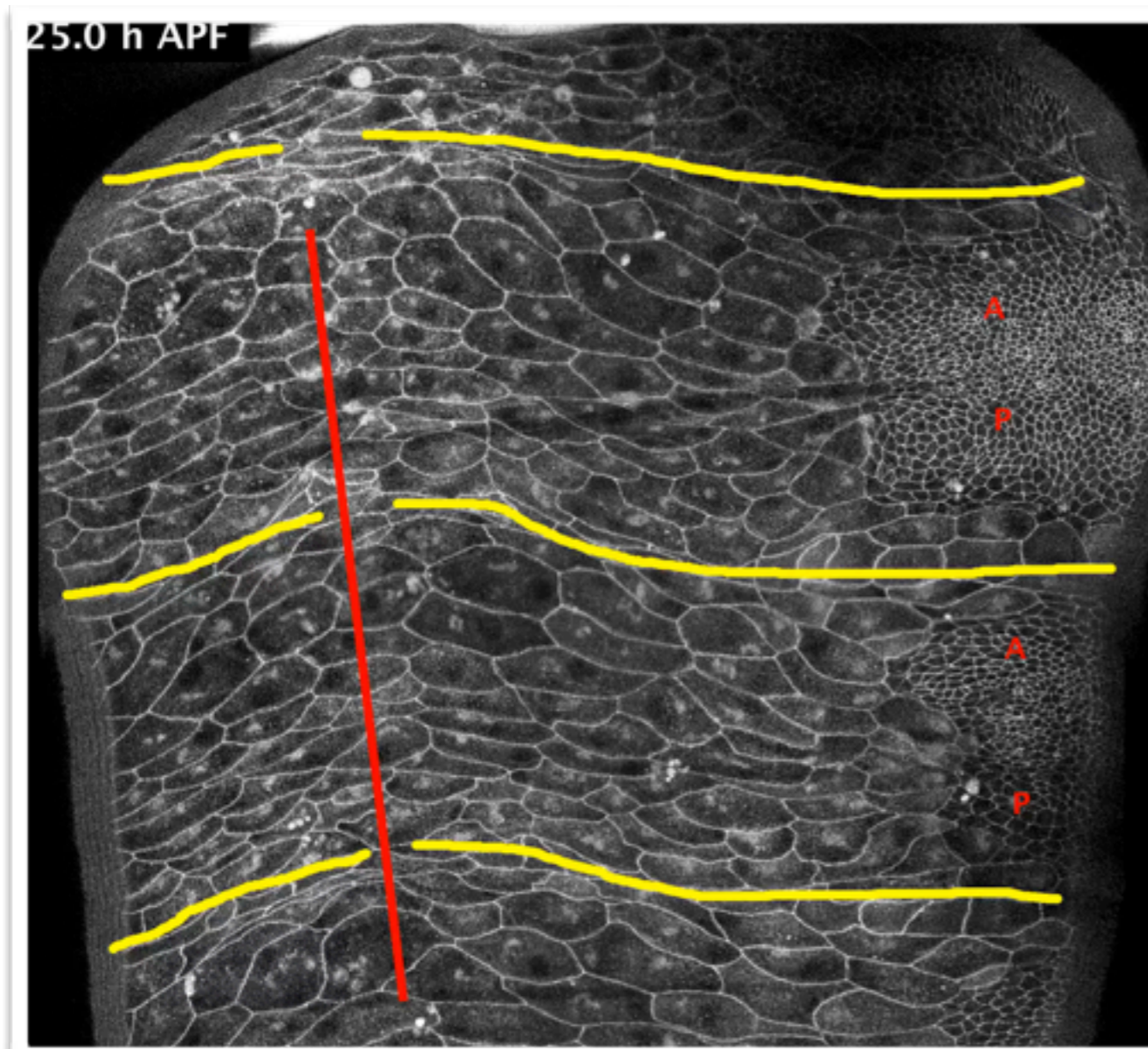
Modelling of competition for DNA binding sites

More general: What sets the time point of genome activation in activator repressor model?

Tadros and Lipshitz, 2009

Tissue formation and cellular mechanics

Modelling of cell mechanics using a cellular-vertex model for tissues



top left, bottom right figures:
courtesy of C. Dahmann group TUD



Frank Jülicher
Christian Dahmann
Marcus Michel



Funding acknowledgements



IOP Institute of Physics

