

## Mid - Term Review

January 23rd, 2014

IHP - Paris, France

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Ph. D. Student at

**LPTMS - Laboratoire de Physique Théorique  
et Modèles Statistiques**

Orsay, France

**Supervisors: Prof. Silvio Franz & Prof. Olivier Martin**



Past...



## Bachelor's and Master's degree

at Sapienza University of Rome

under the supervision of Prof. **Enzo Marinari** and  
**Francesca Di Patti**, Ph.D.

Specialization in *Statistical Physics and Systems Biology*

with two extra-curriculum attended courses of  
*Biochemistry and Molecular Biology*



# Training so far...

**Concepts fondamentaux de la biologie et de l'écologie** by M. El Karoui, C. Dillmann and T. Giraud within the master's degree in **Mathématiques pour les Sciences du Vivant** at Université Paris - Sud XI, Orsay, France, September 2012.

**Advanced French** organized by **CNRS**, April 2013.

Several conferences in the Île-de-France.

**Seminars at the host - institution** (especially those of **Physics - Biology Interface** organized by Martin Lenz (LPTMS) at LPS - Saclay over the whole 2013).

# Training so far...

**Spring School in Complex Systems** at ICTP, Trieste, Italy - May - June 2013 .

**Cargèse Summer School on Quantitative Population Genetics** - July 2013 organized by M. Vergassola (UCSD, USA), A. Walczak (ENS, Paris) and M. Desai (Harvard, Boston, USA).

**Hillerod NETADIS Summer School**, Denmark, September 2013.

**Collaboration** at Sapienza Università di Roma, with Prof. **Enzo Marinari** and **Andrea De Martino**, February 2013.

**Secondment at King's College of London** under the supervision of Prof. **Peter Sollich**, November-December 2013.

# Short - Term Planned Training...

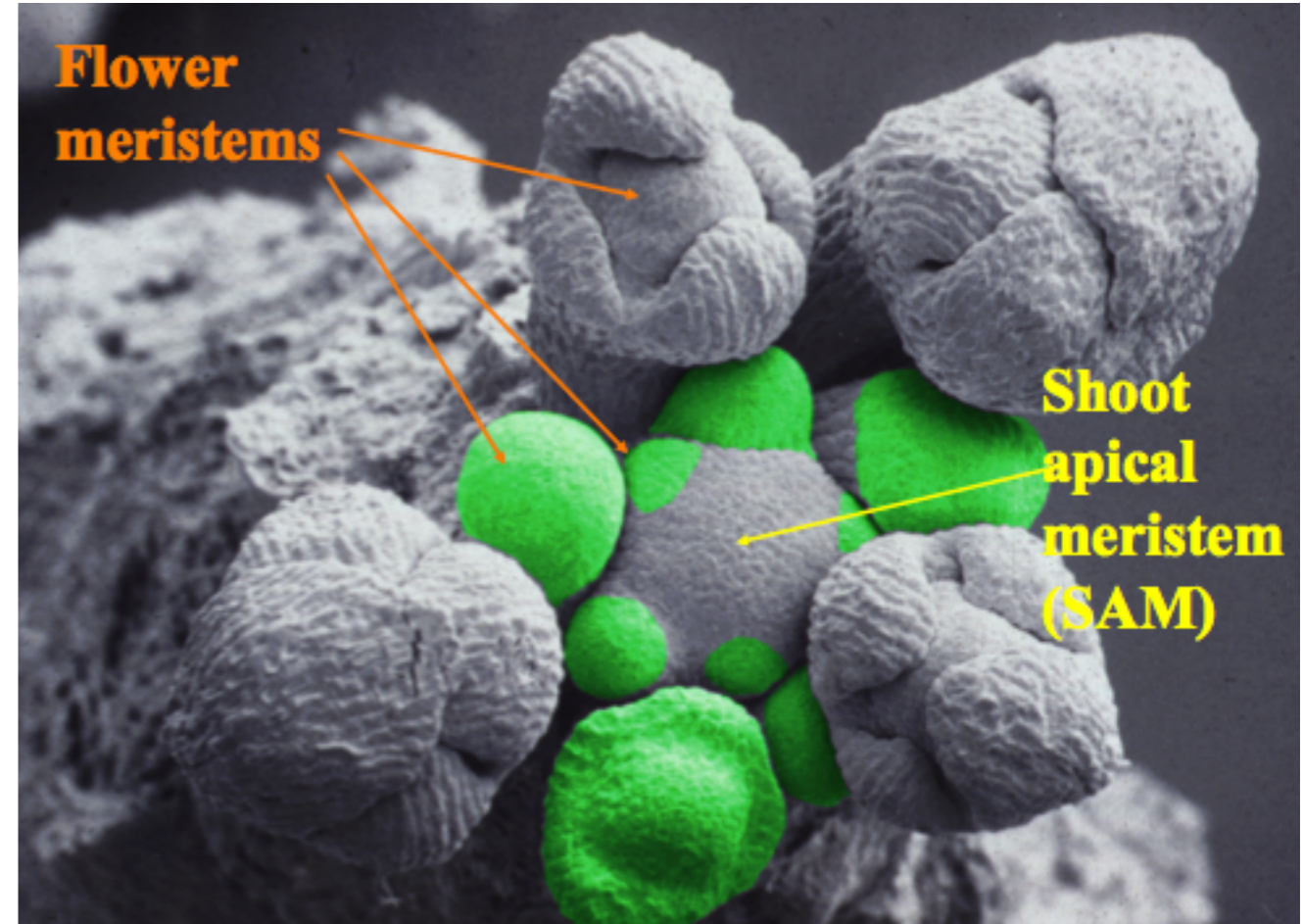
**Journées de Physique Statistique**, January 31st, ESPCI, Paris, France

**Statistical Inference in Physics**, doctoral class (ED107), May 2014

**Netadis Summer School**, July 2014, Cortona, Italy

**Second Secondment**

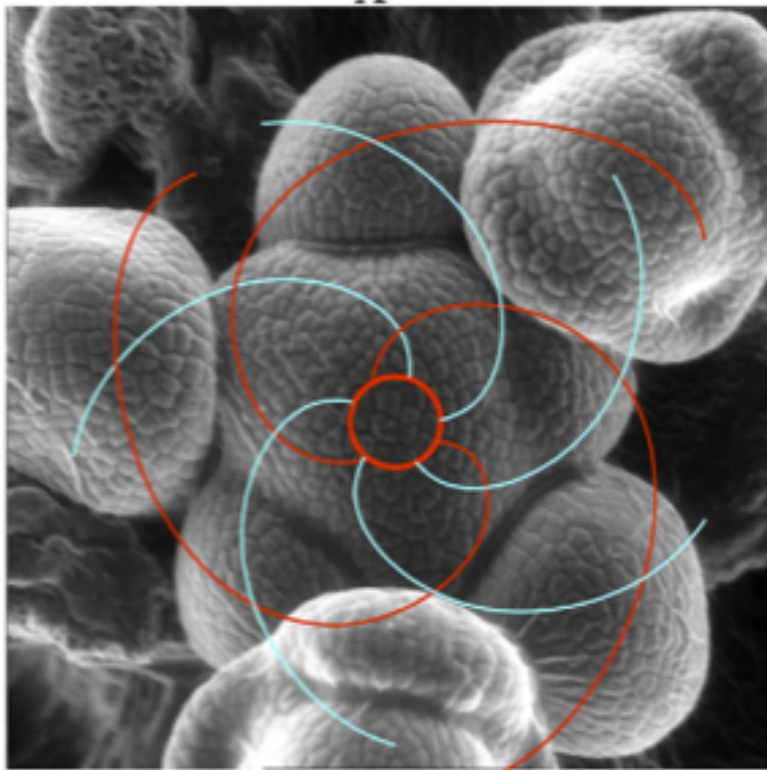
# Floral Morphogenesis in *A. Thaliana*



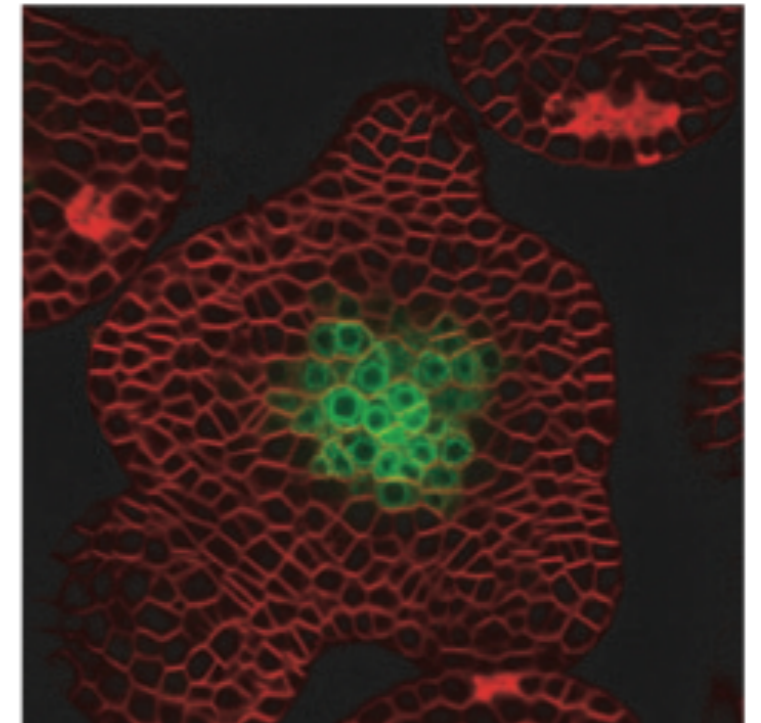
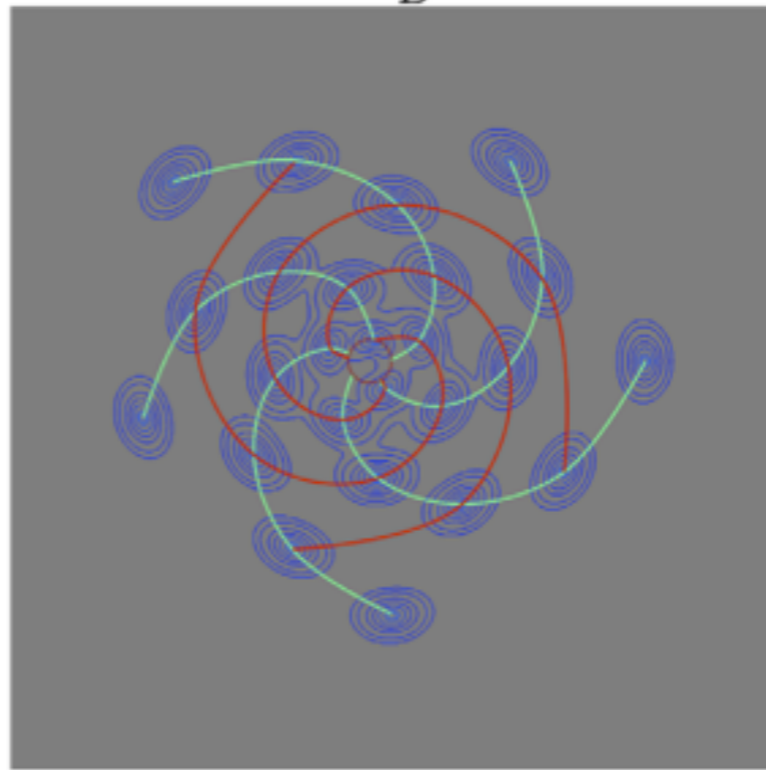
# Main Features of Morphogenesis in *A. Thaliana*

**Observation:** Organs (as leaves, petals, carpels, etc.) in plants arise following an ordered spatio - temporal pattern (**phyllotaxis**).

**In particular in flowers:**



F.Bésnard, *Ph.D. Thesis*, ENS Lyon, 2011



H. Jonsson et al., *Bioinformatics*, 2005

**Hormone Auxin** plays the major role in **morphogenesis** and **cell differentiation**.

# Why Plants?

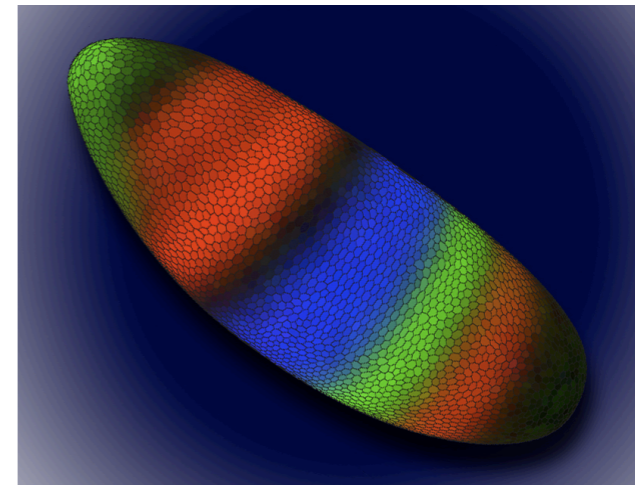
Plants provide food, feed, chemicals and raw material. Improvements to plant growth has become a major stake both because of the rising world population and because of global (climate) change.

**EASIER THAN**



Human embryo

**A BIT MORE DIFFICULT  
THAN**



Fruit fly embryo

**Understanding the mechanisms and role of auxin transport is both of fundamental interest and an inevitable stumbling block for *reprogramming* plant growth.**

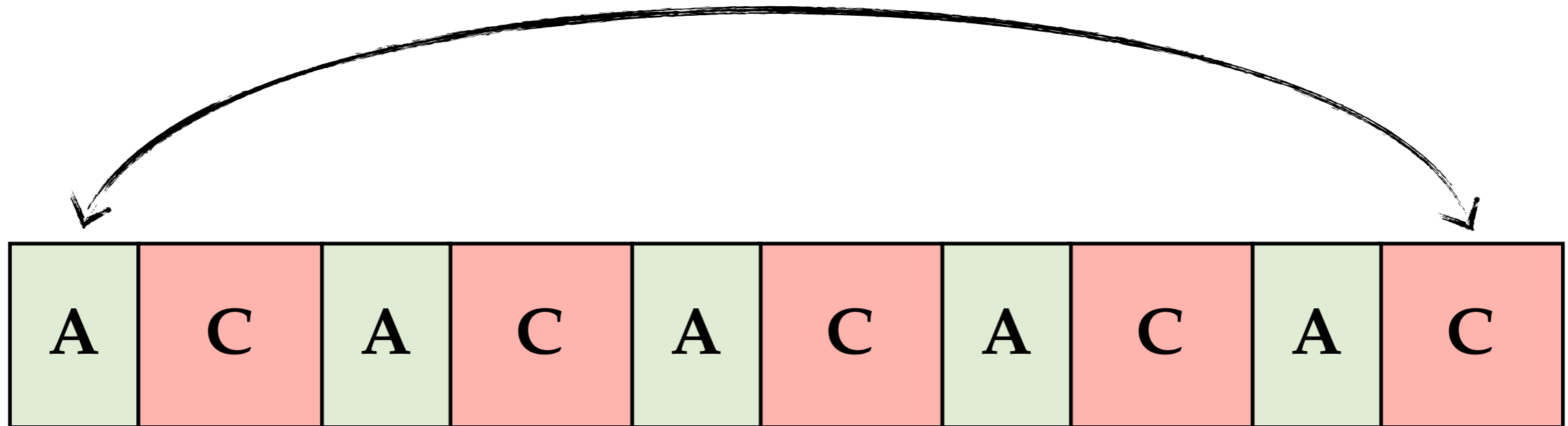


# The model

Both on chain and 2D lattice.

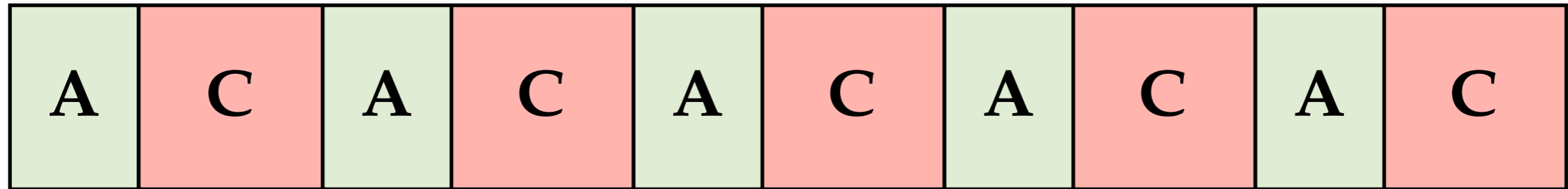
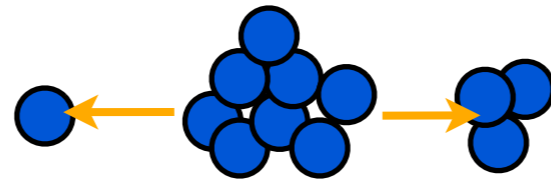
For the sake of simplicity:

Chain of  
cells and apoplasts (space between two adjacent cells)



# The model

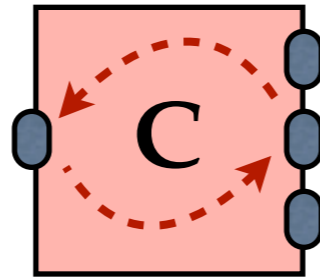
Outgoing Flux



Diffusion

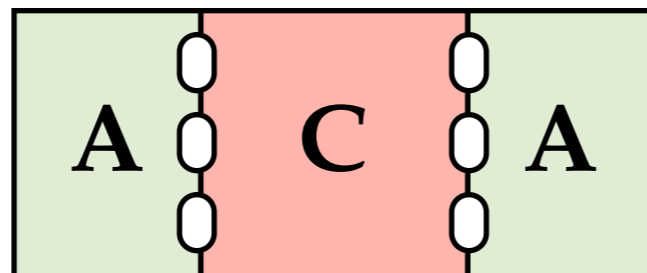
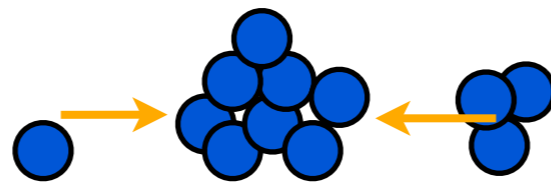
+

Active Transport by PINs



These transporters get recycled from a face to the other according to the amount of Auxin to be pumped.

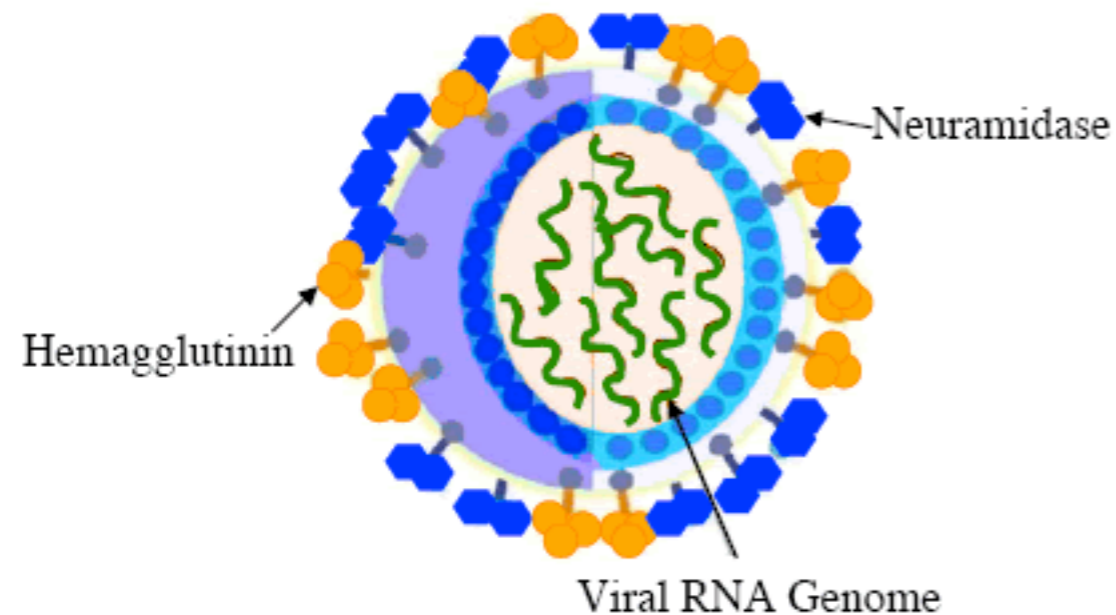
Ingoing Flux - Diffusion + Active Transport by AUX1



No recycling

# Side Project - Evolutionarily Conserved Sectors in Influenza A Sequences

within the Master's Thesis Project of **Nicola Quadri** (University of Padua, Italy) under the supervision of **Prof. Silvio Franz**



**Hemagglutinin** is the protein bounded by the human immune response and of major interest for vaccines preparation.

## MAIN QUESTIONS:

- are **next mutations** predictable somehow?
- are there some **conserved sectors** of sites along this protein?
- are **samples** offered by biological databases **informative**?

# Impact on future career

Many skills  
independence in work, methods, knowledge in a  
specific advanced sector, computational techniques and  
so on...

**BUT**  
Main point of this Ph.D.

## TRAVELING

**requires** adaptation  
**obliges** to a finer organization of work  
**allows** for collaborations

**Thank you  
for  
your attention**