



# Banff International Research Station

for Mathematical Innovation and Discovery

## Multiscale Modeling of Cell Wall Mechanics and Growth in Walled Cells

October 18 - 23, 2015

### MEALS

\*Breakfast (Buffet): 7:00 – 9:30 am, Sally Borden Building, Monday – Friday

\*Lunch (Buffet): 11:30 am – 1:30 pm, Sally Borden Building, Monday – Friday

\*Dinner (Buffet): 5:30 – 7:30 pm, Sally Borden Building, Sunday – Thursday

Coffee Breaks: As per daily schedule, in the foyer of the TransCanada Pipeline Pavilion (TCPL)

**\*Please remember to scan your meal card at the host/hostess station in the dining room for each meal.**

### MEETING ROOMS

All lectures will be held in the lecture theater in the TransCanada Pipelines Pavilion (TCPL). An LCD projector, a laptop, a document camera, and blackboards are available for presentations.

### SCHEDULE

#### Sunday, October 18

16:00 Check-in begins (Front Desk – Professional Development Centre - open 24 hours)

17:30-19:30 Buffet Dinner

20:00 Informal gathering in 2nd floor lounge, Corbett Hall

Beverages and small assortment of snacks are available on a cash honor system.

#### Monday, October 19

7:00-8:45 Breakfast

8:45-9:00 Introduction and Welcome by BIRS Station Manager, TCPL

9:00-9:30 Rosemary Dyson - Multiscale modelling of plant root growth

**9:30-10:00 Richard Smith - Mechanical models of plant cells**

10:00-10:30 Coffee Break

10:30-10:50 Olivier Ali - Force-driven polymerization of a hydrogel as a fundamental mechanism behind cell wall matrix expansion

10:50-11:10 Bara Altartouri - Visualization of cell wall components as a tool to understand cell wall mechanics

11:10-11:30 Erik Nielsen - Automated image analysis of cellulose synthase, CESA6, movements in *Arabidopsis thaliana*

11:30-12:45 Lunch

12:45-2:00 Guided Tour of The Banff Centre; meet in the 2nd floor lounge, Corbett Hall

Group Photo; meet in foyer of TCPL (photograph will be taken outdoors so a jacket might be required).

2:00-2:30 Alain Goriely - Ten ways to model growth?

2:30 -3:00 Discussion

- 3:00-3:30 Coffee Break
- 3:30-4:00 Henrik Jönsson - Modeling plant cell walls: plates, shells and biological topology optimization
- 4:00-4:30 Adelin Barbacci - Another brick in the wall (part 2): Modeling growth, mechanical properties & biosynthesis
- 4:30-5:00 Joseph Turner - Time-dependent material response of plant cell walls and its importance for measurements and modeling
- 5:00-7:30 Dinner
- 7:30-7:50 Ethan Garner - Orientation of MreB motion depends on Rod shape - implications for a local feedback mechanism from Rod Shape establishment in *B. Subtilis*.
- 7:50-8:20 Simon Foster - Bacterial cell wall architecture
- 8:20- Drinks and discussion

## Tuesday, October 20

- 7:00-9:00 Breakfast
- 9:00-9:30 Josh Shaevitz - Understanding bacterial growth in 3D
- 9:30-10:00 Sean Sun - Modeling and experiments in *E. coli* cell wall growth
- 10:00-10:30 Coffee Break
- 10:30-10:50 Michael Crowley - **Molecular Modeling of Cell Wall Components and Their Interactions**
- 10:50-11:10 KC Huang - Molecular dynamics simulations of cytoskeletal mechanics
- 11:10-11:30 Zemer Gitai - Why do bacteria have the shapes they do?
- 11:30-12:30 Lunch
- 1:00-5:30 Free Time (Burgess Shale visit for those signed up)
- 5:00-7:30 Dinner
- 7:30-7:50 Bill Klug - Bacterial cell wall mechanics and osmotic response
- 7:50-8:20 Rico Rojas - Comparative mechanics of cell-wall expansion
- 8:20-8:40 Mary Tierney - Endosomal trafficking pathways important for cell wall organization and polarized growth in *Arabidopsis*
- 8:40- Drinks and discussion

## Wednesday, October 21

- 7:00-9:00 Breakfast
- 9:00-9:30 Fred Chang - Role of cell mechanics in regulation of cell polarity in fission yeast
- 9:30-10:00 **Siobhan Braybrook - More than a gel: pectin as a vital component of the mechanical plant cell wall**
- 10:00-10:30 Coffee break
- 10:30-10:50 **Yoël Forterre - How plants feel gravity: a force or position sensor?**
- 10:50-11:10 Shafayet Zamil - Bridging subcellular and tissue scale mechanical properties of plant cell wall material using multiscale FEA modeling: The contributions of middle lamella interface and cell shape
- 11:10-11:30 Amir Jafari Bidhendi - Fungal spore cell wall mechanics
- 11:30-12:30 Lunch

- 1:30-2:00 Daniel Cosgrove - Plant cell wall enlargement: expansions, endoglucanase and the mechanism of 'acid growth"
- 2:00-2:30 Solomon Bartnicki-Garcia - Fungal cell wall morphogenesis predicted by computer modeling of vesicle migration
- 2:30-3:00 Discussion
- 3:00-3:30 Coffee break
- 3:30-3:50 Rishi Bhalerao - Elucidating the role of vesicular trafficking in ethylene and auxin mediated differential growth
- 3:50-4:10 Yue Rui - Experimental analysis and computational modeling of the walls of stomatal guard cells in Arabidopsis thaliana
- 4:10-4:30 **Lisa Willis – Cell-size homeostasis in walled cells**
- 4:30-5:00 Arezki Boudaoud - Beneath form: the mechanics of inner cell walls in Arabidopsis
- 5:00-5:30 Discussion
- 5:30-7:30 Dinner
- 7:30- **Drinks and discussion**

## **Thursday, October 22**

- 7:00-9:00 Breakfast
- 9:00-9:30 David Ehrhardt – Control of cell-wall synthesis in the plant root
- 9:30-10:00 Przemyslaw Prusinkiewicz - Modeling the development of Physcomitrella patens leaves
- 10:10-10:50 Coffee break
- 10:50-11:20 Mauricio Rincon - Lessons on cell wall mechanics from the mechanical analysis of bacterial cellulose
- 11:20-11:40 Douglas Cook - Failure initiation and cell wall modeling
- 11:40-1:30 Lunch
- 1:30-5:30 Free time
- 5:30-7:30 Dinner
- 7:30-8:30 Discussion on selected problem
- 8:30- Drinks and discussion

## **Friday, October 23**

- 7:00-9:00 Breakfast
- 9:00-11:00 Breakout sessions for group on biological challenges presented earlier in the week; Topics will be identified during the week
- 11:00-1:30 Lunch and depart

## **Checkout by 12 noon.**

\*\* 5-day workshop participants are welcome to use BIRS facilities (BIRS Coffee Lounge, TCPL and Reading Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12 noon. \*\*