

**FIFTH ANNUAL  
INTERDISCIPLINARY  
QUANTITATIVE BIOLOGY  
WINTER BOOT CAMP**

**CRYO-ELECTRON  
TOMOGRAPHY**

ORGANIZED BY

**RUTGERS**



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**ThermoFisher**  
SCIENTIFIC



**PROGRAM**

**January 8 – 12, 2018**

Institute for Quantitative  
Biomedicine (IQB)

Rutgers University | Busch Campus  
Proteomics Building  
GPS Address: 679 Hoes Lane West  
Piscataway, NJ 08854-8076

[iqb.rutgers.edu/bootcamp](http://iqb.rutgers.edu/bootcamp)

# 5<sup>th</sup> Annual Interdisciplinary Quantitative Biology Winter Boot Camp

## Cryo-Electron Tomography

The Center for Integrative Proteomics Research, home to the Institute for Quantitative Biomedicine, and the Graduate Program in Quantitative Biomedicine are delighted to be hosting the Fifth Annual Rutgers Interdisciplinary Quantitative Biology Boot Camp. This year's Boot Camp is focused on Cryo-Electron Tomography. Boot Camp is designed to complement traditional Rutgers course offerings by actively illustrating to our students, staff, and faculty, and research scientists from the pharmaceutical industry, the value of integrating biology and medicine with mathematics, physics, chemistry, computer science, statistics and biostatistics, and engineering.

The 2018 immersive one-week Boot Camp has been designed to provide participants with: (1) a fundamental understanding of the cryo-electron microscope and its capabilities and limitations; (2) an overview of sample preparation techniques for cryo-electron tomography (cryoET) applications; (3) an introduction to high-throughput tomographic data collection workflow; (4) familiarity with the computational approaches and tools used for processing cryo-ET image data and determining and interpreting three-dimensional structures derived therefrom.

Instruction will take the form of morning lectures on the theory and applications of cryoET, addressing the powers of this modern form of microscopy, and methods for analyzing and interpreting the data obtained. In addition to the lectures and invited presentations, a broad range of collaborative hands-on afternoon workshops will empower attendees with the skills needed to uncover the three-dimensional structures of complex biological machines. Attendees will be divided into teams, each tasked with understanding and presenting the methodologies required in the determination of published cryoET-derived structures. There will also be career development activities, tours of and exercises within the Rutgers New Jersey Cryo-Electron Microscopy and Tomography Core Facility, and a variety of fun activities for relaxing and networking with others.

The final morning of the Boot Camp will include a participant-led presentation on cryoET-derived structures and methods from published work. This activity will require collaborative synthesis of the material covered in the one-week program.

The Boot Camp would not have been possible without tireless efforts of the many contributors listed in the back of this Program. Special thanks go out to Michelle Sanghera, Kenneth Dahlenberg, Bernie Cariaga, and Don Corrette of the Institute for Quantitative Biomedicine and/or the Center for Integrative Proteomics Research, and Rutgers undergraduate student Jerry Pierre.

Financial contributions from ThermoFisher Scientific, Leica, Gatan, and JEOL are much appreciated.

**On the cover: A tomogram taken at a PC12 cell process.**

Chen, M., Dai, W., Sun, S. Y., Jonasch, D., He, C. Y., Schmid, M. F., Chiu, W., and Ludtke, S. J. (2017), Convolutional Neural Networks for Automated Annotation of Cellular Cryo-electron Tomograms. *Nature Methods*. **14**: 983-985

**Location:**

All sessions will be held or initiated in **Proteomics, Room 120**

**Laptops:**

Laptop computers are required for workshops and group assignments. See page 11 for software specifications.

**Activity Legend**



Lecture



Workshop



Lab Demo



Networking Opportunity



Group Assignment

**DAY 1**

10:00 AM		<b>Welcome</b> Stephen K. Burley; Rutgers University Gail Ferstandig Arnold; Rutgers University
10:20 AM		<b>Introduction to Cryo-EM/ET, Single Particle vs Tomography</b> Arek Kulczyk; Rutgers University
11:00 AM		<i>Coffee Break</i>
11:20 AM		<b>Tomography Applications in Cell Biology</b> Jeffrey Lengyel; ThermoFisher Scientific
11:50 AM		<b>Sample Prep for Tomography</b> Wei Dai; Rutgers University
12:30 PM		<i>Lunch Provided</i>
1:30 PM		<b>Meet 'n Greet; Career Byte: Being Organized, Making Business Cards</b> Gail Ferstandig Arnold; Rutgers University
2:15 PM		<b>Group Organization Meeting</b>
2:45 PM		<b>Sample Preparation Hands-on Demonstrations:*</b> <ul style="list-style-type: none"> <li> • <b>Plunge Freezing</b> Jason Kaelber; Rutgers University</li> <li> • <b>Plating Cells on EM Grids</b> Wei Dai, Paul Castellano; Rutgers University</li> <li> • <b>Structural Visualization Using Chimera, Part I</b> Brian Hudson; Rutgers University</li> </ul>

\* The hands-on demonstrations on Day 1 and 2 will be offered to groups on a revolving basis

## DAY 2

10:00 AM



### KEYNOTE

*In situ Structures of Molecular Complexes by Cryo-electron Tomography*

Peijun Zhang; University of Oxford, Diamond Light Source

11:00 AM

*Coffee Break (Group Photo)*

11:20 AM



**Correlative Light Electron Microscopy (CLEM) Principles**

Louise Bertrand; Leica Microsystems

11:50 AM



**Fundamental Challenges in Biological Tomography**

Jason Kaelber, Rutgers University

12:30 PM

*Lunch Provided*

1:30 PM



**Career Byte: Using LinkedIn and ORCID**

Gail Ferstandig Arnold; Rutgers University

2:00 PM



**Group Discussion**

2:30 PM

**Hands-on Demonstrations:**



• **Correlative Light Electron Microscopy Demonstration**

Louise Bertrand; Leica Microsystems



• **Tomographic Data Collection on the Talos Arctica Microscope**

Jason Kaelber; Rutgers University



• **Structural Visualization Using Chimera, Part II**

Brian Hudson; Rutgers University







4:45 PM



**Jeopardy for Scientists**

Melissa Banal, Jennifer Jiang; Rutgers University

## DAY 3

- |          |  |  |
|----------|--|--|
| 10:00 AM |   | <b>4D Electron Microscopy with a Millisecond Temporal Resolution</b><br>Shigeki Watanabe; Johns Hopkins University School of Medicine  |
| 11:20 AM |  | <i>Coffee Break</i>  |
| 11:20 AM |   | <b>Biocuration at the Protein Data Bank</b><br>Luigi Di Costanzo; Rutgers University   |
| 11:50 AM |   | <b>Assembly of Clustered Protocadherin Neuronal Recognition Complexes Studied by X-ray Crystallography and Cryo-electron Tomography</b><br>Julia Brasch; Columbia University |
| 12:30 AM |  | <i>Lunch (Independent)</i>   |
| 1:30 PM  |   | <b>Group Discussion</b>  |
| 2:30 PM  |   | <b>Tilt Series Alignment and Reconstruction: IMOD Tutorial</b><br>Wei Dai; Rutgers University  |
| 4:30 PM  |  | <b>Downtown Meeting, Harvest Moon</b><br><i>Gather for carpooling in Proteomics Lobby</i>  |

## DAY 4

10:00 AM



***High-throughput Cryo-electron Tomography:  
Visualizing Host-pathogen Interaction at  
High Resolution***

Jun Liu; Yale University School of Medicine

11:00 AM

*Coffee Break*

11:20 AM



***Tomography for Everyone! Fiducial-less Alignment  
for All Applications***

Alex Noble; New York Structural Biology Center

11:50 AM



***Subtomogram Averaging***

Jason Kaelber; Rutgers University

12:30 PM

*Lunch (Independent)*

1:30 PM



**Group Discussion**

2:15 PM



**Subtomogram Averaging Tutorial: *Dynamo***

Alex Noble; New York Structural Biology Center

## DAY 5

10:00 AM



### **Helium Ion Microscopy**

Viacheslav (Slava) Manichev; Rutgers University

11:00 AM



### **JEOL Microscopes for Biological Applications**

Jaap Brink; JEOL U.S.A.

11:30 AM

*Coffee Break*

11:45 AM



### **Group Presentation**

1:00 PM

*Lunch Provided*

2:00 PM



### **Tutorial: Data Annotation and Segmentation**

Muyuan Chen; Baylor College of Medicine

4:00 PM



### **The Electron Microscopy Data Bank (EMDB)**

Cathy Lawson; Rutgers University

4:40 PM

### **Conclusion**

Stephen K. Burley, Gail Ferstandig Arnold; Rutgers University



## Contributors

### The organizers would like to extend a special thank you to the Boot Camp contributors:

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University of Oxford  
Director, Electron Bio-Imaging Centre (eBIC)  
Diamond Light Source

### Software

Boot Camp Participants will be using their own laptops (**Mac or Linux; not Windows**) for their project research and visualizations. Please make sure you have the following software installed **PRIOR** to the start of Boot Camp:

1. **Web Browser:** current generation Firefox, Google Chrome, Safari, or Internet Explorer
2. **Java:** latest version. See [java.com](http://java.com)
3. **UCSF Chimera:** free for academic use; follow download and installation instructions at [www.cgl.ucsf.edu/chimera/download.html](http://www.cgl.ucsf.edu/chimera/download.html)
4. **Word processing, slide making/presenting, and spreadsheet software:** Word, PowerPoint, and Excel or any tools with similar functionality
5. **IMOD:** [bio3d.colorado.edu/imod/download.html](http://bio3d.colorado.edu/imod/download.html)
6. **Dynamo:** [dynamo-bcm.org](http://dynamo-bcm.org)
7. **EMAN2:** [blake.bcm.edu/emanwiki/EMAN2/Install](http://blake.bcm.edu/emanwiki/EMAN2/Install)

Recommended items:

1. Power supply cords
2. External mouse (very useful for structural visualization)

External participants will have the option to use WiFi as Guests.

Also, please note that no laptops will be available to be handed out as loaners during Boot Camp.

### Parking

Familiarize yourself with the parking arrangement that applies to you:

- **Faculty/Staff/Guests/Students with Type 6 or Type 9 Parking Permit:** Park in faculty/staff lots (shown in yellow-green on the map on the back cover).
- **Students without Type 6 or 9 Parking Permits:** Park near Richardson and Nichols Apartments (shown in pink on the map).
- **Visitors:** Pull up at the Drop Off point in the circle in front of CABM (see back cover) and call 848-445-0103 for your week-long parking permit.

### Sakai

Rutgers registrants, log in with your NetID. External registrants will be given Guest logins.

If you have any complications, please contact Michelle Sanghera at [Msanghera@iqb.rutgers.edu](mailto:Msanghera@iqb.rutgers.edu) to request access.

### Questions?

Contact Michelle Sanghera in **Proteomics, Room 106** or email [events@iqb.rutgers.edu](mailto:events@iqb.rutgers.edu).

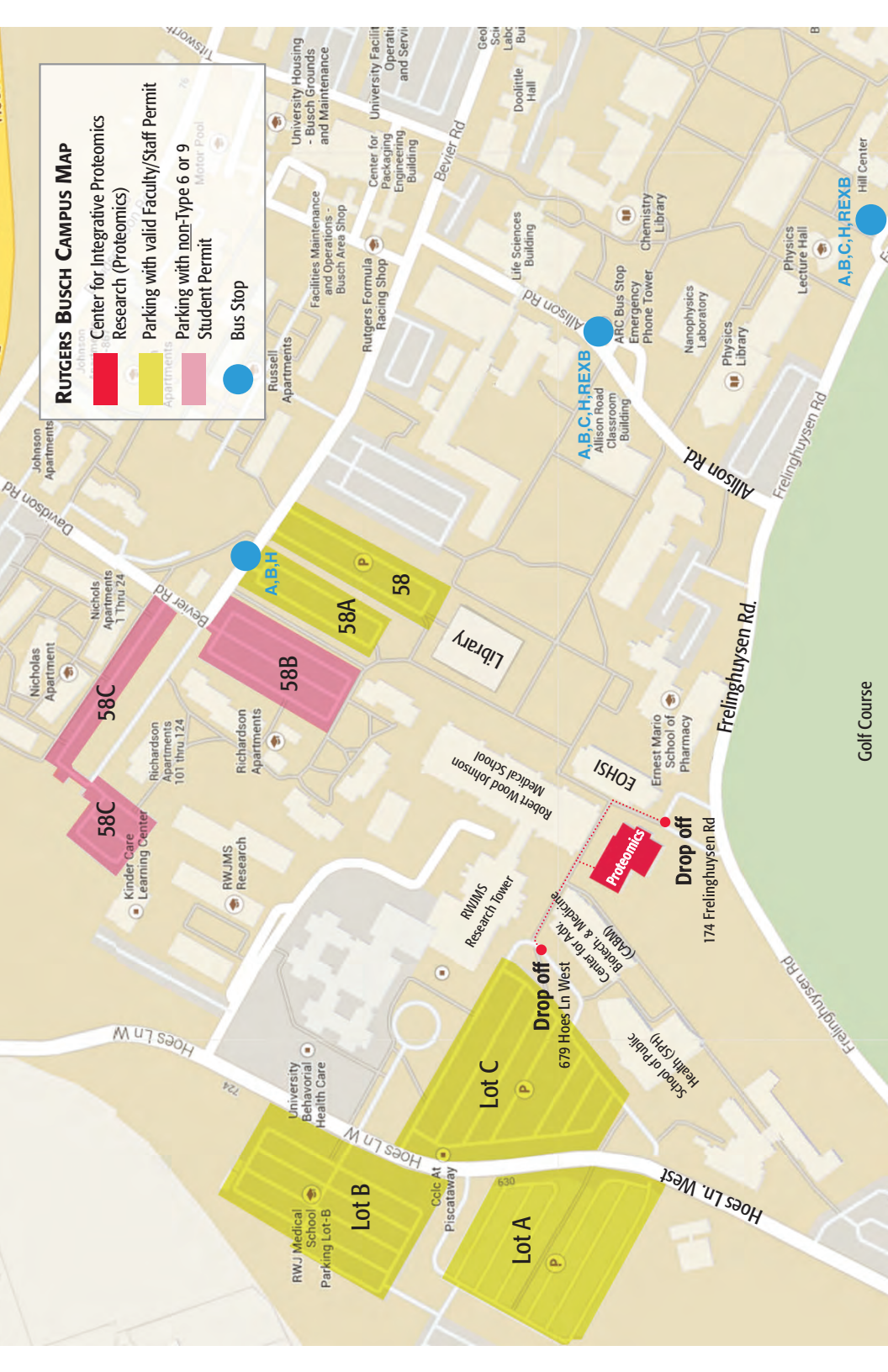
# RUTGERS BUSCH CAMPUS MAP

Center for Integrative Proteomics Research (Proteomics)

Parking with valid Faculty/Staff Permit

Parking with non-Type 6 or 9 Student Permit

Bus Stop



Golf Course