



# The Big Picture of Archaeal Biology: Evolutionary Diversity, Metabolic Range, and Information Processing Systems from the Coalescence of Ecological, Cellular and Molecular Studies

July 23 - 28, 2017

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## Chairs

Thomas J. Santangelo and Nick Robinson

## Vice Chairs

Rachel J. Whitaker and Finn Werner

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## Waterville Valley

56 Packard's Road

Waterville Valley, NH, US

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## Conference Description

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The breadth and depth of archaeal biology has exponentially increased since the pioneering work of Carl Woese revealed that the Archaea represent a distinct and diverse division of life. No one discipline can alone capture the essence and enormity of archaeal biology; the strength of the community has emerged from the collaborative efforts of environmental, biophysical, cellular, and evolutionary biologists focused on establishing the interconnections underlying archaeal metabolism and molecular biology. The "Archaea: Ecology, Metabolism and Molecular Biology" GRC conference is the foremost multi-disciplinary meeting for all members of the archaeal community to discuss the latest developments in the field. The meeting highlights the newest discoveries in a broad range of topics: new paradigms in the ecology and diversity of archaea; evolution and the latest theories on the "trees of life"; archaeal metabolism, genome function and systems biology; archaeal viruses and cellular defense (including the CRISPR/Cas systems), DNA informational processing (including replication, transcription, repair, and chromatin organization) and translation and post-translational modifications.

This meeting provides an ideal platform for leaders in diverse disciplines to exchange new ideas, collaborate, and tackle important biological questions using complementary approaches. The conference has a long history and a strong reputation for high-quality and cutting edge research, while also providing a friendly and supportive environment for younger scientists to

interact with world experts in this field. Tom Santangelo and Nick Robinson look forward to receiving your application and warmly invite you to the 2017 meeting.

## Conference Program

Sunday	
2:00 pm - 9:00 pm	Arrival and Check-in
6:00 pm - 7:00 pm	Dinner
7:30 pm - 7:40 pm	Introductory Comments by GRC Site Staff / Welcome from the GRC Chair
7:40 pm - 9:30 pm	<b>Keynote Session: Archaeal Biology: Past and Present</b> Discussion Leader: <b>Zvi Kelman</b> (IBBR, University of Maryland / NIST, USA)
7:40 pm - 7:55 pm	Introduction by Discussion Leader
7:55 pm - 8:45 pm	<b>Patrick Forterre</b> (Institut Pasteur, France) "Carl Woese's Legacy 40 Years After: LUCA and the Universal Tree of Life"
8:45 pm - 9:10 pm	Discussion
9:10 pm - 9:30 pm	General Discussion
Monday	
7:30 am - 8:30 am	Breakfast
9:00 am - 12:30 pm	<b>Metabolism and Ecology</b> <i>Mechanisms and ecological implications of known and metagenomic-predicted metabolic systems.</i> Discussion Leader: <b>Kira Makarova</b> (National Center for Biotechnology Information, National Library of Medicine, NIH, USA)
9:00 am - 9:10 am	Introduction by Discussion Leader
9:10 am - 9:30 am	<b>Anna-Louise Reysenbach</b> (Portland State University, USA) "Expanding Archaeal Genomic Diversity from Deep-Sea Hydrothermal Vent Metagenomes"

9:30 am - 9:35 am	Discussion
9:35 am - 9:55 am	<b>Jose De La Torre</b> (San Francisco State University, USA) "Ecogenomics and Biogeography of Thermophilic Ammonia-Oxidizing Archaea Across Three Continents"
9:55 am - 10:00 am	Discussion
10:00 am - 10:15 am	<b>Sean Jungbluth</b> (DOE Joint Genome Institute, USA) "Illuminating the Phylogenetic Breadth and Metabolic Potential of Microbial Life with Thousands of Archaeal Metagenome-Assembled Genomes"
10:15 am - 10:20 am	Discussion
10:20 am - 10:50 am	Group Photo / Coffee Break
10:50 am - 11:10 am	<b>Cecile Gubry-Rangin</b> (University of Aberdeen, United Kingdom) "Eco-Evo in <i>Thaumarchaeota</i> "
11:10 am - 11:15 am	Discussion
11:15 am - 11:35 am	<b>Roland Hatzenpichler</b> (Montana State University, USA) "Metabolic Potential and <i>In Situ</i> Activity of Thermophilic Uncultured Archaea at Single Cell Resolution"
11:35 am - 11:40 am	Discussion
11:40 am - 11:55 am	<b>Filipa Sousa</b> (Archaea Biology and Ecogenomics Division, University of Vienna, Austria) "Archaea Metabolic Diversity: A Genomic Perspective"
11:55 am - 12:00 pm	Discussion
12:00 pm - 12:30 pm	Poster Previews
12:30 pm - 1:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	<b>Poster Session</b>
6:00 pm - 7:00 pm	Dinner

7:30 pm - 9:30 pm	<p><b>New Archaeal Lineages and Archaeal Viruses</b>  <i>Diversity, evolution and bioinformatic analyses of archaeal lineages and archaeal viruses.</i>  Discussion Leader: <b>Mark Young</b> (Montana State University, USA)</p>
7:30 pm - 7:35 pm	Introduction by Discussion Leader
7:35 pm - 7:55 pm	<p><b>Simonetta Gribaldo</b> (Insitut Pasteur, France)  "The Growing Tree of Archaea: A New Look on the Diversity and Evolution of the Third Domain of Life"</p>
7:55 pm - 8:00 pm	Discussion
8:00 pm - 8:20 pm	<p><b>Eugene Koonin</b> (National Institutes of Health, USA)  "Discovery of Unexpected, Novel Classes of Archaea and Their Viruses"</p>
8:20 pm - 8:25 pm	Discussion
8:25 pm - 8:45 pm	<p><b>David Prangishvili</b> (Institut Pasteur, France)  "Crenarchaeal Viruses: No End to Surprises"</p>
8:45 pm - 8:50 pm	Discussion
8:50 pm - 9:05 pm	<p><b>Laura Eme</b> (Uppsala University, Sweden)  "Archaea and the Origin of Eukaryotes"</p>
9:05 pm - 9:10 pm	Discussion
9:10 pm - 9:25 pm	<p><b>Ana Gutierrez</b> (Unite d'Ecologie, Systematique et Evolution, Universite Paris Sud, France)  "Exploring Metabolic Interactions of Highly Diverse Archaea in Microbial Mats from the Atacama Desert"</p>
9:25 pm - 9:30 pm	Discussion
<b>Tuesday</b>	
7:30 am - 8:30 am	Breakfast

9:00 am - 12:30 pm	<p><b>CRISPR Systems</b>  <i>Activities, development, and applications.</i>  Discussion Leader: <b>Qunxin She</b> (University of Copenhagen, Denmark)</p>
9:00 am - 9:10 am	Introduction by Discussion Leader
9:10 am - 9:30 am	<p><b>Michael Terns</b> (University of Georgia, USA)  "CRISPR-Cas Systems of <i>Pyrococcus furiosus</i>"</p>
9:30 am - 9:35 am	Discussion
9:35 am - 9:55 am	<p><b>Uri Gophna</b> (Tel Aviv University, Israel)  "CRISPR-Cas Ecology in Archaea: From Shared Immune Memory to Maintenance of Genomic Variation Within Populations"</p>
9:55 am - 10:00 am	Discussion
10:00 am - 10:15 am	<p><b>Israela Turgeman</b> (Tel Aviv University, Israel)  "Inter-Species Targeting by CRISPR-Cas Systems Is Pervasive in Halophilic Archaea and Can Affect Genome Dynamics"</p>
10:15 am - 10:20 am	Discussion
10:20 am - 10:50 am	Coffee Break
10:50 am - 11:10 am	<p><b>Dina Grohmann</b> (University of Regensburg, Germany)  "Archaeal Defence Reloaded: Mechanisms of Substrate-Recognition and Targeting by Archaeal Argonaute"</p>
11:10 am - 11:15 am	Discussion
11:15 am - 11:35 am	<p><b>Xu Peng</b> (University of Copenhagen, Denmark)  "CRISPR-Cas Regulation in the Hyperthermophilic Archaeon <i>Sulfolobus</i>"</p>
11:35 am - 11:40 am	Discussion
11:40 am - 11:55 am	<p><b>Thandi Schwarz</b> (Ulm University, Germany)  "Self-Targeting and Gene Repression with the CRISPR-Cas System of <i>Haloferax volcanii</i>"</p>
11:55 am - 12:00 pm	Discussion

12:00 pm - 12:30 pm	Poster Previews
12:30 pm - 1:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	<b>Poster Session</b>
6:00 pm - 7:00 pm	Dinner
7:30 pm - 9:30 pm	<p><b>Cell Biology</b>  <i>Movements, divisions, and interactions.</i>  Discussion Leader: <b>Mechthild Pohlschroder</b> (University of Pennsylvania, USA)</p>
7:30 pm - 7:40 pm	Introduction by Discussion Leader
7:40 pm - 8:00 pm	<p><b>Iain Duggin</b> (University of Technology Sydney, Australia)  "Duelling FtsZs in <i>Haloferax volcanii</i> Cell Division"</p>
8:00 pm - 8:05 pm	Discussion
8:05 pm - 8:25 pm	<p><b>Sonja-Verena Albers</b> (University of Freiburg, Germany)  "Regulation and Assembly of the Archaellum Motor Complex"</p>
8:25 pm - 8:30 pm	Discussion
8:30 pm - 8:45 pm	<p><b>Robert Gunsalus</b> (University of California, Los Angeles, USA)  "Isolation, Characterization and Structure of an Archaeal Flagellum"</p>
8:45 pm - 8:50 pm	Discussion
8:50 pm - 9:05 pm	<p><b>Mohea Couturier</b> (Stockholm University, Sweden)  "Identification of DNA Methylations in the Hyperthermophilic Crenarchaeon <i>Sulfolobus acidocaldarius</i>"</p>
9:05 pm - 9:10 pm	Discussion
9:10 pm - 9:25 pm	<p><b>Emily St. John</b> (Portland State University, USA)  "Understanding Symbiosis in a Novel New Zealand Nanoarchaeote-Host System"</p>
9:25 pm - 9:30 pm	Discussion

## Wednesday

7:30 am - 8:30 am	Breakfast
9:00 am - 12:30 pm	<b>DNA Replication, Recombination, and Repair Systems</b> Discussion Leader: <b>Lori Kelman</b> (Montgomery College, USA)
9:00 am - 9:10 am	Introduction by Discussion Leader
9:10 am - 9:30 am	<b>Thorsten Allers</b> (University of Nottingham, United Kingdom) "Life Without Replication Origins: Is There a Minimum Size Limit for Recombination-Dependent DNA Replication?"
9:30 am - 9:35 am	Discussion
9:35 am - 9:55 am	<b>Stephen D. Bell</b> (Indiana University, USA) "Archaeal DNA Replication"
9:55 am - 10:00 am	Discussion
10:00 am - 10:20 am	<b>Edward Bolt</b> (University of Nottingham, United Kingdom) "Remodelling of Blocked and Broken Replication Forks by Hel308 and Homologous Helicases, to Control Recombination"
10:20 am - 10:25 am	Discussion
10:25 am - 10:55 am	Coffee Break
10:55 am - 11:15 am	<b>Andrew Gardner</b> (New England Biolabs, USA) "A SMRT Way to Map Genome-Wide Archaeal DNA Replication and Repair"
11:15 am - 11:20 am	Discussion
11:20 am - 11:40 am	<b>Changyi Zhang</b> (University of Illinois at Urbana-Champaign, USA) "Becoming <i>Sulfolobus</i> , Progenote to Present: Functional and Evolutionary Analysis of Essential Genes in the Archaeal Model <i>Sulfolobus islandicus</i> "
11:40 am - 11:45 am	Discussion
11:45 am - 12:05 pm	<b>Malcolm White</b> (University of St. Andrews, United Kingdom) "Evolution and Mechanism of Nucleotide Excision Repair"

12:05 pm - 12:10 pm	Discussion
12:10 pm - 12:25 pm	<b>James Chong</b> (University of York, United Kingdom) "Non-Essential MCM-Related Proteins Mediate a Response to DNA Damage in <i>Methanococcus maripaludis</i> "
12:25 pm - 12:30 pm	Discussion
12:30 pm - 1:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	<b>Poster Session</b>
6:00 pm - 7:00 pm	Dinner
7:00 pm - 7:30 pm	<b>Business Meeting</b> <i>Nominations for the Next Vice Chair; Fill in Conference Evaluation Forms; Discuss Future Site and Scheduling Preferences; Election of the Next Vice Chair</i>
7:30 pm - 9:30 pm	<b>Protein Biology</b> <i>Translation, modifications, and recycling.</i> Discussion Leader: <b>Bettina Siebers</b> (University of Duisburg-Essen, Germany)
7:30 pm - 7:35 pm	Introduction by Discussion Leader
7:35 pm - 7:55 pm	<b>Tobias Warnecke</b> (Imperial College London, United Kingdom) "The Impact of Archaeal Histones on a Naïve Prokaryote"
7:55 pm - 8:00 pm	Discussion
8:00 pm - 8:15 pm	<b>Julie Maupin-Furlow</b> (University of Florida, USA) "Ubiquitin-Like Protein Modification and Associated Pathways in Archaea"
8:15 pm - 8:20 pm	Discussion
8:20 pm - 8:40 pm	<b>Michael Rother</b> (Technische Universität Dresden, Germany) "Mechanism and Regulation of Selenoprotein Synthesis in <i>Methanococcus</i> "



8:40 pm - 8:45 pm	Discussion
8:45 pm - 9:05 pm	<b>Christopher Lennon</b> (University at Albany, SUNY, USA) "Archaeal Inteins as Environmental Sensors"
9:05 pm - 9:10 pm	Discussion
9:10 pm - 9:25 pm	<b>Jennifer Chow</b> (University of Hamburg, Germany) "Assigning Functions to Unknown Proteins in Archaea: Activity Profiles, Genetic Complementation and Structural Analysis of Carboxylesterases for Identifying Metabolic Functions"
9:25 pm - 9:30 pm	Discussion
<b>Thursday</b>	
7:30 am - 8:30 am	Breakfast
9:00 am - 12:30 pm	<b>RNA Biology</b> <i>Transcriptomics and transcription machinery.</i> Discussion Leader: <b>Eveline Peeters</b> (Vrije Universiteit Brussel, Belgium)
9:00 am - 9:05 am	Introduction by Discussion Leader
9:05 am - 9:25 am	<b>Lennart Randau</b> (Max Planck Institute for Terrestrial Microbiology, Germany) "RIP-Seq Analyses Identify Protein-sRNA Interactomes in <i>Sulfolobus acidocaldarius</i> "
9:25 am - 9:30 am	Discussion
9:30 am - 9:50 am	<b>Thomas Fouqueau</b> (University College London, United Kingdom) "Functional Diversification of Transcript Cleavage Factors"
9:50 am - 9:55 am	Discussion
9:55 am - 10:10 am	<b>Fabian Blombach</b> (University College London, United Kingdom) "Stress-Induced Reconfiguration of the Basal Transcription Machinery in Archaea"
10:10 am - 10:15 am	Discussion

10:15 am - 10:30 am	<b>Sapir Ofer</b> (University College London, United Kingdom) "The <i>Methanococcales</i> -Specific Histone Variant MJ1647 Is Associated with Transcriptionally Active Loci"
10:30 am - 10:35 am	Discussion
10:35 am - 11:00 am	Coffee Break
11:00 am - 11:15 am	<b>Katsuhiko Murakami</b> (Pennsylvania State University, USA) "Structural Insights to Transcription in Euryarchaeal <i>Thermococcus kodakarensis</i> RNA Polymerase"
11:15 am - 11:20 am	Discussion
11:20 am - 11:40 am	<b>Joerg Soppa</b> (Goethe University Frankfurt, Germany) "Diverse Functions of Small RNAs in Halophilic Archaea: From Non-Coding Regulatory sRNAs to Microprotein-Encoding sRNAs"
11:40 am - 11:45 am	Discussion
11:45 am - 12:05 pm	<b>Ruth Schmitz-Streit</b> (University of Kiel, Germany) "Newly Identified Players in Nitrogen Regulation in <i>Methanosarcina mazei</i> "
12:05 pm - 12:10 pm	Discussion
12:10 pm - 12:25 pm	<b>Ken Jarrell</b> (Queen's University, Canada) "Bypassing the Need for the Transcriptional Activator EarA Through a Spontaneous Deletion in the BRE Portion of the fla Operon Promoter in <i>Methanococcus maripaludis</i> "
12:25 pm - 12:30 pm	Discussion
12:30 pm - 1:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 5:30 pm	<b>Poster Session</b>
5:30 pm - 7:30 pm	<b>Systems- and Synthetic-Biology</b> <i>Advantages, challenges, and industrial applications.</i> Discussion Leader: <b>Frank Robb</b> (Institute of Marine and Environmental Technology, University of Maryland, Baltimore, USA)

5:30 pm - 5:35 pm	Introduction by Discussion Leader
5:35 pm - 5:55 pm	<b>Amy Schmid</b> (Duke University, USA) "Calm Under Stress: How Regulatory Networks Control Cellular Decision-Making in Archaeal Extremophiles"
5:55 pm - 6:00 pm	Discussion
6:00 pm - 6:20 pm	<b>Susumu Sakata</b> (National Institute of Advanced Industrial Science and Technology, Japan) "A Novel Mode of Metabolism in a Methanogen that Directly Produces Methane from Coal"
6:20 pm - 6:25 pm	Discussion
6:25 pm - 6:45 pm	<b>Florin Musat</b> (Helmholtz Centre for Environmental Research - UFZ, Germany) "Oxidation of Higher Alkanes in Archaea: A Role for Methyl-Coenzyme M Reductases"
6:45 pm - 6:50 pm	Discussion
6:50 pm - 7:05 pm	<b>Silvan Scheller</b> (Aalto University, Finland) "Extracellular Transfer of Methane-Derived Electrons to Soluble Oxidants: Experimental Findings and Envisioned Industrial Applications"
7:05 pm - 7:10 pm	Discussion
7:10 pm - 7:25 pm	<b>Nicole Buan</b> (University of Nebraska, USA) "Using Archaea for What They Do Best: Redirecting Carbon and Energy Towards Isoprene as an Anaerobic Respiration/Fermentation Product"
7:25 pm - 7:30 pm	Discussion
8:00 pm - 9:00 pm	Dinner
<b>Friday</b>	
7:30 am - 8:30 am	Breakfast
9:00 am	Departure

## Contributors

 <p><b>Gordon Research Conferences</b></p>	 <p><b>Carl Storm Underrepresented Minority Fellowship</b></p>	
 <p><b>PORTLAND PRESS</b></p>	<p>nature <b>microbiology</b></p>	<p>nature <b>ecology &amp; evolution</b></p>
 <p><b>NEW ENGLAND BioLabs<sup>®</sup> Inc.</b></p>	 <p><b>COV</b> LAB PRODUCTS ANAEROBIC CHAMBERS &amp; GLOVE BOXES</p>	 <p><b>genes</b></p>