Biomolecular condensates are cellular compartments that concentrate proteins and nucleic acids without an encapsulating membrane. They act in processes across the biological spectrum, from RNA metabolism to signaling and gene regulation. Macromolecular phase separation, akin to the separation of oil from water, has emerged over the past several years as a key organizer both of condensates and of micron-scale cell organization in general. This conference brings together for the first time scientists studying biomolecular condensates and macromolecular phase separation from varied perspectives and across different scales of length and time. Theory, biophysics, biochemistry, cell biology and developmental biology will be joined together to address central questions in the field – how is molecular specificity in condensates achieved, how are the material properties and spatial structure of condensates controlled, how do composition and physical properties lead to emergent functions, how does aberrant formation of condensates lead to diseases such as neurodegeneration and cancer? By bringing together leading scientists from diverse areas impacted by phase separation, the conference seeks to clarify the current state of knowledge in this exciting new field and identify important future directions.

Plenary Session Topics:
• Physical Mechanisms of Macromolecular Phase Separation and Regulation
• Structure and Substructure of Biomolecular Condensates
• Biochemical and Biological Function of Biomolecular Condensates
• New Phase Separating Systems
• Specificity
• Biomolecular Condensates in Disease

Visit www.keystonesymposia.org/19D5 for more details.
**Workshop**

**Regulation**

Physical Mechanisms of Macromolecular Phase Separation and Genetics, Germany

**Welcome and Keynote Address**

*Michael K. Rosen*, University of Texas Southwestern Medical Center, USA

*Anthony Hyman*, Max Planck Institute of Molecular Cell Biology & Genetics, Germany

Clifford P. Brangwynne, Princeton University, USA

Moving through Intracellular Phase Space

THURSDAY, APRIL 11

Arrival and Registration

**Physical Mechanisms of Macromolecular Phase Separation and Regulation**

*Julia Mahamid*, European Molecular Biology Laboratory, Germany

Frank Jülicher, Max-Planck-Institute for the Physics of Complex Systems, Germany

The Physics of Protein Condensates

Nicolas L. Fawzi, Brown University, USA

Short Talk: Structure/Function of LC Domain Phase Separation in RNA-Binding Proteins FUS and TDP-43

Robert Tycko, NIDDK, National Institutes of Health, USA

Structure of Low-Complexity Protein Assemblies

Diana M. Mitrea, St. Jude Children's Research Hospital, USA

Short Talk: Dynamic Rearrangements within NPM1-Mediated Scaffolds: Implications for Ribosome Biogenesis Regulation

Rohit V. Pappu, Washington University in St. Louis, USA

Multiscale Structure of Biomolecular Condensates

Workshop

*Michael K. Rosen*, University of Texas Southwestern Medical Center, USA

Krishna Shrinivas, Massachusetts Institute of Technology, USA

Enhancer Features that Mediate Formation of Localized Transcription Condensates

Liang Wang, Tsinghua University, China

Histone Modifications Regulate Chromatin Compartmentalization by Contributing to a Phase Separation Mechanism

Matthias Altmeyer, University of Zurich, Switzerland

Phase Separation of 53BP1 Ascertain Liquid-Like Behaviour of DNA Repair Compartment

Christoph Zechner, Max Planck Institute of Molecular Cell Biology and Genetics, Germany

Noise Buffering by Phase Separated Compartments

Huaiying Zhang, Carnegie Mellon University, USA

Phase Transition Drives Telomere Clustering

Miriam Linsenmeier, ETH Zurich, Switzerland

A Droplet-Based Microfluidic Platform to Investigate the Kinetics of Synthetic Membraneless Organelles in Cell-Like Volumes

Meta Heidenreich, Weizmann Institute of Science, Israel

A Synthetic Minimal System Connects Atomic Structure to Mesoscale Phenotypes of Protein Phase Separation

**Structure and Substructure of Biomolecular Condensates**

*Rohit V. Pappu*, Washington University in St. Louis, USA

Julia Mahamid, European Molecular Biology Laboratory, Germany

Visualizing the Structural Basis of Liquid-Like Stress Granules in situ

Haiyang Yu, Ludwig Institute for Cancer Research, USA

Short Talk: Molecular and Structural Mechanisms for Intranuclear Tertiary Phase Separation of TDP-43 Liquid Droplets

Abby F. Dernburg, University of California, Berkeley, USA

Pattern Formation within a Liquid Crystalline Compartment Regulates Meiotic Recombination

Geeta J. Narlikar, University of California, San Francisco, USA

Phase-Separation Mechanisms in Heterochromatin

Wen Zhou, Harvard Medical School, USA

Short Talk: Mechanism of Human cGAS Activation and Regulation

**Poster Session 1**

FRIDAY, APRIL 12

**Biochemical and Biological Function of Biomolecular Condensates**

*Amy Gladfelter*, University of North Carolina at Chapel Hill, USA

J. Paul Taylor, St. Jude Children's Research Hospital, USA

Cooperative Interactions between G3BP1 and mRNA Permit Phase Separation that Seeds the Assembly of Stress Granules

Sindhuja Sridharan, European Molecular Biology Laboratory, Germany

Short Talk: The Many Roles of ATP in Organizing the Cellular Proteome

Lucas Pelkmans, University of Zürich, Switzerland

Molecular Regulators of Macromolecular Phase Separation

Geraldine Seydoux, Johns Hopkins School of Medicine, USA

Recruitment of RNA to RNA Granules by Intrinsically-Disordered Proteins

Anatol W. Fritsch, Max Planck Institute of Molecular Cell Biology and Genetics, Germany

Short Talk: The Heat is On: Controlling Germ Granule Segregation in C. elegans

Elio Aaron Abbondanzieri, University of Rochester, USA

Short Talk: A Bacterial DNA-Binding Protein Forms Liquid Crystalline Complexes with DNA Capable of Supporting Unimpeded Transcription

Songon An, University of Maryland, Baltimore County, USA

Short Talk: Membraneless Metabolic Granules for Glucose Metabolism and Their Functional Contributions to Cellular Metabolism in Living Cells: The Glucosome

Oliver Mueller-Cajar, Nanyang Technological University, Singapore

Short Talk: The Distinct Phase Separations Underlying Diverse Pyrenoids- the CO2-Fixing Membraneless Organelles of Green Algae and Diatoms
NIH Grant Writing
Ian M. Fingerman, NCI, National Institutes of Health, USA
John Satterlee, NIDA, National Institutes of Health, USA

New Phase Separating Systems

*Lucas Pelkmans, University of Zurich, Switzerland
Richard A. Young, Whitehead Institute for Biomedical Research, USA
Arnaud Hubstenberger, Institute of Biology Valrose, France
Marina Feric, NCI, National Institutes of Health, USA

Short Talk: Condensing the Mitochondrial Genome into Gel-Like Droplets
Pallavi Gopal, Yale School of Medicine, USA

Spatiotemporal Dynamics of TDP-43 Ribonucleoprotein Granules in Neuronal Physiology and Pathologic Transitions in Disease
Yacheng Liao, HHMI Janelia Research Institute, USA
Short Talk: RNA Granules Hitchhike on Lysosomes for Long-Distance Transport, Using Annexin A11 as a Molecular Tether

Poster Session 2

SATURDAY, APRIL 13

Specificity

*Geraldine Seydoux, Johns Hopkins School of Medicine, USA
Ruth Lehmann, New York University, USA

RNA Organization within Phase Transitioned Germ Granules
Amy Gladfelter, University of North Carolina at Chapel Hill, USA
How RNA Structure Controls Specificity in Intracellular Phase Separation

Wenmin Xing, University of Texas Southwestern Medical Center, USA
Short Talk: A Quantitative Inventory of Yeast P Body Proteins Reveals Principles of Compositional Specificity

Florian Stengel, University of Konstanz, Germany
Short Talk: Mass Spectrometry-Based Proteomics for the Structural Characterisation of Biomolecular Condensates

Maria Hondele, Institute of Biochemistry, Switzerland
Short Talk: DEAD-box ATPases Are Global Regulators of Phase-Separated Organelles and RNA Flux

Ibrahim Cisse, Massachusetts Institute of Technology, USA
Super-Resolution Imaging of Transcription in Live Mammalian Cells

Akinori Yamasaki, Institute of Microbial Chemistry, Japan
Short Talk: Functional and Molecular Insights into Selective Autophagy of Phase Separated Cargo

Cell Stress and Disease

*Anthony Hyman, Max Planck Institute of Molecular Cell Biology & Genetics, Germany

Christine Mayr, Memorial Sloan Kettering Cancer Center, USA
TIS Granules Enable the Formation of Specific Protein-Protein Interactions
D. Allan Drummond, University of Chicago, USA
Phase Separation as an Adaptive Response to Cell Stress
Simon Alberti, Max Planck Institute of Molecular Cell Biology and Genetics, Germany
A Phosphorylation-Controlled Conformational Switch Drives Stress Granule Formation by Unlocking RNA Multivalency

Jay W. Schneider, University of Texas Southwestern Medical Center, USA
Short Talk: Pathogenic Biomolecular Condensates Drive Heart Failure in Human RBM20 Cardiomyopathy Gene-Edited Pigs

Meeting Wrap-Up: Outcomes and Future Directions (Organizers)

SUNDAY, APRIL 14

Departure