

Kavli Institute for Theoretical Physics

Exploration Conference



**Interfaces and Mixing
in Fluids, Plasmas, Materials**

**23 – 26 October 2023
Santa Barbara, USA**

We deeply thank

Kavli Institute for Theoretical Physics

We appreciate

international research community, professional organizations, publishers

Interfaces and Mixing, their Dynamics and Kinetics

govern a broad range of processes in nature and technology

- in fluids, plasmas and materials;
- in turbulent and in coherent states;
- from celestial to atomic events;
- under conditions of high and low energy density.
- Examples include
 - supernovae and fusion,
 - planetary convection and solar flares,
 - fluid instabilities and interfacial mixing,
 - turbulence and turbulent mixing,
 - reconnection events in quantum fluids and in plasmas,
 - materials processing and electro-catalysis,
 - purification of water and nanofabrication.
- In these realistic environments
 - flow fields change sharply and rapidly, accelerations are strong;
 - energy releases are high, relaxations are weak
 - phases of matter are well pronounced.
- **Interfaces and interfacial mixing couple micro- to macro scales.**
- **They are challenging to study**
 - in the kinetic limit and in the continuous limit
 - in theory, experiments, simulations.

What interfaces are?

- **Interfaces are phase boundaries broadly defined.**
- Interfaces can separate
 - two distinct kinds of matter, and/or
 - the same matter with distinct thermodynamics / electro-dynamic properties.
- Interfaces can form
 - when two matters meet, and/or
 - when one matter gains non-uniform structures.
- The matter (fluid, plasma, material) can
 - experience a phase transition, be out of thermodynamic equilibrium, and/or
 - undergo a change in (chemical) composition.
- The phase boundaries
 - can appear microscopically vanishing, and yet
 - can possess observable macroscopic interfacial fluxes.
- At interfaces
 - properties of matter experience dramatic changes at minuscule scales
 - microscopic interfacial transports define the macroscopic fields in the bulk.
- **Interface is a place where balances are achieved.**
- **Interface dynamics is eligible to first principle theoretical considerations.**

Conference Objectives

- We intend to explore the group theory based methodologies for solving conservation laws far from equilibrium.
- We aim to associate theoretical solutions with physical observables in synergy with experiments and simulations.
- We target to approach the dynamics of interfaces and interfacial mixing at the levels of detail and abstraction not achieved before to capture their fundamentals in very distinct physical regimes.
- We examine
 - whether in fluids unstable interfaces can lead to turbulence and its anomalous scaling;
 - whether in plasmas the interface topology and transports are linked to volumetric fields;
 - whether in multi-phase materials the energy can scatter beyond conventional diffusion and/or can be trapped at atomic scales.
- The Conference provides the opportunity
 - to bring together researchers from many areas of science, mathematics, engineering;
 - to focus the attention on the long-standing problems of the unstable non-equilibrium dynamics and kinetics of interfaces and interfacial mixing.

Science, Mathematics, Technology

Interfaces and Interfacial Mixing and their Dynamics and Kinetics impact nearly every area of science, mathematics and engineering.

- Mathematics
 - studies things that do not exist in nature;
 - gets a precise knowledge about objects existing in our mind only.
- Science
 - studies things that do exist in nature;
 - gets an approximate knowledge about objects independent of our mind.
- Technology & Engineering
 - control things that are man-made;
 - gets information with account for many minds and many natural processes.
- What do Mathematics, Science, Engineering have in common?
 - **Opinion Independent Results.**

This is the Target of Our Research.

Committees

- Coordinators of the KITP Exploration Conference
 - Snezhana I. Abarzhi
 - William A. Goddard III
 - Katepalli R. Sreenivasan
- Scientific Advisory Committee of the Exploration Conference
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 - W. David Arnett (The University of Arizona, USA)
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 - James G. Glimm (State University of New York Sony Brook, USA)
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- The KITP Administration
 - Lars Bildsten (Director, the KITP, USA)
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- The KITP Support
 - Lisa Stewart (Chief Administrative Officer, the KITP, USA)
 - David Kaczorowski (Program Manager, the KITP, USA)
 - Claudia Gutierrez (Conference Coordinator, the KITP, USA)
 - Alina Gutierrez (Online Talks - Production & IT Coordinator, the KITP, USA)

Invited Speakers, Lecturers, Participants

- Our participants are:
 - active researchers - national / international, seasoned / young;
 - members of leading research institutions / highly reputable professional organizations;
 - from academia, national laboratories, industry.

Abarzhi, Snezhana I
Alexandrov, Anastasia
Azechi, Hiroshi
Barclay, Bryce
Bellan, Josette
Bellan, Paul
Boffetta, Guido
Bolanos, Simon
Campbell, David K
Chan, WH Ronald
Chashechkin, Yuli
Chefranov, Sergei G
Chekhlov, Alexei
Chen, Gui-Qiang
Chen, Li-Jen
Chen, Xi
Clark, Aurora
Cowley, Steven
Daripa, Prabir
Das, Amita
Doughty, Benjamin L
Duin, Adri van
Fielding, Drummond
Fisher, Robert

Fortunelli, Alessandro
Fukumoto, Yasuhide
Glimm, James G
Goddard, William A III
Gotoh, Toshiyuki
Graziani, Frank R
Hara, Ken
Herrmann, Marcus
Hill, Desmon L
Hosking, David
Hou, Thomas Y
Hurisse, Olivier
Huysmans, Luca
Hwang, Connor H
Ilyin, Dan V
Irvine, William TM
Iyer, Kartik
Ji, Yong
Kamal, Tulin
Kerstein, A R
Klimenko, Alex
Knobloch, Edgar
Li, J Tony
Li, Xiaolin

Lopez, Juan M
Mahalov, Alex
Matsuoka, Chihiro
Migdal, Alexander
Morita, Akihiro
Nepomnyashchy, Alik
Oh, Peng
Osher, Stanley
Schlossman, Mark
Sreenivasan, Katepalli R
Sydora, Richard
Tordella, Daniela
Verma, Mahendra K
Vishniac, Ethan
Vorobieff, Peter
Wallstrom, Timothy
Wang, Lipo
Welfert, Bruno D
Williams, Kurt C
Wright, Cameron E
Zhakhovsky, Vasili
Zingale, Michael

- We thank you for your valuable contributions to the Conference Program.
- We gratefully acknowledge your understanding our needs in tight scheduling.

Conference Structure

- The Conference Topics include
 - Interfaces and Mixing
 - Theory; Experiments; Simulations.
 - Fluids
 - Instabilities & Interfacial Mixing; Turbulence & Turbulent Mixing; Realistic Environments.
 - Plasmas
 - Astrophysical Plasma; High Energy Density Plasma; Canonical Plasma.
 - Materials
 - Interfacial Processes; Reactive Dynamics; Matter at the Extremes.
- The Conference consists of lectures and talks. The format is hybrid.
 - The Program contains 56 lectures and talks, with $\sim 2/3$ in-person and $\sim 1/3$ virtual talks.
 - Discussions are anticipated after presentations and during breaks.
 - The Book of Abstracts includes over 70 accepted presentations.
- The research contributions to the Conference are the high quality works.
 - Presentations by leading experts invited by the Organizers.
 - Presentations by members of international research community.
 - Submissions are peer-review [coordinators & members of scientific advisory committee].

Publications and Proceedings

- Presentations are digitally recorded by the KITP.
 - Recordings are available at the KITP web-site and KITP YouTube Channel (doi).
 - Links to the Accepted Presentations are also available at tmbw.org.
- Book of Abstracts is prepared.
 - The Book of Abstracts can be found at tmbw.org.
- Conference works are invited to
 - special collections organized in renowned journals by lead publishers
 - US National Academy of Sciences, Springer Nature, Institute of Physics, Frontiers, MDPI.
- You are welcome to submit your research to the Conference Publications.
 - Please stay tuned for updates and technical details.
- We fully leverage capabilities of 'Turbulent Mixing and Beyond' Program (20+ books since 2007)
 - Springer & Springer Nature Applied Science; National Academy of Sciences of the USA & Proceeding of the National Academy of Sciences of the USA; Royal Society Publishing & Philosophical Transactions of the Royal Society; Frontiers Publishing & Frontiers of Applied Mathematics and Statistics; American Institute of Physics & Physics of Fluids and Physics of Plasma; Institute of Physics & Physica Scripta; International Center for Theoretical Physics.

Welcome

The Kavli Institute for Theoretical Physics
Exploration Conference
'Interfaces and Mixing in Fluids, Plasmas, Materials'

is organized

- to advance knowledge of fundamental aspects of non-equilibrium dynamics and kinetics of interfaces and interfacial mixing;
- to progress their predictive modeling capabilities, physical description and, ultimately, control;
- to positively impact the progress of science, technology and society.

The success of the Conference consists from the successful work of all of us.

You are encouraged to highlight the strongest parts of your work.

Welcome!