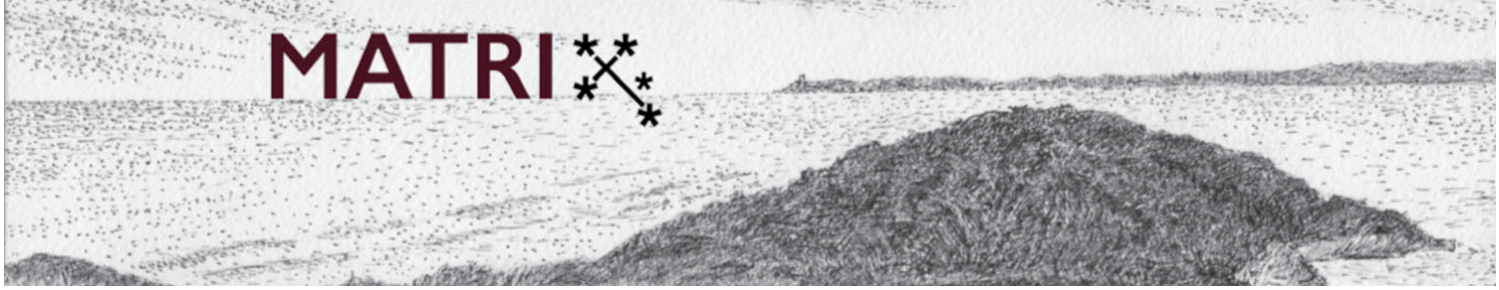


MATRIX Program Scientific Report

Program Name
Conservation laws, boundary value problems, interfaces and mixing – non-equilibrium processes at continuous and at kinetic scales

Program Dates
04 – 08 Nov 2019

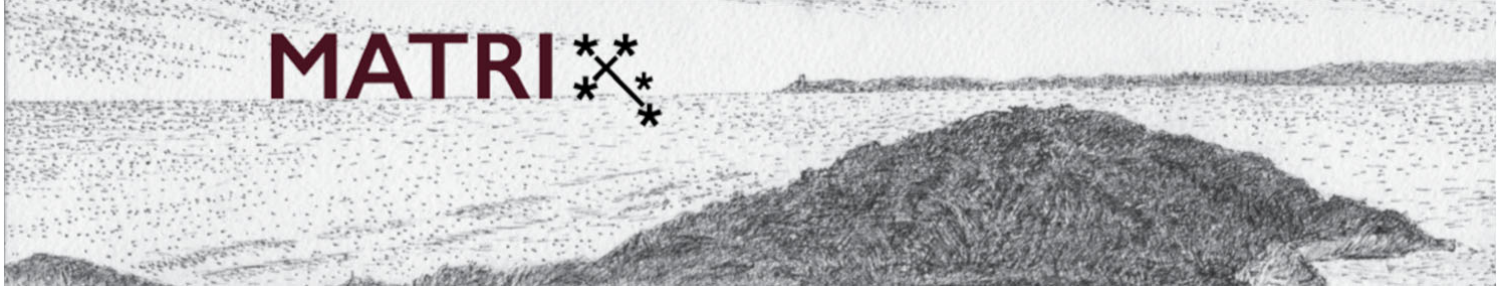
INSERT GROUP PHOTO OR PHOTO OF THE GROUP WORKING

Organisers
Snezhana I. Abarzhi, University of Western Australia, AUS; Alik Nepomnyashchy, Technion, Israel;

Joseph Klewicki, Unibersity of Melbourne, AUS; Anthony Roberts; University of Adelaide, AUS.

Scientific Description
We organized for the MATRIX the Program 'Conservation laws, boundary value problems, interfaces and mixing – non-equilibrium processes at continuous and at kinetic scales.'
Interfacial transport and mixing are non-equilibrium processes coupling kinetic to macroscopic scales. They occur in fluids, plasmas and materials over celestial events to molecules. Addressing the societal challenges posed by alternative energy sources, efficient use of non-renewable resources, purification of water and development of reliable therapeutics in medicine, requires a better understanding of non-equilibrium interfacial transport and mixing.
Our Program was built upon recent achievements in understanding interfacial transport and mixing using theoretical analysis, large-scale numerical simulations, and data analysis. The Program brought together mathematicians and scientists from applied mathematics, applied analysis, dynamical and complex systems, stochastic processes and data analysis, dynamics of fluid and plasmas, industrial mathematics and material science. The Program motivated the discussions of rigorous mathematical problems, theoretical approaches and state-of-the-art numerical simulations along with advanced data analysis techniques. The participants included leading experts and researchers at experienced and early stages of their carriers and students from Australia and from abroad. The Program served to explore the state-of-the-art in the areas of interfaces and non-equilibrium transport, to elaborate the methods of studies of boundary value problems at kinetic and at continuous scales, and to chart new research directions in this field. The results of the Program are submitted for publication in the MATRXI Annals.

Related programs
In 2019 the related programs included the 2019 Invited Mini-conference 'Interfaces and Mixing' at the American Physical Society March Meeting, and the invited mini-conference 'Mixing in Plasmas' at the 2019 Annual Meeting of the Division of Plasma Physics of the American Physical Society.



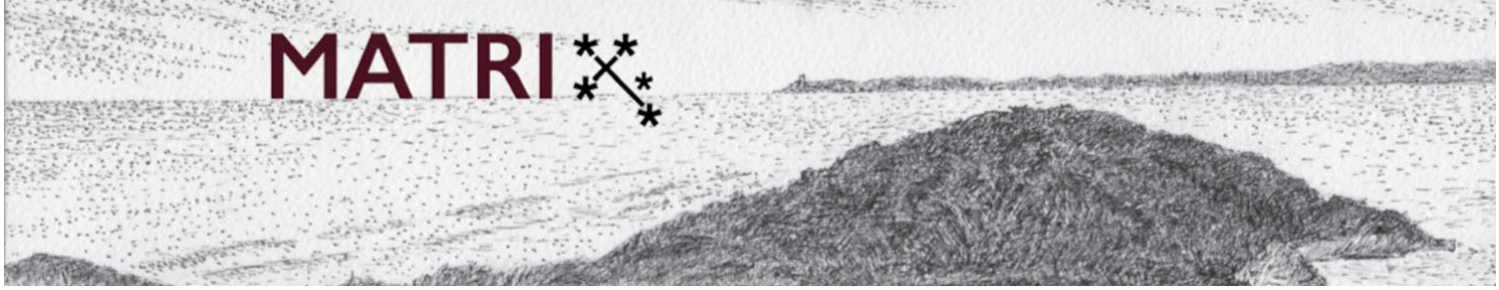
Participants

Our participants included:

Prof	Snezhana I. Abarzhi	University of Western Australia, AUS
Mr	Tanmay Agrawal	University of Melbourne, AUS
Dr	Paulo de Almeida	Altron Bytes Systems Integration, ZA
Prof	Yasuhide Fukumoto	Kyushu University, Japan
Dr	Ashleigh Hutchinson	University of the Witwatersrand, ZA
Dr	Ash Khan	RMIT University, AUS
Prof	Joseph Klewicki	University of Melbourne, AUS
Prof	Alexander Klimenko	University of Queensland, AUS
Prof	Xiaolin Li	SUNY Stony Brook, USA
Prof	Alik Nepomnyashchy	Technion, Israel
Dr	Jimmy Philip	University of Melbourne, AUS
Prof	Antony Roberts	University of Adelaide, AUS
Ms	Mako Sato	Kyushu University, Japan
Prof	Saleh Tanveer	Ohio State University, USA
Dr	Helen Wang	SUNY Stony Brook, USA
Mr	Kurt Williams	University of Western Australia, AUS
Mr	Cameron Wright	University of Western Australia, AUS

Attention to Diversity

Our participants included colleagues from Australia (9 participants), USA (3 participants), Japan (2 participants), Israel (1 participant), and South Africa (2 participants). These were 8 professors, 5 researchers, 4 students. The participants included 4 female and 13 male participants.



Embedded Events

The Program included:

MATRIX PROGRAM: CONSERVATION LAWS, INTERFACES, and MIXING

04 Nov 2019, Monday

	Breakfast	08.00-9.00
Program Organizers	Welcome	09.00-9.15
Nepomnyashchy A	Excitation and control of interfacial instabilities	09.15-10.00
Klewicki J	Structure of passive scalar transport in turbulent channel flow	10.00-10.45
	Morning Break	10.45-11.15
Roberts A	Rigorous modeling determines both a macro-scale model and its boundary conditions	11.15-12.00
	Lunch	12.00-13.30
Program Participants	Collaboration	13.30-15.00
	Afternoon break	15.00-15.30
Program Participants	Collaboration	15.30-17.00
	Dinner	19.00-20.00

05 Nov 2019, Tuesday

	Breakfast	08.00-9.00
Li X	Lagrangian front tracking and applications to conservation law, fluid mixing, and phase transition problems	09.00-9.45
Abarzhi SI	Interface dynamics: New mechanisms of stabilization and destabilization and structure of flow fields	09.45-10.30
	Morning Break	10.30-11.00
Hutchinson A	Application of a modified Prandtl mixing length model to the turbulent classical far wake with a variable mainstream flow	11.00-11.30
Nepomnyashchy A	Longwave oscillatory instabilities	11.30-12.00
	Lunch	12.00-13.30
Program Participants	Collaboration	13.30-15.00
	Afternoon break	15.00-15.30
Program Participants	Poster Session	15.30-17.00
	MATRIX chees and wine	17.00
	Dinner	19.00-20.00

06 Nov 2019, Wednesday

	Breakfast	08.00-9.00
Tanveer S	Analysis of Two fluid Couette Flows	09.00-9.45
Klimenko A	Entropy, mixing and the direction of time	09.45-10.30
	Morning Break	10.30-11.00
Li X	Modeling of fabric surface through front tracking with application to parachute inflation	11.00-11.30
Klimenko A	Thermodynamics and kinetics of anti-symmetric extension of the second law to antimatter	11.30-12.00
	Lunch	12.00-13.30
Program Participants	Collaboration	13.30-15.00

	Afternoon break	15.00-15.30
Program Participants	Collaboration	15.30-17.00
	Dinner	19.00-20.00

07 Nov 2019, Thursday

	Breakfast	08.00-9.00
Fukumoto Y	Effect of compressibility in the reaction zone of a premixed flame and its implication to the Darrieus-Landau instability	09.00-9.45
Abarzhi SI	High energy density plasmas, fluid instabilities and interfacial mixing	09.45-10.30
	Morning Break	10.30-11.00
Hutchinson A	Comparison of algebraic closure models applied to the two-dimensional turbulent classical far wake	11.00-11.45
Williams K	Singular behaviors and new morphologies in Rayleigh Taylor instability	11.45-12.15
	Lunch	12.00-13.30
Program Participants	Collaboration	13.30-15.00
	Afternoon break	15.00-15.30
Program Participants	Collaboration	15.30-17.00
	Dinner	19.00-20.00

08 Nov 2019, Friday

	Breakfast	08.00-9.00
Program Participants	Collaboration	09.00-10.30
	Morning Break	10.30-11.00
Khan A	Determination of a transient shape of a sludge blanket in an anaerobic lagoon	11.00-11.30
Program Organizers	Final Report	11.30-12.00
	Lunch	12.00-13.30
Program Participants	Departure	13.30-17.00

To conclude: This Program has produced serious scientific results, served to develop the new collaborations, and to further advance one of the most interesting and challenging areas of mathematics, science and engineering. The participants highly evaluated the Program.