«ETTORE MAJORANA» FOUNDATION AND CENTRE FOR SCIENTIFIC CULTURE

TO PAY A PERMANENT TRIBUTE TO ARCHIMEDES AND GALILEO GALILEI, FOUNDERS OF MODERN SCIENCE AND TO ENRICO FERMI, THE "ITALIAN NAVIGATOR", FATHER OF THE WEAK FORCES

INTERNATIONAL SCHOOL OF STATISTICAL PHYSICS

16th Course: *THE STATISTICAL PHYSICS OF ACTIVE MATTER*

ERICE-SICILY: 1 – 6 OCTOBER 2018

Sponsored by the: • Italian Ministry of Education, University and Scientific Research • Sicilian Regional Government

PROGRAMME AND LECTURERS

Short-wavelength photon-in/ photon-out with a "Home Lab" plasma source
• D. BLEINER, Laboratory for Advanced Analytical Technologies, Dübendorf, CH

Modeling propulsion and controlled Steering of magnetic nanohelices
• T. ALA-NISSILA, Aalto and Loughborough University, Espoo, FI

Quorum sensing and cluster formation of active particles
• C. BECHINGER, University of Konstanz, Konstanz, DE

Active phase separation – a universal approach
• F. BERGMANN, Universität Bayreuth, Bayreuth, DE

Dynamics and statistics of gyrotactic swimmers in turbulence
• G. BOFFETTA, University of Torino, Torino, IT

Active growth and pattern formation in membrane-protein systems
• F. CAGNETTA, University of Edinburgh, Edinburgh, UK

Dynamics of assemblies of active particles
• C. COTTIN-BIZONNE, Institute Lumiére Matiere, Villeurbanne, FR

Phase coexistence in two-dimensional passive and active dumbbell systems
• P. DIGREGORIO, University of Bari, Bari, IT

Mechanics of tissue competition: The surprising role of cross adhesion
• J. ELGETI, Forschung Zentrum Jülich, Jülich, DE

Multiscale time reversal asymmetry in biological active matter
• N. FAKHRI, MIT, Cambridge, MA, US

Diffusion of polymers through periodic networks of lipid-based nanochannel
• R. GHANBARI, ETH Zürich, Zürich, CH

Guided mechanochemical self-organization
• S. GRILL, Biotec, TU Dresden, Dresden, DE

The noisy basis of morphogenesis: mechanics of inversion in the green alga Volvox
• P.A. HAAS, University of Cambridge, Cambridge, UK

A unifying theory of branching morphogenesis
• E. HANNEZO, IST Austria, Klosterneuburg, AT

Controlling stability and transport of magnetic microswimmers by an external field
• S. JABBARI-FAROUJI, University of Mainz, Mainz, JP

From two-dimensional melting to motility induced phase separation in systems active brownian hard disks
• D. LEVIS, EPFL, Lausanne, DE

Cellular jamming in three dimensions
• J. LIPPOLDT, University Leipzig, Leipzig, DE

Smart droplets: How active emulsions can mimic bioswimmers
• C. MAASS, Max Planck Institute, Göttingen, DE

Extracting dynamics from data in active matter: Force and tissue dynamics of neural stem cells
• M. SANO, University of Tokyo, Tokyo, JP

Clustering-induced self-propulsion of isotropic catalytic particles
• S. MICHELIN, Ecole Politechnique, Paliseau, FR

Collective rotations of active particles interacting with obstacles
• Z. MOKHTARI, University of Göttingen, Göttingen, DE

Cluster phases and bubbly phase separation in active fluids
• C. NARDINI, CEA Paris Saclay, Gif Sur Yvette, FR

Autonomous extraction of work from active matter
• P. PIETZONKA, University of Cambridge, Cambridge, UK

Force generation by migrating bacteria
• B. SABASS, Forschung Zentrum Jülich, Jülich, DE

Self-organization of spherical microswimmers: Role of hydrodynamic and chemotactic fields
• H. STARK, Technical University Berlin, Berlin, DE

Front motion in minimal active models
• F. STEGEMERTEN, University of Münster, Münster, DE

Motility regulation as a self-organisation principle
• J. TAILLEUR, Université Paris Diderot, Paris, FR

Active superelasticity in cell sheets
• X. TREPAT, IBEC, Barcelona, ES

Magnetotactic bacteria droplets: a controllable motor
• B. VINCENTI, ESPCI Paris-PMMH Lab, Paris, FR

Highly non-trivial motions of crawling and proliferating cells on substrate
• R. YAMAMOTO, Kyoto University, Kyoto, JP

Self-organization of bacterial active fluids in space and time
• Y. WU, The Chinese University of Hong Kong, Shatin, Hong Kong, HK

PURPOSE OF THE COURSE

The term active matter refers to collections of self-driven entities that take energy form the environment to generate organized motion at large scales. Examples abound in the living world, ranging from the flocking of birds to the sorting and organization of cells in morphogenesis. Theoretical work over the last two decades has shown that many aspects of the complex organization seen in nature from bird flocks to cell groups can be captured by physical models based on a minimal set of interactions, leading to the emergence of the new field of active matter. This has additionally inspired the development of ingenious synthetic chemical and mechanical analogues with life-like properties, such as "active" colloids, micron-size polystyrene spheres partly coated with a catalyst that promotes the decomposition of one of the components of the ambient fluid, resulting in self-propulsion of the colloidal particles driven by self-catalytic reactions. Recent years have witnessed a very rapid growth of the field and substantial advances in the development of the statistical mechanics of active systems that do not obey detailed balance and the classification and characterization of their phases and behaviours. This has been paralleled by experimental advances in the design of new controlled synthetic active matter systems that provide stringent testing ground for the theory, with the goal of ultimately learning how to mimic nature and design new materials with specific tunable functions. The Course will bring together leading theorists and experimentalists in the field and is expected to attract young scientists from diverse disciplines. On the basis of these previous events, the Erice Course is expected to push forward the field of active matter by generating new collaborations, especially among theorists and experimentalists.

APPLICATIONS

Persons wishing to attend this Course should apply via e-mail to:
Professor Maria Cristina Marchetti, UCSB, Santa Barbara, CA, US
E-mail: *mcmarche@syr.edu*

PLEASE NOTE

Participants must arrive in Erice on 1 October, no later than 7 p.m.

POETIC TOUCH

According to legend, Erice, son of Venus and Neptune, founded a small town on top of a mountain (750 metres above sea level) more than three thousand years ago. The founder of modern history — i.e. the recording of events in a methodic and chronological sequence as they really happened without reference to mythical causes — the great Thucydides (~500 B.C.), writing about events connected with the conquest of Troy (1183 B.C.) said: «*After the fall of Troy some Trojans on their escape from the Achaei arrived in Sicily by boat and as they settled near the border with the Sicanians all together they were named Elymi: their towns were Segesta and Erice.*» This inspired Virgil to describe the arrival of the Trojan royal family in Erice and the burial of Anchise, by his son Enea, on the coast below Erice. Homer (~1000 B.C.), Theocritus (~300 B.C.), Polybius (~200 B.C.), Virgil (~50 B.C.), Horace (~20 B.C.), and others have celebrated this magnificent spot in Sicily in their poems. During seven centuries (XIII-XIX) the town of Erice was under the leadership of a local oligarchy, whose wisdom assured a long period of cultural development and economic prosperity which in turn gave rise to the many churches, monasteries and private palaces which you see today. In Erice you can admire the Castle of Venus, the Cyclopean Walls (~800 B.C.) and the Gothic Cathedral (~1300 A.D.). Erice is at present a mixture of ancient and medieval architecture. Other masterpieces of ancient civilization are to be found in the neighbourhood: at Motya (Phoenician), Segesta (Elymian), and Selinunte (Greek). On the Aegadian Islands — theatre of the decisive naval battle of the first Punic War (264-241 B.C.) — suggestive neolithic and paleolithic vestiges are still visible: the grottoes of Favignana, the carvings and murals of Levanzo.

Splendid beaches are to be found at San Vito Lo Capo, Scopello, and Cornino, and a wild and rocky coast around Monte Cofano: all at less than one hour's drive from Erice.

More information about the other activities of the "ETTORE MAJORANA" FOUNDATION AND CENTRE FOR SCIENTIFIC CULTURE can be found on the WWW at the following address:
http://www.ccsem.infn.it

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DIRECTORS OF THE COURSE

P. HÄNGGI – F. MARCHESONI
DIRECTORS OF THE SCHOOL

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PRESIDENT EMFCSC