

Conference Report

Chirality@The Nanoscale Symposium

Congresso Stefano Franscini (CSF), Monte Verità, Ascona,
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Abstract: From October 13 to 17, 2019, nearly 90 scientists from all over the world gathered on the Monte Verità congress site of the ETH Zurich to discuss their latest findings about chirality in different fields of physical sciences. A program consisting of 20 invited speakers, 18 hot topic oral contributions and 27 poster presentations have been put together by the organizers.

After previous Chirality@The Nanoscale symposia in Sitges (E), Liverpool (UK) and Leuven (BE) at four-year intervals, the organizers (Christine Tran & Karl-Heinz Ernst; Empa, Magali Lingenfelder; EPFL and Thomas Bürgi; UNIGE) invited researchers from the field to the beautiful Lago Maggiore. The ETH Zurich site Congressi Stefano Franscini (CSF) above Ascona on the Monte Verità with its esoteric history was the ideal place for exchange of newest developments. The Gordon Research Conference style schedule allowed plenty of time for discussions outside the lecture hall. The good views, good weather, the friendly staff and the excellent meals created the appropriate atmosphere for discussions of different aspects of chirality in astrochemistry, molecular motors, electron spin filtering, surface science, helicenes, origin of life, crystallization and autocatalytic chemistry.

After arrival and registration on a beautiful Sunday, the crowd was welcomed by the conference chair (KHE), who stressed the importance of the financial support and acknowledged the sponsoring provided by the Swiss National Science Foundation (SNSF), the Swiss Chemical Society (SCS), Empa, EPFL, ETH, Publishers, such as American Chemical Society (ACS Nano), Wiley (HCA) and the Royal Society of Chemistry, as well as companies, such as Novartis and abcr|Gute Chemie.

The Sunday night session consisted of two invited talks by **Natalie Katsonis** from Mesa+, University of Twente and **Cornelia Meinert** from the Université Cote d'Azur, Nice. Katsonis reported about her recent results on motility of droplets, which were driven by light after being modified with chiral synthetic molecular motors. Meinert, in turn, discussed the possibility of photochirogenesis in interstellar space and presented laboratory-based experiments simulating cometary conditions and showing the photosynthesis of amino acids and sugar molecules from carbon dioxide, ammonia and water ice.

The Monday started with the lecture of the Nobel laureate **Ben Feringa** from the University of Groningen, who took the audience through 'chiral space' and presented the latest findings on molecular rotary motors and molecular machines. Chirality in self-assembled molecular networks at the solid liquid interface was the topic of **Steven De Feyter**, KU Leuven. By means of scanning tunneling microscopy (STM) he discussed different aspects of chirality in monomolecular layers, bilayers and in confined space.

Chirality-induced spin selectivity (CISS) was the topic after the coffee break of one invited and three contributed talks. The pioneer of this effect, **Ron Naaman** from the Weizmann Institute gave several examples how electrons transmitted through heli-



Fig. 1. Nobel laureate Ben Feringa giving his lecture at Monte Verità.

cal molecular systems become spin polarized and that magnetic surface systems may cause different adsorption energies of enantiomers. Even the electrooxidation of water can be influenced by spin-polarized electrodes.

The afternoon session was devoted to helicenes. **Matthew Fuchter** from Imperial college showed how these can be incorporated in organic optoelectronics in order to detect or emit circularly polarized light. **Narcis Avarvany** of Moltech-Anjou Laboratory, Université d'Angers, presented the design of chiral tetrathiafulvalene-based materials for studying magnetochiral anisotropy in electric conductance. Enantioselective helicene-chemistry on metal surfaces was discussed by **Ivo Stary** from the Czech Academy of Sciences in Prague, whereby a cascade of enantioconservative on-surface reactions lead to enantiofacially pure planar hydrocarbons.

The poster session on Monday night was a lively event with lots of discussions in front of posters dealing with numerous aspects of chirality.

The Tuesday morning started with four lectures on different aspects of chirality of surfaces, such as one-dimensional chiral wires and unidirectional rotation of small molecules as well as enantioselective chemistry on intrinsically chiral solid surfaces. **Andrew Gellman** of Carnegie-Mellon University, Pittsburg, showed that decomposition chemistry of tartaric acid proceeds with high enantiospecificity on surfaces with opposite handedness. Theoretical aspects of chiral self-assembly on surfaces was discussed by **Irena Paci** from University of Victoria, British Columbia, Canada. The complex phase behavior of amino acids and helicenes demonstrated that appropriate modelling is still extremely challenging.

Tailored metallic nanohelices dispersed in a fluid give strong circular extinction, as **Peer Fischer**, Max-Planck Institute for Intelligent Systems, Stuttgart, demonstrated. Based on plasmonic effects, also strong nonlinear optical responses were reported.

New insights into chiral crystallization were presented by **Cristobal Viedma**, Universidad Complutense, Madrid and **Bart Kahr**, New York University. Viedma discussed aspects of the special ripening that has become named after him. Kahr presented an often overlooked issue, namely, that many crystals do not grow in a straight fashion, but rather twist. He also pointed out that this has been described already in 1929 for many different spherulites by Ferdinand Bernauer in his book 'Gedrißte Kristalle'.

The quest for direct determination of absolute configuration of molecules in the gas phase was described by **Robert Berger**, Universität Marburg. This included Coulomb explosion imaging, laser cooling and high-precision spectroscopy of ultracold molecules.

Clearly the highlight of the meeting was the public talk for the Ascona locals by **Uwe Meierhenrich** from the Université Cote d'Azur, Nice, which was translated simultaneously into Italian. He gave a detailed – in part in 3D red-green stereoscopy – account of the ESA Rosetta mission to the comet 67P/Churyumov-Gerasimenko, its lander Philae and his personal involvement in the lander COSAC instrument having a chiral gas chromatography column.

Wednesday morning was devoted to asymmetric autocatalysis, chiral self-assembly of J-aggregates and CD spectroscopies. **Keno Soai** from Tokyo University of Science presented his famous autocatalytic reaction of pyrimidine alkanol, leading to almost enantiopure pyrimidine carbaldehyde without extra chiral bias. Advantages of matrix-isolation VCD spectroscopy, in which molecules are trapped in solid argon or xenon, were discussed by **Christian Merten** from Ruhr University in Bochum. Template effects for inducing chirality in supramolecular porphyrin assemblies were featured by **Roberto Purello** of Università degli Studi di Catania.

The weather on Wednesday afternoon was ideal for the excursions to the botanical gardens of Isole Brissago and up the mountain to Cardada/La Cimetta. Hence, the attendees had the choice between a ride on a boat or in a cable car.

The evening session before the conference dinner consisted of one invited and two contributed talks. By means of natural design strategies for brilliant colors, **Silvia Vignolini** from the University of Cambridge, UK, presented synthetic strategies to biomimetic photonic systems.

On departure day, chiral liquid crystals, amplification of imbalances in chiral crystallization and dyes in chiral crystals were the main topics. **David Walba**, University of Colorado at Boulder, talked about bent-core liquid crystals and the possibility to form liquid conglomerates from achiral molecules that assemble in macroscopic enantiomorphous domains. Attrition-supported crystallization and amplification by enantio-imbances was the topic of the presentation of **Wim Noorduin** from AMOLF Amsterdam. He showed that pharmaceutically relevant enantiopure solids can be obtained as long as the inversion barrier of enantiomers in solution is small. **David Amabilino** from the University of Nottingham presented how twisted crystals can be obtained from functional organic molecules.

The symposium concluded with the bestowal of the CSF Award for young scientists to **Elizabeth Kilalea** from University of Nottingham, UK, for her outstanding poster presentation. She showed how achiral compounds grow into twisted crystalline



Fig. 2. On the Lago Maggiore on the way to Isole Brissago.



Fig. 3. Winner of the CSF Award for young scientists: Elizabeth Kilalea, awarded for her poster presentation.

fibers, analyzed their packing *via* X-ray diffraction and unraveled their surface structure with atomic force microscopy.

In conclusion, the 4th Chirality@The Nanoscale Symposium was a very successful exchange of scientists working in the realm of chirality beyond sole chemical synthesis. Based on the high quality of the presentations and the excellent location, the organizers got very positive feedback from the participants. What started as an one-time event in 2007, has become a conference series about a little bit overlooked part of science.

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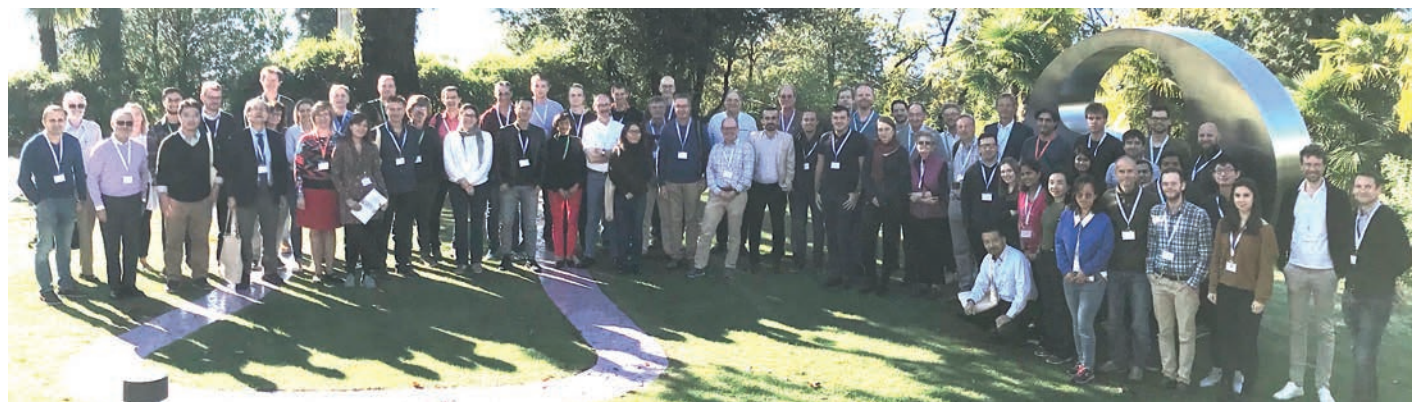


Fig. 4. Attendees of the Chirality@The Nanoscale Symposium on Monte Verità above Ascona.