C5 Activity Report for the IUPAP Council and Commission Chairs Meeting
October 2020-October 2021

Officers/Members 2017-2021 (tenure extended by one year owing to Covid-19)

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Activity Report

This review covers the period April 2020 – October 2021 with a summary of the immediate previous period.

1.0 Activity Previous Period April 2019 – October 2020

1.1 Conferences Organized and Endorsed

B conference

International Conference on Quantum Fluids and Solids (QFS 2019)
August 7-13, 2019, University of Alberta, Edmonton, Canada; chairs: John Beamish, John Davis
The International Symposium on Quantum Fluids and Solids (QFS2019) was held at the Centennial Centre for Interdisciplinary Sciences on the University of Alberta campus, August 7 through 13, 2019. This conference is held annually, except in years when the QFS community meets as part of the larger International Conferences on Low Temperature Physics (LT conferences). The QFS conference location traditionally rotates between Europe, Asia and North America. Recent QFS meetings were held at the University of Tokyo in Japan (2018) and in Prague, Czech Republic (2016), and LT28 was held in Sweden in 2017.

QFS2019 attracted 170 registered participants from 20 different countries. The highest participation came from Japan (36) followed by USA (33), Canada (30), UK (18), Finland (7), Korea (7), France (6), Germany (5), India (4), Australia (3), Czech Republic (3), Russia (3), and Slovakia (3). There were also 13 registered accompanying persons from 5 different countries.

The conference program was prepared by the local organizing committee consisting of the QFS2019 co-Chairs, John Beamish and John P. Davis, together with Lindsay LeBlanc and Joseph Maciejko and administrative assistance from Kailey Robertson and Skylar Brown. Speakers were selected based on input from the QFS2019 International Advisory Committee, which included 30 members of the QFS community from 13 countries. The final program included 43 invited talks plus an additional 17 oral presentations selected from the submitted abstracts. The 60 speakers came from 17 different countries. The talks were supplemented by three poster sessions with a total of 109 poster presentations. From these, an international committee of poster judges selected nine winners of "best poster" awards.

The scientific program included the traditional QFS core topics, including superfluid ^{3}He and ^{4}He, 2D films and confined helium, quantum solids, electrons on helium, quantum turbulence and

vortices, and experimental techniques and devices. The conference also included sessions on related areas of physics, including superfluid opto-mechanics, cold atoms, topological and quantum Hall systems, and dark matter detection. Also, a half-day workshop on Quantum Turbulence was organized by Wei Guo and Makoto Tsubota and held at the QFS venue on August 10, with 12 oral presentations and nearly 40 participants. The conference proceedings have been published as a special issue of the Journal of Low Temperature Physics, with John Beamish as the guest editor.

Despite challenging demographics, women were represented in the local organizing committee (1/4, i.e. 25%), and on the QFS2019 International Scientific Advisory Committee (6/30, 20%). Five of the speakers at QFS 2019 were women (8%), although four other women were invited to speak but were unable to accept our invitations. Overall, 12 (7%) of the registered participants were women, a low number, but representative of the current demographics of this research field.

1.2 Commission Meetings

The last in person meeting of commission C5 was at the A conference, LT28 in August 2017. Subsequent business has been conducted by e-mail and will continue in this mode until the next face-to-face meeting at the 29th Low Temperature Conference, LT29, originally scheduled in 2020 and now delayed to August 2022. The site of LT29 is Sapporo, Japan and is currently scheduled to be a hybrid conference. Work is in progress to identify the next A conference, the International Low Temperature Conference, LT30, in 2025. The next ultra-low temperature B conference, ULT2020 was originally scheduled for 2020 as a satellite conference to LT29 and has been delayed to 2022, and will be held in Otaru, Japan.

1.3 C5 Sponsored Prizes Awarded for presentation at LT29

IUPAP C5 Young Investigator Prize:
Samuli Autti, Lancaster University, UK
For observations at low temperatures of half-quantum vortices, time crystals and magnon Bose-Einstein condensation in superfluid ^{3}He
Ke Wang, University of Minnesota, USA
For observations at low temperatures of single-electron silicon qubits, graphene electron-optics, a quantum transistor, and confinement of charged excitons in transition metal dichalcogenides

Fritz London Memorial Prize 2020:
Frank Steglich, Max Planck Institute for Chemical Physics of Solids, Germany
For his discovery and exploration of the unconventional superconductivity in heavy fermion metals.
Valerii Vinokur, Argonne National Laboratory, USA
For his pioneering work on the theoretical investigation of superconductivity in disordered materials and type II superconductivity
Qi-Kun Xue , Tsinghua University, China
For his pioneering work on the experimental discovery of quantum anomalous Hall effect and edge channel in magnetic topological insulators

Simon Memorial Prize 2020:
Jukka Pekola, Aalto University
For fundamental achievements in quantum thermodynamics, metrology and cryogenics based on nanoscale electronic devices.

2.0 Activity Current Period 2020-2021

2.1 Sponsored Conferences held this Period

B conference

The Online International Symposium on Quantum Fluids and Solids (QFS2021) was organized by the Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science (IISc), Bangalore, India. This B conference was proposed and accepted by C5 and IUPAP; but one year ago it was decided to convert from an in-person to fully remote conference owing to restrictions associated with the Covid-19 pandemic.

This conference is held annually, except when the QFS community meets as part of the larger International Conferences on Low Temperature Physics (LT conferences). The QFS conference location traditionally rotates between Europe, Asia, and North America. Recent QFS meetings were held in Prague, Czech Republic (2016), in Tokyo, Japan (2018), and Edmonton, Canada (2019).

QFS2021 was conducted from 10th August through 19, 2021, with one off-day on 15th August 2021. The conference attracted 305 registered participants from 28 different countries. The highest participation came from Japan (73), followed by the USA (61), UK (34), India (30), Russia (15), Finland (12), Canada (12), South Korea (9), Czech Republic (7), France (7), and China (5). The conference was held online, with 37 invited talks and 15 contributed talks selected from the submitted abstracts. Of the 52 talks by speakers from 15 different countries, the three plenary lectures were of 50-minute duration and were presented live by the speakers. The plenary session was also live-streamed through YouTube and was open to everyone, regardless of registration. The other 49 talks from the regular sessions were of 15 or 30-minute duration, for which the speakers provided recorded videos before the conference. These videos were played during the session, which avoided any possible network problems at the speakers' end. The session chair moderated the Q&A both immediately after the talk and at the end of the session. In line with the tradition of QFS, there was no parallel event during these regular talk sessions. The talk sessions' timing (5:30 PM – 7:45 PM IST) was chosen to ensure participation worldwide, corresponding to late evening in Japan and Australia and early morning on the west coast of the USA. The online platform provided an auditorium-like view during the talk sessions, which converted into a networking lounge when the session was not in progress. The networking lounge contained a total of 500+ tables that could accommodate 2-6 participants each, and the participants sitting across the same table could have live video conferences. It was possible to search for and locate other participants and then meet them at these tables. The networking lounge was used extensively by participants throughout the conference.

In addition to the talks, there were poster sessions with a total of 125 poster presentations. The posters were 5-minute recorded presentations that were available for viewing throughout the conference on the online platform. The poster sessions with approximately 20 presenters were conducted on six days, during which the presenters were allocated tables where participants could visit and have live discussions. An international committee of poster judges selected ten winners of the "best poster" awards.

The scientific program included the traditional QFS core topics, including superfluid ^{3}He and ^{4}He, 2D films and confined helium, quantum solids, electrons on helium, quantum turbulence, and experimental techniques and devices. The conference also included talks on related areas of physics, including superfluid opto-mechanics, cold atoms, quantum Hall systems, and dark matter detection. The conference program was prepared by a local organizing committee consisting of the QFS2021 chair Ambarish Ghosh, co-chair Rahul Pandit, and others (see list of names given below). Speakers were selected based on input from the QFS2021 International Advisory Committee, which included 37 members of the QFS community from 13 countries.

The conference proceedings will be published as a special issue of the Journal of Low Temperature Physics, with Ambarish Ghosh as the guest editor for the proceedings. The deadline for submission of papers is 30th September 2021. Two independent reviewers will referee each paper.

The total budget of QFS2021 was roughly 700.000 INR (~ 8000 Euro). Most of this was raised from external sources, including 6500 euros (~ 560,000 INR) from the International Union of Pure and Applied Physics (IUPAP) and 120000 INR from corporate sponsors (Oxford Instruments, ATOS, Anarghya Innotech, and Lakeshore Cryotronics. The registration fee for QFS2021 was waived for all

participants. Three companies (Oxford Instruments, Anarghya Innotech, and ATOS) participated as exhibitors during the conference on the online platform.

The QFS organizing committee supported diversity, mainly through encouraging and assisting women and scientists from developing countries. Given the current gender imbalance in the QFS research community, this was challenging. Also, tiny numbers of institutions in developing countries can support experimental research in the quantum fluids and solids area.

Women were represented in the local organizing committee (1/8, i.e. 12%) and on the QFS2021 International Scientific Advisory Committee (7/37, 19%) despite the challenging demographics. There were 52 speakers, with 40 males, 11 females (21%), and one undisclosed. Of the 305 registered participants, 260 were men, 42 were women (14%), and three did not disclose their gender. The women's representation was low but representative of the current demographics of this research field.

2.2 Anticipated, Accepted and Sponsored Conferences Delayed owing to Covid-19

A conference

The 29th International Conference on Low Temperature Physics (LT29) August 16-22, 2022, Sapporo, Japan. It is expected that there will be ~1,200 participants. The Co-chairs are Naoto Nagaosa, Rikken and Yoshiteru Maeno, University of Kyoto. This proposal was approved by C5 at its meeting at LT28. It was submitted to IUPAP for approval as an A conference, and was endorsed by C5 for IUPAP. It was realized, and confirmed on March 31, 2020, that proceeding with this conference was unwise in light of the spreading pandemic Covid-19. On April 22 IUPAP accepted a request for delay of two years to August 18-24 2022 and is currently being planned as a hybrid conference in the next period. There is a back-up plan to reconsider the structure of the conference by converting it to being fully remote, a decision expected in June 2022 based on many factors related to the ongoing Covid pandemic

B conference

ULT2020, Frontiers of Low Temperature Physics, is planned for August 26-29, 20202, Otaru, Japan, with chair: Keiya Shirahama, Keio University. This conference, is a satellite of LT29 (A conference) and will cover the following topics: Quantum fluids, solids, and gases, Unconventional and topological superfluids and superconductors, Strongly correlated condensed matter systems, Quantum hydrodynamics, particularly quantum turbulence, Magnetism, particularly quantum spin liquids, Quantum phase transitions and criticality, Ultralow temperature techniques and its application to quantum information science. The number of anticipated attendees is ~200. It was approved as a B conference by IUPAP and is endorsed by C5. It was realized and confirmed on March 31, 2020 that proceeding with this conference was unwise in light of the spreading pandemic Covid-19. On April 22 IUPAP communicated its acceptance of a request for delay of two years to follow the earlier A conference LT29 in August 2022.

William Halperin, C5 chair
September 30, 2021