

# The G2-series

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## Abstract

The G2-series is about strong and beautiful mathematics involving group actions on combinatorial objects. It includes the following events:

G2S2-2021: Groups and Graphs, Semigroups and Synchronization, Sochi, Russia, August 9-13, 2021, <https://siriusmathcenter.ru/en/all-russian-conference>.

G2G2-2021: Graphs and Groups, Geometry and GAP, Portotož-Rogla, Slovenia, June 20 - July 3, 2021, <https://conferences.famnit.upr.si/event/13>.

G2D2-2019: Groups and Graphs, Designs and Dynamics, Yichang, China, August 12–25, 2019, <http://math.sjtu.edu.cn/conference/G2D2>.

G2R2-2018: Graphs and Groups, Representations and Relations, Novosibirsk, Russia, August 06–19, <http://math.nsc.ru/conference/g2/g2r2>.

G2M2-2017: Groups and Graphs, Metrics and Manifolds, Yekaterinburg, Russia, July 22–30, 2017, <http://g2.imm.uran.ru/g2m2>.

G2S2-2016: Graphs and Groups, Spectra and Symmetries, Novosibirsk, Russia, August 15–28, 2016, <http://math.nsc.ru/conference/g2/g2s2>.

G2A2-2015: Groups and Graphs, Algorithms and Automata, Yekaterinburg, Russia, August 09–15, 2015, <http://g2a2.imm.uran.ru>.

G2C2-2014: Graphs and Groups, Cycles and Coverings, Novosibirsk, Russia, September 23–26, 2014, <http://math.nsc.ru/conference/g2/g2c2>.

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We started this series in 2014 in Akademgorodok with organising a small workshop “Graphs and Groups, Cycles and Coverings”, G2C2-2014, in the frame

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of the International cooperation between Slovenia and Russia in 2014-2015. By that time, two joint projects were supported by the Slovenian Research Agency. The first project on “Quasi-coverings and Finite Group Actions on Graphs” was conducted by Tomaž Pisanski and Alexander Mednykh, and the second project on “Cycles and paths in symmetric graphs” was conducted by Dragan Marusič and Elena Konstantinova. The main research topics of these two projects as graphs and groups, cycles and coverings give the title of the event. Klavdija Kutnar, Tomaž Pisanski, István Kovács, Aleksander Malnič, István Estélyi from University of Primorska and University of Ljubljana made significant talks at the workshop. A few wonderful talks were delivered by Russian participants including Sergey Lando from National Research University Higher School of Economics and Alexandr Gaifullin from Steklov Mathematical Institute. In total, we had 12 plenary talks given by senior researchers from Slovenia, Russia, USA, and 8 contributed talks given by young researchers from Sobolev Institute of Mathematics, Novosibirsk State University, and Krasovskii Institute of Mathematics and Mechanics. The main participants of the workshop can be found on the workshop photo presented in Figure 1.

This workshop led to the next G2-event which was initiated by Sergey Goryainov and Natalia Maslova. Impressed by the G2C2 success, they asked why was there no regular algebraic graph theory conference in Russia on the international scale. In 2015 we had the International Conference and PhD Summer School on “Groups and Graphs, Algorithms and Automata”, G2A2-2015, which was held in a very beautiful recreation area named Ivolga (this is a Russian name for the Eurasian golden oriole) located near Yekaterinburg. The G2 was organised by Krasovskii Institute of Mathematics and Mechanics of Ural Branch of Russian Academy of Sciences and Ural Federal University named after the first President of Russia B.N. Yeltsin.

At that time it was decided to play with “Groups” and “Graphs” in the title of the events alternating their ordering from the G2’s to the G2’s as well as play with the next letter abbreviating words reflecting the main topics of the current event. Moreover, we used the same logo as it was designed by Vava Stefoglo for the G2C2. Vava is not a mathematician but received a good education in mathematics. She designed the logo to look like a faceted diamond not keeping in a mind any mathematical sense. However, as it was observed later by many G2-participants the logo corresponds to a Cayley graph over the additive group of order eighth as  $Cay(\mathbb{Z}_8, \{\pm 1, \pm 2\})$ . Moreover, this graph is a Deza graph. Both topics - Cayley graphs and Deza graphs - are among the areas of the G2 interests. Thus, since 2014 we have got the G2 logo. The only part of the logo is changed from year to year: inside a diamond we use G2 on a regular basis but we change the next letter depending on the G2 title.

In the framework of the G2A2-2015 the lecture courses were given by Klavdija Kutnar, who is currently the rector of University of Primorska (UP) in Koper, Dragan Marusič, the former rector of UP, and Tomaž Pisanski, who is considered by many Slovenian mathematicians to be the “father of Slovenian discrete mathematics”. Klavdija and Dragan emphasised on “Graphs and their automorphism groups” while Tomaž gave more details on “Symmetries in

graphs with using Python and Sage”. The special gratitude went to Tomaz for his brilliant explanations on how to write programs and papers in Python and Sage. Jack Koolen and Tatsuro Ito joined to the G2A2 as invited speakers, and since that time they participate at the G2 on a regular basis. Many students and young researchers from Novosibirsk and Yekaterinburg were involved in organising the G2. Among them Sergey Goryainov, Natalia Maslova, Alexey Medvedev, Ekaterina Khomyakova, Alexandr Valyuzhenich. The main lecturers and the main organisers of the G2A2 are presented in Figure. 2

In 2016 the G2-events came back to Akademgorodok as the International Conference and PhD-Master Summer School on “Graphs and Groups, Spectra and Symmetries”, G2S2-2016, with taking place during two week in Novosibirsk State University and being of a truly international scale. In particular, the China-Japan-South Korea school of algebraic combinatorics was well-represented including invited speakers and graduate students. In a sense, this East Asian school of mathematics was founded by Eiichi Bannai and Tatsuro Ito. Since 2015 Tatsuro is one of the main speakers at all the G2-events, while Eiichi joined at the G2 in 2019. As it was noticed by Alexander Ivanov, the source of many ideas discussed during the conference was Com<sup>2</sup>Mac, The Combinatorial and Computational Mathematics Center, POSTECH, Korea, 1999-2008, supervising by Jin Ho Kwak who participated at the G2S2. 15 participants of the G2S2 were the members of this institution for a while. In general, more than 110 experts on finite group theory, graph theory, algebraic combinatorics, low-dimensional geometry and topology from 19 countries (Brazil, Canada, China, Czech Republic, Finland, Germany, Hungary, India, Iran, Israel, Italy, Japan, Slovakia, Slovenia, South Korea, Taiwan, United Kingdom, USA and Russia) participated at the G2S2. Young scientists, PhD students, graduate and undergraduate students were presented by 75 participants.

The G2S2-events were organised by Sobolev Institute of Mathematics and Novosibirsk State University, Novosibirsk, Russia, with cooperation of the Krasovskii Institute of Mathematics and Mechanics, Yekaterinburg, Russia. The organising committee includes René van Bevern, Sergey Goryainov, Ekaterina Khomyakova, Elena Konstantinova, Denis Krotov, Alexey Medvedev, Kristina Rogalskaya, Anna Simonova, Ev Sotnikova and Ivan Takhonov. The program committee includes Alexander Gavriluk, Elena Konstantinova (co-chair), Denis Krotov, Alexander Makhnev, Natalia Maslova, Alexander Mednykh (co-chair) and Andrey Vasil’ev. The conference was supported by the Russian Foundation for Basic Research and Novosibirsk State University, Project 5-100.

The program of the G2S2 Conference has contained 63 talks. The most important directions of algebraic graph theory, topological graph theory, algebraic combinatorics with applications to coding theory, networks, computer science were reflected in the lectures given by 19 plenary speakers, among which there were Anton Betten (Colorado State University, USA), Shaofei Du (Capital Normal University, China), Mitsugu Hirasaka (Pusan National University, South Korea), Klavdija Kutnar (University of Primorska, Slovenia), Jin Ho Kwak (Beijing Jiaotong University, China), Dragan Marusič (University of Primorska, Slovenia), Akihiro Munemasa (Tohoku University, Japan), Mikhail Muzychuk

(Netanya Academic College, Israel), Roman Nedela (Institute of Mathematics and Computer Science, Slovak Republic), Patric Östergård (Aalto University School of Electrical Engineering, Finland), Ilia Ponomarenko (Steklov Institute of Mathematics, St. Petersburg, Russia), Andrey Vasil'ev (Sobolev Institute of Mathematics, Russia), Yaokun Wu (Shanghai Jiao Tong University, China). There were also 43 contributed talks presented by young mathematicians from Brazil, China, India, Italy, Iran, Japan, Germany, Russia, Slovakia, UK.

The program of the G2S2 Summer School has contained four lecture courses. It was started with the course on “Another viewpoint of Euler graphs and Hamiltonian graphs” given by Lih-Hsing Hsu, Providence University, Taiwan, one of the authors of the book “Graph Theory and Interconnection Networks”, 2008. Within the course it was shown that it may appear that there is little left to do in regards to the study of the Hamiltonian property of vertex-transitive graphs unless there is a major breakthrough on the famous Lovász conjecture. However, if we extend the concept of the traditional hamiltonian property to other hamiltonicity properties, then there is still much left to explore. In this series of lectures some of these hamiltonicity properties, namely fault tolerant Hamiltonian, spanning connectivity, and mutually independent hamiltonicity were introduced. The second course on “Graphs and their eigenvalues” was given by Bojan Mohar, the holder of a Canada Research Chair in graph theory at Simon Fraser University in Vancouver, Canada. Together with Carsten Thomassen he coauthored the monograph “Graphs on Surfaces”, The Johns Hopkins University Press, 2001. In his course spectral graph theory was presented with some applications to chemistry. It was a very useful course especially for students since some practical approaches were shown to calculate spectral characteristics of different classes of graphs.

There were two further courses on group theory. Alexander Ivanov, Imperial College London, UK, the author of the book “The Monster Group and Majorana Involutions”, Cambridge University Press, 2009, presented Majorana theory which is a new developing axiomatic approach to the Monster group and its non-associative 196884-dimensional algebra. This was the wonderful course at the advanced level with the lecturer who is “the best over the best” due to Sergey Goryainov opinion which was shared by other participants as well. Group theory was also the foundation of the course on “The Cayley Isomorphism Problem” conducted by Ted Dobson, Mississippi State University, USA, and University of Primorska, Slovenia. In general, the Cayley Isomorphism Problem asks for necessary and sufficient conditions for two Cayley graphs of a group to be isomorphic. This course taught techniques to approach the Cayley Isomorphism Problem. Modifications of these techniques were applied to the isomorphism problem on graphs that are highly symmetric but not Cayley graphs nor even vertex-transitive. Applications of these techniques to isomorphism problems for other classes of combinatorial objects were also shown. This course was one of the favourite courses by students allowed them to get new methods and approaches with simple explanations from the lecturer.



Figure 1: Conference photo of G2C2-2014 in the front of Sobolev Institute of Mathematics, Siberian Branch of Russian Academy of Science, Novosibirsk, Russia.

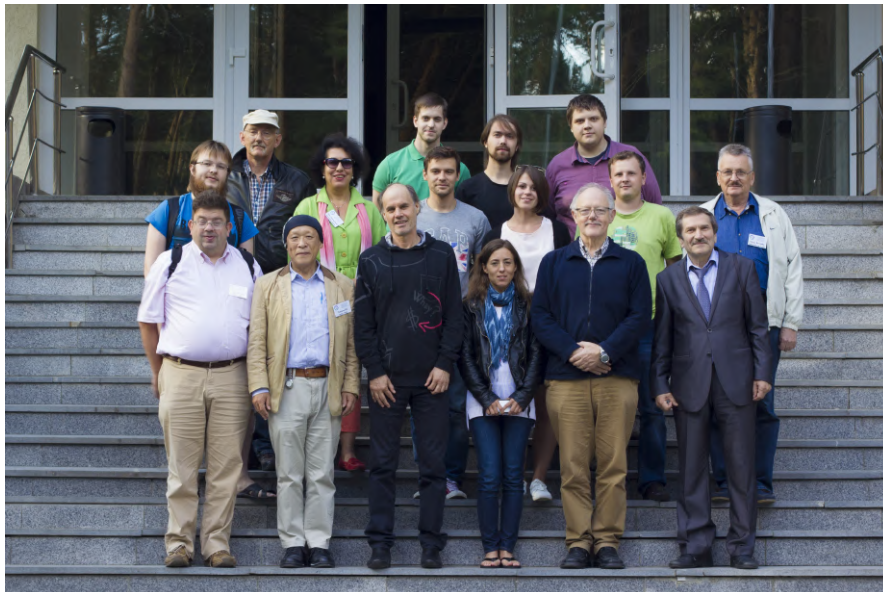


Figure 2: Main lecturers and main organisers of G2A2-2015, the recreation area Ivolga, Syisert, Sverdlovsk oblast, Russia.

The International Conference and PhD-Master Summer School «Graphs and Groups, Spectra and Symmetries» 2016						
Monday August 15	Tuesday August 16	Wednesday August 17	Thursday August 18	Friday August 19	Saturday August 20	Sunday August 21
07:30 – 09:45 Breakfast						
10:00 – 13:00 Morning Sessions						
PhD-Master Summer School		Conference		PhD-Master Summer School		Conference
10:00 – 10:50 Minicourse 1: Hsu Lecture 1	10:00 – 10:50 Minicourse 1: Hsu Lecture 3	10:00 – 10:50 Invited talk: Marušič	10:00 – 10:50 Minicourse 1: Hsu Lecture 5	10:00 – 10:50 Minicourse 1: Hsu Lecture 7	10:00 – 10:50 Invited talk: Munemasa	
11:00 – 11:50 Minicourse 1: Hsu Lecture 2	11:00 – 11:50 Minicourse 1: Hsu Lecture 4	11:00 – 11:50 Invited talk: Kutnar	11:00 – 11:50 Minicourse 1: Hsu Lecture 6	11:00 – 11:50 Minicourse 1: Hsu Lecture 8	11:00 – 11:50 Invited talk: Östergård	
11:50 – 12:10 Coffee break						
12:10 – 13:00 Minicourse 2: Dobson Lecture 1	12:10 – 13:00 Minicourse 2: Dobson Lecture 3	12:10 – 13:00 Invited talk: Muzychuk	12:10 – 13:00 Minicourse 2: Dobson Lecture 5	12:10 – 13:00 Minicourse 2: Dobson Lecture 7	12:10 – 13:00 Invited talk: Kazarin	
13:00 – 14:30 Lunch						
14:30 – 19:00 Afternoon Sessions						
PhD-Master Summer School		Conference		PhD-Master Summer School		Conference
14:30 – 15:20 Minicourse 2: Dobson Lecture 2	14:30 – 15:20 Minicourse 2: Dobson Lecture 4	14:30 – 15:20 Invited talk: Wu	14:30 – 15:20 Minicourse 2: Dobson Lecture 6	14:30 – 15:20 Minicourse 2: Dobson Lecture 8	14:30 – 15:20 Invited talk: Vasil'ev	
15:20 – 16:00 Coffee break						
16:00 – 19:00 Conference						
Goryainov	Kondrat'ev	16:00 – 16:50 Invited talk: T. Ito	Gholaminezhad	Kubota	Special Session 16:00 – 17:00 Ponomarenko "Graph isomorphism in quasipolynomial time" (L. Babai, 2015)	
Shalaginov	Maslova	17:00 – 17:50 Invited talk: Koolen	Rajabi Parsa	Mogilykh		
Kabanov	Zvezdina	17:50 – 18:10 Invited talk: Gavriluk	Narayan	Gorodilova		
Mityanina	Zenkov	18:10 – 19:00 Invited talk: Moringulov	Simonova	Potapov		
Tslovkina	Baykalov	19:00 – 20:00 Invited talk: Vasil'eva	Golmohammadi	Vasil'eva	17:00 – 19:00 Discussions	
Gyürki	Ghorbani	19:00 – 20:00 Dinner	Taranenko			
20:00 – 22:00 Problem solving Minicourse 1	20:00 – 22:00 Problem solving Minicourse 2	Football	20:00 – 22:00 Problem solving Minicourse 1	20:00 – 22:00 Problem solving Minicourse 2	19:00 – 22:00 Conference dinner	

The International Conference and PhD-Master Summer School «Graphs and Groups, Spectra and Symmetries» 2016						
Monday August 22	Tuesday August 23	Wednesday August 24	Thursday August 25	Friday August 26	Saturday August 27	Sunday August 28
07:30 – 09:45 Breakfast						
10:00 – 13:00 Morning Sessions						
PhD-Master Summer School		Conference		PhD-Master Summer School		Conference
10:00 – 10:50 Minicourse 3: Ivanov Lecture 1	10:00 – 10:50 Minicourse 3: Ivanov Lecture 3	10:00 – 10:50 Invited talk: Betten	10:00 – 10:50 Minicourse 3: Ivanov Lecture 5	10:00 – 10:50 Minicourse 3: Ivanov Lecture 7	10:00 – 10:50 Invited talk: Hirasaka	
11:00 – 11:50 Minicourse 3: Ivanov Lecture 2	11:00 – 11:50 Minicourse 3: Ivanov Lecture 4	11:00 – 11:50 Invited talk: Tarannikov	11:00 – 11:50 Minicourse 3: Ivanov Lecture 6	11:00 – 11:50 Minicourse 3: Ivanov Lecture 8	11:00 – 11:50 Invited talk: Ham	
11:50 – 12:10 Coffee break						
12:10 – 13:00 Minicourse 4: Mohar Lecture 1	12:10 – 13:00 Minicourse 4: Mohar Lecture 3	12:10 – 13:00 Invited talk: Kwak	12:10 – 13:00 Minicourse 4: Mohar Lecture 5	12:10 – 13:00 Minicourse 4: Mohar Lecture 7	12:10 – 13:00 Invited talk: Nedela	
13:00 – 14:30 Lunch						
14:30 – 19:00 Afternoon Sessions						
PhD-Master Summer School		Conference		PhD-Master Summer School		Closing
14:30 – 15:20 Minicourse 4: Mohar Lecture 2	14:30 – 15:20 Minicourse 4: Mohar Lecture 4	14:30 – 15:20 Invited talk: Du	14:30 – 15:20 Minicourse 4: Mohar Lecture 6	14:30 – 15:20 Minicourse 4: Mohar Lecture 8		
15:20 – 16:00 Coffee break						
16:00 – 19:00 Conference						
Whybrow	Goyal	16:00 – 16:50 Invited talk: Ponomarenko	Ryabov	Inoue		
Churikov	Nagar	17:00 – 17:50 Invited talk: Ziv-Av	Reichard	Glebov		
Kravtsova	Jalali-Rad	17:50 – 18:10 Invited talk: Andryukhina	Valyuzhenich	Bykov		
Matkin	Skrunkovich	Open problems session	Mednykh	Osaye		
Skuratovskii	K. Ito	19:00 – 20:00 Dinner	Andryukhina	Heydari		
Shlepkin	Mulazzani		Valba	Starikova		
20:00 – 22:00 Problem solving Minicourse 3	20:00 – 22:00 Problem solving Minicourse 4	Volleyball	20:00 – 22:00 Problem solving Minicourse 3	20:00 – 22:00 Problem solving Minicourse 4		

Figure 3: The timetable of G2S2-2016.

More details about the scientific program of the G2S2-2016 one can find in the report paper [1] where the main results presented at the conference were observed. Besides the great scientific program, the G2S2 was successful in virtue of professional approaches to designing the website and issuing the poster by Kristina Rogalskaya and to page-proofing the book of abstracts by Ekaterina Khomyakova. The G2S2 timetable prepared by Ekaterina is shown in Figure 3. At that time Ekaterina also had been taken care of the G2 coffee breaks. The participants enjoyed a lot by fresh watermelons, melons, pears, grapes, peaches.

There is no doubts that the G2S2 stimulated further cooperation between mathematicians over the world and led to a productive exchange of visits, scientific researches, projects and more. As example, the Iranian-Russian project conducted by Saieed Akbari and Elena Konstantinova was funded for three years by the Iranian National Science Foundation and Russian Foundation for Basic Research. The Russian team of the project was mainly consisting of the G2S2 participants from Novosibirsk, Yekaterinburg, Chelyabinsk, and with having Alexey Medvedev as PhD student at Central European University, Hungary.

Finally, it becomes a good tradition that everyone whenever attends the G2 tries their best not to miss further events. This was confirmed by the International Conference and PhD-Master Summer School on “Groups and Graphs, Metrics and Manifolds”, G2M2-2017, which was held in Yekaterinburg in 2017 and was influenced by a number of participants of the Group Theory conference held in Novosibirsk a week before. Akihiro Munemasa and his PhD students from Tohoku University, Tatsuro Ito, Jack Koolen, Shaofei Du, Yaokun Wu, Alexander Ivanov, Alexander Gavriluk participated at the G2 again. The G2M2 was organised under the guidance of Vladislav Kabanov. The organising committee includes Mikhail Volkov, Vitaly Baransky, Ivan Belousov, Sergey Goryainov, Anatoly Kondrat’ev, Anton Konygin, Alexander Makhnev, Natalia Maslova, Tat’yana Senchonok, and Marianna Zinov’eva. There were organised many excursions during the G2M2 as within Yekaterinburg as outside of the city. One of the excursions was to the museum complex located in Verkhnyaya Pyshma which is nearby to Yekaterinburg. This private museum is dedicated to the mechanical and military history of the Ural Federal District of Russian Federation. The complex constitutes military, automotive, and aviation museums, and has a substantial collection of vehicles and other artifacts.

The G2M2-2017 Summer School was presented by a lecture course on “Introduction to the character theory of finite groups of Lie type” given by Alexandre Zalesski from the National Academy of Sciences of Belarus, Minsk. Character theory of finite groups of Lie type is an advanced area of representation theory of finite groups containing numerous fascinating results. The aim of the lectures was to focus on the key elements of the theory in order to help beginners to orient in the area and understand the central ideas of the theory. It was the perfect course given by the wonderful lecturer. Young researchers from Japan, China, Iran, Peru, USA, Slovenia, Russia enjoyed a lot of this course. In particular, Bernard Matthew from the University Berkeley, USA, who participated at the G2 since 2016. In Figure 4 one can see participants of the G2M2 in the front of the building of the Ural Federal University located on Lenin Avenue.

By 2018, the G2-event has grown to a congress level thanks to the number of outstanding mathematicians from all around the world that attended as the main speakers at the conference and as course lectures at the summer school.

The International Conference and PhD-Master Summer School on “Graphs and Groups, Representations and Relations”, G2R2-2018, was held in August in Novosibirsk State University. During two weeks we had incredible team of invited speakers including Leonid Bokut (Sobolev Institute of Mathematics, Russia), Edwin van Dam (Tilburg University, The Netherlands), Alexander Gavrilyuk (Pusan National University, South Korea), Sergey Goryainov (Krasovskii Institute of Mathematics and Mechanics, Russia), Štefan Gyürki (Matej Bel University, Slovakia), Vsevolod Gubarev (Sobolev Institute of Mathematics, Russia), Bobo Hua (Fudan University, China), Tatsuro Ito (Anhui University, China), Alexander Ivanov (Imperial College London, UK), Louis H. Kauffman (University of Illinois, USA), Jack Koolen (University of Science and Technology of China), István Kovács (University of Primorska, Slovenia), Sergey Lando (National Research University Higher School of Economics, Russia), Mario Mainardis (University of Udine, Italy), Atsushi Matsuo (The University of Tokyo, Japan), Tomaž Pisanski (University of Ljubljana, Slovenia), Leonard H. Soicher (Queen Mary University of London, UK), Evgeny Vdovin (Sobolev Institute of Mathematics, Russia), Norman Wildberger (University of New South Wales, Australia), Jiping Zhang (Peking University of China) (see Figure 5). At the first time in the G2 history, all invited talks and lectures were recorded and uploaded to YouTube channel. Moreover, it was discussed with Jiping Zhang to proceed a special issue of the G2S2 in the journal “Algebra Colloquium”. This idea was supported by Chongying Dong, the Editor-in-Chief of the journal. Twelve papers were contributed to the Special Issue of G2R2 which was successfully edited and published in Volume 27, Issue 01 on March 2020. For more details on the content of the Special Issue, please have a look on the preface by A. A. Ivanov and E. V. Konstantinova [2].

The G2R2 Summer school was presented by four courses each of which contained eight 50-minutes lectures. Two lecture courses were devoted to the theory of association schemes. The first course on “Permutation representations of finite groups and association schemes” was given by Akihiro Munemasa from Tohoku University, Japan, and the second course on “Coherent configurations and association schemes: structure theory and linear representations” was delivered by Mikhail Muzychuk from Ben-Gurion University of the Negev, Israel. Both lecture courses were perfectly associated with each other. Moreover, they were associated with problem sessions conducted by Grigory Ryabov. Two other lecture courses were presented by topics from topological graph theory. Namely, we had the lecture course on “Graph coverings and harmonic morphisms between graphs” by Roman Nedela, University of West Bohemia, Czech Republic, and the lecture course on “Groups and symmetry in low dimensional geometry and topology”. The lectures of the last course were delivered by Alexander Mednykh while the lecture notes were prepared by Gareth Jones, University of Southampton, UK. Since Roman and Alexander had a long history of scientific collaboration these lecture courses were in a very nice addition to each other.





Figure 4: Conference photo of G2M2-2017 in the front of the Ural Federal University, Lenin Avenue, Yekaterinburg, Russia.



Figure 5: Conference photo of G2R2-2018 in the front of the tower of Novosibirsk State University, Akademgorodok, Novosibirsk, Russia.



Figure 6: Participants of the G2R2 Summer School: Sam Mattheus, Riya Dogra, Rhys Evans, Ismael Morales (from left to right), Akademgorodok, Novosibirsk, Russia.



Figure 7: Participants from Shanghai Jiao Tong University and China Three Gorges University: Chengyang Qian, Zeying Xu, Da Zhao, Yan Zhu, Huye Chen (from left to right, first row) and Zhuoke Yang, Yanzhen Xiong (second row), Novosibirsk Zoo, Russia, 2018.

The international audience of the summer school was big enough. There were several reasons for this. The first reason was that the G2R2 Summer School was included into the program of Siberian Summer Schools of Novosibirsk State University. In the frame of this program, the G2R2 Summer School was extended by a cultural program including local tours and a day trip to Altai. Moreover, Novosibirsk State University has awarded 10 scholarships for this Summer School Program which allowed us to get excellent listeners from Spain, Belgium, India, Japan, China, South Korea, UK. One of these students was Rhys Evans from Queen Mary University of London. In 2021 he has got a one-year postdoc position at Mathematical Center in Akademgorodok. One can see him on the photo which was taken together with Sam Mattheus from Vrije Universiteit Brussel, Belgium, Riya Dogra from Shiv Nadar University, India, and Ismael Morales from Autonomous University of Madrid, Spain (see Figure 6). The second reason was that the G2 became a very popular in China thanks a good cooperation with Yaokun Wu from Shanghai Jiao Tong University, China. By his recommendations many Chinese students came to Akademgorodok in 2018. For example, we had 10 students from Northwestern Polytechnical University specialising in education and research in the fields of aeronautical, astronautical and marine engineering. We also had 7 students from Shanghai Jiao Tong University. Some of them are presented on the photo taken during an excursion to Novosibirsk Zoo (see Figure 7). There is a very nice video on “Siberian Summer School G2R2 2018” where participants talk about the experience they have got and express their impressions. The video is presented by Novosibirsk State University at YouTube channel.

As the result, the prominent Chinese participants, including Jiping Zhang, Yaokun Wu, and Shaofei Du, suggested to move the next event further eastwards to China. Thus, after discussions with Zongzhu Lin from China Three Gorges University, China, and Kansas State University, USA, the next G2-events were planned to be held at the Three Gorges Mathematical Centre in Yichang, China. The International Conference and PhD-Master Summer School on “Groups and Graphs, Designs and Dynamics”, G2D2-2019, was largely organised by Yaokun Wu and Sergey Goryainov who has got a postdoc position at Shanghai Jiao Tong University by that time. The G2D2 was also supported by Eiichi Bannai (China Three Gorges University, China), Genghua Fan (Fuzhou University, China), Tatsuro Ito (Anhui University, China), Zhiying Wen (Tsinghua University, China), Qing Xiang (University of Delaware, USA), Mingyao Xu (Peking University, China), Xiangdong Ye (University of Science and Technology of China), Jack Koolen (University of Science and Technology of China), Caiheng Li (Southern University of Science and Technology, China).

The G2D2-events were held on the highest level with more than 150 participants from all continents (see Figure 8). There were given 28 invited talks and 45 contributed talks, 4 colloquium talks and 4 lecture courses. This meeting followed the strong tradition of G2-events built over the years. By Alexander Ivanov, “The tradition can be described by three main features: highest quality of mathematics, friendly cooperative atmosphere and a wide range of topics all connected by invisible links”.





Figure 8: Conference photo of G2D2-2019, Three Gorges Mathematical Centre at China Three Gorges University, Yichang, China.



Figure 9: Opening ceremony of the 8th European Congress of Mathematics, the Congress centre Bernardin, Portorož, Slovenia, 2021.



Figure 10: Opening ceremony of the first Conference of International Mathematical Centers, Sochi, Russia, 2021.



Figure 11: Mathematical discussions, G2S2-2021, Sirius Mathematics Center, Sochi, Russia.

One more important tradition was continued. A special issue of the G2D2 was published in the Art of Discrete and Applied Mathematics in Volume 4, No 2 on February 2021 [3]. Besides this, nice lecture notes were prepared on “Laplacian eigenvalues and optimality” by Rosemary A. Bailey and Peter J. Cameron, University of St Andrews, UK; on “Topics in representation theory” by Tullio Ceccherini-Silberstein, Università del Sannio, Italy; on “Symbolic dynamics and the stable algebra of matrices” by Mike Boyle, University of Maryland, USA, and Scott Schmieding, Northwestern University, USA; on “Spectral analysis of growing graphs - a quantum probability point of view” by Nobuaki Obata, Tohoku University, Japan. Publishing of these lecture notes is in progress.

The next G2 was planned to be held as a satellite of the 8th European Congress of Mathematics in Slovenia in 2020. However, due to the worldwide coronavirus pandemic (COVID - 19) in 2020, the 8ECM was moved from 2020 to 2021. Moreover, the 8ECM organisers and the European Mathematical Society announced that it is moved online. Actually, a few main participants came to the venue of the congress that is the Congress centre Bernardin in Portorož, Slovenia. All online talks were managed from this centre by the organisers. In Figure 9 opening ceremony of the congress is shown.

In the framework of the congress we had two satellite events. The first one was the G2G2 Minisymposium on “Graphs and Groups, Geometries and GAP” (MS-ID 7) as the internal satellite of the 8th European Congress of Mathematics. The second one was the G2G2 Summer School on “Graphs and Groups, Geometries and GAP” as the external satellite event of the 8th European Congress of Mathematics. It was held in Rogla immediately after the congress. The main organisers were Clara Franchi (Università Cattolica del Sacro Cuore, Italy), Alexander Ivanov, Elena Konstantinova, and Mario Mainardis (University of Udine, Italy). Our special thanks go to Alexey Medvedev (Université de Namur, Université Catholique de Louvain, Belgium) for the technical support and for managing online communications with participants during almost two years while the school was organised, postponed, and then again organised. Two lecture courses of eighth lectures each including problem solving sessions constituted the main part of the Summer School. The courses offered an innovative unification of two topics of growing importance: the use of computational methods and the study of vertex operator algebras. These two areas are of particular significance in the context of algebraic combinatorics and of the action of finite groups. The lecture courses were given by Leonard Soicher and Atsushi Matsuo both have been already participated at the previous G2.

The summer of 2021 year was a tricky time for the organisers of the G2 since one more G2-event on “Groups and Graphs, Semigroups and Synchronization”, G2S2-2021, was held in Sochi as a part of the first Conference of International Mathematical Centers. This G2 was organised by Natalia Maslova from Ural Mathematical Center, Yekaterinburg, and Elena Konstantinova from Mathematical Center in Akademgorodok, Novosibirsk. Young researchers, postdocs and students from Moscow, Saint-Petersburg, Nizhny Novgorod, Yekaterinburg, Chelyabinsk, Novosibirsk, Krasnoyarsk gave talks at Sirius Mathematics Center in Sochi. Opening ceremony of the Conference is presented in Figure 10 where

Victor A. Sadovnichy, the rector of Moscow State University is giving online greetings to participants of the conference. There is one more photo in Figure 11 showing mathematical discussions by Grigory Ryabov, Victor Panshin, Leonid Shalaginov at Sirius Mathematics Center in Sochi. Manuscripts based on the talks given at the G2S2-2021 in Sochi are collected to a special issue of Proceedings of the Steklov Institute of Mathematics.

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