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INTRODUCTION TO THE PROCEEDINGS OF WGTTG2021

FRANCESCO BELARDO, FRANCESCO G. RUSSO* AND PIERGUIDO SARTI

ABSTRACT. We describe the Italy-South Africa Research Program 2018–2020, focusing on the mobility scheme “Algebraic Graph Theory and Complex Networks” which supported a series of scientific initiatives between the University of Cape Town (Cape Town, South Africa) and the University of Naples Federico II (Naples, Italy) during the years 2018–2021. We sketch the relevant steps of the collaboration, focusing on the creation of a network of researchers between Italy and South Africa in the fields of Graph Theory and Combinatorics. In this context it becomes more relevant the role of the “Workshop on Graphs, Topology and Topological Groups 2021” and of the corresponding proceedings.

1. A brief description of ISARP 2018–2020

South Africa and Italy have a long lasting bilateral partnership in science and technology. The Italy-South Africa Research Programme (ISARP) is implemented and funded by the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) and the National Research Foundation of the South African Department of Science and Innovation within the framework of the Scientific and Technological Cooperation Agreement between the Government of the Republic of Italy and the Government of the Republic of South Africa, signed in Pretoria on 15 January, 1998 and entered into force on 19 February, 2000.

ISARP aims to facilitate the development of sustainable institutional links between the two countries. The overall aim of this Programme is not only to build on existing, outstanding and established research partnerships but to also foster new linkages and engagements with small cohorts of young and emerging researchers for new links between South Africa and Italy. The selection process is based on scientific soundness, excellence being an essential criteria from both countries.

A new call for proposals is going to be jointly issued in the coming months by the South African National Research Foundation and MAECI - Directorate General for Cultural and Economic Promotion and Innovation – Office IX.

Manuscript Type: Workshop on Graphs, Topology and Topological Groups (Cape Town, South Africa).

*Corresponding author.

SA-ITA executive programme
Shaping future S&T cooperation: 2018-2020

- Successful mobility Projects

No	Thematic Area	Title	Italian PI	South African PI
1	New Technologies for Social Science	A spatial and social investigation at the Moxomatsi village, Mpumalanga (SSIMM)	Dr. S. BARBA UniSA	Dr. E. NKAMBULE Tshwane University of Technology, Pretoria
2	Green Energy	Optimal power distribution from renewable energy resources	Dr. S. RUGGERI UniCA	Dr. D. OYEDOKUN University of Cape Town
3	Green Energy	Synthesis and characterization of innovative materials with both multiferroic and photovoltaic properties	Dr. D. DEL MONTE CNR	Dr. VV. SRINIVASU University Johannesburg
4	Green Energy	BIO-waste-to-ENERGY	Dr. FAVARO UniPD	Dr. R. CRIPWELL Stellenbosch University
5	Green Energy	Evaluation of novel metal-organic framework composites for biogas purification	Dr. A. LANZINI Politecnico TO	Dr. R. OBOIRIEN CSIR - Materials Science and Manufacturing, Pretoria
6	Green Energy	Carbon emissions reduction and climate change protection through zero waste.	Dr. D. SPIGA UniCA	Dr. D. TROIS University of KwaZulu-Natal
7	ICT	Algebraic Graph Theory and Complex Networks	Dr. BELARDO UniNA	Dr. F. RUSSO University of Cape Town
8	Green Energy	Novel High Temperature Zr based nano-structured coatings for selective solar absorbers for Concentration Solar Power applications	Dr. B. SOTILLO BUZARRA CNR	Dr. L. KOTSEDI (NANOAFNET), IThemba LABS, National Research Foundation, Western Cape

FIGURE 1. Successful projects of mobility schemes within ISARP 2018–2020.

The latest call for proposals was issued in 2017, inviting applications from South African and Italian partnering research institutions for two funding schemes, one to support Joint Research Projects (JRP) - aimed at promoting collaborative projects with clearly defined goals - and one to facilitate Research Staff Exchange – where only costs related to travel are funded (see Figure 1).

The cooperation areas span a wide range of sectors in the applied and theoretical sciences and technology. The list is periodically revised to align the areas of cooperation to emerging sectors of mutual interest and opportunity.

Multilateral or bilateral funding programs - like ISARP, the network of Science and Technology Attachés – which has been greatly expanded in the last two years, and the Trieste Science Hub are important parts of the Italian science diplomacy tools.

Science and technology represent a composite sector profoundly linked to areas of cooperation such as research and trade. Researchers, entrepreneurs and institutions now have new modern tools to ease the access regarding the Italian science and technology system and its opportunities. The MAECI, in collaboration with the Ministry of University and Research, has created the platform Innovitalia: <https://innovitalia.esteri.it/>, which aims at offering those who work in the research and innovation system, both in Italy and abroad, constant updates on the actions of Italian scientific diplomacy and on opportunities for bilateral and multilateral scientific and technological cooperation. The portal intends to enhance the network of Italian researchers abroad (see e.g. Figure 2 for an idea of the distribution in scientific sectors of the Italian researchers in South Africa), offering a space for networking

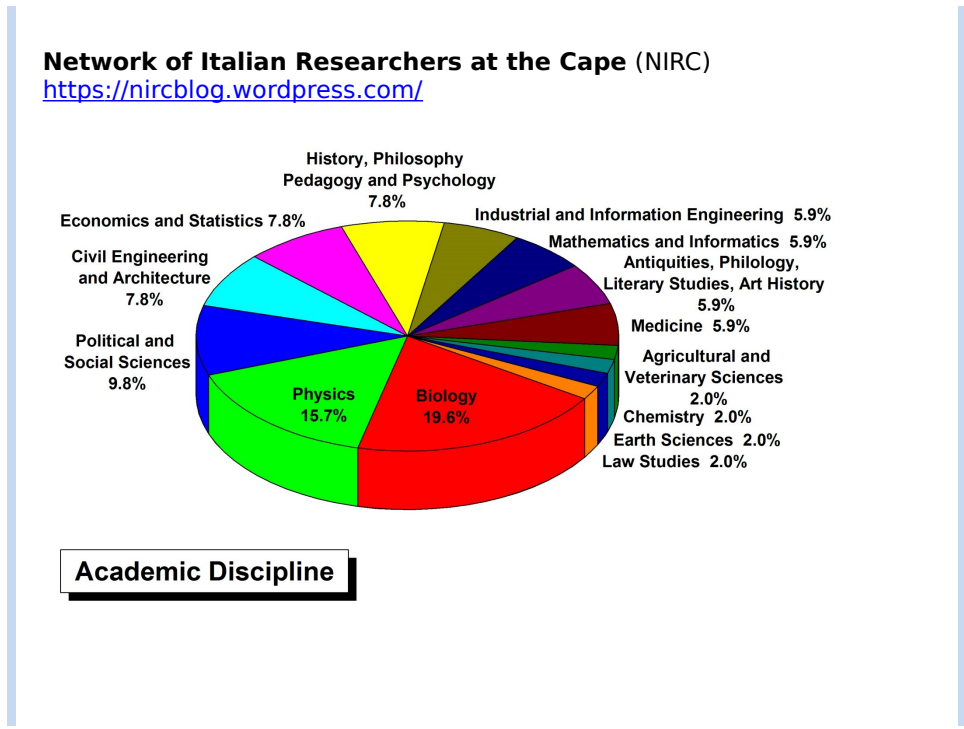


FIGURE 2. Presence of Italian researchers in the Western Cape in 2021.

and collaboration between the various actors of Italian research and innovation on the international scene, sharing information on research, work and specialization opportunities in different countries.

The proceedings of the “Workshop on Graphs, Topology and Topological Groups” WGTTG2021, and the corresponding volume of contributions in the “Transactions on Combinatorics”, should be interpreted as the final product of a scientific program between Italy and South Africa, designed to cooperate on topics of Spectral Graph Theory, Complex Networks and Combinatorics. These three fields are indeed relevant for the formation of young academics in South Africa, but they are also three fields which can contribute to the creation of a scientific network of long term.

2. The scientific initiatives of “Algebraic Graph Theory and Complex Networks”

Since WGTTG2021 is a part of ISARP 2018–2020, we should mention that WGTTG2021 was supported by the National Research Foundation of South Africa (NRF) and by the Ministero deli Affari Esteri e della Cooperazione Internazionale of Italy (MAECI), but these two institutions supported in fact the whole project “Algebraic Graph Theory and Complex Networks” within ISARP 2018–2020. We are going to mention briefly the main steps of the collaboration during the years 2018–2021.

The first moment of interaction between the principal investigators of “Algebraic Graph Theory and Complex Networks” goes back to the meeting

Workshop on Algebraic Graph Theory and Complex Networks



FIGURE 3. Workshop on Algebraic Graph Theory and Complex Networks in September 2018 (Naples, Italy).

University of Naples Federico II

Naples, Italy, 13th and 14th of September 2018

<http://www.dma.unina.it/ocsuser/ocs/index.php/WAGTCN/2018>

This meeting held in person and it allowed young South African researchers to travel, putting them in contact with experts in the fields of Spectral Graph Theory and Combinatorics.

From the motivation, the people involved, the energies and the level of the scientific talks of this meeting, it was clear that the mutual interactions would have been of benefit both for the research unit of the Italian principal investigator and for the research unit of the South African principal investigator, namely

Topology, Algebra and Dynamical Systems

University of Cape Town

<https://sites.google.com/site/topolalgeb/home>

Since the group of research “Topology, Algebra and Dynamical Systems” had some young post-graduate students, who were interested to acquire knowledge in combinatorics, there was the chance to have a series of lectures of advanced level one year later. The lectures dealt with Spectral Graph Theory and were presented within the periodic activities of the research group in Cape Town, namely

Course for PhD and MSc students

Spectral Graph Theory of Signed Graphs



FIGURE 4. A PhD course on Spectral Graph Theory at University of Cape Town during the month of December 2019.

University of Cape Town, 13/16/17/18/19 December 2019

https://drive.google.com/file/d/15SoJRL4TaLCdhd_7h0_mXUvn825m15R0/view

Of course, the lectures were face-to-face and this was another important moment of collaboration, where it was possible to share ideas and perspectives in algebraic combinatorics.

The last step was supposed to happen in March 2020, but there were restrictions due to covid19, and these restrictions changed deeply the social behaviours during the years 2020 and 2021. In particular it has changed the usual tradition to do research in person via meetings and workshops. Therefore the original plans, regarding the realization of the “Workshop on Graphs, Topology and Topological Groups”, were modified and the meeting was postponed and it held online in March 2021, due to a persisting situation of uncertainty for travels and mobility.

Despite the difficulties due to covid19 restrictions, the energy of the people involved, the presence of the institutions and the motivation both from the Italian part and the South African part were intensive, in fact WGTG2021 was successful. This meeting had a large number of participants, offering a forum of scientific discussion between the national experts in the area of graph theory both in Italy and in South Africa, but saw also participants from Nigeria, Spain, Germany, Turkey, Iran, Serbia, USA, Sweden, Ethiopia, Namibia. We mention the main links of WGTG2021 below:

Workshop on Graphs, Topology and Topological Groups 2021 [Online]

University of Cape Town, Cape Town, South Africa

10th of March 2021, Zoom Meeting

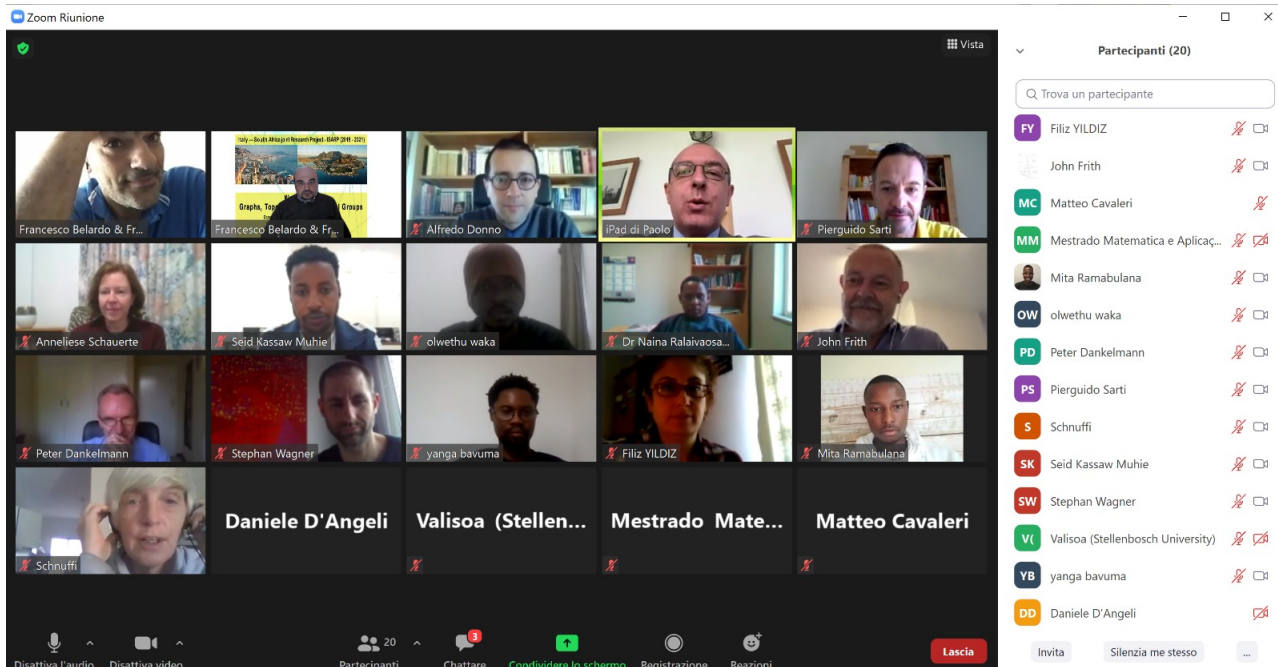


FIGURE 5. WGTTG2021 [Online] in March 2021 (Cape Town, South Africa).

<https://sites.google.com/site/topolalgeb/home/conferences/wgttg-2021-online>

It should be mentioned the additional activity of formation for young academics, developed as a parallel event of WGTTG2021. This was a course of advanced level, which touched a sensitive topic of research such as the geometric group theory. Our warmest thanks go to Prof. Enric Ventura (Universitat Politècnica de Catalunya, Barcelona, Spain) who gave this course and offered his experience and availability to the participants of WGTTG2021. It represented another significant opportunity of growth for the young South African academics involved in the project:

Course for PhD and MSc students

Stallings Graphs and the Lattice of Subgroups of Free Groups

University of Cape Town, 8/9/11/12 March 2021

https://drive.google.com/file/d/16rg45oWv-daqextax71CLFZJO_NTSZMF/view

The publication of the proceedings of WGTTG2021 is the concrete and permanent trace of the whole collaboration. We should thank explicitly Prof. Alireza Abdollahi (University of Isfahan, Isfahan, Iran), since he gave the availability to publish the contributions of our meeting in the “Transactions on Combinatorics”. The result is a volume of very fine quality, whose authors and titles appear below:

Authors: Y. Bavuma

Title: A short note on the decomposition of the central product of groups

Authors: F. Belardo and M. Brunetti

Title: On eigenspaces of some compound complex unit gain graphs

Authors: M. Cavaleri, A. Donno and D. D'Angeli

Title: On the characteristic polynomial and spectrum of Basilica Schreier graphs

Authors: J. Delgado and E. Ventura

Title: A list of applications of Stallings automata

Authors: H.P. Künzi and F. Yildiz

Title: A directed graph associated with a T_0 -quasi-metric space

Authors: V.R. Misanantenaina and S. Wagner

Title: A polynomial associated with rooted trees and specific posets

Authors: S.K. Muhie

Title: Spectral properties of the non-permutability graph of subgroups

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Francesco Belardo

Dipartimento di Matematica e Applicazioni “R. Caccioppoli”, Università degli Studi di Napoli Federico II, Via Cintia, Complesso Universitario Monte S. Angelo, I-80126 , Naples, Italy

Email: fbelardo@gmail.com

Francesco G. Russo

Department of Mathematics and Applied Mathematics, University of Cape Town, Private Bag X1, 7701, Rondebosch
Cape Town, South Africa

and

Department of Mathematics and Applied Mathematics, University of the Western Cape, New CAMS Building, Private
Bag X17, 7535, Bellville, South Africa

Email: francescog.russo@yahoo.com

Pierguido Sarti

Ministero degli Affari Esteri e della Cooperazione Internazionale, Ambasciata d'Italia in Pretoria, 796, George Avenue,
0083 Arcadia, Pretoria, South Africa

and

Istituto Nazionale di Astrofisica, Istituto di Radioastronomia, Area della Ricerca, Via Gobetti 101, I-40127, Bologna,
Italy

Email: pretoria.scienza@esteri.it