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STUDI ROMA TRE

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Report on the WAMS school on Representation Theory College of Science, University of Sulaymaniyah, Sulaymaniyah/ Kurdistan Region/ Iraq

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1 Preamble

This report covers three activities:

- Second International Conference of Mathematics (SICME-Erbil2019) Salahaddin University - Erbil (February 3 - 5, 2019) http://su.edu.krd/sicme2018/
- Pre-school for the WAMS school on Representation Theory, College of Science, University of Sulaimani (January 17-19, 2019) http://www.rnta.eu/Sulaimani2019/preschool.html
- WAMS school on Representation Theory, College of Science, University of Sulaymaniyah (February 7 - 9, 2019) http://www.rnta.eu/Sulaimani2019/

More detailed information regarding every single event can be found in the appropriate web pages above. This report can be downloaded at

http://www.mat.uniroma3.it/users/pappa/missions/reports/2019_Sulaimani_WAMS.pdf The events reported here are to be considered as "followups" of the WAMS research school Topics in algebraic number theory and Diophantine approximation that took place in Erbil in March 2017

http://science.su.edu.krd/index.php/

news-and-events/302-proposal-for-a-wams-school-in-erbil

2 SICME-Erbil2019

SICME took place at Salahaddin University. An International Scientific committee and a remarkable work by the Kurdish colleagues that formed an extremely efficient organizing committee, contributed to a very successful event.



There were 2 Invited speakers from Iran, 3 from France, 2 from Italy and 1 from Iraq. The opening ceremony was attended by the French Consul General Dominique Mas and by the President of Salahaddin University Professor Doctor Ahmed Enwer Dezaye. Also the Italian Consul, Mrs Serena MURONI, was invited but she was not present.

During the days of the conference there were two fruitful meetings:

- The first was at the Minister of Education of the Kurdish Government with the Honorable Minister of Education Pishtiwan Sadiq. During this meeting some proposals and plans for future collaboration of Kurdish Institutions (including high schools) and foreign mathematicians. At the meeting were present some of the International participants to SICME2019 from France, Iran and Italy, including the Director of CIMPA Ludovic Rifford and myself.
- The second was at Salahaddin University with the President of the University Prof. Dr. Ahmed Enwer Dezaye. The meeting was more concentrated on the interests of Salahaddin University and possibility of future actions including the recent application for a collaboration between Salahaddin University and the Università Roma TRE under the umbrella of Erasmus+ program. At the meeting were present some of the International participants to SICME2019 from France, Jordan and Italy, including Ludovic Rifford and myself. Some ideas regarding a future action with Jordan were proposed. One of the possibility is the proposal of a WAMS school in Numerical Analysis.

At both meeting the mathematicians were lead by the Dean of the faculty of Sciences Prof. Dr. Herish Omar Abdullah who was also the main organizer of SICME2019.



The Italian participants were supported by the research groups of INDAM. In particular I was supported by GNSAGA. The initial program had a significant larger number of Italian participants. Unfortunately there was



an extremely high number of cancellations. The cancellations were due in part to the wrong belief that there are security problems in Kurdistan and in part to the fact the some of the invited speakers had plans to visit the United States in the near future. Due to American regulation, people that have previously visited Iraq are not entitled to the ESTA U.S. and have to apply for an entry VISA. This complication has caused some of the cancellations by Italian speakers.

3 Pre-school for the WAMS school.

This activity was proposed by the local organizers and was meant as a preparation for the local participants to the WAMS school.

I believe that the idea of a pre-school is highly successful and I feel that the suggestion to organize a pre-school might constitute a general recommendation to future WAMS schools.

The detailed schedule of the pre-school is the following:

Details of the program

Location: Department of Mathematics, College of Science, University of Sulaimani, M13.

Date: January 17-19, 2019

Event Objectives:

• Thursday, January 17th, 2019

Times	Activity/Session	Speaker
12:00-12:10	Opening Session, Welcome and Introductions	Dr. Chwas Abbas Ahmed
12:10-12:55	Some special types of groups and subgroups	Dr. Kawa Ahmed Hasan
12:55-1:40	Some basic concepts of ring theory	Dr. Adil Kadir Jabbar
1:40-2:00	Break	
2:00-3:00 Real and complex matrix groups		Dr. Muzafar Fatah Hama

• Friday, January 18th, 2019

Times	Activity/Session	Speaker
08:30-09:20	Exponential, differential equations, and one parameter subgroups	Dr. Muzafar Fatah Hama
09:20-10:10	Some basic concepts of module theory	Dr. Adil Kadir Jabbar
10:10-10:30	Break	
10:30-11:30	Group homomorphism and classical isomorphism theorems	Dr. Kawa Ahmed Hasan



• Saturday, January 19th, 2019

Times	Activity/Session	Speaker	
09:00-09:50	Jordan-Hölder Theorem	Dr. Chwas Abas Ahmed	
09:50-10:40	Tangents spaces and lie algebra	Dr. Muzafar Fatah Hama	
10:40-10:00	Break		
11:00-12:00 Exact sequences and chain conditions on modules		Dr. Adil Kadir Jabbar	

4 The WAMS School

During the school 5 courses were given:

• INTRODUCTION TO GROUP THEORY, Giandomenico Boffi:

Actions of groups on sets, Symmetric group and alternating group. Cayley's theorem. Direct products of groups, Sylow's theorem. Applications: classification of groups of small order, The alternating group is simple. Classification of finite abelian groups, finitely-generated abelian groups.

• **REPRESENTATION OF LIE GROUPS AND LIE ALGEBRAS**, Mohammad Eftekhari:

Introduction to Lie groups and Lie algebras (over R or C) Generalisation: Lie groups and algebras over finite fields (the so called finite groups of Lie type) Representations of finite groups of Lie type (Harish-Chandra approach) Representations of finite groups of Lie type (Deligne-Lusztig approach using l-adic cohomology) Computing character tables using perverse sheaves (the so called character sheaves)

• TOPICS IN REPRESENTATION THEORY, Chwas Abbas Ahmed:

Conjugacy classes of symmetric groups and parameterizations of simple modules. Counting standard tableaux of fixed shape: Young diagrams and tableaux, standard tableaux, Young–Frobenius formula, hook formula. Construction of fundamental modules for symmetric groups: Action of symmetric groups on tableaux, tabloids and polytabloids; permutation modules on Young subgroups.

• INTRODUCTION TO REPRESENTATION THEORY, Francesco Pappalardi:

Modules over rings and algebras, simple modules, Schur's lemma. Actions of groups on vector spaces, representations. Group algebras, modules, complete reducibility, Wedderburn's theorem. Characters, orthogonality relations. Tensor product of representations. Restriction and induction.

• INTRODUCTION TO GALOIS THEORY, Michel Waldschmidt:

Field extensions. Degree of extension. Algebraic numbers. Geometric constructions with ruler and compasses. The Galois group of an extension. The Galois correspondence between subgroups and intermediate fields. Splitting field for a polynomial. Transitivity of the Galois group on the zeros of an irreducible polynomial in a normal extension. Properties equivalent to normality. Galois groups of normal separable extensions. Properties of Galois correspondence for normal separable extensions. Normal subgroups and normal intermediate extensions. The Fundamental Theorem of Galois Theory.



There was also a special lecture on representation theory given by Pierre Cartier. The schedule of the lectures has been:

February 7th, 2019

February 8th, 2019

February 9th, 2019

09:00-10:40	Introduction to group theory	
11:00-12:40	Introduction to representation theory	
12:40-14:00	Lunch break	
14:00-15:40	Representation of Lie groups and Lie algebras	

09:00-10:40 Introduction to group theory 11:00-12:40 Introduction to representation theory 12:40-14:00 Lunch break 14:00-15:40 Introduction to Galois theory

11:00-12:40 Introduction to Galois theory
12:40 14:00 Lunch broak
14:00 15:40 Topics in representation theory

The participants were more than 60. Among them there were 8 Iranians (6 from Zanjan e 2 from Teheran) and at least 8 Iraqis (not Kurdish).

Given the special venue for the school, we feel that the turnout is quite satisfactory. The classroom was very comfortable as was the rest of the campus of the University of Sulaimani which would be an ideal location for future CIMPA activities.

The local organizers, Dr. Chwas A. Ahmed and Dr. Ayad M. Ramadan did a remarkable job. Thanks to their efforts, we did not record any noticeable problem. The atmosphere was very pleasant and all the schedules were always respected.

A "trombinoscope" of the participants of the school can be found in:

http://www.rnta.eu/Sulaimani2019/portraits/

Wams school on Representation Theory

College of Science, University of Sulaymaniyah

Sulaymaniyah/ Kurdistan Region/ Iraq. February 7 - 9, 2019



Chwas ABBAS AHMED (KURDISTAN - IRAO)



Avin MOHAMMED (KURDISTAN - IRAO)



Ayad RAMADAN (KURDISTAN - IRAO)



Basiyah ABDULRAHIM (KURDISTAN - IRAO)



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Dana JAMAL SAEED (KURDISTAN - IRAQ)



Giandomenico BOFFI (ITALY)



(KURDISTAN - IRAQ)



(KURDISTAN - IRAQ)



Halgurd DARWESH



Francesco PAPPALARDI (ITALY)



Hanaw AMIN (KURDISTAN - IRAQ)



(KURDISTAN - IRAQ)



Hajivand FARSHAD HASANI



Hawsar HAMARASHID (KURDISTAN - IRAQ)







Khabat HAMASAED (KURDISTAN - IRAQ)



Maryam EMAM-JOMEH ZADEH (IRAN)



Mohammad EFTEKHARI (KURDISTAN & FRANCE)



Karwan JWAMERY (KURDISTAN - IRAQ)



Khelan HUSSEN (KURDISTAN - IRAQ)



Mediya MRAKHAN (KURDISTAN - IRAQ)





Karzan MOHAMMAED (KURDISTAN - IRAQ)



Mahmood SHIHAB (IRAQ)



Michel WALDSCHMIDT (FRANCE)



Kawa HASAN

(KURDISTAN - IRAQ)



Moghadam GOHARTAJ FARHOODI (IRAN)









Mohammed NOKHAS MURAD KAKI (KURDISTAN - IRAQ)



Noor HAZM (KURDISTAN - IRAQ)



(KURDISTAN - IRAQ)

Nzar ABDULLAH

(KURDISTAN - IRAQ)



(KURDISTAN - IRAQ)



Payman HAMAALI (KURDISTAN - IRAQ)



Nabeel ARIP (TIKRIT - IRAQ)



Pery KARIM (KURDISTAN - IRAQ)



(KURDISTAN - IRAQ)



(KURDISTAN - IRAQ)



Reza ABDOLMALEKI (IRAN)



Setareh RAJABI (IRAN)



Shokhan Hamasalilh (KURDISTAN - IRAQ)



Roonak SAEED

(IRAQ)

Shadia MAJEED NOORI

(KIRKUK - IRAQ)

Twana HUSEIN

(KURDISTAN - IRAQ)

A WAJ





(KURDISTAN - IRAQ)



Runak ABDULLAH (KURDISTAN - IRAQ)



Shazad SHAWQI (KURDISTAN - IRAQ)



Zahra SHAHIDI (IRAN)



Sammer QASIM HASAN (BAGHDAD - IRAQ)



Shilan OTHMAN (KURDISTAN - IRAQ)



Zhwan AMIN (KURDISTAN - IRAQ)

The budget

The contribution from CIMPA was used almost completely. Regarding the International participants, there were 12 applications from Iran (4 from Teheran and 8 from Zanjan), two applications from Egypt and one



from Perù.

The organizing committee decided to accept all the applications from Iran. Thanks to the contribution the Institute for Advanced Studies in Basic Sciences (IASBS) of Zanjan through Professor Rashid Zaare-Nahandi, chairman of the Department of Mathematics, part of the travel expenses of the Zanjaninans participants were covered by IASBS. Part was also covered by Salahaddin University. To three of the Teheraninans was offered to cover the travel expenses and one of them cancelled. At the end in Sulaimani there were 6 Zanjaninans and 2 Teheraninans. The local expenses were completely covered for all the participants (non from Sulaimani) and all the speakers. The travel expenses of the Teheraninans were covered completely by CIMPA.

Due to difficulties to obtain entry visa in Iraq, the organizing committee decided to not accept the other international applicants.

There was also a large number of applications from Iraqis (non Kurdish). They were all accepted but at the end, only a small number of them actually came to Sulaimani.

We believe that, given the success in international participation to this WAMS school, it is to be expected that for future events in Kurdistan, the number of international applicants will grow significantly. For this reason, I believe that an higher financial investment might be justified.

The possibility for satisfy all the requests to cover living expenses, including those from Iraqi (non Kurdish) participants, is due to an extremely good planning that was done by the local organizers that managed to negotiate good deals with the Hotel in Sulaimani.

Sulaimani University contributed financially to the school. I hope that for future events the contribution will be confirmed and also enlarged.

FINAL BUDGET

11/02/2019

1	€ 370			travel expenses	Michel Waldschmidt
2	€ 160			contrib to travel expenses	Adib ABDOLLAHI
3	€ 160			contrib to travel expenses	Maryam EMAM-JOMEH ZADEH
4	€ 96	د.ع. 130.000	06/02/19	dinner	4 speakers+7participants
5	€ 240	د.ع. 324.000	07/02/19	lunch	54 participants & speakers
6	€74	د.ع. 100.000	07/02/19	dinner	8 iranian participants
7	€ 59	د.ع. 80.000	08/02/19	dinner	7 Iranian participants
8	€ 74	د.ع. 100.000	09/02/19	dinner	7 Iranian participants
9	€ 444	د.ع. 600.000	6-10/02/19	Hotel in Suli	8 participants from Iran
10	€ 444	د.ع. 600.000	6-9/02/19	Hotel in Suli	5 speakers
11	€ 504	د.ع. 680.000	6-9/02/19	Hotel in Suli	7 Iraqi participants
12	€ 143	د.ع. 193.125	9-10/02/19	Hotel in Erbil	3 speakers
13	€ 89	د.ع. 120.000	10/02/2019	transport Suli - Iran Border	6 Iranian participants
14	€ 89	د.ع. 120.000	09/02/2019	transport Suli – Erbil	5 speakers
	€ 2.947			TOTAL SPENT	
	€ 53			LEFT	

1€ = 1.350 IQD

WAMS SCHOOL SULAIMANI 2019

5 Followups

Sulaimani University would be an excellent destination for future CIMPA schools. I hope that there will be more proposals for WAMS school and CIMPA schools to be hosted at the University of Sulaimani. Connections with local faculties and students might lead to further research collaboration and even to exchange of students.

There is also the plan to involve the local organizer Dr. Chwas Abbas Ahmed to a WAMS school in Armenia for May 2020. If fact, in the occasion of recent contacts with Prof. Dr. Yuri Movsisyan, I have been asked to consider the proposition of a WAMS school in Algebra at Yerevan State University. The possibility to involve colleagues from Sulaimani and from Iran in the enterprise would be highly desirable.

