Nonassociative algebras and applications 2018

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On September 10-21, 2018, a CIMPA research school was conducted by the Romanovsky Institute of Mathematics of the Academy of Sciences of Uzbekistan with the support of CIMPA (Centre International de Mathematiques Pures et Appliquees), IMU CDC (International Mathematical Union, Commission for Developing Countries) and National University of Uzbekistan. The topics of the research school included various aspects of the theory of non-associative algebras, their representation theories and applications, including Lie algebras, Leibniz algebras, Jordan algebras and other classes of algebras and superalgebras. The purpose of the project was to conduct several mini-courses by leading world mathematican in nonassociative algebras for young researches from the regions of Uzbekistan and neighboring countries. Speakers and lectures of mini-courses included such prominent experts as Fields medalist Efim Zelmanov (University of California at San Diego, USA), Andrea Solotar (University of Buenos Aires, Argentina), Abdenacer Makhlouf (Universite de Haute Alsace, France), Irina Kashuba and Vyacheslav Futorny (University of San Paulo, Brazil), Olivier Mathieu (Universite Lyon, France), Fedor Sukochev(University of New South Wales, Australia), Xiaojun Chen and Wenchuan Hu (Sichuan University, China). Participants included students and young researches from Uzbekistan, Kazakhstan, India, Vietnam and Italy.

On September 10, the opening ceremony of the CIMPA School was held at the Mathematics Department of the National University of Uzbekistan. The ceremony was attended by the director of CIMPA Professor Ludovic Rifford, Vise President of National University of Uzbekistan and also the Cultural Attache of the Embassy of France in Uzbekistan.

Professor E.Zelmanov gave a 6 hours mini-course on Nonassociative algebras. First he gave general overview on the subject. Then he presented a classification of Lie and Jordan (super)algebras. He also mentioned some recent results on representation theory of Jordan algebras.

Professor A. Makhlouf formal deformation of (Non)associative algebras. He introduced deformation theory of algebras over operads. He discussed in great details Gerstenhaber's work on deformation of associative algebras: Maurer-Cartan formalism, Hochschild cohomology. He briefly touched deformation quantization of Poisson manifolds.

Professor A. Solotar gave an introductory course on Hochschild (co)homology. She first introduced the necessary background material from homological algebra. Then she defined the Hochschild (co)homology, and gave explanation through explanation the lower terms. Along this she gave many examples of explicit computations. She discussed various structures on the Hochschild (co)homology such the cup and cap product. Finally she briefly applied them in the study of noncommutative geometry, such as Calabi-Yau algebras.

Professor I. Kashuba gave an 8 hours mini-course on Representation of Jordan algebras and superalgebras. First, she gave a brief course on representation of finite groups and character theory. Then she reminded classical work of N.Jacobson on representation of Jordan algebras. She explained Cantor-Kocher-Tits construction to establish representation theory of Jordan and Lie algebras.

Professor O.Mathieu gave an 8 hours mini-course on Harmonic polynomials and the cohomology of G/B. Olivier introduced harmonic polynomials for any reductive algebraic group G and presented various characterization of $\mathcal{H}$, the space of harmonic functions. He gave a detailed proof of Chevalley's theorem. Using Demazuer's operator on the cohomology of G/B, he described a canonical basis for the space $\mathcal{H}$.

Professor X. Chen gave a 6 hours mini-course on Poisson algebras. In the first two lectures, he briefly reviewed the definition of Poisson algebras and their examples, Poisson homology and cohomology and the differential calculus structure on them, and unimodular Poisson structures and the Poincare duality. In the second two lectures, he discussed the deformation quantization of unimodular Poisson algebras and related it with Calabi-Yau algebras. Finally, he discussed the noncommutative Poisson structures introduced by Kontsevich, Crawley-Boevey and Van den Bergh, and related them with representation theory and derived algebraic geometry.

All of the above mini-courses were very lively, participants actively involved in discussions and asked many questions. In addition to mini-courses, several research talks were presented: Sh. Ayupov *"Local and 2-local derivations and automorphisms of finite-dimensional Lie algebras"*, F.Sukochev *"Derivations into ideals of a semifinite von Neumann algebra"*, V.Futorny *Gelfand-Tsetlin Theory*, B. Omirov *"On nilpotent Leibniz algebras and their derivations"*, U.Rozikov *"Evolution algebras of free and bisexual populations"*, K. Kudaybergenov *"Local and 2-local derivations and automorphisms of Leibniz algebras"* , F.Eshmatov *"Transitivity of cyclic quiver varieties"*, W. Hu *"The structure of Chow varieties and Lawson homology theory"*, A. Khudoyberdiyev *"Degenerations and deformations of Leibniz algebras"*. Two of the students of the school also presented their research. A.Caratenuto of SISSA(Italy) gave a talk on *"Differential calculus on Jordan modules"* and R.Saha (India) presented a talk on *"Equivariant Leibniz Cohomology"*

In general, the school was a great success and was very useful for the further scientific work of young scientists and future cooperation. Director of CIMPA, Professor L.Rifford has sent a letter with gratitude for a well-organized school and he has promised further support of our activities.