- Below is the schedule for our talks followed by the abstracts (go there).
- All talks are scheduled in room 5/I (room Tiberiu Popoviciu) Central Building.
  - Here is a pin on Google Maps.
  - Due to construction sites in the area, the current access to the building is from the **east**, from Emmanuel de Martonne street.
  - The conference room does not have blackboards. We have a smartboard and a large display with the auxiliary equipment.
  - The room 5/I is in the **southeast corner** of the building, 1st floor.
- The online talks will be streamed in room 5/I via Zoom.
- All talks will be streamed online via Zoom and each registered participant will receive a link per email.
  - Don't forget to **synchronize with the local time** in Cluj-Napoca.

| Day 1, Tuesday, September 12 | | |
|---|---|---|
| 8:50 Registration | | |
| 9:00–9:50 | Jan Trlifaj | AECs, categoricity, and deconstructible classes of modules |
| 10:00–10:50 | Manuel Saorín | Hearts of set-generated t-structures have a set of generators |
| Coffee Break | | |
| 11:20–12:10 | Alberto Tonolo | Injective and divisible modules over the Jacobson algebra |
| 12:20–13:10 | Michal Hrbek | Product-complete tilting complexes and Cohen-Macaulay hearts |
| Lunch Break | | |
| 15:00–15:50 online | Tomasz Brzeziński | Lie algebras on affine spaces |
| Coffee Break | | |
| 16:10–17:00 online | Bernard Rybołowicz | On affinity of affine spaces with ternary operations |

| Day 2, Wednesday, September 13 | | |
|---|---|---|
| 9:00–9:50 | Ana Bălibanu | Moment maps and multiplicative reduction |
| 10:00–10:50 | Alexander Martsinkovsky | A functorial approach to the autonomy of a control system |
| Coffee Break | | |
| 11:20–11:45 | Miruna-Ștefana Sorea | A quadratic identity in the shuffle algebra and an alternative proof for de Bruijn's formula |
| 11:45–12:10 | Patrick Serwene | Fusion Systems and their applications in block theoretic conjectures |
| Lunch Break | | |
| 14:30–17:30, City tour, guide: Andrei Mărcuș | | |

| Day 3, Thursday, September 14 | | |
|---|---|---|
| 9:00–9:50 | Dan Ciubotaru | Elliptic representations of Weyl groups, affine Hecke algebras, and p-adic groups |
| 10:00–10:50 | Sorin Dăscălescu | Picard groups of quasi-Frobenius algebras and a question on Frobenius strongly graded algebras |
| Coffee Break | | |
| 11:20–12:10 online | Meinolf Geck | Characters of finite Chevalley groups |
| 12:20–13:10 | Radu Stancu | Fusion Stable Burnside Rings |
| Lunch Break | | |
| 15:00–15:50 online | Călin Chindriș | The Jordan type of a quiver representation |
| Coffee Break | | |
| 16:10–16:35 | Virgilius-Aurelian Minuță | Relations between module triples, and derived equivalences for wreath products |
| 16:35–17:00 | Constantin-Cosmin Todea | Stable unital bases, hyperfocal subalgebras and basic Morita equivalences |
| 19:00, Conference Dinner at Roata, here is a pin on Google Maps | | |

| Day 4, Friday, September 15 | | |
|---|---|---|
| 9:00–9:50 | Ana Agore | The set-theoretic Yang-Baxter equation, Kimura semigroups and functional graphs |
| 10:00–10:50 | Gigel Militaru | The universal coacting bialgebra of a Poisson algebra. Applications |
| Coffee Break | | |
| 11:20–12:10 | Stefaan Caenepeel | Aspects of the formal theory of monads, including adjunctions, entwining structures and Galois theory |
| 12:20–13:10 | Csaba Szántó | Ringel-Hall polynomials associated to tame quivers |
| Lunch Break | | |
| 15:00–15:25 | Iulian Simion | Epimorphic subgroups in simple algebraic groups |
| 15:25–15:50 | Simion Breaz | On a characterization of (co)silting objects |
| Coffee Break | | |
| 16:10–17:00 | Manuel Cortés-Izurdiaga | Verdier quotients of homotopy categories of rings and Gorenstein-projective precovers |

| Day 5, Saturday, September 16 | | |
|---|---|---|
| 9:00–9:50 | Jan Žemlička | On the structure of ADS and self-small abelian groups |
| 10:00–10:25 | Grigore Călugăreanu | The formula ABA=Tr(AB)A for matrices |
| 10:25–10:50 | Mădălin-Gabriel Mitrofan | Waring decompositions for matrices over finite fields |
| Coffee Break | | |
| 11:20–12:10 | Dolors Herbera | A new look to direct sum decompositions of torsion-free modules |

# ABSTRACTS

## Day 1, Tuesday, September 12

8:50 Registration

9:00–9:50 **Jan Trlifaj**

Title: **AECs, categoricity, and deconstructible classes of modules**

Abstract: The Morley-Shelah Categoricity Theorem is a major result of classic model theory of first-order structures. Its generalization to abstract elementary classes (AECs) remains open: the Eventual Categoricity Conjecture (ECC) says that if $\mathcal{C}$ is an AEC then there exists a cardinal $\lambda$ such that if $\mathcal{C}$ is categorical in $\lambda$, then $\mathcal{C}$ is categorical in all cardinals $\geq \lambda$. Shelah's Categoricity Conjecture (SCC) claims that one can take $\lambda = \beth_{(2^\kappa)^+}$ where $\kappa$ is the Löwenheim-Skolem number of $\mathcal{C}$.

Interesting classes of AECs, the AECs *of roots of Ext*, arise in homological algebra. They have the form $(\mathcal{A}, \leq)$ where $\mathcal{A}$ is a left hand class of a hereditary cotorsion pair of modules, $\mathcal{A}$ is deconstructible and closed under direct limits, and $\leq$ is the relation $A \leq A'$, iff $A'/A \in \mathcal{A}$.

We prove that SCC holds for all AECs of roots of Ext. We also show that if $(\mathcal{D}, \leq)$ is any AEC such that $\mathcal{D}$ is deconstructible and $\leq$ refines direct summands, then $\mathcal{D}$ is necessarily closed under direct limits. Finally, we prove the analog of ECC for all deconstructible classes of modules (joint work with Jan Šaroch).

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10:00–10:50 **Manuel Saorín**

Title: **Hearts of set-generated t-structures have a set of generators**

Abstract: A popular problem in recent times has been to give conditions that guarantee that a given t-structure in a triangulated category with coproducts have a Grothendieck heart. The problem essentially divides in two 'disconnected' parts, namely, to check when that heart is AB5 (i.e. has exact direct limits) on one side and check when it has a set of generators on the other. This second part has been normally tackled by assuming some model for the ambient triangulated category, .e.g being the homotopy category of some model category, some stable $\infty$-category or the base of a strong stable derivator.

Based on recent results of Neeman, we will show in this talk that one can get rid of the existence of such a model, assuming instead that the triangulated category is well-generated, a condition that is satisfied by all examples appearing in practice. Our main result claims that in such an ambient category any t-structure generated by a set of object has a heart with a set of generators.

Coffee Break

11:20–12:10 **Alberto Tonolo**

Title: **Injective and divisible modules over the Jacobson algebra**

Abstract: Let $K$ be a field. The Jacobson algebra is the $K$-free algebra on two non commuting variables $x, y$ modulo the relation $xy = 1$. Since the Jacobson work in the late 40's, many mathematicians have extensively examined its properties in both the ring-theoretic and module-theoretic contexts. The Jacobson algebra is isomorphic to the Leavitt path algebra associated to the Toeplitz graph. In this talk we describe the indecomposable injective modules over the Jacobson algebra and we exhibit an example of a not injective divisible module.

12:20–13:10 **Michal Hrbek**

Title: **Product-complete tilting complexes and Cohen-Macaulay hearts**

Abstract: We show that the cotilting heart associated to a tilting complex T is a completion of an artinian abelian category if and only if T is product-complete. The main ingredient of the proof is the contramodule theory over topological endomorphism rings of Positselski and Šťovíček. We then apply this to the specific setting of the derived category of a commutative noetherian ring R. We show that there is a derived equivalence between mod-R and an artinian category if and only if R is a homomorphic image of a Cohen-Macaulay ring. We then discuss some consequences for t-structures in $D^b(mod - R)$ and for the theory of Gorenstein complexes. This is a report on the joint work arXiv:2307.16722 with Lorenzo Martini.

Lunch Break

15:00–15:50 **Tomasz Brzeziński** (online)

Title: **Lie algebras on affine spaces**

Abstract: We first explore the definition of an affine space which makes no reference to the underlying vector space and then formulate the notion of a Lie bracket and hence a Lie algebra on an affine space in this framework. Since an affine space has neither distinguished elements nor additive structure, the concepts of antisymmetry and Jacobi identity need to be modified. We provide suitable modifications and illustrate them by a number of examples. The talk is based on a joint work with James Papworth.

Coffee Break

16:10–17:00 **Bernard Rybołowicz** (online)

Title: **On affinity of affine spaces with ternary operations**

Abstract: When one considers a vector space or a module over a ring, there is always the neutral element that intuitively is the beginning of a space or module. This talk is about structures and spaces that might not have the beginning. I will introduce the audience to trusses and their modules. Trusses were introduced in 2017 by Tomasz Brzeziński to unify notions of rings and braces. The oddly-looking structure of a truss has a surprising interpretation in ring theory. I will discuss in detail the links between trusses and rings. Further, I will introduce an affine version of a module over a truss called heaps of modules and discuss how affine spaces are particular examples of heaps of modules. At the end, I will discuss various properties of heaps of modules.

## Day 2, Wednesday, September 13

9:00–9:50 **Ana Bălibanu**

Title: **Moment maps and multiplicative reduction**

Abstract: Symplectic reduction is a process that eliminates the symmetries of a Poisson manifold equipped with a Hamiltonian group action. Many algebraic varieties which are of interest to representation theory arise as reductions of symplectic spaces associated to algebraic groups. We introduce several new reduction procedures, some of which are multiplicative analogues of "classical" examples of symplectic reduction. This is joint work with Maxence Mayrand.

10:00–10:50 **Alexander Martsinkovsky**

Title: **A functorial approach to the autonomy of a control system**

Abstract: A linear control system is just an underdetermined system of linear differential equations. The free variables can be chosen arbitrarily and are called the inputs. The system is said to be controllable if any final stage can be reached (in finite time) from any initial stage by choosing the inputs. A system is said to be observable if the entire state of the system can be determined (in finite time) from the available outputs. For any system one can speak of the dual system, and a classical result of Kalman states that the dual system is observable if and only if the original system is controllable, and vice versa.

An arbitrary system need not be controllable and the part of the system that cannot be controlled is referred to as the autonomy. Any system can also be described algebraically by a finitely presented module M over a suitable algebra of differential operators. In that language, the autonomy corresponds to the Bass torsion of M. In view of Kalman's theorem one is led to ask if the Kalman duality admits an algebraic description. As the first step toward answering this question, I will propose a functorial approach to torsion, which is complemented by a suitable duality of functors.

Coffee Break

11:20–11:45 **Miruna-Ștefana Sorea**

Title: **A quadratic identity in the shuffle algebra and an alternative proof for de Bruijn's formula**

Abstract: Motivated by a polynomial identity of certain iterated integrals, first observed in the setting of lattice paths, we prove an intriguing combinatorial identity in the shuffle algebra. It has a close connection to de Bruijn's formula when interpreted in the framework of signatures of paths. This is joint work with Laura Colmenarejo (NC State University, U.S.A.) and Joscha Diehl (University of Greifswald, Germany).

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11:45–12:10 **Patrick Serwene**

Title: **Fusion Systems and their applications in block theoretic conjectures**

Abstract: Fusion systems arise from both finite groups and finite group blocks. A conjecture suggests the equivalence of these construction approaches. We explore the conjecture's implications in Block Theory and discuss the broader applications of fusion systems, particularly in addressing key conjectures within this field.

Free Afternoon

## Day 3, Thursday, September 14

9:00–9:50 **Dan Ciubotaru**

Title: **Elliptic representations of Weyl groups, affine Hecke algebras, and p-adic groups**

Abstract: In representation theory, the characters of induced representations are explicitly known in terms of the character of the inducing representation. This leads to the question of understanding the elliptic representation space, i.e., the space of representations modulo the properly (parabolically) induced characters. I will give an overview of the description of the elliptic space for finite Weyl groups, affine Weyl groups, affine Hecke algebras, and their connection with the geometry of the nilpotent cone of a semisimple complex Lie algebra. These results fit together in the representation theory of semisimple p-adic groups, where they lead to a new description of the elliptic space within the framework of the local Langlands parametrisation.

10:00–10:50 **Sorin Dăscălescu**

Title: **Picard groups of quasi-Frobenius algebras and a question on Frobenius strongly graded algebras**

Abstract: This is joint work with Constantin Năstăsescu and Laura Năstăsescu. Our initial aim was to answer the question: does the Frobenius (symmetric) property transfers from a strongly graded algebra to its homogeneous component of trivial degree? Related to it, we investigate invertible bimodules and the Picard group of a finite dimensional quasi-Frobenius algebra $R$. We compute the Picard group, the automorphism group and the group of outer automorphisms of a 9-dimensional quasi-Frobenius algebra which is not Frobenius, constructed by Nakayama. Using these results and a semitrivial extension construction, we give an example of a symmetric strongly graded algebra whose trivial homogeneous component is not even Frobenius. We investigate associativity of isomorphisms $R^* \otimes_R R^* \simeq R$ for quasi-Frobenius algebras $R$, and we determine the order of the class of the invertible bimodule $H^*$ in the Picard group of a finite dimensional Hopf algebra $H$. As an application, we construct new examples of symmetric algebras.

Coffee Break

11:20–12:10 **Meinolf Geck** (online)

Title: **Characters of finite Chevalley groups**

Abstract: One of the major open problems in finite group theory is the determination of the character tables of the finite simple groups (and related groups like automorphism groups or central extensions). As far as finite Chevalley groups are concerned, the work of Lusztig provides a general plan for computing character tables. We report on the current state of affairs and also on recent progress in this area.

12:20–13:10 **Radu Stancu**

Title: **Fusion Stable Burnside Rings**

Abstract: The Burnside ring $B(G)$ of a finite group $G$ is defined on the isomorphism classes of finite $G$-sets, with operations given by the disjoint union and the direct product of G-sets. For $p$ a prime number, a fusion system $F$ of a finite $p$-group $S$ is a category with objects the subgroups of $S$ and morphisms injective group homomorphisms between the subgroups of $S$. This category mimics the conjugation information on $S$ given by a finite group $G$ containing $S$. One can then define the $S$-sets stable by $F$. They form a subring $B(F)$ of the Burnside ring of $S$. Ten years ago Sune proved that, under some natural conditions on $F$, the underlying monoid $B_+(F)$ of $B(F)$ is free. In this talk I will investigate conditions on $F$ that are equivalent with the freeness of the monoid $B_+(F)$. This is a joint work with Nicolas Lemoine and Aktham Mula.

Lunch Break

15:00–15:50 **Călin Chindriș** (online)

Title: **The Jordan type of a quiver representation**

Abstract: In this talk, I will introduce the class of quiver representations of constant Jordan type, extending the notion of a module of constant Jordan type for elementary abelian p-groups (whose group algebras are commutative truncated polynomial algebras) to quivers (whose path algebras are non-commutative). I will also describe a process that assigns to a quiver representation a sequence of coherent sheaves on toric quiver varieties in such a way that the representation is of constant Jordan type if and only if the corresponding sheaves are locally free. If time permits, I will talk about the Jordan type of representations of posets and explain its relevance in the context of multiparameter peristent homology. This is based on joint work with Andy Carroll, Dan Kline, and Zongzhu Lin.

Coffee Break

16:10–16:35 **Virgilius-Aurelian Minuță**

Title: **Relations between module triples, and derived equivalences for wreath products**

Abstract: In the representation theory of finite groups an important strategy used in the verification of the local-global conjectures is to reduce their statements to some inductive conditions on simple groups. In order to obtain such reduction theorems the language of character triples and the study of the relations between them has proven useful. Particularly, recent results of Britta Späth, utilize the relations $\geq$, $\geq_c$ and $\geq_b$ between character triples.

Together with Andrei Marcus, we have introduced a categorical version of these three relations and we have proved that they are consequences of some special types of group graded Morita equivalences, group graded Rickard equivalences and group graded derived equivalences respectively.

Furthermore, motivated again by the reduction theorems, we construct such equivalences for wreath products and we establish the compatibility between our categorical relations and the constructed wreath products.

16:35–17:00 **Constantin-Cosmin Todea**

Title: **Stable unital bases, hyperfocal subalgebras and basic Morita equivalences**

Abstract: We investigate a conjecture introduced by Barker and Gelvin involving source algebras of p-blocks of group algebras. We reduce this conjecture to a similar statement about the hyperfocal subalgebras of the source algebras. The class of blocks verifying the conjecture is closed under basic Morita equivalences.

19:00, Conference Dinner at Roata, here is a pin on Google Maps

## Day 4, Friday, September 15

9:00–9:50 **Ana Agore**

Title: **The set-theoretic Yang-Baxter equation, Kimura semigroups and functional graphs**

Abstract: We provide an answer, in a special but relevant case, to an open problem of Drinfel'd by proving that the category of solutions of the set-theoretic Yang-Baxter equation of Frobenius-Separability (FS) type is equivalent to the category of pointed Kimura semigroups. As applications, all involutive, idempotent, nondegenerate, surjective, finite order, unitary or indecomposable solutions of FS type are classified. For instance, if $|X| = n$, then the number of isomorphism classes of all such solutions on $X$ that are (a) left non-degenerate, (b) bijective, (c) unitary or (d) indecomposable and left-nondegenerate is: (a) the Davis number $d(n)$, (b) $\sum_{m|n} p(m)$, where $p(m)$ is the Euler partition number, (c) $\tau(n)+\sum_{d|n}\left\lfloor \frac{d}{2} \right\rfloor$, where $\tau(n)$ is the number of divisors of $n$, or (d) the Harary number $\mathfrak{c}(n)$. The automorphism groups of such solutions can also be recovered as automorphism groups $\mathrm{Aut}(f)$ of sets $X$ equipped with a single endo-function $f : X \to X$. We describe all groups of the form $\mathrm{Aut}(f)$ as iterations of direct and (possibly infinite) wreath products of cyclic or full symmetric groups, characterize the abelian ones as products of cyclic groups, and produce examples of symmetry groups of FS solutions not of the form $\mathrm{Aut}(f)$. Based on joint work with A. Chirvasitu and G. Militaru.

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10:00–10:50 **Gigel Militaru**

Title: **The universal coacting bialgebra of a Poisson algebra. Applications**

Abstract: We introduce the *universal algebra* of two Poisson algebras $P$ and $Q$ as a commutative algebra $\mathcal{P}(P, Q)$ satisfying a certain universal property. If $P$ is $n$-dimensional, then $\mathcal{P}(P) := \mathcal{P}(P, P)$ is the initial object in the category of all commutative bialgebras coacting on $P$. As an algebra, $\mathcal{P}(P)$ is the quotient of the polynomial algebra $k[X_{ij} \,|\, i, j = 1, \cdots, n]$ through an ideal generated by $2n^3$ non-homogeneous polynomials of degree $\leq 2$. Several applications are provided.

Coffee Break

11:20–12:10 **Stefaan Caenepeel**

Title: **Aspects of the formal theory of monads, including adjunctions, entwining structures and Galois theory**

Abstract: Brzeziński (2002) introduced Galois theory for corings with a fixed grouplike element. El Kaoutit, Gómez Torrecillas (2003) generalized this to so-called comatrix corings. This establishes a general framework for existing Galois theories: classical Galois theory, Hopf-Galois theory, Galois theory for partial actions, Hopf-Galois theory for weak Hopf algebras etc.

(Co)rings are (co)monads in the bicategory *Bim* of algebras, bimodules, and bimodule maps. The theory therefore has a bicategorical flavour, and the idea of this talk is to provide a framework for Galois theory within 2-categories and bicategories. It is well-known that algebraic and categorical notions, like (co)algebras, Frobenius algebras, entwining structures, adjunctions, can be introduced in 2-categories. For example, algebras in a 2-category are usually called monads, and can be organized into a new 2-category in two different ways (Street, 1971). We review this theory and provide several new 2-categorical applications. We generalize the Galois theory for comatrix corings, under the assumption that certain (co)equalizers exist in the categories that build up the given 2-category.

12:20–13:10 **Csaba Szántó**

Title: **Ringel-Hall polynomials associated to tame quivers**

Abstract: Classical Hall algebras associated with discrete valuation rings were introduced by Steinitz and Hall to provide an algebraic approach to the classical combinatorics of partitions. The multiplication is given by Hall polynomials which play an important role in the representation theory of the symmetric groups and the general linear groups. In 1990 Ringel defined Hall algebras for a large class of rings, namely finitary rings, including in particular path algebras of quivers over finite fields. Far reaching analogues of the classical ones, these Ringel-Hall algebras provided a new approach to the study of quantum groups using the representation theory of finite dimensional algebras. They can also be used successfully in the theory of cluster algebras or to investigate the structure of the module category.

In case of Ringel-Hall algebras corresponding to Dynkin quivers and tame quivers we know due to Ringel, Hubery, respectively Deng and Ruan, that the structure constants of the multiplication are again polynomials in the number of elements of the base field. These are the Ringel-Hall polynomials. If we are looking at Hall polynomials associated to indecomposable modules, the classical ones are just 0 or 1, the Ringel-Hall ones in the Dynkin case are also known and have degree up to 5. However we do not have too much information about the Ringel-Hall polynomials in the tame cases.

In the first part of the talk we survey the indecomposable representations of tame quivers over finite fields. The second part is dedicated to the presentation of our tools and results related to the determination of tame Ringel-Hall polynomials associated to indecomposables.

Lunch Break

15:00–15:25 **Iulian Simion**

Title: **Epimorphic subgroups in simple algebraic groups**

Abstract: The category of linear algebraic groups admits non-surjective epimorphisms. Images of such morphisms are proper epimorphic subgroups. We restrict our attention to simple groups over algebraically closed fields. While maximal epimorphic subgroups are well understood, our understanding of minimal closed epimorphic subgroups is less satisfactory. After discussing criterias for epimorphicity and examples, we comment on a recent result with D. Testerman: For simple algebraic groups of rank 2 defined over algebraically closed fields, the minimal dimension of a closed epimorphic subgroup is 3.

15:25–15:50 **Simion Breaz**

Title: **On a characterization of (co)silting objects**

Abstract: I will present a proof that can be dualized for the characterization of silting objects in triangulated categories with coproducts as those objects $U$ that are (weak) generators of the category, they belong to the corresponding right orthogonal class $U^{\perp_{>0}}$, and the classes $U^{\perp_{>0}}$ are closed under direct sums. This characterization is already known for well generated categories, but the standard proofs use the Brown Representability Theorem, hence they cannot be dualized.

Coffee Break

16:10–17:00 **Manuel Cortés-Izurdiaga**

Title: **Verdier quotients of homotopy categories of rings and Gorenstein-projective precovers**

Abstract: A main problem in Gorenstein homological algebra is to determine the rings satisfying that the class of all Gorenstein-projective modules is precovering. Since Gorenstein-projective modules are those isomorphic to a cylce of a totally acyclic complex of projective modules, there are some research in which the study of Gorenstein-projective modules is made in terms of several categories determined by complexes of projectives. In the talk we will consider several properties of $\mathbf{K}(\mathrm{Proj})$, the homotopy category of unbounded complexes of projectives, and of $\mathcal{K}$, the full subcategory of $\mathbf{K}(\mathrm{Proj})$ whose class of objects consists of all totally acyclic complexes, which imply the existence of Gorenstein-projective precovers in the category of modules.

[1] Cortés-Izurdiaga, Manuel. Verdier quotients of homotopy categories of rings and Gorenstein-projective precovers. To appear in Sci. China Math.

## Day 5, Saturday, September 16

9:00–9:50 **Jan Žemlička**

Title: **On the structure of ADS and self-small abelian groups**

Abstract: The aim of the talk is to classify the structure of two particular classes of abelian groups, ADS groups and self-small products of finitely generated groups. In addition to the standard tools of the structural theory of abelian groups, each of the two descriptions uses a single classical structural result. Those key facts are decomposability of any proper mixed abelian group in the case of ADS groups and slenderness of the group of all integers in case of self-small groups.

10:00–10:25 **Grigore Călugăreanu**

Title: **The formula ABA=Tr(AB)A for matrices**

Abstract: Let A be a square matrix over any commutative ring. The formula in the title holds for A and any matrix B of the same size if and only if all 2 x 2 minors of A equal zero.

10:25–10:50 **Mădălin-Gabriel Mitrofan**

Title: **Waring decompositions for matrices over finite fields**

Abstract: We prove that all $n \times n$ matrices, $n \geq 2$, over fields of cardinality $p^2$, where $p$ is a prime, are sums of (at most) three $(p+1)$-th powers, even not all the elements of these fields are sums of $(p+1)$-th powers.

Coffee Break

11:20–12:10 **Dolors Herbera**

Title: **A new look to direct sum decompositions of torsion-free modules**

Abstract: Let R be a commutative domain. We are interested in following challenge: when is the class F of arbitrary direct sums of finitely generated torsion-free R-modules closed under direct summands? The results we obtain are particularly nice in the case of domains of Krull dimension 1 and, in general, they show that such an innocent-looking closure condition is quite strong .

For example, if R is local and has Krull dimension 1, F is closed under direct summands if and only if indecomposable finitely generated torsion-free modules have local endomorphism ring. If R is h-local and F is closed under direct summands, then the localization of R at any maximal ideal, except may be one, must satisfy that any finitely generated ideal is two-generated. Hence, if R is a Noetherian domain of Krull dimension 1, F is closed under direct summands implies that any localization of R at a maximal ideal, except may be one, is a Bass domain. We are able to prove that the converse of this last result is true, provided that the integral closure of R into its field of fractions is module finite over R.

The results presented are part of work in progress with Roman Alvarez and Pavel Prihoda.