Gabonese Workshop in arithmetic and beyhond

Ecole Normale Supérieure

Libreville, Gabon

October 24 - November 4, 2024

Coordinators

Cécile Armana, University of Franche-Comté, France

Tony Ezome, École Normale Supérieure de Libreville, Gabon

Christian Maire, University of Franche-Comté, France

Ariane Mézard, École Normale Supérieure de Paris, France

Maurice Obame, École Normale Supérieure de Libreville, Gabon

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website of the event
website of the programme *Arithmetic and Geometry in central Africa*

The Gabonese Workshop in Arithmetic will take place in École Normale Supérieure (ENS) in Libreville, Gabon, from October 24 to November 4, 2024. It will consist of three main activities:

- **Two Advanced Courses for PhD and Master students** , The courses will be given in collaboration with École Normale Supérieure de Paris (ENS Paris) by pairing an African PhD student or with a recently defended PhD thesis, and a student from ENS Paris. One course will be given by Frédéric van Wijland, Professor at University Paris-Cité, on mathematical aspects of physics, and will be open to physicists and mathematicians at the ENS Libreville: This course would be proposed as a CIMPA course. The second course is given by Ariane Mézard, Professor at Paris Sorbonne University, and ENS Paris, and by Cécile Armana, maîtresse de conferences, Franche-Comté University. This course includes two series of lectures given in pairs by ENS Libreville and ENS Paris.

- A **Series of Research Lectures** . For this event we expect about 35 participants, mostly from Central Africa. This event will be open to all mathematicians, especially young African researchers. We will encourage the participation of women. Young researchers, especially those who are PhD students, will have the opportunity to present their recent work.

- A **series of events to promote mathematics** This event will be organized in partnership with the Institut Français in Gabon:
  - Two half-days are planned for high school students,
  - A half-day for the economic community of Gabon,
  - A screening of the movie *Le théorème de Marguerite.*

There are also scheduled lecture sessions given by Master Students (MS).

	morning	afternoon	evening
October 24		green / blue	
October 25	green	green / blue	
October 26	green	green (partial)	
October 27			
October 28	green	yellow / green	light blue
October 29	green	yellow / green	light blue
October 30	green	yellow	
October 31	light blue	yellow	
November 1	green	yellow	
November 2	green	green	
November 3			
November 4	light blue		

Advanced Courses

These courses are intended for master and PhD students, and future teachers in mathematics, as part of their initial training and to help them gain sufficient perspective into the field they will be teaching.
This school is partially supported by https://www.cimpa.info/ in the form of CIMPA courses.

The program consists of two courses:

– *Complex analysis* by Ariane Mézard, École Normale Supérieure de Paris, France; and Cécile Armana, Franche-Comté University. This course includes two series of lectures given in pairs by ENS Libreville and ENS Paris: Mozer Maleghi/Jules Fressonnet and Geordann Igouwe/Antiago Reyes.

– *Statistics in high dimension* by Frédéric van Wijland, Professor at University Paris-Cité, France. Exercise sessions will be led by Santiago Reyes (ENS Paris).

	9am-10am	10:30-11:30	1:30-2:30	2:45-3:45	4:00-5:00
October 24		Opening ceremony			MS
October 25					MS
October 26					
October 28			RL	RL	RL
October 29			RL	RL	ENS Pairs
October 30			RL	RL	RL
October 31	IF	IF	RL	RL	ENS pairs
November 1			RL	RL	RL
November 2					
November 4	IF	IF			

Abstracts of the courses

MEZARD Ariane

Complex analysis I

Une idée fructueuse en mathématiques consiste à associer une fonction analytique aux objets algébriques. Après quelques rappels d'analyse complexe, nous illustrerons cette approche via l'étude des fonctions L associées aux courbes elliptiques et des nombreuses conjectures qui y sont associées.

ARMANA Cécile

Complex analysis II

Les formes modulaires sont des fonctions analytiques sur le demi-plan supérieur, symétriques sous l'action d'un sous-groupe de transformations. Elles apparaissent naturellement dans l'étude des courbes elliptiques complexes. Nous introduirons aux premiers éléments de leur théorie et à des résultats profonds de théorie des nombres qui leur sont liés.

VAN WIJLAND Frédéric

Statistics in high dimension

High dimensional data are everywhere, from physical systems to the spreading of epidemics, the world of economic agents or that of neural networks and machine learning. The course aims at stressing the basic techniques underpinning our understanding of the emergence of collective behaviors in very large assemblies of interacting agents. The outline of the course is as follows:
- *Phase transitions in equilibrium. Stochastic calculus made concrete, and a taste of concentration of measure. The example of the Ising model.*
- *Epidemic spreading. Absorbing phase transitions in SIS and SIR models. Fully connected graph versus scale-free network.*
- *Random matrices and high-dimensional data analysis. Dyson Brownian motion, Wigner semi-circle law, Wishart statistics and MarÄDenko-Pastur. Application to economics.*
- *The Baik-Ben Arous-Péché transition. Role of an outlier. Signal reconstruction.*
- *Learning and neural networks. Determinisitic dynamical systems and stochasticity. Chaos. Criticality of the brain. Optimal storage properties.*

The lectures will be accompanied by many examples and exercises sessions.

Master Students lectures

Thursday, October 24

4:00-4:20 Pierre Ebayi
4:25-4:45 Joseph Fomekong
4:50-5:10 Copernic Bougouendji

Friday, October 25

4:00-4:20 Lhamma Ngaissou
4:25-4:45 Drame Oumarou
4:50-5:10 Aldo Lokossa

Wednesday, October 30

5:10-5:30 Pierre Ebayi

Lectures in pairs ENS Libreville / ENS Paris

Tuesday, October 29

4:00-4:30 Mozer Maleghi
4:35-5:05 Jules Fressonnet

Wednesday, October 30

4:00-4:30 Geordann Igouwe
4:35-5:05 Santiago Reyes

Abstracts

BOUGOUENDJI Copernic, ENS Libreville, Gabon

Quelques résultats concernant les prop-p extensions

L'étude des pro-p extensions $\hat{k}$ d'un corps k s'est activement développée à partir des années 60 grâce aux travaux de plusieurs mathématiciens de renoms tels que Serre, Iwasawa, Shafarevich, et bien d'autres. Le groupe de Galois G_k d'une telle extension est un groupe profini dont la structure est parfois très complexe. Lorsque ce groupe est libre, il est plus

facile à étudier, permettant ainsi de mieux comprendre l'arithmétique du corps $\hat{k}$. Dans cet exposé, nous allons décrire les conditions dans lesquelles l'on peut affirmer que G_k est un groupe libre.

EBAYI Perre, Université des Sciences et Techniques de Masuku, Gabon

Field Extensions and Minimal Ramification

In this talk, we will present three fundamental results in field theory: the Kronecker-Weber theorem, which describes the abelian extensions of $\mathbb{Q}$, the Scholz-Reichardt theorem on the realization of ℓ-groups as Galois groups, and the Shafarevich theorem on solvable groups. We will conclude by discussing the lower bound on the minimal number of primes that ramify in Galois extensions where the group is a finite nilpotent group of odd order, while examining the techniques used to obtain these results.

FOMEKONG Joseph, Bamenda University, Cameroun

Factorization of prime ideals in the ring of integers and applications in cryptography

In this work, we present the factorization of prime ideals in the ring of integers and its use in the number field sieve algorithm. This work serves to solve the problem of non-uniqueness of the factorization in the ring of integers which is therefore a powerful tool for the analysis of certain crypto systems. For this reason, we will first present the number field while emphasizing the ring of integers and present the ideals in the ring of integers. Then, we will talk on the factorization of elements in certain rings of integers of extensions of number fields and we shall witness the non-uniqueness of this factorization, and shall correct this, using prime ideals. And finally, we will present the use of prime ideal factorization in the number field sieve algorithm.

FRESSONNET Jules, ENS Paris, France

Elliptic curves and complex multiplication

In this presentation, we will introduce the notions of elliptic curves equipped with their group law. We will be interested in characterizing complex multiplication for elliptic curves over $\mathbb{C}$. In order to do that, we will show that any such curve is isomorphic to $\mathbb{C}/\Lambda$, a quotient of $\mathbb{C}$ certain lattice.

IGOUWE Geordann, ENS Libreville, Gabon

The Riemann Zeta function

The Riemann zeta function is a special function introduced by Leonhard Euler for real numbers and later extended to complex variables by Bernhard Riemann while studying the distribution of prime numbers. Using this function, mathematicians such as Hadamard and de la Vallée-Poussin were able to prove the prime number theorem, highlighting the importance of this function in analytic number theory. In this talk, we will introduce the Riemann zeta function, discuss some of its properties, and explore its connection to

the distribution of prime numbers. Additionally, we will introduce the field $\mathbb{Q}_p$ of p-adic numbers, with the aim of investigating the properties of the zeta function in this context.

LOKOSSA Aldo, ENS Libreville, Gabon

Revêtements de courbes algébriques

Dans cet exposé, nous parlerons de revêtements de courbes algébriques. L'étude des revêtements est un domaine de recherche très actif. Plusieurs mathématiciens se sont intéressés à ce sujet, avec une attention particulière pour les revêtements de petit degré. Nous rappelerons ce qu'est un revêtement de courbes algébriques, et présenterons quelques résultats de classification dans le cas galoisien. Puis nous mettrons en exergue un lien entre les revêtements de courbes et extensions de corps. Et enfin nous mettrons en évidence un moyen d'étudier les revêtements de courbes dans le cas non-galoisien.

MALEGHI Mozer, ENS Libreville, Gabon

The elliptic finctions

The first studies on elliptic integrals date back to the work of Leibniz and Bernoulli. They were particularly interested in calculating the arc length of ellipses, which led them to integrals that they could not express using classical mathematical functions (such as polynomials or exponentials). Later, Niels Henrik Abel (1802-1829) and Carl Gustav Jacobi (1804-1851) discovered that these integrals had remarkable cyclic properties. To study them better, they introduced new mathematical functions called "elliptic functions". These functions quickly proved very useful in many areas of mathematics, particularly number theory. In this talk, we will characterize elliptic functions, we will analyze their periodic aspect and we will explore the structure of set of these functions.

NGAISSOU Lhamma, Douala University, Cameroun

Modal Θ-valent skew codes over $\mathbb{F}_{2\mathbb{Z}}$ and application in algebraic DNA cryptography

Error-correcting codes are used to the reconstruct digital data, which are subject to alteration their storage and transmission. They are also used in cryptography to encrypt and authenticate data. Among the classes of codes proposed in the litterature to efficiently deal with these aspects mentioned above, we have the modal Θ-valent codes are a class of codes defined from the alphabets based on chrysippian modal Θ-valent logic. In this presentation, it is a question of defining and studiying algebraically the skew modal Θ-valent codes and modal Θ-valent skew DNA codes and apply them to algebraic DNA cryptography.

OUMAROU Drame, Université des Sciences et Techniques de Masuku, Gabon

Titre.

Therory of representation of numbers highlights the link existing between the symbolic dynamics, the analytic number theory and the ergodic theory. Given a real number $\beta < -1$, we are interested in the closure of the set of expansions in negative base β, called β-shift.

We study the existence of a unique measure of maximal entropy on this symbolic system and the irreducibility of this full-shift in non-negligible subsets with respect to this measure. Endowed with the shift map σ, the negative β-shift is coded under certain conditions. However, we show that in all cases, the measure of maximal entropy is supported on a set coded by a positive recurrent code. We first define a strictly increasing function ϕ from $\mathbb{N}$ to $\{0,1\}^*$ by $\phi(k) = 1(00)^k$ and a strictly increasing sequence of algebraic integers $(\gamma_n)n \geq 0$ that converges to 1, with the first term being the golden ratio. These definitions allowed us to find a bijection between $]-\infty, -\gamma_0]$ and each of the intervals $]-\gamma_{n-1}, -\gamma_n]$, thus creating a link between the β-shift for $\beta \leq -\frac{1+\sqrt{5}}{2}$ and the β-shift for β taken in $]-\frac{1+\sqrt{5}}{2}, -1]$. By relying on the notion of towers associated with prefix codes, we establish the existence of a unique measure of maximal entropy on the tower associated with the code P_β of the β-shift, as well as the existence of a unique measure on $P_\beta^{\mathbb{Z}}$. We show that $P_\beta^{\mathbb{Z}}$ is the support of any invariant measure on S_β. Finally, we explicitly determine this measure. Thus, we establish the intrinsic ergodicity of the bilateral negative β-shift.

REYES Santiago, ENS Paris, France

The *p*-adic Zeta Function

The study of p-adic functions becomes particularly insightful when examining p-adic interpolation, a concept that holds significant relevance in number theory and algebraic geometry. This presentation will explore the intricate connections between p-adic interpolation, the theory of distributions, and the integration of measures. We will also discuss the Mellin-Mazur transform, which plays a crucial role in linking these ideas to the definition of p-adic zeta functions. Importantly, we will highlight the relationship between p-adic zeta functions and real zeta functions, showcasing the depth and complexity of p-adic analysis.

Promotion of Mathematics

These events will take place in Institut Français du Gabon:
— Two half-days are planned for high school students,
— A presentation of our activities to the economic community of Gabon,
— A screening of the movie *Le théorème de Marguerite* (October 29, at 7pm).

Presentation of our activities

Institut Français

Monday October 28, 2024 at 6pm.

Welcoming message by the French Ambassy in Gabon

Message by Rufin Didzambou, Directeur Général, ENS Libreville

— *Training and Research*
Tony Ezome, ENS Libreville

— *Research and Applications (I)*
Frédérique Oggier, Birmingham University

— *Research and Applications (II)*
Frédéric van Wijland, Paris Cité University

— *Mathematics in Gabonese society, a project with you*
Ariane Mézard, ENS Paris and Paris Sciences et Lettres

Lectures for High School students

October 31

9:30	Welcome Session
	The Story of Numbers, by Ariane Mézard
	Criminal Story, by Isabelle Ngningone
10:35	break
	Coded Story, by Tony Ezome
	Mathematics in Gabonese Society, by Tony Ezome and Maurice Obamé
	Questions

November 4

9:30	Welcome Session
	The Story of Numbers, by Ariane Mézard
	The Story of a Theorem, by Cécile Armana
10:35	break
11:10	*Coded Story*, by Tony Ezome
	Mathematics in Gabonese Society, by Tony Ezome and Maurice Obamé
	Questions

Abstracts

The Story of Numbers. The natural emergence of algebraic and transcendental numbers, and some open questions.

Criminal Story. How mathematics can be used to solve criminal investigations.

Coded Story. Mathematics at the heart of cutting-edge coding and decryption techniques for secret messages.

The Story of a Theorem. Behind the scenes of the discovery and proof of a famous mathematical theorem.

Research Lectures

Monday, October 28

1:30-1:55   Régis Babindamana
2:00-2:25   Judicaël Obame
2:45-3:10   Fulgence Eyi
3:15-3:40   Moustapha Camara
3:45-4:10   André Bialebama (online)
4:15-4:40   Karim Sankara (online)

Tuesday, October 29

1:30-1:55   Saïdou Mahmoudou
2:00-2:25   Vincent Kouakou
2:45-3:10   Tony Ezome
3:15-3:40   Brice Miyaoka

Wednesday, October 30

1:30-1:55   Basile Guy Richard Bossoto
2:00-2:25   Florent Nguema
2:45-3:10   Winnie Ossete
3:15-3:40   Cécile Armana

Thursday, October 31

1:30-1:55   Rufin Eyelangoli
2:00-2:25   Mohamed Ipopa (online)
2:45-3:10   Brice Doumbe (online)
3:15-3:40   Jules Ntsiri
4:00-4:25   Ephraim Poncho-Kotey
4:30-4:55   Roslan Ibara
5:00-5:25   Paule Joyce Mbenangoye

Friday, November 1

1:30-1:55   Demba Barry
2:00-2:25   Hermann Soré
2:45-3:10   Moussa Fall
3:15-3:40   Gérémino Ella (online)
4:00-4:25   Constant Mombo (online)
4:30-4:55   Christian Maire

Abstracts of the lectures

ARMANA Cécile, University de Franche-Comté, France

Drinfeld singular moduli, units and points on hyperbolas

Singular moduli are j-invariants of CM elliptic curves. They have remarkable arithmetic properties: they are algebraic integers and play a central role in class field theory for quadratic imaginary fields. In the context of analogies between elliptic curves and Drinfeld modules of rank 2 over $\mathbb{F}_q[T]$, Drinfeld singular moduli have similar properties. In this joint work with Bruno Anglès, Vincent Bosser et Fabien Pazuki, we prove that the equation $XY = \gamma$ has no solution with singular moduli coordinates when $\gamma \in \overline{\mathbb{F}}_q[T]$ has small degree. We also prove that there are at most finitely many Drinfeld singular moduli that are algebraic units. Both results are function-field counterparts of results of Bilu, Masser and Zannier (2013), and Habegger (2015) for the classical j-invariant.

BABINDAMANA Régis, Marien Ngouabi University, Republic of Congo

Classe des codes cycliques projectifs à deux poids

Un code linéaire $\mathscr{C}$ est projectif si le poids minimum de son orthogonal est au moins égal à 3. Un code à deux poids est un code qui a exactement deux poids non nuls. Un code cyclique $\mathscr{C}$ projectif à deux poids est soit irréductible, soit il est la somme directe de deux codes cycliques irréductibles à un poids.

BARRY Demba, University of Bamako, Mali

The descent of biquaternion algebras

Let K/F be a separable quadratic field extension and let B be a biquaternion algebra defined over K with trivial corestriction. We associate with B a degree 3 cohomological invariant that determines whether B has a descent to F up to isomorphism. We show the connection between the non-triviality of this invariant and the existence of indecomposable algebras of degree 8 and exponent 2. As applications, we give examples of indecomposable algebras of degree 8 and exponent 2 aver a field of cohomological dimension 3.
In characteristic 2, the results of this talk are based on a joint work with A. Chapman and A. Laghribi.

BIALEBAMA Bouesso André Saint Eudes, Marien Ngouabi University, Republic of Congo

Pfaffian Calabi-Yau threefolds in six dimensional product of projective spaces

J.-P. Serre proved that a Gorenstein variety has codimension 1 or 2 if and only if it is a complete intersection. This is no longer true for codimension 3 Gorenstein varieties. This observation suggests that codimension 3 Gorenstein varieties form a suitable class of varieties to study when investigating non-complete intersection Gorenstein varieties. D. Buchsbaum and D. Eisenbud proved that codimension 3 Gorenstein varieties arise

as Pfaffians of skew-symmetric maps of vector bundles of odd ranks. In this talk, we investigate non-complete intersection 3-codimensional Calabi-Yau threefolds that appear as pfaffians of skew symmetric odd sized matrices of multi-homogeneous polynomials in 6-dimensional product of projective spaces. In particular, we classify all decomposable vector bundles giving rise to a 3-codimensional Pfaffian Calabi-Yau threefold. Moreover, we propose a method for computing their Hodge numbers.

BOSSOTO Basile Guy Richard, Marien Ngouabi University, Republic of Congo

On Lie-Rinehart-Poisson algebras structures

We define the Schouten-Nijenhuis bracket on the algebra of the module of Kähler differentials. We give the main features of Poisson manifolds by using the universal property of derivation. We prove the equivalence between a Lie-Rinehart algebra structure and a Poisson structure and we recover Lichnerowicz's notion of Poisson manifold. We show that a symplectic Lie-Rinehart algebra structure induce a nondegenerate Poisson structure and conversely. Joint work with Norbert Mahoungou Moukala.

CAMARA Moustapha, University Assane Seck of Ziguinchor, Sénégal

Points algébriques de degré au plus 3 sur des courbes $y^2 = x^5 + A$.

On étudie les points algébriques de degré au plus 3 sur des courbes hyperelliptiques de genre 2 d'équations affines

$$\mathscr{C}_A : y^2 = x^5 + A \text{ avec } A \in \mathbb{N}^*.$$

Notons que le cas $A = 1$ a été traité par Schaefer qui a déterminé les points algébriques de degré au plus 2, puis par Fall qui a déterminé les points algébriques de degré 3. Dans cet exposé, nous nous intéressons au cas où $A = n^2$ avec $n \in \{4, 5, 8, 10, 12, 16, 20, 27, 36, 144, 162, 216, 400, 432, 625, 1250, 1296\}$.

DOUMBE BANGOLA Brice Landry, Université des Sciences et Techniques de Masuku, Gabon

Asymptotic behaviour of a phase field system derived from a generalization of Maxwell-Cattaneo's law with a singular potential

In this lecture, we study the asymptotic behaviour of a Caginalp-type phase field system derived from a heat conduction law which is a generalization of the Maxwell-Cattanéo law and whose potential is singular. This type of law has the advantage of correcting the heat conduction paradox that appears when the Fourier law is considered. The potential considered is typically logarithmic. However, from a theoretical point of view, it is essential to obtain the property of strict separation of the order parameter in order to make sense of the equations. We first prove the existence and uniqueness of the solution thanks to the separation property. We also address the question of the dissipativity of the system. Finally, we obtain the existence of the global attractor.

ELLA Gérémino, Université des Sciences et Techniques de Masuku Franceville, Gabon

Hydrodynamic characteristics of a curved fluid layer with two porous boundaries

This work aims to study the characteristics of a flow of a curved fluid layer between two porous boundaries. We use a coordinate transformation system and a flow function including the two velocity variables to simplify the two-dimensional Navier-Stokes equations. The results show that the problem produces symmetric streamlines when the fluid maintains its main direction of motion near the two porous boundaries of the thin fluid layer. The asymmetric solutions found highlight inversions of the flow reversal near each porous boundary. A curvature of the streamlines manifests the change in direction of motion due to flow reversal.

EYI OBIANG Fulgence, Université des Sciences et Techniques de Masuku Franceville, Gabon

A good class to construct solutions for skew Brownian motion equations

We investigate continuous processes of the class (Σ). First, we derive a series of new characterization results. Second, we construct solutions for skew Brownian motion equations using continuous stochastic processes of the class (Σ).

EYELANGOLI Rufin, École Normale Supérieure de Brazzaville, Republic of Congo

Extension du Théorème de Koëbe

Dans ce travail, une extension du Théorème de Koëbe a été proposée. En effet, dans la classe S (classe des fonctions univalentes et holomorphes dans $\Delta = \left\{ z \in \mathbb{C} : |z| < 1 \right\}$, normées telles que, $f(0) = 0$ et $f'(0) = 1$), il est démontré que:

Théorème de Koëbe. *Quelque soit $f \in S$, on a:*

$$\frac{r}{(1+r)^2} \leq \left| f(z) \right| \leq \frac{r}{(1-r)^2}, r = |z|.$$

Nous esssayons d'étendre ce résultat dans une classe plus large que la classe S.

Théorème. *Soit f une fonction définie et univalente dans $\Delta = \left\{ z \in \mathbb{C} : |z| < 1 \right\}$.*

Supposons que f soit analytique dans Δ, sauf aux points $a_k \in \Delta$, $k = 1 \cdots n$ (f analytique presque partout). Si $f'(0) \neq 0$, alors :

$$\frac{r}{(1+r)^2(1+r^n)} \left| f'(0) \right| - \left| f(0) \right| \leq \left| f(z) \right| \leq \left| f(0) \right| + \frac{(-1)^n r}{(1+r^n)(1-r)^2} \left| f'(0) \right|.$$

EZOME Tony, Université des Sciences et Techniques de Masuku, Gabon

Ring extensions, arithmetic functions and (pseudo)-primality

This talk is concerned with the study of prime detection and primality proving by using ring extensions and arithmetic functions. The results presented come from joint works with Couveignes, Djella, Lercier and Luca. We start by recalling the classical Miller-Rabin pseudo-primality test and AKS primality test. And then, we describe generalizations using classical results from Galois ring extensions and 1-dimensional algebraic groups. To conclude the talk, we describe an efficient pseudo-primality test wich is the product of a multiple rounds Miller-Rabin test by a Galois test. We also specify the reliability of this product test by using methods from analytic number theory.

FALL Moussa, University Assane Seck of Ziguinchor, Sénégal

Morphismes et points algébriques sur certaines familles de courbes.

Nous donnons dans cet exposé des résultats obtenus sur des courbes de Hurwitz et quotients de courbes de Fermat. Dans la première partie, nous définissons les courbes de Hurwitz et les quotients de courbes de Fermat. Puis nous construisons des morphismes birationnels entre elles. Dans la deuxième partie, nous nous intéressons à la détermination des points algébriques de petits degrés sur les quotients de la septique de Fermat. Enfin dans la dernière partie, nous donnons une paramétrisation des points algébriques de petits degrés sur certaines courbes de Hurwitz en utilisant les morphismes birationnels.

IBARA Roslan, Université Marien Ngouabi, République du Congo

Genus theory, governing field, ramification and Frobenius

In this talk we develop, through a governing field, genus theory for a number field K with tame ramification in T and splitting in S, where T and S are finite disjoint sets of primes of K. It allows expressing the S-T genus number of a cyclic extension L/K of degree p in terms of the rank of a matrix constructed from the Frobenius elements of the primes ramified in L/K, in the Galois group of the underlying governing extension. For quadratic extensions $L/\mathbb{Q}$, the matrices in question are constructed from the Legendre symbols between the primes ramified in $L/\mathbb{Q}$ and the primes in S. Joint work with Maire.

IPOPA Mohamed, Université des Sciences et Techniques de Masuku Franceville, Gabon

Asymptotic Behavior and Numerical Simulations of a Conservative Phase Field Model with Two Temperatures

One type of problem that has attracted a great deal of attention from mathematicians in recent years is the phase field system. Among these phase transition systems, the family of conservative systems is very important in metallurgy. In this paper, we focus on the study of a conservative variant of the Caginalp-type phase field system with homogeneous Neumann boundary conditions. We begin the work by focusing on the well-posedness of the problem. Subsequently, the asymptotic behaviour of the solutions is examined by proving the existence of a finite-dimensional global attractor. To conclude the work, we present a method for numerically approximating the solutions and carry out some numerical tests.

KOUAKOU Vincent, University Nagui Abrogoua, Ivory Coast

On Matrix Strong Diophantine 27-Tuples and Matrix Elliptic Curves

We introduce an algorithm which allows us to prove that there exists an infinite number of matrix strong Diophantine 27-tuples. We show that Diophantine quadruples generate matrix elliptic (or hyperelliptic) curves which have each 54 matrix points.

MAHMOUDOU Saïdou, CERMEL Lambaréné, Gabon

Introduction à la bioinformatique pour le Gabon (GABIOMATIC)

La bioinformatique est devenue un outil essentiel pour les sciences de la vie. Cependant, les pays à revenu faible et intermédiaire sont à la traîne dans l'utilisation des outils de recherche informatique, malgré leur utilité évidente dans des domaines tels que la biodiversité, la bio criminalité et la sensibilisation aux épidémies. Dans le cadre de ce projet, nous prévoyons de dispenser une formation en bioinformatique à un nombre important de chercheurs d'horizons et d'institutions divers au Gabon, dans le but de permettre aux centres de recherche gabonais d'effectuer leurs propres analyses de données génomiques bioinformatique sur place. La pandémie de coronavirus COVID-19 a démontré le rôle de la bioinformatique dans la détection des différentes variantes du virus au fil du temps afin de permettre la prise de décisions politiques et sanitaires. Dans cet exposé, nous présenterons le projet Gabiomatic, les activités menées à ce jour et quelques applications avec des données de séquençage provenant d'échantillons de COVID-19.

MAIRE Christian, Université de Franche-Comté, France

On the strong Massey property for number fields

Let $n \geq 3$. We show that for every number field K with $\zeta_p \notin K$, the absolute Galois group G_K of K satisfies the strong n-fold Massey property relative to p. Joint work with Ján Mináč, Ravi Ramakrishna and Nguyen Duy Tân.

MBENANGOYE Paule Joyce, Université des Sciences et Techniques de Masuku, Gabon

Caractérisation d'une nouvelle classe de processus stochastiques

Soit le processus $X = M + A$, où M est une martingale locale càdlàg et A un processus prévisible càdlàg adapté à variation finie avec $A_{0-} = A_0 = 0$.
Lorsque $Supp(dA) \subset \{t \geq 0 : X_t = 0\}$, notre processus appartient à la classe (Σ) et lorsque $Supp(dA) \subset \{t \geq 0 : X_{t-} = 0\}$, notre processus appartient à la classe (Σ^r). Nous allons vous présenter l'étude de ces deux classes. Elles sont très étudiés dans la littérature. D'où notre interêt pour une étude unifiée de ces deux classes. Dans un premier temps, nous allons rappeler quelques résultats importants de ces deux classes. Deuxièmement, nous donnerons un nouveau résultat de caractérisation de la classe (Σ^r). Enfin nous définirons et donnerons des résultats de caractérisation de notre nouvelle classe.

MIAYOKA Brice, Marien Ngouabi University, Republic of Congo

Chabauty-Coleman Method for Plane Quartics of rank 1

In this talk, we describe the computation of $\mathbb{Q}$-rational points on plane quartics whose Jacobian has Mordell-Weil rank 1. The main sophisticated ingredient is the Chabauty-Coleman method. We also describe our implementations in Magma.

MOMBO Yves Constant, Université des Sciences et Techniques de Masuku Franceville, Gabon

Bandpass-Type NGD Design Engineering and Uncertainty Analysis of RLC-Series Resonator Based Passive Cell

This paper investigates the design method, characterization, and innovative uncertainty analysis of bandpass (BP) type negative group delay (NGD) passive cell. The lumped passive topology under study consists of a resistor and a passive RLC-series network. The voltage transfer function (VTF) based circuit theory introducing the BP NGD specicication analytical expressions is established in function of the R, L, and C lumped component parameters. The BP NGD performance is evaluated by figure of merit (FOM) formula. To demonstrate the BP NGD function, the design method was applied to a proof-of-concept (POC) operating at $125 - kHz$ RFID standard center frequency. The BP NGD theory is validated by both AC simulation and measurement of POC and discrete component-based circuit prototype. The BP NGD specification variations are interpreted with respect to the influence of constituting component uncertainties via comparison between the established NGD uncertainty theory and co-simulated sensitivity analyses.

NGUEMA Florent, Université des Sciences et Techniques de Masuku Franceville, Gabon

Titre.

Resume.

OBAME Judicaël, Université des Sciences et Techniques de Masuku Franceville, Gabon

Integrating advanced mathematics into medical entomology and vector ecology research

Vector-borne diseases, such as malaria, dengue, and Zika virus, pose significant public health challenges, especially in tropical regions like Gabon. Understanding the dynamics of these diseases for better mitigation strategies requires a comprehensive approach that combines field-based biological research with advanced mathematical modeling and statistical analysis. Our research focuses on the ecology and behavior of disease vectors, particularly mosquitoes, and the factors influencing the transmission dynamics of arboviruses from forest ecosystems to human populations. Here we explore how applied mathematics, specifically models such as SIR, SEIR, R0, or other techniques including but not limited to frequentist, Bayesian inference, time-series analysis, and spatial-temporal modeling,

can improve our understanding of vector population dynamics, and arboviruses' spread and identify the associated key environmental and behavioral determinants.

OSSETE Winnie, Université Marien Ngouabi, République du Congo

Une introduction à la théorie de Hodge

Si on considère une courbe ou une surface donnée par des équations polynomiales, on peut calculer des périodes qui sont définies comme des valeurs de certaines intégrales sur des contours fermés. La période du pendule pesant en est un exemple. La théorie de Hodge est un ensemble d'outils d'analyse et de calcul différentiel qui relient ces périodes à des propriétés géométriques qui tiennent plutôt du domaine de l'algèbre. Le but de cet exposé est de présenter une brève introduction à la théorie de Hodge.

PONCHO-KOTEY Ephraim Nii Amon, University of Ghana, Ghana

Intersection Theory on Surfaces to Compute Discrete Logs

In this talk, we are interested in equivalence relations between cycles on varieties and applications. More precisely, we will study aspects of intersection theory on surfaces and their applications to improve the Function field sieve.

SANKARA Karim, Université Nazi Boni, Burkina Faso

On the existence of S-splitting p-Hilbert class field tower with given Galois group G

In this talk, we investigate the inverse Galois problem for the p-Hilbert tower with splitting condition. This problem was addressed by Ozaki in 2011. He shows that any finite p-group G occurs as the Galois group of the p-Hilbert tower of a totally complex number field $K/\mathbb{Q}$. In his work, Ozaki does not estimate neither the degree of $K/\mathbb{Q}$ nor the the quantity of ramification in $K/\mathbb{Q}$. In 2022, Hajir, Maire, Ramakrishna generalized Ozaki's result for any number field having class number prime to p (with mixed signature). They estimate not only the degree of $F/\mathbb{Q}$ but also the number of ramified primes. The aim of this talk is to present a new result. Let G be a (finite) p-group. Starting with a number field k_0 with trivial class group, and for a finite set S of primes of k_0, we construct tamely ramfied p-extensions L/k_0 such that the p-Hilbert class field tower $L_p(L)$ of L is S-splitting, and such that $Gal(L_p(L)/L) \simeq G$. Futhermore, we give explicit bound on $[L : k_0]$ and the number of primes of L/k_0 in terms of #G and #S. Joint work with Maire.

SORÉ Hermann, Nazi Boni University, Burkina Faso

Coalgebraic K-theory

Recently some authors (Péroux and Klanderman) have introduced definitions for K-theory in the coalgebraic context by dualizing the classical algebraic one. The purpose of this talk is therefore threefold. First we will introduce some basics of classical K-theory of a ring. Then we will recall some properties of coalgebras over a field. Finally we will explain the

dualizing process for defining the coalgebraic version of K-theory and we will give some first results in that direction.

TINDZOGHO NTSIRI Jules, Université des Sciences et Techniques de Masuku Franceville, Gabon

Lie rings in Model theory

Lie rings are an example of non-associative algebraic structures whose classification remains unfinished. 30 years ago Rosengarten studied Lie rings equipped with a dimension called Morley rank, classifying Lie $\mathbb{K}$-algebras in Morley rank at most 3, where $\mathbb{K}$ is an interpretable field. In collaboration with Adrien Déloro, Sorbonne University, we pursued the question, proving in particular that there is no simple Lie ring of Morley rank 4. The talk will present the ranked universe, through definable (or interpretable) sets, the Morley rank and mention in passing the Cherlin-Zilber Conjecture on groups. Then, making the link with the latter, we will present the different results that have been obtained on Lie rings, from Rosengarten's thesis to our recent work. Funding from the CIRM-AIMS program, supporting visits to CIRM, France and then to Masuku, Gabon was essential in making our collaboration possible.

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