FCK COVID-19

A VIRTUAL CONFERENCE – 25-27 APRIL 2020

Due to the COVID-19 pandemic there is less traveling around the world right now (which might be good for the climate but bad for research). In order to strengthen scientific communication, the number theory group at Würzburg university is organizing a virtual conference entitled FCK COVID-19 where FCK may stand for *"Functions - Curves - Knots"* or something else.

We are very happy about your participation! Stay healthy!

Speakers, their talks & abstracts

Christoph Aistleitner (Graz University of Technology):

Local is the new global

This is a non-technical talk on some recent work related to local and global statistics of arithmetic sequences of real numbers in the unit interval. Here "global" means concepts such as equidistribution and discrepancy, while "local" means pair correlations, neighbor spacings, and the likes. We outline some connections, and discuss some open problems. The Riemann zeta function will also give an appearance at some point. The talk is accompanied by a walk in the garden.

`one video 'Aistleitner_FCK_Covid' (23 min., 176 MB)`

Ramūnas Garunkštis (Vilnius University):

Zeros of the Lerch zeta-function
and of its derivative for equal parameters

A. Speiser proved that the Riemann hypothesis is equivalent to the absence of non-real zeros of the derivative of the Riemann zeta-function left of the critical line. His result has been extended by N. Levinson and H.L. Montgomery to the statement that the Riemann zeta-function and its derivative have approximately the same number of non-real zeros left of the critical line. Jointly with R. Tamosiunas we obtain the Levinson-Montgomery type result for the Lerch zeta-function with equal parameters. For the Lerch zeta-function, the analogue of the Riemann hypothesis is usually not true and its zeros usually are distributed asymmetrically with respect to the critical line. However, for equal parameters, the symmetry of the zeros is almost restored.

`one video 'GarunkstisWuerzburg2020' (37 min., 2 GB)`

Anne-Maria Ernvall-Hytönen (University of Helsinki):

Higher moments of exponential sums involving Fourier coefficients of cusp forms

Short exponential sums involving Fourier coefficients of holomorphic cusp forms are very difficult to estimate. It is very likely that the best known bounds are still far from reality. Therefore, we have estimated higher moments of such sums to gather information about their behaviour in average.

`one video 'covid-conference-talk_ernvall-hytonen_4' (27 min., 36 MB)`

Roma Kačinskaitė (Vytautas Magnus University):

Class of partial zeta-functions and universality

The universality property in the Voronin sense of the Riemann zeta-function $\zeta(s)$, $s = \sigma + it$, says roughly that any analytic non-vanishing function can be approximated uniformly on any compact subsets of the strip $\{s \in \mathbb{C} : 1/2 < \sigma < 1\}$ by shifts of $\zeta(s)$. The mixed joint universality gives the possibility to connect into one tuple two different types of zeta-functions (one of those zeta-functions has the Euler product expression over primes and the other does not) and to show that any two target functions can be approximated simultaneously by a suitable vertical shift of two different type zeta- or L-functions, and that the set of such shifts has a positive lower density. In this talk, we present the mixed joint discrete universality results for the tuple consisting of the partial Matsumoto zeta-functions $\varphi_h(s)$ and the periodic Hurwitz zeta-functions $\zeta(s, \alpha; \mathfrak{B})$, and give certain generalizations.

`one video 'Kacinskaite' (42 min., 38 MB)`

Katja Mönius (Würzburg University):

Circulant graphs, Schur rings and So's conjecture

According to a conjecture of So from 2005, two integral circulant graphs $\mathrm{Cay}(\mathbb{Z}_n, S)$ and $\mathrm{Cay}(\mathbb{Z}_n, T)$ are isomorphic if and only if $S = T$. The isomorphism problem for circulant graphs was solved by Muzychuk in 2004 based on the theory of Schur rings. In this talk, we present the relation between Schur rings and isomorphism of cirulant graphs which leads us to a proof of So's conjecture.

`one video 'talk_katja' (52 min., 135 MB)`

Marc Munsch (Graz University of Technology):

Zeros of Littlewood polynomials

The study of the location of zeros of polynomials with coefficients constrained in different sets has a very rich history. The case of random polynomials has been studied intensively and the asymptotic number of real zeros has been computed in various cases (Gaussian, Bernoulli etc). The problem is definitely much harder in the deterministic case. However some results are known concerning the maximal number of real zeros of a polynomial with $+-1$ coefficients. We present more precise results for the family of Fekete polynomials which are related to zeros of real Dirichlet L- functions. This is part of a joint work with Klurman and Lamzouri.

`one video 'Talk Fekete.mkv' (28 min., 79 MB)`

Łukasz Pańkowski (Adam Mickiewicz University, Poznań):

Joint extreme values of L-functions

We consider L-functions $L_1, \dots, L_k$ from the Selberg class with polynomial Euler product and satisfying Selberg's orthonormality condition. We show that on every vertical line $s = \sigma + it$ with $\sigma \in (1/2, 1)$, these L-functions simultaneously take large values of size $\exp\left(c\frac{(\log t)^{1-\sigma}}{\log\log t}\right)$ inside a small neighborhood. This is joint work with K. Mahatab and A. Vatwani.

`one video 'Pankowski(FCK_Covid_19)' (73 min., 208 MB)`

Athanasios Sourmelidis (Würzburg University):

A Shortcut in Universality via Euler products

In 1975 S.M. Voronin proved the celebrated universality theorem for the Riemann zeta-function $\zeta(s)$, which states that for any admissable set K inside the critical strip, any non-vanishing function f defined on K and any $\epsilon > 0$

$$\liminf_{T\to\infty} \frac{1}{T} m\{\tau \in [0,T] \,:\, \max_{s\in K} |\zeta(s+i\tau) - f(s)| < \epsilon\} > 0,$$

where $m\{\,\}$ denotes the Lebesgue measure. Recently, Ł.Pańkowski proved an analogous result, where in place of τ in the argument of $\zeta(s+i\tau)$ one can have an arbitrary polynomial in τ. His result has been, furthermore, generalized by A. Laurinčikas for a wider class of functions $\{\varphi(\tau)\}$ which includes the polynomials. In both cases, the authors have obtained their theorems in a more general setting, that is for Dirichlet L-functions and Lerch zeta-functions instead of just $\zeta(s)$. At first we will shortly discuss the aforementioned results and introduce the notion of discrete universality. Then we will provide the discrete analogue of Pankowski's result in the case of Dirichlet L-functions. The main features of our approach is a

metric result with respect to mean value theorems for Weyl sums, as well as that L-functions admit an Euler product in their half-plane of absolute convergence. This allows a degree of flexibility when dealing with universality theorems, since we can employ (appropriately) their logarithms inside the critical strip.

`in the folder 'Shortcut_via_Euler' there are two video 'Shortcut_Part1' and 'Shortcut_Part2' (10 min., 123 MB& 14 min., 181 MB) and a pdf with the slides: 'shortcut_Athanasios'`

Teerapat Srichan (Kasetsart University, Bangkok):

On square-full primitive roots in short intervals

Let p be an odd prime. By using the exponent pairs method the asymptotic formula for the number of the square-full primitive roots modulo p in short intervals is obtained.

`one video 'Teerapat Present FCK COVID 19' (15 min., 43 MB)`

Jörn Steuding (Würzburg University):

The Julia line of a Riemann-type functional equation

The notion of a *Julia line* is a concept introduced by Gaston Julia in his improvement upon Picard's Great Theorem. In this talk we apply this idea to Dirichlet series satisfying a Riemann-type functional equation (more precisely, elements of the *extended Selberg class*) and discuss aspects of their value-distribution. This is joint work in progress with Ade Irma Suriajaya and Thanasis Sourmelidis, and it extends previous joint work of the speaker with Justas Kalpokas and Maxim Korolev.

`two videos 'steuding1' (25 min., 115 MB) and 'steuding2' (29 min., 112 MB) plus the slides without video and sound`

Pascal Stumpf (Würzburg University):

On coverings of residue classes by translates

We study coverings for the ring of integers modulo (a natural number) n by translates of a subset. In particular, we consider the case, when our subset is given by the multiplicative group of units modulo n, where we can also find some connections to the maximal gap between consecutive reduced residue classes modulo n.

`one video 'coverings_pascal' (3 min., 70 MB) plus slides as pdf: 'coverings_pascal'`

Ade Irma Suriajaya / Chacha (Faculty of Mathematics, Kyushu University):

An upper bound for Stieltjes constants of L-functions in the extended Selberg class

The coefficients of the Laurent expansion of the Riemann zeta function near $s = 1$, widely known as "Stieltjes constants", were first studied by Stieltjes in 1885 followed by many authors, such as Briggs, Mitrovič, Matsuoka, and Saad Eddin. An explicit upper bound for the Stieltjes constants of Dirichlet L-functions is also known. We are interested in investigating the Stieltjes constants for L-functions in the extended Selberg class. In this talk, we show an upper bound we obtained for these coefficients. This is a joint work with Shōta Inoue (Nagoya University) and Sumaia Saad Eddin (JKU Linz).

`one video 'Chacha_FCK_COVID-19_1080p' (51 min., 1.1 GB) and another version with less resolution as 'Chacha_FCK_COVID-19_540p' (51 min., 379MB) and a link as pdf: 'URLs_to_Chacha_FCK_COVID-19.pdf'`

Janyarak Tongsomporn (Walailak University, Nakhon Si Thammarat):

The Waring Problem for Hurwitz's Quaternion Integers

In 1770, Lagrange proved that every positive integer can be written as a sum of four integer squares. The same year Waring claimed that "every positive integer is a sum of nine (integer) cubes, a sum of at most 19 biquadrates, etcetera", however, without giving a proof. In 1909, Hilbert solved the so-called Waring's problem by showing that for every $\ell \in \mathbb{N}$ there exists some $g(\ell \in \mathbb{N}$ such that every $n \in \mathbb{N}$ is a sum of at most $g(\ell)$ ℓ-th powers. For most values of ℓ the true value for $g(\ell)$ is given by $2\ell + \lfloor (3/2)^\ell \rfloor - 2$. Ever since Hilbert's proof Waring's problem has also been studied for other semigroups and rings. Recently, in 2018, Pollack solved Waring's problem for the set of Lipschitz quaternion integers $\mathcal{L} := \mathbb{Z}[i, j, k]$, introduced by Lipschitz in 1886. Extending recent work of Pollack on Waring's problem for the ring of Lipschitz quaternion integers, we study Waring's problem with respect to the larger ring of Hurwitz quaternion integers $\mathcal{H} := \mathbb{Z}[i, j, k, \rho]$, chosen by Hurwitz in 1896, where $\rho := \frac{1}{2}(1 + i + j + k)$. This is joint work with Nicola Oswald and Jörn Steuding.

`slides and abstract as pdf-files`

Vagia Vlachou ((University of Patras):

Disjoint universality connected with differential operators

In this talk, we study disjoint universality for certain sequences of operators, that are connected with the differential operator. Actually, the motivation to study such sequences comes from Universal Taylor series, if you change the role of the center of convergence.

`one video 'VlachouFCKcovid19' (41 min., 106 MB)`

Christian Weiß (University of Applied Sciences Ruhr West):

Reducing the curse of dimensionality of bracketing numbers

Bracketing numbers may be regarded as a tool to discretize star-discrepancy. Unfortunately, it is very hard to calculate them explicitly for dimensions greater than one. Therefore, research has so far concentrated to give bounds. All these bounds depend on the dimension in an exponential way. In this talk, we aim to improve this depenendence by using Faulhaber's formula. Furthermore, we give applications of the results to discrepancy theory. This is joint work with Michael Gnewuch and Hendrik Pasing.

`one video 'talk_FCK_Covid_CW' (25 min., 64 MB)`