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On the Arithmetic and Geometry of Quaternion Algebras: A New Spectral Correspondence for Maaß Waveforms

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Let \mathcal{A} be an indefinite rational division quaternion algebra with discriminant d equal to pq where p and q are primes such that $p, q > 2$ and let \mathcal{O}_{pq} be a maximal order in \mathcal{A} . Further, let $\mathcal{O}_{pq, p^{2r}q^{2s}}, r, s \geq 1$ be an order of index $p^{2r}q^{2s}$ in \mathcal{O}_{pq} with Eichler invariant equal to negative one at p and at q . Finally, let $\mathcal{O}_{pq, p^{2r}q^{2s}}^1$ be the cocompact Fuchsian group given as the group of units of norm one in $\mathcal{O}_{pq, p^{2r}q^{2s}}$. Using the classical Selberg trace formula, we show that the positive Laplace eigenvalues, including multiplicities, for Maaß newforms on $\mathcal{O}_{pq, p^{2r}q^{2s}}^1$ coincide with the Laplace spectrum for Maaß newforms defined on the Hecke congruence group $\Gamma_0(M)$ where, M , the level of the congruence group, is equal to $p^{2r+1}q^{2s+1}$, i.e., the discriminant of $\mathcal{O}_{pq, p^{2r}q^{2s}}$.

Biography

Terrence Richard Blackman was born in Georgetown, Guyana. He is an old boy of the famed Guyanese high school, Queens College. Terrence graduated Cum Laude with honors in mathematics from Brooklyn College and he holds M.Phil and Ph.D. degrees, in mathematics, from The Graduate School of City University of New York. He is currently a member of the Department of Mathematics at Medgar Evers College.

Terrence's research concerns aspects of the Jacquet-Langlands correspondence. One recalls that, among other things, this correspondence establishes that to any nonconstant eigenfunction of the Laplacian on a cocompact Fuchsian group there corresponds a nontrivial cuspform with the same eigenvalue on some non-cocompact Fuchsian group. It is desirable to formulate these spectral correspondences in classical language so as to make them explicit. This approach has its roots in the 1950's in the work of Eichler and Selberg. This work was taken up in the 1980's by Dennis Hejhal and furthered by Jens Bolte and Stefan Johansson in 1999, Andreas Strombergsson in 2000 and Morten Risager in 2003. Terrence's work on spectral correspondences of Maaß waveforms (square-integrable eigenfunctions of the Laplace-Beltrami operator on certain Riemann surfaces with constant negative curvature and finite area) is in this tradition. These investigations are, broadly speaking, number-theoretic and they involve ideas associated with harmonic and complex analysis.

Terrence is also interested in and engaged with research on pedagogical issues which surround the teaching and learning of mathematics in urban, majority African American, settings. He is particularly concerned with the challenges and opportunities of the integration of technology, particularly those related to the use of Computer Algebra Systems, in this environment. He is actively engaged in many projects to facilitate access to mathematics via the web and to create and deploy "intelligent" math texts. He has presented this work at local, national and international conferences on the use of technology in mathematics education.

Dr. Blackman is a frequent public speaker on issues related to African American success in mathematics. He lives in Brooklyn NY with his wife Anna, son Madiba, daughter Sasha and their dog Peter.