# PETER SCHOLZE TO RECEIVE 2013 SASTRA RAMANUJAN PRIZE

The 2013 SASTRA Ramanujan Prize will be awarded to Professor Peter Scholze of the University of Bonn, Germany. The SASTRA Ramanujan Prize was established in 2005 and is awarded annually for outstanding contributions by young mathematicians to areas influenced by the genius Srinivasa Ramanujan. The age limit for the prize has been set at 32 because Ramanujan achieved so much in his brief life of 32 years. The prize will be awarded in late December at the International Conference on Number Theory and Galois Representations at SASTRA University in Kumbakonam (Ramanujan's hometown) where the prize has been given annually.

Professor Scholze has made revolutionary contributions to several areas at the interface of arithmetic algebraic geometry and the theory of automorphic forms. Already in his master's thesis at the University of Bonn, Scholze gave a new proof of the Local Langlands Conjecture for general linear groups. There were two previous approaches to this problem, one by Langlands–Kottwitz, and another by Harris and Taylor. Scholze's new approach was striking for its efficiency and simplicity. Scholze's proof is based on a novel approach to calculate the zeta function of certain Shimura varieties. This work completed in 2010, appeared in two papers in *Inventiones Mathematicae* in 2013. Scholze has generalized his methods partly in collaboration with Sug Woo Shin to determine the $\ell$-adic Galois representations defined by a class of Shimura varieties. These results are contained in two papers published in 2013 in the *Journal of the American Mathematical Society*.

While this work for his master's was groundbreaking, his PhD thesis written under the direction of Professor Michael Rapoport at the University of Bonn was a more marvelous breakthrough and a step up in terms of originality and insight. In his thesis he developed a new $p$-adic machine called *perfectoid spaces* and used it brilliantly to prove a significant part of the weight monodromy conjecture due to the Fields Medalist Pierre Deligne, thereby breaking an impasse of more than 30 years. This work was presented in a massive paper that appeared in *Publications Mathématiques de l'IHES* in 2012. In a paper that appeared in *Forum of Mathematics $\pi$* in 2013, Scholze extended his theory of perfectoid spaces to develop a $p$-adic Hodge theory for rigid analytic spaces over $p$-adic ground fields, generalizing a theory due to Fields Medalist Gerd Faltings for algebraic varieties. As a consequence he answers a question on spectral sequences that Abel Prize Winner John Tate had raised four decades earlier. One key ingredient of Scholze's approach is his contruction of a *pro-etale site*; this has led to a new foundation of etale cohomology which he is investigating with Bhargav Bhatt.

Yet another seminal work of Scholze is his collaboration with Jared Weinstein extending earlier results of Rapoport-Zink on moduli spaces of $p$-divisible groups. Scholze-Weinstein show that at an infinite level, these carry a structure of a perfectoid space. One significant consequence of this is that it yields a very simple description of $p$-divisible groups over the ring of integers of an algebraically closed extenstion of the $p$-adic rationals which is analogous to Riemann's description of Abelian varieties over the complex numbers.

Scholze's most recent work establishes the existence of Galois representations associated with the mod p cohomology of locally symmetric spaces for linear groups over a totally real or $CM$ field. It has startling implications on the Betti cohomology of locally

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symmetric spaces. The Betti cohomology of a modular cure is torsion free, but the Betti cohomology of locally symmetric spaces may have torsion, and hence cannot be computed in terms of automorphic forms. Numerical evidence going back to the 1970s suggested that some analogue of the Langlands program should apply to these torsion classes. Scholze's breakthrough is the first progress in this direction in 40 years.

Peter Scholze was born in Dresden in December 1987 — at the time of the Ramanujan Centennial. At the age of 25 now, he is already one of the the most infuential mathematicians in the world. As a student he was a winner of three gold medals and one silver medal at the International Mathematics Olympiads. He finished his Bachelor's Degree in three semesters and his Masters courses in two semesters. He was made Full Professor soon after his PhD. His work has been estimated by experts to possess the quality of the timeless classics and expected to have a major impact in the progress of mathematics in the coming decades.

Peter Scholze was the unanimous choice by the Prize Committee to receive the award this year. The international panel of experts who formed the 2013 SASTRA Ramanujan Prize Committee were Professors Krishnaswami Alladi - Chair (University of Florida), Kathrin Bringmann (University of Cologne), Roger Heath-Brown (Oxford University), David Masser (University of Basel), Barry Mazur (Harvard University), Ken Ribet (University of California, Berkeley), and Ole Warnaar (University of Queensland).

Previous winners of the SASTRA Ramanujan Prize are Manjul Bhargava and Kannan Soundararajan in 2005 (two full prizes), Terence Tao in 2006, Ben Green in 2007, Akshay Venkatesh in 2008, Kathrin Bringmann in 2009, Wei Zhang in 2010, Roman Holowinsky in 2011, and Zhiwei Yun in 2012. By awarding the 2013 prize to Peter Scholze, the SASTRA Ramanujan Prize continues its great tradition of recognizing the most exceptional work in mathematics by a young mathematician.

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While this work for his master's was groundbreaking, his PhD thesis written under the direction of Professor Michael Rapoport at the University of Bonn was a more marvelous breakthrough and a step up in terms of originality and insight. In his thesis he developed a new $p$-adic machine called *perfectoid spaces* and used it brilliantly to prove a significant part of the weight monodromy conjecture due to the Fields Medalist Pierre Deligne, thereby breaking an impasse of more than 30 years. This work was presented in a massive paper that appeared in the mathematical publications of IHES in 2012. Scholze has further developed his theory of perfectoid spaces to make breakthroughs on several fundamental problems in Hodge theory, and on spectral sequences.

Yet another seminal work of Scholze is his collaboration with Jared Weinstein extending earlier results of Rapoport-Zink on moduli spaces of $p$-divisible groups. One significant consequence of this work is it yields a very simple description of $p$-divisible groups over the ring of integers of an algebraically closed extenstion of the $p$-adic rationals which is analogous to Riemann's description of Abelian varieties over the field of complex numbers.

Scholze's most recent work establishes the existence of Galois representations associated with the mod p cohomology of locally symmetric spaces for linear groups over a totally real or $CM$ field. It has startling implications on the Betti cohomology of locally symmetric spaces. Scholze's breakthrough is the first progress in this direction in 40 years.

The 2012 SASTRA Ramanujan Prize citation reads as follows:

"Peter Scholze is awarded the 2013 SASTRA Ramanujan Prize for his pathbreaking contributions that lie at the interface of Arithmetic Algebraic Geometry and the Theory of Automorphic Forms, and especially in the area of Galois Representations. The prize recognizes his unusually original and remarkable Masters Thesis at the University of Bonn in which he gave a new proof of the Local Langlands Conjecture for $p$-adic local fields that was published in two papers in *Inventiones Mathematicae* in 2013, and generalizations of these methods to $\ell$ adic representations of Shimura varieties in collaboration with Sug-Woo Shin that appeared in two papers in the *Journal of the American Mathematical Society* in 2013. The prize recognizes his revolutionary PhD thesis at the University of Bonn in which he initiates the theory of perfectoid spaces, to prove an important case of the weight monodromy conjecture of Fields Medalist Pierre Deligne, and discusses far reaching ramifications of the study of perfectoid spaces in Hodge theory, and spectral sequences, as described in his monumental paper in *Publications Mathématiques de l'IHES*, and his 2013 paper in *Forum of Mathematics*, $\pi$. The prize also recognizes his important collaboration with Jared Weinstein extending earlier work of Rapoport-Zink on moduli spaces of $p$-divisible groups. Finally the prize recognizes his most recent work on the existence of Galois representations for mod $p$ cohomology of locally symmetric spaces for linear groups over a totally real or CM fields that has surprising implications on the Betti cohomology of locally symmetric spaces."

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