



---

## FRANK NELSON COLE PRIZE IN NUMBER THEORY

---

This prize (and the Frank Nelson Cole Prize in Algebra) was founded in honor of Professor Frank Nelson Cole on the occasion of his retirement as secretary of the American Mathematical Society after twenty-five years of service and as editor-in-chief of the *Bulletin* for twenty-one years. The endowment was made by Cole, contributions from Society members, and his son, Charles A. Cole. The prize is for a notable paper in number theory published during the preceding six years. To be eligible, the author should be a member of the AMS or the paper should have been published in a recognized North American journal. This prize is awarded every three years.

### Citation

#### Chandrashekhara Khare and Jean-Pierre Wintenberger

The 2011 Frank Nelson Cole Prize in Number Theory is awarded to Chandrashekhara Khare and Jean-Pierre Wintenberger for their remarkable proof of Serre's modularity conjecture. In 1973 Jean-Pierre Serre made the audacious and influential conjecture that any irreducible two-dimensional representation of the absolute Galois group  $\text{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$  that is odd (in the sense that the determinant of complex conjugation is  $-1$  and not  $+1$ ) arises from modular forms. This conjecture has many extremely important consequences: it implies that all odd rank 2 motives over  $\mathbb{Q}$  are modular, it implies the Artin conjecture for odd two-dimensional representations of  $\text{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$  and, as Gerhard Frey and Serre realized in the mid-1980s, it implies Fermat's Last Theorem. Serre's conjecture has inspired much extremely important work. In the 1990s Wiles used ideas relating to Serre's conjecture to prove Fermat's Last Theorem and much of the Shimura-Taniyama conjecture. However, Serre's conjecture and the modularity of all odd rank 2 motives over  $\mathbb{Q}$  still seemed completely out of reach. Serre's conjecture is essentially a statement about insoluble Galois groups, which had not been seriously touched in any previous work. In 2004 Khare and Wintenberger stunned the community when for the first time they found a plausible, and extremely beautiful, strategy to attack Serre's conjecture. See their paper "On Serre's conjecture for 2-dimensional mod  $p$  representations of  $\text{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$ " (*Annals of Math. (2)* 169 (2009) no. 1, 229–253). They continued to refine their strategy, while at the same time Mark Kisin made important and very original improvements to the modularity lifting theorems on which their strategy relies. Khare first proved the level one case of Serre's conjecture in his paper "Serre's modularity conjecture: the level one case" (*Duke Math. J.* 134 (2006), no. 3, 557–589), and then Khare and Wintenberger completed the full proof of Serre's conjecture in their papers "Serre's modularity conjecture (I) and (II)" (*Invent. Math.* 178 (2009), no. 3, 485–504 and 505–586).