Short citation:

Maryna Viazovska is awarded the Fields Medal 2022 for the proof that the E_8 lattice provides the densest packing of identical spheres in 8 dimensions, and further contributions to related extremal problems and interpolation problems in Fourier analysis.

Long citation:

A very long-standing problem in mathematics is to find the densest way to pack identical spheres in a given dimension. It has been known for some time that the hexagonal packing of circles is the densest packing in 2 dimensions, while in 1998 Hales gave a computer assisted proof of the Kepler conjecture that the faced centered cubic lattice packing gives the densest packing in 3 dimensions. The densest packing wasn't known in any other dimension until in 2016 Viazovska proved that the E_8 lattice gave the densest packing in 8 dimensions and, very shortly afterwards, together with Cohn, Kumar, Miller and Radchenko, proved that the Leech lattice gave the densest packing in 24 dimensions. Viazovska's approach built off work of Cohn and Elkies, who had used the Poisson summation formula to give upper bounds on the possible density of sphere packings in any dimension. Their work had suggested that in 8 and 24 dimensions there might exist a radial Schwartz function with very special properties (for instance it and its Fourier transform should vanish at the lengths of vectors in the respective lattice packings) which would give an upper bound equal to the lower bound coming from the known lattice packings. Viazovska invented a completely new method to produce such functions based on the theory of modular forms.

Viazovska has developed these ideas in other directions. With Radchenko she proved the unexpected result that any even Schwartz function such that it and its Fourier transform vanish at the square root of every non-negative integer must be identically zero. In fact they showed that any even Schwartz function can be written $\sum_{n=0}^{\infty}(a_n(x)f(\sqrt{n}) + b_n(x)\hat{f}(\sqrt{n}))$ for certain special functions a_n and b_n.

With Cohn, Kumar, Miller and Radchenko she showed that the E_8 and Leech lattice not only gave optimal sphere packings in dimensions 8 and 24, but that they minimize energy for every potential function that is a completely monotonic function of squared distance.