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Sphere packing, Fourier interpolation, and the Universal Optimality Theorem

I will discuss recent work on the optimal arrangement of points in euclidean space. In addition to the solution to the sphere packing problem in dimensions 8 and 24 from 2016, the "Universal Optimality" conjecture has now been proved in these dimensions as well. This shows that $E_8$ and the Leech lattice minimize energy for any completely monotonic function of distance-squared, a fact which was previously not known for any configuration of points in any dimension $> 1$. Beyond giving a new proof of these sphere packing results, Universal Optimality also gives information about long-range interactions. Another application is to find the global minimum of the log-determinant of the laplacian among flat tori in those dimensions. The techniques involve arranging both a function and its Fourier transform to vanish at certain points, which leads to a new interpolation formula that recovers a radial Schwartz function from the values of it, its Fourier transform, and their derivatives, at special arithmetic points. (Joint work with Henry Cohn, Abhinav Kumar, Danylo Radchenko, and Maryna Viazovska.)