Bohemian Matrix Art

*by Rob Corless, Editor-in-Chief of Maple Transactions*

The following three works are all from the Bohemian Matrix Calendar 2022. They were chosen for the calendar by sampling reactions from an informal focus group (in the Spiral Vortex case, by a sequence of Twitter polls). All three were computed and imaged in Maple.

Artist's Statement:
Mathematical art must be true to the underlying mathematics. Colours and views can be chosen for artistic reasons, but the fundamental truth of the objects being portrayed must not be deliberately obfuscated. The art, if there is any at all, lies in the choices that can be made without sacrificing that truth. Indeed there are many choices: resolution, view, and the infinite array of colour schemes are only the beginning. All of these current images are planar, but there is no reason to restrict it so, and indeed some images not shown here were portrayed on a Riemann sphere, for instance.

The colour schemes here were chosen from *perceptually uniform* palettes; indeed we used Viridis for two of these. I thank John May for putting this (public domain) palette into Maple.

Where's a Time Lord when you need one?
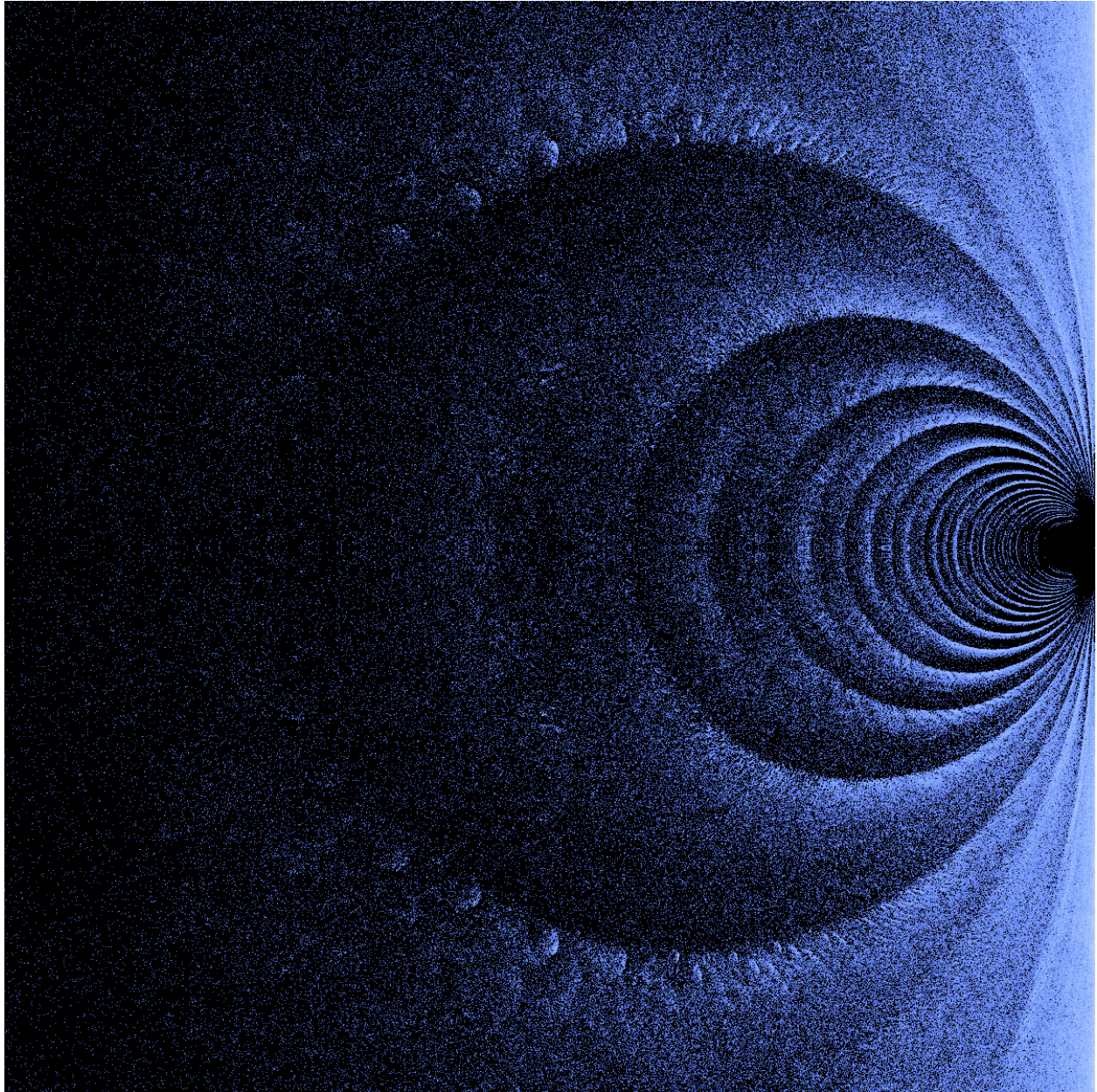
This work, from the August image of the calendar, zooms in near the origin of the complex plane; the origin is the apparent point of tangency of the apparent circles. The image is a density plot in the complex plane of eigenvalues of complex symmetric matrices, all of whose entries are either -1+i or -1-i. The dimension of all one hundred million sampled matrices (out of sixty-eight billion or so possible) was m=8. Brighter colours indicate a greater density of eigenvalues. Almost nothing is known for sure about this picture, except that all eigenvalues have nonnegative real part. We do not even know if the apparent circles really are circles.

Vortex Spirals
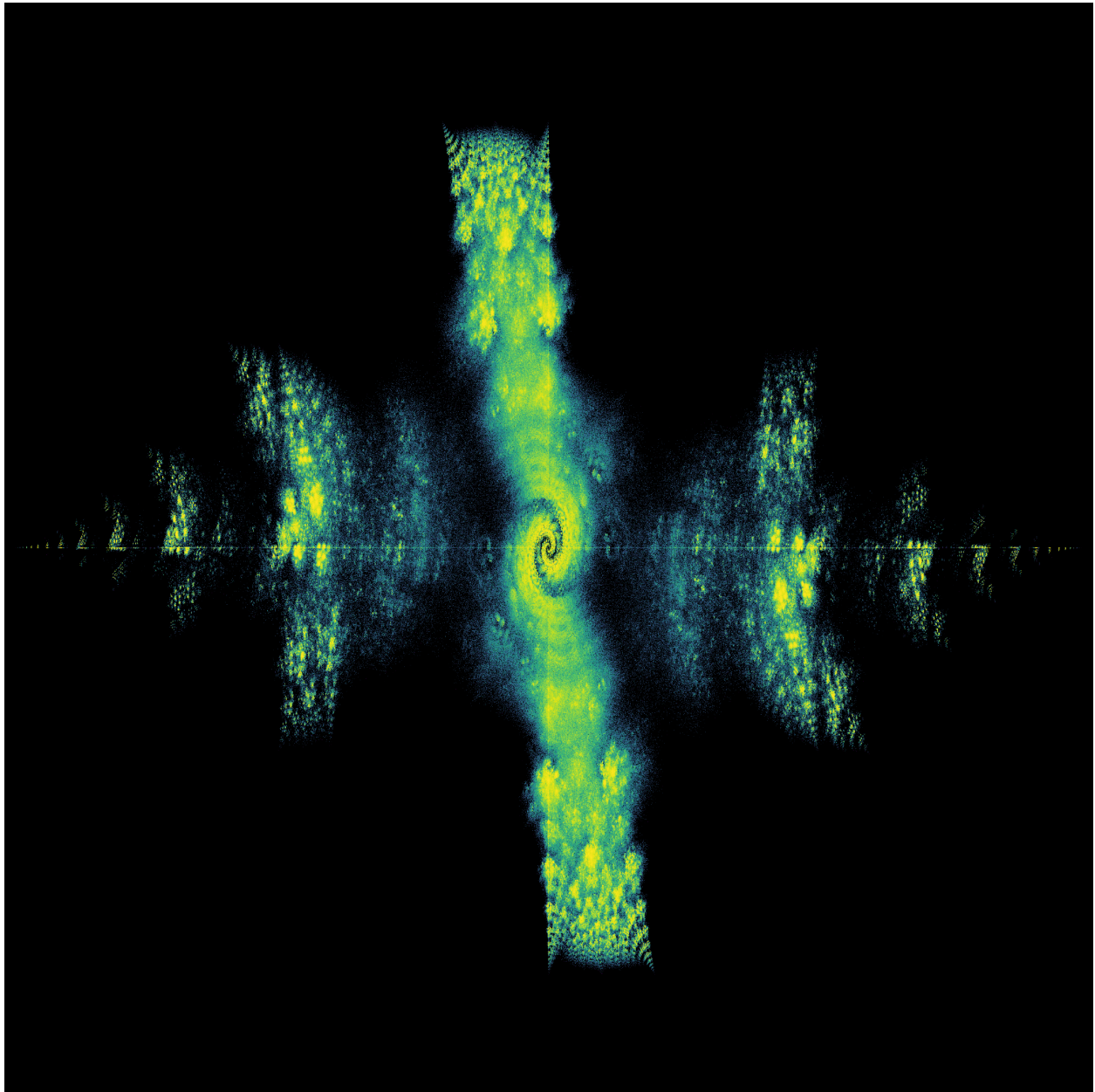
This was the January image (and the subject of the Twitter poll). The matrices are complex skew-symmetric tridiagonal matrices with nonzero entries 2, 5i, and 2+i. Hotter colour indicates higher density. The dimension of each matrix is 14 by 14, and all 1,594,323 matrices were used. The vortex appearance is unexplained. See https://doi.org/10.5206/mt.v1i2.14360 (in Maple Transactions) to learn more about this class of Bohemian matrices.

Burning the asymmetric candle at both ends
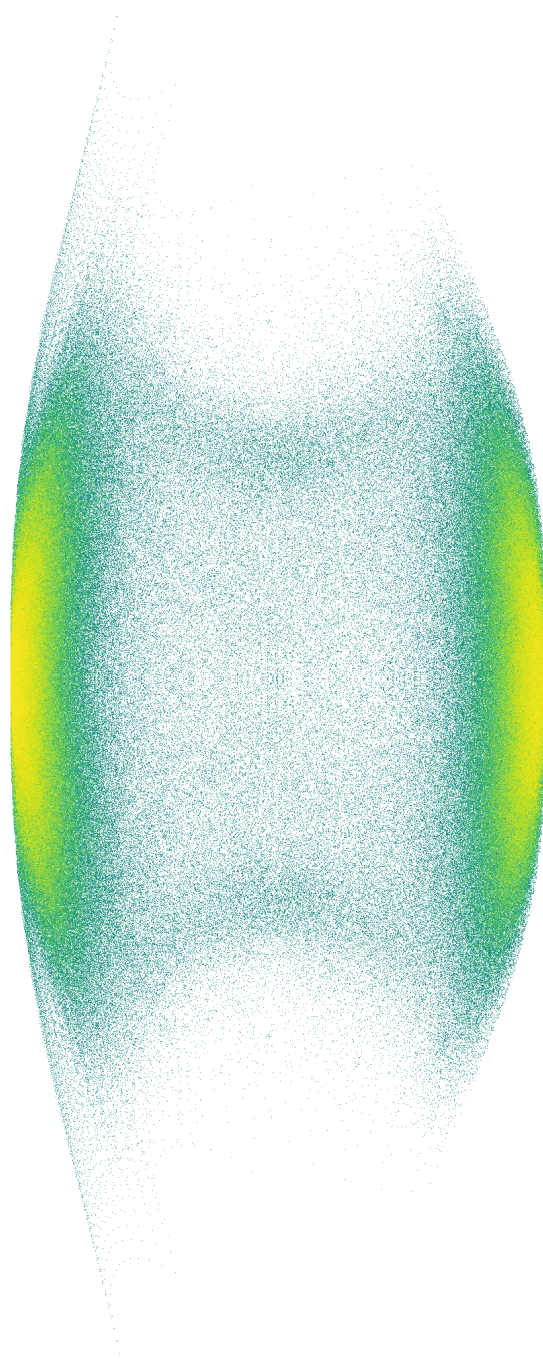
This image is my personal favourite. I do not understand the asymmetry, or the tapered shape. The image is a density plot of all eigenvalues of the 131,072 dimension 18 "Wedge Hankel" matrices (a type that I made up, which so far as I know has no applications whatsoever) with nonzero entries i/4 or -i/4, with zero antidiagonal and the sub-anti-diagonal all -1. Below that sub-anti-diagonal all entries are zero. Almost nothing is known about this family of matrices, so far as I know.