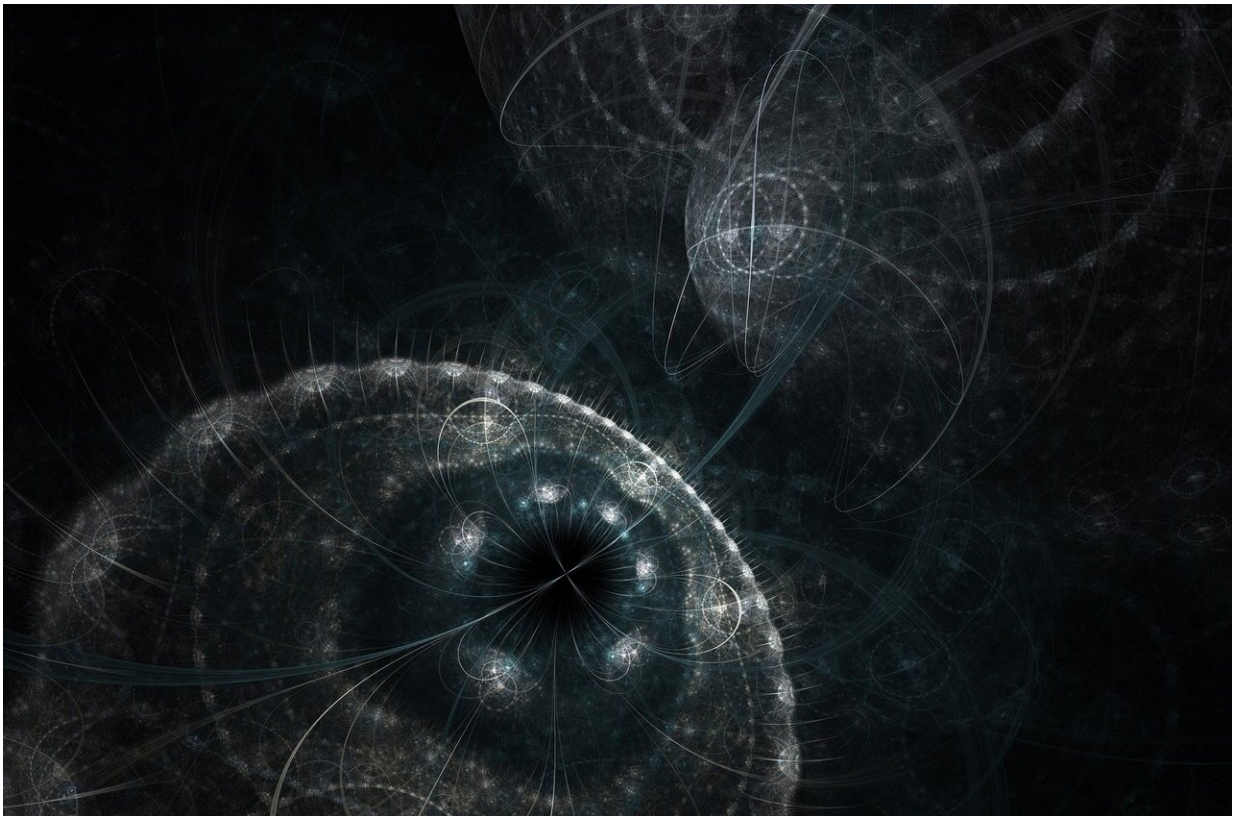


# Infinite number of quantum particles gives clues to big-picture behavior at large scale

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In quantum mechanics, the Heisenberg uncertainty principle prevents an external observer from measuring both the position and speed (referred to as momentum) of a particle at the same time. They can only know

with a high degree of certainty either one or the other—unlike what happens at large scales where both are known. To identify a given particle's characteristics, physicists introduced the notion of quasi-distribution of position and momentum. This approach was an attempt to reconcile quantum-scale interpretation of what is happening in particles with the standard approach used to understand motion at normal scale, a field dubbed classical mechanics.

In a new study published in *EPJ ST*, Dr. J.S. Ben-Benjamin and colleagues from Texas A&M University, USA, reverse this approach; starting with quantum mechanical rules, they explore how to derive an infinite number of quasi-distributions, to emulate the [classical mechanics](#) approach. This approach is also applicable to a number of other variables found in quantum-scale particles, including particle spin.

For example, such quasi-distributions of position and momentum can be used to calculate the quantum version of the characteristics of a gas, referred to as the second virial coefficient, and extend it to derive an infinite number of these quasi-distributions, so as to check whether it matches the traditional expression of this physical entity as a joint distribution of position and momentum in classical mechanics.

This approach is so robust that it can be used to replace quasi-distributions of position and [momentum](#) with time and frequency distributions. This, the authors note, works for both well-determined scenarios where time and frequency quasi-distributions are known, and for random cases where the average of time and average of frequency are used instead.

**More information:** J. S. Ben-Benjamin et al, From von Neumann to Wigner and beyond, *The European Physical Journal Special Topics* (2019). [DOI: 10.1140/epjst/e2018-800063-2](https://doi.org/10.1140/epjst/e2018-800063-2)

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