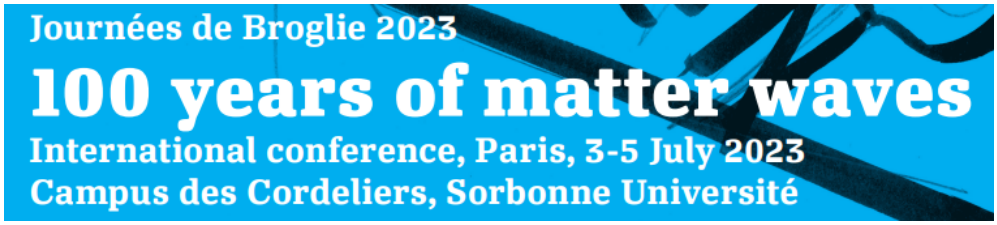

Universal Matter-Wave Interferometry

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Abstract

When Louis de Broglie proposed his idea on matter waves in 1923, he claimed that this idea was likely to ‘solve all problems related to quanta’.

His idea inspired Schrödinger’s wave equation and became the basis for a century of many quantum technologies. However, the fundamental nature of the quantum wave has remained a matter of debate throughout the century, as there is no well-defined cut between the coherent quantum evolution and our classical experience.

This has motivated a series of quantum experiments in Vienna throughout with different types of atoms, polyaromatic hydrocarbons, clusters of organic molecules, vitamins, neurotransmitters and polypeptides in meanwhile half a dozen of different types of matter-wave interferometers. All these experiments confirm quantum mechanics to be correct and even to apply to objects that were deemed too complex or too agitated to show quantum wave behavior, still thirty years ago.

I will describe ongoing explorations to expand these studies to objects of increasing mass and complexity. We will discuss measures of macroscopicity and experiments to probe potential deviations from quantum theory.

Given the universality of de Broglie’s ideas, we will discuss how to exploit the matter-wave nature of large molecules to gain new insight into materials science and biophysical chemistry.