The Characterization of photonic quantum wave-particle duality fluctuation phenomenon by Bayesian inference (AI)

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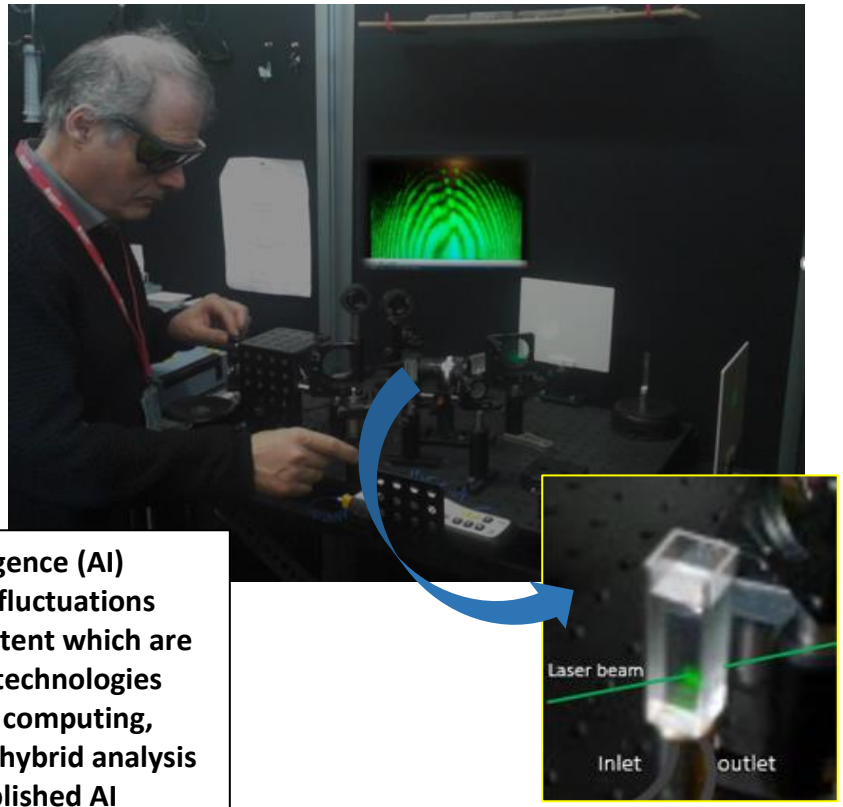
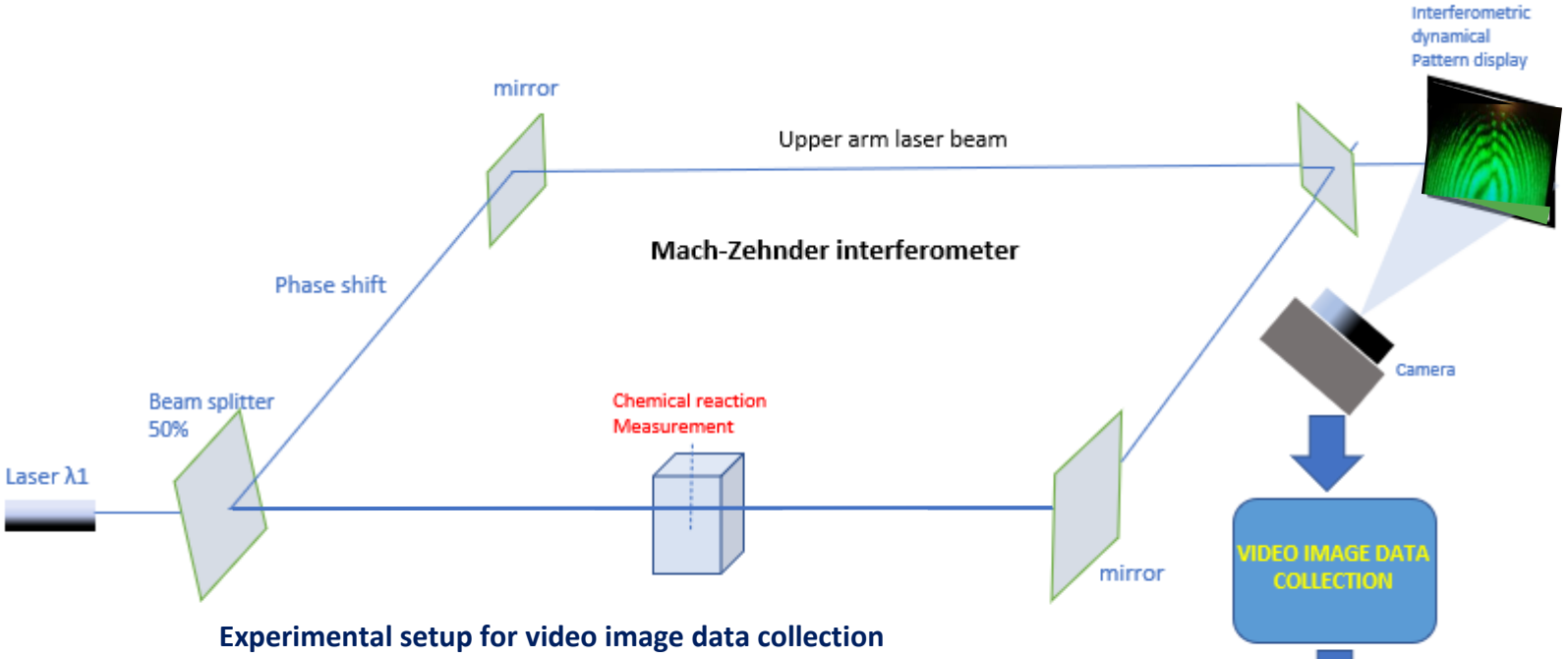
INTRODUCTION:

Abstract: **The magnitudes of atomic exchange [1] activities between the chemical substances (by interactions at interferometer's test chamber) had already been observed earlier by quantization of interferometric (Mach-Zehnder) quantum eraser pattern's motions caused by the photonic wave-particle duality fluctuations [2][3]. In our further experiments here, such fluctuations have been characterised by use of Bayesian inference technique (AI) which was capable of revealing the hidden information/links in the wave-particle duality fluctuation phenomenon, as normally not visible to human observer in a complex time-domain sequence of measurements. Within this work, the constructive role of AI techniques [4] (Bayesian Networks [5] in particular) has been emphasised which would lead to more effective analysis of a quantum phenomenon in the future.**

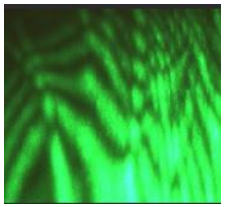


The aim of this study is to demonstrate how far Artificial Intelligence (AI) methods can help interpret the quantum wave-particle duality fluctuations phenomenon domains and outputs to unveil their invisible content which are normally invisible to human observers. Nowadays as quantum technologies move gradually towards the hybrid forms (like hybrid quantum computing, etc.), AI may play a further complementary role to establish an hybrid analysis domain for the quantum experiments. In this study a well established AI method called "Bayesian Inference"[5] is used to discover hidden links between the experimental attributes by automated detection of substantial information flow between them to unveil subtle contents.

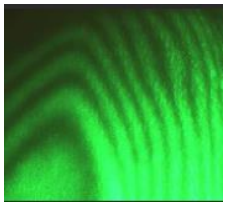
EXPERIMENTS:



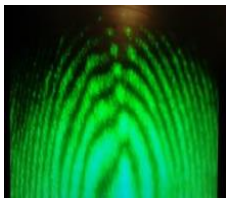
Experimental setup for video image data collection



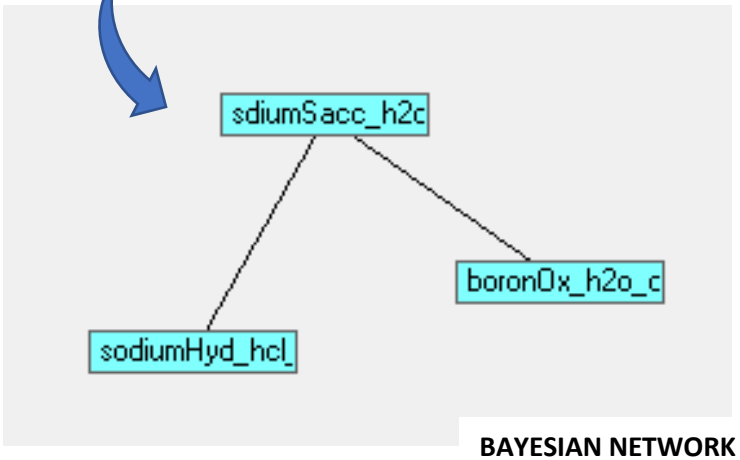
Boron Oxide + H_2O



Sodium Hydroxide + Hydrochloric Acid



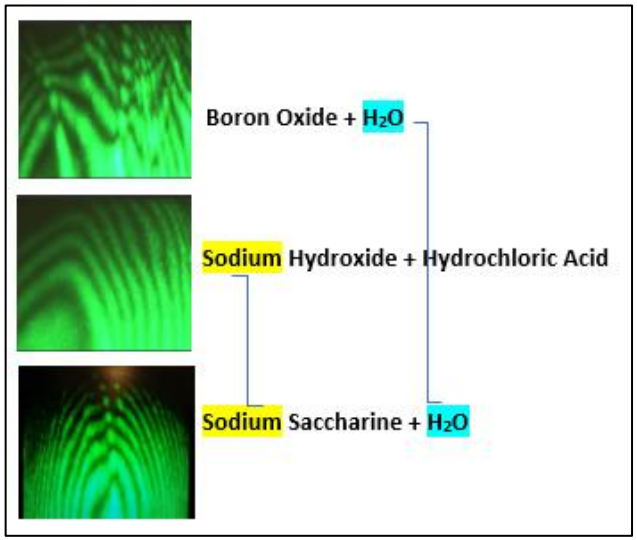
Sodium Saccharine + H_2O

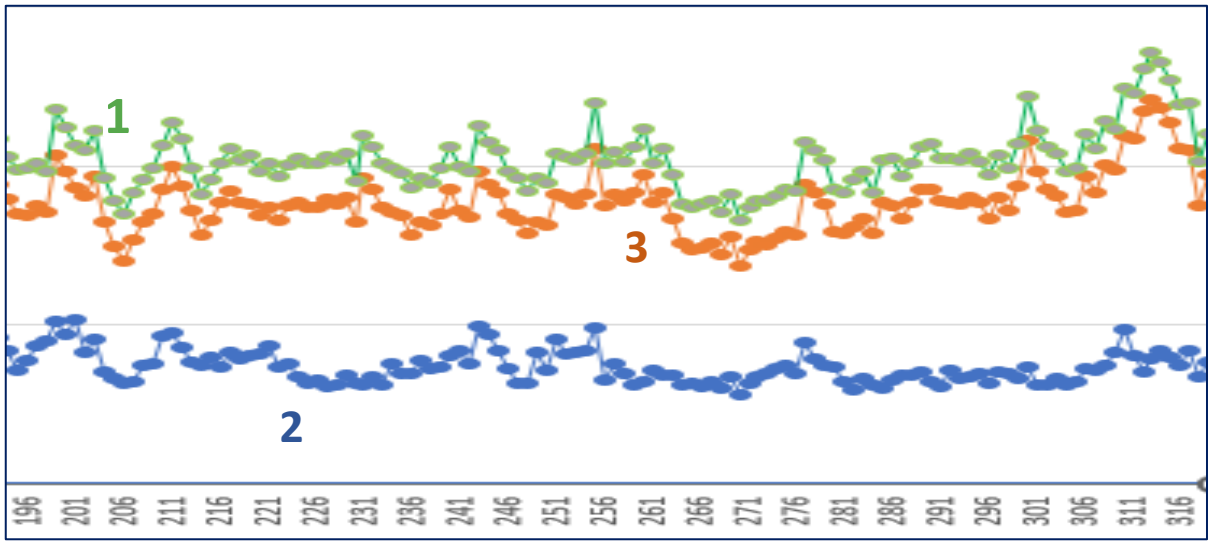


BAYESIAN NETWORK

Chemical reactions' hidden links are discovered via quantum wave-particle duality fluctuation phenomenon analysis by AI (Bayesian inference) method, in regards to Water (H_2O) and Sodium (Na) substance hidden contents.

RESULTS AND DISCUSSION:





Wave-particle duality fluctuation pattern sequences of different types of chemical reactions measured by Mach-Zehnder interferometer by which quantum-erasing phenomenon has been exploited [3] via test tube

In most cases, extremely complex and identical quantum wave-particle duality experimental outputs are not possible to interpret by naked eye or conventional statistical methods, where the AI methods would inevitably be needed to unveil hidden properties of the experiments. Here in our case the time-domain sequence of measurements of wave-particle duality fluctuations corresponding to the chemical reaction sequences (on the right) have been interpreted by Bayesian Inference (Bayesian Networks) method for low level analyses.

REFERENCES:

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