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Analysis of an In-Flight Water Droplet: Literature-Based Considerations and Novel Perspectives

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Preliminary Remarks

The characterization of water jets and of each single droplet composing them is complicate and challenging because of the many non-linarites affecting both the system properties and the process itself. This is why literature generally offers empirical or semi-empirical modelling attempts, too tight to the specific case study conditions, albeit recent systematizations have been provided [1-3]. Thus it is currently arising as a main scientific issue the following question: which is the best way to represent and describe the dynamics of water droplets travelling in air? In addition to a complementary question, are there new possibilities to explore the problem looking at it from another point of view?

Problem and Solution

After examining closely many literature contributions, among which [4-8], and after many specific deepenings, we arrived at the conclusion that a ballistic approach better allows for a tight-to-the actual process analytical description of an in-flight water droplet, thus providing the form of generality that is always crucial in assessing the quality of a scientific investigation. This belief led us to a systematic modelling effort, put into action in recent publications [1-3]. If this, on the one hand, gave a more generally applicable tool to the scientist and to the operator facing a flying droplet-related issue, on the other gave us suspicion of the fact that treating such problem in the "classical" way (i.e. considering the droplet itself within a Newtonian context) could show just one side of the coin. The other side is represented by the Quantum approach, which has never before been associated to this specific scientific field. This idea has been exposed and discussed in occasion of a recent international conference, attracting interest and participation [9]. The base for this novel approach is obviously the time-dependent Schrodinger's equation, written in the form:

$$D^2\nabla^2\psi(\vec{x},t)-\frac{1}{2}\cdot m\cdot V(\vec{x},t)\cdot\psi(\vec{x},t)=-i\cdot D\cdot\left(\frac{\partial}{\partial t}\right)\cdot\psi(\vec{x},t) \qquad (1)$$

Where: $D=\frac{\hbar}{2\cdot m}$ [m^2s^{-1}] is the diffusion coefficient; $\psi(\vec{x},t)=R(\vec{x},t)\cdot\exp(S(\vec{x},t))$; $R(\vec{x},t)$ is the wave function amplitude; $S(\vec{x},t)$ is the wave function phase. Equation (1), as in Wyatt [10] and Ghosh [11], may be split in a system of two equations so called "quantum fluid dynamics equations", which is not here necessary to report. A not negligible further development may certainly be that of applying the Scale Relativity theory [12] to such Quantum modelling attempt, for a droplet of any dimension in a problem involving a space-time frame [9].

Concluding Remarks

Modelling water droplets dynamics is not only a very complicate issue but it involves so many simultaneous aspects that an analytical and generally applicable method is often difficult to be reached. In this editorial we stated that not only we strongly believe that a ballistic approach is able to provide the broadest guarantees of a physically reliable and actual description but we also put on the table the big problem of a complete description, which may pass through the combination of a classical and a Quantum structuring of the problem. A close examination is currently being performed and will be the object of a future editorial.

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