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Magnetic Resonance Imaging (MRI) measurements of sprays

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Sprays are dynamic collections of droplets dispersed in a gas. They are used in many industrial and agricultural applications such as manufacturing processes, fuel injection, painting, and crop protection. Furthermore, "Sprays are among the most intellectually
challenging and practically important topics in fluid mechanics"(Fansler, Parrish, 2014), requiring quantitative measurements for experimental verification of theoretical models..

Magnetic Resonance Imaging (MRI) is a non-invasive, three-dimensional imaging technique capable of measuring optically opaque media. The MR signal is directly proportional to the sample density, making the technique most sensitive for the liquid inside the nozzle and in the near-nozzle regions. These are also regions which represent a significant challenge for the most common optical methods used in spray characterization.

We have recently demonstrated the potential of MRI for spray studies (JMR 2016; JMR 2017; Appl.MR 2020). Density and velocity mapping can be performed for water inside ceramic nozzles with a sub-mm resolution. High spray speeds (> 10-20 m/s) in the near-nozzle region require development of magnetization preparation techniques to sensitize nuclear magnetization to parameters of interest. Considerable measurement challenges involve a trade-off between a high spatial resolution and time-of-flight effects caused by sample's high speeds. Our current research focuses on bulk measurements of dynamic parameters of sprays (velocity distributions, dispersion, etc) in various regions of atomization, with the ultimate objective of translating the measurements to portable NMR setups.

Keyword-1

Magnetic Resonance Imaging

Keyword-2

disperse media

Keyword-3

MRI of materials

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