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# (G*) Application of Bayesian Techniques to Optical Emission Spectroscopy: Estimation of electron density evolution through time-integrated Hα and validation via time-resolved measurements.

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In-liquid pulsed spark discharges are transient plasmas with demonstrated applications, such as electrical discharge machining or nanomaterial synthesis. The characteristics of in-liquid discharges, such as temperature and density of the various present species (electrons, ions, radicals, etc.), are not well known. One way to probe the plasma parameters is to perform Optical Emission Spectroscopy (OES). In the case of in-water discharges, the hydrogen Balmer alpha (Hα) line is emitted and mostly broadened by Stark effect, itself related to the electronic density. However, the fast evolution of the plasma properties on the nanosecond scale makes the measurement and interpretation of the spectrum challenging. In these plasmas, the electronic density varies significantly by a few orders of magnitude during a discharge period of ˜1 µs. This leads to an Hα profile that cannot be fitted by a conventional Voigt profile, especially over extended integration times. In this work, we present a method based on Bayesian inferences to exploit the time-integrated emission profile of the Hα line. The method coupled to a model derived with high accuracy the line profile and the evolution of the electronic density. The results are in a good agreement with time resolved measurements performed with shorter integration time (50 ns). This kind of method is a promising inexpensive tool to study plasmas that exhibit more complex spectra and significantly evolve over time.

## Keyword-1

plasma-liquid

## Keyword-2

bayesian

## Keyword-3

spectroscopy

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