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# APPLICATION OF MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE IN PLASMA SPECTROSCOPY

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**Abstract.** Plasma spectroscopy represents the non-contact and non-perturbative plasma diagnostics tool that is widely used. One such application, considered in this work, is the determination of electron density from Stark broadening of emitted spectral lines. The other, laser-induced breakdown spectroscopy (LIBS) is often used for quantitative analysis of sample constitution. Finally, to track impurity transport mechanisms, extreme ultraviolet (EUV) and vacuum ultraviolet (VUV) plasma spectroscopy are used in many fusion devices to monitor highly charged impurity ions. Over the years many approximative formulae and robust models were developed to simulate the shape of emitted spectral lines due to the Stark effect from which line width and shift can be determined. Since a lot of these codes request substantial computational resources, the application of machine learning (ML) for quick estimation of line width was considered (Tapalaga et al. 2022). Usually, the usage of ML in LIBS quantitative analysis is followed by the recording of a large enough database with enough variance in it for precise analysis. Therefore, the usage of an already recorded database for training of the ML model was investigated for additional acceleration of the procedure, and its potential was discussed (Traparic and Ivkovic. 2023). Last but not least, variational autoencoder (VAE) was employed to model the so-called Unresolved Transition Array (UTA) structure, that rises due to the emission from highly charged tungsten ions. The application considered here is the validation of collisional radiative models and estimation of plasma core temperature and electron temperature profile in devices that don't have advanced diagnostics for this purpose.

## References

Tapalaga, I., Traparić, I., Trklja Boca, N. *et al.*: 2022 *Neural Comput & Applic* **34**, 6349–6358

Traparić, I., Ivković, M. : 2023 *Eur. Phys. J. D* **77**, 30.