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Improving the accuracy of diagnostic methods through synergy with modeling, sensitivity analysis and uncertainty quantification

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Advanced analysis of experimental data from plasma measurements often relies on a model of the underlying physics. This is true for most active and passive spectroscopic methods and perhaps even more so for probe and electrical diagnostics. Plasma modeling and simulation, on the other hand, is often understood as a complementary tool for obtaining "ab-initio" understanding of plasma dynamics. On both sides, researchers suffer from lack of fundamental data (cross sections, quenching rates) or large uncertainty thereof.

In this contribution, we provide an example of how modeling and simulation can work in synergy with experimental work in order to make the diagnostic techniques more accurate. We illustrate how one can use methods of sensitivity analysis to identify those parameters that truly influence the result of the data interpretation. We also leverage an uncertainty analysis method to quantify how the uncertainty in the fundamental data propagates to the uncertainty of the measured plasma properties. We believe that the combination of these powerful tools shows good potential for improving the accuracy and reliability of plasma diagnostic techniques in general.