# Applying Error-in-Variables Techniques to Tokamak Experimental Data

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Empirical Log-linear Power Law fits to experimental data are used frequently in Tokamak research, as in many other fields. Most commonly these fits are performed using Ordinary Least Squares (OLS). A key assumption in the derivation and application of OLS is that any random scatter in the data must be present only on the dependent variable otherwise the fits become biased. If errors on the data do not agree with this assumption then more sophisticated fitting techniques must be applied. We present an analysis of the errors in the International Global Confinement Database (IGD) and the International Global H-mode Threshold Database (IGDBTH) which shows that in both cases the errors on the dependent and independent variables are comparable. As such we apply Errors-in-Variables Orthogonal Regression (EVOR) which treats the errors in the dependent and independent variables in an equal manner.

For the IGD the errors in two of the independent variables were found to be of similar magnitude to the dependent variable. The OLS scalings predicted a Beta dependence in the confinement time, which did not agree with recent dedicated experiments. The EVOR scalings reduced this dependence, improving the scalings agreement with the dedicated experiments. The new scalings were not found to affect the predicted confinement for the ITER baseline.

Applying the same method to the IGDBTH produced similar results. Refitting using EVOR produced a modified scaling. This scaling predicts a small increase in the threshold power required to achieve an H-mode in ITER, however it still falls within the ITER design parameters.